

FOOD SAFETY



Nearly all foodborne illnesses from foodservice and food retail establishments could be prevented with good food handling practices. Most foodborne illnesses linked to foodservice and food retail are due to poor personal hygiene, cross-contamination, and/or temperature abuse.

Personal cleanliness is essential to prevent foodborne hazards from being transferred from a food handler to a food. Good personal hygiene includes washing hands and other parts of the body that may touch food. It also involves good health of the food handler and proper use of hair restraints and gloves. Cross-contamination from a food handler to a food can be avoided with good personal hygiene.

Cross-contamination from a food can be controlled with appropriate cleaning and sanitizing programs. Cross-contamination from one food to another food is best avoided by keeping foods separate from each other. This is especially important for raw and ready-to-eat foods. Cross-contamination is also controlled with preventative strategies during food preparation.

Temperature abuse involves improper receiving, storage, cooking, cooling, reheating, hot holding, and/or cold holding of foods. Depending

Keeping Food Safe in Foodservice and Food Retail Establishments

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on the type of food, there are specific requirements for temperature control to ensure food safety.

Factors Leading to Foodborne Illnesses

The main causes of reported foodborne illnesses are due to foods being mishandled (Figure 1). Foods that are implicated are usually "potentially hazardous foods."

Potentially hazardous foods are foods that are capable of supporting growth of disease-causing microorganisms. These types of foods are usually high in protein and moisture and have a pH >4.6. Mishandling of potentially hazardous foods can contribute to foodborne illness.

About 20% of all foodborne outbreaks are attributed to poor personal hygiene due to an infected person touching the food. Cross-contamination can be attributed to about 14% of all foodborne outbreaks (includes improper cleaning). Temperature abuse, including improper heating and holding of a food is by far the most common factor leading to foodborne illness. Nearly all foodborne illness can be in some way linked to temperature abuse.



Figure 1. Factors leading to reported foodborne illnesses. (Ranked by % number of outbreaks)

40%	Improper cooling of foods
21%	Time lapse between preparing to serving
20%	Infected persons touching food
16%	Inadequate cooking
16%	Improper hot storage
12%	Inadequate reheating
11%	Contaminated raw food
7%	Cross-contamination
7%	Improper cleaning
4%	Use of leftovers

From CDC, 1989

Personal Hygiene

There are several personal habits that are not appropriate and can lead to unsafe food. Body fluids can be a significant source of harmful microorganisms and can easily be transferred to a food. If an employee is ill and is coughing, sneezing, or has discharges from the eyes, nose, or mouth, this individual should not work with exposed foods. If the employee is insistent about working, be sure that he/she has no contact (direct or indirect) with food.

Eating, drinking, and using tobacco should be prohibited while working with an exposed food. All of these practices could transfer harmful microorganisms from a person's mouth to an exposed food.

Handling of animals is strictly prohibited within a food retail establishment. If an employee touches an animal, hands should be cleaned and sanitized immediately.

Food safety begins with and relies on the cleanliness of the food handler. Personal cleanliness involves knowing when and how hands and other parts

of the body should be washed before touching food. Personal hygiene also includes clothing and other personal items (like jewelry) that a food handler may be wearing while on the job. Proper use of hair restraints and gloves are a part of good personal hygiene. Careful control and knowledge of personal health and certain personal habits, such as eating, drinking, and smoking, are also important in reducing the likelihood of foodborne illness.

Hand Washing

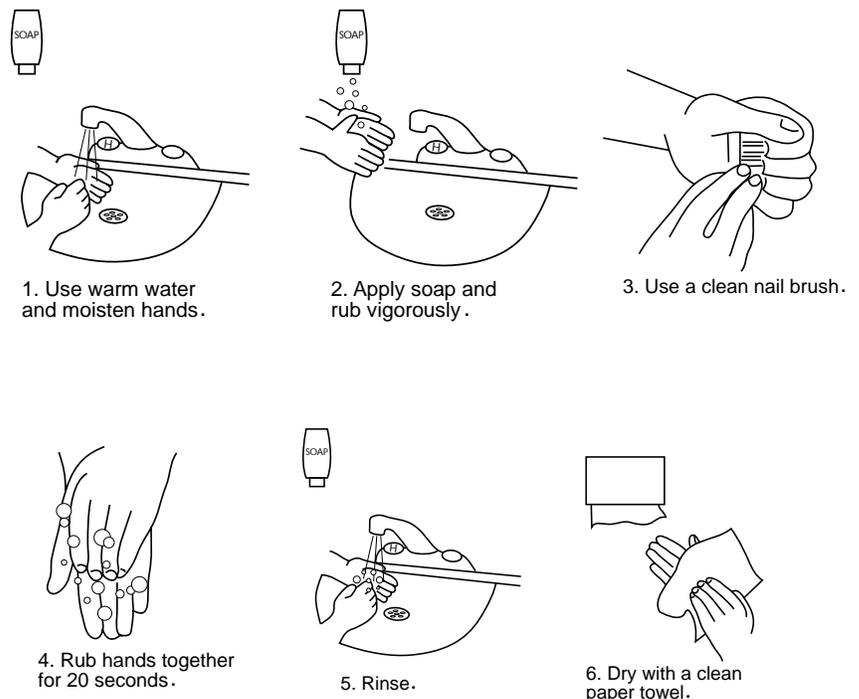
Handling and preparing foods with hand contact is a common way to transfer foodborne hazards to and from foods. It is important to ensure that the hands of a food handler are kept clean before, during, and after handling foods. Hands should be washed according to the following activities described in Figure 2.

Figure 2. When should hands be washed?

- (A) After touching bare human body parts
- (B) After using the restroom
- (C) After handling animals
- (D) After coughing, sneezing, using a tissue, using tobacco, eating, or drinking
- (E) After handling soiled equipment or utensils
- (F) Before food preparation
- (G) During food preparation
- (H) When switching between raw foods and ready-to-eat foods
- (I) After engaging in any activities that may contaminate hands

(From 1995 FDA Food Code)

Figure 3. Proper hand washing.



(From 1995 FDA Food Code)

Employees need to clean their hands, wrists, forearms, and other exposed parts of the body with an approved cleaning compound (soap). Proper hand washing involves application of the cleaning compound and vigorously rubbing of the hands for 20 seconds followed by a thorough rinse with clean cold water (Figure 3). Ensuring that the cleanliness of areas underneath fingernails and in between fingers is particularly important.

Under certain circumstances, there are special hand washing procedures. After defecating, contact with body fluids and discharges, handling waste containing fecal matter, and before handling food, hands should be: a) washed twice (20 seconds each time), and b) the fingernails and in-between fingers should be washed using a sanitized nail brush.

Both cleaning and sanitizing of hands are important. Although not usually required, hands may also be sanitized after being cleaned. Cleaning hands helps to remove dirt and other organic matter such as food. Sanitizing hands helps to reduce the number of harmful bacteria and viruses that may be naturally present on the hands. If using a hand sanitizing product, be sure to read the label. Most sanitizers have a recommended concentration and contact time (time in contact with hands). When used together, cleaning and sanitizing are very effective in reducing the likelihood of foodborne hazards.

Protective Clothing

To keep body parts from coming into contact with exposed foods, there are several protective apparel that can be worn. Hair restraints and beard restraints should be worn to reduce contact with human hair. Disposable gloves and protective smocks may also be worn to reduce transfer of microorganisms to an exposed food. This is especially important when working with raw foods followed by handling ready-to-eat foods. Keep in mind that protective

apparel is just like a second skin. If your hands can be contaminated after touching something, so can the protective apparel.

Besides maintaining good personal hygiene, the food handler needs to keep clean the clothes and other personal items that he/she may wear. A clean, white uniform or apron is desired. When shifting from raw to ready-to-eat foods, protective clothing may be worn to reduce contamination. While preparing food, food employees should not wear jewelry on their hands or arms.

Food Contamination

Food can be contaminated with anything it contacts (Figure 4). In a foodservice or food retail establishment, cross-contamination can occur from a food handler, from any food contact surface, and from another food.

Reducing cross-contamination from the food handler can be controlled with good personal hygiene. Washing hands and keeping work clothes clean are the

first step. Ensuring that employees remain clean during food preparation helps to eliminate cross-contamination from the food handler. Remember that a food handler can contribute harmful microorganisms from another food or food contact surface as well as those naturally present in the human body.

There are numerous food contact surfaces that may be contaminated by a raw food or from a food handler. Cutting boards are a good example. If a raw food is prepared on a cutting board, then ready-to-eat foods (such as salad ingredients) are prepared, expect contamination from the raw food to the food contact surface (i.e. cutting board) to the ready-to-eat food. In this example, several strategies could help prevent the possibility of cross-contamination:

- 1) Separate cutting boards can be used for raw foods and for ready-to-eat foods. Color coding helps to assure this (i.e. red for raw foods, green for ready-to-eat).

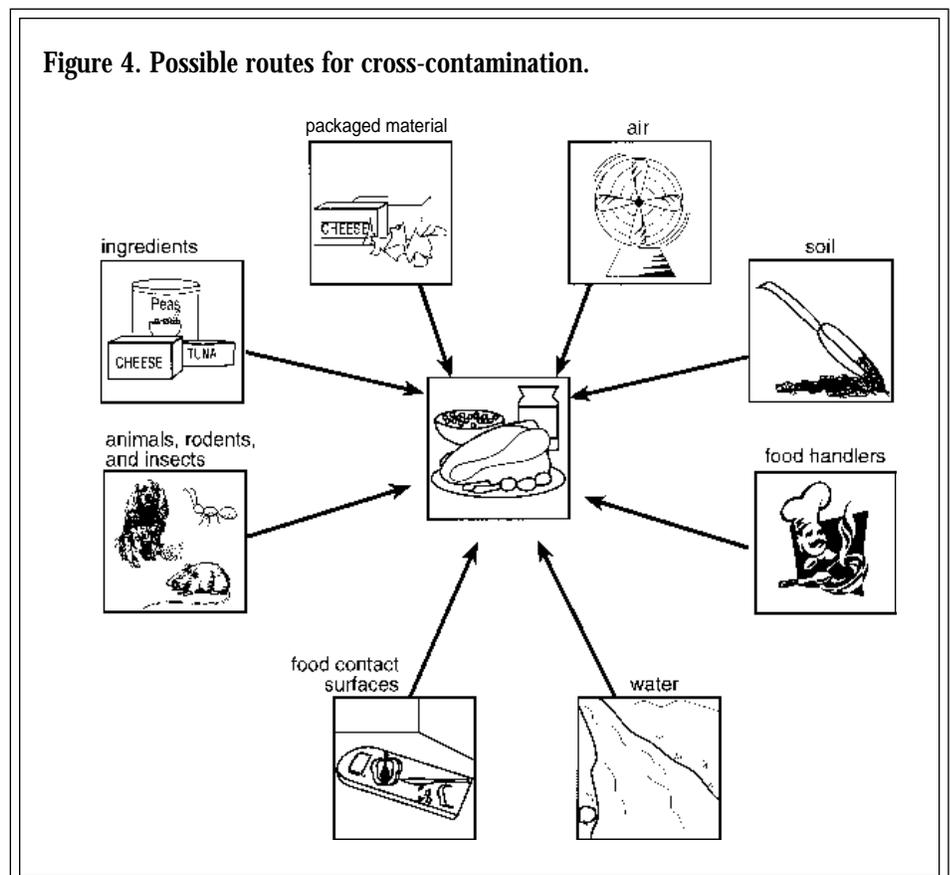


Figure 5. Steps involved in food preparation and serving.

- Freezing
- Thawing
- Cold Storage
- Cooking
- Cooling
- Reheating
- Hot Holding
- Cold Holding

2) After cutting the raw food, the cutting board and utensils (knife) could be properly cleaned and sanitized before cutting ready-to-eat foods.

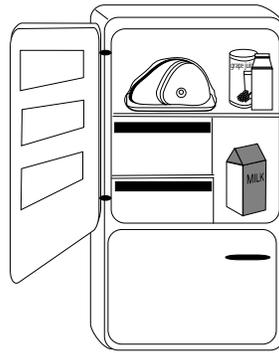
3) The ready-to-eat foods could be prepared first followed by preparation of raw foods.

Storage, Preparation, and Storage Temperatures

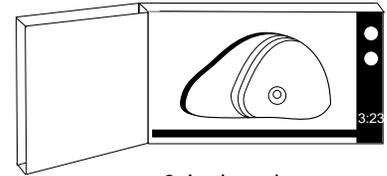
Temperature is perhaps the most critical means of control in the prevention of foodborne illness. Harmful (disease-causing) microorganisms grow within a temperature range of 41°F to 140°F (referred to as the “Temperature Danger Zone”). Many foods, especially raw animal products, naturally contain harmful microorganisms. Keeping foods out of the Temperature Danger Zone prevents disease-causing microorganisms from growing in foods. Proper cooking and reheating of food is important because heat destroys disease-causing microorganisms that may be present. Ensuring proper heating and storage temperatures is essential for assuring safe food in retail operations. Temperature guidelines differ depending on the type of food and method of heating method.

Most food preparation in food retail involves one or more of the following steps shown in Figure 5. For many operations, especially small supermarkets, food products are simply stored until purchase by the consumer. For other operations, such as a large

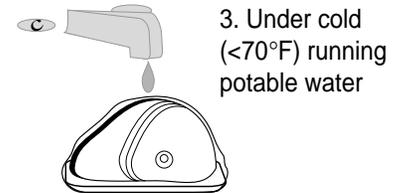
Figure 7. Preferred methods of thawing food.



1. In the refrigerator (<41°F)



2. In the microwave



3. Under cold (<70°F) running potable water

(From 1995 FDA Food Code)

restaurant, large quantities of food may be prepared and served over a period of days. These operations are more complex and may involve many steps shown in Figure 5.

Freezing

Most pathogenic microorganisms will not grow below 41°F, or their growth will be very slow. However, many spoilage microorganisms (which cause foods to taste and smell bad) can grow at temperatures well below 41°F. Most foods that are frozen in food retail are done to improve quality and increase the shelf-life of the product. Most foods will freeze at about 28-30°F. To ensure safe freezer temperatures, be sure that your freezer is maintained at least 28-30°F or below (foods should be frozen

solid). Ideally, foods should be frozen at 0°F or below to maintain quality.

There are other examples where freezing foods can be beneficial in improving food safety. Bacteria are generally not destroyed during freezing but parasites can be destroyed. For pork or fish, where parasites may be a concern, parasitic destruction guidelines have been established (Figure 6).

Thawing

Foods are generally thawed in four different ways: in the refrigerator, in the microwave, under cold running water, and at room temperature (Figure 7). The preferred method of thawing is in the refrigerator since the temperature of foods thawed this way will never exceed 41°F. Thawing in the refrigerator can take a long time, usually more than a day. In retail establishments, especially restaurants, thawing in the refrigerator can be difficult since supply and demand for entrees can vary. Often, restaurant foods need to be thawed quickly. Microwave thawing offers the best solution for rapid thawing of

Figure 6. Guidelines for parasitic destruction.

1. Food should be frozen throughout to 4°F and held for 7 days.
or
2. Food should be frozen throughout to 31°F (requires a blast freezer) and held for 15 hours.

(From 1995 FDA Food Code)

foods. Potentially hazardous foods that are microwave-thawed should be cooked immediately after thawing. Another alternative for thawing is to place frozen foods under cold running water. Foods may be thawed using a potable (safe to drink) water supply cooler than 70°F. When using this method, thawing time should be less than two hours, or when a food reaches 41°F (which ever comes first). This method may be effective for thawing large pieces of meat (i.e. turkey). Thawing at room temperature is the most dangerous way to thaw. Room temperature thawing should be avoided since foods thawed in this manner will be exposed to temperatures between 41-140°F.

Cold Storage

Since we know that harmful microorganisms grow only above 41°F, foods should be stored below 41°F. Although harmful microorganisms can grow at less than 41°F, the growth is extremely slow. Refrigerator and cold rooms differ in their capacity to keep foods cold. It is critical to ensure that the refrigerator and foods stored in the refrigerator are both maintained below 41°F (Figure 8). Cold holding of food to be served, as in a salad bar, should also be maintained below 41°F.

Figure 8. Guidelines for cold storage of foods.

1. Foods to be held at cold storage should be maintained below 41°F.

(From 1995 FDA Food Code)

Cooking

Proper cooking of foods is probably the most important way a food handler in food retail can promote safe food to the customer. If a potentially hazardous food is cooked to the proper temperature, harmful microorganisms will be eliminated in

Figure 9. Cooking guidelines for various retail foods.

<u>Food Type</u>	<u>Internal Temperature*</u>	<u>Time</u>
Roast beef (rare)	130°F	121 minutes
Roast beef (rare)	140°F	12 minutes
Eggs, meat, fish	145°F	15 seconds
Pork products, game animals, ground beef	155°F	15 seconds
Poultry, stuffed meats	165°F	15 seconds
*Microwave cooking	Add 25°F	_____

(From 1995 FDA Food Code)

most cases. Cooking guidelines as published in the 1995 FDA Food Code are based on scientific studies.

Cooking methods in different food retail operations can differ (Figure 9). Most foods are cooked in a conventional oven or in a microwave. Foods heat unevenly when cooked in the microwave versus a conventional oven. Therefore, cooking temperature guidelines have been established for both cooking methods. Generally, foods need to be cooked to a higher cooking temperature when microwaved to assure safety.

Cooking temperatures for foods should be measured with a calibrated temperature measuring device (i.e. metal stem thermometer). Temperature should be measured in the part of the food that is heated last. This is usually the center or thickest part of the food. Time can be measured with a clock or watch.

Raw animal foods such as meat, eggs, and fish, should be cooked to an internal temperature of at least 145°F for at least 15 seconds. For ground beef, pork, and other game animal products, a cooking guideline of at least 155°F for at least 15 seconds is recommended. Pork and game animals need a higher cooking temperature due to the possible presence of parasites. Ground beef, as

opposed to a beef roast, requires a higher cooking temperature due to the increased surface area generated from the meat grinding operation. For poultry and stuffed meats, an internal temperature of at least 165°F for at least 15 seconds is required.

When cooking foods in the microwave oven, the distribution of heat is often uneven. To distribute heat more evenly, frequent stirring and rotation of the food is recommended. Since the heat distribution may be uneven, internal cooking temperatures for the foods described above should be heated to an additional 25°F. For example, poultry cooked in a conventional oven should reach an internal temperature of 165°F for 15 sec., while poultry cooked in a microwave should reach an internal temperature of 190°F for 15 sec.

Cooling

After proper cooking, potentially hazardous foods need to be cooled as rapidly as possible. Remember that improperly cooled foods are the number one factor involved in foodborne illness. When foods are cooled, they enter the temperature danger zone. There is no way to avoid it. However, certain cooling strategies can be employed to shorten the time foods are between 140-41°F during cooling.

There are guidelines for the time that foods are between 140-41°F during cooling. The retail food industry usually recommends that foods be between 140°F and 41°F for less than four hours. The 1995 FDA Food Code recommends that foods be cooled from 140°F to 70°F within 2 hours, and from 70°F to 41°F within an additional 4 hours.

Large quantities of food and foods that are dense or viscous can take a considerable amount of time to cool. A large stock pot of chili can take up to a day to cool completely to <41°F in a refrigerator! Improper cooling is a common mistake made by food handlers in food retail establishments. Be sure to monitor cooling temperature and time for foods that are cooked and cooled in your establishment. For more effective cooling, try some of the cooling methods described in Figure 10.

Hot Holding, Cold Holding, Reheating

All potentially hazardous foods that have been cooked or cooked/cooled/reheated, need to be hot held at above 140°F. All potentially hazardous foods that are to be eaten cold need to be held below 41°F. Again the key is to keep foods out of the temperature danger zone. All potentially hazardous foods that have been cooked and cooled, regardless of the type of food, must be reheated to at least 165°F in less than 2 hrs.

Conclusion

An understanding of good personal hygienic practices, cross-contamination, and the importance of temperature are all critical foodborne illness prevention concepts for food retail workers to know. A good understanding of these concepts and implementation of preventative measures will help

decrease the likelihood of foodborne illness. Food safety education and training are the most effective methods to prevent foodborne illness. A food handler must not only know “what” to do, but also “how” and “why” it is being done.

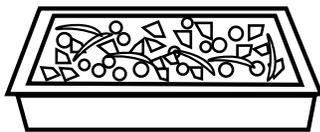
References

U.S. Department of Health and Human Services, Public Health Services, Food and Drug Administration. 1995. *Food Code (1995)*. U.S. Department of Commerce. Springfield, Va.

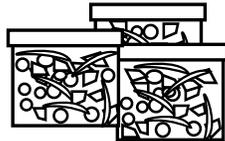
Hooper, A.J. 1989. Foodborne illnesses of tomorrow are here today. *Dairy, Food, and Environmental Sanitarian* 10(9):549-551.

Summary of Notifiable Diseases, U.S. 1988, Centers for Disease Control, *MMWR*, 1989 37:51

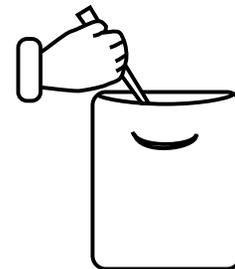
Figure 10. Methods to reduce cooling (from 140° F-41°F) time for food.



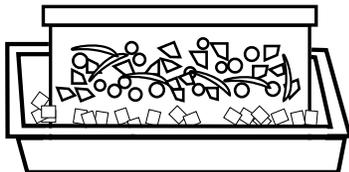
Transferring food into shallow pans (less than 2" high)



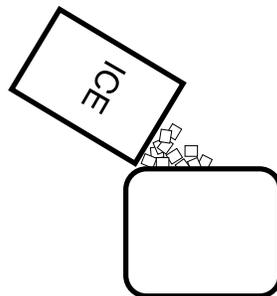
Transferring food into smaller containers



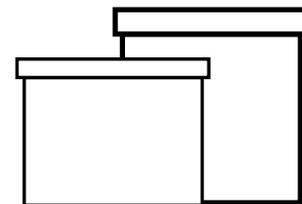
Stirring food while cooling



Placing containerized food in an ice water bath



Adding potable ice directly to a condensed food



Using containers that facilitate heat transfer

(From 1995 FDA Food Code)