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Food Safety within the Household: Risk Reduction[1]

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The Centers for Disease Control and Prevention (CDC) estimates that 48 million Americans acquire foodborne illness every year, 128,000 are hospitalized, and 3,000 die (CDC 2011). In 2013, 12% of all foodborne illnesses with a single reported setting (86 outbreaks and 1,078 reported instances of illness) were attributed to food preparation occurring in private homes. Many cases of foodborne illness are not reported, and of those that are, the causative agent is not investigated or identified. In 2013, the top five identified bacterial and viral foodborne illness agents attributed to home food preparation were *Salmonella*; norovirus; shiga-toxin-producing *Escherichia coli* (e.g., serovars O104, O111, O157:H7 and others); *Clostridium perfringens*; and *Campylobacter* (Scallan et al. 2011).

Household Risks and How They Occur

Salmonella

Food poisoning from *Salmonella* infections can cause serious illness and even death; symptoms include acute diarrhea, vomiting, dehydration, septicemia, or bacteremia (i.e., bacteria in bloodstream) (Bell and Kyriakides 2009a). Possible secondary illnesses associated with this infection are reactive arthritis, meningitis, and urinary-tract infections, etc. In home-kitchen settings, *Salmonella* is often linked to egg and egg-based products like homemade mayonnaise in which the choice of acidulant (acetic acid vs. citric acid) and other factors influence the survival of *Salmonella* introduced through contamination of raw eggs (Radford et al. 1993). Chicken and other poultry, produce, fruits, chocolate, and nuts have also been implicated as vehicles of *Salmonella* transmission. These food sources may become contaminated with *Salmonella* by contact with fecal matter (either directly or through cross-contamination), inadequate cooking techniques, and cross-contamination due to poor personal hygiene or improperly cleaned equipment.

Norovirus

Noroviruses are responsible for 20 million reported cases of acute gastroenteritis, or stomach flu, each year (CDC 2024). Symptoms typically begin within 12 hours of ingestion of contaminated food and may include nausea, vomiting, diarrhea, abdominal cramps, headaches, fever/chills, and muscle aches. Norovirus is highly contagious and contact with as few as 100 virus particles is sufficient to cause illness. Foodborne norovirus transmission can occur anywhere people consume food prepared by others. In home-kitchen settings, food can be easily contaminated through handling by infected persons, contact with infectious stool or vomit on kitchen surfaces, or contact with aerosolized vomitus droplets from an infected person (CDC 2024).

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Shiga-Toxin-Producing *Escherichia coli* (STEC)

Shiga-toxin-producing *Escherichia coli* (STEC) bacteria, such as *E. coli* O157:H7, can cause severe abdominal cramping, bloody diarrhea, and vomiting (Bell and Kyriakides 2009b). STEC infections can lead to hemolytic uremic syndrome (HUS), which is potentially fatal, especially in young children. *E. coli* O157:H7 infections occur when people consume contaminated food or water products, including undercooked meat, unpasteurized milk products, and leafy green vegetables. Between 2003 and 2012, ground beef and leafy greens were implicated as the source of more than 25% of all reported *E. coli* outbreaks in the United States (Heiman et al. 2015). In home-kitchen settings, washing contaminated ready-to-eat leafy greens in tap water may have the unintended effect of cross-contaminating previously uncontaminated portions, thus increasing the potential for STEC infection (Jensen et al. 2015).

Clostridium perfringens

As the second-most common bacterial agent of foodborne illness in the United States, *Clostridium perfringens* affects nearly one million individuals each year (Grass et al. 2013). Only a fraction of these cases are actually reported due to the mild, self-limiting nature of resultant symptoms. Generally, individuals experience abdominal pain, stomach cramps, and diarrhea within 6–24 hours after consuming contaminated food. High-protein foods of animal origin, including meat and meat products, stews, broth, soups, gravies, milk, etc., are commonly implicated as sources of *C. perfringens* infection. Because the bacteria is naturally present in the normal intestinal flora of animals, proper cooking of food to an internal temperature of 165°F or higher for at least 15 seconds is necessary to inactivate the bacteria. Additionally, cooked food should be kept hot at 140°F before serving or rapidly cooled to 41°F for storage (FDA 2013).

Campylobacter

Campylobacter is the primary cause of a type of foodborne gastroenteritis known as campylobacteriosis. Resulting symptoms appear between 2–5 days after ingestion of contaminated material, last between 7–10 days, and are usually flu-like in nature: acute diarrhea, fever, nausea, and vomiting. Because the bacteria occurs as a natural part of the normal flora of domestic animals like cattle and poultry, raw or undercooked meat (especially chicken) is a frequent source of foodborne *Campylobacter* illness in home kitchen settings (Blackburn and McClure 2009). Other vehicles of infection include contaminated water, raw or unpasteurized milk, and salad vegetables. Cross-contamination due to inadequate hygiene practices within the kitchen is a high risk factor for contracting *Campylobacter*

Risk Reduction Requires Knowledge and Behavior Change

Even though the number of foodborne illness cases occurring in domestic settings appears to be decreasing, educating consumers about home food safety is of the utmost importance (Scott 2003). Having insufficient knowledge of the risks associated at each level of food preparation can increase the number of incidents of foodborne illnesses at home (Collins 1997). Yet, the correlation between knowledge of proper hygiene practices and actual hygienic behavior in the home kitchen is still low among consumers (Worsfold and Griffith 1997).

The most common food-safety handling mistakes that occur within the household are improper food storage, inadequate cooking or reheating temperatures, cross-contamination, and infected food handlers (Scott 2003). However, research has shown that maintaining good hygiene practices can greatly help reduce many of the occurrences of foodborne illnesses (Scott 1996).

Food Storage

Food must be stored in a manner that minimizes microbial growth. Cooked food should be stored in the refrigerator below 41°F or in the freezer below 0°F (FDA 2013). Because refrigeration does not completely eliminate the potential growth of pathogenic bacteria, leftover food stored in the refrigerator should be consumed or discarded within 3 to 5 days. Expiration dates for foods should also be checked regularly. Frozen food should be thawed either in the refrigerator until ready, under cold running water (below 70°F), or in a microwave oven (FDA 2013). Raw foods and cooked foods should be stored separately in the refrigerator in order to prevent cross-contamination between the two. Furthermore, each item should be covered or wrapped (FDA 2013).

Cooking and Reheating

In the prevention of microbial growth, proper cooking of food is equally important. All cooking equipment (e.g., ovens and microwaves) should be used as instructed in the manufacturer's guide and should be maintained and cleaned (FDA 2013). Internal cooking temperatures should reach and sustain the safe minimum as recommended in Table 1 and should be checked with the appropriate

food thermometer in accordance with these latest USDA guidelines.

Keeping It Clean

High-risk sources of cross-contamination in the kitchen include hands and food-contact surfaces such as cutting boards and counter tops (FDA 2013). It is very important to adequately wash hands with warm, soapy water and a sanitizing solution before handling food, before eating, after using the restroom, after handling a pet or child, and after contact with raw meat or other high-risk food items. The use of a dishwasher has been found to be more effective in reducing contamination of cutting boards and flatware than by washing by hand (FDA 2013).

Resources for Educators

Healthy People 2020, an initiative set forth by the US Department of Health and Human Services (HHS), has already begun to outline objectives that will improve these food safety practices among consumers (DOH 2011). These objectives (Figure 1) aim to increase the number of people who wash hands and food contact surfaces (CLEAN), do not cross-contaminate (SEPARATE), cook to adequate temperatures (COOK), and refrigerate promptly (CHILL). Thus, adequate hygiene factors are the basis of many educational and assistance programs aimed at improving food safety in home kitchen settings. Each of these food-safety goals can be traced back to the general conclusion that prevention of foodborne illness occurs through proper food preparation and sanitation techniques (Collins 1997).

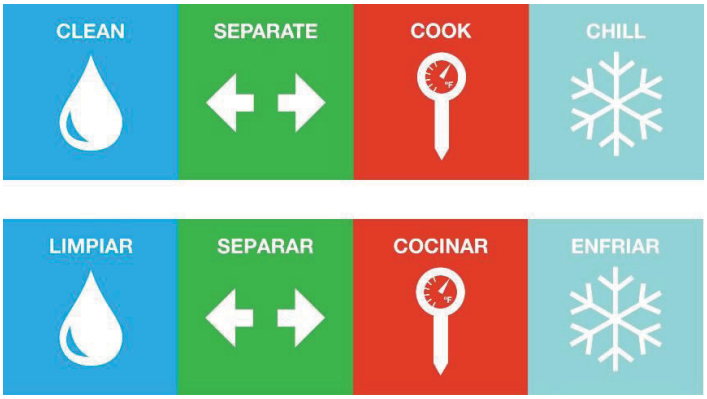

Figure 1. CLEAN-SEPARATE-COOK-CHILL / LIMPIAR-SEPARAR-COCINAR-ENFRIAR
Credits: http://www.healthypeople.gov/

The Partnership for Food Safety Education is a non-profit organization that works to eliminate illness and death from foodborne disease through various educational campaigns. It was established in 1997 in response to a need for increased awareness of food safety among consumers (especially among at-risk populations including pregnant women, young children, the elderly, and the immuno-compromised). Food-safety education campaigns such as "Fight BAC!" and "Be Food Safe" provide information on potential causes and associated costs of foodborne illness and promote lifestyle changes in accordance with preventative guidelines (The Partnership for Food Safety 2024).

Another campaign that began in 2011 is Food Safe Families. It is a collaboration between the USDA's Food Safety Inspection Service (FSIS), the US Food and Drug Administration (FDA), and the Centers for Disease Control and Prevention (CDC). Its aim is to raise awareness about foodborne illness and encourage consumers to make lifestyle changes that lower their risk of contracting foodborne illness and practice safe food-handling techniques. The target audiences are English- and Spanish-speaking families who cook at least four times a week (USDA-FSIS 2011).

Closing Remarks

Although food-safety education is well established, people continue to be affected by foodborne illnesses associated with unsafe food handling at home. Many individuals just might not be aware of the potential risks associated with certain food-handling practices. Additionally, individuals with adequate knowledge of food-safety practices might not always apply these standards in home-kitchen settings. Because of these risks, the Healthy People 2020 seeks to educate consumers about foodborne illness in a manner that promotes harm-reducing lifestyle changes (DOH 2011).

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Table 1. Safe Minimum Cooking Temperatures Chart

Category	Food	Temperature (°F)/Cooking Instructions	Rest Time
Ground meat & meat mixtures	Beef, pork, veal, lamb	160	None
	Turkey, chicken	165	None
Whole cuts of beef/veal/lamb	Steaks, roasts, chops	145	3 minutes
Whole cuts of poultry	Chicken & turkey, whole	165	None
	Poultry breasts, roasts	165	None
	Poultry thighs, legs, wings	165	None
	Duck & goose	165	None
	Stuffing (cooked alone or in bird)	165	None
Whole cuts of pork	Fresh pork chops, loin	145	3 minutes
	Fresh ham (raw)	145	3 minutes
	Precooked ham (to reheat)	140	None
Eggs & egg dishes	Eggs	Cook until yolk and white are firm.	None
	Egg dishes	160	None
Leftovers & casseroles	Leftovers	165	None
	Casseroles	165	None
Seafood	Fin fish	145 or cook until flesh is opaque and separates easily with a fork.	None
	Shrimp, lobster, and crabs	Cook until flesh is pearly and opaque.	None
	Clams, oysters, and mussels	Cook until shells open during cooking.	None
	Scallops	Cook until flesh is milky white or opaque and firm.	None

Source: Keep Food Safe (https://www.foodsafety.gov/food-safety-charts/safe-minimum-internal-temperatures)