

# The Big 6

## Foodborne Pathogens

### The Anatomy of Offenders

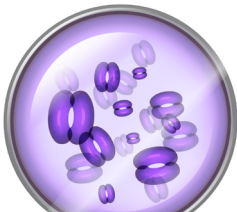
You are about to be confronted with a large amount of detail on each of the main threats to food safety. Read each carefully and take your time to understand the key information.

As a manager or person-in-charge, you need a working knowledge of each threat to pass the final exam and more importantly, to keep your customers safe.

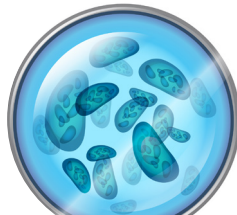
**We strongly recommend that you download this document and use it as a reference guide. It is also helpful when training and demonstrating safe food practices to your staff.**

Remember, knowing your enemy is halfway to defeating them!

## The Big 6



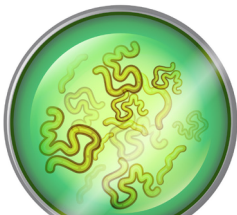
Norovirus



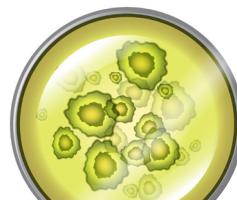
Hepatitis A



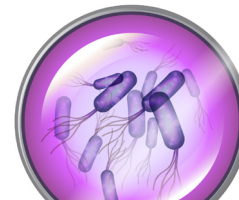
Salmonella



Salmonella typhi



Shigella



E. coli



**Salmonella**

## Pathogenic Bacteria

### Nontyphoidal Salmonella (NTS)

#### Description

- Facultative anaerobic, (does not need oxygen to live), rod-shaped pathogenic bacteria (non-spore forming). Salmonella remains one of the biggest causes of foodborne illness in the US.
- Salmonella can survive for weeks outside the body. Infective dose is usually over 100,000+ bacteria per gram of food and it needs to multiply to high numbers before it can cause illness.

#### Source

- Carried naturally in many farm animals.
- Foods affected include raw food of animal origin including: meat, sausages, poultry, eggs, egg products, milk and dairy products.
- It can also affect vegetables if they have been in contact with animal feces.

#### Preferences

- Survives freezing temperatures but killed by heat above 131oF.
- In low or moderate numbers, it is usually killed by the acid in the stomach.

### SYMPTOMS

#### Fever • Headaches • Abdominal Pain • Diarrhea • Vomiting

Affects all groups with reduced immunity. The young, old, pregnant, and ill.

Incubation Period (Onset Time):	12 – 72 hours
Duration:	1 – 7 days
Carrier Status:	Yes - can be carried in the human intestine.

#### Controls

- Separation of TCS foods and ready to eat foods
- Correct thawing techniques
- Cook all poultry foods above 165oF
- Always cook eggs to 145oF or higher unless the customer requests
- Don't use or serve un-pasteurized milk, juice or cider
- Cook burgers and other ground beef products to their minimum internal temperatures
- Wash fruits and vegetables thoroughly if they will be eaten raw
- Reputable suppliers that can prove the safety of the food supply chain
- Effective cleaning and sanitization procedures to avoid cross contamination
- Exclude food handlers who are vomiting or experiencing diarrhea or have been diagnosed with a Salmonella based infection



**Salmonella typhi**

## Pathogenic Bacteria

### Salmonella Typhi (Typhoid)

#### Description

- Typhoid is probably the most severe of all foodborne illness.
- It's a common killer where there is poor sanitation.
- Typhoid is caused by the Salmonella Typhi bacteria.
- **It only takes a small number of bacteria to makes someone sick.**
- People with typhoid fever will carry bacteria in their bloodstream and intestines.

#### Source

- Originates from contact with the feces of infected people and animals (note how many foodborne illnesses are connected with fecal matter).
- Foods affected include water and milk contaminated by sewage, and shellfish from sewage contaminated beds, also ready to eat foods and beverages.

#### Preferences

- Any environment where food gets contaminated with feces or urine (or easy cross-contamination occurs).
- Loves areas of flooding, particularly in warmer climates.
- **Cannot survive boiling or cooking, but can survive in refrigerators and freezers.**
- Multiplies best at 98.6oF, (body temperature).

## SYMPTOMS

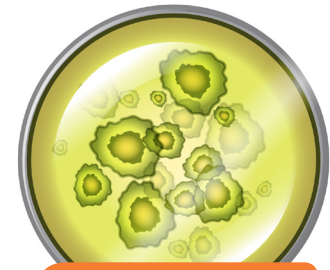
**High Temperature • Fever • Abdominal Pain • Diarrhea • Vomiting  
Mental Confusion • Pink Spots on Skin**

Also, a feeling of being increasingly unwell. With treatment mortality rate is approximately 1-2%.  
Without treatment death occurs in approximately 1 in 3 incidences.

Incubation Period (Onset Time):	7 - 21 days
Duration:	3 - 4 weeks
Carrier Status:	Yes

#### Controls

- Ensuring all water is safe (potable) with no risk of contamination
- Ensure no cross-contamination between sewage and clean water
- High standards of personal hygiene
- Have a strict hand washing policy and monitor staff
- Effective cleaning and sanitization procedures to avoid cross contamination
- Cook food to its minimum internal temperature recommendation
- Effective sewage disposal
- Exclude food handlers who have been diagnosed with a Salmonella Typhi based infection
- Pay close attention to any staff that travel to Third World countries where typhoid is a common illness
- Exclude food handlers who are vomiting or experiencing diarrhea or have been diagnosed with a Salmonella based infection



**Shigella**

## Pathogenic Bacteria

### Shigella spp.

#### Description

- This bacterial illness is sometimes called bacillary dysentery.
- **It only takes a small number of bacteria to makes someone sick.**
- This infection occurs when food workers who are carriers of the bacteria fail to wash their hands after using the toilet.
- Flies also are responsible as they can transmit the bacteria from feces to food.

#### Source

- Bacteria is found in the feces of infected humans and can survive for weeks after the symptoms have ended.
- Contaminated water or food.

#### Preferences

- Any food that is regularly touched by hands, such as salads containing TCS Foods.
- TCS Foods, raw produce, green salads, and foods such as tuna, turkey, macaroni and potato salad.

### SYMPTOMS

**Abdominal Pain • Diarrhea • Bloody Stools • Fever**

Incubation Period (Onset Time):	1 to 7 days
Duration:	5 to 7 days
Carrier Status:	Yes

#### Controls

- Have a strict hand washing policy and monitor staff, especially after using toilet
- Rapidly cool foods to 41°F or below
- Cook food to its minimum internal temperature recommendation
- Eliminate flies from your establishment
- Exclude food handlers who have diarrhea or have been diagnosed with a Shigella spp based infection



**E. coli**

## Pathogenic Bacteria

### Shiga toxin-producing E. coli (STEC)

#### Description

- An aerobic, (**needs oxygen**), rod shaped pathogenic bacteria, (**non-spore forming**), that produce an enterotoxin, (**toxin/poison**).
- Most strains of E. coli are harmless, but some can cause food poisoning including severe diarrhea in young babies and children. Sometimes called “traveler’s diarrhea”.
- E. coli 0157 is a particularly dangerous strain of this bacteria.
- **It only takes a very small number of these bacteria to makes someone sick.**

#### Source

- Infected cattle and humans.
- Bacteria found in the feces of infected humans and can survive for weeks after the symptoms have ended.

#### Preferences

- Raw meat, ground beef, under cooked burgers, gravy, raw milk.
- Can grow with or without water and can survive and multiply in refrigerators running as low as 36°F.
- Will grow in relatively high salt, sugar and acid concentrations, and even pickled food products.
- Can survive on stainless steel surfaces for up to 60 days if not properly cleaned and sanitized.
- Cooking above 122°F starts to slow down growth.

## SYMPTOMS

### Diarrhea • Vomiting • Fever • Abdominal Pain

Not serious for most healthy people - however, it can be fatal in groups such as young, ill, old or people with a compromised immune system.

Incubation Period (Onset Time):	12 – 24 hours
Duration:	1 - 5 days
Carrier Status:	Naturally present in the human intestine

#### Controls

- Approved suppliers
- Separation of storage and work areas for raw and high-risk foods to prevent cross-contamination
- Thorough cooking and temperature control of chilled ready-to-eat foods
- Cook food, especially ground beef to its minimum internal temperature recommendation
- Effective cleaning and sanitization procedures to avoid cross contamination of work surfaces and contact areas
- Good personal hygiene to prevent cross-contamination
- Exclude food handlers who have diarrhea or have been diagnosed with a Shigella based infection



**Norovirus**

## Pathogenic Bacteria

### Norovirus

#### Description

- Norovirus is the most common type of viral gastroenteritis in the US, with its short-lived, aggressive diarrhea and projectile vomiting.
- It affects approximately twenty million people a year in the US.
- **It only takes a small amount of the virus to makes someone sick.**
- It is very contagious.

#### Source

- Infected food handlers.
- Ready to eat foods, contaminated water, raw shellfish from contaminated water.
- It is commonly spread person-to-person by fecal-oral, oral-oral, and by poor personal hygiene, poor handwashing and bare hand contact.
- Virus is often found in the feces of infected humans for days after the symptoms have ended.

#### Preferences

- Spreads quickly among people in confined environments such as hospitals, prisons, schools, nursing homes and cruise ships.
- It is also called the “cruise ship bug” and the “winter vomiting bug” as it usually peaks in winter when people tend to be indoors more often.

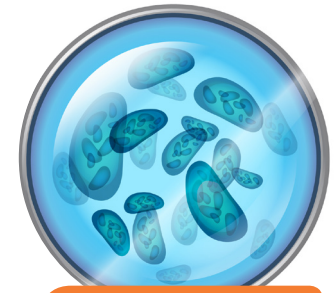
## SYMPTOMS

**Nausea • Projectile Vomiting • Diarrhea • Abdominal Pain  
Moderate Fever-Like Symptoms**

Incubation Period (Onset Time):	1 - 2 days
Duration:	1 - 3 days
Carrier Status:	Yes

#### Controls

- Exclusion of infected food handlers who are vomiting or have diarrhea or have been diagnosed with a Norovirus
- Have a strict hand washing policy and monitor staff
- Strict personal hygiene standards
- Avoid bare hand contact with ready to eat foods
- Approved suppliers for shellfish
- Effective cleaning and sanitization



**Hepatitis A**

## Pathogenic Bacteria

### Hepatitis A

#### Description

- Hepatitis A is a viral liver infection, widespread across the world.
- In developing countries, and in regions with poor hygiene standards, the incidence of infection with this virus is high.
- Many millions of people worldwide are estimated to become infected each year.
- **It only takes a small amount of the virus to makes someone sick.**

#### Source

- Infected food handlers.
- Ready to eat foods, contaminated water, raw shellfish from contaminated water, sewage.
- It is commonly spread person-to-person by the fecal-oral route, poor handwashing and bare hand contact.
- An infected person quite often will not show symptoms for several weeks and are highly infectious.

#### Preferences

- Prefers untreated water and sewage contaminated water.
- Water filtering shellfish such as mussels and oysters.
- **Cooking will NOT destroy the virus.**

## SYMPTOMS

### Fever • Nausea • Abdominal Pain • Jaundice

Symptoms usually clear up within two months, although occasionally last up to six months. Older adults tend to have more severe symptoms. In most cases the liver will make a full recovery.

Incubation Period (Onset Time):	10 - 50 days
Duration:	2 - 6 months
Carrier Status:	Yes

#### Controls

- Exclusion of infected food handlers who have been diagnosed with Hepatitis A
- Exclude food handlers who have had jaundice for seven days or less
- Have a strict hand washing policy and monitor staff
- Strict personal hygiene standards
- Avoid bare hand contact with ready to eat foods
- Approved suppliers for shellfish
- Effective cleaning and sanitization

## Additional Organisms That Can Cause a Foodborne Illness

In addition to the Big 6, there are other organisms that can cause a Foodborne Illness -we have detailed these culprits as they are just as dangerous as the Big 6.

As you read through the following information, you will quickly realize that the same controls are needed for all the major threats to food safety. Make sure you spend some time training your staff on these additional threats.

### Bacillus cereus

#### Description

- A spore former that is found in soil/dirt.
- An aerobic, **(needs oxygen to live), spore forming** bacteria that produces a heat-resistant exotoxin, **(toxin/poison)**.
- Soil-dwelling, spore-forming food poisoning bacteria commonly associated with cooked rice and other starchy foods including pasta and potatoes.
- If cooked at less than 212°F, bacterial spores survive and germinate, releasing toxins, (exotoxins), which cause the food poisoning illness.

#### Source

- Foods affected include rice, cereals, and spices.
- Soil/dirt.

#### Preferences

- Loves inadequate cooking and poor refrigeration.
- Hates good food hygiene practice including avoiding reheating rice dishes.

## SYMPTOMS

### Nausea • Vomiting • Abdominal Pain • Diarrhea

Incubation Period (Onset Time):	1 – 5 hours
Duration:	12 - 24 hours
Carrier Status:	No

#### Controls

- Always cook foods to recommended internal temperatures (You tend to cook rice and pasta in boiling water which is at 212°F for approx. 15 to 20 minutes, so the best control is the reduction of time in the danger zone after cooking)
- Strict Time & Temperature controls including hot and cold holding
- Cool food correctly and minimize time in the Temperature Danger Zone
- Refrigerated storage, (cold pasta/rice salads)
- Avoid re-heating rice dishes
- Take care to prevent cross-contamination
- General good hygiene standards and practices for a kitchen



## Clostridium Perfringens

### Description

- A spore former that is found in soil/dirt.
- An anaerobic, **(does not need oxygen to live)**, rod-shaped **spore forming** bacteria that produces an endotoxin, **(toxin/poison)**.
- **These bacteria multiply rapidly in meat that is slowly cooked, and in food that is in the Temperature Danger Zone.**
- It will form protective spores even at high temperatures and once the food goes back into the Temperature Danger Zone, bacterial multiplication re-commences.
- Infective dose is usually over 1,000,000+ bacteria per gram of food.

### Source

- Human and animal intestines.
- Soil/dirt.
- Flies, raw meat, poultry and vegetables particularly root vegetables, (potatoes & carrots). Dried products can also be contaminated.
- **Infection often acquired at events such as banquets/weddings, where food is prepared in large quantities and kept out on service for prolonged periods without adequate temperature control.**

### Preferences

- Ordinary cooking does not kill spores but does reduce numbers significantly.
- It will not grow at refrigerated temperatures.
- Spore forming preserves it from the effect of drying, freezing, chemicals, and heat.

## SYMPTOMS

### Abdominal Pain • Diarrhea

Vomiting, fever or nausea does not normally occur.  
Can be fatal in groups such as young, ill, old or convalescing.

Incubation Period (Onset Time):	8 – 22 hours
Duration:	1 - 2 days
Carrier Status:	Yes

### Controls

- Cool hot food rapidly
- Reheat food to a minimum of 165°F for 15 seconds
- Hot hold at 135°F or above
- Strict Time & Temperature controls including hot and cold holding
- Separate cooked and raw foods at all stages
- Regular cleaning to remove all dirt and soil from food preparation areas
- Careful washing of fruit and vegetables
- Don't keep high-risks TCS foods on display without temperature control (hot-hold and cold-hold)
- Approved suppliers
- Have a strict hand washing policy and monitor staff
- Strict personal hygiene standards

## Clostridium Botulinum

### Description

- A spore former that is found in water and soil/dirt.
- An anaerobic, **(does not need oxygen to live), spore forming** bacteria that produces a neurotoxin, **(toxin/poison)**.
- These bacteria can contaminate almost any food.
- Without medical treatment, death is likely!
- Extremely nasty and dangerous food poisoning bacteria.
- These bacteria produce spores that can survive high cooking temperatures and processes such as canning.
- It will produce a heat resistant neurotoxin that can prove fatal.
- The bacteria do not multiply well in refrigeration, high acidic foods or any food with a low moisture content.

### Source

- Incorrectly canned food.
- Reduced oxygen packaged foods.
- Temperature abused vegetables, (baked potatoes).
- Untreated garlic and oil dressings.

## SYMPTOMS

**Headache • Nausea • Vomiting • Weakness  
Impaired Speech • Difficulty Swallowing**  
Damage to the central nervous system

Incubation Period (Onset Time):	12 – 36 hours
Duration:	If untreated with the use of antitoxin, death is likely
Carrier Status:	No

### Controls

- Strict, hold, cool and re-heat policies
- Strict Time & Temperature controls
- Approved suppliers
- Strict inspection of imported food products such as canned goods
- Destroy any blown or damaged cans

## Campylobacter Enteritis

**Campylobacter Jejuni** – accounts for 90% of cases

**Campylobacter Coli** – accounts for 10% of cases

### Description

- Often called the 'barbecue bug'.
- **It only takes a small number of bacteria to makes someone sick.**

### Source

- Campylobacter is commonly found in poultry but also in meat, stews/gravies and untreated water.

### Preferences

- These bacteria spread easily and have a low infective dose, so only a few bacteria in a piece of undercooked chicken, or bacteria transferred from raw chicken onto other ready-to-eat foods, can cause illness.
- It can be controlled by correct cooking at the minimum recommended cooking temperatures.

## SYMPTOMS

### Abdominal Pain • Diarrhea • Fever • Headaches • Vomiting

Can often show as flu-like symptoms

Incubation Period (Onset Time):	1 - 11 days (Normally 2 – 5 days)
Duration:	
Carrier Status:	Long term carriers have been detected

### Controls

- Always cook foods to recommended internal temperatures, (especially poultry)
- Strict Time & Temperature controls
- Have a strict hand washing policy and monitor staff especially after handling raw meats to reduce the risk of cross contamination
- Prevent cross-contamination between raw poultry and ready-to-eat foods
- Potable, safe supply of water

## Listeria Monocytogenes

### Description

- Listeriosis, an infection caused by Listeria, and can pose major health risks during pregnancy.
- It is not normally dangerous to healthy adults, but can affect people with weakened immune systems, pregnant women and the elderly.
- Pregnant women are approximately 20 times more likely than other healthy adults to get listeriosis.
- In pregnant women, it is typically a mild, flu-like illness and can lead to miscarriage.
- In the child, listeriosis can lead to pneumonia, meningitis and sepsis.

### Source

- It can be found in soil and water and some animals, including poultry and cattle.
- It can be present in raw, (unpasteurized) milk and foods made from raw milk.
- It commonly affects ready-to-eat foods such as, pates, soft cheeses, prepared salads, dairy products, hot dogs and deli meats.

### Preferences

- Listeria is unlike many other bacteria as it can grow even in the cold temperature of the refrigerator.
- Products such as pate and soft cheese that are stored over a long period of time, even in a refrigerator, can be most at risk.
- **Listeria can be killed by cooking and pasteurization.**

## SYMPTOMS

**Fever • Sepsis • Pneumonia • Meningitis • Abortion**

Incubation Period (Onset Time):	3 - 70 days
Duration:	
Carrier Status:	Yes

### Controls

- Strict Time & Temperature controls
- Always cook raw meats to recommended minimum internal temperatures
- Do not allow cross-contamination from raw/undercooked food to ready to eat foods
- Destroy any product that has an expired use by date
- Do not use unpasteurized dairy products
- Avoidance of high-risk foods such as pate and soft cheese by at risk groups such as pregnant women and the elderly
- Effective hand washing processes to reduce the risk of cross contamination
- Well observed cleaning schedule with regular sanitization
- Proper training of food handlers on the importance of date monitoring of refrigerated products

## Staphylococcus Aureus

### Description

- A spore former that is found in humans, particularly in our hair, nose, throat and infected cuts.
- An anaerobic, **(does not need oxygen to live), spore forming** bacteria that produces an exotoxin, **(toxin/poison)**.

### Source

- Commonly found on healthy skin, nose, hands, throat and hair.
- Also spots, septic wounds, infected cuts, burns and scratches.
- Any food that requires handling during the preparation stage is in danger from cross contamination.
- Foods affected include milk, cream, TCS foods, and cooked, ready-to-eat meats.
- Also affected are raw milk from cows and goats.

### Preferences

- Easily transferred to food by food handlers touching the areas of their bodies we have detailed and then handling food without washing their hands.
- A dangerous bacteria that is salt-tolerant and heat resistant, it produces a toxin, (exotoxin), in temperatures between 44°F and 118°C.
- **Cooking is no defense if the bacteria have been left long enough in the Temperature Danger Zone to allow the toxins to multiply to a dangerous level.**

## SYMPTOMS

### Severe Vomiting • Abdominal Pain • Diarrhea

Remember, it's the toxin that the bacteria produce that actually harms the person, not the physical presence of the bacteria.

Incubation Period (Onset Time):	1 – 7 hours
Duration:	24 hours
Carrier Status:	Yes – and very common

### Controls

- Strict Time & Temperature controls when cooking, cooling and reheating food
- Have a strict hand washing policy and monitor staff especially if they are handling and prepping food to reduce the risk of cross contamination
- Ensure all wounds are covered
- Demonstrate and train staff to understand the high personal hygiene standards required