

Preventing Foodborne Illness Associated with *Clostridium perfringens*¹

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This is one in a series of fact sheets discussing common foodborne pathogens of interest to food handlers, processors and retailers.

What is the *Clostridium perfringens* organism?

Clostridium perfringens is a Gram-positive bacterial pathogen that has the capability of forming an endospore. The dormant spores can change to potentially harmful vegetative cells if exposed to cooking temperatures and allowed to stand at temperatures between 41°F and 120°F, especially the temperature range of 70°F–120°F. *Clostridium perfringens* vegetative cells are killed in foods when the foods are cooked at 140°F or above. However, spores may still be present after cooking. Spores can survive the cooking process. *Clostridium perfringens* can only thrive in conditions of very little or no oxygen: that is, it is an anaerobic organism. *Clostridium perfringens* will not grow at refrigeration or freezing temperatures.

Where is *Clostridium perfringens* found?

Clostridium perfringens is found dispersed in the environment in locations such as soil, sediment, and the intestines of domestic animals, feral animals, and humans. The organism is also found in sewage and in areas prone to animal and sewage contamination. *Clostridium perfringens* spores have also been isolated from raw foods.

Clostridium perfringens typically causes foodborne sickness when foods are served after improper storage, or held at inadequate storage temperatures such as on an improperly maintained steam table. It is a problematic microorganism for institutional food service handlers.

What kinds of foods are associated with *Clostridium perfringens*?

Clostridium perfringens thrives in high-protein foods of animal origin such as meat and meat products, meat dishes, stews, soups, gravies, and

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milk. To a lesser extent, poultry products, pork, lamb, fish, shrimp, crab, legumes (beans), potato salad, and macaroni and cheese may contain *Clostridium perfringens*. These protein-containing foods, when kept at improper storage temperatures between 41°F and 120°F, provide the greatest risk of infection and disease from *Clostridium perfringens*, since spores present after cooking can germinate and potentially grow to high, dangerous numbers. A danger zone exists between 70°F and 120°F. Foods need to be cooled rapidly through this zone on their way down to 41°F. The food code recommends that food should not be in this zone for more than 2 hours. In the majority of cases involving these foods, keeping food in the danger zone too long was the main cause of *Cl. perfringens* food poisoning.

Which populations are at high risk for *Clostridium perfringens* foodborne illness?

Hospitals, nursing homes, prisons, and school cafeterias are places that pose the highest risk of an outbreak of foodborne illness due to *Clostridium perfringens*. In these locations, foods are cooked but may not be kept at safe, adequate temperatures, prior to serving. Although *Clostridium perfringens* may be present in small numbers in raw foods, improper storage and handling of these foods allow the pathogen to grow to high, harmful numbers.

The young and the elderly are most susceptible and are frequent victims of *Clostridium perfringens* poisoning, experiencing longer and more severe symptoms. There are fewer complications in adults under the age of 30.

What are the symptoms and progression of the disease?

Clostridium perfringens gastroenteritis can result after 8–22 hours of consuming food contaminated with large numbers of the vegetative form of *Clostridium perfringens*. In the intestines, the vegetative cells of *Clostridium* produce the heat-resistant enterotoxin that causes the foodborne illness. This is called a food toxicoinfection. Symptoms include severe abdominal cramps and pain, diarrhea, and flatulence. These symptoms occur

during the 8–24 hours after consuming a contaminated meal. They usually last a single day, but less severe symptoms may continue for 1–2 weeks. These longer episodes are usually associated with the extremely young or the elderly. Other common symptoms include fever, chills, and headache. In severe cases, dehydration and other complications can result in death of the infected individual. However, most symptoms usually last approximately 24 hours, leading many infected individuals to believe that they had a case of the "24-hour flu." *Clostridium perfringens* can also produce toxins in foods if held at unsafe temperatures, which can lead to a foodborne illness known as an intoxication. The storage conditions which can lead to *Cl. perfringens* growth are an environment with proper air and moisture levels for this bacteria, and temperatures ranging between 70°F and 140°F. To date, only one death due to a case of *Cl. perfringens* intoxication has ever been officially reported.

How is *Clostridium perfringens* disease diagnosed in humans?

Associated symptoms and the disease's delayed onset precede confirmation by toxin detection in fecal (stool) samples of affected individuals. The illness can also be confirmed by the detection of the causative organism in the suspected food that was consumed or by its presence in the patient's feces.

Disease Occurrence of *Clostridium perfringens*

Gastroenteritis, which is the inflammation of the stomach and/or intestines, is the most common outcome of *Clostridium perfringens* related illness. Large numbers of persons are typically affected. According to CDC estimates, as many as 250,000 individuals are affected by *Cl. perfringens* each year. The number of *Cl. perfringens* foodborne illnesses is under-reported due to the mildness of symptoms, brief illness duration, and lack of routine testing by public health officials.

How can *Clostridium perfringens* foodborne illness be controlled and prevented?

Since *Clostridium perfringens* can grow rapidly at elevated temperatures and forms heat-resistant spores, preventing growth is paramount. Foods should be cooked to an internal temperature of 165°F or higher to inactivate the pathogen's vegetative cells. Additionally, the cooked food must be chilled rapidly to 41°F or less, or kept at hot holding temperatures of 140°F or higher to prevent any activation and growth of *Clostridium perfringens* spores.

Large portions of meat, broth, gravies, and other foods commonly associated with *Cl. perfringens* must meet specific guidelines noted in the 2009 FDA Food Code. These guidelines specify that potentially hazardous food shall be cooled within 2 hours from 140°F to 70°F, and within 6 hours from the initial 140°F to 41°F. Large containers of food may take an extended period of time to cool to 41°F and therefore should be separated into smaller portions, such as pans with a food height of no more than four inches. In addition, storage containers should be stacked to encourage good airflow both above and below to facilitate rapid cooling. Leftover foods should be reheated to 165°F or greater, which can inactivate any vegetative cells that have germinated during cooling, as well as other foodborne pathogens which may have cross-contaminated the food.

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