# FOOD SAFETY


## Abstract

Foodborne illnesses are more widespread than people realize. They are defined as illness caused by consumption of food or water contaminated by a microorganism such as bacteria or viruses or a parasite. Foodborne illnesses are commonly referred to as food poisoning and they can have serious consequences, especially in certain more vulnerable population groups. The diagnosis of food poisoning is by exclusion, and based on signs and symptoms and an ability to track when food and what type was eaten. The signs and symptoms of food poisoning are nonspecific in nature and are discussed. Treating food poisoning involves rest and fluids. There is no best fluid for treating food poisoning. It is most important for the food poisoned person to remain well hydrated. The majority of food poisoning incidents are caused by improper handling, preparation, and/or storage of food, which means that food poisoning is preventable if food is properly handled, prepared and stored.


## Learning Objectives:

1. Describe foodborne illnesses and distinguish them from other medical conditions.
2. Describe the treatment options for food poisoning.
3. Identify the guidelines for the proper handling, preparation, and storage of food.

## Introduction

Foodborne illnesses are more common than most people realize. Foodborne illnesses, often called food poisoning, can cause serious illness. These signs and symptoms are nonspecific in nature, and there are many medical problems that can produce a clinical picture that is similar to food poisoning. Once a person has been diagnosed with a foodborne illness, there are available treatments that help control the symptoms for the duration of the illness. Food safety can prevent the majority of foodborne illnesses. Food safety involves proper food handling, preparation and food storage.

## The Importance of Food Safety

Food safety is important because foodborne illnesses are more widespread than people realize and foodborne illnesses can have serious consequences. A CNA should be familiar with the signs and symptoms of food poisoning. Statistics from the Centers for Disease Control and Prevention (CDC) and other sources emphasize why food safety concerns everyone. These statistics, set out in Table 1, represent an average year in the United States.

**Table 1: Foodborne Illness Statistics, United States**

- **1 in 6 people - 48 million - will develop a foodborne illness.**
- **128,000 people will need to be hospitalized for treatment of a foodborne illness.**
- **Foodborne illnesses will cause 3000 deaths.**
- **97% of foodborne illnesses are caused by improper food handling.**
- **79% of foodborne illnesses occur in restaurants or other commercial establishments.**

## Food Poisoning Definition

Food poisoning is defined as an illness caused by consumption of food or water contaminated by a microorganism such as bacteria or viruses or a parasite, such as *Toxoplasma gondii*. There are many different microorganisms that can cause foodborne illnesses. In most cases of food poisoning, the microorganism that is responsible is not identified but in the cases in which the causative agent is identified, it is usually one of the eight microorganisms listed in Table 2. All of these microorganisms except *Norovirus* are bacteria.

**Table 2: Causes of Foodborne Illnesses**

| |
|---|
| **Campylobacter** |
| **Clostridium perfringens** |
| **Escherichia coli** |
| **Listeria monocytogenes** |
| **Norovirus** |
| **Salmonella** |
| **Shigella** |
| **Staphylococcus aureus** |

These microorganisms have differing onsets, duration, and food products that are typically carriers of a specific microorganism. These may be summarized as follows.

### Campylobacter jejuni

Onset of effects is 2-5 days. Duration of the illness is 2-10 days. Carried by common food products such as raw/undercooked poultry and unpasteurized milk.

### Clostridium perfringens

Onset of effects is 8-16 hours. Duration of the illness is usually 24 hours. Carried by common food products such as meats and poultry.

**E. coli O157:H7**

Onset of effects is 1-8 days. Duration of the illness is 5-10 days. Carried by common food products such as undercooked beef (especially hamburger) and raw fruits and vegetables.

**Listeria monocytogenes**

Onset of effects is 9-48 hours. The duration of the illness is variable. Carried by common food products such as soft cheeses and delicatessen meats.

**Norovirus**

Onset of effects is 24-48 hours Duration of the illness is 1-2 days. Carried by common food products such as shellfish and salads.

**Salmonella**

Onset of effects is 12-72 hours. Duration of the illness is 4-7 days. Carried by common food products such as eggs, fruits, meat, poultry, and vegetables.

**Shigella**

Onset of effects is 4-7 days. Duration of the illness is 24-48 hours. Carried by common food products such as raw produce.

**Staphylococcus aureus**

Onset of effects is 1-6 hours. Duration of the illness is 24-48 hours. Carried by improperly refrigerated or unrefrigerated egg-based products and meats.

The *Salmonella* bacteria is one of the most well-known causes of food poisoning and a brief discussion of this microorganism and the illness it can cause is helpful for a general understanding of foodborne illnesses.

The *Salmonella* bacteria is commonly found in the environment and in the gastrointestinal tract of animals and humans. It is carried on the skin of reptiles and amphibians such as lizards and turtles that are kept as pets. Approximately 95% of all cases of *Salmonella* infection are caused by ingestion of contaminated food.

*Salmonella* food poisoning is called Salmonellosis. Beef, eggs, egg shells, and poultry are the most common food sources of *Salmonella*, but many other types of food can be contaminated with *Salmonella*. Once the contaminated food enters the gut most of the *Salmonella* bacteria are destroyed by the stomach acids. However, if the food has a high level of contamination of *Salmonella* some of the bacteria will survive, enter the wall of the small intestine, and begin to multiply. The bacterial infection and the toxins produced by *Salmonella* bacteria cause inflammation of the small bowel and 12-72 hours after the exposure the signs and symptoms of Salmonellosis begin.

**Table 3: Signs and Symptoms of Salmonellosis**

| |
|---|
| **Abdominal pain and cramping, often severe**<br>**Chills** |

**Diarrhea: May be bloody or contain pus**
**Fever: This can be > 102° F**
**Headache**
**Muscle aches**
**Nausea**
**Vomiting**

Children are the population group most affected by foodborne *Salmonella*, and neonates are especially susceptible, but adults over 60 and people who have a compromised immune system are at risk, as well. Salmonellosis typically has a duration of 4-7 days but it may take several weeks before normal bowel habits are restored.

*Salmonella* food poisoning is incapacitating to a degree that is far out of proportion to its seriousness. Basically, someone who has Salmonellosis feels terrible but the illness is not dangerous. The great majority of people will recover uneventfully. Death caused by Salmonellosis is rare and serious complications are uncommon.

## Common Features of Foodborne Illnesses

*Salmonella* food poisoning is in many ways a typical foodborne illness and common features of foodborne illnesses are highlighted here.

- The contaminated food may not look, smell, or taste bad.
- Food-borne illnesses take time to develop, anywhere from several hours to several days.
- The signs and symptoms can be very intense.
- The signs and symptoms of food poisoning are nonspecific in nature.
- The great majority of people who have food poisoning recover.
- Complications are very unusual and death from food poisoning is rare.

- Children weigh less than adults so the number of microorganisms they ingest is proportionately higher, placing them at greater risk.
- People > age 60 have less acid in their stomach so more of the offending microorganisms survive.
- People > age 60 are more likely to have a weakened immune system so they are more likely to develop food poisoning.
- Children, the elderly, and people who have a compromised immune system, such as, someone those infected with human immunodeficiency virus (HIV) or a chronic illness are at greater risk for developing food poisoning complications.

Since the signs and symptoms of food poisoning are nonspecific, a person with these symptoms must determine if food poisoning or another medical condition has occurred. This is especially true for population groups that are more vulnerable to complications from foodborne illnesses.

**Signs and Symptoms**

The signs and symptoms that are typical of food poisoning are abdominal pain and cramping, chills, diarrhea, fever, headache, muscle aches, nausea, and vomiting. As mentioned previously, these signs and symptoms are nonspecific in nature, and there are many medical problems that can produce a clinical picture that is similar to food poisoning.

The great majority of foodborne illnesses are not serious and do not require a physician's attention. The medical provider will need to know if someone has food poisoning or if the person's symptoms are due to appendicitis, a bowel obstruction, or a gallbladder infection. This is

important to determine because a person who has the signs and symptoms of food poisoning may not have food poisoning but may need to be referred for a more serious medical condition.

Guidelines that can help a clinician determine if a patient's symptoms are caused by food poisoning or a medical condition include those raised here.

- If the affected individual is < 5 years or > 60, the patient's physician should be notified. People in those age groups are more likely to develop complications from food poisoning.
- If the affected individual has a compromised immune system, the patient's physician should be notified. Also, if the affected individual has diabetes or chronic medical problems a physician should be notified. For a diabetic patient, diarrhea and vomiting can cause dehydration and dehydration can cause very high or very low blood sugar levels.
- If the signs and symptoms are severe or if they are minor and last for more than 24 hours a physician should be notified.
- If the signs and symptoms are severe or if they are minor and last for more than 24 hours or if the patient is very young, old or has a chronic medical illness and a physician cannot be contacted within a reasonable amount of time, then being admitted to an emergency room is reasonable.

**When to Seek Medical Attention**

The points outlined above are straight-forward, practical advice on when to seek emergency attention for possible food poisoning. There is strong reasoning behind them and most people would be inclined to follow these suggestions. Parents whose young child has become sick will take the

child to the pediatrician. People who have chronic medical illnesses will usually call or see a physician if they are sick. However, individuals with food poisoning, other than children, elderly adults, or persons with a chronic medical illness, may view emergency care as unnecessary and excessive.

Food poisoning cannot be cured. The great majority of foodborne illnesses contracted by young, healthy patients are not serious and do not require a physician's attention. If a physician is consulted, however, he/she may prescribe only a few hours of intravenous (IV) fluid replacement and a medication to treat nausea and vomiting (an antiemetic), but this level of treatment would be the exception. A physician will usually advise a patient with food poisoning to rest, stay hydrated, and to follow up medically if the illnesses has not resolved in a few days.

## Diagnosis of Food Poisoning

There are no laboratory tests that can be used to diagnose food poisoning on a timely basis. Stool cultures can isolate and identify the microorganism that is causing food poisoning and confirm the presence of food poisoning. Unfortunately, the results of stool culture testing are not immediately available. It usually takes two to three day or perhaps longer for the results of a stool culture test to be ready

Because of this limitation and because the signs and symptoms of food poisoning can be mimicked by many medical illnesses, food poisoning is considered to be a *diagnosis of exclusion*. The physician examines and interviews the patient and will possibly order some laboratory testing. The physician will then consider all of the evidence and if the clinical

picture cannot be explained by a medical illness - if medical causes are excluded as the cause - the patient is diagnosed as having food poisoning.

Although food poisoning is not a serious problem for young, healthy individuals there is clearly a benefit to contacting a physician or being seen by a physician. For most people, food poisoning is almost always a miserable experience but it is benign and is self-limiting. On the other hand, medical problems with the same symptoms as food poisoning, such as a kidney stone, peritonitis, or a lower gastrointestinal tract bleed, may have serious consequences if treatment is delayed.

It may be obvious that someone has food poisoning. For example, if four people who ate the same food all developed abdominal pain, diarrhea, and vomiting eight hours later then its likely they all came down with food poisoning. Many times, it can be difficult to determine if food poisoning has occurred between the time of eating contaminated food and the onset of food poisoning. Diagnosing food poisoning is at times not easy for a physician so it cannot be expected that a lay person can differentiate between a foodborne illness and something else. If there is any doubt, a physician should be consulted.

## Treatment for Food Poisoning

If there is no immediate need to see a physician, there are "home remedies" that are familiar to everyone that can be used. Rest and fluids as tolerated are helpful. Products such as Gatorade® can help replace electrolytes that have been lost through diarrhea or vomiting, but there is no best fluid for treating food poisoning. What someone drinks is much less important than staying hydrated.

The best approach is to take small amounts of liquid and do so frequently. It may feel good to drink a large amount at one time but this may cause vomiting; small sips are best. Rest is helpful as it allows the immune system time to work ands it allows the body to focus its energies on recuperating. Rest also decreases the need for food and fluids and as most people have a difficult time eating and drinking during a bout of food poisoning, this is another benefit of rest.

Over-the-counter analgesics can be used to reduce a fever and treat muscle aches, but they must be used correctly. Patient's should never take more than the recommended maximum amount of drugs such as acetaminophen (Tylenol®) or ibuprofen (Advil®); exceeding the dosing limits of these medications will not be helpful and can be harmful. Over-the counter medications such as Pepto Bismol® or Imodium® that can slow down or stop diarrhea are not usually recommended for treating food poisoning. Diarrhea is one of the ways the body expels the microorganisms and for certain types of food poisoning these medications may be harmful.

Diarrhea caused by food poisoning can be constant and copious and it is very uncomfortable for the patient. However, the use of over-the-counter anti-diarrheals is not recommended for treating the diarrhea caused by food poisoning for two reasons. First, it is unlikely that these products will significantly decrease the duration or severity of diarrhea. Second, these drugs allow the microorganism to stay in the gastrointestinal tract and multiply and this could increase the risk of complications. In 2012 an outbreak of food poisoning caused by *Clostridium perfringens* occurred in a state psychiatric hospital in

Louisiana. Three patients died and all three were taking a prescription medication that slowed gastrointestinal motility.

In some cases, a patient may seek treatment for food poisoning through a physician. Emergency room care for food poisoning is typically limited to IV fluids and perhaps an antiemetic medication such as ondansetron (Zofran®) that will treat nausea and vomiting. The great majority of cases of food poisoning last only a few days and the patients recover without specific care so antibiotics are not routinely used to treat poisoning. However, if a stool culture confirms the presence of a specific microorganism the physician may recommend an antibiotic.

## Food Safety Prevention

The majority of food poisoning incidents are caused by improper handling, preparation, and/or storage of food. While there is no known cure, food poisoning is preventable. Food safety provides rules and procedures in the handling, preparation and storage of foods that, if followed, can help reduce foodborne illnesses.

### Food Handling and Preparation

Food handling and preparation are vital steps for ensuring food safety and preventing foodborne illnesses. Research has shown that many foodborne illnesses that occur in the home happen because of improper food handling and preparation. Many well publicized foodborne illness outbreaks in 2015 and in years past that involved restaurants and/or commercially produced food products were all the result of improper food handling and preparation.

Restaurants and the food service industry must comply with local food safety regulations, and these regulations typically require that employees and owners take training classes in food preparation and food handling. For example, anyone in New York City who is involved in food preparation must take the Food Protection Training course. Individual state retail and food service codes and regulations can be viewed at the Food and Drug Administration (FDA) website.
http://www.fda.gov/Food/GuidanceRegulation/RetailFoodProtection/FoodCode/ucm122814.htm.

Fortunately, it is not difficult to prepare and handle food correctly and many of the concepts that form the basis of food handling and food preparation are familiar to experienced CNAs. In addition, there is a lot of free and easily available information about these topics that can be readily found on-line. The simplest way to ensure that a person is correctly preparing and handling food is to consider this a three part process: Clean, Separate, and Cook.

**Cleaning: Food, Utensils, Surfaces and Personal Hygiene**

Most food that people eat is packaged, processed, or pre-cooked so cleaning it is not a concern but when food is being freshly prepared, cleaning is important. Microorganisms live everywhere in the environment, even in the most well-kept home or well-maintained restaurant. Countless microorganisms live in and on humans and animals, especially on a person's hands. Some of these microorganisms can be easily spread to food during preparation and handling and cause food poisoning. This can be prevented by conscientious handwashing, of the utensils and food preparation services, and of the food itself. These steps are all important but the process starts with handwashing.

Handwashing is arguably the most important step in safe food preparation. Every CNA knows the importance of handwashing in infection control. Handwashing prevents the transmission of infections from one patient to another or from an infected health care worker to a patient, and handwashing is equally important for preventing food contamination and for essentially the same reasons.

Many of the requirements of handwashing that apply to food preparation and food handling are the same as those that apply to infection control. These are outlined in Table 4.

**Table 4: Hand-washing, Food Preparation and Food Handling**

| |
|---|
| **Wet the hands with warm or cold running water.**<br>**Apply some soap and rub the hands together to make lather.**<br>**Scrub the areas between the fingers, scrub the backs of the hands, and be sure to scrub areas in and around the fingernails.**<br>**Wash the hands for at least 20 seconds.**<br>**Rinse the hands under running water and dry them using a clean paper towel or an air dryer.** |

The easiest way to know when a person should wash the hands during food preparation is to remember this phrase: B*efore, after, between, and always.*

- Wash the hands before beginning any food preparation/food handling process.
- Wash the hands after handling uncooked or raw foods and meats.

- Wash the hands when switching from handling one type of food to another, such as cutting meat and then cutting vegetables,
- Always wash the hands during food preparation and always wash the hands after using the bathroom.

Many outbreaks of food poisoning are caused by microorganisms that live in the gastrointestinal tract. Investigations into these outbreaks often show that the food was contaminated with fecal material because someone who handled the food did not properly wash the hands after using the bathroom.

Cleaning utensils and food preparation surfaces is also an important part of good food preparation and keeping food free from contamination. Brief contact of food with a spoon, knife, a kitchen counter, or a cutting board may seem to be harmless. However, these utensils and surfaces can easily be a home for microorganisms which can then be transmitted to foods. In addition, kitchen utensils and kitchen surfaces can be a vehicle of transmission of microorganisms, for example, a contaminated knife handle can spread microorganism to the hands and from the hands to the food being prepared.

**Cleaning Utensils, Food and Kitchen Surfaces**

Utensils and food preparation surfaces should be washed, such as cutting boards and countertops before using them. When handling food, the utensils and food preparation surfaces should be washed after using them and between uses. For example, when using a cutting board to slice meat the board should not be used to cut vegetables unless it has been washed with hot, soapy water. The same rule applies for the use of forks, knives, spoons, spatula, and other utensils.

A cloth or dish towel should not be used repeatedly to clean utensils or food preparation surfaces; the fabric can easily harbor microorganisms.

Finally, fruits, produce, and vegetables should always be cleaned before food handling or preparation. The surfaces of fruit, produce, and vegetables can easily be contaminated and washing will remove microorganisms.
Eggs, meat, poultry, and seafood should not be washed. The bacteria in these foods cannot be removed by washing. Washing may spread bacteria to other surfaces and cause cross-contamination, and bacteria in meat, poultry, and seafood will be destroyed by freezing or cooking so there is no need to wash these items before cooking.

Commercially produced eggs sold in supermarkets are washed before they reach the store. If they are washed at home this may cause a small crack that can allow surface bacteria to contaminate the inside of the egg.

Fruits and vegetables should be washed by rinsing them under lukewarm water. Soaps should not be used because soap residue can be left behind; this is not dangerous but it will affect the flavor. When preparing a fruit or a vegetable such as an apple, a cucumber, or a potato that has a firm surface and it will be cut or peeled before serving, wash the outside before cutting or peeling. This removes dirt and it also prevents bacteria on the skin from being carried from the surface to the interior by the knife. After washing, the produce should be dried with a paper towel. If fruit and vegetables are packaged and labeled pre-washed they do not have to be washed.

## Separating Foods

Separation is another way to prevent cross-contamination between foods. Rules for food separation are in set out in Table 6.

**Table 6: Rules for Food Separation**

- **Use separate cutting boards, plates, and utensils for foods, one each for eggs, meat, poultry, seafood, and fruits and vegetables. If this is not possible then wash the cutting board and the plates if they are to be used for more than one type of food.**
- **Use separate cutting boards, pates, and utensils for cooked and raw foods.**
- **Always separate meat, poultry, seafood, and fruits and vegetables when shopping. Try to avoid having them contact each other.**
- **Raw meat, poultry, and seafood that are stored in the refrigerator should be in plastic bags or containers. This will prevent their juices from leaking onto other foods.**

## Cooking

Cooking is a very effective way of destroying the microorganisms that cause foodborne illnesses. There are a huge number of resources available that can help a person determine how to safely cook food. For example, the website www.FoodSafety.gov. has links that instruct consumers on the proper cooking of essentially any food that may be consumed. Cooking temperatures for some commonly consumed foods are in Table 7.

**Table 7: Cooking Temperatures**

**Ground meat: Beef, lamb, pork, veal -160°**
**Ground meat: Chicken and turkey - 165°**
**Fresh beef, lamb, veal - 145°**
**Fresh poultry - 165°**
**Fresh ham and pork - 145°**
**Eggs and egg dishes: Cook eggs until the yolk and white are firm. Cook egg dishes to 160°.**
**Seafood: Finned fish - Cook until 145° or until the flesh is opaque and separates easily with a fork.**
**Seafood: Clams, mussels, and oysters - Cook until the shells open.**
**Seafood: Crabs, lobster, shrimp – Cook until the flesh is pearly and opaque.**

Fresh beef, ham, lamb, pork, and veal should be allowed to rest for 3-4 minutes after the cooking temperature has been reached. During this resting period the food continues to cook and this destroys more microorganisms. A food thermometer should be used to check food temperatures. The thermometer should be placed in the thickest part of the food and in several other areas, as well, and this should be done near the end of the recommended cooking time. When using the food thermometer for several dishes, it should be cleaned after each use.

It may seem impossible to retain all of this information about food cleaning, separation, and cooking. Many perishable items have a Food Safety Label that provides basic helpful information about cooking, handling, and storage that pertains to the individual item.

## Food Storage

Proper storage is essential for ensuring food safety, and there are two aspects of storage that are important: *temperature* and *time*.

Temperature usually refers to keeping foods cold or frozen and foods that must be kept cold or frozen are sometimes called perishable items.

Many foods that are perishable and have high moisture content must be refrigerated to prevent the growth of microorganisms. Bacteria such as *E. Coli* and *Salmonella* and other microorganisms that cause foodborne illnesses will multiply very rapidly if they are not kept cold. These bacteria and other microorganisms that cause foodborne illnesses reproduce most quickly when the surrounding temperature is between 40° and 140°, and this temperature range is called "the Danger Zone" when it applies to food. Some bacteria in foods can double in number in 20 minutes when the food is in the Danger Zone so maintaining food at the proper temperature, especially foods that need refrigeration or freezing, is important.

There are two different types of microorganisms in food. *Pathogenic* microorganisms cause food poisoning but they do not usually affect the appearance, odor, or taste of a food, so a food that is contaminated and can cause food poisoning may seem fine to eat. *Spoilage* microorganisms will *c*ause food to look, smell, and taste bad but will not cause food poisoning. Pathogenic microorganisms will quickly multiply if food is in the Danger Zone; spoilage can happen even if foods are refrigerated.

*Refrigeration* and *freezing* are two ways food are safely stored. Refrigerator temperatures should be 40° and freezer temperatures should be 0°. Important points about food refrigeration and freezing include:

- Refrigerate foods as soon as you get home from the store.
- Eggs, meat, milk, produce, and seafood should be refrigerated within two hours of being at room temperature, and within an one hour if the surrounding temperature is 90° or hotter. Some authorities feel that eggs can be safely stored at room temperature. In the right

circumstances this may be true but it is safer to store them in the refrigerator and this is recommended by FoodSafety.gov.

- There are exceptions but most foods that require refrigeration should be discarded if they are at a temperature greater than 40° for two hours. Some exceptions to this rule would be butter, fruits, hard cheeses, margarine, and vegetables.
- If the power goes out, food in the refrigerator should be safe as long as the power discontinuation was less than four hours.
- Make sure there is enough room in the refrigerator for air to circulate.

The proper temperature is also important for canned goods and dried foods. Canned goods, grains, flours, spices, rice, and other dry foods are sometimes called non-perishable or shelf-stable items. The terms are not true in the strictest sense because some of these foods can spoil. However, dried foods such as grains, oils, spices, and cereals do not need to be kept at cold temperatures or frozen and they are unlikely to be a good medium for microorganisms or a risk for food poisoning.

Canned goods have been cooked at a high temperature and then vacuum sealed so they are not exposed to air. The first part of the process destroys microorganisms and the second part prevents microbial growth, so canned foods can be stored indefinitely at room temperature. The shelf-stable foods should be kept at 50° - 70°.

## Freezing Foods and Thawing

Any food, except for eggs and canned goods, can be stored by freezing. Eggs can be cracked by freezing and canned goods may swell and lose their seals. Freezing does not destroy microorganisms that cause food poisoning. It simply stops them from multiplying and puts the ones that

are present in a dormant state. Freezing also prevents growth of microorganisms that cause food spoilage.

Foods that are stored at 0° will always be safe to eat. However, whether or not they will be palatable and attractive is a different matter. Even when foods are properly stored in a freezer they will eventually lose texture and taste. A piece of meat that has been in a freezer for two years may not cause food poisoning but it may not be pleasant to eat. There are recommended storage times for frozen foods, for example, one year for uncooked meats. However, this simply means that after one year the meat may be edible but it may be tough and somewhat tasteless. Recommended storage times are not the same as an expiration date.

Freezing food does not require extensive preparation, but wrapping foods keeps them from developing freezer burn and becoming damage. Meats can be stored in their original packaging, but this type of covering is not airtight so placing meats in a container or covering them with an additional layer of wrapping is recommended.

Foods that are frozen can develop freezer burn. Freezer burn happens when frozen foods are not completely sealed. Contact with air causes the food to become dry and discolored: meats usually become grey or brown and have a leathery texture. Foods that have freezer burn are safe, just not very tasty. Cut away the freezer burned sections and the food will be fine to eat.

Thawing frozen foods should be done in a microwave, in the refrigerator, or in cold water. It is *not* recommended to thaw frozen foods on a counter

top at room temperature because this can allow microorganisms in the food to multiply. It should be remembered that freezing does not kill the bacteria and other microorganisms that can cause food poisoning, it only keeps them dormant. If a frozen food is exposed to Danger Zone temperatures, 40°-140° it may become unsafe to eat. If food has been thawed in the refrigerator it can be re-frozen and it will be safe to eat. A person should not refreeze foods left outside the refrigerator longer than 2 hours or longer than 1 hour in temperatures above 90°.

If there is a power outage foods in the freezer should be safe to eat if the power outage is two day or less. Once power has been restored a person should check to see if the foods still have ice crystals and if they do they are safe to eat.

**Food Storage: Time**

Often people have questions about the time of food storage: How long can milk keep? How long are eggs good for in the refrigerator? Are pork chops that has been in the refrigerator for a week still safe to eat? Questions such as these are common concerns people have about their food. There are authoritative websites that have information about the time limits for safe storage, but food labels also provide guidance.

Packaging Date - "Best if Used By":

Food packaging will often have a date the item is best consumed by before discarding it. It is sometimes called the "use by date". The best if used by date indicates the time at which a product will begin to lose quality. If the food is eaten that has passed the best if used by date it may not have its optimum quality of taste and desired texture but it will be safe to eat. Many products will be okay to eat for a period of time

after the best used by date. Milk, for example, will be safe for a week after that point if it has been properly stored.

Sell by Date:

The sell by date is used by stores so that they can remove food items from the shelves. After the sell by date has been passed it is assumed that the buyer may have the product at home long enough for the product to eventually become unsafe to eat.

Expiration Date:

The expiration date is the most straightforward of the time-related food labels. Once a food item has passed its expiration date it is not safe to eat and it should be discarded.

Best used by, sell by, and expiration dates are not required by Federal law for most foods; these labels are voluntary. However, infant formulas and some baby foods are required to be labeled with an expiration date and infant formula and baby foods should never be used if they have passed the expiration or the sell by date.

The amount of time in which food can be safely stored depends, of course, on what the food it is. Several examples are provided here.

Cooked Poultry Dishes:
For freshness and quality cooked poultry dishes should be eaten within 3-4 days when stored in refrigerator; and, 4-6 months if stored frozen.
Eggs in the Shell
For freshness and quality eggs in the shell should be eaten within 3-5 weeks when stored in refrigerator.

Fruit Juice in Boxes:
For freshness and quality fruit juice in boxes should be consumed within 8-12 days if refrigerated after opening.

Ground Beef:
For freshness and quality ground beef should be cooked and eaten within 1-2 days if it has been stored in a refrigerator; and, 3-4 months if it has been frozen.

Milk:
For freshness and quality, milk should be consumed within 1 week when stored in refrigerator; and, 3 months if stored frozen.

Rice, white and wild:
For freshness and quality white and wild rice should be eaten within 2 years if stored in a pantry between 50-70° and unopened; and, 1 year if stored in a pantry between 50-70° and opened.

These and other recommended food storage guidelines can be found on the U.S. Health & Human Service sponsored FoodSafety.Gov website.
On the opening page of the website, the reader may click on the title "Keep Food Safe" and a menu will pop up that has a link to the FoodKeeper App.

**Canned Goods**

Canned goods are a special item when food storage is discussed. Canned goods are considered to be safe to eat for up to 5 years if they are stored

at the proper temperature, and there are some authorities who feel that as long as canned goods have been stored properly and the can is intact, the food will never be unsafe to eat.

However, canned goods can become spoiled and/or contaminated, and canned goods should not be eaten if any of the following is found.

- The can is heavily rusted.
- The seal has been broken.
- The can is leaking.
- The can is swollen.
- If the can has been frozen.
- The can is heavily dented.
- When opening the can there is a strong, prolonged hissing noise or the liquid contents are strongly forced out.
- The can is bulging.
- The contents appear spoiled or have a foul odor.

Many people are concerned that they may develop *botulism* from canned goods. Botulism is a very dangerous disease caused by the *Clostridium botulinum* bacteria. Canned foods can contain *Clostridium botulinum* because this bacteria does not require air to grow and multiply and it does not survive well in acidic foods. Fortunately, foodborne botulism is rare. There are typically about 20 cases of botulism in the United States in any given year. However, foodborne botulism is quite dangerous and even an extremely small exposure to *Clostridium botulinum* can cause foodborne botulism. The bacteria and its spores may be destroyed by heating but the risk of developing botulism is not worth taking a chance. If any of the aforementioned conditions apply to a can of food, it should not be eaten. Even a tiny amount of suspect food should be discarded.

## Case Study: Food Poisoning

The following case study was obtained from a PubMed search and discusses the dangers of food poisoning in the home.

The authors reported on a 40 year old man who was hospitalised with suspected dehydration and gastrointestinal issues. The patient had a medical history of asthma and autism spectrum disorder. He lived alone, in his own house, and was self-sufficient. He was reportedly in healthy condition prior to his admission with this sudden illness.

The patient's medical history had been unclear because family had been away for a week prior to his illness, and the patient was unable to provide a full account of his situation. He was believed to have been vomiting for about two days, and had a cough with gagging. He also complained of having pain in the throat, chest and abdomen. When his next of kin was contacted, they reported having found food in waste containers and that the patient had a lot of old food in the house.

On admission to hospital, the patient appeared drowsy, in weak condition, and could barely sit up in the hospital without a lot of assistance. He appeared dry to his nasal and throat passages, and had widespread abdominal tenderness. His vital signs were obtained, showing a blood pressure of 124/68 mmHg that dropped to 92/51 soon after admission, however improved after being given intravenous fluid. The patient's pulse was regular at 70 beats/minute. His breathing was rapid and shallow, with a frequency of 26 per minute, and labored. The patient's lung sounds were reduced. The urine appeared dark.

A neurological examination showed that the patient had weakness, and difficulty standing or moving about. His pupils were dilated and did not react to light. His reflexes were equal to both hands.

When laboratory and radiology testing was done the patient had high inflammatory markers and abdominal distention to the bowels. It was assumed that his abdominal pain was due to bowel distention.

The patient had low health risks prior to this admission, He was a non-smoker and his asthma condition had been stable. Yet, he was suffering from respiratory failure and his clinicians needed to rule out other cause, such as pneumonia. During his hospitalization, the patient became febrile. The blood gases indicated that he had respiratory failure.

The patient appeared very debilitated very quickly. Soon after admission, the patient's bedside caregiver noticed he appeared more sluggish and informed the nursing supervisor and physician of his deterioration. His breathing and oxygen saturation worsened. While the physician was present, the patient experienced respiratory and circulatory failure and advanced cardiopulmonary resuscitation was started.

The patient required emergency intubation and respiratory assistance and was moved to the Intensive Care Unit (ICU). The patient had a fluctuating blood pressure and was very unstable. The medical team began to question other causes such as a blood clot or stroke. Head scans were taken in radiology but revealed no disease. Radiology scans of the patient's chest, abdomen and pelvis were also obtained and no acute disease found. Finally, a lumbar puncture test was performed, and the findings were normal.

Although there were no signs of aspiration when the patient was intubated, it was assumed, that he may have aspirated and so he was treated preventively with antibiotics. Eventually, he improved and the temperature normalized. At first, he was thought to have normal strength performance and extubation and discontinuation of respiratory support was considered, but his oxygen saturation fell again. He was noted to have lack of swallowing movements and weakness in both lower extremities. The patient began to suffer increasing respiratory failure and had to be re-intubated and placed back on respiratory support.

A clinical neurological examination showed the patient had a reduced level of consciousness. Staff could not communicate with him, but he showed he could respond to painful stimuli. The patient laid in bed with half-open eyes, and neither opened or closed his eyes on request. His pupils were dilated without reaction to light. The patient did not squeeze hands when requested, but had equal strength of the upper extremities. He could not spontaneously move his lower extremities.

The medical team reported that the patient's neurological findings could be consistent with botulism or, alternatively, an inflammatory condition of the gut. In this patient, symptoms coupled with the symptoms nausea, abdominal pain, intestinal distention and abdominal tenderness, dry mucous membranes and eventual respiratory failure, were consistent with botulism. Normal cerebrospinal fluid was obtained and studied, and confirmed the suspicion of botulism.

**Discussion**

Foodborne botulism is diagnosed in some countries by injecting a patient's undiluted serum into mice. The diagnosis is confirmed if the mice develop symptoms consistent with botulism. When this patient's diagnosis was confirmed, the medical team contacted the infectious diseases department because of their suspicion of botulism. The patient received botulism antitoxin.

A stool sample was obtained from the patient and samples for botulism diagnostics were obtained. Four days later, the botulism diagnosis was confirmed. Two mice had been injected with serum from the patient and developed clear symptoms of botulism and died.

The fact that the patient eventually tested positive for botulism was not considered surprising, given that the health team later discovered he had eaten spoilt food. The patient had no diarrhea symptoms; on the contrary, he had bowel dilation and lack of motility as part of the botulism. Because the team did not culture stool initially this weakened their suspicion of botulism. They focused more on the patient's respiratory compromise and possible other cause for his acute deterioration, such as assumed aspiration pneumonia.

Soon after treatment, the patient rapidly improved – respirator treatment was discontinued and the patient was moved to a medical unit. He was mobilised with a walker and able to eat and drink independently. However, he remained in rehabilitation until his general strength was restored.

The patient's house was inspected and found to be full of spoilt food, and it had to be thoroughly cleaned. Finding the exact source of the botulism

was impossible under the circumstances, as it was assumed that bacterial growth and toxin formation had most probably taken place during storage of food at his home. The patient's disease was assumed to be foodborne.

The use of botulinum toxin is also known to have been considered in connection with bioterrorism – either by inhalation or injected into food. Foodborne botulism was most common in the early 1900s, as the use of canning became more common. In some seaside countries it is seen in connection with fish fermentation and meat curing. Foodborne botulism is now a rarity in most parts of the world.

Initial symptoms of foodborne botulism are nausea, vomiting, abdominal pain, diarrhea, dry mouth and sore throat. The patient in this case had most of these symptoms at the time of admission, but they were nonspecific, and may have been due to a number of causes.
The authors stated that patience is important in the treatment of botulism, as it may take up to 100 days for an improvement to occur. Botulism is treated with a single dose of botulism antitoxin manufactured from the blood of an immunised horse or sheep. When botulism is suspected, it is important to start treatment rapidly, and not wait for a final diagnosis.

When the patient's family went into his home they found much of his food in waste containers. He apparently had been looking for food that was still edible in waste containers from food shops in his neighborhood. This type of food hoarding is called "dumpster diving". Those who engage in dumpster diving are generally able to determine whether the food is spoilt. However, when it comes to botulinum toxin, determining whether

food is spoilt is not always possible because some types of toxin do not change the odor, taste or appearance of food. The patient's family determined that the patient not only found obtained food this way but stored it for long periods, sometimes without adequate refrigeration.

Botulism diagnostics takes time. If foodborne botulism is suspected, laboratory samples must be quickly obtained and antitoxin started. Respiratory failure is the main cause of death related to botulism. Therefore, patients with inexplicable respiratory failure should be closely monitored and botulism considered as a possible cause of food poisoning.

## Summary

Foodborne illnesses, typically referred to as food poisoning, are common occurrences. The majority of food poisoning incidents are caused by improper handling, preparation, and/or storage of food. Food safety can prevent the majority of foodborne illnesses.

Food poisoning is defined as an illness caused by consumption of food or water contaminated by a microorganism such as bacteria or viruses or a parasite. Food poisoning can take hours to several days to develop and the typical signs and symptoms include abdominal pain, diarrhea, nausea, and vomiting.

The great majority of food poisoning cases resolve without harm or complications and death from food poisoning is rare. However, infants, the elderly, and people who have chronic medical illnesses and/or a compromised immune system may be harmed by food poisoning. There is no specific treatment for food poisoning. Patients are advised to rest and stay well hydrated and in a week or two the illnesses should pass.

People who are at a high risk for complications - the groups previously mentioned - should consult a physician if they have food poisoning.

Proper food handling, preparation, and storage can significantly reduce the risk for food poisoning. Good food handling and preparation involves cleaning food; hand-washing; cleaning utensils and preparation surfaces; separating foods during preparation and handling; and, cooking foods correctly. All of these will prevent microorganisms from growing, multiplying, or cross contaminating food. Food storage methods such as freezing and refrigeration are also important for preventing food poisoning. Unlike cooking, which destroys microorganisms, freezing and refrigeration simply stop them from growing and multiplying but they are very effective methods of food safety if done properly.