



## Preventing Foodborne Illness: Shigellosis<sup>1</sup>

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### What is *Shigella*?

*Shigella* is a Gram-negative, nonmotile, non-sporeforming, rod-shaped bacterium capable of causing disease in humans. Disease occurs when virulent *Shigella* organisms are consumed and invade the intestinal mucosa, resulting in tissue destruction. Some *Shigella* strains produce enterotoxin and Shiga-toxin (very much like the verotoxin of *E. coli* O157:H7). *Shigella* poisoning, also known as “shigellosis,” is typically self-limiting, treatable, and most people recover quickly.

### What causes the foodborne illness shigellosis?

Shigellosis is an infectious disease caused by bacteria of the genus *Shigella*, characterized by potentially sudden and severe diarrhea (gastroenteritis or bacillary dysentery) in humans. *Shigella* thrives in the human intestine and is commonly spread through both food and person-to-person contact. Some persons who are infected may show no symptoms at all, but may still pass the *Shigella* organism to others (carriers). Shigellosis is the third most common

foodborne bacterial illness (about 30% less common than *Salmonella* and 20% less than *Campylobacter*).

### How is *Shigella* spread?

Shigellosis is principally a disease of humans and primates, such as monkeys and chimpanzees. The organism is frequently found in water polluted with human feces.

*Shigella* cells must be swallowed to cause the disease. And are often spread when people do not wash their hands with soap and water after using the restroom, or changing a diaper. People who get *Shigella* on their hands can infect themselves by eating, smoking, or otherwise directly or indirectly touching their mouths. They can also spread the germs to anything they touch, potentially making others sick. In rare cases, swimming water in ponds, lakes, and pools can also spread *Shigella* if not properly treated and if enough water is swallowed. Such contamination may originate from sewage leaks and infected swimmers (particularly if they have or recently have had diarrhea).

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## Long term effects of shigellosis

Up to 3% of persons who are infected with *Shigella* may later develop chronic joint pain, swelling and irritation of the eyes, and sometimes painful urination. This is a reaction to the previous gastroenteritis and is called “reactive arthritis,” or Reiter's Syndrome. It is a rare autoimmune disease that can occur after a bout of gastroenteritis from *Salmonella* or *Shigella*.

## How to diagnose a *Shigella* infection?

Diagnosing *Shigella* as the causal agent of an illness requires laboratory testing to identify the bacteria in the stool of a possibly infected individual. Laboratory tests can also tell which species of *Shigella* are present to help determine which antibiotics are suitable for treatment.

*Shigella* is not a normal inhabitant of the human colon, but cultures are sometimes falsely negative. This is because *Shigella* shares several characteristics with normally occurring colon bacteria (native flora), making it difficult to isolate it from a stool specimen.

## What foods have been commonly associated with *Shigella*?

While the majority of illnesses associated with *Shigella* are waterborne, approximately 20% have been linked to food (an estimated 80,000 cases per year). A wide variety of foods may be infected with *Shigella*. Some foods that have been identified in *Shigella* outbreaks include salads (potato, shrimp, tuna, chicken, turkey, macaroni, fruit, and lettuce), chopped turkey, rice balls, beans, pudding, strawberries, spinach, raw oysters, luncheon meat, and milk. Contamination of these or other foods is through the fecal-oral route. This means the food has come in contact with water that has been contaminated, or has been handled under other unsanitary conditions. It is possible for any food that has been mishandled to become contaminated and spread the disease.

## How to minimize the risk of shigellosis in your plant or establishment

One of the most important sanitation steps to reduce the spread of shigellosis is the treatment of municipal water supplies. Water treatment for public consumption is a safe and highly effective preventative measure that has been in place for many years. Additionally, the treatment of sewage alleviates the spread of many disease-causing organisms, including *Shigella*. For this reason, use of municipal water supplies is recommended for all food handling facilities.

Improved worker and facility hygiene at picking and packing facilities is a major step in preventing shigellosis caused by contaminated produce. To increase the safety of domestically produced foods, both the U.S. Department of Agriculture (USDA) and the Food and Drug Administration (FDA) have established a hazard analysis and critical control points system (HACCP) for several sectors of the food industry. In hopes of further minimizing the risks of foodborne illness, the FDA has since considered establishing similar food safety standards throughout other areas of the food industry, including domestic and imported food products.

## What is HACCP?

Hazard Analysis and Critical Control Points, or HACCP, is a food safety program developed for astronauts by the National Aeronautics and Space Administration (NASA) nearly 30 years ago. Many HACCP principles are already in place and regulated by the USDA and the FDA for the low-acid canned food industry, the seafood industry, the juice industry, and in meat and poultry processing plants (the USDA regulates meat and poultry; the FDA all other foods).

HACCP focuses on identifying and preventing hazards that could cause food-borne illnesses by applying science-based controls, from raw material to finished products. It involves seven basic principles:

1. Analyze potential hazards.

2. Identify critical control points.
3. Establish preventive measures with critical limits for each control point.
4. Establish procedures to monitor the critical control points.
5. Establish corrective actions to be taken when monitoring shows that a critical limit has not been met.
6. Establish procedures to verify that the system is working properly.
7. Establish effective recordkeeping to document the HACCP system.

### **Sanitary conditions for food product receiving, handling, processing, and storage**

The stringent requirements of the HACCP program have been argued as being too cumbersome or inappropriate for some food handling operations—specifically minimally processed foods. For these facilities, adoption of a program of general good manufacturing practices for food (GMPs), as defined by the FDAs Code of Federal Regulations, title 21, Part 110, is suggested. An outline of such GMPs is available from the FDAs Center for Food Science and Applied Nutrition and suggests the minimum general sanitation requirements for an FDA-inspected food handling and processing facility. To address any specific needs of an individual facility (such as for a particular procedural step or for the safe use of a particular piece of equipment), sanitation standard operating procedures (SSOPs) should also be developed and followed. Each facility should also be aware of and adhere to any appropriate state and/or local regulations. The Florida statutes for retail food establishments can be found at: <http://www.leg.state.fl.us/statutes>, Title 29: Chapter 381, and Title 33: Chapter 509.

The FDA Food Code outlines appropriate processing and cooking requirements for many food products processed in a retail facility. However, if certain high-risk food products (such as seafood,

sushi, fresh juice, specialty meats, and others) are processed in the retail establishment, additional controls and the issuance of a variance (government permission for exception in the application of a given law, ordinance, or regulation) by the regulatory authority is required before processing can occur (Food Code 3-502.11).

### **Receiving**

Specifications for receiving can be found in section 3-202.11 of the 2001 Food Code. The following guidelines cover the basic points to be addressed during receiving:

- Potentially hazardous foods (PHFs) should be at a temperature of 41°F (5°C) or below when received, unless otherwise specified by law (e.g., milk, shellfish).
- Raw shell eggs should be received at an ambient air temperature of 45°F (7°C) or less.
- PHFs that are received hot should be at a temperature of 140°F (60°C) or above.
- PHF should be received with no evidence of temperature abuse, such as thawing.

### **Handling and sanitation**

Before and after use, clean and sanitize all cooking equipment, utensils, and work surfaces with a mild food grade bleach solution (100-200 ppm of free chlorine) or chemical sanitizers listed in 21 CFR 178.1010. Sanitizing solutions should be used in accordance with instructions on the EPA-approved manufacturer's label.

- Let air-dry, if possible, or use clean or single-use disposable kitchen towels or paper towels.
- Use only potable water to wash and prepare food.
- For display or service, select perishable foods last and put them away first.
- Rinse and sanitize dishcloths often (or use single-use disposable towels) and use separate dish towels for each part of the kitchen.

- Keep foods covered. Flies, other insects or accidental splashing during preparation of other foods can spread contaminants.

### Processing

The easiest way to prevent foodborne illnesses is to ensure that foods are thoroughly cooked. It should be noted that certain foods that are typically served uncooked, such as raw vegetables and fresh fruits, will obviously not benefit from the cooking process. For these items, other factors such as washing, sanitation, worker hygiene, and proper storage, take on much greater importance. For specific recommendations, consult the 2001 FDA Food Code.

### Storage

Once a product has been received and/or processed, it is usually displayed or stored. Some guidelines that will help prevent contamination at this time include:

- Frozen food should remain frozen until it is used.
- If frozen food is displayed in a refrigerated case, it should remain at or below 41°F (5°C).
- Product must be cooled adequately; refer to sections 3-501.14 and 3-501.15 of the 2001 Food Code.
- Hold cooked product above 140°F (60°C) while displaying and under 41°F (5°C) during storing.
- Properly label all stored product.
- Refrigerate at or below 41°F (5°C) or freeze at 0°F (-18°C).
- Avoid cross-contamination: keep raw foods away from ready-to-eat foods while shopping, storing, and preparing foods.

### Personal hygiene

**The #1 method of avoiding contamination of food with viral, bacterial and/or parasitic disease is for all food handlers to regularly and properly wash their hands.**

### When to wash hands

While regular hand washing is recommended, some events that should always be followed by thorough hand washing with soap and warm water for 20 seconds include:

- Before handling, preparing, or serving food.
- Before handling clean utensils, or dishware.
- After using the restroom.
- After touching your face, cuts, or sores.
- After smoking, eating or drinking.
- After handling raw meat—especially poultry.
- After touching unclean equipment, working surfaces, soiled clothing, soiled wiping cloths, etc.
- After collecting and taking out the garbage.
- Before and after assisting someone with diarrhea, after cleaning the bathroom, and after changing diapers.

### What is the proper procedure for hand washing?

1. Wet your hands with warm water
2. Apply soap and wash your hands for 20 seconds
  - Pay attention to hard-to-reach areas like knuckle creases, between fingers and under finger nails
  - Include the forearm past the wrist as you wash
3. Rinse and then dry with a single-use paper towel

Some other hygienic tips are:

- Do not share food, drinks, spoons, or straws.
- If you have a child in day-care who has diarrhea, inform the day-care providers; they can make sure germs are not spread to other children.

- Do not let anyone who has diarrhea use a pool or swim in a pond while they are sick.

## References

FDA. Oct. 2001. HACCP: A state-of-the-art approach to food safety. Last date of access: 3 August 2005. <http://www.cfsan.fda.gov/~lrd/bghaccp.html>

FDA/CFSAN. *Shigella* spp. Jan 2005. Chapter 19 in “The Bad Bug Book.” Last date of access: 3 August 2005. <http://vm.cfsan.fda.gov/~mow/chap19.html>

Mead, P.S., L. Slutsker, V. Dietz, L.F. McCaig, J.S. Bresee, C. Shapiro, P.M. Griffin, and R.V. Tauxe. 1999. Food-related illness and death in the United States. *Emerging and Infectious Diseases* **5**:607-625. Last date of access: 3 August 2005. Available as .pdf at <http://www.cdc.gov/ncidod/eid/vol5no5/pdf/mead.pdf>

Ringrose J. H., A.O. Muijsers, Y. Pannekoek, B.A. Yard, C.J.P. Boog, L. Van Alphen, J. Dankert and T.E.W. Feltkamp. 2001 Influence of infection of cells with bacteria associated with reactive arthritis on the peptide repertoire presented by HLA-B27. *J. Med. Microbiol.* **50**:385-389.

Stehulak, N. Ohio State University extension fact sheet, HYG-5563-98. *Shigella*: An infectious foodborne illness. Last date of access: 3 August 2005. <http://ohioline.osu.edu/hyg-fact/5000/5563.html>

The Florida Legislature. 2005. The 2005 Florida Statutes. Last date of access: 3 August 2005. [http://www.leg.state.fl.us/Statutes/index.cfm?App\\_mode=Display\\_Statute&URL](http://www.leg.state.fl.us/Statutes/index.cfm?App_mode=Display_Statute&URL)