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Understanding & Preventing Foodborne Illness

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Suggested CDR Learning Codes: 8040, 8110
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Learning Objectives

At the conclusion of this course, the student will be able to:

1. Discuss the most common causes of foodborne illness, and five reasons why it is likely to occur more often.
2. Identify groups at special risk for foodborne illness.
3. Identify the primary symptoms of foodborne illness and explain why it is often misdiagnosed.
4. Explain why certain pathogens are described as "emerging" and what that means for foodhandling operations.
5. Name the seven most prevalent pathogens and discuss their origin, effects and preventive measures to combat their spread.
6. Explain the concept of cross contamination and outline methods of prevention.

There are several reasons to learn about food safety. Your job may require it, or you may think it would be useful for your clients. Even if your work has little to do with food safety directly, you may want to know more for personal reasons, or to be more aware of the concerns of fellow workers who are directly responsible. Whatever your motivation, there is no doubt that food safety has risen to a level of critical importance for all nutrition professionals. There are compelling and intriguing reasons for this.

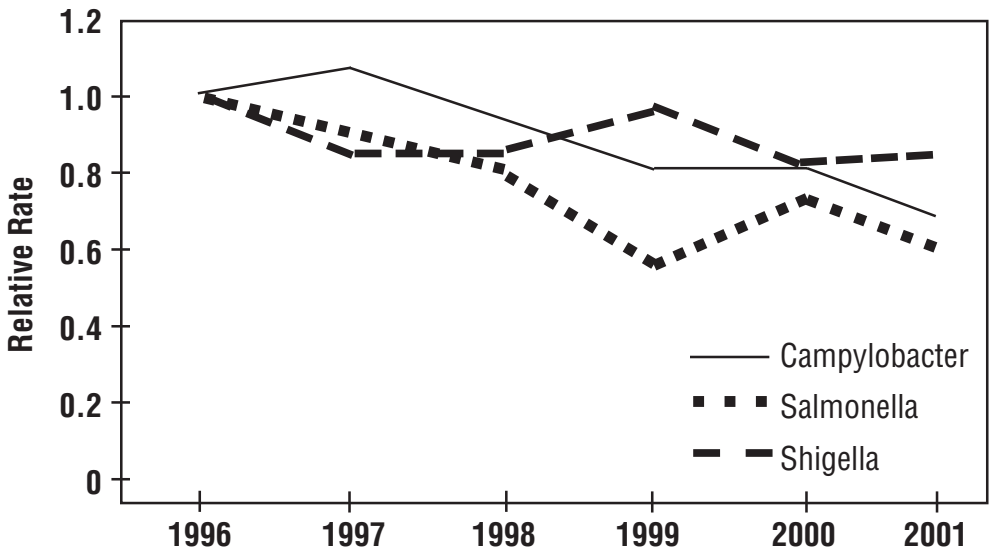
Awareness of foodborne illness and food safety in general has increased in the last 20 years for a simple reason: notorious and widely reported incidents have created awareness and concern. The 1993 California case of Shiga-toxin-producing *E. Coli* in food at a Jack in the Box restaurant was a watershed event, as it took food contamination out of the "bad potato salad at the Sunday school picnic" realm and into the world of mass food production and service. Professionals were especially concerned because the restaurant chain was not breaking any California laws, and their storage, handling, preparation and service procedures were certainly not atypical of the industry as a whole.

After that came stories involving fresh apple juice, frozen strawberries, packaged lettuce, dry cereal — all foods we would never have feared or suspected of causing harm. The perception was that our food supply was seriously impaired — but has the incidence of foodborne illness actually increased? It depends on who you ask. The *New York Times* has reported that cases of *E.coli* infection, commonly linked with undercooked red meat but sometimes detected on unwashed fruits and vegetables, more than doubled in five years, from 1,667 in 1995 to 4,341 in 2000 (Weese, 2005).

Others would argue that the incidence has actually *decreased* due to more stringent enforcement of food codes. An interesting study in Los Angeles demonstrated the impact of posting restaurant rating cards for public observation. In the first year following the implementation of the grading system, there was a 13 percent reduction in the number of hospitalizations for foodborne illness in Los Angeles (Simon, *et al., 2005*). Coincidence or direct effect? It is hard to say . . .

Probably the best source of information and statistics on foodborne illness is the Centers for Disease Control, through their data-gathering program called *FoodNet* (*MMWR Weekly*, 2002). CDC states that an estimated 76 million persons contract foodborne illnesses each year in the United States. While their data show a trend toward decreasing incidence of major bacterial foodborne illnesses, indicating progress, the data do not show a sustained decline in some infections, indicating that increased efforts are needed to reduce further the incidence of foodborne illnesses. The following two charts will verify this point.

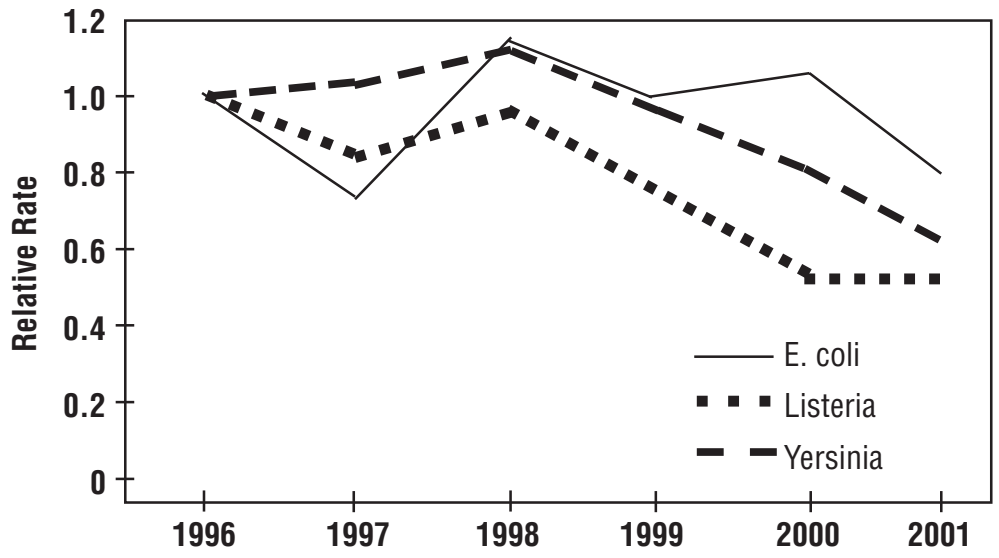
Relative Rates* of *Campylobacter, Salmonella* and *Shigella*



Relative rates*, adjusted for site, of laboratory-diagnosed cases of *Campylobacter, Salmonella*, and *Shigella*

*Bacterial pathogens with highest incidences of the 10 studied diseases.
FoodNet, United States, 1996-2001

Relative Rates for *E. coli* 0157, *Listeria* & *Yersinia* infections



Relative rates*, adjusted for site, of laboratory-diagnosed cases of *E coli 0157, Listeria*, and *Yersinia* infections.

FoodNet, United States, 1996-2001

Underdiagnosis?

One of the reasons that statistics are so inconsistent is that many incidences are never diagnosed, and consequently go unreported and undetected. The primary symptoms of foodborne illness are nausea, vomiting and diarrhea — the same symptoms of many flu strains. A person experiencing these symptoms may consider that they may be food-related, but when they consider the food that they have most recently eaten, they realize that friends or family member who ate the same food are not sick, and so conclude that the food was not the cause. The truth is, their symptoms may be caused by food that was eaten several days earlier. (Elaboration of this concept will be considered later in this article.)

If underreporting is the rule, the 76 million figure may be grossly deflated, and there may be many times that number of actual foodborne illness occurrences each year. Why? With all the modern conveniences, chemicals, appliances and regulations we have, why do may professionals argue that it is *more* difficult to serve safe food now than it was 25 years ago? What has changed to cause this?

Although there are many possible answers to this question, we will look at four primary reasons here.

• **Pathogens have become more virulent.** *E. coli* is one of the most common organisms found in the world. The Shiga-toxin producing *E. Coli* strain mentioned earlier (known as *E. coli 0157 – H7*) was unknown several decades ago. This strain has mutated to become far more deadly than any of its predecessors.

The manufacturer whose unpasteurized apple juice contained this pathogen found that the pathogen had been picked up when the apples he used fell to the ground (McCarthy, 1996). Since the "natural" juice wasn't heat treated, the pathogen survived. Please note that his marketing and our general cultural bias would make most people consider unpasteurized juice *healthier* because it is in its raw state.

One strain (there are over 200) of *Salmonella,* known as *S. enteriditis*, has developed the capacity to migrate into a chicken's ovaries, hence contaminating eggs before the shells are formed or the eggs are laid (*Food Safety Notebook*, 1996). Previously, it was felt that an intact egg, one with no cracks in its shell, was safe to be used for in uncooked products (such as meringues or hollandaise sauce). Now, we can't be sure there is no contamination inside the egg, so shell eggs can only be used for thoroughly cooked products, and if any part of the egg is to remain liquid, such as in soft-cooked eggs, only pasteurized eggs should be used.

Both the Shiga-toxin producing *E.Coli,* and *Salmonella enteritidis* are considered "emerging pathogens."

Many states have made this mandatory for highly susceptible population groups, but it is voluntary in most other cases. Restaurants that use fresh unpasteurized eggs because they think it makes the best hollandaise sauce take a significant chance, indeed. Should a case of foodborne illness result in a lawsuit against them, they would have a difficult defense.

An recent interesting case highlights the hazards for restaurateurs. A well known upscale restaurant chain recently was contacted because two customers had become ill after eating there. The offending food was identified; it was to have been made with pasteurized eggs (the recipe specifically stated that), and the egg carton label said the eggs were pasteurized. The vendor had misrepresented the product, however, and the eggs had not been pasteurized. Although the restaurant was exonerated in this case, it learned a valuable lesson in confirming the integrity of vendors.

• **Centralization of supply.** Another reason that foodborne illness is more difficult to control is that our food increasingly comes from large production plants. Rather than obtaining our produce and meats from local markets, they come from megaproducers, perhaps thousands of miles away. Such a producer could be preparing food for hundreds of thousands of persons. If an error occurs in one of these plants, many people will potentially be affected.

This was vividly demonstrated a number of years ago in the case of ice cream. The mix had become contaminated with *S. enteriditis*. Before the incident was over, it was documented that 120,000 persons had become ill from this pathogen (Hennessy T, *et al*., 1996).

• **Foreign sources.** Not only does food not come from a local market, sometimes it doesn't even come from this country. Global transportation of food has had an impact on the safety of our food. Although our products are far from pathogen-free, we do have systems in place to product most food. My personal visits to other countries to inspect production systems there proved to me that the most rudimentary safeguards are not in place. Even if the production system is satisfactory, the lack of controls through the entire chain of storage and delivery increases risk.

• **Restaurant eating.** Finally, the single most important factor is that people don't prepare their own food as often — they eat out more. As we will see, our home practices are often not perfect, but we don't prepare food for hundreds of other people, so if we make a mistake, the effects are minimal.

But in the public sector, as a recent article stated, the safety of the food eaten "is directly related to the personal hygiene habits of the average teenager."

In generations past, teens were constantly told to wash their hands before eating and after using the restroom. Those constant reminders faded as mothers went to work. Not to put too fine a point on it, let's say the average teenager has little sense of importance of handwashing, despite training and regulation in the workplace.

For greatest safety, when you eat out, "eat hot." Temperature kills most pathogens. Although salads provide good nutrition, you might prefer to eat lettuce that someone didn't "wipe " on. (Sorry, but reality is harsh!)

All food producers, handlers and vendors have a stake in providing safe food — and increasingly, they pay a heavy financial price for failing. Our country is increasingly litigation oriented; people are more likely to seek monetary damages for harm done, and there are law firms that specialize in foodborne illness cases (the site www.marlerclark.com is a good example.)

Remember, biological food contamination cannot be detected by the senses: you cannot see or taste pathogens. Food spoilage can be detected easily, but the presence of microbes, the source of the worst contamination, cannot. Therefore, foodservice operations must have a defensible operation supported with a HACCP plan, and must also insist that their vendors do too. Serving food is far from simple! (HACCP — Hazard Analysis Critical Control Point — systems are beyond the scope of this article. The Nutrition Dimension course *Implementing HACCP*, available in both book and electronic format, is recommended.)

Vulnerability

The obvious answer to this is institutional clients and patients —the very old, the very young and the immunocompromised. The latter group would include the post-surgical patient, the HIV/AIDS person, people recovering from a serious disease, on chemotherapy or radiation. The degree to which a person gets sick depends on how strong they are and the actual number of pathogens they ingest —in other words, how vulnerable were they, and how contaminated was the food?

Thus, the responsibility of foodservice professionals depends in part on who they serve. For those serving the general public such as a restaurant, the obligation is to follow and enforce the local codes, and abide by what is considered "good practice" — such as using pasteurized eggs. For those serving a highly susceptible population group as outlined above, these "good practices" are mandatory. According to the 2005 *FDA Food Code*, if serving a highly susceptible population group, a food service must require workers to wear gloves when touching ready to eat food and not serve unpasteurized eggs (if eggs are in a soft form) or unpasteurized juice.

It is management's job to identify the customer served, assess the degree of vulnerability and institute and enforce appropriate policies.

Even the best-run facility or production venue is vulnerable due to bioterrorism.

"Bioterrorism" is a word that we associate more with the nightly news than with our jobs — anthrax letters or reservoir contamination comes to mind. While most food operations address food safety – the *unintentional* contamination of a food supply — very few are prepared to deal with *intentional* contamination .

Since Sept. 11, 2001, international awareness of the vulnerability of our food and water supply has grown. The World Health Organization states "food is … the most vulnerable to intentional contamination by debilitating or lethal agents. The diversity of sources of foods, including the global market, makes prevention difficult, if not impossible" (WHO, 2002). In fact, food offers the perfect vehicle for large-scale terrorist attacks (Sobel, 2002).

Government, state and local agencies and private organizations have prepared guidelines for all stages of the food chain (US FDA, 2003). Realizing that the foodservice industry has the potential to be a target of terrorism, they are addressing efforts to a diverse set of establishments: restaurants, cafeterias, grocery and convenience stores, church kitchens, day care, bars, camps etc. Restaurants have been especially pro-active in this. Regrettably, we have certainly not heard the end of this issue.

With these things in mind, we need to be watchful for signs and symptoms, so that identification and intervention can be prompt.

Recognizing Foodborne Illness

The symptoms of foodborne illness are varied, though, as mentioned earlier, the most common symptoms are nausea, vomiting and diarrhea. Less frequently, symptoms may include headache, blurred vision, tingling sensations, rashes; the worst symptoms, kidney and respiratory failure, are a factor of onset time and medical intervention, or lack of it.

Actually, we all have probably had a foodborne illness, but because the symptoms were not extreme, we credit the incident to "the flu" because we do not understand concept of onset time. Onset time is, simply, "the time it takes for symptoms to show up" — how long after a food is consumed is the victim puking his guts out,

afraid that he may die? The last sentence is no exaggeration: anyone who has experienced a significant foodborne illness never forgets the incident.

Every pathogen has a characteristic onset time. These onset times will vary according to several variables, and each chart will have some inconsistencies, but generally the earliest onset time is approximately one hour (*Staphylococcus* and *Anisakis*). Of the common pathogens, the longest onset time is approximately 30 to 50 days (Hepatitis A).

The emerging pathogens stagger the imagination by extending the onset time to 10 or 20 years, very conservative estimates state "several years" (Mad Cow Disease and Variant Creutzfeldt-Jakob Disease, 2005). It is interesting to note that the symptoms of "Mad Cow" disease are characterized by dementia (Mad Cow Disease, 2005). Since dementia is widespread in our older population, the study of this new disease will be very complex.

Another pathogen with a complicated onset time is *Campylobacter*. Usually symptoms of this illness (vomiting, diarrhea) are self-limiting and clear up in three to five days. For this reason, tests were rarely done and the incidence of this organism in human food was very underrated. It is now, however, considered one of the most frequent causes of foodborne illness.

Most people who get campylobacteriosis recover completely within two to five days, although sometimes recovery can take up to 10 days. Rarely, some long-term consequences can result from a *Campylobacter* infection; some people may have arthritis following campylobacteriosis; others may develop a rare disease which affects the nerves of the body beginning several weeks after the diarrheal illness, called Guillain-Barré syndrome. This occurs when a person's immune system is triggered to attack the body's own nerves, and can lead to paralysis that lasts several weeks and usually requires intensive care. It is estimated that approximately one in every 1,000 reported campylobacteriosis cases leads to Guillain-Barré syndrome; as many as 40 percent of Guillain-Barré syndrome cases in this country may be triggered by campylobacteriosis (Center for Disease Control, 2005).

Pathogens worth knowing

In the following sections, we will discuss those pathogens most worth knowing about and the three most common causes of foodborne illness. After that we'll examine the foods that cause the greatest risk and how to handle them.

• ***Salmonella.*** There are more than 2,000 types of *Salmonella*, all pathogenic to humans, so disease from this pathogen, or class of pathogens, is fairly common. *Salmonella enteritidis*, mentioned earlier, is associated mostly with eggs and poultry — estimates are that over half of all chickens sold in this country contain Salmonella (Reed, 1993), but because this pathogen does not produce a toxin, thorough cooking of the poultry renders it harmless.

The threat becomes more prevalent through cross-contamination, the spread of contamination from raw to ready-to-eat food. Unfortunately, fruits and vegetables are increasingly associated with this pathogen.

• ***Staphylococcus aureus*** **("Staph")**. Staph is one of the most commonly identified causes of foodborne illnesses for three reasons. First, it is easily spread by people with minor illnesses (runny noses, sore throats) who work with or touch the food —sick people should not be handling food, but even a customer's sneeze may contaminate restaurant food. Staph may also come from infected cuts or skin lesions.

Second, Staph produces a toxin that is particularly resistant to high temperatures and survives normal cooking.

Third, the incubation time for Staph is fairly quick — from 30 minutes to six hours. Therefore, the connection between the food and the symptoms is more likely to be identified.

• ***Clostridium perfringens***. *Clostridium* species include the deadly but rare botulism variety, but *C. perfringens*, often known as the "cafeteria germ" because of its association with steamtable food, is much more

common. A spore-former, it lingers and resists destruction through hear, so it becomes a particular threat in leftover foods.

• ***Campylobacter jejuni***. A very underreported pathogen, *Campylobacter* may be one of the most common causes of diarrhea. A recent analysis of eight randomly purchased chickens in a leading US city showed *Campylobacter* contamination in seven (Allen, 1997). It is carried in the gastrointestinal tract of poultry and cattle and, once brought into a processing plant, it spreads to many other carcasses.

Cases of *Campylobacter* aren't easily identified because most affect only an individual or a family, and symptoms usually run their course without treatment within three to five days. The actual number of incidents are probably five to 10 times higher than reported because people often don't seek medical care. Even so, it is estimated that this pathogen affects 1.37 million to 1.75 million people per year (Allen, 1997); the CDC estimates the number between two and four million per year. *Campylobacter* may be a triggering organism for arthritis, and in rare instances may be linked to the development of Guillain-Barre syndrome, a muscle wasting disease, as mentioned above.

• ***Escherichia coli 0157:H7*.** One of the most well known pathogens now, but virtually unheard of 10 years ago, it is considered an "emerging pathogen." *E. coli 0157:H7* (commonly called simply "157") is feared for its lethal capability and its amazing ability to adapt to new environments. It is usually transmitted through the fecal material of animals — it is postulated that the apple juice mentioned earlier became contaminated from ground apples (apples harvested after falling on the ground) in areas contaminated by wild animals or livestock. This pathogen may also be spread from person to person, especially in day care centers and nursing homes. As with all other pathogens, the very young and very old are most susceptible.

The best control measure is heat, either cooking food thoroughly (hamburger should be cooked to a minimum of 155 degrees) or pasteurization, as in the case of milk or apple juice. It is fairly certain that this pathogen will continue to gain headlines in the years to come.

• ***Shigella***. A genus of bacteria, several species of which are known to cause diarrhea and even dysentery.

I have personal experience with this little beauty. In the summer of 1996, my family made a three-day trip to Mexico. Two days later, we attended the fireworks display at the Republican National Convention, in nearby San Diego. We had purchased food from a nearby restaurant for a picnic before the fireworks.

The next day, three of us suffered gastrointestinal distress. Our first reaction was that the picnic food from the restaurant was contaminated — wasn't it the most recently eaten? Upon further thought, however, I came to a different diagnosis: *Shigella*, from the Mexico excursion. The clue was that we all ate the same picnic food, but only three people who had consumed fish tacos three days before in Mexico had the problem. I knew that *Shigella* has an incubation time of one to seven days (usually three to five), so the onset of symptoms would point to this. Also, Shigella is transmitted through poor handwashing, and the taco stand was in a beach area where adequate sanitation facilities were difficult to provide

Shigella was prevalent in the past, but was very well controlled by the 1940s in this country due to the prevalence and sophistication of public water systems. However, it has seen a recent upsurge, due primarily to the increase in day care centers. Infection is usually seen in children ages one to four. Easily eliminated by heat, *Shigella* is usually associated with cold foods — those fish tacos had the usual raw shredded cabbage.

• ***Hepatitis A***. Hepatitis A virus usually results in fever, jaundice, abdominal pain and malaise. In adults there is a 2 percent risk of progression to liver failure with a death rate of one in 250. Most people who contract the disease are unable to return to work for at least six weeks.

Vaccines that offer 100 percent protection for at least 10 years have been developed, and vaccinations of food workers, although not usually required, has become a point of discussion in many areas.

• **Prions**. Just what we need: another pathogen! The newest member of the pathogen family does not fit the classification of pathogens as we know it. They are not bacteria, viruses, yeasts or molds, but a protein molecule. A recent discovery changed all the ground rules that scientists used when studying infectious diseases — proteins were never classified as infectious; they simply occurred as part of an organism. In fact, the idea that a

protein molecule could be infectious was considered "insane" by scientists, the man responsible for identifying prions, Dr. Stanley Pusiner, was ridiculed for years. But then, in 1997, he was awarded the Nobel Peace Prize for his work on prions (Soderholm)!

Prions first came into public awareness with the Mad Cow disease epidemic in England in 1986, and it is now a given that they are the cause, and that, more frightening, they migrate from the meat of animals into the human brain.

The apparent mechanism of action is for the prions to enter cells and convert normal proteins found within the cells to prions like themselves. The converted proteins have all the same components of the original protein, but now they act completely differently. The protein associated with the Mad Cow disease is highly stable, resisting temperatures even as high as those used for sterilization. It also resists freezing, drying and irradiation. One of the most interesting complications of this disease is the incubation time, which is usually stated at seven to 10 years, perhaps longer. The efforts to identify and isolate cattle with the disease are well known, as in a recent banning of Canadian cattle imports to the US.

With all those nasty bugs about, it's comforting to know that prevention of most foodborne illness is well within our grasp.

Prevention

All foods are capable of carrying microorganisms, but some pose greater risk. Some are obvious, but some will surprise you.

• **High protein foods.** Have you ever wondered why protein is so attractive to microorganisms? The nitrogen in the protein molecule fuels the growth just as it does in the growth of all organisms. The high protein foods that are not heat treated are especially worrisome: fresh eggs, steak tartare, sushi, ceviche, raw milk.

Sushi, especially, is not only not heat treated, it is highly handled. Sushi has become so popular that a great many people are involved in its production, not just the highly trained traditional sushi chef. Eat with caution.

• **Raw produce**, especially that which grows on the ground, such as melons. In fact, melons are specifically mentioned in the FDA *Food Code* as a potentially hazardous food. In addition, sprouts, parsley and cilantro are often cited in foodborne illness cases — sprouts are statistically more likely to be a source of *E.Coli* than ground beef! Parsley and cilantro owe their problem status to the fact that they grow low to the ground and have curly leaves which are hard to clean. The 2007 Supplement to the Food Code now identifies cut tomatoes as a potentially hazardous food. Tomatoes have been implicated in over a dozen foodborne outbreaks since 1990, typically due to *Salmonella*.

• **Foods such as foil-wrapped potatoes**, garlic in oil mixtures and fried onions left on the stove for extended periods of time are a potential source of botulism, which grows in environments that lack oxygen. The oil in the garlic and oil mixtures and the fried onions provide the anaerobic environment; the foil wrapping the potatoes does the same.

Each of these mixtures must be allowed to sit in danger zone temperatures for several hours to pose a problem. Often, leftover potatoes are left on the counter all night, then unwrapped and used in potato salad, a common restaurant practice; we've all seen the grill piled with heaps of cooked onions. (Good news: commercially prepared chopped garlic in oil contains a preservative to prevent the growth of botulism.)

The most commonly cited poor handling practice that results in foodborne illness is improper cooling of hot foods. When mom said: 'Leave the food out to cool before you put it in the fridge" she was exactly wrong! I remember having Thanksgiving dinner with a friend. There was quite a bit of food left over. As we cleaned up, I asked her how she was going to store the leftovers. "We'll leave them on the counter until we eat them. My Mama used to just cover them with a sheet to keep the flies off. Sometimes it took days for us to eat them all." Wow!

According to the FDA *Food Code*, hot food must be cooled to reach a temperature of 70 degrees F. within two hours and 41 degrees within an additional four hours. This simply doesn't happen without effort.

First, hot food must be placed in a cool pan. The depth of the food should be no more than 4 inches, 2 inches for thick foods such as gravy or thick soups. Cover loosely and place directly in the refrigerator. Sometimes, it is necessary to place the food in the freezer for a couple of hours to speed the cooling process. Once the food has reached 41 degrees, cover tightly and mark the container with the date prepared.

If a large piece of meat or poultry is to be cooled, it should be cut into smaller portions to speed the cooling process. Meals prepared at home for large number of people pose a challenge – there rarely is enough equipment to handle large amounts of food properly.

The second most commonly cited problem is, not surprisingly, handwashing or the lack thereof. It's not just poor restroom hygiene that creates problems; our hands are everywhere: on raw food, on our noses, on the phone, petting the dog. It is simply impossible to keep our hands clean at all times. The best approach is to *never* touch ready-to-eat food with hands that have not just been washed. In fact, almost all food contamination concerns deal with ready-to-eat foods, not those that are to be cooked before consumption. The reason is simple: high temperature is the best defense in killing pathogens.

Hands can be the culprit in the third cause of foodborne illness: cross contamination. Cross contamination is the spread of contamination from raw to ready-to-eat food. The opportunities are endless:

- opening a package of chicken and then preparing sandwiches;
- cutting salad vegetables on the same cutting board used to cut raw meat;
- thawing raw protein in a container that drips on food below;
- using a utensil to "dot" margarine on raw fish – repeatedly;
- using hands to break up raw ground meat in the frying pan, then picking up the spatula;
- pouring marinade used on raw meat over cooked product.
- taking steaks to the grill and then using the same platter for the cooked meat; and
- mixing a raw egg product in a blender and then mixing a smoothie to drink.

We are all guilty of some risky behavior, some of the time. A little conscientious attention to cross contamination can prevent problems.

An executive of a large fast food chain once observed, "It all boils down to three things: time/temperature control, handwashing and cross contamination. The rest are frilly rules."

I agree. Be aware of the length of time that potentially hazardous foods are exposed to the temperature danger zone, wash hands thoroughly and often, and avoid the contamination of raw to ready-to-eat food. Most risk will be eliminated, and that may be enough.

Is foodborne illness a greater threat to us today than it was 25 years ago? Yes. Do we know a great deal more about this subject now than we knew 25 years ago? Yes. Our challenge is to apply the knowledge that we know. As food safety professionals, we must be vigilant in our efforts to observe what workers do and educate them in procedures that will protect our target populations. At home, we must continue our efforts, as it is far more likely that we will relax as we enter this supposedly non-threatening environment. Foodborne illness will always be with us. We will rise to the challenge.

References

Allen A. "Hidden Threat: Foodnorne Illness." San Diego *Union Tribune* p. A1. October 5, 1997.

Center for Disease Control, Division of Bacterial and Mycotic Diseases, "Campylobacter Infections." http://www.cdc.gov/ncidod/dbmd/diseaseinfo/campylobacter_g.htm#Are%20there%20long-term%20consequences Accessed November 21, 2005.

Food Safety Notebook, June, 1996.

Hennessy T, *et al.* A National Outbreak of Salmonella Enteritidis Infection From Ice Cream. *New England Journal of Medicine*, 334(20):1281-1286, 1996.

Mad Cow Disease and Variant Creutzfeldt-Jakob Disease.
http://www.emedicinehealth.com/articles/40435-1.asp Accessed November 21, 2005.

Mad Cow Disease.
http://www2.lifespan.org/Services/Infectious/Diseases/mad_cow.htm Accessed November 21, 2005

McCarthy M. *E.coli 0157:H7* Outbreak in USA Taced to Apple Juice. *Lancet*, 348(9037):1299, 1996.

MMWR Weekly, April 19, 2002. Preliminary FoodNet Data on the Incidence of Foodborne Illnesses — Selected Sites, United States, 2001. *MMWR Weekly,* April 19, 2002 / 51(15);325-9
http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5115a3.htm Accessed November 25, 2005.

Reed G, *et al.* Foodborne Illness (Part 2). *Dairy, Food and Environmental Sanitation,* 13(12):706, 1993.

Simon P, *et al.* Impact of restaurant hygiene grade cards on Foodborne-Disease hospitalizations in Los Angeles County.
http://www.stanford.edu/~pleslie/hospitalizations.pdf Accessed November 25, 2005.

Sobel J. Threat of Biological Terroirist Attack on the US Food Supply: The CDC Perspective, *Lancet* 2002: 359:874-80.

Soderholm S. A Beginners Guide to Prions.
http://www.geocities.com/CapeCanaveral/Lab/6275/index.html

US Food and Drug Administration (USFDA) Risk Assessment for Food Terrorism and Other Food Safety Concerns, October 13, 2003.

Weese J. Is Foodborne Illness on the Rise? Alabama Cooperative Extension System Newsline. Alabama Cooperative Extension System food scientist, (334-844-3269.)
http://www.aces.edu/dept/extcomm/newspaper/april6a01.html Accessed November 25, 2005.

World Health Organization (WHO), Food Safety Department, FOOD SAFETY ISSUES: Terrorist Threats to Food, guidance for Estalishing and Strengthening Prevention and Response Systems (2002), p.5

Examination for PFI08

1. The primary symptoms of foodborne illness are:
   a. Headache and nerve pain
   b. Vomiting and diarrhea
   c. Hives and nausea
   d. Joint pain and muscle weakness

2. An example of an emerging pathogen is:
   a. *Salmonella enteritidis*
   b. Hepatitis E
   c. Avian bacteria
   d. *Shigella*

3. A frequent cause of foodborne illness is:
   a. A broken water line
   b. Improper handwashing
   c. Overcooking
   d. Buying food from an unapproved source

4. Higher standards are required when serving highly susceptible populations. An example of a highly susceptible population group would be:
   a. The very poor
   b. Someone with AIDS
   c. Those who don't know the source of their food
   d. A person not knowledgeable in food safety

5. According to the 2003 *Food Code*, it is mandatory that a highly susceptible population group NOT receive:
   a. Unpasteurized apple juice
   b. Scrambled eggs
   c. Ham sandwiches
   d. Chopped garlic

6. Bioterrorism:
   a. Is a threat that potentially affects everyone
   b. Is mandated by the Federal Government
   c. Is a major threat for day care centers
   d. Targets meat and poultry producers

7. The onset time for Hepatitis A is:
   a. 12 hours
   b. 2 days
   c. 7 days
   d. 30-50 days

8. Staphyloccus aureus is most commonly associated with:
- a. Poultry
- b. Cold foods
- c. Sick people
- d. Improper handwashing

9. Prions are:
- a. The suggested source of Mad Cow disease
- b. Contaminated shellfish
- c. Naturally occurring contaminants associated with fish
- d. Fruits imported from other countries

10. An examples of cross contamination includes:
- a. Food dripping on other food
- b. Poor freezer control
- c. Food held at temperatures above 41 degrees F
- d. Contamination spreading from one species to another

Continuing Education credit

is available for this module for the following professions:

Registered Dietitians/Dietetic Technicians: 2 CPEUs
Certified Dietary Managers: 2 Clock Hours
Certified Health Education Specialists: 2 CEUs

To earn credit, you must complete the examination on the preceding pages, by purchasing access to our Interactive OnLine Testing System at:
http://www.nutritiondimension.com/

Begin by writing down your answer choices, then visit our website:
http://www.nutritiondimension.com/

Click on: Course Catalog
Click on: Nutrition Professionals or Certified Health Educators
Click on: EDnow! Modules
Click on: Order number for this module: PFI08

You will be prompted to submit personal and professional certification information, your credit card number and the Order number for this module. You will then gain an access code to complete the exam for this module.

If you have not used our online testing system before, we recommend that you review the process first by clicking on Interactive OnLine Testing, and that you schedule your first testing session during our office hours (M-F, 7:30 am - 4:30 pm, PT), so that you can call for assistance while on-line, if necessary.

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