



Pathogen Tracker Game Encyclopedia

Pathogens

As human beings, we have millions of bacteria in and on our bodies - in fact, they make up two pounds of our body weight. Most of these bacteria are helpful. However, some bacteria cause disease; these organisms are pathogenic.

A pathogen is a microorganism, such as a bacterium or fungus that causes disease. A "foodborne" pathogen is one that infects you when you eat contaminated food. There are more than 200 known foodborne diseases caused by pathogens; however, the actual figure is estimated to be much larger. The Centers for Disease Control and Prevention (CDC) estimated in 2011 that more than 9.4 million episodes of foodborne illness occur in the US every year, resulting in 56,000 hospitalizations and 1,400 deaths.

Outbreak

There is no exact number of instances of disease that must occur for an outbreak to be declared. To determine if an outbreak has occurred, you must compare the number of illnesses reported over the last few months that were caused by the strain you are investigating with the number of illnesses reported over the same period of time that were caused by other strains of the same pathogen and species (e.g. baseline rate). If the number of illnesses reported that were caused by the strain you are investigating seems unusually high compared to the number of illnesses caused by other strains of the same pathogen and species, then an outbreak can officially be declared.

Symptoms of Foodborne Illness

- *E. coli* O157:H7
 - sudden onset of abdominal pain and severe cramps, followed within 24 hours by diarrhea
 - diarrhea becomes watery and then may become bloody
- *Listeria monocytogenes*
 - fever, muscle aches, and gastrointestinal symptoms such as nausea or diarrhea
 - headache, stiff neck, loss of balance, confusion, obtundation or convulsions can occur
 - infection during pregnancy can lead to miscarriage, infection of the newborn, or even stillbirth
- *Salmonella*

- diarrhea, often with fever and abdominal cramps
- nausea and vomiting
- diarrhea often includes mucous and is occasionally bloody

Riboprints

Ribotyping is a method of genetic fingerprinting. Genetic fingerprinting in general refers to differentiating bacteria beyond the species or subspecies level. It analyzes the DNA sequences that code for the RNA portion of ribosomes, the important protein-synthesizing parts of cells. These sequences in particular are analyzed because of their consistency among species.

Ribotyping requires several steps:

1. Samples are taken from the infected people while they are hospitalized or under the care of a health care provider, and cultured in the laboratory.
2. After growing or culturing the bacteria in the sample, a colony of the likely pathogen is isolated. This colony is referred to as an "isolate."
3. The DNA is purified and extracted. This DNA is then cut by restriction enzymes into many exact fragments.
4. Once the DNA is divided, it is treated in one of two ways. The DNA is either "amplified" with primers specific for ribosomes and transferred onto a gel using polymerase chain reaction (PCR), or probed with ribosomal DNA probes if using Southern blotting.
5. No matter which technique is used, banding patterns will appear on the gel or blotter, creating a riboprint. These banding patterns are used to compare the different subtypes in our database. An example of a riboprint can be seen at the start of this article.

Pathogen Tracker

Pathogen Tracker is an innovative Web-based tool for information exchange on bacterial subtypes and strains and for studies of bacterial biodiversity and strain diversity. An early version was first developed in the lab of Cornell University Food Scientist Dr. Martin Wiedmann to track a 1999 outbreak of *Listeria* in which 21 people died.

Pathogen Tracker allows researchers and public health professionals to upload digital images produced in their labs and to compare this image against others stored in the Pathogen Tracker database. This database also contains genetic, phenotypic and source information for bacterial isolates of foodborne and zoonotic pathogens and food spoilage organisms collected by Dr. Kathryn Boor's and Dr. Martin Wiedmann's research groups at Cornell and their collaborators.

You are being given special access to the Pathogen Tracker database through the FBII. The FBII Web interface will make it easy for you to get the information you need to do your job as an outbreak investigator. You will be able to identify the strains of the bacteria isolated from the group of people who have suffered foodborne illness and use this information in your search for the source of the disease.

Interviewing and Food Sources

Interviewing the patients about every food they have eaten in the last few months would be very time consuming. Therefore the interviews must focus only on the foods commonly associated with the pathogen being investigated. Here is a resource with a list of possible food sources for a few different pathogens. Be sure to take notes on the foods relevant to your case.

E. coli O157:H7

beef (particularly ground beef), poultry, raw milk, apple cider, cantaloupe, vegetables

Listeria monocytogenes

deli meats (sliced turkey, roast beef etc.), hot dogs, smoked fish, soft cheese (Camembert, Brie, etc.), milk, raw milk, butter, ice cream, raw vegetables, deli salads

Salmonella

meat, poultry, shellfish, eggs, milk, chocolate, vegetables, fruits, peanuts

How Hotdogs Are Made

There are many steps in the process of making hotdogs:

1. Meat is selected and placed into a mixer. Spices are added and the mixture is ground into a batter called an "emulsion."
2. The emulsion is then pumped into a stuffer-linker machine, where it flows into casings. The hotdogs are made into long links.
3. Next the hotdogs are sent to the smoke house to be cooked.
4. After being smoked and cooked, the hotdogs are sprayed with cold water. They are sent through a peeler where the casings (i.e., skins) are removed.
5. The hotdogs are then sent to the packaging area where they are vacuum-sealed in plastic film.
6. Finally the hotdogs are ready to be shipped to stores and vendors.

USDA Guidelines

After Ready-To-Eat food products (e.g., hot dogs, sliced deli meats) from a processing plant have been found to be contaminated with *Listeria monocytogenes*, the USDA recommends that the plant initiate an immediate recall of all potentially contaminated products. The plant will generally work with the USDA and experts in food safety to identify the sources of contamination. The plant will often be shut down for a period of time while contamination sources are tracked and plans are developed for disinfecting the plant and for preventing contamination of finished products in the future. If the company that owns the plant refuses to comply with the USDA's recommendations the USDA may remove its approval of the company. Once a company can provide evidence that a suitable plan to prevent future contamination incidences has been put into action, that the plant has been cleaned and sanitized appropriately, and that intensive testing does not show any *L. monocytogenes* contamination, the plant can be re-opened. The plant will often operate under closer USDA supervision and testing for a while.