**Foodborne Illnesses and the Human Body Response**

**Introduction**

 So far this semester, we have learned that the human body, no matter how researched or studied, remains a mysterious and amazing place. At a cellular level, the human body is a very busy place! We are all composed of cells, living tissues, and organs, skeletal and muscular systems. The smallest of these are the cells—small but mighty. The cells that make up the human and animal bodies are self-sufficient and help our bodies to keep moving. Unless something, say a bacterium comes along and disrupts their daily routines. What could possibly do this? What is small enough to disrupt the cells that make up our bodies? Keep reading to find out!

**What is a Foodborne Illness?**

To begin this chapter on foodborne illnesses, we must identify what exactly foodborne illnesses are and where they come from. What exactly is a foodborne illness? Well, a foodborne illness or rather “food poisoning” occurs when food or water contaminated with bacteria or other toxins is consumed [1]. What pathogens cause a foodborne illness?

According to the U.S Public Health Service, there are about ten microorganisms or viruses identified as being the biggest culprits of foodborne illness [3]. These pathogens include but are not limited to the following:

* ***Campylobacter jejuni***
* ***Clostridium botulinum***
* ***Escherichia coli 0157:H7***
* ***Listeria monocytogenes***
* ***Norovirus***
* ***Salmonella***
* ***Staphylococcus aureus***
* ***Shigella sonnei***
* ***Toxoplasma gondii***
* ***Vibrio vulnificus***

By taking a look at figure 1 following this chapter, you will see a complete list of the ten microorganisms or viruses and their sources of contamination identified by the U.S Public Health Service. Some of these pathogens may sound familiar to some and for others this may be the first time you have encountered them. You may also be thinking how scary these names are—which is common. Some if not most of these microorganisms can cause high distress in your body and in some cases possible death! To get a better idea of how these pathogens cause distress and possible death, keep reading!

**Common Pathogens that Cause Foodborne Illnesses**

 As mentioned above, the U.S Public Health Service has identified ten out of hundreds of pathogens that are responsible for foodborne illnesses. To get a better idea of what each pathogen does to your body, we will break them down individually with a short description. Just know that most of these pathogens will have a similar structure as well as similar symptoms. However, it is important to note these similarities and differences for any future reference (there will also be a figure at the end of this chapter to reference to).

***Campylobacter jejuni***

 ***Campylobacter jejuni*** can best be described as a gram-negative, rod-shaped enteric bacterium that is typically acquired through contact with contaminated food, mostly poultry [3]. So what exactly does ***Campylobacter*** do to your body if you come into contact with it? Typically, the incubation period for this pathogen is 2-3 days, once the incubation period is over, symptoms will present. These symptoms include but are not limited to the following: diarrhea (may be bloody), fever, vomiting, and stomach cramps [3]. When these symptoms present, what happens to your body is this, ***Campylobacter*** causes a gastroenteritis reaction that induces the fever, abdominal cramps, and diarrhea. Normally, ***Campylobacter*** lasts for about 2-10 days and in some extreme cases, antibiotics may be required [3]. The need for antibiotics is worst-case scenario but symptoms will subside and resolve on their own.

***Clostridium botulinum***

 ***Clostridium botulinum*** also known as botulism can be deadly. ***C. botulinum*** is a spore-forming bacterium that is most commonly found in soil. This particular bacterium is classified as the most lethal toxin known to humankind as well as one of the most potentially dangerous bioterrorism agents [3]. Just imagine! This bacterium could be found in your own backyard. Makes you re-think all of those mud pies you may have eaten in the past! ***C. botulinum*** is mainly contracted through home-canned foods with a low acid content as well as improperly canned commercial foods. The incubation period for this pathogen is not very long; in fact, the incubation period is roughly 12-72 hours! The symptoms that present with ***C. botulinum*** are dangerous and these are makes this pathogen so dangerous! The symptoms that appear are blurred vision, diarrhea, vomiting, dysphagia (difficulty swallowing), and various degrees of muscle weakness. The most dangerous symptom associated with this pathogen is the fact that it can cause respiratory failure due to the blockage of acetylcholine release from motor neurons! Botulism toxin binds to the receptors on the motor nerve terminals preventing the release of acetylcholine [3]. Botulism can last anywhere from days to months depending on the severity as well as if medical treatment was sought.

***Escherichia coli 0157:H7***

 ***Escherichia coli 0157:H7*** or most commonly referred to as ***E. coli 0157:H7***is known as a highly pathogenic foodborne illness. This is because of its ability to be associated with numerous types of sources. Sources that include the following: fresh spinach, hamburger, unpasteurized milk and juice as well as fast food restaurants in general. ***E. coli 0157:H7*** is a gram-negative rod-shaped enteric bacterium (think ***Campylobacter jejuni)***! This pathogen produces the same symptoms—bloody diarrhea, abdominal cramps, and a possible fever. The typical incubation period for this pathogen is 1-8 days and the duration can be anywhere from 5-10 days, depending on the individual. Medical treatment is not necessary; symptoms will subside on their own.

***Listeria monocytogenes***

 ***Listeria monocytogenes*** is a gram-positive bacterium that can incubate anywhere from 2-70 days with a duration of several days to weeks [4]. Listeria has a wide range of sources of contamination, these include, unpasteurized dairy products, including soft cheeses, deli meats, smoked fish, hot dogs, and deli prepared salads. Symptoms that may present with this pathogen can vary but the most common symptoms include, fever, diarrhea, stiff neck, confusion, and weakness [4]. If these symptoms present, more specifically a stiff neck, medical attention needs to be sought. Most often, if severe, antibiotics will need to be administered for symptoms to subside. ***Listeria monocytogenes*** is interesting because it has the ability to grow in the cold temperatures of the refrigerator. Listeria is killed by pasteurization and heating.

***Norovirus***

 The ***Norovirus*** is unlike any of the previously mentioned pathogens. Unlike the other mentioned pathogens, the ***Norovirus*** is in fact a virus not a bacterium. What this means is that unlike a bacterium a virus is a non-living pathogen. The ***Norovirus*** is a single stranded RNA, non-enveloped virus that causes gastroenteritis. The symptoms that present with the ***Norovirus*** are like those of the bacterium pathogens—which is the only similarity between them. Symptoms typically last about 33 hours and this includes, watery diarrhea (non-bloody), possible low grade fever, migraine, dehydration, and abdominal cramps [4]. According to the CDC, ***Norovirus*** is highly contagious and the sources of contamination include fecal contaminated food or water and via droplet per vomiting.

***Salmonella***

This next pathogen is likely to be one of the most commonly known—***Salmonella.*** This pathogen is most associated with contaminated eggs, poultry, unpasteurized milk or juice. Have you ever been told to not eat raw cookie dough or to lick the bowl after someone baked a cake? Think ***Salmonella***! The typical incubation period of this particular pathogen is 1-3 days with a duration time of about 4-7 days. ***Salmonella*** is a gram-negative rod-shaped bacterium. That when consumed, causes abdominal cramping, fever, and diarrhea (possibly bloody). Typically, no medical intervention is required; symptoms will subside on their own.

***Staphylococcus aureus***

One of the most common foodborne pathogens besides ***Salmonella*** is ***Staphylococcus aureus***. The main source of contamination is cooked foods high in protein, salads, bakery products and dairy products that are held too long at room temperature. ***Staphylococcus aureus*** has a tendency to have a rapid onset of symptoms that include vomiting and sever nausea [3]. The incubation period for this pathogen is very short, shorter than any other pathogen! The incubation period is 1-6 hours after contamination and the duration is known as a 24-hour bug but can last up to 48 hours after onset of symptoms. ***Staphylococcus aureus*** is a gram-positive coccoid bacterium that is able to produce a heat-stable enterotoxin during the growth of ***Staphylococcus aureus*** in food. The most common cause of ***Staphylococcus aureus*** is direct contact with food workers carrying the bacterium or through contaminated dairy products.

***Shigella sonnei***

Much like ***Campylobacter*** and ***Salmonella***, this pathogen causes gastroenteritis within the body! Gastroenteritis is usually associated with abdominal pain, cramps, fever, and diarrhea that may contain blood and mucus. ***Shigella sonnei*** is a gram-negative rod shaped bacterium and it is easily transmittable through fecal-oral contamination as well as ready to eat foods handled by infected food workers [3]. In extreme cases, ***Shigella sonnei*** can induce seizures within children; however, the cause of this symptom is unknown at this time. The typical incubation period for ***Shigella sonnei*** is 24-48 hours and the duration of this illness is generally 4 to 7 days. Medical intervention is not required; however, depending on the severity of symptoms, antibiotics may be given.

***Toxoplasma gondii***

Out of the ten pathogens listed by the CDC, this pathogen is the only parasite listed in the top ten-foodborne pathogens. ***Toxoplasma gondii*** is a protozoan parasite that causes ***Toxoplasmosis***. Do you or anyone you know happen to own a cat? Well, cats are a known carrier of this parasite. However, cats are not the only way to contract the parasite that causes ***Toxoplasmosis***. One can contract ***Toxoplasmosis*** through cat feces, pregnant women should not be cleaning out litter boxes. This is due to this parasite living in the cat feces. One can get this parasite by accidentally touching or ingesting anything that has been exposed to cat feces. One can also contract this parasite by eating undercooked or contaminated meat (mainly pork, lamb, and venison). In addition, one can contract this parasite by receiving an infected organ transplant or infected blood via transfusion; however, these cases are rare. If contracted, you would feel like you have the flu, complete with swollen lymph glands and muscle aches that could last for up to a month or more. In more severe cases, ***Toxoplasmosis*** can cause brain, eye, and organ damage. Who is most at risk? Pregnant women (no cleaning the cat litter box), those with weakened immune systems—those with AIDS, people on chemotherapy, and those who have recently received an organ transplant. If an infection is suspected, consultation with your doctor will be necessary. Once consulted, specific blood tests will be necessary to confirm an infection. Non-pregnant women and those with strong immune systems will not require treatment; symptoms will subside on their own. If one is pregnant, going through chemotherapy or any of the above mentioned, treatment will be sought by the physician.

***Vibrio vulnificus***

 ***Vibrio*** is a genus of a gram-negative curved rod-shaped bacterium that includes several species that humans are highly susceptible. The incubation period is 1-7 days after the ingestion of undercooked or raw shellfish and contaminated seafood. Symptoms that present are vomiting, abdominal pain, diarrhea, and in some cases wound infections (but that is a completely different chapter). ***Vibrio vulnificus*** is a pathogen that if contracted, will require antibiotics.

**Seafood Poisoning**

 Although there are only ten pathogens that this chapter has covered, there are many more in the world. The ten listed are just at the top of the list! If you are a seafood lover, watch out! You will need to make sure that your food is properly prepared, because there are numerous types of food poisoning that pertain just to fish and seafood alone! These include but are limited to the following:

* Scomborid poisoning from bacteria in dark fish meat (tuna, mahi-mahi, mackerel)
* Puffer fish poisoning
* Poisoning from shellfish that feed on certain types of algae
* Ciguatera poisoning in tropical fish (grouper, snapper, shark, etc.)

If eating fish, just make sure that it is properly prepared. You do not want to get sick on a nice vacation!

**Who is Most at Risk?**

Foodborne pathogens do not discriminate. Any and every one is susceptible to foodborne pathogens. Those that are especially vulnerable are the elderly and infants. This is due to a weakened immune system, and bodies not being able to fight off these pathogens (as a healthy body would be able to do). Those that have weakened immune systems can include those that are receiving chemotherapy, pregnant, blood transfusion patients, children, and those that may have or in the process of going through an organ transplant.

**If you Feel at Risk**

Just be aware of what you are eating and if you can, make sure that it is properly prepared. As a consumer, you are able to ask about preparation conditions and see certificates from the health department to ensure proper food handling techniques and guidelines. If you feel that something is not right with your food, and cleanliness is an issue, do not continue to finish your food or eat at the establishment. If deemed necessary, report the establishment to your nearest health department.

**Steps to Help Prevent Foodborne Pathogens**

Here are a few steps that can help prevent:

* Cook foods to their proper temperatures
* Always refrigerate your food especially food that is not going to be eaten right away and leftovers
* Wash your hands
* Clean any dishes or utensils that have been used to prepare food
* Keep juices from meat, seafood, and poultry away from ready-to-eat foods
* Wash fruits and vegetables before consuming

These are just some helpful tips to help prevent you from contracting a foodborne illness! If you think that you have contracted a foodborne illness from a restaurant or even family or friends, let the establishment know immediately. This will help prevent others from contracting a foodborne illness. In some instances, you may even have to report it to your local health department—this mainly concerns if you feel that you have contracted an illness from a restaurant.

**What is Next?**

 Yes, this chapter was lengthy and most pathogens have the same symptoms, however, foodborne pathogens are important to everyday life. Now, that you have learned about the top ten-foodborne pathogens and more, you are ready to move onto the next chapter. In the next chapter, we will be taking a more advanced look at food microbiology and the human body response.

**References**

**[**1] (2017, March 13). Retrieved March 17, 2017, from <http://www.cdc.gov/>

[2] F. (2009, August 21). FoodSafety.gov/poisoning/causes/bacteriaviruses/listeria/index.html. Retrieved March 17, 2017, from https://www.foodsafety.gov/

[3] Foodborne pathogens. (n.d.). Retrieved March 17, 2017, from <http://www.fightbac.org/food-poisoning/foodborne-pathogens>

[4] Food Poisoning. (n.d.). Retrieved March 15, 2017, from <http://umm.edu/health/medical/altmed/condition/food-poisoning>

[5] Pigott, D. C., MD. (2008). Foodborne Illness. Emergency Medicine Clinics of North America, 475-497. doi:10.1016/j.emc.2008.01.009

[6] Taxoplasmosis. (2005). Retrieved March 17, 2017, from <http://www.cfsph.iastate.edu/IICAB/>

**Figures**

Figure 1

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| **Microorganism** | **Source of Contamination** |
| ***Campylobacter jejuni*** | Raw and undercooked poultry and other meat, raw milk and untreated water. |
| ***Clostridium botulinum*** | Improperly prepared home-canned foods |
| ***Escherichia coli 0157:H7*** | Beef, undercooked or raw hamburger, produce, raw milk, and unpasteurized juices and ciders. |
| ***Listeria monocytogenes*** | Unpasteurized dairy products, including soft cheeses, deli meats, smoked fish, hot dogs, and deli prepared salads. |
| ***Norovirus*** | Any food contaminated by someone who is infected with this virus. |
| ***Salmonella*** | Raw and undercooked eggs, undercooked poultry and meat, fresh fruits and vegetables, and unpasteurized dairy products. |
| ***Staphylococcus aureus*** | Cooked foods high in protein, salads, bakery products, dairy products, that are held too long at room temperature |
| ***Shigella sonnei*** | Salads, unclean water and any food handled by someone who is infected with bacterium |