Waterborne Diseases: Bacteria in our water

Bacteria

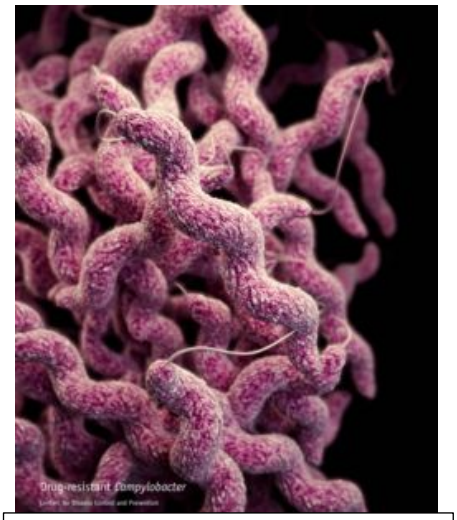
- Bacteria are everywhere around, on and inside us.
- Some bacteria are very useful to us, creating fermented products such as yoghurt, kefir, vinegar, sauerkraut, tempeh, kimchi, miso, kombucha and pickles to name only a few.
- We rely on *beneficial bacteria* to survive.
    - Bacteria in our intestinal system help to break down the food we eat, and compete with harmful bacteria, keeping them from taking over.
    - *Bifidobacteria* appear in babies' guts very soon after birth and are also found in adult intestines.
    - Sometimes people take *probiotic* supplements that contain several species of bacteria, particularly if an illness or antibiotic treatment has affected normal bacterial growth in the gut.

- The kind of bacteria we are concerned about in our water, though, are the harmful bacteria that will make us ill, like Campylobacter and E. coli.
- Size: 0.2 micron to 5 microns – about 1/10 of the size of waterborne parasites
- Infectious dose: 10 to 10,000 organisms or more, but Campylobacter are sensitive to hydrochloric acid in the stomach, so the infectious dose may be lower for people using acid reducing medications.
- Bacteria can reproduce through cloning as well as through sexual reproduction.
- E. coli can double in number every 20 minutes – 15 times faster than the parasites.
  One E. coli can produce 500 in only 3 hours; 63 trillion in just over a day!
- How long until I get sick? 1 day to 1 week
- How long does illness last? 2 to 10 days
- How long am I contagious?
    - From first contact with the bacteria until a few days after you no longer have symptoms.

"Campylobacter" *Campylobacter jejuni*

i. Description and symptoms:

- Campylobacter are comma or s-shaped rods with long thread-like extensions at each end (flagella).
- Once the bacteria are swallowed, they move towards their desired environment using their whip-like flagella.
- When they reach the target area of the gut, they invade the cells that line the intestines causing acute inflammation. Some strains also produce a cholera-like toxin which increases the severity of symptoms.
- Infection results in irritation of the intestines, fever, nausea and vomiting, cramping and severe abdominal pain, intestinal bleeding and watery foul-smelling diarrhea with mucus.



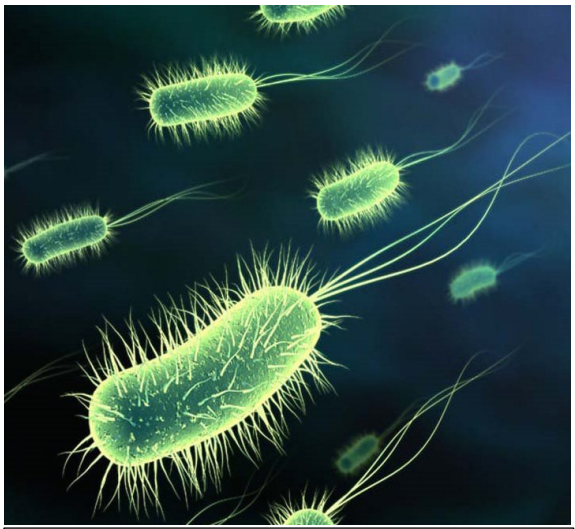
https://www.microscopemaster.com/campylobacter.htm

ii. Treatment

- Lots of fluids and electrolytes are lost through diarrhea (especially watery diarrhea). To prevent dehydration, physicians will often prescribe oral/intravenous fluids.
- Generally, antibiotics are not used, because Campylobacter is increasingly resistant to the clinically important antibiotics and this rising resistance is a serious concern for public health. (Almost 25% of Campylobacter infections are antibiotic resistant.)
- Campylobacter infection is generally self-limiting with or without use of antibiotics.
- However, complications can arise.
  - Long term effects may result in irritable bowel syndrome (IBS) or inflammatory bowel disease (IBD).
  - Infection with Campylobacter is also associated with reactive arthritis (Reiter's syndrome) which results in painful swelling of joints – often the knees and/or ankles.
  - Guillain-Barré Syndrome (GBS) is often associated with Campylobacter infection. 40% of cases occur after such infections. GBS is an auto-immune disease in which the immune system attacks the body's own nerve cells, resulting in paralysis.

"E. coli" *Escherichia coli*

i. Description and symptoms:



https://stopfoodborneillness.org/pathogen/stec-shiga-toxin-producing-e-coli/

- Coliforms can be readily tested for in water and are therefore used as "indicator organisms". Although finding coliforms in a water source does not confirm that the water is dangerous, it is a very strong sign of fecal contamination. (*More about this in a later section.)*
- Many coliforms are harmless rod-shaped bacteria that are part of the normal bacterial "flora" of healthy people and animals. However, there are some types that cause serious illness.
- The pathogenic (disease-causing) E. coli pictured here have long flagella that allow them to swim actively, and shorter hair-like structures (called pili or fimbrae) that can anchor the bacteria to the inside of intestines with adhesive tips, rather like the way mussels attach themselves to a rock.
- One of the more common pathogenic strains is E. coli O157:H7, which has caused many illness outbreaks around the world. Once swallowed and having travelled into the intestines, the bacteria bind to soft tissues and begin releasing Shiga toxin. The toxin damages and kills the surface cells which then slough off and are expelled from the body as profuse bloody diarrhea. The toxin also causes cramps and vomiting, but usually not fever. Abdominal tenderness can be severe.

ii. Treatment

- In about 85% of the cases, these symptoms will go away in a week or so, but even once all symptoms appear to be gone, chronic low-grade infection can continue, causing carriers to become re-infected or to infect others.
- 15% (often children, especially those under 5 years old) will develop systemic infections which can result in a type of kidney failure called "hemolytic uremic syndrome" (HUS). Although most people with HUS recover (5% fatality rate), some will suffer long-term kidney dysfunction and other complications including seizures, diabetes, chronic intestinal problems and high blood pressure.
- As with Campylobacter infection, dehydration is of utmost concern and fluids and electrolytes must be administered to maintain normal urine output in spite of fluid loss from vomiting and diarrhea.
- Antibiotic treatment is advised *against* for E. coli infections as it may increase the risk of developing HUS kidney failure. Furthermore, E. coli is quickly developing resistance to previously effective antibiotics.
- Treatment of HUS may require hospitalization with intravenous fluid support, blood transfusions and kidney dialysis.

Next up:
Drinking Water Safety Part 4: Waterborne Diseases Go Viral