



Dealing with Foodborne Illness: Typhoid Fever, *Salmonella* Typhi¹

Karen Carver, Michael J. Mahovic, Renée M. Goodrich, and Keith R. Schneider²

What is typhoid fever?

Typhoid fever is a blood infection caused by consumption of food or water contaminated by the bacterium *Salmonella enterica*, subspecies *enterica*, serovar Typhi; commonly referred to as *Salmonella typhi* or *S. typhi*. Sometimes you will see the serovar capitalized, i.e., *Salmonella* Typhi. This is not to be confused with the many other members of the bacterial group *Salmonella* (often called “non-typhi *Salmonella*”), which invade the intestines to cause salmonella food poisoning, or salmonellosis.

Typhoid fever may cause a sudden onset of several different symptoms, including fever, headache, nausea, constipation, diarrhea, rose spots across the abdomen, and loss of appetite. Destruction of internal organs is the leading cause of death associated with this illness. Fortunately, typhoid fever is easily controlled. And as a result, is relatively uncommon in industrialized nations like the United States. There are approximately 400 cases of typhoid fever per year in the US, about 70% of these cases occur following international travel. Over the past 10 years, travel to non-industrialized nations, such as

regions in Asia, Africa, and South America have presented the highest risk of contracting typhoid fever.

What causes typhoid fever?

S. Typhi is only carried by humans; no other animal vectors are known. Shedding of the *Salmonella* Typhi bacteria occurs in the stool of infected persons and also in people that are considered chronic carriers, those that continue to carry the disease and may or may not exhibit symptoms (occurs in about 1-4% of infected individuals). The only mode of transmission of typhoid fever is through the ingestion of human feces containing *S. Typhi*. This is often called the fecal-oral pathway.

Once contaminated food or water is swallowed, the bacteria multiply in the intestines and spread into the bloodstream where they are taken in by cells called mononuclear phagocytes. Phagocytes are cells of the immune system that are responsible for killing bacteria and viruses. However, *S. Typhi* is not deactivated by these cells after ingestion; instead, it is

-
1. This document is FSHN05-14, one of a series of the Food Science and Human Nutrition Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date: August, 2005. Visit the EDIS Web Site at <http://edis.ifas.ufl.edu>
 2. Karen Carver, undergraduate student; Michael J. Mahovic, graduate student, Plant Pathology Department, University of Florida, Gainesville, FL; Renée M. Goodrich, associate professor, Food Science and Human Nutrition Department, Citrus Research and Education Center, Institute of Food and Agricultural Studies, Cooperative Extension Service, University of Florida, Lake Alfred, FL 33850; and Keith R. Schneider, assistant professor, the Food Science and Human Nutrition Department, Institute of Food and Agricultural Studies, Cooperative Extension Service, University of Florida, Gainesville.

The Institute of Food and Agricultural Sciences (IFAS) is an Equal Opportunity Institution authorized to provide research, educational information and other services only to individuals and institutions that function with non-discrimination with respect to race, creed, color, religion, age, disability, sex, sexual orientation, marital status, national origin, political opinions or affiliations. U.S. Department of Agriculture, Cooperative Extension Service, University of Florida, IFAS, Florida A. & M. University Cooperative Extension Program, and Boards of County Commissioners Cooperating. Larry Arrington, Dean

capable of multiplying within them. After multiplying, *S. Typhi* spills out of the cell and into the blood stream, spreading throughout the body creating a systemic infection and causing associated symptoms.

The bacteria can move from the bloodstream into the lymphatic system and then into other tissues and major organs of the body. During the bacterial invasion into these areas, the gallbladder, liver, intestines, and spleen can be the most affected. Perforation of the intestinal wall causes leakage in the abdominal cavity, thus resulting in peritonitis that is a frequent cause of death from typhoid fever. Many other complications can also occur ranging from a ruptured spleen to meningitis, and even coma.

Onset of typhoid fever may take 3 days to 3 months to occur, largely dependent on the number of cells initially ingested.

What are the symptoms associated with typhoid fever?

The symptoms associated with typhoid fever include sudden onset of fever, headache, nausea, and loss of appetite. Constipation, diarrhea, and rose spots across the abdomen can also occur. Large numbers of bacteria present in the bloodstream will result in a sustained high fever, which will last 4 to 8 weeks in an untreated individual. Symptoms may become noticeable anywhere from three days to three months after ingestion.

Rose spots on the lower abdomen are generally a characteristic symptom in diagnosis. But, stool, blood, and bone marrow samples should be obtained for diagnosis. Given all three are cultured, more than 90% of the patients will be culture-positive in the early stages of disease. If only blood is used, tests are reduced in efficacy 50-70%.

Who is at risk?

There are no particular groups that are more or less susceptible to typhoid fever. Some individuals, however, may become infected but remain symptom free. These people will still carry the bacteria and are capable of infecting others.

If traveling to areas where typhoid fever is prevalent, it is recommended that you get the immunization for typhoid fever. Such immunizations require up to a week before they are effective and only remain so for a few years. If traveling to countries of high risk, it's recommended that you follow a few guidelines to avoid infection:

1. Avoid raw fruits and vegetables that cannot be peeled.
2. Do not buy foods from street vendors.
3. All food consumed should be thoroughly cooked and still hot and steaming.
4. Drink only bottled (or boiled) water.

What foods have been commonly associated with typhoid fever?

Food and drinking water are most often contaminated by infected individuals that have not utilized proper personal hygiene practices. Water can also become contaminated from coming into contact with raw sewage. Although not carriers, shellfish may be contaminated if harvested from beds that have become contaminated with sewage. Eating raw vegetables that have been fertilized by contaminated soil or water can also be a danger.

In short, *any* food allowed to come into contact with feces from infected individuals can be contaminated with bacteria that cause typhoid fever.

What sanitation methods have been used to prevent the spread of typhoid fever?

Because the only mode of transmission of typhoid fever is through the ingestion of human feces containing *S. Typhi*. Personal hygiene and good sewage handling and treatment facilities keep the spread of such a disease to a minimum.

As with true foodborne diseases, and as a good general sanitary practice, both personal and professional, good hand washing is very important.

Personal hygiene

The major cause of foodborne illness in retail establishment comes from poor personal hygiene, particularly a lack of proper hand washing. Dirty hands can contaminate food. This is particularly true of an illness such as typhoid fever that is only spread by contamination with infected human waste.

Although hands may look clean, the bacteria that cause illness are too small to be seen. Therefore, whenever you are preparing food and you come in contact with items that are not part of the assembly process, rewash your hands. The same is true even when wearing gloves.

THERE IS NO FIVE SECOND RULE WHEN IT COMES TO FOOD SAFETY!

Millions of bacteria and other germs can be transferred on contact. Here is a list of times when should you wash your hands:

- 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

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.
3. Rinse, and then dry your hands with a single-use paper towel.

Good practices for food product receiving, handling, processing, and storage

The FDA defines cGMPs in 21 CFR, Part 110. These cGMPs outline minimally required general sanitation requirements in FDA inspected food handling and processing facilities. It is recommended that more specific and stringent standard operating procedures (SOPs) be developed for individual facilities. In addition, the sanitation recommendations for food service and retail food facilities outlined in the FDA 2001 Food Code (FDA 2001) have been adopted into many state and local regulations. As there may be some variation in 2001 Food Code adoption, it is important that each facility check with the appropriate state and/or local regulatory authority. The Florida statutes can be found at <http://www.leg.state.fl.us/statutes>, Title 33:Chapter 509.

In addition to setting and adhering to strict sanitation requirements in the facility, a retail establishment should also develop SOPs for receiving and storage of food products and ingredients. Appropriate controls and requirements should be established and strictly adhered to if food processing is being performed. The FDA 2001 Food Code outlines appropriate processing and cooking requirements for many food products processed in a retail facility. However, if certain high-risk food products (e.g., sushi, fresh juice, specialty meats, and others) are processed in the retail establishment, rather than in a more traditional processing facility, additional controls and the issuance of a variance by the regulatory authority is required before processing can occur (Food Code 3-502.11). The growing retail practice of cooking, preparing, and packaging foods traditionally processed in controlled plant

environments raises safety concerns. Any processing of food at the retail level needs to be closely monitored.

As an establishment becomes cleaner, it becomes harder to detect foodborne pathogens. At this point, testing becomes more limited in its ability to prevent foodborne illness. This is why programs that promote and monitor the use of barriers and/or hurdles are so important. When instituted properly, these activities will reduce the risk of a foodborne illness. Nothing can be done to completely eliminate bacterial contamination short of vacuum sealing, irradiating, and storing all your products frozen.

Since most consumers prefer a fresh product, programs should be implemented that reduce the probability of illness to a point that it is minuscule.

Receiving

Specifications for receiving can be found in section 3-202.11 of the 2001 Food Code <http://www.cfsan.fda.gov/~dms/foodcode.html>. The following guidelines cover the basic points that should be addressed:

- Potentially Hazardous Food (PHF) should be at a temperature of 41°F or below when received, unless specified by law (e.g., milk, shellfish).
- PHFs that are received hot should be at a temperature of 140°F or above.
- PHF should be received with no evidence of temperature abuse such as evidence of thawing.

For recommendations that are more specific consult the 2001 Food Code: <http://www.cfsan.fda.gov/~dms/foodcode.html>

Storage

Once a product has been received and/or processed, it will be displayed or stored. There are some general guidelines governing these practices as well.

- Frozen food should remain frozen until it is used.

- If frozen food is displayed in a refrigerated case and allowed to thaw, the food should remain at 41°F or below.
- Frozen food should be thawed at a temperature of 41°F or below or under running water at a temperature of 70°F or below.
- Frozen product can be thawed as part of the cooking process.
- Product must be cooled adequately. Refer to sections 3-501.14 and 3-501.15 of the 2001 Food Code: <http://www.cfsan.fda.gov/~dms/foodcode.html>.
- Cooked product should be maintained above 140°F while displayed and stored at or under 41°F.
- Properly label all stored product.

Historical Interest: Typhoid Mary

In the early 1900s, a woman by the name of Mary Mallon was the first “healthy carrier” of typhoid fever in the US. It's estimated that 47 people were infected by Mary; of those 47 people, three died.

Mary Mallon worked as a cook for very wealthy families. After half of the household of one of the families she cooked for became ill with typhoid fever, they hired investigators to determine the cause. At first, they were unable to discover a source of the illness. However, it was eventually determined that Mary was the cause of the illness in that household and several others. Health officials were notified and eventually Mary was detained, despite much resistance.

She was taken to a hospital in New York, where stool samples were taken and she tested positive for typhoid bacteria, even though she remained symptom-free. The health department then transferred her to an isolated area on North Brother Island, N.Y. where she spent a couple years, but was eventually released. Mary was given strict guidelines by health

officials to stay away from any work that would involve food preparation or any type of care for people.

Approximately five years after her release, an outbreak of typhoid fever in a Manhattan, New York, hospital was reported. Twenty-five persons became ill, two of which died. It was soon discovered that Mary Mallon was working there as a cook, under a fictitious name. At this point she was recaptured and again isolated on North Brother Island for the remainder of her life, about 28 years.

References

Centers for Disease Control and Prevention. 20 June 2005. Typhoid Fever. Last date accessed: 21 July 2005.
http://www.cdc.gov/ncidod/dbmd/diseaseinfo/typhoidfever_g.htm

Corales, R. 11 August 2004. Typhoid Fever. Last date accessed: 21 July 2005.
<http://www.emedicine.com/MED/topic2331.htm>

Leavitt, Judith Walzer. 20th Century History: Typhoid Mary. Reprinted from *Typhoid Mary: Captive to the Public's Health*. Beacon Press, Boston. 1996. Last date of access: 21 July 2005.
<http://history1900s.about.com/library/weekly/aa062900b.htm>

Wisconsin Department of Health and Family Services. Disease Fact Sheet Series: Typhoid Fever. Last date of access: 21 July 2005.
<http://dhfs.wisconsin.gov/communicable/Communicable/factsheets/TyphoidFever.htm>

World Health Organization. April 2003. Typhoid vaccine. Last date of access: 21 July 2005.
<http://www.who.int/vaccines/en/typhoid.shtml>