United States Army Food Safety and Sanitation Certification Course

US Army Center for Health Promotion and Preventive Medicine
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CHAPTER 1 - INTRODUCTION

Fundamentals of Food Safety and Protection

Throughout history the preservation, safety and protection of food has been of paramount concern for Commanders of military armies. Scurvy and hunger had disabled more of Napoleon's soldiers than combat itself. During the Civil War, combat lines moved at such an accelerated pace away from stockpile locations, that an urgent need for food that could be preserved for long periods of time and transported over great distances was created. Past experience and statistics have shown that during wartime, disease and non-battle injuries (DNBI) account for nearly 80% of all casualties. Foodborne illness outbreaks have plagued military operations throughout history in every environment, combat and training, field and garrison. Though most cases are not fatal, they temporarily reduce an individual's ability to fight off other diseases, and can impair a unit's ability to continue fighting or supporting a mission.

Commanders and food service workers are charged with the responsibility of providing safe food to their soldiers. This is achieved by preventing the contamination of subsistence and by reducing the effects of contamination that has already occurred. To prevent foodborne illnesses, managers need to maintain control over food, people, equipment, and facilities.

History of Food Protection/Preservation

In the late 1600's, microscope inventor Antonie Van Leeuwenhoek reported seeing "animalcules" through his new apparatus. However, almost 200 years went by before the connection of microorganisms and food poisoning and other diseases was made. As such, many different forms of food preservation have been used over the years.

Ice & Refrigeration

In prehistoric times, man found that his food would last longer if kept in cool environments or packed in snow. This allowed for storage and the ability to use food at a later time when hunting or gathering was not very successful. Eventually, ice was harvested in the winter from large bodies of water to keep foods cool during the warmer months. With societal industrialization and mechanization the pure mechanical manufacturing of ice from water is common. Even today, ice is still manufactured for food preservation.

Chemicals were also used to chill some foods. For example, chemicals like sodium nitrate or potassium nitrate were added to water causing the temperature to fall. This method was used to cool wine in the 1500's. The evolution to mechanical cooling, a compressor with refrigerant, was finally introduced in the late 1800's.

Refrigeration technology continues to evolve. In 1996, there was a change made in the type of refrigerant used to comply with the Clean Air Act. The old refrigerant (freon) was replaced with HFC 134a, determined to be less injurious to the Earth's ozone layer and just as effective in keeping food cold.

The main and obvious effect of refrigeration is retarding bacterial growth. Bacteria are ubiquitous in nature. They are in the soil, air, water, and the foods we eat. When they have nutrients, moisture, and a conducive environment (pH and temperatures), they can multiply rapidly (exponentially). Bacteria grow most rapidly in the range of temperatures between 40 and 140 °F, some doubling in number in as little as 10 minutes. A properly functioning refrigerator set at 34-38 °F will adequately protect foods.

Heat

Louis Pasteur's viewing of microorganisms led not only to his understanding of their ability to cause disease, but also to the development of processing to control pathogenic bacteria. The best known of Pasteur's methods is pasteurization, which is designed to destroy all pathogens that can be transmitted through milk to humans. Pasteurization originally involved keeping a large, finite volume of milk in large tanks at approximately 42 degrees Celsius (161 degrees Fahrenheit) for about 30 minutes. This is called batch pasteurization. A newer way of accomplishing the same effect is the high temperature-short time method, or abbreviated HTST – has the same lethal effect, but the fluid is continuously flowing, and controlled by time, temperature and pressure. HTST pasteurization is widely used in the food industry, not only to semisterilize liquids, but also to inhibit enzyme action in beverages, such as orange juice, that can cause the beverages to deteriorate.

As previously mentioned, food preservation for armies, especially those with lengthy supply lines were a significant problem. The basis for what would become the canning industry resulted from Napoleon's offer of a prize for a means of preserving food for his armies. The winner was Nicolas Appert, who preserved foods by placing them in glass containers, heating them and then sealing the containers. Shortly afterwards, a British patent for canning with tin-coated steel cans was awarded to Peter Durand, but the solder was eventually proven to cause lead poisoning. The invention and design of the double-fold can seal has enabled commercial canners to eliminate this hazard.

Modern commercial canning techniques are specifically designed to kill the anaerobic sporeforming organism *Clostridium botulinum*, the bacteria responsible for causing botulism. Cases of food poisoning from commercially canned goods are rare and usually involve unique or unusual products. Growth of *Clostridium botulinum* results from incomplete sterilization of alkaline foods, such as green beans, potatoes, and sweet corn. (Home canning alkaline foods in tomato juice, which is acidic, is safer than canning them in water.) Raw chopped garlic cloves in olive oil, for example, can harbor *C. botulinum* because the oil can create an environment void of free oxygen. Spores on the garlic germinate in the oil and manufacture toxin. Most cases of botulism are from consuming these types of home-canned foods.

U.S Food and Drug Law History

From the beginnings of civilization people have been concerned about the quality and safety of foods and medicines. In 1202, King John of England proclaimed the first English food law, the Assize of Bread, which prohibited adulteration of bread with such ingredients as ground peas or beans. Regulation of food in the United States dates from early colonial times. Federal controls over the drug supply began with inspection of imported drugs in 1848. The following chronology describes some of the milestones in the history of food and drug regulation in the United States.

In 1862, President Lincoln appointed Charles Wetherill, to serve in the new Department of Agriculture. This was the beginning of the Bureau of Chemistry, the predecessor of the Food and Drug Administration. In 1880, Peter Collier, chief chemist, U.S. Department of Agriculture, who, developed extensive experience in food adulteration investigations, recommends passage of a national food and drug law. It wasn't until 1906 however, until the original Food and Drug Act is passed by Congress and signed by President Theodore Roosevelt. This legislation prohibited interstate commerce in misbranded and adulterated foods, drinks and drugs. The Meat Inspection Act was passed the same day. A book written by Upton Sinclair called *The Jungle* revealed the shocking insanitary conditions in meat-packing plants. The widespread use of poisonous preservatives and dyes in foods, and cure-all claims for worthless and dangerous patent medicines were also major problems leading to the enactment of these laws.

In 1913, the first labeling law, the Gould Amendment was passed. This required that food package contents be "plainly and conspicuously marked on the outside of the package in terms of weight, measure, or numerical count."

The name of the Food, Drug, and Insecticide Administration was shortened to Food and Drug Administration (FDA) under an agricultural appropriations act in 1930. Eight years later, the Federal, Food, Drug, and Cosmetic (FDC) Act was passed by Congress. This authorized factory inspections, authorized standards of identity and quality for foods, and provided that safe tolerances be set for unavoidable poisonous substances. In 1939 the first of these authorized standards were issued for canned tomatoes, tomato puree, and tomato paste.

In 1958, manufacturers of new food additives were required to establish their safety by the enacting of the Food Additives Amendment. A key portion of this amendment, the Delaney proviso, also prohibited the approval of any food additive shown to induce cancer in humans or animals. Also in 1958, the FDA published in the Federal Register the first list of Substances Generally Recognized As Safe (GRAS**)**. Two years later, the Color Additive Amendment was enacted, requiring manufacturers to establish the safety of color additives in foods, drugs and cosmetics. The Delaney proviso again prohibited the approval of any color additive shown to induce cancer in humans or animals. Sanitation programs for milk, shellfish, food service, and interstate travel facilities, and for preventing poisoning and accidents were taken over from other units of the Public Health Service by the FDA in 1969. President Nixon also ordered FDA to review its GRAS list, because of controversy over the FDA's ban of cyclamate.

After several outbreaks of botulism from canned foods, the Low-Acid Food Processing regulations were issued in 1973 to ensure that low-acid packaged foods have adequate heat treatment and are not hazardous. In 1982, tamper resistant packaging regulations were issued by the FDA to preclude poisonings such as deaths from cyanide placed in Tylenol capsules. The Federal Anti-Tampering Act passed in 1983 mad it a crime to tamper with packaged consumer products. Finally, in 1990, the Nutrition, Labeling, and Education Act required all packaged foods to bear nutrition labeling and all health claims for foods to be consistent with terms defined by the Secretary of Health and Human Services. The law preempted state requirements about food standards, nutrition labeling, and health claims and, for the first time, authorized some health claims for foods. The food ingredient panel, serving sizes, and terms such as "low fat" and "light" were defined and standardized.

These are just a select few points that highlight the evolution of the current food regulatory system as we know it today. Many other pieces of legislation have been passed, and are too numerous to mention here. To put what we've offered here in perspective, many universities have Food Law courses lasting a complete semester!

CHAPTER 2 – IMPORTANCE OF FOOD SAFETY

Food Safety Hazards

Only a small percentage of actual foodborne illness cases ever get reported. The Centers for Disease Control and Prevention conducted a study in 1999, compiling and analyzing information from multiple surveillance systems and medical sources. They concluded that foodborne diseases cause an estimated 76 million illnesses every year in the United States. These illnesses result in approximately 325,000 hospitalizations and 5,000 deaths. An estimated 14 million illnesses and 1,800 deaths are caused by known pathogens: primarily *Salmonella*, *Listeria*, and *Toxoplasma* species. Other or unknown agents account for the remaining 62 million illnesses. Overall, foodborne diseases appear to cause more illnesses but fewer deaths than previously estimated.

Even in the military, documenting the occurrence of foodborne illnesses is a challenge. During peacetime only about ten percent of all foodborne illnesses are reported or properly diagnosed. From the physician side, many cases of foodborne illness are dismissed as the 24-hour flu. Between 1998 and 1999, the Army had documented over 800 cases involving food or waterborne diseases.

The impact of a foodborne illness outbreak within a unit can be very devastating. In 1998 a foodborne outbreak occurred in Saudi Arabia from an Army dining facility supporting operations. One hundred and ten soldiers were hospitalized for at least 24 hours as they suffered from abdominal pain, fever, vomiting, and severe diarrhea. Forty percent came from a single infantry unit. Had this occurred during Desert Storm, Operation Just Cause in Panama, or Somalia, the readiness of the unit would have been significantly impaired and could have resulted in mission failure.

Why Is Sanitation Important?

Modern processing methods and excessive food handling increase the opportunity for contamination to take place. Fast food restaurants are classic examples, serving a large number of customers. The additional processing steps and longer lines of supply have increased the risk of hazards that can cause contamination. For example, a frozen food product that is in good condition when it leaves the manufacturer's plant may be damaged by thawing in the railroad car or truck that carries it to the wholesalers and again, in the delivery truck that carries it to the food service operator. The same potential exists in our dining facilities and field feeding operations.

Sanitation is one of the most cost-effective means available to the military for preventing disease and improving soldiers' well-being. As food service managers and leaders, we must practice sanitation and food safety for the following reasons:

a) Protect the health of soldiers. Good personal hygiene is a critical measure against foodborne illness. By establishing a systematic approach to training and supervising workers, the responsible manager will help protect the safety of the food served in addition to enhancing the quality of the dining experience.

b) Protect food service workers. The food service manager is obligated to protect customers and workers from individuals who have health problems or personal habits that can affect food safety. It is important to note that a healthy worker with poor personal habits is also very likely to cause food contamination. Today, in commercial food service, consumers are increasingly willing to use the law to seek compensation for products that have caused them harm. This right is reserved under the Uniform Commercial Code (UCC). Even though military patrons are prohibited from filing a claim against their dining facility, the implications of an illness outbreak can impact both soldier and unit readiness, and may result in a systematic decline in the headcount.

c) Legal Obligation. Federal, State, and local governmental agencies set regulations and standards to protect the public from foodborne illness. The U.S. Food and Drug Administration has a model ordnance, the Food Code, to assist health departments in a food service inspection program. The Army uses a similar system, TB MED 530, which provides standards for protection and is enforced by the installation medical authority.

Food Sanitation & Safety Terms

Before we begin our discussion on food safety, there are some common food safety and sanitation terms that we must be familiar with:

(1) **Clean**. Free of visible soil.

(2) **Sanitize**. To reduce the number of microorganisms to a safe level either through heat or chemicals.

(3) **Sterilize**. To make free of microorganisms. In food service we do not sterilize food contact surfaces.

(4) **Contamination**. The presence of harmful substance in food.

(5) **Cross-contamination**. The transfer of a harmful substance from one food to another by direct or indirect contact. (This is a common mistake in army dining facilities from poor work habits.) Direct cross-contamination involves the transfer of a harmful agent from raw foods to cooked or ready-to-eat foods. An example of direct contact: blood from thawing ground beef dripping onto fresh produce stored on a shelf below the beef in the walk-in refrigerator. If the fresh produce is not disinfected (sanitized) prior to use on the salad bar, pathogens from the blood (i.e., E. coli) may be present on the product, resulting in a foodborne illness. Indirect cross-contamination involves the transfer of a harmful agent to foods by hands, utensils, or equipment. An example of indirect contact: raw chicken prepared with a knife and cutting board may have pathogens, such as *Salmonella* or *Campylobacter*, already present on the product. These pathogens are transferred to the knife and cutting board during preparation. If the knife and cutting board are not cleaned and sanitized after use, pathogens may be transferred onto other products (i.e., fresh produce for salad bar), resulting in a foodborne illness.

(6) **Spoilage**. Damage to the edible quality of a food. Food that is unsafe to eat will not always smell or taste spoiled, however.

(7) **Potentially Hazardous Foods (PHF's)**. Foods that allow the rapid growth of bacteria. There are several physical and environmental characteristics that will make a food potentially hazardous. These characteristics are discussed quite extensively later in this book.

(8) **Temperature Danger Zone**. Temperature range where bacteria can grow and reproduce rapidly (between 40 and 140 degrees F, or between 5 and 60 degrees C.) Potentially hazardous foods should be kept at temperatures below 40 ^{o}F or above 140 ^{o}F.

(9) **Foodborne Illness**. Illness transmitted to humans due to the ingestion of food that contains harmful pathogens or their byproducts (toxins).

(10) **Foodborne Illness Outbreaks (FBIOs)**. Generally, we think of a foodborne illness outbreak as involving 20, 50, or even hundreds of individuals. In reality, an outbreak is defined as the laboratory confirmed incidence of clinical illness involving two or more people that ate a common food.

Analyzing the Cause of Foodborne Illnesses

In order to prevent foodborne illnesses from occurring, we must understand the contributing factors and the nature of foodborne diseases. The factors that are most responsible for causing foodborne illness fall into three general groups: <u>food, people, and facilities.</u>

The Role of Food

Not all food is safe when it arrives at the facility. The food service manager must work with reputable suppliers approved by the Veterinary Activity, or other recognized regulatory agency (when required), and implement strict receiving procedures to help ensure safe food. Once it arrives, the food must be clean, uncontaminated, unspoiled and in the proper state of refrigeration.

The Role of People

People pose the major risk to safe food due to communicable or intestinal diseases, open sores, or poor personal hygiene and work habits. A manager has to overcome the problem with unsanitary customers. Nevertheless, the role of food service workers must include being healthy, being well-trained, practicing good hygiene habits, as well as being motivated. This involves good supervision reinforced with continuous training.

The Role of Facilities

Eliminating hard-to-clean work areas, faulty or overloaded refrigerators or other equipment, dirty surroundings, poor housekeeping, and conditions attractive to pest infestation make up the third focus of our analysis. Foodservice facilities should be well designed, well constructed, and constructed using proper materials.

Factors that Contribute to Foodborne Disease

The Centers for Disease Control and Prevention conducted a study to determine what causes a foodborne illness. They found that not one but many factors were traced to food handlers. The eight leading causes were identified as:

1) Cross-contamination between raw and cooked and/or ready-to-eat foods. It generally results from poor personal hygiene (worker's hands), or from using unsanitized equipment.

2) Inadequate re-heating of potentially hazardous foods. All leftovers intended to be served hot must be re-heated to 165 ^{o}F within a 2-hour period.

3) Foods left in the temperature danger zone (TDZ) too long. Time in the TDZ is cumulative. After 4 hours the potentially hazardous foods must be discarded.

4) Raw, contaminated ingredients used without further cooking. Examples of this are sliced melons, salad vegetables, and raw eggs used in sauces and salad dressings.

5) Foods prepared too far in advance. This is generally coupled with holding food in the TDZ too long.

6) Infected food handlers and poor work habits. Between September 1998 and May 2000, there were two confirmed foodborne illness outbreaks in Army dining facilities attributed to cross-contamination of food by infected employees; At least 200 soldiers were hospitalized.

7) Failure to properly heat or cook food.

8) Failure to properly cool food is the number one cause of FBIOs in the United States. Poor cooling practices result in potentially hazardous foods held in the TDZ for long periods of time.

Highly Susceptible Populations

Other factors that contribute to the onset of a foodborne illness are the individuals' susceptibility. Human resistance to disease and illness depends on many factors: age, weight, current state of health, medications, stress, and fatigue. Infants and young children are more susceptible because they do not have a fully developed immune system. Pregnant women are also more susceptible because of the chemical and physiological changes occurring in their bodies. Foodborne pathogens and toxins may have adverse effects on the unborn fetus as well as the mother. Elderly people may have a depressed immune system due to chronic illness, medications, or simply as a result of the aging process. Their bodies are not as resistant to new infections as younger individuals, and they are less resilient in their recovery when exposed to foodborne toxins.

Medications, such as antibiotics, antacids, and immuno-suppressive drugs, reduce the body's ability to fight off new infections. Individuals taking medications are already sick or injured and their immune system is weakened in its fight to recover.

Service members are classified as highly susceptible when they are deployed or participating in extended field training exercises. Physical and emotional stress weakens the immune system, as does fatigue. These situations can be further aggravated by soldiers taking medications and/or exposed to exotic diseases or extreme environmental conditions.

Food Safety Responsibilities

Ensuring safe food is not the sole responsibility of the food service worker. TB MED 530 outlines the responsibilities and duties of leaders and support elements, as well as food service mangers and workers. The Installation Commander maintains the sanitary control of all food and beverages served or dispensed on the installation. This includes fixed food service facilities, mobile, and vending operations. The commander ensures that the construction, alteration, or modification of food service facilities are accomplished only after the plans have been reviewed and approved by the installation medical authority (IMA). The commander also ensures that all food service personnel are adequately trained and have been medically cleared to handle and serve food.

The IMA, or Preventive Medicine Service, advises the commander on the food sanitation and food safety implications of military operations. Preventive Medicine conducts official food safety inspections; provides medical examination of food service personnel; provides technical guidance and assistance for sanitation training of non-supervisory personnel; establishes a formal training program for certification of supervisory food service personnel; participates in an integrated pest management program and recommends non-chemical controls; and conducts epidemiological investigations of suspected foodborne illness outbreaks.

Similar to the duties of Preventive Medicine, the Veterinary Activity conducts necessary sanitation inspections in accordance with (IAW) AR 40-657 for food procurement, processing, storage, shipment, receipt, and distribution. Veterinary personnel also investigate reports of food infested, adulterated, or damaged by pests.

The Installation Food Advisor (IFA) ensures that food service contracts include requirements for the contractor person-in-charge, food employees, and kitchen police to receive required sanitation training. The IFA assists the Contract Officer Representative (COR) in coordination with the IMA in developing food sanitation and safety standards and evaluating contractor performance of food service sanitation and safety requirements. The IFA also provides the IMA with distribution and dissemination instructions for inspection reports and evaluation of contract food operations.

The food service facility manager is responsible for providing safe food under clean and sanitary conditions. Managers must be able to demonstrate their knowledge of foodborne disease prevention and the application of food risk management principles (HACCP). Managers must ensure all food service personnel are trained in the principles of food service sanitation IAW TB MED 530 and supervise and enforce employee personal hygiene practices. They must also retain a copy of TB MED 530 in the facility, for reference.

The person-in-charge may be a shift leader or intermediate supervisor subordinate to the dining facility manager. The new TB MED 530 requires the person-in-charge to be knowledgeable in foodborne diseases and their prevention. It is generally the responsibility of the person-in-charge to ensure that the standards of TB MED 530 are achieved. The person-in-charge closely supervises all food service workers to observe hygiene, food handling, and sanitation practices.

In coordination with the Preventive Medicine Activity, the Department of Public Works (DPW, also referred to as the facility engineers) is responsible for pesticide application when non-chemical measures have failed. Applying chemical controls is the responsibility of ONLY trained, certified pest management personnel. TB MED 530 strictly prohibits food service personnel from applying pesticides in food preparation or service areas. DPW is also the agent responsible for executing work orders for structural deficiencies in the food service facility.

Recognizing the Threat

Now that we have discussed the factors that contribute to foodborne illnesses, we will now take a closer look and the agents in food that can lead to illness or injury. Most foodborne outbreaks result from poor sanitation, worker hygiene, and food handling practices. There are three categories of hazards that are responsible for causing foodborne illnesses and/or injuries:

1) <u>Biological Hazards.</u> Of the three categories, biological hazards present the most significant threat, accounting for at least two thirds of foodborne illnesses. Biological hazards are discussed in greater detail in Chapter's 8 and 9.

2) <u>Chemical Hazards.</u> Chemical hazards involve intoxication due to chemical contamination of food. These chemicals are often in the form of residues on food or food contact surfaces. Pesticides and metal residues are the primary hazards in this category, however, other chemicals, such as cleaning compounds or camouflage paint can also present a chemical hazard to food.

Metal residues produce a toxic effect in minute quantities. Foods can become contaminated by using the wrong equipment in the dining facility. For example, if a galvanized container is used to prepare or store acidic foods, such as orange juice, lemon aid, or tomato sauce, a chemical reaction can occur, causing the zinc to leach out of the metal coating and contaminate the product. Lead-based flatware and crystal can present a similar problem. People have also become sick by using refrigerator shelves, containing cadmium, as barbecue grills. When we prepare foods, we must use only equipment designed for that use.

Residues from detergents, cleaning solutions, or concentrated sanitizers may also present itself as a problem. Managers must ensure that food service personnel use only chemicals approved by the Environmental Protection Agency (EPA) for food service. Also, all chemicals should be used IAW the manufacturers' label and proper procedures must be followed for handling and storage.

Chemicals can get into our foods by misusing pesticides either on the farm or in our facility. One example of this is using a pesticide spray in food preparation areas. Food service workers are prohibited by TB MED 530 to apply pesticides in food storage, preparation, or service areas. The best control measures to reduce the potential of pesticide residue intoxication are to purchase food only from veterinary approved sources and to wash all fresh fruits and vegetables regardless of their source.

3) <u>Physical Hazards.</u> Physical hazards involve injuries caused by chewing or ingesting foreign objects in food. Although physical hazards are serious to the individual affected, they are not as significant as biological hazards. Unlike bacteria, the threat of a physical hazard impacts fewer people because it does not multiply or spread on its own. Some examples of physical hazards include metal shavings that can get into food by using a worn can-opener.

Other metal objects, such as magnets, packing staples, tacks, and pins, can accidentally fall into food. Glass can get into ice if we use a drinking glass as an ice scoop. Unprotected light bulbs can also present a problem if the bulb is shattered. Particulates such as hair, fingernails, and sputum do not cause physical injury when consumed, however, they do transport biological contaminants and are considered physical hazards. Wood, stones, bones or any other foreign matter are also physical hazards that can be found in food. The accidental swallowing of un-frilled and frilled toothpicks has occurred when eating meatballs or sandwiches. Good facilities planning and the training of personnel in safe operating procedures can reduce many of these physical hazards.

Allergens

In the past, food additives were listed as a chemical hazard to food. Today, however, the Food and Drug Administration classifies food additives as allergens. Food additives, such as monosodium glutamate (MSG), nitrates, and sulfating agents, are used as flavor enhancers or food preservatives. They are important for us to note because they do cause some people to become ill; therefore, they should be limited in their use. Latex gloves have also been linked to causing significant allergic reactions and illness in some individuals. You can prevent food service workers and consumers from being victims of a glove reaction by using only food-grade disposable plastic gloves instead of latex. It is important to note that the cost of plastic disposable gloves is significantly less than that of latex gloves. Other food-grade gloves, such as disposable vinyl and nitrile, are available as an alternative to latex and offer the same close/snug fit as a latex glove.

Layers of Protection

We can prevent foodborne illness by remembering to enforce the "Layers of Protection." The leading causes of foodborne illness in the Army come from violations in the food safety layers of protection associated with the following; (1) Personal hygiene and work habits; (2) Time and temperature discipline; and (3) Proper cleaning and sanitizing.

Personal Hygiene and Identifying Unsanitary & Unhealthy Personnel

Supervisors must identify unsanitary and unhealthy personnel. Observations made by supervisors at the beginning of the work shift and throughout the day are the only effective means of identifying health risks. Things to look for include cuts or burns on fingers, hands, and arms; oozing sores, pimples, or boils; and significant coughing or sneezing. Workers also have an obligation to disclose their condition to the supervisor if they are experiencing fever, vomiting, or diarrhea.

Health Requirements

TB MED 530 (discussed in Chapter 5) provides a list of communicable diseases that must be disclosed to the supervisor by the worker. Acute gastrointestinal illnesses, such as jaundice, diarrhea, and sore throat with fever, and other diseases transmissible through food, such as Hepatitis A and *Shigella* species, are just a few of the reportable diseases and symptoms. Food service workers that are sick or have had diarrhea must be cleared by the IMA before returning to work. An SOP outlining criteria for sick call, prohibiting personnel from working in food preparation or service areas, and return to food service duties must be established in the food service facility and approved by the IMA. The Preventive Medicine Service can assist food managers in developing this SOP.

Uniform Standards

Uniforms must be clean. Cook whites are generally worn in garrison. An outer smock or apron is optional in garrison, but must be kept clean if worn. BDUs are the standard of dress in field feeding operations and must be kept as clean as possible. This means food service workers in the field should be changing and laundering their BDUs more frequently than other soldiers in the unit.

Hair contains *Staphylococcus* bacteria that can easily be transmitted into food; therefore, hair restraints, such as a hat or hair net must be utilized by all food handlers. For workers who do not have hair on their head, a hat must be worn to prevent perspiration from dripping onto food. Civilian food handlers and soldiers with shaving profiles that have a beard must wear a beard restraint (commonly referred to as a snood.) There are also nets that resemble a sleeve and are designed to restrain the hair on excessively hairy arms.

The only authorized jewelry to be worn by food handlers is a plain, smooth wedding band and when applicable, a medical alert bracelet or necklace. Only supervisors not actively engaged in food preparation may wear a watch. The reason for this standard is food particles containing pathogens can easily be wedged into fine crevices and may not be removed during normal handwashing.

Hygiene Standards

Fingernails for food service workers must not extend beyond the fleshy tip of the finger and must be neatly trimmed and smooth. False fingernails, fingernail adornments, and fingernail polish are not authorized as they may fall into the food, causing a hazard.

Eating and drinking is prohibited in all food preparation areas. The only exception to this policy is during routine recipe sampling as long as an appropriate method, such as the two-utensil method, is used. Also, workers may drink water as long as it is in a completely enclosed container, such as a cup with lid and straw, or a sports bottle, that will prevent the contamination of the worker's hands when drinking.

Handwashing

The CDC states that, "the single most important means of preventing the spread of infection is proper handwashing. The most common source of contamination leading to illness is the fecal-oral route. Hands become contaminated after using the latrine. Infective bacteria and viral contamination is then transferred to the host (human) via contaminated food or utensils.

Disposable, single use gloves must be used when handling ready-to-eat foods. The only alternatives to disposable gloves are handling these foods with utensils or food-grade tissue paper. Hands must be washed between glove changes and gloves must be changed between food tasks. In accordance with TB MED 530, food service workers must wash their hands after taking a break, smoking, using the latrine, applying make-up, between different food handling tasks, before putting on disposable gloves and between glove changes, and any other time the hands potentially become contaminated.

Handwashing Standards

There must be a designated sink in the food preparation area for handwashing. The pot and pan sink and the janitor's sink are not authorized for use as a handwashing sink. Hot and cold running water must be present. The hot water must have a minimum temperature of 110 ^{o}F. Liquid soap is preferred (but not required). A trash receptacle must be present for the disposal of paper towels. Only disposable paper towels or air dryer are authorized for drying hands. Common towels and an individual's apron are not suitable for drying hands. Handwashing procedures require lathering all exposed skin up to mid-forearm for a minimum of 20 seconds. A nailbrush should be used to scrub around the nail bed. After 20 seconds of scrubbing, rinse and dry.

Time & Temperature Discipline

The second layer of protection involves time and temperature controls throughout the flow of food. Bacteria reproduce rapidly when conditions present are ideal. One of those ideal conditions that we are able to control and monitor is temperature. In food service operations we must assume all potentially hazardous foods are contaminated; therefore, we must be disciplined in our time and temperature controls. We can "spot-check" time and temperature at various key stages in the flow of food through the facility. These stages include: receipt, storage, thawing, preparation, cooking, holding, serving, leftover management, cooling, and reheating.

Thermometers. A bi-metallic, stem-type thermometer (i.e., baby-dial or thermocouple) must be used to measure the internal temperature of foods. These thermometers should be calibrated each day, preferably at the beginning of the work shift, to within ± 2 ^{o}F. Digital probe thermometers that do not have a calibration adjustment mechanism must not be used when the calibration verification yields a value more than ± 2 ^{o}F from the required reading.

Equipment Thermometers. Each piece of equipment used for hot or cold food storage and holding, or for cooking should have an indicating thermometer placed inside the unit. These thermometers should be accurate within ± 3 ^{o}F. Thermometers built into the equipment are not always reliable. Thermometers should be placed closest to the door of each unit so as to indicate the warmest reading for cold storage and the coolest reading for hot holding. Unauthorized thermometers include mercury, glass, and zone type.

Time-Temperature Indicators (TTI). Time-Temperature Indicators are used to monitor temperatures during transport or storage of sous vides, modified atmosphere packaged, cook-chill foods, and operational field rations (i.e., MREs).

Calibrating Thermometers

Probe thermometers can be calibrated using either the ice-water or boiling point methods. The ice-water method is the most common and can be achieved by filling an insulated cup or container to the top with ice, then adding water to the rim. The top of the container should then be sealed with plastic wrap. Press the probe thermometers through the plastic and into the container until the entire stem is submerged. Wait for a minute or two, until the temperature reading on the dial (or digital display) stabilizes. The thermometer should yield a reading of 32 ± 2 ^{o}F. Thermometers that are above or below this standard must be adjusted. Do not assume that a thermometer off by ± 3 ^{o}F at cold temperatures is off by the same margin of error at hot temperatures – often the margin of error on the upper scale is greater than 10 ^{o}F.

Thawing

Potentially hazardous foods held in cold storage must have an internal product temperature of 40 ^{o}F (4.4°C) or less to significantly retard or reduce bacterial growth. Frozen potentially hazardous foods must be tempered using a process that will either keep the internal product temperature from exceeding 40 ^{o}F or will ultimately raise the temperature to adequately kill existing pathogens. These are the only three approved methods for thawing potentially hazardous foods:

(1) In a refrigeration unit set at an ambient temperature of 38 ^{o}F. This is the most preferred method and requires proper menu planning. The ambient temperature of the refrigeration unit will ensure that the product internal temperature does not rise above 40 ^{o}F. It may take 24 to 72 hours to thaw products using this method, so advanced menu planning is required.

(2) Thawing as part of the conventional cooking process generally involves products that need little or no preparation. These items thaw as they cook. Microwave ovens are also suitable for thawing, but are seldom used in large feeding operations. Items thawed in a microwave must be immediately transferred to a conventional cooking process; there should be no time delay between steps.

(3) The least preferred method, although acceptable, is placing the item under potable running water that is set at 70 ^{o}F or less. This method has several requirements when used:

a. The potentially hazardous foods should be kept in its original wrapper (i.e., plastic) if possible.

b. The frozen item(s) should then be placed in a pan or pot, which is then placed into the sink.

c. Water at 70 ^{o}F or less should be set at a pressure strong enough to agitate loose particles as it flows over the product.

d. There should be a constant turnover of water during this process. Placing the potentially hazardous food in a pan or pot will allow water to overflow into the sink. When the potentially hazardous food is too large for a pot or pan, it should be placed directly into the sink without allowing the water to pool.

Regardless of the method used, caution should be taken to avoid cross contamination and time in the temperature danger zone should be minimized.

Preparation and Cooking

Time and temperature controls become critical during preparation and cooking because this is the most likely stage that bacteria will have an opportunity to grow or survive. Time in the danger zone is cumulative from the time of receipt to the time of cooking. TB MED 530 allows a maximum of 4 hours in which a potentially hazardous food can be held in the danger zone before it must be discarded. As you will find out in Chapter 7, bacterial growth is rapid once they've become adjusted to their environment, some capable of doubling every 15 to 20 minutes.

Incorporating batch preparation and progressive cooking into your operations will significantly reduce the potential hazard of violating time and temperature standards.

All products containing poultry; stuffed foods, such as stuffed noodle shells and bell peppers; and all leftovers intended to be eaten hot must be cooked to an internal product temperature of 165 ^{o}F and held at that temperature for a minimum of 15 seconds.

Pork roasts/chops; ground beef; and eggs prepared in bulk must be cooked to 155 ^{o}F for 15 seconds. Whole muscle meats, such as beef and lamb; fish and seafood; and made-to-order eggs must be cooked to an internal temperature of 145 ^{o}F for 15 seconds. These are just some examples of the cooking standards. Refer to TB MED 530, paragraph 3-42 for a complete product listing.

Holding and Serving

Several controls must be in place while holding food prior to and during service. Protecting products from contamination is the first consideration. For example, tubing on bulk milk dispensers must be cut so that no more than one inch protrudes from the dispenser. The tube must also be cut diagonally (45-degree angle) to allow excess milk to drip free from the tube between use. Tubing that is too long or not cut properly will allow milk to become trapped in the tube and will subsequently result in bacterial growth since it is not refrigerated. Other examples might include condiments being dispensed using individual packages or approved dispensing units. Items such as salad dressing, mustard, ketchup, and other bulk containers should be wiped down between meals. Ice should be dispensed by food service workers or using an automatic ice dispensing unit. Serving lines and self serve hot or cold bars should be protected using sneeze guards. Items on the serving line protected by a sneeze guard and controlled (served) by food service workers may be retained as leftovers. Self-service items, however, cannot be retained as a leftover or reissued unless it is individually wrapped (i.e., slice of pie or cookies individually wrapped on a plate).

Assuming everything is contaminated when it comes into the facility, time and temperature discipline will help to prevent the growth of bacteria already existing on potentially hazardous foods. Cold potentially hazardous foods must be held at 40 ^{o}F or below and hot (already cooked) potentially hazardous foods must be held at 140 ^{o}F or above.

Thermometers should be used to periodically spot check the internal product temperature of potentially hazardous foods in both hot and cold holding. Verifying equipment temperature settings and calibration will also help to ensure suitable product holding standards can be achieved.

Items in hot holding or on the serving line that fall below the 140 ^{o}F standard should be re-heated to 165 ^{o}F or discarded once a cumulative time of 4 hours in the TDZ has occurred. This corrective action becomes a judgement call for the person-in-charge. Bulk items stored in food warmers found to have an internal food temperature below 140 ^{o}F should be corrected; items on the serving line may not require re-heating if they will be served within the next 30-45 minutes. Deficient items on the serving line must be discarded at the end of the meal. Items that have been re-heated to 165 ^{o}F are considered leftovers and cannot be retained for an additional 24 hours.

Leftovers

Leftovers are defined as any unserved food remaining at the end of the meal period for which it is prepared. Leftovers must be labeled with the item name or description, and the date and time it was removed from service. Only items that were held at safe temperatures, protected from contamination, and served by food service workers may be retained as leftovers. Leftovers may be retained for up to 24 hours if cooled properly and held at 40 ^{o}F or below. Hot leftovers may be retained for up to 5 hours if held at 140 ^{o}F or above. This is often used when there is a short break between meal periods. Hot leftovers must be protected from contamination and must not be allowed to fall below 140 ^{o}F at any time. Although safe by standards, TB MED 530 does not recommend holding hot potentially hazardous foods for more than 5 hours because it will significantly degrade the quality of the food. Leftovers that will be held for 24 hours must be rapidly cooled to prevent any existing spores from becoming vegetative, resulting in more bacterial growth.

Rapid cooling is achieved by reducing bulk products and increasing the surface area of a product. Use 2-inch shallow pans, ice baths, slicing, stirring, blast chillers, or a combination of these methods. Hot items must be cooled from temperatures that are above 140 ^{o}F to 70 ^{o}F within 2 hours, then from 70 ^{o}F to 40 ^{o}F or below within an additional 4 hours. This cooling process must be documented to show the initial time and temperature at the beginning of cooling, the time when the temperature of 70 ^{o}F or below was attained, and the time when 40 ^{o}F or below was achieved. If you fail to reach 70 ^{o}F within 2 hours, you may rapidly re-heat the product to 165 ^{o}F and then try cooling the product again, or you should simply discard the item. Using a combination of methods to reduce product bulk and increase surface area will ensure that the cooling standard can be achieved. All chilled leftovers intended to be served hot must be re-heated to 165 ^{o}F within a 2-hour time period before being offered for service.

Sandwiches

A made-to-order sandwich is one that is prepared based on a consumer's request. Leftovers may be used to prepare made-to-order sandwiches, but these sandwiches cannot be subsequently retained as a leftover if not served. In mass feeding operations, made-to-order sandwiches may be batch prepared no more than 1 hour prior to service and must be disposed of 3 hours after preparation if not consumed.

Pre-Prepared Sandwiches are sandwiches that are being prepared for intended service beyond the current meal period. No leftovers may be used when preparing these sandwiches.

Pre-prepared sandwiches must be rapidly cooled to 40 ^{o}F or below within the prescribed cooling standard.

Hot sandwiches may be held up to 5 hours at 140 ^{o}F. Frozen sandwiches prepared by a food manufacturer may be retained IAW the manufacturers' recommendation/expiration date on the label. Sandwiches that are pre-prepared then frozen in the dining facility must be consumed or discarded within 7 days of its removal from the freezer.

Refrigerated pre-prepared sandwiches purchased from a manufacturer must be consumed IAW the label. Sandwiches pre-prepared in a designated sandwich preparation area may be retained for up to 60 hours if held at 40 ^{o}F or below. (Most dining facilities DO NOT have a designated sandwich preparation area; therefore, these refrigerated sandwiches cannot be held beyond 5 hours).

Pre-Prepared Potentially Hazardous Foods

Pre-prepared potentially hazardous foods are defined as food that is prepared (cooked or raw) in advance for future service beyond a specific meal. These items are cooked or prepared and immediately cooled to 40 ^{o}F or below within the prescribed standard. Pre-prepared potentially hazardous foods must be labeled as "pre-prepared" with the date and time the item was prepared.

The expiration of pre-prepared potentially hazardous foods are as follows:

When frozen in the dining facility, pre-prepared potentially hazardous foods must be consumed within 24 hours from the date of thaw (date removed from freezer).

Manufacturer-processed frozen foods must be consumed within 7 days from the date of preparation. Time is cumulative and only includes the non-frozen period for the product. If the product was frozen immediately upon production and was received frozen by the dining facility, the product may be held for up to 7 days from the date it was removed from the freezer.

Refrigerated ready-to-eat potentially hazardous foods packaged by a food processing plant and dispensed from a bulk open container (i.e, potato salad or pre-prepared tuna salad) must be consumed within 48 hours of container opening. This requirement does not apply to deli-packaged meats.

Cleaning and Sanitizing

All non-food contact surfaces in a dining facility must be cleaned after each meal to maintain proper sanitation control in the facility. Food contact surfaces, such as food service equipment and utensils, must be properly cleaned and sanitized using a three-compartment sink, dishwasher, or clean-in-place method. Sponges, steel wool, wooden handled brushes, and common dishtowels are prohibited for use in Army dining facilities. Reusable wiping cloths may be used only if they are stored in a sanitizing solution.

Manual Cleaning and Sanitizing (3 compartment sink method)

When using the 3-compartment sink for cleaning and sanitizing, each of the compartments must be clean prior to use. The wash sink must contain hot, soapy water that is at least 110°F. Bulk powdered hand dishwashing compound is the recommended soap to be used for manual warewashing. It should be mixed using a concentration of 12 ounces of soap to 20 gallons of water or in accordance with the manufacturers recommendations. Do not use machine dishwashing compound(s) for manual warewashing. The rinse sink must contain hot, clear water that is at least 120 °F. When the water becomes soapy or a grease film develops, the sink must be emptied and refilled with clear hot water. The sanitizing sink can be prepared depending on the method of sanitization (heat or chemical). Regardless of the method used, the water in the sanitizing sink should be clear. If the heat method is used, items must be completely immersed for 30 seconds in water that is at least 171 °F. If chemical methods are used, sanitizers must be used at the proper concentration to effectively kill pathogenic organisms. Commercial Grade Sanitizers should be used in accordance with the manufacturers' instructions on the label.

Chlorine Bleach. Prepare a 100 parts per million (ppm) solution; adjust water temperature to 75 °F; completely immerse items for a minimum of 15 seconds. Spot check the chlorine residual to ensure an adequate sanitizing strength is present. Residuals in excess of 200 ppm require an additional clear rinse of the items being sanitized. To prepare a 100-ppm solution, mix 2 tablespoons of bleach for every 4 gallons of water. For example, if you fill the sink with 20 gallons of water it would take 10 tablespoons of bleach to attain a 100-ppm solution. Ten tablespoons is slightly less than two-thirds of a cup [2/3 cup = 10.67 tablespoons].

Iodine Solution. Concentrations should be between 12.5 and 25 ppm; water temperature should be between 75 and 120 °F; contact time should be at least 30 seconds.

Quaternary Ammonia Compounds. A concentration of 200-ppm should be used with a minimum water temperature of 75°F for a contact time of 30 seconds. Concentrations above 200 ppm require an additional clear water rinse. Clean utensils should be protected from further contamination.

Sanitizing In-Place Equipment and Food Contact Surfaces

When sanitizing food contact surfaces of clean-in-place equipment, the general rule of thumb is to double the recommended sanitizing concentration. For chlorine bleach, however, a 100-ppm solution is adequate. For all other chemicals, a second clear water rinse may be necessary due to possible chemical residuals. Verify maximum concentrations for commercial-grade sanitizers on the manufacturers' labels.

Sanitizers must be used at the proper concentration to effectively kill pathogenic organisms. Spot-check water temperature and pH as they may affect the residual concentration of a sanitizing solution when prepared. Equipment and utensils that have been cleaned and sanitized must be allowed to air dry.

Cleaning Schedules

An SOP and cleaning schedule will ensure sanitation continuity within the food service facility. Reasons for an organized cleaning program include:

(a) Encourages planning by identifying all your facility sanitation resource requirements.

(b) Distributes the workload.

(c) Reduces duplication of effort.
(d) Pinpoints responsibility.
(e) Establishes a basis for inspection.
(f) Provides a training aid. Managers can identify hard to clean areas or equipment and incorporate them into the workers' training program.
(g) Ensures that task will not be overlooked.

Steps in a Cleaning Program

When developing a cleaning program SOP, employ the following steps:

1. Survey your cleaning needs. Evaluate all areas of the facility to include latrines, storage areas, and food preparation areas.
2. Accumulate cleaning materials suitable for each type of surface or equipment being cleaned. Only use chemical approved by the EPA for food service when cleaning food contact surfaces.
3. Devise a cleaning schedule: Who, What, When, and How.
4. Introduce the cleaning program and HAZCOM procedures to all food service workers and assigned kitchen patrol personnel.
5. Supervise all cleaning and sanitizing processes.

CHAPTER 3 – HAZARD ANALYSIS CRITICAL CONTROL POINT SYSTEMS

The HACCP Plan

There are seven principles to establishing a Hazard Analysis Critical Control Point System. They are 1) Conduct a hazard analysis, 2) Determine critical control points (CCPs), 3) Establish critical limits, 4) Establish monitoring procedures, 5) Establish corrective actions, 6) Establish verification procedures, and 7) Establish record-keeping and documentation procedures.

Before a HACCP plan can be initiated, a flow diagram of the operation must be developed. This flow diagram illustrates the flow of a particular item of food (including all ingredients) from the time it's received on the dock, to the point it is consumed by the patron. This flow diagram presents a visual tool with which to aid in identifying hazards associated with the path a particular food item takes. Now you are ready to start preparing the HACCP plan.

Conduct a hazard analysis (Principle 1)

After addressing the preliminary tasks discussed above, the HACCP team conducts a hazard analysis and identifies appropriate control measures. The purpose of the hazard analysis is to develop a list of hazards that are of such significance that they are reasonably likely to cause injury or illness if not effectively controlled. Hazards that are not reasonably likely to occur would not require further consideration within a HACCP plan. It is important to consider in the hazard analysis the ingredients, each step in the process, product storage and distribution, and final preparation and use by the consumer. When conducting a hazard analysis, safety concerns must be differentiated from quality concerns. A hazard is defined as a biological, chemical or physical agent that is reasonably likely to cause illness or injury in the absence of its control. Thus, the word hazard as used in this document is limited to safety.

A thorough hazard analysis is the key to preparing an effective HACCP plan. If the hazard analysis is not done correctly and the hazards warranting control within the HACCP system are not identified, the plan will not be effective regardless of how well it is followed. The hazard analysis and identification of associated control measures accomplish three objectives: Those hazards and associated control measures are identified. The analysis may identify needed modifications to a process or product so that product safety is further assured or improved. The analysis provides a basis for determining CCPs in Principle 2.

The process of conducting a hazard analysis involves two stages. The first, hazard identification, can be regarded as a brain storming session. During this stage, the HACCP team reviews the ingredients used in the product, the activities conducted at each step in the process and the equipment used, the final product and its method of storage and distribution, and the intended use and consumers of the product. Based on this review, the team develops a list of potential biological, chemical or physical hazards that may be present, introduced, increased, or controlled at each step in the production process. Hazard identification focuses on developing a list of potential hazards associated with each process step under direct control of the food operation. A knowledge of any adverse health-related events historically associated with the product will be of value in this exercise.

After the list of potential hazards is assembled, stage two, the hazard evaluation, is conducted. In stage two of the hazard analysis, the HACCP team decides which potential hazards must be addressed in the HACCP plan. During this stage, each potential hazard is evaluated based on the severity of the potential hazard and its likely occurrence. Severity is the seriousness of the consequences of exposure to the hazard. Considerations of severity (e.g., impact of sequelae, and magnitude and duration of illness or injury) can be helpful in understanding the public health impact of the hazard. Consideration of the likely occurrence is usually based upon a combination of experience, epidemiological data, and information in the technical literature. When conducting the hazard evaluation, it is helpful to consider the likelihood of exposure and severity of the potential consequences if the hazard is not properly controlled. In addition, consideration should be given to the effects of short term as well as long-term exposure to the potential hazard. Such considerations do not include common dietary choices that lie outside of HACCP. During the evaluation of each potential hazard, the food, its method of preparation, transportation, storage and persons likely to consume the product should be considered to determine how each of these factors may influence the likely occurrence and severity of the hazard being controlled. The team must consider the influence of likely procedures for food preparation and storage and whether the intended consumers are susceptible to a potential hazard. However, there may be differences of opinion, even among experts, as to the likely occurrence and severity of a hazard. The HACCP team may have to rely upon the opinion of experts who assist in the development of the HACCP plan.

Hazards identified in one operation or facility may not be significant in another operation producing the same or a similar product. For example, due to differences in equipment and/or an effective maintenance program, the probability of metal contamination may be significant in one facility but not in another. A summary of the HACCP team deliberations and the rationale developed during the hazard analysis should be kept for future reference. This information will be useful during future reviews and updates of the hazard analysis and the HACCP plan.

While the process and output of a risk assessment is significantly different from a hazard analysis, the identification of hazards of concern and the hazard evaluation may be facilitated by information from risk assessments. Thus, as risk assessments addressing specific hazards or control factors become available, the HACCP team should take these into consideration.

Upon completion of the hazard analysis, the hazards associated with each step in the production of the food should be listed along with any measure(s) that are used to control the hazard(s). The term control measure is used because not all hazards can be prevented, but virtually all can be controlled. More than one control measure may be required for a specific hazard. On the other hand, more than one hazard may be addressed by a specific control measure (e.g. pasteurization of milk). For example, if a HACCP team were to conduct a hazard analysis for the production of frozen cooked beef patties, enteric pathogens such as*Salmonella* and *Escherichia coli* in the raw meat would be identified as hazards. Cooking is a control measure that can be used to eliminate these hazards. The following is an example of a hazard analysis summary table for this product.

Step	Potential Hazard(s)	Justification	Hazard to be addressed in plan? Yes/No	Control Measure(s)
5. Cooking	Enteric pathogens: e.g., *Salmonella*, verotoxigenic-*E. coli*	enteric pathogens have been associated with outbreaks of foodborne illness from undercooked ground beef	Yes	Cooking

The hazard analysis summary could be presented in several different ways. One format is a table such as the one given above. Another could be a narrative summary of the HACCP team's hazard analysis considerations and a summary table listing only the hazards and associated control measures.

Determine critical control points (CCPs) (Principle 2)

A critical control point is defined as a step, in the flow of food, at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level. The potential hazards that are reasonably likely to cause illness or injury in the absence of their control must be addressed in determining CCPs.

Complete and accurate identification of CCPs is fundamental to controlling food safety hazards. The information developed during the hazard analysis is essential for the HACCP team in identifying which steps in the process are CCPs. One strategy to facilitate the identification of each CCP is the use of a CCP decision tree. Although application of the CCP decision tree can be useful in determining if a particular step is a CCP for a previously identified hazard, it is merely a tool and not a mandatory element of HACCP. A CCP decision tree is not a substitute for expert knowledge.

Critical control points are located at any step where hazards can be prevented, eliminated, or reduced to acceptable levels. Examples of CCPs may include: thermal processing, chilling, testing ingredients for chemical residues, product formulation control, and testing product for metal contaminants. CCPs must be carefully developed and documented. In addition, they must be used only for purposes of product safety. For example, a specified heat process, at a given time and temperature designed to destroy a specific microbiological pathogen, could be a CCP. Likewise, refrigeration of a precooked food to prevent hazardous microorganisms from multiplying, or the adjustment of a food to a pH necessary to prevent toxin formation could also be CCPs. Different facilities preparing similar food items can differ in the hazards identified and the steps which are CCPs. This can be due to differences in each facility's layout, equipment, selection of ingredients, processes employed, etc.

Establish critical limits (Principle 3)

A critical limit is a maximum and/or minimum value to which a biological, chemical or physical parameter must be controlled at a CCP to prevent, eliminate or reduce to an acceptable level the occurrence of a food safety hazard. A critical limit is used to distinguish between safe and unsafe operating conditions at a CCP. Critical limits should not be confused with operational limits which are established for reasons other than food safety.

Each CCP will have one or more control measures to assure that the identified hazards are prevented, eliminated or reduced to acceptable levels. Each control measure has one or more associated critical limits. Critical limits may be based upon factors such as: temperature, time, physical dimensions, humidity, moisture level, water activity (a_w), pH, titratable acidity, salt concentration, available chlorine, viscosity, preservatives, or sensory information such as aroma and visual appearance. Critical limits must be scientifically based. For each CCP, there is at least one criterion for food safety that is to be met. An example of a criterion is a specific lethality of a cooking process such as a 5D reduction in *Salmonella*. The critical limits and criteria for food safety may be derived from sources such as regulatory standards and guidelines, literature surveys, experimental results, and experts. An example is the cooking of beef patties. The process should be designed to ensure the production of a safe product. The hazard analysis for cooked meat patties identified enteric pathogens (e.g., verotoxigenic *E. coli* such as *E. coli* O157:H7, and salmonellae) as significant biological hazards. Furthermore, cooking is the step in the process at which control can be applied to reduce the enteric pathogens to an acceptable level. To ensure that an acceptable level is consistently achieved, accurate information is needed on the probable number of the pathogens in the raw patties, their heat resistance, the factors that influence the heating of the patties, and the area of the patty which heats the slowest.

Collectively, this information forms the scientific basis for the critical limits that are established in TB MED 530. Some of the factors that may affect the thermal destruction of enteric pathogens are listed in the following table. In this example, the HACCP team concluded that a thermal process equivalent to 155° F for 16 seconds would be necessary to assure the safety of this product. To ensure that this time and temperature are attained, the HACCP team for one facility determined that it would be necessary to establish critical limits for the oven temperature and humidity, belt speed (time in oven), patty, initial temperature, patty thickness and composition (e.g., all beef, beef and other ingredients). Control of these factors enables the facility to produce a wide variety of cooked patties, all of which will be processed to a minimum internal temperature of 155° F for 16 seconds. In another facility, the HACCP team may conclude that the best approach is to use the internal patty temperature of 155° F and hold for 16 seconds as critical limits. In this second facility the internal temperature and hold time of the patties are monitored at a frequency to ensure that the critical limits are constantly met as they exit the oven. The example given below applies to the first facility.

Process Step	**CCP**	**Critical Limits**
5. Cooking	YES	Oven temperature:___° F Time; rate of heating and cooling (belt speed in ft/min): ____ft/min Patty thickness: ____in. Patty composition: e.g. all beef Oven humidity: ____% RH

Establish monitoring procedures (Principle 4)

Monitoring is a planned sequence of observations or measurements to assess whether a CCP is under control and to produce an accurate record for future use in verification. Monitoring serves three main purposes. First, monitoring is essential to food safety management in that it facilitates tracking of the operation. If monitoring indicates that there is a trend towards loss of control, then action can be taken to bring the process back into control before a deviation from a critical limit occurs. Second, monitoring is used to determine when there is loss of control and a deviation occurs at a CCP, i.e., exceeding or not meeting a critical limit. When a deviation occurs, an appropriate corrective action must be taken. Third, it provides written documentation for use in verification.

An unsafe food may result if a process is not properly controlled and a deviation occurs. Because of the potentially serious consequences of not meeting a critical limit, monitoring procedures must be effective. Ideally, monitoring should be continuous, which is possible with many types of physical and chemical methods. For example, the temperature and time for the scheduled thermal process of low-acid canned foods is recorded continuously on temperature recording charts. If the temperature falls below the scheduled temperature or the time is insufficient, as recorded on the chart, the product from the retort is retained and the disposition determined as in Principle 5. Likewise, pH measurement may be performed continually in fluids or by testing each batch before processing. There are many ways to monitor critical limits on a continuous or batch basis and record the data on charts. Continuous monitoring is always preferred when feasible. Monitoring equipment must be carefully calibrated for accuracy.

Assignment of the responsibility for monitoring is an important consideration for each CCP. Specific assignments will depend on the number of CCPs and control measures and the complexity of monitoring. Personnel who monitor CCPs are often associated with production (e.g., line supervisors, selected line workers and maintenance personnel) and, as required, quality control personnel. Those individuals must be trained in the monitoring technique for which they are responsible, fully understand the purpose and importance of monitoring, be unbiased in monitoring and reporting, and accurately report the results of monitoring. In addition, employees should be trained in procedures to follow when there is a trend towards loss of control so that adjustments can be made in a timely manner to assure that the process remains under control. The person responsible for monitoring must also immediately report a process or product that does not meet critical limits.

All records and documents associated with CCP monitoring should be dated and signed or initialed in ink by the person doing the monitoring. When it is not possible to monitor a CCP on a continuous basis, it is necessary to establish a monitoring frequency and procedure that will be reliable enough to indicate that the CCP is under control. Statistically designed data collection or sampling systems lend themselves to this purpose.

Most monitoring procedures need to be rapid because they relate to on-line, "real-time" processes and there will not be time for lengthy analytical testing. Examples of monitoring activities include: visual observations and measurement of temperature, time, pH, and moisture level.

Microbiological tests are seldom effective for monitoring due to their time-consuming nature and problems with assuring detection of contaminants. Physical and chemical measurements are often preferred because they are rapid and usually more effective for assuring control of microbiological hazards. For example, the safety of pasteurized milk is based upon measurements of time and temperature of heating rather than testing the heated milk to assure the absence of surviving pathogens.

With certain foods, processes, ingredients, or imports, there may be no alternative to microbiological testing. However, it is important to recognize that a sampling protocol that is adequate to reliably detect low levels of pathogens is seldom possible because of the large number of samples needed. This sampling limitation could result in a false sense of security by those who use an inadequate sampling protocol. In addition, there are technical limitations in many laboratory procedures for detecting and quantifying pathogens and/or their toxins.

Establish corrective actions (Principle 5)

The HACCP system for food safety management is designed to identify health hazards and to establish strategies to prevent, eliminate, or reduce their occurrence. However, ideal circumstances do not always prevail and deviations from established processes may occur. An important purpose of corrective actions is to prevent foods that may be hazardous from reaching consumers. Where there is a deviation from established critical limits, corrective actions are necessary. Therefore, corrective actions should include the following elements: (a) determine and correct the cause of non-compliance; (b) determine the disposition of non-compliant product and (c) record the corrective actions that have been taken. Specific corrective actions should be developed in advance for each CCP and included in the HACCP plan. As a minimum, the HACCP plan should specify what is done when a deviation occurs, who is responsible for implementing the corrective actions, and that a record will be developed and maintained of the actions taken. Individuals who have a thorough understanding of the process, product and HACCP plan should be assigned the responsibility for oversight of corrective actions. As appropriate, experts may be consulted to review the information available and to assist in determining disposition of non-compliant product.

Establish verification procedures (Principle 6)

Verification is defined as those activities, other than monitoring, that determine the validity of the HACCP plan and that the system is operating according to the plan. The NAS (1985) [(2)] pointed out that the major infusion of science in a HACCP system centers on proper identification of the hazards, critical control points, critical limits, and instituting proper verification procedures. These processes should take place during the development and implementation of the HACCP plans and maintenance of the HACCP system. An example of a verification schedule is provided below.

One aspect of verification is evaluating whether the facility's HACCP system is functioning according to the HACCP plan. An effective HACCP system requires little end-product testing, since sufficient validated safeguards are built in early in the process. Therefore, rather than relying on end-product testing, firms should rely on frequent reviews of their HACCP plan, verification that the HACCP plan is being correctly followed, and review of CCP monitoring and corrective action records.

Another important aspect of verification is the initial validation of the HACCP plan to determine that the plan is scientifically and technically sound, that all hazards have been identified and that if the HACCP plan is properly implemented these hazards will be effectively controlled. Information needed to validate the HACCP plan often include (1) expert advice and scientific studies and (2) in-process observations, measurements, and evaluations. For example, validation of the cooking process for beef patties should include the scientific justification of the heating times and temperatures needed to obtain an appropriate destruction of pathogenic microorganisms (i.e., enteric pathogens) and studies to confirm that the conditions of cooking will deliver the required time and temperature to each beef patty.

Subsequent validations are performed and documented by a HACCP team or an independent expert as needed. For example, validations are conducted when there is an unexplained system failure; a significant product, process or packaging change occurs; or new hazards are recognized. In addition, a periodic comprehensive verification of the HACCP system should be conducted by an unbiased, independent authority. Such authorities can be internal or external to the food operation. This should include a technical evaluation of the hazard analysis and each element of the HACCP plan as well as on-site review of all flow diagrams and appropriate records from operation of the plan. A comprehensive verification is independent of other verification procedures and must be performed to ensure that the HACCP plan is resulting in the control of the hazards. If the results of the comprehensive verification identifies deficiencies, the HACCP team modifies the HACCP plan as necessary.

Verification activities are carried out by individuals within a company, third party experts, and regulatory agencies. It is important that individuals doing verification have appropriate technical expertise to perform this function.

Example of a Comprehensive HACCP Verification Schedule

Activity	Frequency	Responsibility	Reviewer
Verification Activities Scheduling	Yearly or Upon HACCP System Change	HACCP Coordinator	Food Service Supervisor
Initial Validation of HACCP Plan	Prior to and During Initial Implementation of Plan	Independent person[a]	HACCP Team
Subsequent validation of HACCP Plan	When Critical Limits Changed, Significant Changes in Process, Equipment Changed, After System Failure, etc.	Independent person[a]	HACCP Team
Verification of CCP Monitoring as Described in the Plan (e.g., monitoring of patty cooking temperature)	According to HACCP Plan (e.g., once per shift)	According to HACCP Plan (e.g., Line Supervisor)	According to HACCP Plan (e.g., Quality Control)
Review of Monitoring, Corrective Action Records to Show Compliance with the Plan	Monthly	Quality Assurance	HACCP Team
Comprehensive HACCP System Verification	Yearly	Independent person[a]	Food Service Supervisor
[a] Done by others than the team writing and implementing the plan. May require additional technical expertise as well as laboratory and plant test studies.			

Establish record-keeping and documentation procedures (Principle 7)

Generally, the records maintained for the HACCP System should include the following:

1. A summary of the hazard analysis, including the rationale for determining hazards and control measures.
2. The HACCP Plan
3. Listing of the HACCP team and assigned responsibilities.
4. Description of the food, its distribution, intended use, and consumer.
5. Verified flow diagram.
6. HACCP Plan Summary Table that includes information for:
    a. Steps in the process that are CCPs
    b. The hazard(s) of concern.
    c. Critical limits
    d. Monitoring*
    e. Corrective actions*
    f. Verification procedures and schedule*
    g. Record-keeping procedures*

* A brief summary of position(s) responsible for performing the activity and the procedures and frequency should be provided

The following is an example of a HACCP plan summary table:

CCP	**Hazards**	**Critical limit(s)**	**Monitoring**	**Corrective Actions**	**Verification**	**Records**

This general information will be put to use more in depth in later chapters. The information presented in Chapter 3 was meant to introduce the general principles of HACCP, and to give the reader the ability to start applying them as they relate to food safety.

CHAPTER 4 – KEEPING FOODS SAFE

Food Preservation and Protection

Successful food preservation often involves combining at least two or more of the six basic methods: dehydration, heating, freezing, fermentation, chemical preservation, or irradiation.

Dehydration (or drying) prevents the rotting of meat, the germination of stored grains, and the sprouting of certain vegetables. It also inhibits the growth of microorganisms, but some of these dormant germs can become dangerous with rehydration of the food. (The Chinese and the Italians really used their noodles when, independently, they invented starchy dried foods with a very long shelf life.)

Heating can increase shelf life by destroying bacteria that cause disease/spoilage. Examples include canning, pasteurization, and cooking. The main point is that a food product must be heated to a specific temperature for a specific period of time. The time-temperature relationship is essential in guaranteeing safe, wholesome food.

Freezing preserves foods by basically stopping bacterial growth, and stopping enzymatic activity. As previously mentioned, ancient peoples living in areas with cold winters would observe that frozen foods remained in good condition (at least to unsophisticated taste buds) almost indefinitely — whereupon humans developed rudimentary cold storage by cooling the recesses of caves and other shelters with ice and snow.

Fermentation is a gradual chemical change caused by the enzymes of some bacteria, molds, and yeasts. Fermented beverages were common in the earliest civilizations of Mesopotamia and Egypt. Wine was a social drink and it was usually more potable than the available water. Winemaking also served as a means of storing nutrients from grapes almost indefinitely. Similarly, Asians turned mare's milk into koumiss — a fermented beverage that keeps much longer than unprocessed milk. Many cheeses with a long shelf life are produced by lactic-acid fermentation. Pickling, also a fermentation and a very early form of food preservation is done by treating foods with vinegar, or some other acid.

Food additives have been used by humans for thousands of years. Today it is hard to understand how precious salt was in ancient times, when it was valued partly as an effective preservative. Salted herring were exported in large quantities from North Sea fishing communities and consumed throughout most parts of Middle Europe.

Irradiation is not a new technology, merely now beginning to be accepted in the food industry to kill pathogenic bacteria and spoilage microorganisms on everyday type foods. In fact, the technology has been used on spices and other foods for almost 50 years now.

These processing methods are employed to utilize current technologies to reduce/eliminate microbial loads on foods. There are other things that are inherent upon food handlers to do to ensure future contamination opportunities are minimized as well. These are summed up in four words: Clean, Separate, Chill, Cook.

Clean: Wash hands and surfaces often

Bacteria can spread throughout the kitchen and get on to cutting boards, knives, sponges and counter tops. Here's how to prevent food contamination from outside sources:

Wash hands in hot soapy water before preparing food and after using the bathroom, changing diapers and handling pets. For best results, use warm water to moisten their hands and then apply soap and rub their hands together for 20 seconds before rinsing thoroughly.

Wash cutting boards, knives, utensils and counter tops in hot soapy water after preparing each food item and before going on to the next one.

Use plastic or other non-porous cutting boards. Cutting boards should be run through the dishwasher - or washed in hot soapy water - after use.

Consider using paper towels to clean up kitchen surfaces. Or, if using cloth towels, consumers should wash them often in the hot cycle of the washing machine.

Separate: Don't cross-contaminate

Cross-contamination is how bacteria spread from one food product to another. This is especially true for raw meat, poultry and seafood. It's imperative to keep these foods and their juices away from ready-to-eat foods. Key principles to preventing cross contamination are:

Keep/handle raw meat, poultry and seafood separate from each other and from other food.

Store raw meat, poultry and seafood on the bottom shelf of the refrigerator so juices don't drip onto other foods.

If possible, use one cutting board for raw meat products and another for salads and other foods that are ready to be eaten.

Always wash cutting boards, knives and other utensils with hot soapy water after they come in contact with raw meat, poultry and seafood.

Never place cooked food on a plate that previously held raw meat, poultry or seafood.

Chill: Refrigerate promptly

Food safety experts advise consumers to refrigerate foods quickly because cold temperatures keep most harmful bacteria from growing and multiplying. It is recommended refrigerators maintain a temperature of 40°F or lower and freezer units maintain a temperature of below 0°F. These temperatures should be checked occasionally with an appliance thermometer. Other steps include:

Refrigerate or freeze perishables, prepared food and leftovers within two hours.

Never defrost (or marinate) food on the kitchen counter at room temperature. Use the refrigerator, cold running water or the microwave.

Divide large amounts of leftovers into small, shallow containers for quick cooling in the refrigerator.

With poultry and other stuffed meats, remove the stuffing and refrigerate it in a separate container.

Cook: Cook to proper temperatures

Food safety experts agree that foods are properly cooked when they are heated for a long enough time and at a high enough temperature to kill the harmful bacteria that cause foodborne illness. To best ensure proper internal temperatures are attained is to:

Use a meat thermometer, which measures the internal temperature of cooked meat and poultry, to verify that the meat is cooked all the way through.

Cook roasts and steaks to at least 145°F. Whole poultry should be cooked to 180°F for doneness.

Cook ground meat, where bacteria can spread during grinding, to at least 160°F. Information from the Centers for Disease Control and Prevention (CDC) links eating undercooked, pink ground beef with a higher risk of illness. If a thermometer is not available, do not eat ground beef that is still pink inside.

Cook eggs until the yolk and white are firm, not runny. Don't use recipes in which eggs remain raw or only partially cooked.

Cook fish until it is opaque and flakes easily with a fork.

Make sure there are no cold spots in food (where bacteria can survive) when cooking in a microwave oven. For best results, cover food, stir and rotate for even cooking. If there is no turntable, rotate the dish by hand once or twice during cooking.

Bring sauces, soups and gravy to a boil when reheating. Heat other leftovers thoroughly to 165°F.

CHAPTER 5 - REQUIREMENTS OF TB MED 530

Food shall be safe, unadulterated and honestly presented. Honestly presented specifically means that food shall be offered for human consumption in a way that does not mislead or misinform the patron or consumer. Food or color additives, colored overwraps, or lights may not be used to misrepresent the true appearance, color, or quality of a food. Raw food or food cooked to less than the required internal temperatures shall not be served to a highly susceptible population.

Food Sources

Food shall be obtained from approved sources that comply with Army Regulation 40-657/NAVSUPINST 4355.4F/MCO P10110.31G. Food in a hermetically sealed container shall be obtained from a food processing plant that is regulated by the appropriate regulatory agency that has jurisdiction over the plant. Food prepared in a private home may not be used or offered for human consumption in a food establishment. This requirement does not apply to private/social functions (such as chapel suppers, family childcare (FCC) homes, neighborhood cookouts, unit bake sales, or similar functions) provided the food is identified as home-prepared food on a sign or label. Packaged food shall be labeled as specified by law. Fish, other than molluscan shellfish, that are intended for consumption in their raw form and allowed as specified (paragraph 3-42c(1) of TB MED 530) may be offered for sale or service if they are obtained from a supplier that freezes the fish properly; or they are frozen on the premises and meet the requirements specified in TB MED 530.

Wild mushroom species picked in the wild shall be obtained from sources where each mushroom is individually inspected and found to be safe by an approved mushroom identification expert. The only exceptions are outlined in TB MED 530. Meats shall be obtained from establishments listed in USDA's Meat and Poultry Inspection Directory. Game animals received for sale or service shall be commercially raised for food. There are very specific requirements spelled out regarding the purchase and consumption of game animals by military food service facilities.

Temperature

Refrigerated potentially hazardous foods shall be at a temperature of 40 degrees Fahrenheit (°F) (4.4°C) or below when received. The only exception to this requirement is if a temperature other than 40 °F (4.4 °C) for a potentially hazardous food is specified in law governing its distribution (such as laws governing milk, molluscan shellfish, and shell eggs), the food may be received at the specified temperature. However, food shall be cooled to 40 °F (4.4 °C) within 4 hours of receiving. Potentially hazardous foods that are cooked to a proper temperature and for a time specified and received hot shall be at a temperature of 140 °F (60 °C) or above. A food that is labeled frozen and shipped frozen by a food processing plant shall be received frozen. Upon receipt, potentially hazardous foods shall be free of evidence of previous temperature abuse.

Additives

Food may not contain unapproved food additives or additives that exceed amounts specified in Title 21 Code of Federal Regulations (CFR), part 170 through 21 CFR 180 relating to food additives (GRAS). Foods may also not contain any prior sanctioned substances that exceed amounts specified in 21 CFR 181, 21 CFR 182, 21 CFR 184, and 21 CFR 186, substances that exceed amounts specified in 9 CFR 318.7, or pesticide residues that exceed provisions specified in 40 CFR 185.

The CFR is a codification of the general and permanent rules published in the *Federal Register* by the Executive departments and agencies of the Federal Government. The CFR is divided into 50 titles that represent broad areas subject to Federal regulation. Each title is divided into chapters that usually bear the name of the issuing agency. Each chapter is further subdivided into parts covering specific regulatory areas. Large parts may be subdivided into subparts. All parts are organized in sections, and most citations to the CFR will be provided to the section level.

Package Integrity

Food packages shall be in good condition and protect the integrity of the contents so that the food is not exposed to adulteration or potential contaminants. Food package defects are classified in 7 CFR 42.

Shellfish/Shellstock Requirements

Raw, shucked shellfish shall be obtained in nonreturnable packages bearing a legible label that identifies the name, address, and certification number of the shucker-packer or repacker of the molluscan shellfish and a "Sell by" date for packages with a capacity of less than 1/2 gallon (1.87 liter (L)) or the date shucked for packages with a capacity of 1/2 gallon (1.87 L) or more.

Because these animals are filter feeders, they concentrate microorganisms from the ocean water in their systems. This can result in an overload of microbes to an individual consumer by ingesting just one shellfish. Therefore, traceability is very important for investigation of foodborne illness outbreaks if one were to occur. Shellstock shall be obtained in containers bearing legible source identification tags or labels that are affixed by the harvester and each dealer that depurates, ships, or reships the shellstock, as specified in the FDA's National Shellfish Sanitation Program Manual of Operations, Part II Sanitation of the Harvesting, Processing, and Distribution of Shellfish.

The harvester's tag or label shall list the following information in the following order:

(a) The harvester's ID number that is assigned by the shellfish control authority.

(b) The date of harvesting.

(c) The most precise identification of the harvest location or aquaculture site that is practicable based on the system of harvest area designations that is in use by the shellfish control authority, including the abbreviation of the name of the state or country in which the shellfish are harvested.

(d) The type and quantity of shellfish.

(e) The following statement in bold, capitalized type:

"THIS TAG IS REQUIRED TO BE ATTACHED UNTIL CONTAINER IS EMPTY OR RETAGGED AND THEREAFTER KEPT ON FILE FOR 90 DAYS."

Each dealer's tag or label shall list the dealer's name and address, and the certification number assigned by the shellfish control authority, the original shipper's certification number, including the abbreviation of the name of the state or country in which the shellfish are harvested, the same information as specified for a harvester's tag.

If a place is provided on the harvester's tag or label for a dealer's name, address, and certification number, the dealer's information shall be listed first.

When received by a food establishment, shellstock will be reasonably free of mud, dead shellfish, and shellfish with broken shells. Dead shellfish/shellstock with badly broken shells shall be discarded. Molluscan shellfish may not be removed from the container in which they are received other than immediately before sale or preparation for service. The only exceptions to this requirement are that (1) shellstock may be removed from the container in which they are received, displayed on drained ice, or held in a display container, and a quantity specified by a consumer may be removed from the display or display container and provided to the consumer if the source of the shellstock on display is identified and recorded as required, and they are protected from contamination; and (2) shucked shellfish may be removed from the container in which they were received and held in a display container from which individual servings are dispensed upon a consumer’s request if the labeling information for the shellfish on display is retained and correlated to the date when, or dates during which, the shellfish are sold or served; and they are protected from contamination.

Shellstock tags shall remain attached to the container in which they are received until the container is empty. The identity of the source of shellstock that are sold or served shall be maintained by retaining shellstock tags or labels for 90 calendar days from the date the container is emptied by using an approved system that keeps the tags or labels in chronological order. Ensure that shellstock from one tagged or labeled container are not commingled with shellstock from another container.

Protection from Contamination after Receiving

Hands

Food employees must properly wash their hands whenever there may have been a chance they may have become contaminated in any way. Except when washing fruits and vegetables food employees may not contact exposed, ready-to-eat food with their bare hands and must use suitable utensils (such as deli tissue, spatulas, tongs, single-use gloves, or dispensing equipment). Food employees shall minimize bare hand and arm contact with exposed food that is not in a ready-to-eat form. The local IMA or designated representative can approve a waiver for food establishments that show proof and demonstrate through their actions that their variance in procedures will not have a negative impact on food safety and will protect public health.

Tasting

A food employee may not use a utensil more than once to taste food that is to be sold or served. A two- utensil method for recipe tasting is appropriate. This is accomplished by using one utensil to remove the food from the container and to place the food in a clean, sanitary bowl or plate. Use a second utensil to taste the food. Discard any unused portion of food that was removed, and clean and sanitize the utensil and bowl or plate.

Preventing Contamination of Packaged and Unpackaged Food

Food shall be protected from cross contamination by separating raw animal foods, during storage, preparation, holding, and display, from raw ready-to-eat food, and cooked ready-to-eat food. Except when combined as ingredients, separating types of raw animal foods (such as beef, fish, lamb, pork) from each other, during storage, preparation, holding, and display by--

(1) Using separate equipment for each type.

(2) Arranging raw potentially hazardous foods by cooking temperature, with those products requiring lower cooking temperatures at the top and those products requiring higher cooking temperatures at the bottom.

(3) Arranging each type of food in equipment so that cross contamination of one type with another is prevented, and preparing each type of food at different times or in separate areas.

(4) Storing ready-to-eat food and cooked foods either in separate refrigeration units or above raw potentially hazardous foods.

(5) Clean and sanitize equipment and utensils as specified in chapter 4 of TB MED 530.

(6) Storing the food in packages, covered containers, or wrappings. This does not apply to whole, uncut, raw fruits and vegetables and nuts in the shell that require peeling or hulling before consumption. It does not apply to primal cuts, quarters, or sides of raw meat or slab bacon that are hung on clean, sanitized hooks or placed on clean, sanitized racks. It also does not apply to whole, uncut, processed meats (such as country hams, and smoked or cured sausages) that are placed on clean, sanitized racks, or food being properly cooled. This also does not apply to shellstock.

(7) Cleaning hermetically sealed containers of food of visible soil before opening.

(8) Protecting food containers that are received packaged together in a case or overwrap from cuts when the case or overwrap is opened.

(9) Storing damaged, spoiled, or recalled food (being held for credit, redemption, disposal, or return) in designated areas that are separated from food, equipment, utensils, linen, and single-service and single-use articles. Identified suspected containers shall be isolated and held for inspection by the veterinary services personnel or the IMA or designated representative.

(10) Separating fruits and vegetables from ready-to-eat food, before they are washed as specified in paragraph 3-20 of TB MED 530.

Food Storage Containers, Identified With Common Name of Food

Working containers holding food or food ingredients that are removed from their original packages (such as cooking oils, flour, herbs, potato flakes, salt, spices, and sugar) for use in the food establishment shall be identified with the common name of the food, except that containers holding food that can be readily and unmistakably recognized, such as dry pasta, need not be identified.

Pasteurized Eggs, Substitute for Raw Shell Eggs for Certain Recipes

Pasteurized eggs or egg products shall be substituted for raw shell eggs in the preparation of foods (such as Caesar salad, hollandaise or béarnaise sauce, mayonnaise, eggnog, ice cream, and egg-fortified beverages) that are not cooked to a high enough temperature for the proper length of time.

Pasteurized Dry Milk, Substitute for Fresh Milk for Certain Recipes

Pasteurized dry milk or reconstituted pasteurized milk products may be used as a substitute for fresh pasteurized milk in instant desserts, milk shakes, and whipped products, or for cooking and baking purposes.

Protection from Unapproved Additives

Food shall be protected from contamination that may result from the addition of unsafe or unapproved food or color additives, or unsafe or unapproved levels of approved food and color additives. A food employee may not apply sulfiting agents to fresh fruits and vegetables intended for raw consumption or to a food considered to be a good source of vitamin B_1.

Washing Fruits and Vegetables

Before being cut, combined with other ingredients, cooked, served, or offered for human consumption in ready-to-eat form, raw fruits and vegetables shall be thoroughly washed in water to remove soil and other contaminants, and completely immersed for 30 seconds in a 5-ppm free available chlorine (FAC) or 100-ppm total chlorine solution, or equivalent product approved by the regulatory authority. Leafy items shall have core/hearts removed prior to immersion to facilitate thorough product exposure to chlorine. Finally, they shall be rinsed in drinking water. The IMA or designated representative can use alternative sanitizing procedures if they are scientifically sound and approved. An acceptable FDA vegetable sanitizing solution can also be used.

Whole, raw fruits and vegetables that are intended for washing by the consumer before consumption and commercially processed and packaged vegetables in a ready-to-eat form need not be washed before they are sold. In emergency feeding situations where fresh fruits and vegetables are grown in areas of “night soil” or sewage used as fertilizer, the IMA or designated representative may allow procurement and consumption if the raw fruits and vegetables are thoroughly washed in drinking water and approved detergent solution followed by a rinse with clean potable water. All leafy vegetables are completely taken apart to expose entire food surface to cleaning and disinfection. After washing the raw fruits and vegetables must be completely immersed in a minimum 200-ppm chlorine solution for 30 minutes or soaked in hot, 160 °F (72 °C) drinking water for 1 minute. (Chlorine solution is prepared by mixing1 ounce of household liquid bleach (National Stock Number (NSN) 6910-00-598-7316, 5 percent sodium hypochlorite) in 2 gallons of cool drinking water. Food Service Disinfectant (NSN 6840-00-810-6396, Chlorine-Iodine Type) is approved for washing and disinfecting fruits and vegetables).

Ice

Ice may not be used as food after use as a medium for cooling the exterior surfaces of food (such as melons or fish), packaged foods (such as canned beverages), or cooling coils and tubes of equipment.

Packaged food may not be stored in direct contact with ice or water if the food is subject to the entry of water because of the nature of its packaging, wrapping, or container or its positioning in the ice or water. Generally, unpackaged food may not be stored in direct contact with undrained ice. Whole, raw fruits or vegetables; cut, raw vegetables (such as celery or carrot sticks or cut potatoes); and tofu may be immersed in ice or water. Raw chicken and raw fish that are received immersed in ice in shipping containers may remain in that condition while in storage awaiting preparation, display, service, or sale.

Ice intended for consumer use shall be dispensed from self-service, automatic ice dispensing machines or placed in cleaned and sanitized self-draining container(s) and self-service dispensers where cleaned and sanitized scoops, tongs, or other ice-dispensing utensils are used. Glassware is prohibited for scooping ice.

Equipment and Utensils

Food may not contact surfaces of equipment and utensils that are not cleaned and sanitized. During pauses in food preparation or dispensing, food preparation and dispensing utensils shall be stored in the food with their handles above the top of the food and the container. In food that is not potentially hazardous, utensils shall be stored with their handles above the top of the food within containers or equipment that can be closed, such as bins of sugar, flour, or cinnamon. Utensils may also be stored on a clean portion of the food preparation table or cooking equipment, and shall be cleaned and sanitized at proper frequencies.

Other methods of storage include in running water of sufficient velocity to flush particulates to the drain if used with moist food, such as ice cream or mashed potatoes, or, in a clean, protected location if the utensils, such as ice scoops, are used only with a food that is not potentially hazardous.

Gloves

If used, single-use gloves shall be used for only one task, such as working with ready-to-eat food or with raw animal food; used for no other purpose; and discarded when damaged or soiled or when interruptions occur in the operation. Slash-resistant gloves that are used to protect the hands during operations requiring cutting shall be used in direct contact only with food, such as frozen food or a primal cut of meat, that will be subsequently cooked. Slash-resistant gloves may be used with ready-to-eat food that shall not be subsequently cooked if the gloves have a smooth, durable, and nonabsorbent outer surface or are covered with a smooth, durable, nonabsorbent glove or a single-use glove.

Cloth gloves may not be used in direct contact with food, such as frozen food or a primal cut of meat, unless the food is subsequently cooked. Cloth gloves shall be washed and sanitized at least daily and shall be changed when there is an interruption in the operation or when they become damaged or soiled.

Using Clean Tableware for Second Portions and Refills

Food employees may not use tableware, including single-service articles, soiled by the consumer to provide second portions or refills. Self-service consumers should not use soiled tableware, including single-service articles, to obtain additional food from the display and serving equipment. However, self-service consumers may reuse cups and glasses if refilling is a contamination-free process. A sign similar to the one shown shall be posted to inform the consumer of this requirement.

Please obtain clean tableware before obtaining additional food

Food Storage

Food shall be protected from contamination by storing the food in a clean, dry location where it is not exposed to splash, dust, or other contamination. It shall be stored at least 6 inches (in) (15 centimeters (cm)) above the floor. Food in packages and working containers may be stored less than 6 in (15 cm) above the floor on certain occasions.

Pressurized beverage containers, cased food in waterproof containers, such as bottles or cans; and milk containers in plastic crates may be stored on a floor that is clean and not exposed to floor moisture (mop water, spills, condensation, etc.) although this practice is not recommended.

Prohibited Food Storage Areas

Food may not be stored in locker rooms, toilet rooms, dressing rooms, or mechanical rooms. Food may also not be stored in rooms used to hold garbage, under sewer lines that are not shielded, under leaking water lines, under open stairwells or under any other sources of contamination.

Potentially hazardous foods dispensed through a vending machine shall be in the package in which it was placed at the food establishment or food processing plant at which it was prepared. During preparation, unpackaged food shall be protected from environmental sources of contamination.

Food Display

Except for nuts in the shell and whole, raw fruits and vegetables that are intended for hulling, peeling, or washing by the consumer before consumption, food on display shall be protected from contamination by the use of packaging; counter, service line, or salad bar food guards (sneeze guards); display cases; or other effective means.

Condiments, Protection

Condiments shall be protected from contamination by being kept in either dispensers that are designed to provide protection; protected food displays provided with the proper utensils, original containers designed for dispensing; or individual packages or portions.

Condiments at a vending machine location shall be in individual packages or provided in dispensers that are filled at an approved location, such as the food establishment that provides food to the vending machine location; a food processing plant that is regulated by the agency that has jurisdiction over the operation, or; a properly equipped facility that is located on the site of the vending machine location.

Condiments may be made available from condiment self-service dispensing equipment at those locations having an on-duty attendant. Use of relish bowls and other similar non-self-closing condiment containers is prohibited.

Consumer Self-Service Operations

Raw, unpackaged animal food (such as beef, lamb, pork, poultry, and fish) may not be offered for consumer self-service. This does not apply to consumer self-service of ready-to-eat foods at buffets or salad bars that serve foods such as sushi or raw shellfish, or ready-to-cook individual portions for immediate cooking on the equipment and consumption, such as consumer-cooked meats or consumer-selected ingredients for Mongolian barbecue.

Consumer self-service operations for ready-to-eat foods shall be provided with suitable utensils or effective dispensing methods that protect the food from contamination. Utensils and food containers may be labeled with the corresponding name of the food.

Food employees trained in safe operating procedures shall monitor consumer self-service operations like buffets and salad bars.

With the exception of carry-out or ala carte operations, customers shall be prohibited from taking any potentially hazardous foods home (doggy bagged) from buffet or other customer self-service operations. However, prepared potentially hazardous foods not placed on serving lines and maintained as leftovers may be offered for take home. The person-in-charge should provide appropriate food handling safety directions with the take-home product (for example, Keep refrigerated, heat thoroughly before serving).

Returned Food, Reservice or Sale

After being served or sold and in the possession of a consumer, food that is unused or returned by the consumer may not be offered as food for human consumption. Food that is not potentially hazardous, such as crackers and condiments, in an unopened original package and maintained in sound condition may be re-served or resold.

Dispensing of Milk, Cream, and Nondairy Products

Milk and milk products for drinking purposes shall be provided to the consumer in an unopened, commercially filled package not exceeding 1 pint or 16 fluid ounces (.473 L) in capacity or drawn for immediate consumption from a commercially filled container stored in a mechanically refrigerated bulk milk dispenser. If a bulk dispenser for milk or milk products is not available and portions of less than 1 pint are required for mixed drinks, cereal, dessert service, or in a glass for drinking, milk and milk products may be poured from a commercially filled plastic container of 1-gallon (3.785 L) capacity and the filled plastic container returned immediately to the refrigerated storage. Cream or half-and-half shall be provided in an individual service container or a protected dispenser that pours, or it shall be drawn from a refrigerated dispenser designed for such service. When dispensers that pour are emptied, they shall be washed and sanitized before reuse (refilling). Liquid nondairy creamer or whitening agents shall be provided in an individual service container that shall be at or below 40 °F (4.4 °C) during storage, display, or service.

An exception is granted for child development services. Milk or milk products may be transferred from bulk milk dispensers or commercial 1-gallon (3.785 L) containers or smaller into a small, cleaned and sanitized serving pitcher. Pitchers shall be covered and transported immediately to the child activity rooms. All milk remaining in the serving pitchers after the meal or snack shall be discarded. Serving pitchers shall not be used as storage containers.

Dispensing of Cereal and Breads

Breakfast cereals may be dispensed in individual serving packages, in 12- to 16-ounce packages, or in protected bulk cereal bowls. Proper utensils shall be provided for consumer self-service. Any cereal remaining in the bulk cereal bowls after the serving period shall be discarded.

Bread and bread rolls may be dispensed in individual serving packages, bulk dispensers, or in pans or bowls protected by use of food guards, display cases, or other effective means. Proper utensils shall be provided for consumer self-service. Any bread or bread rolls remaining in the pans or bowls after the serving period shall be discarded.

Section IV. DESTRUCTION OF ORGANISMS OF PUBLIC HEALTH CONCERN

Cooking Raw Foods

Raw animal foods, such as eggs, fish, meat, poultry, and foods containing these raw animal foods shall be cooked to heat all parts of the food to set minimum requirements for temperature and time. A temperature of 145 °F (63 °C) or above for 15 seconds for raw shell eggs that are broken and prepared for immediate service in response to a consumer’s order, and for fish, seafood, beef, veal, lamb, mutton, and select commercially raised game animals.

A temperature of 155 °F (68 °C) for 15 seconds or the temperature specified in the table below that corresponds to the cooking time and temperature for pork and certain exotic species of game animals, comminuted fish, meats and game animals, injected meats, and eggs that are not prepared for immediate service to a consumer.

A temperature of 165 °F (74 °C) or above for 15 seconds for poultry; and certain wild game animals; stuffed fish; stuffed meat; stuffed pasta; or stuffing containing fish, meat, poultry, or ratites. Poultry and ratites shall not be stuffed. Stuffing and dressing shall be cooked separately. Stuffing containing fish, meat, poultry, or ratites shall be cooked to the minimum temperature for the ingredient requiring the highest cooking temperature.

Whole beef roasts and corned beef roasts shall be cooked in an oven that is preheated to the temperature specified for the roast's weight in the following table and that is held at or above that temperature. All parts of the food must be heated to a food temperature specified in the table below that corresponds to the holding time and temperature.

An establishment may vary from these requirements only if the food is a raw animal food (such as raw egg, raw fish, raw-marinated fish, raw molluscan shellfish, or steak tartare) or a partially cooked food (such as lightly cooked fish, rare meat, and soft cooked eggs) that is served or offered for sale in a ready-to-eat form, and the consumer is properly informed. The other except is if the regulatory authority grants a variance based on an approved HACCP plan that is submitted by the permit holder that documents scientific data or other information showing that a lesser time and temperature regimen results in a safe food. Fruits and vegetables that are cooked for hot holding shall be cooked to a temperature of 140 °F (60 °C).

Oven Parameters Required for Destruction of Pathogens on the Surface of Roasts of Beef and Corned Beef

	Oven Temperature Based on Roast Weight	
Oven Type	Less than 4.5 kg (10 lbs)	4.5 kg (10 lbs) or more
Still Dry	350 °F (177 °C) or more	250 °F (121 °C) or more
Convection	325 °F (163 °C) or more	250 °F (121 °C) or more
High Humidity[1]	250 °F (121 °C) or less	250 °F (121 °C) or less

[1]Relative humidity greater than 90% for at least 1 hour as measured in the cooking chamber or exit of the oven; or in a moisture-impermeable bag that provides 100% humidity.

Minimum Holding Times Required at Specified Temperatures for Cooking All Parts of Roasts of Beef and Corned Beef

Temperature °F (°C)	Time[1] in Minutes	Temperature °F (°C)	Time[1] in Minutes	Temperature °F (°C)	Time[1] in Minutes
130 (54)	121	136 (58)	32	142 (61)	8
132 (56)	77	138 (59)	19	144 (62)	5
134 (57)	47	140 (60)	12	145 (63)	3

[1]*Holding time may include postoven heat rise.*

Microwave Cooking

Raw animal foods cooked in a microwave oven shall be rotated or stirred throughout or midway during cooking to compensate for uneven distribution of heat. They must also be covered to retain surface moisture. Regardless of type, all raw animal foods cooked exclusively in a microwave shall be heated to a temperature of at least 165 °F (74 °C) in all parts of the food. Upon completion of the cooking process, they will be allowed to stand covered for 2 minutes after cooking to obtain temperature equilibrium.

Parasite Destruction

Before service or sale in ready-to-eat form, raw, raw-marinated, partially cooked, or marinated-partially cooked fish other than molluscan shellfish shall be frozen throughout to a temperature of -4 °F (-20 °C) or below for 168 hours (7 days) in a freezer **or** -31 °F (-35 °C) or below for 15 hours in a blast freezer.

Fish species of tuna may be served or sold in a raw, raw-marinated, or partially cooked ready-to-eat form and are exempt from the freezing requirements include *Thunnus alalunga, Thunnus albacares* (Yellowfin tuna), *Thunnus atlanticus*, *Thunnus maccoyii* (Bluefin tuna, Southern), *Thunnus obesus* (Bigeye tuna), and *Thunnus thynnus* (Bluefin tuna, Northern).

Records, Creation and Retention

If raw, raw-marinated, partially cooked, or marinated-partially cooked fish are served or sold in ready-to-eat form, the person-in-charge shall record the freezing temperature and time to which the fish are subjected to that temperature, and retain the records at the food establishment for 90 calendar days beyond the time of service or sale of the fish. One exception to this requirement are Army food establishments that freeze raw fish for parasite destruction shall submit and obtain approval from the IMA or designated representative prior to operation. Food establishments shall be approved by the IMA or designated representative to serve or sell these fish species. The other exception is if a supplier freezes the fish, a written agreement or statement from the supplier stipulating that the fish supplied are frozen to a temperature and for an adequate approved time may substitute for the records specified above.

Reheating for Immediate Service

Cooked and refrigerated food that is prepared for immediate service in response to an individual consumer order, such as a roast beef sandwich au jus, may be served at any temperature.

Reheating for Hot Holding

Potentially hazardous foods that are cooked, cooled, and reheated for hot holding shall be reheated so that all parts of the food reach a temperature of at least 165 °F (74 °C) for 15 seconds. Potentially hazardous foods reheated in a microwave oven for hot holding shall be reheated so that all parts of the food reach a temperature of at least 165 °F (74 °C) and the food shall be rotated or stirred, covered, and allowed to stand covered for 2 minutes after reheating. Ready-to-eat food taken from a commercially processed, hermetically sealed container or from an intact package from an approved food processing plant shall be heated to a temperature of at least 140 °F (60 °C) for hot holding. Reheating for hot holding shall be done rapidly, and the time the food is between the temperatures of 40 °F (4.4 °C) or less and 165 °F (74 °C) may not exceed 2 hours. Remaining unsliced portions of roast beef that are properly cooked may be reheated for hot holding if the oven parameters and minimum time and temperature conditions are met.

LIMITATION OF GROWTH OF ORGANISMS OF PUBLIC HEALTH CONCERN

Frozen Food and Thawing

Stored frozen foods shall be maintained frozen. When frozen potentially hazardous foods are required for use, they shall be thawed in one of the following manners (listed in order of preference -- from most to least desirable):

a. In refrigeration that maintains the food temperature at 40 °F (4.4 °C) or less.

b. As part of a cooking process, if the food that is frozen is fully cooked as previously discussed; or thawed in a microwave oven and immediately transferred to conventional cooking equipment with no interruption in the process.

c. Completely submerged in running water at a water temperature of 70 °F (21 °C) or below, with sufficient water velocity to agitate and float off loose particles in an overflow, for a period of time that does not allow thawed portions of ready-to-eat food to rise above 40 °F (4.4 °C), or for a period of time that does not allow thawed portions of a raw animal food requiring cooking to be above 40 °F (4.4 °C) for more than 4 hours total exposure time (including the time the food is exposed to the running water and the time needed for preparation for cooking).

d. Using any procedure if a portion of frozen ready-to-eat food is thawed and prepared for immediate service in response to an individual consumer's order.

Cooling

Cooked potentially hazardous foods shall be cooled within 2 hours, from 140 °F (60 °C) to 70 °F (21 °C); and within 4 hours, from 70 °F (21 °C) to 40 °F (4.4 °C) or less (6 hours total time). Potentially hazardous foods shall be cooled within 4 hours to 40 °F (4.4 °C) or less if prepared from ingredients at ambient temperature, such as reconstituted foods and canned tuna.

Fluid milk and milk products and molluscan shellstock received in compliance with laws allowing a temperature above 40° F (4.4° C) during shipment from the supplier, shall be cooled within 4 hours to 40 °F (4.4 °C) or less. Shell eggs also are not required to arrive at 40°F since they are often delivered shortly after laying/processing and may not have had enough time to be fully cooled. The eggs should be delivered on a refrigerated vehicle and must be placed immediately upon their receipt in refrigerated equipment that is capable of maintaining food at 40 °F (4.4 °C) or less.

Cooling Methods

Cooling shall be accomplished in accordance with the established time and temperature criteria specified in TB MED 530 (paragraph 3-52) by using one or more of the following methods; placing the food in shallow pans, separating the food into smaller or thinner portions, using equipment designed for rapid cooling, stirring the food in a container placed in an ice water bath, using containers that facilitate heat transfer, or adding ice as an ingredient, depending on the type of food being cooled.

When placed in cooling or cold-holding equipment, food containers in which food is being cooled shall be arranged in the equipment to provide maximum heat transfer through the container walls. However, food may be loosely covered or uncovered if protected from overhead contamination during the cooling period to facilitate heat transfer from the surface of the food.

A cooling log or chart shall be maintained during the cooling period to record the time and temperature of food being cooled.

Potentially Hazardous Foods, Hot and Cold Holding or Display

Sufficient holding facilities shall be available to assure the maintenance of potentially hazardous foods at the required temperature during hot or cold holding. Except during preparation, cooking, or cooling, or when time is used as the public health control, all potentially hazardous foods shall be maintained at 140 °F (60 °C) or above, or at 40 °F (4.4 °C) or below (except roasts cooked at approved alternate temperatures and for times provided or properly reheated may be held at a temperature of 130 °F (54 °C) or above).

Ready-to-Eat, potentially hazardous foods, Date Marking and Disposition

Labeling ready-to-eat, potentially hazardous foods shall be accomplished with DA Label 177 (Pre-prepared Food) (see below) or other system approved by the IMA or designated representative. This paragraph applies also to sandwiches. The intent of proper handling does not address quality issues or physical changes associated with food that is frozen which does not possess health risks (that is, buildup of ice crystals, rupturing of cell walls due to freezing, or separation of components).

<table>
<tr><td colspan="3">PRE-PREPARED FOOD
TB MED 530; OTSG</td></tr>
<tr><td rowspan="2">Prepared</td><td>DATE</td><td>TIME</td></tr>
<tr><td>06/20/2002</td><td>1045</td></tr>
<tr><td>Use by</td><td>06/23/2002</td><td>1045</td></tr>
</table>

DA Label 177, Aug 91

DA Label 177, Pre-prepared Food (Sample)

Refrigerated, ready-to-eat, potentially hazardous foods prepared and held refrigerated in a food establishment shall be clearly marked at the time of preparation to indicate the date of preparation or the date of opening for food prepared and packaged by a food processing plant; **and** the date of consumption which is 7 calendar days or less from, and including, the date of preparation or date the original container is opened, if the food is maintained at 40 °F (4.4 °C) or less. Food not consumed within this time period shall be discarded.

Ready-to-eat, potentially hazardous foods prepared in a food establishment, or prepared and packaged by a food processing plant, and subsequently frozen shall be clearly marked with the date when the food is thawed for immediate use, to indicate that the food shall be consumed within 24 hours or the consume-by date, which is 7 calendar days or less from, and including, the day of preparation or the date the original container of food was prepared and packaged by a food processing plant if the food is maintained at 40 °F (4.4 °C) or less. This 7-calendar-day period or less shall be cumulative and include only the time prior to and after removal from the freezer. Food not consumed within this time period shall be discarded.

Refrigerated, ready-to-eat, potentially hazardous foods dispensed from an opened container and packaged by a food processing plant as specified in paragraph's a and b above shall be held no longer than 48 hours after dispensing, if the food is maintained at 40 °F (4.4 °C) or less. Food not consumed within this time period shall be discarded. Examples of dispensed items include delicatessen-type salads (for example, macaroni and potato salads, puddings, and jellos).

The IMA or designated representative for food establishments with equipment that cannot meet a 40 °F (4.4 °C) product temperature may grant a waiver and allow potentially hazardous foods to be held at 45 °F (7 °C) with a maximum shelf life of 72 hours.

Marking Sandwiches

Sandwiches are classified as either made-to-order or pre-prepared. Regardless of their classification, all temperature and time control parameters set forth in this chapter apply. Labeling ready-to-eat, potentially hazardous foods as specified in this paragraph shall be accomplished with a DA Label 177 or other method approved by the IMA or designated representative.

Made-to-order sandwiches are sandwiches prepared for immediate service in response to a consumer's order. In mass feeding situations, made-to-order sandwiches may be batch prepared no more than 1 hour prior to service provided that sandwiches are individually wrapped or protected from contamination, each are clearly marked with the date and time of preparation and sandwiches not consumed within 3 hours from the point of preparation shall be discarded. Made-to-order sandwiches shall not be retained as leftovers.

Pre-prepared sandwiches are sandwiches prepared for service beyond a specific meal. These types of sandwiches shall be individually wrapped and clearly marked with the date and time of preparation. Each carton, case, or box of sandwiches shall be labeled with the producer's or manufacturer's name, plant number (when applicable), address, and any other information required by law. Pre-prepared sandwiches include hot sandwiches, refrigerated sandwiches and frozen sandwiches.

Regarding hot sandwiches, the potentially hazardous ingredients shall be cooked to the required internal temperature and held at 140 °F, from preparation to serving or disposal. Maximum shelf life for these sandwiches is 5 hours. Hot sandwiches not consumed within 5 hours shall be discarded as food waste.

Frozen sandwiches produced at a food processing plant shall be consumed by the manufacturer's stated shelf life. The IMA or designated representative shall establish the shelf life for frozen sandwiches prepared at a military food establishment. Frozen sandwiches may either be sold frozen or thawed using one of the approved methods. When removed from the freezer, frozen sandwiches shall be dated with a use by date. Frozen sandwiches produced in a food processing plant shall be used by the manufacturer's stated shelf life, or if prepared in a food establishment shall be consumed within 7 calendar days or less from the date taken from frozen storage. Thawed sandwiches shall not be refrozen.

Refrigerated sandwiches should be prepared from chilled ingredients. Refrigerated sandwiches should also be prepared in a designated sandwich preparation facility. Those prepared at a food processing plant shall be consumed within the manufacturer's stated shelf life.

The IMA or designated representative shall establish a shelf life of at least 60 hours for refrigerated sandwiches prepared at a local food establishment that has a designated sandwich preparation area. A designated sandwich preparation area includes a physical separation from other food operations, designated handwashing facilities, and the wearing of disposable gloves by preparation staff. It must also have a specific cleaning and sanitizing program that includes thorough cleaning and sanitizing of equipment before the start of sandwich preparation, after at least every 4 hours of continuous operation, and after any stoppage of sandwich preparation that exceeds 30 minutes. Special emphasis shall be placed on thorough cleaning and sanitizing of all equipment, floors, walls, and refrigeration; and thorough air-drying of equipment. Any equipment that cannot be air-dried shall be dried with a clean disposable paper towel. Sandwiches prepared at food establishments that do not have a designated sandwich preparation area (for example, sandwich shops and military dining facilities) shall be consumed within 5 hours of preparation. Sandwiches not consumed within time periods specified shall be discarded as food waste. Sandwiches shall not be reworked.

Meat, chicken, tuna fish, eggs, and other similar high-protein salad fillings used in pre-prepared sandwiches shall be commercially acidified to a pH of 4.5 or below. The sandwich or ingredient food processing plant shall provide written laboratory results or certificate of conformance stating that ingredients comply with acidification requirements.

Leftover Disposition

Leftovers prepared and held at proper temperatures and properly protected against contamination may be retained and offered for reservice or consumption. Leftovers shall be labeled with DA Label 178 (Leftovers - Use Within 24 Hours) (see figure below) or other method approved by the IMA or designated representative.

<table>
<tr><td colspan="2">LEFTOVERS - USE WITHIN 24 HOURS
Removed from Service
TB MED 530, OTSG</td></tr>
<tr><td>DATE

</td><td>TIME

</td></tr>
</table>

DA LABEL 178, AUG 91

DA Label 178, Leftover—Use Within 24 Hours (Sample).

Leftovers may be retained up to 5 hours if maintained at 140 °F (60 °C) after initial cooking. They may be kept up to 24 hours at 40 °F (4.4 °C) or below if they are properly cooled using an approved method. They can be served for up to 4 hours if refrigerated leftovers are properly reheated and consumed within 4 hours from the time of reheating. Leftovers not consumed within appropriate time periods or those that exceed established temperature and time requirements shall be discarded. Leftovers may be offered for service once, and remaining food not consumed shall be discarded.

Food that has been creamed or received extensive handling and preparation (for example, hashes, gravies, stuffings, dressings, and creamed meats), raw or partially cooked potentially hazardous foods, food prepared for consumption by a highly susceptible population, and unused or returned food, shall not be retained or offered as leftovers. Leftovers shall not be frozen or mixed with fresh ingredients.

Time as a Public Health Control

Time only, rather than time in conjunction with temperature, may be used as the public health control for a working supply of potentially hazardous foods before cooking or for ready-to-eat potentially hazardous foods that is displayed or held for service for immediate consumption if the following requirements are met:

a. The food shall be marked or otherwise identified to indicate the time that is 4 hours past the point in time when the food is removed from temperature control.

b. The food shall be cooked and served, served if ready-to-eat, or discarded, within 4 hours from the point in time when the food is removed from temperature control.

c. The food in unmarked containers or packages or marked to exceed a 4-hour limit shall be discarded.

d. Written procedures that ensure compliance with those items above for food that is prepared, cooked, and refrigerated before time is used as a public health control are maintained in the food establishment and made available to the regulatory authority upon request.

Variance Requirement

A food establishment shall obtain a variance approval from the regulatory authority before smoking or curing food, brewing alcoholic beverages, using food additives or adding components, such as vinegar, as a method of food preservation rather than as a method of flavor enhancement or to render a food so that it is not potentially hazardous, using a reduced oxygen method of packaging food, (except where a barrier to *Clostridium botulinum* in addition to refrigeration exists), or when preparing food by another method that is determined by the regulatory authority to require a variance.

Reduced Oxygen Packaging, Criteria

A food establishment that packages food using a reduced oxygen packaging method (for example, cook/chill operations) shall have an HACCP plan approved by the IMA or designated representative that contains information that (1) Identifies the food to be packaged, (2) Limits the food packaged to a food that does not support the growth of *Clostridium botulinum* because it has an a_w of 0.91 or less, has a pH of 4.6 or less, or is a meat or poultry product cured at a food processing plant regulated by the USDA and is received in an intact package, or is a food with a high level of competing organisms, such as raw meat or raw poultry. (Except for fish that is frozen before, during, and after packaging, a food establishment may not package fish using a reduced oxygen packaging method).

The HACCP plan must also specify methods for maintaining food at 40 °F (4.4 °C) or below, describe how the packages shall be prominently and conspicuously labeled in bold type on a contrasting background, with instructions to maintain the food at 40 °F (4.4 °C) or below, and discard the food within 14 days or by the manufacturer's "use by" date, whichever is shorter.

Further, the HACCP plan will include operational procedures that prohibit contacting food with bare hands, identify a designated area and method by which physical barriers or methods of separation of raw foods and ready-to-eat foods minimize cross contamination, and specify that access to processing equipment is restricted to responsible, trained personnel familiar with the potential hazards of the operation. Finally the plan will delineate cleaning and sanitization procedures for food-contact surfaces and describe the training program that ensures that the individual responsible for the reduce oxygen packaging operation understands the concepts and procedures required for a safe operation.

Section VI. FOOD IDENTITY, PRESENTATION, AND ON-PREMISES LABELING

Standards of Identity

Packaged food shall comply with standard of identity requirements found in several sections of the Code of Federal Regulations. (9 CFR 319, 21 CFR 131, 21 CFR 133, 21 CFR 135 through 21 CFR 137, 21 CFR 139, 21 CFR 145, 21 CFR 146, 21 CFR 150, 21 CFR 152, 21 CFR 155, 21 CFR 156, 21 CFR 158, 21 CFR 160, 21 CFR 161, 21 CFR 163 through 21 CFR 169; and the general requirements in 21 CFR 130 and 9 CFR 319, Subpart A).

Food Labels

Food packaged in a food establishment shall be labeled as specified by law, including 21 CFR 101 and 9 CFR 317. Except as exempted in the Federal Food, Drug, and Cosmetic Act, section 403(Q)(3) through (5) and nutrition labeling specified in 21 CFR 101 and 9 CFR 317, Subpart B, label information shall include the common name of the food or, in the absence of a common name, an adequately descriptive identity statement; if made from two or more ingredients, a list of ingredients in descending order of predominance by weight, including a declaration of artificial color or flavor and chemical preservatives, contained in the food; an accurate declaration of the quantity of contents; and the name and place of business of the manufacturer, packer, or distributor.

Bulk food that is available for consumer self-dispensing shall be prominently labeled with the manufacturer's or processor's label that was provided with the food **or** a card, sign, or other method of notification that includes the information specified above.

Bulk, unpackaged foods, such as bakery products, and unpackaged foods that are portioned to consumer specification need not be labeled if a health, nutrient content, or other claim is not made, there are no State or local laws requiring labeling, and the food is manufactured or prepared on the premises of the food establishment or at another food establishment or a food processing plant that is owned by the same person and is regulated by the food regulatory agency that has jurisdiction. If required by law, consumer warnings shall be provided. Food establishments or manufacturers' dating information on foods may not be concealed or altered.

Consumption of Raw or Uncooked Animal Foods

If a raw or uncooked animal food (such as beef, eggs, fish, lamb, milk, pork, poultry, or shellfish) is offered in a ready-to-eat form as a deli, menu, vended, or other item, or as a raw ingredient in another ready-to-eat food, the person-in charge shall inform consumers by brochures, deli case or menu advisories, label statements, table tents, placards, or other effective written means of the significantly increased risk associated with certain especially vulnerable consumers eating such foods in raw or undercooked form.

Section VII. SPECIAL REQUIREMENTS

Discarding or Reconditioning Unsafe, Adulterated, or Contaminated Food

Food that is unsafe, adulterated, or not honestly presented shall be reconditioned according to an approved procedure or discarded. Ready-to-eat food that may have been contaminated by an employee who should have been restricted or excluded shall be discarded. Food that is contaminated by food employees, consumers or other persons through contact with their hands, bodily discharges (such as nasal or oral discharges), or other means shall be immediately discarded. These foods shall be disposed of in accordance with Department of Defense (DOD) 4160.21-M, AR 30-1, AR 30-18, and AR 40-657/NAVSUPINST 4355.4F/MCO P10110.31G, as applicable.

Additional Safeguards: Pasteurized Foods, Prohibited Reservice, and Prohibited Food

In a food establishment that serves a highly susceptible population, prepackaged juice or a prepackaged beverage containing juice, that bears a warning label as specified in 21 CFR, subsection 101.17(g) Food Labeling (Warning that product was not pasteurized), may not be served or offered for sale. Pasteurized shell eggs or pasteurized liquid, frozen, or dry eggs or egg products shall be substituted for raw shell eggs in the preparation of foods, such as Caesar salad, hollandaise or béarnaise sauce, mayonnaise, eggnog, ice cream, and egg-fortified beverages, and eggs that are broken, combined in a container, and not cooked to proper internal temperature (145 ^{o}F) immediately; or eggs that are held before service following cooking. Food in an unopened original package may not be re-served. Raw animal foods (such as raw or raw-marinated fish, raw molluscan shellfish, and steak tartare) or partially cooked food (such as lightly cooked fish, rare meat, and soft-cooked eggs), raw seed or bean sprouts may not be served or offered for sale in a ready-to-eat form.

CHAPTER 6 – MANAGEMENT AND PERSONNEL

Person-in-Charge

The food establishment manager shall be the person-in-charge or shall designate a person-in-charge. In the absence of the person in charge, there will be an identified alternate person-in-charge present at the food establishment during all hours of operation. The overall person-in-charge is responsible to ensure that all food handlers receive medical clearances as required by the IMA or designated representative.

Demonstration of Knowledge

Based on the risks of foodborne illness inherent to the food operation being inspected and upon the request of the IMA or designated representative, the person-in-charge shall demonstrate knowledge in several areas. This will include knowledge of foodborne disease prevention and application of HACCP principles. The person-in-charge must also be a certified food protection manager who has shown proficiency of required information by passing a test that is part of an accredited program.

The areas of knowledge also include describing the relationship between the prevention of foodborne disease and the personal hygiene of a food employee, explaining the responsibility of the person-in-charge for an employee who has a disease or medical condition that may cause foodborne disease, describing the symptoms associated with the diseases that are transmissible through food, explaining the significance of time and temperature as it relates to the prevention of foodborne illness.

The person-in-charge should also be able to explain the hazards involved in the consumption of raw or undercooked meat, poultry, eggs, and fish, state from memory the required food temperatures and times for safe cooking of potentially hazardous foods including meat, poultry, eggs, and fish, as well as the safe refrigerated storage, hot holding, cooling, and reheating of potentially hazardous foods. They should be able to describe the relationship between the prevention of foodborne illness and the management and control of cross contamination, hand contact with ready-to-eat foods, handwashing, and maintaining the food establishment in a clean condition and in good repair.

The person-in-charge should also be able to explain the relationship between food safety and providing equipment that is properly designed, constructed, located, installed, operated, maintained, and cleaned. Correct procedures for cleaning and sanitizing utensils and food-contact surfaces of equipment, identifying the source of water used and measures taken to ensure that it remains protected from contamination, such as providing protection from backflow and precluding the creation of cross connections should also be fully understood by the person-in-charge.

The person-in-charge should be able to identify critical control points (CCPs) in the operation from purchasing through sale or service that when not controlled may contribute to the transmission of foodborne illness, and can explain steps that would ensure that the points are properly controlled. He should also be able to explain the details of how the facility complies with the HACCP plan, if the regulatory authority or the food establishment requires a plan.

A full understanding of the procedures, rights, and authorities assigned by TB MED 530 to the food employee, person-in-charge, and the IMA or designated representative is imperative and must also be demonstrated.

Duties of Person-in-Charge

The person-in-charge shall ensure that food establishment operations are not conducted in a private home or in a room used as living or sleeping quarters. Persons unnecessary to the food establishment operation should not be allowed in the food preparation, food storage, or warewashing areas. If steps are taken to ensure that exposed food; clean equipment, utensils, and linens; and unwrapped single-service and single-use articles are protected from contamination, the person-in-charge may authorize brief visits and tours. Employees and other persons, such as delivery and maintenance persons and pesticide applicators, entering the food preparation, food storage, and warewashing areas must comply with all requirements. The person-in-charge should verify frequently that employees are effectively cleaning their hands by routinely monitoring the employees' handwashing.

The person-in-charge should also train employees to observe foods as they are received to determine that they are from approved sources, delivered at the required temperatures, protected from contamination, unadulterated, and accurately presented. Routinely monitoring the employees' observations, reviewing receiving documents, and periodically evaluating foods upon their receipt can accomplish verification that these tasks are being performed properly.

The person-in-charge should also check to see that employees are properly cooking potentially hazardous foods, being particularly careful in cooking those foods known to cause severe foodborne illness and death, such as eggs and comminuted meats. This can be done by daily oversight of the employees' routine monitoring of the cooking temperatures, and evaluation of the cooks' worksheets and other logs. Also, he/she should confirm that employees are using proper methods to rapidly cool potentially hazardous foods that are not held hot by daily oversight of the employees' routine monitoring of food temperatures during cooling.

The person-in-charge must also validate the employees are properly sanitizing cleaned multiuse equipment and utensils before they are reused through routine monitoring of solution temperature, chemical concentration, pH, and exposure time as applicable.

The person-in-charge should ensure that operations cease and the IMA or designated representative is immediately notified in the event of fire, storm, flood, mechanical breakdown, extended power outage (greater than 2 hours), loss of drinking water (potable source), backup of sewage, onset of apparent foodborne illness, imminent health hazard, or similar event that may result in the contamination of food, prevent potentially hazardous foods from being held at required temperatures, or prevent proper, uninterrupted cooking, reheating, or cooling of potentially hazardous foods.

EMPLOYEE HEALTH

Reportable Information

The person-in-charge shall require food employees and food employee applicants to whom a conditional offer of employment is made to report information about their health and activities as they relate to diseases that are transmissible through food. A food employee or applicant shall report the information, including symptoms and the date of onset of jaundice or of a possible illness capable of being transmitted by food, in a manner that allows the person-in-charge to prevent the likelihood of disease transmission, if the food employee or applicant has a symptom caused by illness, infection, or other source that is associated with an acute gastrointestinal illness. Examples include diarrhea, fever, vomiting, jaundice, or a sore throat with fever.

If an employee has a lesion containing pus, such as a boil or infected wound, that is open or draining and is on the hands or wrists, on exposed portions of the arms, or on other parts of the body, this person should be excluded from food preparation facilities unless an impermeable cover, such as a finger cot or stall, protects the lesion and a single-use glove (for hands) is worn over the impermeable cover. ,For arms and other parts of the body, an impermeable cover or a dry, durable, tight-fitting bandage is required.

Employees diagnosed with an illness due to *Salmonella typhi* (S. typhi), *Shigella* spp., *E. coli* O157:H7, or Hepatitis A virus should be excluded completely from the food service facility. Employees diagnosed with other diseases transmissible through food, such as amebiasis, camplyobacteriosis, cholera, norwalk virus, giardiasis, staphylococcal or streptococcal infections, yersiniosis, or had a recent illness should be kept out of food preparation areas as well.

Employees who are suspected of causing, or being exposed to, a confirmed disease outbreak caused by *S. typhi, Shigella* spp., *E. coli* O157:H7, or hepatitis A virus, or a person who lives in the same household as a person who is diagnosed with a disease caused by *S. typhi*, *Shigella* spp., *E. coli* O157:H7, or hepatitis A virus; or exhibits foodborne illness symptoms should be excluded from food preparation areas also.

Persons who traveled out of the Continental United States (CONUS) to areas with identified epidemic or endemic gastrointestinal diseases, or worked outside the Continental United States (OCONUS) and traveled to areas with identified epidemic or endemic gastrointestinal diseases should be excluded until an acceptable time has passed indicating they are free of disease. High-risk geographical areas are published in Health Information for International Travel by the CDC or Medical Environmental Disease Intelligence and Countermeasures by the Armed Forces Medical Intelligence Center.

Employee Exclusions and Restrictions

The person-in-charge shall exclude a food employee from a food establishment if the food employee is diagnosed with an infectious agent capable of being transmitted through food. This person shall also be restricted from working with exposed food, clean equipment, utensils, and linens; and unwrapped single-service and single-use articles. Specific timetables are provided in TB MED 530 for each disease and the length of time an individual must be kept out of the food service operations. An excluded food employee shall be cleared by the IMA or designated representative prior to returning to food operations. All food employees excluded from food operations or suspected of being exposed to or having symptoms of illnesses that might be transmissible by food shall be referred to the IMA or designated representative by the supporting medical activity.

Removal of Exclusions and Restrictions

The person-in-charge may allow an exception for certain illnesses if he or she obtains approval from the IMA or designated representative. The person shall provide written medical documentation (from a licensed medical physician or the IMA or designated representative) to the person-in-charge that specifies that the person may work in an unrestricted capacity in a food establishment, including a food establishment that serves a highly susceptible population, because the person is free of infectious agents capable of causing foodborne illness.

A restriction for certain symptoms can be removed if the person is free of the symptoms and no foodborne illness occurs that may have been caused by the restricted person. If a person is suspected of causing foodborne illness but is free of any symptoms, then the restricted person shall provide written medical documentation to the person-in-charge stating that the restricted person is free of the infectious agent that is suspected of causing the person's symptoms or causing foodborne illness (stools are free of *S. typhi, Shigella* spp., or *E. coli* O157:H7) or that the symptoms experienced result from a chronic noninfectious condition, such as Crohn's disease, irritable bowel syndrome, or ulcerative colitis.

An exclusion involving employees serving highly susceptible populations must provide written medical documentation that specifies that the person is free of *S. typhi, Shigella* spp*., E. coli* 0157:H7*,* hepatitis A virus infection, or other disease transmissible through food, whichever is the infectious agent of concern. Exclusion for jaundice requires the restricted person to provide written medical documentation (from a physician licensed to practice medicine or the IMA or designated representative) that specifies that the person is free of hepatitis A virus. Tables 2-1 and 2-2 in TB MED 530 may be used as an aid to quick reference exclusion and restriction requirements, and clearance requirements.

Reporting by the Person-in-Charge

The person-in-charge shall notify the IMA or designated representative of a food employee or a food employee applicant who is diagnosed with or is exhibiting symptoms of an illness due to *S. typhi, Shigella* spp*., E. coli* O157:H7, hepatitis A virus, or other foodborne illness. The person-in-charge shall not allow food employees or applicants to work until such time that they have a medical release from the IMA or designated representative.

PERSONAL CLEANLINESS

Hands and Exposed Arms, Clean Condition

Food employees shall vigorously wash their hands and the exposed portions of their arms with soap and warm water for at least 20 seconds followed by a thorough rinsing with clean water at designated handwashing facilities. When washing, they should pay particular attention to the areas underneath the fingernails and between the fingers. Employees should wash their hands and exposed portions of their arms at the following times before engaging in food preparation, (including working with exposed food, clean equipment and utensils, and unwrapped single-service and single-use articles), after touching bare human body parts other than clean hands and clean, exposed portions of arms and always after using the toilet.

Employees should also wash their hands after coughing, sneezing, using a handkerchief or disposable tissue, using tobacco, eating, or drinking, after handling soiled equipment or utensils, during food preparation, to remove soil and contamination and to prevent cross contamination when changing tasks. Hands should also be washed when switching between working with raw food and working with ready-to-eat food, or after engaging in other activities that contaminate the hands.

Food employees shall clean their hands in a handwashing lavatory. They may not clean their hands in a sink used for food preparation or in a service sink or a curbed cleaning facility used for the disposal of mop water and similar liquid waste.

A hand sanitizer and a chemical hand sanitizing solution used as a hand dip shall contain active antimicrobial ingredients that are listed as safe and effective for application to human skin as an antiseptic handwash in a monograph for over-the-counter Healthcare Antiseptic Drug Products or previously authorized, and listed for such use in USDA Publication No. 1419. The sanitizer will also have components that are regulated for the intended use as food additives as specified in part 178, title 21, Code of Federal Regulations (21 CFR 178) or be generally recognized as safe (GRAS) for the intended use in contact with food. The sanitizer shall be applied only to hands that are thoroughly cleaned.

If a hand sanitizer or a chemical hand sanitizing solution used as a hand dip does not meet the criteria specified, hands should be rinsed in clean water before hand contact with food or by the use of gloves, or personnel should be limited to situations that involve no direct contact with food, food-contact surfaces, and utensils by the bare hands. A chemical hand sanitizing solution used as a hand dip shall be maintained clean and at a strength equivalent to at least 100-parts per million (ppm) chlorine.

Food employees shall keep their fingernails trimmed, filed, and maintained so the edges and surfaces are cleanable, not rough, and do not extend beyond the fleshy portion of the fingertip.

They are also prohibited from wearing artificial nails; nail jewelry, or any other nail products, such as nail polish or sparkles, during food preparation or while serving food.

With the exception of a plain ring, such as a wedding band, or a medical bracelet, food employees may not wear jewelry, which may be touched, while preparing or serving food. Prohibited jewelry includes nose, tongue, and lip rings; other exposed body jewelry; and watches. This requirement minimizes contamination of hands and harborage of bacteria in the jewelry. Employees who handle only closed food containers, such as stop and shop operations, are exempt. Food employees shall also wear clean outer clothing to prevent contamination of food, equipment, utensils, linens and single-service and single-use articles.

HYGIENIC PRACTICES

Employees shall eat, drink, or use any form of tobacco only in designated areas where the contamination of exposed food; clean equipment, utensils, and linens; unwrapped single-service and single-use articles; or other items needing protection cannot result. A food employee may drink from a closed beverage container with a protected drinking mechanism (sports bottle) if the container is handled in a manner that prevents contamination of the employee’s hands and exposed food or contact surfaces.

Food employees experiencing persistent sneezing, coughing, or a runny nose that causes discharges from the eyes, nose, or mouth may not work with exposed food; clean equipment, utensils, and linens; or unwrapped single-service or single-use articles.

Food employees shall wear authorized hair restraints (such as clean hats, hair coverings or nets, beard restraints, and clothing that covers body hair) that are designed and worn to effectively keep their hair from contacting exposed food; clean equipment, utensils, and linens; and unwrapped single-service and single-use articles. Certain food employees, such as counter staff who only serve wrapped or packaged beverages and foods; hostesses; and wait staff (waiters and waitresses) if they present a minimal risk of contaminating exposed food, clean equipment, utensils, and linens; and unwrapped single-service and single-use articles, are exempt from the hair restraint requirement.

Food employees may not care for or handle animals that may be present, such as patrol dogs, support animals, or pets. Food employees with support animals may handle or care for their support animals and food employees may handle or care for fish in aquariums or molluscan shellfish or crustacean in display tanks, if they wash their hands properly and change outer clothing before returning to food preparation tasks.

TRAINING

Supervisor's or Person's-in-Charge Training

The person-in-charge, the COR, the Quality Assurance Evaluator responsible for performing contract quality assurance functions on food service contracts, and the food service supervisor are required to attend a formal certified training program in food sanitation and pass a written test for certification as a food service manager. This training must be renewed every 4 years or complete 12 hours of continuing education approved by the IMA or designated representative.

The supervisor/ person-in-charge food certified training program shall include the following topics: food, HACCP, facilities, food handlers, and management.

Training records shall be maintained at the food establishment where food employees work and be readily available for review by the IMA or designated representative.

Food Employee's Training

All food employees and KP supervisors shall receive a minimum of 8 hours introductory food sanitation training. New food employees shall receive this 8-hour introductory training within 30 days of beginning food service duties. All food employees shall receive a minimum 4-hour annual food sanitation refresher training that may be accumulated over the 1-year time period after the initial or subsequent refresher training. Temporary food employees, assigned for 30 days or less, or bartenders, waiters, and waitresses that do not prepare food only require 4 hours of initial training and are exempt from the 8 hour training requirement.

Training records shall be maintained at the food establishment where food employees work and be readily available for review by the IMA or designated representative.

CHAPTER 7 – GENERAL MICROBIOLOGY OF FOOD

Key Terms

Microorganism - Small living organism
Pathogen - A disease-causing microorganism
enterotoxins - Substances that are toxic to the intestinal tract causing vomiting, diarrhea, etc.; most common enterotoxins are produced by bacteria
Spoilage Microorganism - Microbe that causes spoilage, but not typically illness
Gram-negative bacteria - Bacteria which lose crystal violet stain but are stained pink when treated by Gram's method
Gram-positive endospore-forming bacteria - Bacteria that form endospores and are gram-positive. Representative genera include *Bacillus and Clostridium*
Toxins - Specific, characterizable, poisonous chemicals, often proteins, with specific biological properties, including immunogenicity, produced by microbes, higher plants, or animals

The Micro World

Biological hazards are the most common threat because of the number of people affected. Biological hazards consist of bacteria, viruses, parasites, and fungi.

Bacteria

Of the biological hazards, bacteria present the greatest concern to food service workers and consumers. Bacteria are single-celled microorganisms that cannot be seen by the naked eye; they are microscopic. This makes it difficult, if not impossible, for food service workers to determine whether or not food has become contaminated. Bacteria have two ways of making us sick: infection and intoxication.

Infection is caused by living bacterial cells. Infective bacterial pathogens reproduce rapidly at temperatures between 40°F and 140°F when adequate nutrients and moisture are present (as with potentially hazardous foods). When you ingest pathogenic bacteria, the living cells incubate in the human body and may induce a foodborne illness. Thorough cooking of foods (IAW the prescribed standards of TB MED 530) will kill harmful infective bacteria, rendering them ineffective towards causing illness when ingested.

Some bacteria produce one or more toxins -- chemical residues -- as a byproduct during reproduction. Toxigenic bacteria are also infective in that the living (vegetative) cells will cause illness when ingested. Cooking or freezing foods contaminated with toxigenic bacterial pathogens may destroy the bacterium; however, the toxins remain present and can induce illness if eaten. Intoxication can result when an individual consumes food with these toxins.

An agent is the disease-causing organism. Causative agents can be found in a reservoir, or passive carrier, such as food, the environment, or the food handler. Food often serves as a mechanism (vector) for transmitting an agent into the human body, the host. The host is a human or animal that serves as a source of nourishment for an agent. A host generally acts like an incubator and allows the harmful organism to reproduce. As an agent reproduces, the host may experience symptoms, an indication of infection or intoxication. The severity of symptoms will vary depending on the type of organism and the susceptibility of the host. The same dose will lead to different signs in different people. Each microorganism has a number or count associated with it that is likely to make an exposed and susceptible person sick. This is referred to as the infective dose.

Another characteristic of bacteria that can lead to a foodborne illness even after foods have been properly cooked is the formation of spores. Some bacteria produce spores as a protection mechanism against adverse environmental conditions. A spore is a thick protein wall that is formed, completely encasing the bacterial cell. Spores are not living cells that can reproduce; the encapsulated cell lies dormant until environmental conditions, such as temperature and moisture level, are conducive for bacterial growth. Adequate cooking of foods (i.e., green beans and rice) potentially contaminated with spore-forming bacteria may destroy living bacterial cells, rendering the product safe to eat. However, spores are left undestroyed in the product. These spores will germinate into a vegetative (reproductive) stage when the product temperature falls below 140 ^{o}F and is allowed to remain there for several hours. Vegetative cells reproduce rapidly in the temperature danger zone and may grow to population levels significant enough to get people sick.

There are two distinctly different groups of bacteria that we must concern ourselves with when talking about food: **pathogenic bacteria**, which are those that cause foodborne illness, and **spoilage bacteria**, the group of bacteria that cause foods to deteriorate and develop unpleasant odors, tastes, and textures.

Pathogenic bacteria grow rapidly in the "Temperature Danger Zone," but they may not affect the taste, smell, or appearance of a food. One typically cannot tell that a pathogen is present by smelling or tasting a food. However, pathogens are a food safety issue and a food quality issue as well.

Spoilage bacteria are usually better at multiplying at low temperatures, such as in the refrigerator. Because of this, they can out compete pathogens in these environments. Eventually they cause food to develop off or bad tastes and smells. Most people would not choose to eat spoiled food, but if they did, they probably would not get sick. Because of this fact, these microorganisms are considered to be food quality issues only.

Bacterial Growth

Growth requirements. Bacteria can double in numbers every 15 to 20 minutes under ideal conditions by binary fission. Potentially hazardous foods are *foods that promote the rapid growth of bacteria.* These are usually the foods associated with foodborne illness outbreaks. In general, bacteria associated with foodborne illnesses have several things in common: physical characteristics and environmental conditions. When these are not suitable, bacterial growth can be eliminated, or greatly retarded. Bacterial growth factors can be remembered using the acronym “TAN POT”: Time, Available Water, Nutrients, pH, Oxygen, and Temperature.

Bacteria: Factors/Conditions Influencing Growth (TAN POT)

Time. Given time with the proper temperature and physical conditions, bacteria will grow rapidly and can reach levels great enough to result in foodborne illness. Bacteria, however, do not start growing right away. We can keep foods already contaminated with bacterial pathogens from making us sick by reducing the cumulative time the product is allowed to remain in the temperature danger zone. As a rule, after 4 hours, discard.

Available water. Bacteria are just like humans in that they need water to survive; moisture helps the bacteria absorb proteins. A moisture free product, such as dried rice or fresh green beans, can become a potentially hazardous food when steamed. Freezing foods binds water molecules, making conditions less favorable for bacterial growth.

Nutrients. Bacteria favor foods that are high in protein. Examples include meats, poultry, cheese, and dairy products. Other physical and environmental characteristics must exist, however, to promote bacterial growth.

pH. Bacteria thrive best in food products that have a mid-range or neutral pH from about 4.6 to 9; the ideal range is between 6.6 and 7.5.

Oxygen Requirements. Some bacteria are aerobic while others are anaerobic. Most bacteria associated with foodborne illness outbreaks are facultative - meaning they can reproduce with or without oxygen. Do not assume that foods packaged in an oxygen-free container (i.e., canned goods) are necessarily safe.

Temperature. Bacteria grow at accelerated rates when potentially hazardous foods are allowed to remain in the temperature danger zone. Most foodborne pathogens reproduce rapidly at a range close to human body temperature. There are some, however, that can thrive either in cooler or hotter ranges. To further classify bacteria, mesophiles are bacteria that grow best between 41 and 113 ^{o}F, thermophiles prefer hotter temperatures (between l09 and 130 ^{o}F), while psychrophiles are cold temperature-loving bacteria (between 31 and 90 ^{o}F). As a rule, keep potentially hazardous foods below 40 ^{o}F or above 140 ^{o}F to prevent bacterial growth.

Bacterial Growth Curve

When environmental temperatures are optimum, such as those in the temperature danger zone, bacteria will begin multiplying. Within hours, bacterial populations can reach levels great enough to result in a foodborne illness. The following graph illustrates a typical growth curve of bacteria under ideal conditions, following the contamination of a food product. The horizontal axis represents time and the vertical axis represents the population or number of bacterial colonies.

There are 4 distinct phases of the bacterial growth cycle:

The **lag phase** is an adjustment period. Bacterial contaminants are introduced to a food product, or a contaminated food item is exposed to new environmental conditions (e.g., removing the item from the refrigerator). During the lag phase, there is no bacterial growth. Bacteria are adjusting to their environment and spores are reverting back to a vegetative stage.

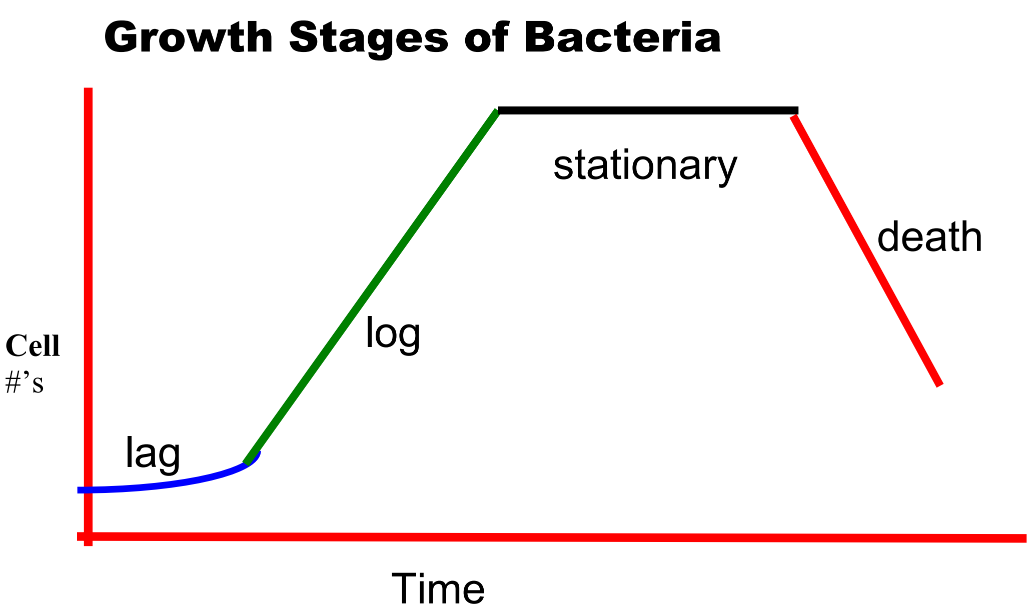
The **log phase** is when growth conditions are optimum (e.g., temperature danger zone) and bacterial cells begin to multiply rapidly.

During the **stationary phase**, the growth rate of bacteria is equal to the death rate due to competition for food. Note: Even though the growth rate has tapered off, bacterial colonies are still multiplying. It is during the stationary phase that toxigenic bacteria have deposited sufficient concentrations of toxins to cause a foodborne intoxication.

The final phase is the **decline or death phase**, where bacterial colonies begin to die off at a faster rate than they are multiplying. Although the growth rate of bacteria appears to be diminished during the stationary and decline phases, it is important to understand that the total bacterial count has far exceeded a number that can be reduced by cooking to render the product safe to eat.

One of the objectives of a food safety system is to prevent the log phase (bacterial growth) from occurring. Because we cannot see bacteria without the aid of a microscope, we (in food service) must assume that all foods that come into our facility are contaminated. If this is the case, strict controls in time and temperature must be met during food storage, preparation, and cooking.

Microbial Growth



Bacterial cells are first inoculated into an environment. During the LAG phase, they are adjusting to this new environment. Once they've established themselves, and have determined that the environment is conducive to growth, they begin multiplying. Rapid multiplication takes place during the log phase. The cells are reproducing logarithmically. The rate at which multiplication occurs varies depending on the environmental conditions, and also will vary from organism to organism.
During the stationary phase, approximately the same numbers are dying, as are being reproduced, therefore maintaining about the same numbers.
The death phase is the rapid decline of numbers in viable cells because the toxicity of their environment or the ability of the environment to sustain the microorganisms was lost (ie; food supplies consumed, available water depleted, etc).

Viruses

Viruses are also categorized as biological hazards. Viruses are much smaller than bacteria and can only be seen with the aid of an electron microscope. Unlike bacteria, viruses do not require potentially hazardous foods to survive. They need a living host to reproduce; therefore, viruses cannot grow in food. Viruses can, however, survive on food contact surfaces for many hours.

Generally, viruses require fewer organisms to make you sick; therefore, it is easy to transmit viruses through water. Many viruses are shed from the body in the stool. Viruses are easily spread to food if food handlers do not wash their hands after using the bathroom. Viruses can contaminate water supplies if there is a cross-contamination between sewage lines and the potable water supplies.

Parasites

Parasites are small or microscopic creatures that need to live on or inside a host to survive. Parasites require a living host for at least one stage of their life cycle and can cause a variety of symptoms. There are single celled parasites also called protozoa, (ie, *Giardia lamblia*, *Entamoeba histolytica*) and multi-cellular parasites (ie, trichina worms, roundworms, tapeworms, flukes, etc).

Fungi

Fungi are in the biological hazard category as well. The fungi consist of molds and yeast. These are found in air, soil, plants, water, animals, and some foods.

Molds produce toxins that can cause illness, infection, and allergic reactions. Molds usually affect food quality and result in spoilage. Molds are obligate aerobes and thus typically grow on the surface of foods in fuzzy looking colonies. They can also grow in extreme environments such as coolers or on dry goods. Unlike bacteria, molds reproduce by forming spores. Molds are generally not poisonous, but they can produce toxins (including aflatoxin), which cause cancer. These toxins are not destroyed by any temperature adjustment as they are heat stable.

Yeasts require sugar and moisture to survive. They are found mostly in jellies and honey. They spoil food in the process of consuming it. Contamination is characterized by bubbles, an alcoholic smell or taste, pink discoloration, or slime (in fruit juices or on pickles). Yeasts are generally beneficial as they are an integral part of making bread, wine, and beer. They will cause spoilage in foods high in sugar or high in acid. A few diseases in human beings are caused by yeast but they are not foodborne or digestive illnesses by nature. To date, no evidence suggests any relationship between food and diseases by yeast.

CHAPTER 8 – FOODBORNE PATHOGENS

The following information is scientific data concerning foodborne pathogens commonly encountered. Much of this information can be found in the FDA's "Bad Bug Book" (http://www.cfsan.fda.gov/~mow/intro.html). An even more detailed discussion of these organisms can be found in Control of Communicable Diseases in Man, edited by Abram S. Beneson (which is updated periodically).

Salmonella spp.

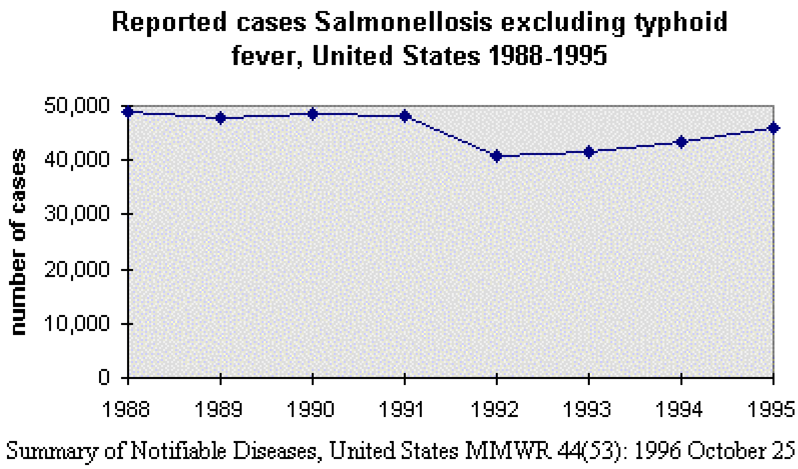
Salmonella are Gram-negative, rod-shaped, nonsporeforming motile bacterium (nonmotile exceptions are *S. gallinarum* and *S. pullorum*). There is a widespread occurrence of *Salmonella* in animals, especially in poultry and swine. Environmental sources of the organism include water, soil, insects, factory surfaces, kitchen surfaces, animal feces, raw meats, raw poultry, and raw seafoods, to name only a few. There are in excess of 2,500 serovars of *Salmonella* identified, all are pathogenic to man, although only a small number of these are frequently seen.

S. typhi and the paratyphoid bacteria are normally septicemic and produce typhoid or typhoid-like fever in humans. Other forms of salmonellosis generally produce milder symptoms. It is estimated that from 2 to 4 million cases of salmonellosis occur in the U.S. annually.

The acute symptoms associated with Salmonella infections are nausea, vomiting, abdominal cramps, diarrhea, fever, and headache. Chronic consequences -- arthritic symptoms may follow 3-4 weeks after onset of acute symptoms. The onset time is usually 6-48 hours. The infective dose can be as few as 15-20 cells, depending upon the age and health of the infected person, and also varies among strains (some seem to be more pathogenic than others). The disease is caused by the penetration and passage of *Salmonella* organisms from the gut into the epithelium of the small intestine where inflammation occurs; there is evidence that an enterotoxin may be produced, perhaps within the enterocyte. The acute symptoms may last for 1 to 2 days or may be prolonged, again depending on host factors, ingested dose, and strain characteristics.

Foods associated with *Salmonella* are raw meats, poultry, eggs, milk and dairy products, fish, shrimp, frog legs, yeast, coconut, sauces and salad dressing, cake mixes, cream-filled desserts and toppings, dried gelatin, peanut butter, cocoa, and chocolate. Various *Salmonella* species have long been isolated from the outside of eggshells. The present situation with *S. enteritidis* is complicated by the presence of the organism inside the egg, in the yolk. This and other information strongly suggest vertical transmission, i.e., deposition of the organism in the yolk by an infected layer hen prior to shell deposition.

The incidence of salmonellosis appears to be rising both in the U.S. and in other industrialized nations. *S. enteritidis* isolations from humans have shown a dramatic rise in the past decade, particularly in the northeast United States (6-fold or more), and the increase in human infections is spreading south and west, with sporadic outbreaks in other regions. The CDC estimates that 75% of those outbreaks are associated with the consumption of raw or inadequately cooked Grade A whole shell eggs.



Reported cases of Salmonellosis in the U.S. excluding typhoid fever for the years 1988 to 1995. The number of cases for each year varies between 40,000 and 50,000. From Summary of Notifiable Diseases, United States MMWR 44(53): 1996 (October 25).

The fatality rate of typhoid fever is 10% compared to less than 1% for most other forms of salmonellosis. *S. dublin* has a 15% mortality rate when septicemic in the elderly, and *S. enteritidis* is demonstrating approximately a 3.6% mortality rate in hospital/nursing home outbreaks. *Salmonella* septicemia has been associated with subsequent infection of virtually every organ system. Postenteritis reactive arthritis and Reiter's syndrome have also been reported to occur generally after 3 weeks. Reactive arthritis may occur with a frequency of about 2%. Septic arthritis, subsequent or coincident with septicemia, also occurs and can be difficult to treat.

All age groups are susceptible, but symptoms are most severe in the elderly, infants, and the infirm. AIDS patients suffer salmonellosis frequently (estimated 20-fold more than general population) and suffer from recurrent episodes. Although conventional culture methods require 5 days for presumptive results, several rapid methods are available which require only 2 days.

CASE STUDIES

In 1985, a salmonellosis outbreak involving 16,000 confirmed cases in 6 states was caused by low fat and whole milk from one Chicago dairy. This was the largest outbreak of foodborne salmonellosis in the U.S. FDA inspectors discovered that the pasteurization equipment had been modified to facilitate the running off of raw milk, resulting in the pasteurized milk being contaminated with raw milk under certain conditions. Persons on antibiotic therapy were more apt to be affected in this outbreak.

In August and September, 1985, *S. enteritidis* was isolated from employees and patrons of three restaurants of a chain in Maryland. The outbreak in one restaurant had at least 71 illnesses resulting in 17 hospitalizations. Scrambled eggs from a breakfast bar were epidemiologically implicated in this outbreak and in possibly one other of the three restaurants. The profiles of isolates from patrons of all three restaurants matched. The Centers for Disease Control (CDC) has recorded more than 120 outbreaks of *S. enteritidis* to date, many occurring in restaurants, and some in nursing homes, hospitals and prisons.

In 1984, 186 cases of salmonellosis (*S. enteritidis*) were reported on 29 flights to the United States on a single international airline. An estimated 2,747 passengers were affected overall. No specific food item was implicated, but food ordered from the first class menu was strongly associated with disease.

Listeria monocytogenes

This is a Gram-positive bacteria and is motile by means of flagella. Some studies suggest that 1-10% of humans may be intestinal carriers of *L. monocytogenes*. It has been found in at least 37 mammalian species, both domestic and feral, as well as at least 17 species of birds and possibly some species of fish and shellfish. It can be isolated from soil, silage, and other environmental sources. *L. monocytogenes* is quite hardy and resists the deleterious effects of freezing, drying, and heat remarkably well for a bacterium that does not form spores. Most *L. monocytogenes* are pathogenic to some degree. Listeriosis is the name of the general group of disorders caused by *L. monocytogenes*.

Listeriosis is clinically defined when the organism is isolated from blood, cerebrospinal fluid, or an otherwise normally sterile site (e.g. placenta, fetus). The manifestations of listeriosis include septicemia, meningitis (or meningoencephalitis), encephalitis, and intrauterine or cervical infections in pregnant women, which may result in spontaneous abortion (2nd/3rd trimester) or stillbirth. The onset of these aforementioned disorders is usually preceded by influenza-like symptoms including persistent fever. Gastrointestinal symptoms such as nausea, vomiting, and diarrhea may precede more serious forms of listeriosis or may be the only symptoms expressed. Gastrointestinal symptoms were epidemiologically associated with use of antacids or cimetidine. The onset time to serious forms of listeriosis is unknown but may range from a few days to three weeks. The onset time to gastrointestinal symptoms is unknown but is probably greater than 12 hours.

The infective dose of *L. monocytogenes* is unknown but is believed to vary with the strain and susceptibility of the victim. From cases contracted through raw or supposedly pasteurized milk, it is safe to assume that in susceptible persons, fewer than 1,000 total organisms may cause disease. *L. monocytogenes* may invade the gastrointestinal epithelium. Once the bacterium enters the host's monocytes, macrophages, or polymorphonuclear leukocytes, it is bloodborne (septicemic) and can grow. Its presence intracellularly in phagocytic cells also permits access to the brain and probably transplacental migration to the fetus in pregnant women. The pathogenesis of *L. monocytogenes* centers on its ability to survive and multiply in phagocytic host cells.

Listeriosis can only be positively diagnosed by culturing the organism from blood, cerebrospinal fluid, or stool (although the latter is difficult and of limited value).

L. monocytogenes has been associated with such foods as raw milk, supposedly pasteurized fluid milk, cheeses (particularly soft-ripened varieties), ice cream, raw vegetables, fermented raw-meat sausages, raw and cooked poultry, raw meats (all types), and raw and smoked fish. Its ability to grow at temperatures as low as 3^{o}C permits multiplication in refrigerated foods.

Incidence data collected in 1987 by CDC suggests that there are at least 1,600 cases of listeriosis with 415 deaths per year in the U.S. The vast majority of cases are sporadic, making epidemiological links to food very difficult. Most healthy persons probably show no symptoms. The "complications" are the usual clinical expressions of the disease.

When listeric meningitis occurs, the overall mortality may be as high as 70%; from septicemia 50%, from perinatal/neonatal infections greater than 80%. In infections during pregnancy, the mother usually survives.

The main target populations for listeriosis are pregnant women, immunocompromised persons, leukemia patients and the elderly. A listerosis outbreak in Switzerland involving cheese suggested that healthy uncompromised individuals could develop the disease, particularly if the foodstuff was heavily contaminated with the organism.

The methods for analysis of food are complex and time consuming. The present FDA method, revised in September, 1990, requires 24 and 48 hours of enrichment, followed by a variety of other tests. Total time to identification is from 5 to 7 days. Recombinant DNA technology may even permit 2-3 day positive analysis in the future.

Outbreaks include the California episode in 1985, which was due to Mexican-style cheese and led to numerous stillbirths. As a result of this episode, FDA has been monitoring domestic and imported cheeses and has taken numerous actions to remove these products from the market when *L. monocytogenes* is found.

There have been other clustered cases, such as in Philadelphia, PA, in 1987. Specific food linkages were only made epidemiologically in this cluster. CDC has established an epidemiological link between consumption of raw hot dogs or undercooked chicken and approximately 20% of the sporadic cases under prospective study.

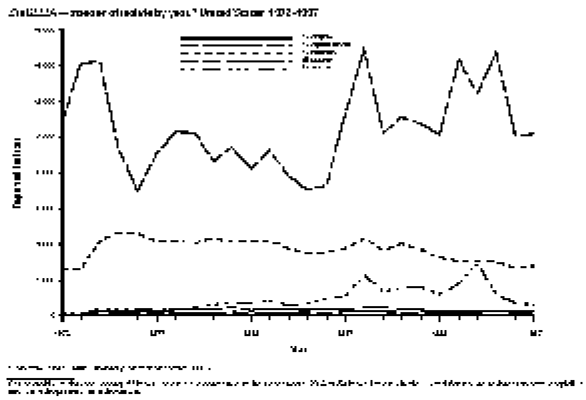
***Shigella* spp.** (*Shigella sonnei*, *S. boydii*, *S. flexneri*, and *S. dysenteriae*)

Shigella are Gram-negative, nonmotile, nonsporeforming rod-shaped bacteria. The illness caused by *Shigella* (shigellosis) accounts for less than 10% of the reported outbreaks of foodborne illness in this country. *Shigella* is principally a disease of humans and other primates such as monkeys and chimpanzees. The organism is frequently found in water polluted with human feces. Symptoms will include abdominal pain; cramps; diarrhea; fever; vomiting; blood, pus, or mucus in stools. The onset time is approximately 12 to 50 hours. The infective dose varies, but can be as few as 10 cells depending on age and condition of the host. The *Shigella spp.* are highly infectious agents that are transmitted by the fecal-oral route. The disease is caused when virulent *Shigella* organisms attach to, and penetrate, epithelial cells of the intestinal mucosa. After invasion, they multiply intracellularly, and spread to contiguous epitheleal cells resulting in tissue destruction. Some strains produce enterotoxin and Shiga toxin (very much like the verotoxin of *E. coli* O157:H7). Diagnosis is made by serological identification of culture isolated from stool.

Salads (potato, tuna, shrimp, macaroni, and chicken), raw vegetables, milk and dairy products, and poultry are foods that are commonly comntaminated with *Shigella* spp. Contamination of these foods is usually through the fecal-oral route. Fecally contaminated water and unsanitary handling by food handlers are the most common causes of contamination. An estimated 300,000 cases of shigellosis occur annually in the U.S. The number attributable to food is unknown, but given the low infectious dose, it is probably substantial.

Reported cases of Shigellosis, United States 1967-1997

Reported isolates of Shigella, United States 1972-1997



Infections are associated with mucosal ulceration, rectal bleeding, drastic dehydration; fatality may be as high as 10-15% with some strains. Reiter's disease, reactive arthritis, and hemolytic uremic syndrome are possible complications that have been reported in the aftermath of shigellosis. Infants, the elderly, and the infirm are susceptible to the severest symptoms of disease, but all humans are susceptible to some degree. Shigellosis is a very common malady suffered by individuals with acquired immune deficiency syndrome (AIDS) and AIDS-related complex, as well as non-AIDS homosexual men. Organisms are difficult to demonstrate in foods because methods are not developed or are insensitive.
From 1986 to 1988, the reported isolation rate of Shigella in the United States increased from 5.4 to 10.1 isolates per 100,000 persons. In addition to the increase in Shigella isolation rates, many communitywide shigellosis outbreaks that have been difficult to control have been reported.

CASE STUDY

In 1985, a huge outbreak of foodborne shigellosis occurred in Midland-Odessa, Texas, involving perhaps as many as 5,000 persons. The implicated food was chopped, bagged lettuce, prepared in a central location for a Mexican restaurant chain. FDA research subsequently showed that *S. sonnei*, the isolate from the lettuce, could survive in chopped lettuce under refrigeration, and the lettuce remained fresh and appeared to be quite edible.

Campylobacter jejuni

Campylobacter jejuni is a Gram-negative slender, curved, and motile rod. It is a microaerophilic organism, which means it has a requirement for reduced levels of oxygen. It is relatively fragile, and sensitive to environmental stresses (e.g., 21% oxygen, drying, heating, disinfectants, acidic conditions). Because of its microaerophilic characteristics the organism requires 3 to 5% oxygen and 2 to 10% carbon dioxide for optimal growth conditions. This bacterium is now recognized as an important enteric pathogen. Before 1972, when methods were developed for its isolation from feces, it was believed to be primarily an animal pathogen causing abortion and enteritis in sheep and cattle. Surveys have shown that *C. jejuni* is the leading cause of bacterial diarrheal illness in the United States. It causes more disease than *Shigella* spp. and *Salmonella* spp. combined.

Although *C. jejuni* is not carried by healthy individuals in the United States or Europe, it is often isolated from healthy cattle, chickens, birds and even flies. It is sometimes present in non-chlorinated water sources such as streams and ponds.

Because the pathogenic mechanisms of *C. jejuni* are still being studied, it is difficult to differentiate pathogenic from nonpathogenic strains. However, it appears that many of the chicken isolates are pathogens.

Campylobacteriosis is the name of the illness caused by *C. jejuni*. It is also often known as campylobacter enteritis or gastroenteritis. *C. jejuni* infection causes diarrhea, which may be watery or sticky and can contain blood (usually occult) and fecal leukocytes (white cells). Other symptoms often present are fever, abdominal pain, nausea, headache and muscle pain. The illness usually occurs 2-5 days after ingestion of the contaminated food or water. Illness generally lasts 7-10 days, but relapses are not uncommon (about 25% of cases). Most infections are self-limiting and are not treated with antibiotics. However, treatment with erythromycin does reduce the length of time that infected individuals shed the bacteria in their feces.

The infective dose of *C. jejuni* is considered to be small. Human feeding studies suggest that about 400-500 bacteria may cause illness in some individuals, while in others, greater numbers are required. A volunteer human feeding study suggested that host susceptibility also dictates infectious dose to some degree. The pathogenic mechanisms of *C. jejuni* are still not completely understood, but it does produce a heat-labile toxin that may cause diarrhea. *C. jejuni* may also be an invasive organism. *C. jejuni* is usually present in high numbers in the diarrheal stools of individuals, but isolation requires special antibiotic-containing media and a special microaerophilic atmosphere (5% oxygen). Most clinical laboratories are equipped to isolate *Campylobacter* spp. if requested. *C. jejuni* frequently contaminates raw chicken. Surveys show that 20 to 100% of retail chickens are contaminated. This is not overly surprising since many healthy chickens carry these bacteria in their intestinal tracts. Raw milk is also a source of infections. The bacteria are often carried by healthy cattle and by flies on farms. Non-chlorinated water may also be a source of infection. However, properly cooking chicken, pasteurizing milk, and chlorinating drinking water will kill the bacteria. As previously noted, *C. jejuni* is the leading cause of bacterial diarrhea in the U.S.

Complications are relatively rare, but infections have been associated with reactive arthritis, hemolytic uremic syndrome, and following septicemia, infections of nearly any organ. The estimated case/fatality ratio for all *C. jejuni* infections is 0.1, meaning one death per 1,000 cases. Fatalities are rare in healthy individuals and usually occur in cancer patients or in the

otherwise debilitated. Only 20 reported cases of septic abortion induced by *C. jejuni* have been recorded in the literature.
Meningitis, recurrent colitis, acute cholecystitis and Guillain-Barre syndrome are very rare complications. Although anyone can have a *C. jejuni* infection, children under 5 years and young adults (15-29) are more frequently afflicted than other age groups. Reactive arthritis, a rare complication of these infections, is strongly associated with people who have the human lymphocyte antigen B27 (HLA-B27).

Isolation of *C. jejuni* from food is very difficult because the bacteria are usually present in very low numbers (unlike the case of diarrheal stools in which 10^6 bacteria/gram is not unusual). The methods require an enrichment broth containing antibiotics, special antibiotic-containing plates and a microaerophilic atmosphere generally a microaerophilic atmosphere with 5% oxygen and an elevated concentration of carbon dioxide (10%). Isolation can take several days to a week.

Usually outbreaks are small (less than 50 people), but in Bennington, VT a large outbreak involving about 2,000 people occurred while the town was temporarily using an non-chlorinated water source as a water supply. Several small outbreaks have been reported among children who were taken on a class trip to a dairy and given raw milk to drink. An outbreak was also associated with consumption of raw clams. However, a survey showed that about 50% of infections are associated with either eating inadequately cooked or recontaminated chicken meat or handling chickens. It is the leading bacterial cause of sporadic (non-clustered cases) diarrheal disease in the U.S.

Staphylococcus aureus

S. aureus is a spherical bacterium (coccus) which on microscopic examination appears in pairs, short chains, or bunched, grape-like clusters. These organisms are Gram-positive. Some strains are capable of producing a highly heat-stable protein toxin that causes illness in humans. Staphylococcal food poisoning (staphyloenterotoxicosis; staphyloenterotoxemia) is the name of the condition caused by the enterotoxins which some strains of *S. aureus* produce.

The onset of symptoms in staphylococcal food poisoning is usually rapid and in many cases acute, depending on individual susceptibility to the toxin, the amount of contaminated food eaten, the amount of toxin in the food ingested, and the general health of the victim. The most common symptoms are nausea, vomiting, retching, abdominal cramping, and prostration. Some individuals may not always demonstrate all the symptoms associated with the illness. In more severe cases, headache, muscle cramping, and transient changes in blood pressure and pulse rate may occur. Recovery generally takes two days, however, it is not unusual for complete recovery to take three days and sometimes longer in severe cases.

A toxin dose of less than 1.0 microgram in contaminated food will produce symptoms of staphylococcal intoxication. This toxin level is reached when *S. aureus* populations exceed 100,000 per gram.

In the diagnosis of staphylococcal foodborne illness, proper interviews with the victims and gathering and analyzing epidemiologic data are essential. Incriminated foods should be collected and examined for staphylococci. The presence of relatively large numbers of enterotoxigenic staphylococci is good circumstantial evidence that the food contains toxin. The most conclusive test is the linking of an illness with a specific food or in cases where multiple vehicles exist, the detection of the toxin in the food sample(s). In cases where the food may have been treated to kill the staphylococci, as in pasteurization or heating, direct microscopic observation of the food may be an aid in the diagnosis. A number of serological methods for determining the enterotoxigenicity of *S. aureus* isolated from foods as well as methods for the separation and detection of toxins in foods have been developed and used successfully to aid in the diagnosis of the illness. Phage typing may also be useful when viable staphylococci can be isolated from the incriminated food, from victims, and from suspected carriers such as food handlers.

Foods that are frequently incriminated in staphylococcal food poisoning include meat and meat products; poultry and egg products; salads such as egg, tuna, chicken, potato, and macaroni; bakery products such as cream-filled pastries, cream pies, and chocolate eclairs; sandwich fillings; and milk and dairy products. Foods that require considerable handling during preparation and that are kept at slightly elevated temperatures after preparation are frequently involved in staphylococcal food poisoning.

Staphylococci exist in air, dust, sewage, water, milk, and food or on food equipment, environmental surfaces, humans, and animals. Humans and animals are the primary reservoirs. Staphylococci are present in the nasal passages and throats and on the hair and skin of 50 percent or more of healthy individuals. This incidence is even higher for those who associate with or who come in contact with sick individuals and hospital environments. Although food handlers are usually the main source of food contamination in food poisoning outbreaks, equipment and environmental surfaces can also be sources of contamination with *S. aureus*. Human intoxication is caused by ingesting enterotoxins produced in food by some strains of *S. aureus*, usually because the food has not been kept hot enough (60°C, 140°F, or above) or cold enough (5°C, 40°F, or below). The true incidence of staphylococcal food poisoning is unknown for a number of reasons, including poor responses from victims during interviews with health officials; misdiagnosis of the illness, which may be symptomatically similar to other types of food poisoning (such as vomiting caused by *Bacillus cereus* toxin); inadequate collection of samples for laboratory analyses; and improper laboratory examination. Of the bacterial pathogens causing foodborne illnesses in the U.S. (127 outbreaks, 7,082 cases recorded in 1983), 14 outbreaks involving 1,257 cases were caused by *S. aureus*. These outbreaks were followed by 11 outbreaks (1,153 cases) in 1984, 14 outbreaks (421 cases) in 1985, 7 outbreaks (250 cases) in 1986 and one reported outbreak (100 cases) in 1987.

Death from staphylococcal food poisoning is very rare, although such cases have occurred among the elderly, infants, and severely debilitated persons. All people are believed to be susceptible to this type of bacterial intoxication; however, intensity of symptoms may vary.

For detecting trace amounts of staphylococcal enterotoxin in foods incriminated in food poisoning, the toxin must be separated from food constituents and concentrated before identification by specific precipitation with antiserum (antienterotoxin) as follows. Two principles are used for the purpose: (1) the selective adsorption of the enterotoxin from an extract of the food onto ion exchange resins and (2) the use of physical and chemical procedures for the selective removal of food constituents from the extract, leaving the enterotoxin(s) in solution. The use of these techniques and concentration of the resulting products (as much as possible) has made it possible to detect small amounts of enterotoxin in food. There are developed rapid methods based on monoclonal antibodies (e.g., ELISA, Reverse Passive Latex Agglutination), which are being evaluated for their efficacy in the detection of enterotoxins in food. These rapid methods can detect approximately 1.0 nanogram of toxin/g of food.

In one outbreak, 1,364 children became ill out of a total of 5,824 who had eaten lunch served at 16 elementary schools in Texas. The lunches were prepared in a central kitchen and transported to the schools by truck. Epidemiological studies revealed that 95% of the children who became ill had eaten a chicken salad. The afternoon of the day preceding the lunch, frozen chickens were boiled for 3 hours. After cooking, the chickens were deboned, cooled to room temperature with a fan, ground into small pieces, placed into l2-inch-deep aluminum pans and stored overnight in a walk-in refrigerator at 42-45°F. The following morning, the remaining ingredients of the salad were added and the mixture was blended with an electric mixer. The food was placed in thermal containers and transported to the various schools at 9:30 AM to 10:30 AM, where it was kept at room temperature until served between 11:30 AM and noon. Bacteriological examination of the chicken salad revealed the presence of large numbers of *S. aureus*. Contamination of the chicken probably occurred when it was deboned. The chicken was not cooled rapidly enough because it was stored in l2-inch-deep layers. Growth of the staphylococcus probably occurred also during the period when the food was kept in the warm classrooms. Prevention of this incident would have entailed screening the individuals who deboned the chicken for carriers of the staphylococcus, more rapid cooling of the chicken, and adequate refrigeration of the salad from the time of preparation to its consumption.
In another outbreak in Queens, New York, 48 people became ill a median of 3 hours after eating lunch in a hospital employee cafeteria. One person was hospitalized. Canned mushrooms served at the salad bar were implicated. Two unopened cans of mushrooms from the same lot as the implicated can contained staphylococcal enterotoxin A.

In Philipsburg, Pennsylvania, 20 people developed illness several hours after eating food from a take-out pizzeria. Four people were hospitalized. Only pizza served with canned mushrooms was associated with illness. Staphylococcal enterotoxin was found in a sample of mushrooms from the pizzeria and in unopened cans with the same lot number.

Clostridium perfringens

Clostridium perfringens is an anaerobic, Gram-positive, sporeforming rod. It is widely distributed in the environment and frequently occurs in the intestines of humans and many domestic and feral animals. Spores of the organism persist in soil, sediments, and areas subject to human or animal fecal pollution. Perfringens food poisoning is the term used to describe the common foodborne illness caused by *C. perfringens*. A more serious but rare illness is also caused by ingesting food contaminated with Type C strains, and is known as enteritis necroticans or pig-bel disease. The common form of perfringens poisoning is characterized by intense abdominal cramps and diarrhea which begin 8-22 hours after consumption of foods containing large numbers of *C. perfringens* bacteria capable of producing the food poisoning toxin. The illness is usually over within 24 hours but less severe symptoms may persist in some individuals for 1 or 2 weeks. A few deaths have been reported as a result of dehydration and other complications.

Necrotic enteritis caused by *C. perfringens* is often fatal. This disease also begins as a result of ingesting large numbers of the causative bacteria in contaminated foods. Deaths from necrotic enteritis (pig-bel syndrome) are caused by infection and necrosis of the intestines and from resulting septicemia. This disease is very rare in the U.S. The symptoms are caused by ingestion of large numbers ($>10^8$) of vegetative cells. Toxin production in the digestive tract is associated with sporulation. This disease is a food infection; only one episode has ever implied the possibility of intoxication (disease from preformed toxin).

C. perfringens poisoning is diagnosed by its symptoms and the typical delayed onset of illness. Diagnosis is confirmed by detecting the toxin in the feces of patients. Bacteriological confirmation can also be done by finding exceptionally large numbers of the causative bacteria in implicated foods or in the feces of patients.

In most instances, the actual cause of poisoning by *C. perfringens* is temperature abuse of prepared foods. Small numbers of the organisms are often present after cooking and multiply to food poisoning levels during cool down and storage of prepared foods. Meats, meat products, and gravy are the foods most frequently implicated.

C. perfringens poisoning is one of the most commonly reported foodborne illnesses in the U.S. At least 10-20 outbreaks have been reported annually in the U.S. for the past 2 decades. Typically, dozens or even hundreds of person are affected. It is probable that many outbreaks go unreported because the implicated foods or patient feces are not tested routinely for *C. perfringens* or its toxin. CDC estimates that about 10,000 actual cases occur annually in the U.S.

Institutional feeding (such as school cafeterias, hospitals, nursing homes, prisons, etc.) where large quantities of food are prepared several hours before serving is the most common circumstance in which perfringens poisoning occurs. The young and elderly are the most frequent victims of perfringens poisoning. Except in the case of pig-bel syndrome, complications are few in persons under 30 years of age. Elderly persons are more likely to experience prolonged or severe symptoms.

Standard bacteriological culturing procedures are used to detect the organism in implicated foods and in feces of patients. Serological assays are used for detecting enterotoxin in the feces of patients and for testing the ability of strains to produce toxin. The procedures take 1-3 days.

In November, 1985, a large outbreak of *C. perfringens* gastroenteritis occurred among factory workers in Connecticut. Forty-four percent of the 1,362 employees were affected. Four main-course foods served at an employee banquet were associated with illness, but gravy was implicated by stratified analysis. The gravy had been prepared 12-24 hours before serving, had been improperly cooled, and was reheated shortly before serving. The longer the reheating period, the less likely the gravy was to cause illness.

The FDA investigated 10 outbreaks in 5 states. In two instances, more than one outbreak occurred in the same feeding facility within a 3-week period. One such outbreak occurred involving 77 prison inmates. Roast beef served as a luncheon meat was implicated as the food vehicle and *C. perfringens* was confirmed as the cause by examining stools of 24 patients. Most of the patients became ill 8-16 hours after the meal. Eight days later, a second outbreak occurred involving many of the same persons. The food vehicle was ham. Inadequate refrigeration and insufficient reheating of the implicated foods caused the outbreaks. Most of the other outbreaks occurred in institutional feeding environments: a hospital, nursing home, labor camp, school cafeteria, and at a fire house luncheon.

***Bacillus cereus* and other *Bacillus* spp.**

Bacillus cereus is a Gram-positive, facultatively aerobic sporeformer whose cells are large rods and whose spores do not swell the sporangium. These and other characteristics, including biochemical features, are used to differentiate and confirm the presence *B. cereus*, although these characteristics are shared with *B. cereus* var. mycoides, *B. thuringiensis* and *B.*

anthracis. Differentiation of these organisms depends upon determination of motility (most *B. cereus* are motile), presence of toxin crystals (*B. thuringiensis*), hemolytic activity (*B. cereus* and others are beta hemolytic whereas *B. anthracis* is usually nonhemolytic), and rhizoid growth which is characteristic of *B. cereus* var. mycoides.

B. cereus food poisoning is the general description, although two recognized types of illness are caused by two distinct metabolites. The diarrheal type of illness is caused by a large molecular weight protein, while the vomiting (emetic) type of illness is believed to be caused by a low molecular weight, heat-stable peptide.

The symptoms of *B. cereus* diarrheal type food poisoning mimic those of *Clostridium perfringens* food poisoning. The onset of watery diarrhea, abdominal cramps, and pain occurs 6-15 hours after consumption of contaminated food. Nausea may accompany diarrhea, but vomiting (emesis) rarely occurs. Symptoms persist for 24 hours in most instances.

The emetic type of food poisoning is characterized by nausea and vomiting within 0.5 to 6 hours after consumption of contaminated foods. Occasionally, abdominal cramps and/or diarrhea may also occur. Duration of symptoms is generally less than 24 hours. The symptoms of this type of food poisoning parallel those caused by *Staphylococcus aureus* foodborne intoxication. Some strains of *B. subtilis* and *B. licheniformis* have been isolated from lamb and chicken incriminated in food poisoning episodes. These organisms demonstrate the production of a highly heat-stable toxin that may be similar to the vomiting type toxin produced by *B. cereus*.

The presence of large numbers of *B. cereus* (greater than 10^6 organisms/g) in a food is indicative of active growth and proliferation of the organism and is consistent with a potential hazard to health.

Confirmation of *B. cereus* as the etiologic agent in a foodborne outbreak requires either (1) isolation of strains of the same serotype from the suspect food and feces or vomitus of the patient, (2) isolation of large numbers of a *B. cereus* serotype known to cause foodborne illness from the suspect food or from the feces or vomitus of the patient, or (3) isolation of *B. cereus* from suspect foods and determining their enterotoxigenicity by serological (diarrheal toxin) or biological (diarrheal and emetic) tests. The rapid onset time to symptoms in the emetic form of disease, coupled with some food evidence, is often sufficient to diagnose this type of food poisoning.

A wide variety of foods including meats, milk, vegetables, and fish have been associated with the diarrheal type food poisoning. The vomiting-type outbreaks have generally been associated with rice products; however, other starchy foods such as potato, pasta and cheese products have also been implicated. Food mixtures such as sauces, puddings, soups, casseroles, pastries, and salads have frequently been incriminated in food poisoning outbreaks.

In 1980, 9 outbreaks were reported to the Centers for Disease Control and included such foods as beef, turkey, and Mexican foods. In 1981, 8 outbreaks were reported which primarily involved rice and shellfish. Other outbreaks go unreported or are misdiagnosed because of symptomatic similarities to *Staphylococcus aureus* intoxication (*B. cereus* vomiting-type) or *C. perfringens* food poisoning (B. cereus diarrheal type). Although no specific complications have been associated with the diarrheal and vomiting toxins produced by *B. cereus*, other clinical manifestations of *B. cereus* invasion or contamination have been observed. They include bovine mastitis, severe systemic and pyogenic infections, gangrene, septic meningitis, cellulitis, panophthalmitis, lung abscesses, infant death, and endocarditis. All people are believed to be susceptible to *B. cereus* food poisoning.

A variety of methods have been recommended for the recovery, enumeration and confirmation of *B. cereus* in foods. More recently, a serological method has been developed for detecting the putative enterotoxin of *B. cereus* (diarrheal type) isolates from suspect foods. Recent investigations suggest that the vomiting type toxin can be detected by animal models (cats, monkeys) or possibly by cell culture.

CASE STUDIES

On July 21, 1993, the Lord Fairfax (Virginia) Health District received reports of acute gastrointestinal illness that occurred among children and staff at two jointly owned child day care centers following a catered lunch. Of the 80 persons, 67 ate the catered lunch. Chicken fried rice prepared at a local restaurant was the only food significantly associated with illness; illness occurred in 14 (29%) of 48 persons who ate chicken fried rice, compared with none of 16 who did not. *Bacillus cereus* was isolated from leftover chicken fried rice and from vomitus from one ill child but not from samples of leftover milk.

On September 22, 1985, the Maine Bureau of Health was notified of a gastrointestinal illness among patrons of a Japanese restaurant. The customers exhibited symptoms of illness while still on the restaurant premises. While the question of the specific vehicle remains incompletely resolved, the clinical and laboratory findings substantially support *Bacillus cereus* as the cause of the outbreak.

Clostridium botulinum

Clostridium botulinum is an anaerobic, Gram-positive, spore-forming rod that produces a potent neurotoxin. The spores are heat-resistant and can survive in foods that are incorrectly or minimally processed. Seven types (A, B, C, D, E, F and G) of botulism are recognized, based on the antigenic specificity of the toxin produced by each strain. Types A, B, E and F cause human botulism. Types C and D cause most cases of botulism in animals. Animals most commonly affected are wild fowl and poultry, cattle, horses and some species of fish.

Foodborne botulism (as distinct from wound botulism and infant botulism) is a severe type of food poisoning caused by the ingestion of foods containing the potent neurotoxin formed during growth of the organism. The toxin is heat labile and can be destroyed if heated at 80°C for 10 minutes or longer. The incidence of the disease is low, but the disease is of considerable concern because of its high mortality rate if not treated immediately and properly. Most of the 10 to 30 outbreaks that are reported annually in the United States are associated with inadequately processed, home-canned foods, but occasionally commercially produced foods have been involved in outbreaks. Sausages, meat products, canned vegetables and seafood products have been the most frequent vehicles for human botulism.

The organism and its spores are widely distributed in nature. They occur in both cultivated and forest soils, bottom sediments of streams, lakes, and coastal waters, and in the intestinal tracts of fish and mammals, and in the gills and viscera of crabs and other shellfish.

Four types of botulism are recognized: foodborne, infant, wound, and a form of botulism whose classification is as yet undetermined. Certain foods have been reported as sources of spores in cases of infant botulism and the undetermined category; wound botulism is not related to foods. Foodborne botulism is the name of the disease (actually a foodborne intoxication) caused by the consumption of foods containing the neurotoxin produced by *C. botulinum*.

Infant botulism, first recognized in 1976, affects infants under 12 months of age. This type of botulism is caused by the ingestion of *C. botulinum* spores which colonize and produce toxin in the intestinal tract of infants (intestinal toxemia botulism). Of the various potential environmental sources such as soil, cistern water, dust and foods, honey is the one dietary reservoir of *C. botulinum* spores thus far definitively linked to infant botulism by both laboratory and epidemiologic studies. The number of confirmed infant botulism cases has increased significantly as a result of greater awareness by health officials since its recognition in 1976. It is now internationally recognized, with cases being reported in more countries.

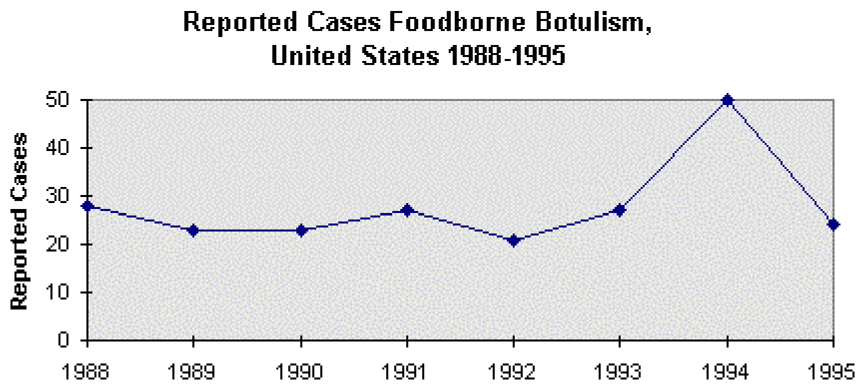
Wound botulism is the rarest form of botulism. The illness results when *C. botulinum* by itself or with other microorganisms infects a wound and produces toxins which reach other parts of the body via the blood stream. Foods are not involved in this type of botulism.

Undetermined categories of botulism involves adult cases in which a specific food or wound source cannot be identified. It has been suggested that some cases of botulism assigned to this category might result from intestinal colonization in adults, with in vivo production of toxin. Reports in the medical literature suggest the existence of a form of botulism similar to infant botulism, but occurring in adults. In these cases, the patients had surgical alterations of the gastrointestinal tract and/or antibiotic therapy. It is proposed that these procedures may have altered the normal gut flora and allowed *C. botulinum* to colonize the intestinal tract.

A very small amount (a few nanograms) of toxin can cause illness. The onset of symptoms in foodborne botulism is usually within 18 to 36 hours after ingestion of the food containing the toxin, although cases have varied from 4 hours to 8 days. Early signs of intoxication consist of marked lassitude, weakness and vertigo, usually followed by double vision and progressive difficulty in speaking and swallowing. Difficulty in breathing, weakness of other muscles, abdominal distention, and constipation may also be common symptoms.

Although botulism can be diagnosed by clinical symptoms alone, differentiation from other diseases may be difficult. The most direct and effective way to confirm the clinical diagnosis of botulism in the laboratory is to demonstrate the presence of toxin in the serum or feces of the patient or in the food that the patient consumed. Currently, the most sensitive and widely used method for detecting toxin is the mouse neutralization test. This test takes 48 hours. Culturing of specimens takes 5-7 days. The types of foods involved in botulism vary according to food preservation and eating habits in different regions. Any food that is conducive to outgrowth and toxin production, that when processed allows spore survival, and is not subsequently heated before consumption can be associated with botulism. Almost any type of food that is not very acidic (pH above 4.6) can support growth and toxin production by *C. botulinum*. Botulinal toxin has been demonstrated in a wide variety of foods, such as canned corn, peppers, green beans, soups, beets, asparagus, mushrooms, ripe olives, spinach, tuna fish, chicken and chicken livers and liver pate, and luncheon meats, ham, sausage, stuffed eggplant, lobster, and smoked and salted fish.

The incidence of the disease is low, but the mortality rate is high if not treated immediately and properly. There are generally between 10 to 30 outbreaks a year in the United States. Some cases of botulism may go undiagnosed because symptoms are transient or mild, or misdiagnosed as Guillain-Barre syndrome.



Summary of Notifiable Diseases, United States MMWR 44(53): 1996 October 25

Botulinum toxin causes flaccid paralysis by blocking motor nerve terminals at the myoneural junction. The flaccid paralysis progresses symmetrically downward, usually starting with the eyes and face, to the throat, chest and extremities. When the diaphragm and chest muscles become fully involved, respiration is inhibited and death from asphyxia results. Recommended treatment for foodborne botulism includes early administration of botulinal antitoxin (available from CDC) and intensive supportive care (including mechanical breathing assistance). All people are believed to be susceptible to the foodborne intoxication. Since botulism is foodborne and results from ingestion of the toxin of *C. botulinum*, determination of the source of an outbreak is based on detection and identification of toxin in the food involved. The most widely accepted method is the injection of extracts of the food into passively immunized mice (mouse neutralization test). The test takes 48 hours. This analysis is followed by culturing all suspect food in an enrichment medium for the detection and isolation of the causative organism. This test takes 7 days.

Two separate outbreaks of botulism have occurred involving commercially canned salmon. Restaurant foods such as sauteed onions, chopped bottled garlic, potato salad made from baked potatoes and baked potatoes themselves have been responsible for a number of outbreaks. Also, smoked fish, both hot and cold-smoke (e.g., Kapchunka) have caused outbreaks of type E botulism.

In October and November, 1987, 8 cases of type E botulism occurred, 2 in New York City and 6 in Israel. All 8 patients had consumed Kapchunka, an uneviscerated, dry-salted, air-dried, whole whitefish. The product was made in New York City and some of it was transported by individuals to Israel. All 8 patients with botulism developed symptoms within 36 hours of consuming the Kapchunka. One female died, 2 required breathing assistance, 3 were treated therapeutically with antitoxin, and 3 recovered spontaneously. The Kapchunka involved in this outbreak contained high levels of type E botulinal toxin despite salt levels that exceeded those sufficient to inhibit *C. botulinum* type E outgrowth. One possible explanation was that the fish contained low salt levels when air-dried at room temperature, became toxic, and then were re-brined. Regulations were published to prohibit the processing, distribution and sale of Kapchunka and Kapchunka-type products in the United States.

A bottled chopped garlic-in-oil mix was responsible for three cases of botulism in Kingston, N.Y. Two men and a woman were hospitalized with botulism after consuming a chopped garlic-in-oil mix that had been used in a spread for garlic bread. The bottled chopped garlic relied solely on refrigeration to ensure safety and did not contain any additional antibotulinal additives or barriers. The FDA has ordered companies to stop making the product and to withdraw from the market any garlic-in-oil mix which does not include microbial inhibitors or acidifying agents and does not require refrigeration for safety.

***Escherichia coli* O157:H7**

Currently, there are four recognized classes of enterovirulent *E. coli* (collectively referred to as the EEC group) that cause gastroenteritis in humans. Among these is the enterohemorrhagic (EHEC) strain designated *E. coli* O157:H7. *E. coli* is a normal inhabitant of the intestines of all animals, including humans. When aerobic culture methods are used, *E. coli* is the dominant species found in feces. Normally *E. coli* serves a useful function in the body by suppressing the growth of harmful bacterial species and by synthesizing appreciable amounts of vitamins. A minority of *E. coli* strains are capable of causing human illness by several different mechanisms. *E. coli* serotype O157:H7 is a rare variety of *E. coli* that produces large quantities of one or more related, potent toxins that cause severe damage to the lining of the intestine. These toxins [verotoxin (VT), shiga-like toxin] are closely related or identical to the toxin produced by *Shigella dysenteriae*. Hemorrhagic colitis is the name of the acute disease caused by *E. coli* O157:H7.

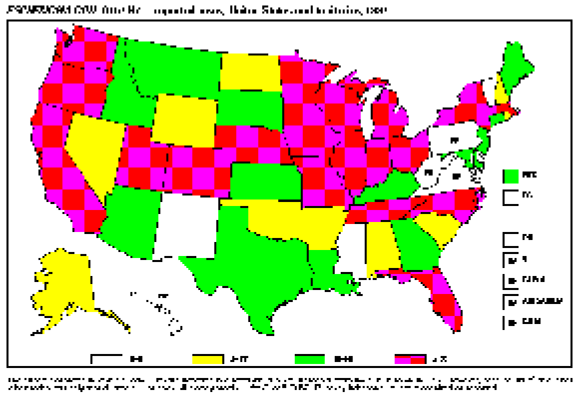
The illness is characterized by severe cramping (abdominal pain) and diarrhea that is initially watery but becomes grossly bloody. Occasionally vomiting occurs. Fever is either low-grade or absent. The illness is usually self-limiting and lasts for an average of 8 days. Some individuals exhibit watery diarrhea only.

The infective dose is currently unknown, but from a compilation of outbreak data, including the organism's ability to be passed person-to-person in the day-care setting and nursing homes, the dose may be similar to that of *Shigella* spp. (as few as 10 organisms).

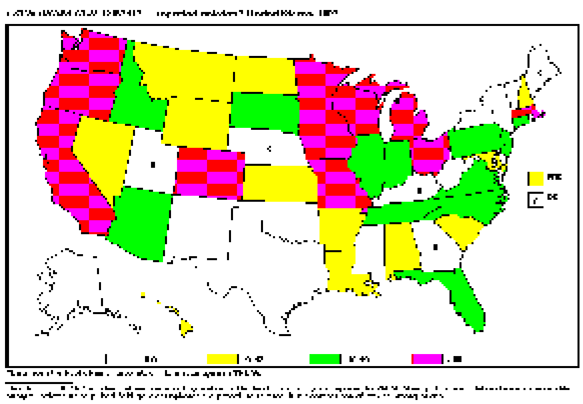
Hemorrhagic colitis is diagnosed by isolation of *E. coli* of serotype O157:H7 or other verotoxin-producing *E. coli* from diarrheal stools. Alternatively, the stools can be tested directly for the presence of verotoxin. Confirmation can be obtained by isolation of *E. coli* of the same serotype from the incriminated food. Undercooked or raw hamburger (ground beef) has been implicated in many of the documented outbreaks, however *E. coli* O157:H7 outbreaks have implicated alfalfa sprouts, unpasteurized fruit juices, dry-cured salami, lettuce, game meat, and cheese curds. Raw milk was the vehicle in a school outbreak in Canada.

Hemorrhagic colitis infections are not too common, but this is probably not reflective of the true frequency. In the Pacific Northwest, *E. coli* O157:H7 is thought to be second only to *Salmonella* as a cause of bacterial diarrhea. Because of the unmistakable symptoms of profuse, visible blood in severe cases, those victims probably seek medical attention, but less severe cases are probably more numerous.

Reported cases of Ecoli O157, United States 1997



Reported isolates of Ecoli O157, United States 1997



Some victims, particularly the very young, have developed the hemolytic uremic syndrome (HUS), characterized by renal failure and hemolytic anemia. Up to 15% of hemorrhagic colitis victims may develop HUS. The disease can lead to permanent loss of kidney function.

In the elderly, HUS, plus two other symptoms, fever and neurologic symptoms, constitutes thrombotic thrombocytopenic purpura (TTP). This illness can have a mortality rate in the elderly as high as 50%. All people are believed to be susceptible to hemorrhagic colitis, but young children and the elderly appear to progress to more serious symptoms more frequently.

Several microbiological methods can be used to isolate *E. coli* O157:H7 from foods. Unlike typical *E. coli*, isolates of O157:H7 do not ferment sorbitol and are negative with the MUG assay (a lab test that identifies a functional gene that most *E.coli* have, but O157:H7 strains do not); therefore, these criteria are commonly used for selective isolation. Sorbitol-MacConkey agar has been used extensively to isolate this organism from clinical specimens. Hemorrhagic colitis agar, a selective and differential medium, is used in a direct plating method to isolate O157:H7 from foods. A third procedure uses Sorbitol-MacConkey medium containing potassium tellurite and Cefixime. It includes an enrichment step and is a new method developed as result of the recent foodborne outbreaks. Rapid methods using a variety of technologies, including recombinant DNA methods, are being developed.

CASE STUDIES

On June 15, 1998, the Division of Public Health, Wisconsin Department of Health and Family Services, was notified of eight laboratory-confirmed and four suspected Escherichia coli O157:H7 infections among west-central Wisconsin residents who became ill during June 8--12. This report summarizes the outbreak investigation, which implicated fresh (held <60 days) cheese curds from a dairy plant as the source of infection.

On September 3, 1999, the New York State Department of Health (NYSDOH) received reports of at least 10 children hospitalized with bloody diarrhea or *Escherichia coli* O157:H7 infection in counties near Albany, New York. All of the children had attended the Washington County Fair, which was held August 23-29, 1999; approximately 108,000 persons attended the fair during that week. Subsequently, fair attendees infected with *Campylobacter jejuni* also were identified. An ongoing investigation includes heightened case-finding efforts, epidemiologic and laboratory studies, and an environmental investigation of the Washington County fairgrounds.

In June and July 1997, simultaneous outbreaks of *Escherichia coli* O157:H7 infection in Michigan and Virginia were independently associated with eating alfalfa sprouts grown from the same seed lot. The outbreak strains in Michigan and Virginia were indistinguishable by molecular subtyping methods.

Vibrio vulnificus

This organism causes wound infections, gastroenteritis, or a syndrome known as "primary septicemia." Wound infections result either from contaminating an open wound with sea water harboring the organism, or by lacerating part of the body on coral, fish, etc., followed by contamination with the organism. The ingestion of *V. vulnificus* by healthy individuals can result in gastroenteritis. The "primary septicemia" form of the disease follows consumption of raw seafood containing the organism by individuals with underlying chronic disease, particularly liver disease. In these individuals, the microorganism enters the blood stream, resulting in septic shock, rapidly followed by death in many cases (about 50%). Over 70% of infected individuals have distinctive bulbous skin lesions.

The infective dose for gastrointestinal symptoms in healthy individuals is unknown but for predisposed persons, septicemia can presumably occur with doses of less than 100 total organisms. The culturing of the organism from wounds, diarrheic stools, or blood is diagnostic of this illness. This organism has been isolated from oysters, clams, and crabs. Consumption of these products raw or recontaminated may result in illness. No major outbreaks of illness have been attributed to this organism. Sporadic cases occur frequently, becoming more prevalent during the warmer months.

In a survey of cases of *V. vulnificus* infections in Florida from 1981 to 1987, Klontz et al. (Annals of Internal Medicine 109:318-23;1988) reported that 38 cases of primary septicemia (ingestion), 17 wound infections, and 7 cases gastroenteritis were associated with the organism. Mortality from infection varied from 55% for primary septicemia cases, to 24% with wound infections, to no deaths associated with gastroenteritis. Raw oyster consumption was a common feature of primary septicemia and gastroenteritis, and liver disease was a feature of primary septicemia.

All individuals who consume foods contaminated with this organism are susceptible to gastroenteritis. Individuals with diabetes, cirrhosis, or leukemia, or those who take immunosuppressive drugs or steroids are particularly susceptible to primary septicemia. These individuals should be strongly advised not to consume raw or inadequately cooked seafood, as should AIDS / ARC patients.

Methods used to isolate this organism from foods are similar to those used with diarrheic stools. To date, all food isolates of this organism have been pathogenic in animal models. FDA has a genetic probe for *V. vulnificus*; its target is a cytotoxin gene that appears not to correlate with the organism's virulence. Sporadic cases continue to occur all year, increasing in frequency during the warmer months. Of all foodborne infectious diseases, infection with *Vibrio vulnificus* is one of the most severe; the case-fatality rate for *V. vulnificus* septicemia exceeds 50% (1,2). Cases are most commonly reported during warm-weather months (April-November), and often are associated with eating raw oysters. During April 1993-May 1996, a total of 16 cases of *V. vulnificus* infection were reported in Los Angeles County.

Vibrio parahaemolyticus

V. parahaemolyticus-associated gastroenteritis is the name of the infection caused by this organism. Diarrhea, abdominal cramps, nausea, vomiting, headache, fever, and chills may be associated with infections caused by this organism. The illness is usually mild or moderate, although some cases may require hospitalization. The median duration of the illness is about 3 days. The incubation period is 4-96 hours after the ingestion of the organism, with an average of 15 hours. Disease is caused when the organism attaches itself to an individuals' small intestine and excretes an as yet unidentified toxin.

Major outbreaks have occurred in the U.S. during the warmer months of the year. Sporadic cases occur along all coasts of the U.S. Diarrhea caused by this organism is usually self-limiting, with few cases requiring hospitalization and/or antibiotic treatment. All individuals who consume raw or improperly cooked fish and shellfish are susceptible to infection by this organism.

The infective dose is thought to be greater than one million organisms to cause disease; this dose may be markedly lowered by coincident consumption of antacids (or presumably by food with buffering capability). Diagnosis of gastroenteritis caused by this organism is made by culturing the organism from the diarrheic stools of an individual.

Infections with this organism have been associated with the consumption of raw, improperly cooked, or cooked, recontaminated fish and shellfish. A correlation exists between the probability of infection and warmer months of the year. Improper refrigeration of seafoods contaminated with this organism will allow its proliferation, which increases the possibility of infection.

Methods used to isolate this organism from foods are similar to those used with diarrheic stools. Because many food isolates are nonpathogenic, pathogenicity of all food isolates must be demonstrated. Although the demonstration of the Kanagawa hemolysin was long considered indicative of pathogenicity, this is now uncertain.

Several other marine vibrios have been implicated in human disease. Some may cause wound or ear infections, and others, gastroenteritis. The amount of evidence for certain of these organisms as being causative of human gastroenteritis is small. Nonetheless, several have been isolated from human feces from diarrhea patients from which no other pathogens could be isolated. Methods for recovery of these organisms from foods are similar to those used for recovery of *V. parahaemolyticus*. The species implicated in human disease include:

Vibrio alginolyticus	*Vibrio furnissii*	*Vibrio carchariae*	*Vibrio hollisae*
Vibrio cincinnatiensis	*Vibrio metschnikovii*	*Vibrio damsela*	*Vibrio mimicus*
Vibrio fluvialis			

CASE STUDY

During July-September 1998, an outbreak of *Vibrio parahaemolyticus* infections associated with consumption of oysters and clams harvested from Long Island Sound occurred among residents of Connecticut, New Jersey, and New York. This is the first reported outbreak of *V. parahaemolyticus* linked to consumption of shellfish harvested from New York waters. During July-August 1997, the largest reported outbreak in North America of culture-confirmed *Vibrio parahaemolyticus* infections occurred. Illness in 209 persons was associated with eating raw oysters harvested from California, Oregon, and Washington in the United States and from British Columbia (BC) in Canada; one person died.

Yersinia enterocolitica

Y. enterocolitica, a small rod-shaped, Gram-negative bacterium, is often isolated from clinical specimens such as wounds, feces, sputum and mesenteric lymph nodes. However, it is not part of the normal human flora. *Y. pseudotuberculosis* has been isolated from the diseased appendix of humans.

Both organisms have often been isolated from such animals as pigs, birds, beavers, cats, and dogs. Only *Y. enterocolitica* has been detected in environmental and food sources, such as ponds, lakes, meats, ice cream, and milk. Most isolates have been found not to be pathogenic.

There are 3 pathogenic species in the genus *Yersinia*, but only *Y. enterocolitica* and *Y. pseudotuberculosis* cause gastroenteritis. To date, no foodborne outbreaks caused by *Y. pseudotuberculosis* have been reported in the United States, but human infections transmitted via contaminated water and foods have been reported in Japan. *Y. pestis*, the causative agent of bubonic plague, is genetically very similar to *Y. pseudotuberculosis* but infects humans by routes other than food.

Yersiniosis is frequently characterized by such symptoms as gastroenteritis with diarrhea and/or vomiting; however, fever and abdominal pain are the hallmark symptoms. *Yersinia* infections mimic appendicitis and mesenteric lymphadenitis, but the bacteria may also cause infections of other sites such as wounds, joints and the urinary tract.

Illness onset is usually between 24 and 48 hours after ingestion, which is the usual route of infection. The true infective dose has not been established.

Diagnosis of yersiniosis begins with isolation of the organism from the human host's feces, blood, or vomit, and sometimes at the time of appendectomy. Confirmation occurs with the isolation, as well as biochemical and serological identification, of *Y. enterocolitica* from both the human host and the ingested foodstuff. Diarrhea is reported to occur in about 80% of cases; abdominal pain and fever are the most reliable symptoms.

Because of the difficulties in isolating *yersiniae* from feces, several countries rely on serology. Acute and convalescent patient sera are titered against the suspect serotype of *Yersinia spp*. Yersiniosis has been misdiagnosed as Crohn's disease (regional enteritis) as well as appendicitis.

Strains of *Y. enterocolitica* can be found in meats (pork, beef, lamb, etc.), oysters, fish, and raw milk. The exact cause of the food contamination is unknown. However, the prevalence of this organism in the soil and water and in animals such as beavers, pigs, and squirrels, offers

ample opportunities for it to enter our food supply. Poor sanitation and improper sterilization techniques by food handlers, including improper storage, cannot be overlooked as contributing to contamination. Yersiniosis does not occur frequently. It is rare unless a breakdown occurs in food processing techniques. CDC estimates that about 17,000 cases occur annually in the USA. Yersiniosis is a far more common disease in Northern Europe, Scandinavia, and Japan.
The major "complication" is the performance of unnecessary appendectomies, since one of the main symptoms of infections is abdominal pain of the lower right quadrant.

Both *Y. enterocolitica* and *Y. pseudotuberculosis* have been associated with reactive arthritis, which may occur even in the absence of obvious symptoms. The frequency of such postenteritis arthritic conditions is about 2-3%. Another complication is bacteremia (entrance of organisms into the blood stream), in which case the possibility of a disseminating disease may occur. This is rare, however, and fatalities are also extremely rare.

The most susceptible populations for the main disease and possible complications are the very young, the debilitated, the very old and persons undergoing immunosuppressive therapy. The isolation method is relatively easy to perform, but in some instances, cold enrichment may be required. *Y. enterocolitica* can be presumptively identified in 36-48 hours. However, confirmation may take 14-21 days or more. Determination of pathogenicity is more complex.

CASE STUDIES

In 1976, an outbreak attributed to chocolate milk occurred in Oneida County, N.Y. involving school children (first reported yersiniosis incident in the United States in which a food vehicle was identified). A research laboratory was set up by FDA to investigate and study *Y. enterocolitica* and *Y. pseudotuberculosis* in the human food supply.

From December 1981 to February 1982, there was an outbreak of *Y. enterocolitica* enteritis in King County, Washington caused by ingestion of tofu. The source of the infection was found to be a non-chlorinated water supply. Manufacturing was halted until uncontaminated product was produced.

In June and July of 1982, there was a *Y. enterocolitica* outbreak in Arkansas, Tennessee, and Mississippi associated with the consumption of pasteurized milk. The source was presumptively identified as externally contaminated milk containers.

Foodborne Illnesses: Bacterial Agents

Etiology	Incubation Period	Signs and Symptoms	Duration of Illness	Associated Foods	Laboratory Testing
Bacillus anthracis	2 days to weeks	Nausea, vomiting, malaise, bloody diarrhea, acute abdominal pain.	Weeks	Insufficiently cooked contaminated meat.	Blood.
Bacillus cereus (diarrheal toxin)	10–16 hours	Abdominal cramps, watery diarrhea, nausea.	24–48 hours	Meats, stews, gravies, vanilla sauce.	Testing not necessary, self-limiting (consider testing food and stool for toxin in outbreaks).

Bacillus cereus (pre-formed enterotoxin)	1-6 hrs	Sudden onset of severe nausea and vomiting. Diarrhea may be present.	24 hrs	Improperly refrigerated cooked and fried rice, meats.	Normally a clinical diagnosis. Clinical laboratories do not routinely identify this organism. If indicated, send stool and food specimens to reference laboratory for culture and toxin identification.
Brucella abortus, B. melitensis, and B. suis	7-21 days	Fever, chills, sweating, weakness, headache, muscle and joint pain, diarrhea, bloody stools during acute phase.	Weeks	Raw milk, goat cheese made from unpasteurized milk, contaminated meats.	Blood culture and positive serology.
Campylobacter jejuni	2-5 days	Diarrhea, cramps, fever, and vomiting; diarrhea may be bloody.	2-10 days	Raw and undercooked poultry, unpasturized milk, contaminated water.	Routine stool culture; *Campylobacter* requires special media and incubation at 42^{o}C to grow.
Clostridium botulinum - children and adults (pre-formed toxin)	12-72 hrs	Vomiting, diarrhea, blurred vision, diplopia, dysphagia, and descending muscle weakness.	Variable (from days to months). Can be complicated by respiratory failure and death.	Home-canned foods with a low acid content, improperly canned commercial foods, home-canned or fermented fish, herb-infused oils, baked potatoes in aluminium foil, cheese sauce, bottled garlic, foods held warm for extended periods of time (eg. in a warm oven).	Stool, serum, and food can be tested for toxin. Stool and food can also be cultured for the organism. These tests can be performed at some State Health Department Laboratories and CDC.
Clostridium botulinum - infants	3-30 days	In infants <12 months, lethargy, weakness, poor feeding, constipation, hypotonia, poor head control, poor gag and suck.	Variable	Honey, home-canned vegetables and fruits.	Stool, serum, and food can be tested for toxin. Stool and food can also be cultured for the organism. These tests can be performed at some State Health Department laboratories and CDC.
Clostridium perfringens toxin	8-16 hrs	Watery diarrhea, nausea, abdominal cramps; fever is rare.	24-48 hrs	Meats, poultry, gravy, dried or precooked foods.	Stools can be tested for enterotoxin and cultured for organism. Because *Clostridium perfringens* can normally be found in stool, quantitative cultures must be done.

Enterohemorr-hagic *E. coli* (EHEC) including *E. coli* 0157:H7 and other Shiga toxin-producing *E. coli* (STEC)	1-8 days	Severe diarrhea that is often bloody, abdominal pain and vomiting. Usually, little or no fever is present. More common in children <4 years.	5-10 days.	Undercooked beef, unpasteurized milk and juice, raw fruits and vegetables (eg. sprouts), salami, salad dressing,and contaminated water.	Stool culture; *E. coli* O157:H7 requires special media to grow. If *E. coli* O157:H7 is suspected, specific testing must be requested. Shiga toxin testing may be done using commercial kits; positive isolates should be forwarded to public health laboratories for confirmation and serotyping.
Enterotoxigenic *E. coli* (ETEC)	1-3 days	Watery diarrhea, abdominal cramps, some vomiting.	3->7 days	Water or food contaminated with human feces.	Stool culture. ETEC requires special laboratory techniques for identification. If suspected, must request specific testing.
Listeria monocytogenes	9-48 hrs for gastrointestinal symptoms, 2-6 weeks for invasive disease	Fever, muscle aches, and nausea or diarrhea. Pregnant women may have mild flu-like illness, and infection can lead to premature delivery or stillbirth. Elderly or immunocompromised patients may have bacteremia or meningitis.	Variable	Fresh soft cheeses, unpasteurized milk, inadequately pasteurized milk, ready-to-eat deli meats, hot dogs.	Blood or cerebrospinal fluid cultures. Asymptomatic fecal carriage occurs; therefore, stool culture usually not helpful. Antibody to listerolysin O may be helpful to identify outbreak retrospectively.
Listeria monocytogenes	At birth and infancy	Infants infected from mother at risk for sepsis or meningitis.	As above.	As above.	As above.
Salmonella spp.	1-3 days	Diarrhea, fever, abdominal cramps, vomiting. *S. typhi* and *S. paratyphi* produce typhoid with insidious onset characterized by fever, headache, constipation, malaise, chills, and myalgia; diarrhea is uncommon, and vomiting is not usually severe.	4-7 days.	Contaminated eggs, poultry, unpasteurized milk or juice, cheese, contaminated raw fruits and vegetables (alfalfa sprouts, melons). *S. typhi* epidemics are often related to fecal contamination of water supplies or street vended foods.	Routine stool cultures.
Shigella spp.	24-48 hrs	Abdominal cramps, fever, and diarrhea. Stools may contain blood and mucus.	4-7 days	Food or water contaminated with fecal material. Usually person-to-person spread, fecal oral transmission. Ready-to-eat foods touched by infected food workers, raw	Routine stool cultures.

				vegetables, egg salads.	
Staphylococcus aureus (pre-formed enterotoxin)	1-6 hrs	Sudden onset of severe nausea and vomiting. Abdominal cramps. Diarrhea and fever may be present.	24-48 hrs	Unrefrigerated or improperly refrigerated meats, potato and egg salads, cream pastries.	Normally a clinical diagnosis. Stool, vomitus, and food can be tested for toxin and cultured if indicated.
Vibrio cholerae (toxin)	24-72 hrs	Profuse watery diarrhea and vomiting, which can lead to severe dehydration and death within hours.	3-7 days. Causes life-threatening dehydration.	Contaminated water, fish, shellfish, street-vended food.	Stool culture; *Vibrio cholerae* requires special media to grow. If *V. cholerae* is suspected, must request specific testing.
Vibrio para-haemolyticus	2-48 hrs	Watery diarrhea, abdominal cramps, nausea, vomiting.	2-5 days	Undercooked or raw seafood including fish, shellfish.	Stool cultures. *Vibrio parahaemolyticus* requires special media to grow. If *V. parahaemolyticus* is suspected, must request specific testing.
Vibrio vulnificus	1-7 days	Vomiting, diarrhea, abdominal pain, bacteremia, and wound infections. More common in the immuno-compromised, or in patients with chronic liver disease (presenting with bullous skin lesions).	2-8 days; can be fatal in patients with liver disease and the immuno-compromised	Undercooked or raw shellfish, especially oysters, other contaminated seafood, and open wounds exposed to sea water.	Stool, wound, or blood cultures. *Vibrio vulnificus* requires special media to grow. If *V. vulnificus* is suspected, must request specific testing.
Yersinia enterocolytica and Y. pseudotuber-culosis	24-48 hrs	Appendicitis-like symptoms (diarrhea and vomiting, fever, and abdominal pain) occur primarily in older children and young adults. May have a scarlitiniform rash with *Y. pseudotuber-culosis*.	1-3 weeks	Undercooked pork, unpasteurized milk, contaminated water. Infection has occurred in infants whose caregivers handled chitterlings, tofu.	Stool, vomitus or blood culture. *Yersinia* requires special media to grow. If suspected, must request specific testing. Serology is available in research and reference laboratories.

Viruses

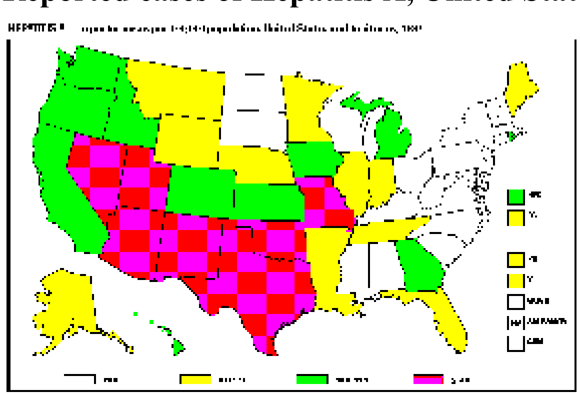
Hepatitis A Virus

Hepatitis A virus (HAV) is classified with the enterovirus group of the Picornaviridae family. HAV has a single molecule of RNA surrounded by a small (27 nm diameter) protein capsid. Many other picornaviruses cause human disease, including polioviruses, coxsackieviruses, echoviruses, and rhinoviruses (cold viruses). The term hepatitis A (HA) or type A viral hepatitis has replaced all previous designations: infectious hepatitis, epidemic hepatitis, epidemic jaundice, catarrhal jaundice, infectious icterus, Botkins disease, and MS-1 hepatitis. Hepatitis A is usually a mild illness characterized by sudden onset of fever, malaise, nausea, anorexia, and abdominal discomfort, followed in several days by jaundice. The infectious dose is unknown but presumably is 10-100 virus particles. Hepatitis A is diagnosed by finding IgM-class anti-HAV in serum collected during the acute or early convalescent phase of disease.

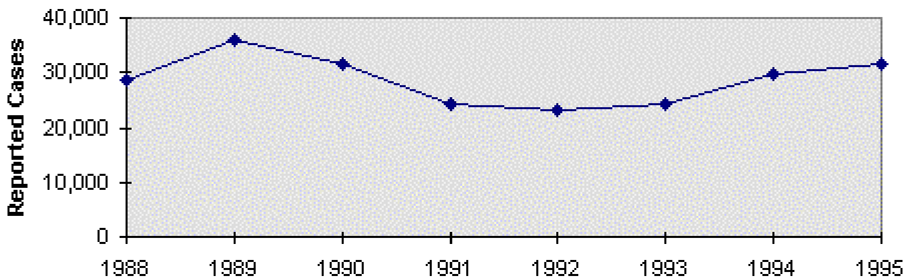
HAV is excreted in feces of infected people and can produce clinical disease when susceptible individuals consume contaminated water or foods. Cold cuts and sandwiches, fruits and fruit juices, milk and milk products, vegetables, salads, shellfish, and iced drinks are commonly implicated in outbreaks. Water, shellfish, and salads are the most frequent sources. Contamination of foods by infected workers in food processing plants and restaurants is common.

Hepatitis A has a worldwide distribution occurring in both epidemic and sporadic fashions. About 22,700 cases of hepatitis A representing 38% of all hepatitis cases (5-year average from all routes of transmission) are reported annually in the U.S. In 1988 an estimated 7.3% cases were foodborne or waterborne. HAV is primarily transmitted by person-to-person contact through fecal contamination, but common-source epidemics from contaminated food and water also occur. Poor sanitation and crowding facilitate transmission. Outbreaks of HAV are common in institutions, crowded house projects, and prisons and in military forces in adverse situations. In developing countries, the incidence of disease in adults is relatively low because of exposure to the virus in childhood. Most individuals 18 and older demonstrate an immunity that provides lifelong protection against reinfection. In the U.S., the percentage of adults with immunity increases with age (10% for those 18-19 years of age to 65% for those over 50). The increased number of susceptible individuals allows common source epidemics to evolve rapidly.

Reported cases of Hepatitis A, United States 1997



Reported cases of Hepatitis A, United States 1988-1995



Summary of Notifiable Diseases, United States MMWR 44(53): 1996 October 25

The incubation period for hepatitis A, which varies from 10 to 50 days (mean 30 days), is dependent upon the number of infectious particles consumed. Infection with very few particles results in longer incubation periods. The period of communicability extends from early in the incubation period to about a week after the development of jaundice. The greatest danger of spreading the disease to others occurs during the middle of the incubation period, well before the first presentation of symptoms. Many infections with HAV do not result in clinical disease, especially in children. When disease does occur, it is usually mild and recovery is complete in 1-2 weeks. Occasionally, the symptoms are severe and convalescence can take several months. Patients suffer from feeling chronically tired during convalescence. Less than 0.4% of the reported cases in the U.S. are fatal. These rare deaths usually occur in the elderly. All people who ingest the virus and are immunologically unprotected are susceptible to infection. Disease however, is more common in adults than in children.

The virus has not been isolated from any food associated with an outbreak. Because of the long incubation period, the suspected food is often no longer available for analysis. No satisfactory method is presently available for routine analysis of food, but sensitive molecular methods used to detect HAV in water and clinical specimens, should prove useful to detect virus in foods. Among those, the PCR amplification method seems particularly promising.

CASE STUDIES

On November 26, 1990, hepatitis A was diagnosed in an employee of a restaurant in Cass County, Missouri. The employee's duties involved washing pots and pans in the restaurant. From December 7, 1990, through January 9, 1991, hepatitis A was diagnosed in 110 persons, including four waitresses, who had eaten at the restaurant; two persons died as a result of fulminant hepatitis.

From 1983 through 1989, the incidence of hepatitis A in the United States increased 58% (from 9.2 to 14.5 cases per 100,000 population). Based on analysis of hepatitis A cases reported to CDC's national Viral Hepatitis Surveillance Program in 1988, 7.3% of hepatitis A cases were associated with foodborne or waterborne outbreaks.

The Norwalk virus family

Norwalk virus is the prototype of a family of unclassified small round structured viruses (SRSVs) which may be related to the caliciviruses. They contain a positive strand RNA genome of 7.5 kb and a single structural protein of about 60 kDa. The family consists of several serologically distinct groups of viruses that have been named after the places where the outbreaks occurred. In the U.S., the Norwalk and Montgomery County agents are serologically related but distinct from the Hawaii and Snow Mountain agents. The Taunton, Moorcroft, Barnett, and Amulree agents were identified in the U.K., and the Sapporo and Otofuke agents in Japan. Their serological relationships remain to be determined. Common names of the illness caused by the Norwalk and Norwalk-like viruses are viral gastroenteritis, acute nonbacterial gastroenteritis, food poisoning, and food infection. The disease is self-limiting, mild, and characterized by nausea, vomiting, diarrhea, and abdominal pain. Headache and low-grade fever may occur. The infectious dose is unknown but presumed to be low.

Specific diagnosis of the disease can only be made by a few laboratories possessing reagents from human volunteer studies. Identification of the virus can be made on early stool specimens using immune electron microscopy and various immunoassays. Confirmation often requires demonstration of seroconversion, the presence of specific IgM antibody, or a four-fold rise in antibody titer to Norwalk virus on paired acute-convalescent sera.

Norwalk gastroenteritis is transmitted by the fecal-oral route via contaminated water and foods. Secondary person-to-person transmission has been documented. Water is the most common source of outbreaks and may include water from municipal supplies, well, recreational lakes, swimming pools, and water stored aboard cruise ships.
Shellfish and salad ingredients are the foods most often implicated in Norwalk outbreaks. Ingestion of raw or insufficiently steamed clams and oysters poses a high risk for infection with Norwalk virus. Foods other than shellfish are contaminated by ill food handlers.

Only the common cold is reported more frequently than viral gastroenteritis as a cause of illness in the U.S. Although viral gastroenteritis is caused by a number of viruses, it is estimated that Norwalk viruses are responsible for about 1/3 of the cases not involving the 6-to-24-month age group. In developing countries the percentage of individuals who have developed immunity is very high at an early age. In the U.S. the percentage increases gradually with age, reaching 50% in the population over 18 years of age. Immunity, however, is not permanent and reinfection can occur.

A mild and brief illness usually develops 24-48 hours after contaminated food or water is consumed and lasts for 24-60 hours. Severe illness or hospitalization is very rare. All individuals who ingest the virus and who have not (within 24 months) had an infection with the same or related strain, are susceptible to infection and can develop the symptoms of gastroenteritis. Disease is more frequent in adults and older children than in the very young.

The virus has been identified in clams and oysters by radioimmunoassay. The genome of Norwalk virus has been cloned and development of gene probes and PCR amplification techniques to detect the virus in clinical specimens and possibly in food are under way.

CASE STUDIES

During August 27-September 1, 1998, 99 (12%) of 835 soldiers in one unit at a U.S. Army training center in El Paso, Texas, were hospitalized for acute gastroenteritis. Their symptoms included acute onset of vomiting, abdominal pain, diarrhea, and fever. Review of medical center admission records for gastroenteritis during the previous year indicated that fewer than five cases occurred each month.

On November 17, 1993, the state health departments of Louisiana, Maryland, and Mississippi notified CDC of several outbreaks of gastroenteritis occurring in their states since November 12. Preliminary epidemiologic investigations identified consumption of oysters as the primary risk factor for illness. On November 16, the Louisiana Department of Health and Hospitals had identified the Grand Pass and Cabbage Reef harvesting areas off the Louisiana coast as the source of oysters associated with outbreaks in Louisiana and Mississippi. Tagged oysters associated with outbreaks in Maryland were traced to the same oyster beds. Small round structured viruses or Norwalk-like viruses were detected by EM and confirmed by RT-PCR in 13 of 26 stool specimens from ill persons in Louisiana, Maryland, Mississippi, and North Carolina.

Rotavirus

Rotaviruses are classified with the *Reoviridae* family. They have a genome consisting of 11 double-stranded RNA segments surrounded by a distinctive two-layered protein capsid. Particles are 70 nm in diameter. Six serological groups have been identified, three of which (groups A, B, and C) infect humans. Rotaviruses cause acute gastroenteritis. Infantile diarrhea, winter diarrhea, acute nonbacterial infectious gastroenteritis, and acute viral gastroenteritis are names applied to the infection caused by the most common and widespread group A rotavirus. Rotavirus gastroenteritis is a self-limiting, mild to severe disease characterized by vomiting, watery diarrhea, and low-grade fever. The infective dose is presumed to be 10-100 infectious viral particles. Because a person with rotavirus diarrhea often excretes large numbers of virus (108-1010 infectious particles/ml of feces), infection doses can be readily acquired through contaminated hands, objects, or utensils. Asymptomatic rotavirus excretion has been well documented and may play a role in perpetuating endemic disease. Specific diagnosis of the disease is made by identification of the virus in the patient's stool. Enzyme immunoassay (EIA) is the test most widely used to screen clinical specimens, and several commercial kits are available for group A rotavirus. Electron microscopy (EM) and polyacrylamide gel electrophoresis (PAGE) are used in some laboratories in addition or as an alternative to EIA. A reverse transcription-polymerase chain reaction (RT-PCR) has been developed to detect and identify all three groups of human rotaviruses.

Rotaviruses are transmitted by the fecal-oral route. Person-to-person spread through contaminated hands is probably the most important means by which rotaviruses are transmitted in close communities such as pediatric and geriatric wards, day care centers and family homes. Infected food handlers may contaminate foods that require handling and no further cooking, such as salads, fruits, and hors d'oeuvres. Rotaviruses are quite stable in the environment and have been found in estuary samples at levels as high as 1-5 infectious particles/gal. Sanitary measures adequate for bacteria and parasites seem to be ineffective in endemic control of rotavirus, as similar incidence of rotavirus infection is observed in countries with both high and low health standards.

Group A rotavirus is endemic worldwide. It is the leading cause of severe diarrhea among infants and children, and accounts for about half of the cases requiring hospitalization. Over 3 million cases of rotavirus gastroenteritis occur annually in the U.S. In temperate areas, it occurs primarily in the winter, but in the tropics it occurs throughout the year. The number attributable to food contamination is unknown.

Group B rotavirus, also called adult diarrhea rotavirus or ADRV, has caused major epidemics of severe diarrhea affecting thousands of persons of all ages in China.

Group C rotavirus has been associated with rare and sporadic cases of diarrhea in children in many countries. However, the first outbreaks were reported from Japan and England.

The incubation period ranges from 1-3 days. Symptoms often start with vomiting followed by 4-8 days of diarrhea. Temporary lactose intolerance may occur. Recovery is usually complete. However, severe diarrhea without fluid and electrolyte replacement may result in death. Childhood mortality caused by rotavirus is relatively low in the U.S., with an estimated 100 cases/year, but reaches almost 1 million cases/year worldwide. Association with other enteric pathogens may play a role in the severity of the disease. Humans of all ages are susceptible to rotavirus infection. Children 6 months to 2 years of age, premature infants, the elderly, and the immunocompromised are particularly prone to more severe symptoms caused by infection with group A rotavirus.

The virus has not been isolated from any food associated with an outbreak, and no satisfactory method is available for routine analysis of food. However, it should be possible to apply procedures that have been used to detect the virus in water and in clinical specimens, such as enzyme immunoassays, gene probing, and PCR amplification to food analysis.

Outbreaks of group A rotavirus diarrhea are common among hospitalized infants, young children attending day care centers, and elderly persons in nursing homes. Among adults, multiple foods served in banquets were implicated in 2 outbreaks. An outbreak due to contaminated municipal water occurred in Colorado, 1981.

Foodborne Illnesses: Viral Agents

Etiology	Incubation Period	Signs and Symptoms	Duration of Illness	Associated Foods	Laboratory Testing
Hepatitis A	30 days average (15-50 days)	Diarrhea; dark urine; jaundice; and flu-like symptoms, (ie, fever, headache, nausea, and abdominal pain.)	Variable, 2 weeks - 3 months	Shellfish harvested from contaminated waters, raw produce, uncooked foods and cooked foods that are not reheated after contact with infected food handler.	Increase in ALT, bilirubin. Positive IgM and anti-hepatitis A antibodies.
Norwalk-like viruses	24-48 hrs	Nausea; vomiting; watery, large-volume diarrhea; fever rare.	24-60 hrs	Poorly cooked shellfish; ready-to-eat foods touched by infected food workers; salads, sandwiches, ice, cookies, fruit.	Clinical diagnosis, negative bacterial cultures, >fourfold increase in antibody titers of Norwalk antibodies, acute and convalescent, special viral assays in reference lab. Stool is negative for WBCs.
Rotavirus	1-3 days	Vomiting; watery diarrhea; low-grade fever. Temporary lactose intolerance may occur. Infants and children, elderly, and immunocompro-mised are especially vulnerable.	4-8 days	Fecally contaminated foods. Ready-to-eat foods touched by infected food workers (salads, fruits).	Identification of virus in stool via immunoassay.
Other viral agents (astroviruses, calciviruses, adenoviruses, parvoviruses)	10-70 hrs	Nausea; vomiting; diarrhea; malaise; abdominal pain; headache; fever.	2-9 days	Fecally contaminated foods. Ready-to-eat foods touched by infected food workers. Some shellfish.	Identification of the virus in early acute stool samples. Serology.

Parasites

Giardia lamblia

Giardia lamblia (intestinalis) is a single celled animal, i.e., a protozoa, that moves with the aid of five flagella. Giardiasis is the most frequent cause of non-bacterial diarrhea in North America. Organisms that appear identical to those that cause human illness have been isolated from domestic animals (dogs and cats) and wild animals (beavers and bears). A related but morphologically distinct organism infects rodents, although rodents may be infected with human isolates in the laboratory. Human giardiasis may involve diarrhea within 1 week of ingestion of the cyst, which is the environmental survival form and infective stage of the organism.

Normally the illness lasts for 1 to 2 weeks, but there are cases of chronic infections lasting months to years. Chronic cases, both those with defined immune deficiencies and those without, are difficult to treat.

The disease mechanism is unknown, with some investigators reporting that the organism produces a toxin while others are unable to confirm its existence. The organism has been demonstrated inside host cells in the duodenum, but most investigators think this is such an infrequent occurrence that it is not responsible for disease symptoms. Mechanical obstruction of the absorptive surface of the intestine has been proposed as a possible pathogenic mechanism, as has a synergistic relationship with some of the intestinal flora.

Giardia can be excysted, cultured and encysted in vitro; new isolates have bacterial, fungal, and viral symbionts. Classically the disease was diagnosed by demonstration of the organism in stained fecal smears.

Several strains of *G. lamblia* have been isolated and described through analysis of their proteins and DNA; type of strain, however, is not consistently associated with disease severity. Different individuals show various degrees of symptoms when infected with the same strain, and the symptoms of an individual may vary during the course of the disease. Ingestion of one or more cysts may cause disease, as contrasted to most bacterial illnesses where hundreds to thousands of organisms must be consumed to produce illness.

Giardia lamblia is frequently diagnosed by visualizing the organism, either the trophozoite (active reproducing form) or the cyst (the resting stage that is resistant to adverse environmental conditions) in stained preparations or unstained wet mounts with the aid of a microscope. A commercial fluorescent antibody kit is available to stain the organism. Organisms may be concentrated by sedimentation or flotation; however, these procedures reduce the number of recognizable organisms in the sample. An enzyme linked immunosorbant assay (ELISA) that detects excretory secretory products of the organism is also available. So far, the increased sensitivity of indirect serological detection has not been consistently demonstrated.

Giardiasis is most frequently associated with the consumption of contaminated water. Five outbreaks have been traced to food contaminated by infected food handlers, and the possibility of infections from contaminated vegetables that are eaten raw cannot be excluded. Cool moist conditions favor the survival of the organism.

Giardiasis is more prevalent in children than in adults, possibly because many individuals seem to have a lasting immunity after infection. This organism is implicated in 25% of the cases of gastrointestinal disease and may be present asymptomatically. The overall incidence of infection in the United States is estimated at 2% of the population. This disease afflicts many homosexual men, both HIV-positive and HIV-negative individuals. This is presumed to be due to sexual transmission. The disease is also common in child day care centers, especially those in which diapering is done.

About 40% of those who are diagnosed with giardiasis demonstrate disaccharide intolerance during detectable infection and up to 6 months after the infection can no longer be detected. Lactose (i.e., milk sugar) intolerance is most frequently observed. Some individuals (less than 4%) remain symptomatic more than 2 weeks; chronic infections lead to a malabsorption syndrome and severe weight loss. Chronic cases of giardiasis in immunodeficient and normal individuals are frequently refractile to drug treatment. Flagyl is normally quite effective in terminating infections. In some immune deficient individuals, giardiasis may contribute to a shortening of the life span. Giardiasis occurs throughout the population, although the prevalence is higher in children than adults. Chronic symptomatic giardiasis is more common in adults than children. Food is analyzed by thorough surface cleaning of the suspected food and sedimentation of the organisms from the cleaning water. Feeding to specific pathogen-free animals has been used to detect the organism in large outbreaks associated with municipal water systems. The precise sensitivity of these methods has not been determined, so that negative results are questionable. Seven days may be required to detect an experimental infection.

In April 1988, the Albuquerque Environmental Health Department and the New Mexico Health and Environment Department investigated reports of giardiasis among members of a church youth group in Albuquerque. The first two members to be affected had onset of diarrhea on March 3 and 4, respectively; stool specimens from both were positive for *Giardia lamblia* cysts. These two persons had only church youth group activities in common.

Cyclospora cayetanensis

Cyclospora cayetanensis was first seen causing human illness (cyclosporiasis) in 1979. Cases began being reported more often in the mid-1980s. In the last several years, outbreaks of cyclosporiasis have been reported in the United States and Canada and are usually associated with water, marine fish, raw milk and raw or fresh produce.

The time between becoming infected and becoming sick is usually about 1 week.
The organism infects the small intestine (bowel) and usually causes watery diarrhea, with frequent, sometimes explosive, bowel movements. Other symptoms can include loss of appetite, substantial loss of weight, bloating, increased gas, stomach cramps, nausea, vomiting, muscle aches, low-grade fever, and fatigue. Some people who are infected with *Cyclospora* do not have any symptoms.

Cyclospora needs time, typically days or weeks, after being passed in a bowel movement to become infectious. Therefore, it is unlikely that *Cyclospora* is passed directly from one person to another. It is unknown whether animals can be infected and pass the infection to people.

People of all ages are at risk for infection. In the past, *Cyclospora* infection was usually found in people who lived or traveled in developing countries. However, people can be infected worldwide, including the United States.

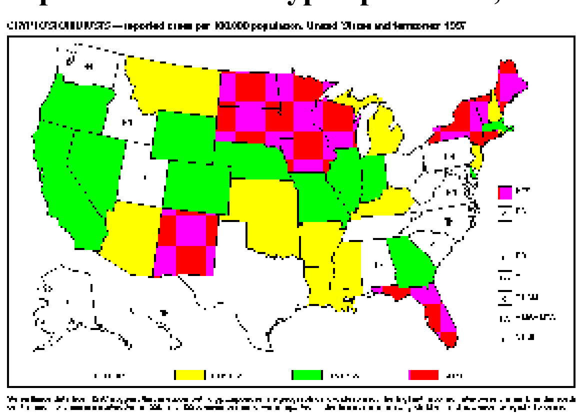
Cryptosporidium parvum

Cryptosporidium parvum, a single-celled protozoa and is an obligate intracellular parasite. It has been given additional species names when isolated from different hosts. It is currently thought that the form infecting humans is the same species that causes disease in young calves. The forms that infect avian hosts and those that infect mice are not thought capable of infecting humans. *Cryptosporidium* spp. infects many herd animals (cows, goats, sheep among domesticated animals, and deer and elk among wild animals). The infective stage of the organism, the oocyst is 3 um in diameter or about half the size of a red blood cell. The sporocysts are resistant to most chemical disinfectants, but are susceptible to drying and the ultraviolet portion of sunlight. Some strains appear to be adapted to certain hosts but cross-strain infectivity occurs and may or may not be associated with illness. The species or strain infecting the respiratory system is not currently distinguished from the form infecting the intestines. Intestinal cryptosporidiosis is characterized by severe watery diarrhea but may, alternatively, be asymptomatic. Pulmonary and tracheal cryptosporidiosis in humans is associated with coughing and frequently a low-grade fever; these symptoms are often accompanied by severe intestinal distress. The infectious dose is thought to be less than 10 organisms and, presumably, one organism can initiate an infection. The mechanism of disease is not known; however, the intracellular stages of the parasite can cause severe tissue alteration.

Oocysts are shed in the infected individual's feces. Sugar flotation is used to concentrate the organisms and acid fast staining is used to identify them. A commercial kit is available that uses fluorescent antibody to stain the organisms isolated from feces. Diagnosis has also been made by staining the trophozoites in intestinal and biopsy specimens. Pulmonary and tracheal cryptosporidiosis are diagnosed by biopsy and staining.

Cryptosporidium spp. could occur, theoretically, on any food touched by a contaminated food handler. Incidence is higher in child day care centers that serve food. Fertilizing salad vegetables with manure is another possible source of human infection. Large outbreaks are associated with contaminated water supplies. Direct human surveys indicate a prevalence of about 2% of the population in North America. Serological surveys indicate that 80% of the population has had cryptosporidiosis. The extent of illness associated with reactive sera is not known.

Reported cases of Cryptosporidiosis, United States 1997



Intestinal cryptosporidiosis is self-limiting in most healthy individuals, with watery diarrhea lasting 2-4 days. In some outbreaks at day care centers, diarrhea has lasted 1 to 4 weeks.

To date, there is no known effective drug for the treatment of cryptosporidiosis. Immunodeficient individuals, especially AIDS patients, may have the disease for life, with the severe watery diarrhea contributing to death. Invasion of the pulmonary system may also be fatal.

In animals, the young show the most severe symptoms. For the most part, pulmonary infections are confined to those who are immunodeficient. However, an infant with a presumably normal immune system had tracheal cryptosporidiosis (although a concurrent viremia may have accounted for lowered resistance). Child day care centers, with a large susceptible population, frequently report outbreaks.

CASE STUDIES

On December 29, 1997, the Spokane Regional Health District received reports of acute gastroenteritis among members of a group attending a dinner banquet catered by a Spokane restaurant on December 18. The illness was characterized by a prolonged (3-9 days) incubation period and diarrhea, which led public health officials to suspect a parasitic cause of the illness. Eight of 10 stool specimens obtained from ill banquet attendees were positive for Cryptosporidium using both modified acid-fast and auramine-rhodamine staining of concentrated specimens.

In October 1996, unpasteurized apple cider or juice was associated with *Cryptosporidium parvum* infections in the Northeast. Apple cider is a traditional beverage produced and consumed in the fall. Cider often is manufactured locally at small cider mills where apples are crushed in presses, and the cider frequently is not pasteurized before sale.

Anisakis simplex and related worms

Anisakis simplex (herring worm), *Pseudoterranova (Phocanema, Terranova) decipiens* (cod or seal worm), *Contracaecum* spp., and *Hysterothylacium (Thynnascaris)* spp. are anisakid nematodes (roundworms) that have been implicated in human infections caused by the consumption of raw or undercooked seafood. To date, only *A. simplex* and *P. decipiens* are reported from human cases in North America. Anisakiasis is generally used when referring to the acute disease in humans. The range of clinical features is not dependent on species of anisakid parasite in cases reported to date. In North America, anisakiasis is most frequently diagnosed when the affected individual feels a tingling or tickling sensation in the throat and coughs up or manually extracts a nematode. In more severe cases there is acute abdominal pain, much like acute appendicitis accompanied by a nauseous feeling. Symptoms occur from as little as an hour to about 2 weeks after consumption of raw or undercooked seafood. With their anterior ends, these larval nematodes from fish or shellfish usually burrow into the wall of the digestive tract to the level of the muscularis mucosae (occasionally they penetrate the intestinal wall completely and are found in the body cavity). They produce a substance that attracts eosinophils and other host white blood cells to the area. The infiltrating host cells form a granuloma in the tissues surrounding the penetrated worm. In the digestive tract lumen, the worm can detach and reattach to other sites on the wall. Anisakids rarely reach full maturity in humans and usually are eliminated spontaneously from the digestive tract lumen within 3 weeks of infection. Penetrated worms that die in the tissues are eventually removed by phagocytic cells. The target population consists of consumers of raw or underprocessed seafood.

In cases where the patient vomits or coughs up the worm, the disease may be diagnosed by morphological examination of the nematode. (*Ascaris lumbricoides*, the large roundworm of humans, is a terrestrial relative and sometimes these larvae also crawl up into the throat and nasal passages.) Other cases may require a fiber optic device that allows the attending physician to examine the inside of the stomach and the first part of the small intestine. These devices are equipped with a mechanical forceps that can be used to remove the worm. Other cases are diagnosed upon finding a granulomatous lesion with a worm on laparotomy. A specific radioallergosorbent test has been developed for anasakiasis, but is not yet commercially marketed.

Seafoods are the principal sources of human infections with these larval worms. The adults of *A. simplex* are found in the stomachs of whales and dolphins. Fertilized eggs from the female parasite pass out of the host with the host's feces. In seawater, the eggs embryonate, developing into larvae that hatch in sea water. These larvae are infective to copepods (minute crustaceans related to shrimp) and other small invertebrates. The larvae grow in the invertebrate and become infective for the next host, a fish or larger invertebrate host such as a squid. The larvae may penetrate through the digestive tract into the muscle of the second host. Some evidence exists that the nematode larvae move from the viscera to the flesh if the fish hosts are not gutted promptly after catching. The life cycles of all the other anisakid genera implicated in human infections are similar. These parasites are known to occur frequently in the flesh of cod, haddock, fluke, pacific salmon, herring, flounder, and monkfish.

Fewer than 10 cases are diagnosed in the U.S. annually. However, it is suspected that many other cases go undetected. The disease is transmitted by raw, undercooked or insufficiently frozen fish and shellfish, and its incidence is expected to increase with the increasing popularity of sushi and sashimi bars.

Severe cases of anisakiasis are extremely painful and require surgical intervention. Physical removal of the nematode(s) from the lesion is the only known method of reducing the pain and eliminating the cause (other than waiting for the worms to die). The symptoms apparently persist after the worm dies since some lesions are found upon surgical removal that contains only nematode remnants.

Candling or examining fish on a light table is used by commercial processors to reduce the number of nematodes in certain white-flesh fish that are known to be frequently infected. This method is not totally effective, nor is it very adequate to remove even the majority of nematodes from fish with pigmented flesh.

Foodborne Illnesses: Parasitic Agents

Etiology	**Incubation Period**	**Signs and Symptoms**	**Duration of Illness**	**Associated Foods**	**Laboratory Testing**	**Treatment**
Cryptosporidium parvum	7 days average (2-28 days)	Cramping, abdominal pain; watery diarrhea; fever and vomiting may be present and may be relapsing.	Days to weeks	Contaminated water supply, vegetables, fruits, unpasteurized milk.	Must be specifically requested. May need to examine water or food.	Supportive care, self-limited. If severe consider paromomycin for 7 days.

Cyclospora cayetanensis	1-11 days	Fatigue, protracted diarrhea, often relapsing.	May be protracted (several weeks to several months)	Imported berries, contaminated water, lettuce.	Request specific examination of the stool for *Cyclospora*. M ay need to examne water or food.	TMP/SMX for 7 days.
Entamoeba histolytica	2-3 days to 1-4 weeks	Bloody diarrhea, frequent bowel movements (looks like *Shigella*), lower abdominal pain.	Months	Fecal-oral; may contaminate water and food.	Examination of stool for cysts and parasites – at least 3 samples. Serology for long-term infections.	Metronidazole and iodoquinol.
Giardia lamblia	1-4 weeks	Acute or chronic diarrhea, flatulence, bloating.	Weeks	Drinking water, other food sources.	Examination for ova and parasites – at least 3 samples.	Metronidazole.
Toxoplasma gondii	6-10 days	Generally asymptomatic, 20% may develop cervical lymphadenopathy and/or a flu-like illness. In immunocompromised patients: central nervous system (CNS) disease, myocarditis, or pneumonitis is often seen.	Months	Accidental ingestion of contaminated substances (eg. putting hands in mouth after gardening or cleaning cat litter box); Raw or partly cooked pork, lamb, or venison.	Isolation of parasites from blood or other body fluids; observation of parasites in patient specimens, such as bronchoalveola r lavage material or	Asymptomatic healthy, but infected, persons do not require treatment. Spiramycin or pyrimethamine plus sulfadiazine may be used for immunocompro-mised persons or pregnant women,

Toxoplasma gondii (congenital infection)	In infants at birth	Treatment of the mother may reduce severity and/or incidence of congenital infection. Most infected infants have few symptoms at birth, but will generally develop signs of congenital toxoplasmosis (mental retardation, severely impaired eyesight, cerebral palsy, seizures) later, unless the infection is treated.		Passed from mother (who acquired acute infection during pregnancy) to child.	lymph node biopsy. Detection of organisms is rare, but serology can be a useful adjunct in diagnosing toxoplasmosis. *Toxoplasma*-specific IgM antibodies should be confirmed by a reference laboratory. However, IgM antibodies may persist for 6-18 months and thus may not necessarily indicate recent infection. For congenital infection: isolation of *T. gondii* from placenta, umbilical cord, or infant blood. PCR of white blood cells, CSF, or amniotic fluid (reference laboratory). IgM and IgA serology (reference laboratory).	in specific cases.
Trichinella spiralis	1-2 days to 2-8 weeks	Nausea, vomiting, diarrhea, abdominal discomfort followed by fever, myalgias, periorbital edema.	Months	Raw or undercooked contaminated meat, usually pork or wild game meat, eg, bear or moose.	Positive serology or demonstration of larvae via muscle biopsy. Increase in eosinophils.	Supportive care + mebendazole.

Foodborne Illnesses: Non-infectious Agents

Etiology	Incubation Period	Signs and Symptoms	Duration of Illness	Associated Foods	Laboratory Testing	Treatment
Antimony	5 min – 8 hrs. usually <1 hr	Vomiting, metallic taste.	Usually self-limited	Metallic container.	Identification of metal in beverage or food.	Supportive care.
Arsenic	Few hrs	Vomiting, colic, diarrhea.	Several days	Contaminated food.	Urine. May cause eosinophilia.	Gastric lavage, BAL (dimercaprol).
Cadmium	5 min – 8 hrs. usually <1 hr	Nausea, vomiting, myalgia, increase in salivation, stomach pain.	Usually self-limited	Seafood, oysters, clams, lobster, grains, peanuts.	Identification of metal in food.	Supportive care.

Cadmium	5 min – 8 hrs. usually <1 hr	Nausea, vomiting, myalgia, increase in salivation, stomach pain.	Usually self-limited	Seafood, oysters, clams, lobster, grains, peanuts.	Identification of metal in food.	Supportive care.
Ciguatera fish poisoning (ciguatera toxin).	2-6 hrs	GI: abdominal pain, nausea, vomiting, diarrhea.	Days to weeks to months	A variety of large reef fish. Grouper, red snapper, amberjack, and barracuda (most common).	Radioassay for toxin in fish or a consistent history.	Supportive care, IV mannitol. Children more vulnerable.
	3 hrs	Neurologic: paresthesias, reversal of hot or cold, pain, weakness.				
	2-5 days	Cardiovascular: bradycardia, hypotension, increase in T wave abnormalities.				
Copper	5 min – 8 hrs. usually <1 hr	Nausea, vomiting, blue or green vomitus.	Usually self-limited	Metallic container.	Identification of metal in beverage or food.	Supportive care.
Mercury	1 week or longer	Numbness, weakness of legs, spastic paralysis, impaired vision, blindness, coma. Pregnant women and the developing fetus are especially vulnerable.	May be protracted	Fish exposed to organic mercury, grains treated with mercury-based fungicides.	Analysis of blood, hair.	Supportive care.
Mushroom toxins, short-acting (museinol, muscarine, psilocybin, coprius artemetaris, ibotenic acid)	< 2 hrs.	Vomiting, diarrhea, confusion, visual disturbance, salivation, diaphoresis, hallucinations, disulfiram-like reaction, confusion, visual disturbance.	Self-limited	Wild mushrooms (cooking may not destroy these toxins).	Typical syndrome and mushroom identified and/or demonstration of the toxin.	Supportive care.
Mushroom toxin, long-acting (amanita)	4-8 hrs diarrhea; 24-48 hrs liver failure	Diarrhea, abdominal cramps, leading to hepatic and renal failure.	Often fatal	Mushrooms.	Typical syndrome and mushroom identified and/or demonstration of the toxin.	Supportive care, life-threatening, life support.
Nitrite poisoning	1-2 hrs	Nausea, vomiting, cyanosis, headache, dizziness, weakness, loss of consciousness, chocolate-brown colored blood.	Usually self-limited	Cured meats, any contaminated foods, spinach exposed to excessive nitrification.	Analysis of the food, blood.	Supportive care, methylene blue.
Pesticides (organophos-phates or carbamates)	Few min to few hours	Nausea, vomiting, abdominal cramps, diarrhea, headache, nervousness, blurred vision, twitching, convul-sions	Usually self-limited	Any contaminated food.	Analysis of the food, blood.	Atropine.

Puffer fish (tetrodotoxin)	< 30 min	Paresthesias, vomiting, diarrhea, abdominal pain, ascending paralysis, respiratory failure.	Death usually in 4-6 hours	Puffer fish.	Detection of tetrodotoxin in fish.	Life-threatening, may need respiratory support.
Scombroid (histamine)	1 min – 3 hrs	Flushing, rash, burning sensation of skin, mouth and throat, dizziness, uriticaria, paresthesias.	3-6 hrs	Fish: bluefin, tuna, skipjack, mackerel, marlin, and mahi mahi.	Demonstration of histamine in food or clinical diagnosis.	Supportive care, antihistamines.
Shellfish toxins (diarrheic, neurotoxic, amnesic)	Diarrheic shellfish poisoning (DSP) - 30 min to 2 hrs	Nausea, vomiting, diarrhea, and abdominal pain accompanied by chills, headache, and fever.	Hrs to 2-3 days	A variety of shellfish, primarily mussels, oysters, scallops, and shellfish from the Florida coast and the Gulf of Mexico.	Detection of the toxin in shellfish; high pressure liquid chromatography.	Supportive care, generally self-limiting. Elderly are especially sensitive to ASP.
	Neurotoxic shellfish poisoning (NSP) – few min to hrs	Tingling and numbness of lips, tongue, and throat, muscular aches, dizziness, reversal of the sensations of hot and cold, diarrhea, and vomiting.				
	Amnesic shellfish poisoning (ASP) - 24-48 hrs	Vomiting, diarrhea, abdominal pain and neurological problems such as confusion, memory loss, disorientation, seizure, coma.				
Shellfish toxins (paralytic shellfish poisoning)	30 min – 3 hrs	Diarrhea, nausea, vomiting leading to paresthesias of mouth, lips, weakness, dysphasia, dysphonia, respiratory paralysis.	Days	Scallops, mussels, clams, cockles.	Detection of toxin in food or water where fish are located; high pressure liquid chromatography.	Life-threatening, may need respiratory support.
Sodium fluoride	Few min to 2 hrs	Salty or soapy taste, numbness of mouth, vomiting, diarrhea, dilated pupils, spasms, pallor, shock, collapse.	Usually self-limited	Dry foods (such as dry milk, flour, baking powder, cake mixes) contaminated with sodium fluoride-containing insecticides and rodenticides.	Testing of vomitus or gastric washings. Analysis of the food.	Supportive care.
Thallium	Few hrs	Nausea, vomiting, diarrhea, painful parethesias, motor polyneuropathy, air loss.	Several days	Contaminated food.	Urine, hair.	Supportive care.
Tin	5 min – 8 hrs. usually <1 hr	Nausea, vomiting, diarrhea.	Usually self-limited	Metallic container.	Analysis of the food.	Supportive care.

Vomitoxin	Few min to 3 hrs	Nausea, headache, abdominal pain, vomiting.	Usually self-limited	Grains, such as wheat, corn, barley.	Analysis of the food.	Supportive care.
Zinc	Hrs	Stomach cramps, nausea, vomiting, diarrhea, myalgias.	Usually self-limited	Metallic container.	Analysis of the food, blood and feces, saliva or urine.	Supportive care.
Etiology	**Incubation Period**	**Signs and Symptoms**	**Duration of Illness**	**Commonly associated Foods**	**Laboratory Testing**	**Treatment**

Prions

Prions are associated with a group of diseases called Transmissible Spongiform Encephalopathies (TSEs). In humans, the illness suspected of being foodborne is variant Creutzfeldt-Jakob disease (vCJD). The human disease vCJD and the cattle disease, bovine spongiform encephalopathy (BSE), also known as "mad cow" disease, appear to be caused by the same agent. Other similar but not identical TSE diseases exist in animals, but there is no known transmission of these to humans. Included among these is chronic wasting disease (CWD) of deer and elk, and the oldest known of these diseases - scrapie - which occurs in sheep and goats . No early acute clinical indications for TSEs have been described. After an extended incubation period of years, these diseases result in irreversible neurological degeneration that becomes the cause of death.

The neurodegenerative phase of vCJD in humans typically involves the formation of "daisy-shaped" areas of damage in the central nervous system. There is also, in common with other TSEs, vacuolization (formation of holes) that gives brain tissue a spongy appearance. This damage is likely the result of accumulations of the abnormally shaped protein i.e., the prion, in the brain. The build-up causes cell death. The most reliable means for diagnosing any TSE is the microscopic examination of brain tissue - a post-mortem procedure. Preliminary diagnoses of vCJD are based on patient history, clinical symptoms, electroencephalograms, and magnetic resonance imaging of the brain.

The major concern for consumers is the potential contamination of meat products by central nervous system tissue (brain and spinal cord) during routine slaughter. This indirect intake of high-risk tissues may have been the source of human illnesses in the United Kingdom and elsewhere. Bovine meat (if free of central nervous system tissue) and milk have shown no infectivity in test animals. Gelatin, derived from the hides and bones of cattle, appears to be very low risk , especially when produced from materials originating in countries free of BSE. Based upon many studies, scientists have concluded that forms of CJD other than vCJD are not associated with food consumption.

There are no reported human cases of vCJD or bovine cases of BSE in the United States. In the United Kingdom, there have been 94 human cases of suspected or confirmed vCJD from 1993, when the illness was first recognized, through February 2001. Since 1986, more than 180,000 cases of BSE have occurred there in cattle, particularly dairy herds. The feeding of rendered TSE-infected animal by-products to cattle is believed to have caused the epidemic of BSE. Practices such as this have now been prohibited, resulting in a dramatic decline in the number of cases. Cases of vCJD usually present with psychiatric problems, such as depression. As the disease progresses, neurologic signs appear -- unpleasant sensations in the limbs and/or face. There are problems with walking and muscle coordination. Sometimes, late in the course of the disease, victims become forgetful and then experience severe problems with processing information and speaking. Uncontrolled muscle twitching and death follow. All cases of vCJD to date have occurred in individuals of a single human genotype that is methionine homozygous at codon 139. About 40% of the total human population belongs to this methionine-methionine homozygous state. The susceptibility of other genotypes is not yet known.

Currently, no practical detection or inactivation methods exist. The abnormally shaped prions are resistant to most heat and chemical treatments. Decontamination methods are so drastic that food subjected to these processes generally becomes inedible. Consequently, the key to food protection is obtaining meat from animals not infected with BSE and protecting against contamination of food with brain and spinal cord tissue.

The epidemic of bovine spongiform encephalopathy in the United Kingdom, that began in 1986 and during its course affected nearly 200,000 cattle, is waning. It leaves in its wake a human outbreak of variant Creutzfeldt-Jakob disease, most probably resulting from the consumption of beef products contaminated by central nervous system tissue.

Although averaging only 10-15 cases a year since its first appearance in 1994, the future magnitude and geographic distribution of this illness cannot yet be predicted. The possibility that large numbers of apparently healthy persons might be incubating the disease raises concerns about iatrogenic transmissions through instrumentation (surgery and medical diagnostic procedures) and blood and organ donations. Government agencies in many countries continue to implement new measures to minimize this risk.

BSE has had a substantial impact on the livestock industry in the United Kingdom. The disease also has been confirmed in native-born cattle in Belgium, Denmark, France, Germany, Italy, Ireland, Liechtenstein, Luxembourg, the Netherlands, Northern Ireland, Portugal, Spain, and Switzerland. The Animal and Plant Health Inspection Service (APHIS) of the U.S. Department of Agriculture (USDA) is enforcing import restrictions and conducting surveillance for BSE to prevent this serious disease from becoming established in the United States.

Since 1996, evidence has been increasing for a causal relationship between ongoing outbreaks in Europe of a disease in cattle, called bovine spongiform encephalopathy (BSE, or "mad cow disease"), and a disease in humans, called variant Creutzfeldt-Jakob disease (vCJD). Both disorders are inevitably fatal brain diseases with unusually long incubation periods measured in years, and are caused by an unconventional transmissible agent.

BSE has not been detected in United States cattle, despite active surveillance efforts by USDA that began in May 1990. The U.S. Department of Agriculture monitors BSE in the United States and the CDC monitors the trends and current incidence of human TSEs in the United States. Rendered feed ingredients contaminated with an infectious agent are believed to have been the source of BSE infection in cattle in the United Kingdom. Some of the feed given to cattle included remnants of the slaughtering process, such as the brain and spinal cord, which harbor the agent that is believed to cause BSE. Although the material is cooked during the rendering process, the BSE agent can survive cooking.

To prevent the establishment and amplification of BSE through feed in the United States, the FDA implemented a final rule that, in most cases, prohibits the feeding of mammalian protein to ruminant animals. This rule, Title 21 Part 589.2000 of the *Code of Federal Regulations*, became effective on August 4, 1997.

CHAPTER 9 PEST CONTROL

INTRODUCTION

Integrated Pest Management (IPM) is defined as the use of all appropriate technology and management practices to bring about pest prevention and suppression in a cost-effective, environmentally sound manner. This concept emphasizes non- chemical control techniques over chemical controls but not the total elimination of pesticides.

Although IPM has been implemented in DoD pest management programs for many years, renewed emphasis is needed. DoD's strategic plan for environmental security, drafted in 1993, mandates a reduction in the environmental risk from pesticides used in DoD programs. The proposed strategy to accomplish this goal includes expanding existing IPM practices. We expect IPM to minimize harm to the ecosystem, human health, and the environment, to reduce the need for pesticides, to reduce pest resistance, and to minimize pesticide waste. It is incumbent upon all personnel involved in military pest management programs to actively support IPM initiatives and provide resources for implementation. This includes trained Pest Controllers (PC), Pest Control Quality Assurance Evaluators (PCQAE), Pest Management Consultants (PMC) and managers and supervisors responsible for real property, food services and custodial services. It has never been more important for the Pest Management Consultants to insure that IPM strategies and methodologies are incorporated into installation pest management plans, installation program review and contracting process, training for DoD pest controllers and pest control Quality Assurance Evaluators.

The information provided here is not all encompassing, nor should a program be based solely on what is provided in this text. The purpose of this chapter is to present a sampling of techniques and procedures to illustrate the facilities management approach to pest control. All of the methods cited have been tried previously, and all have proved successful in real world situations. But since buildings vary enormously, no method will work equally well in all circumstances. The challenge of IPM is that it often cannot be delivered by formula. Once the basic principles have been understood, there is no substitute for resourcefulness and ingenuity in developing practical, site-specific pest management solutions. Another objective of this chapter is to illustrate the variety of control techniques that can be used in Integrated Pest Management.

GENERAL GUIDANCE

The elimination and prevention of pests in buildings is a distinct facilities services program, not just a custodial function, whether performed by in house forces or by contract. Modern pest management begins with the planning, design and maintenance of buildings. Once buildings are constructed inspections often reveal pest problems. All personnel responsible for cleaning and solid waste management programs must contribute to effective pest management. IPM is truly a multi-disciplinary function.

Modern pest control has evolved into a complex and specialized discipline that includes the application of pesticides. Chemicals are still important, but property managers are now faced with increasing public concern about pesticide misuse, toxic materials in the workplace, and increasingly restrictive regulation. Safer chemicals and treatment methods are continuously being developed, and should be incorporated into a pest control programs whenever possible. At the same time, program managers must be aware that numerous products are ineffective or require special skills to use effectively. The old-fashioned type of pest control that consisted of spraying around a building, and chasing the cockroaches from one place to another is ineffective, potentially hazardous, and an unacceptable liability and public relations risk.

The modern method of pest control is often termed Integrated Pest Management, or IPM. IPM methodology includes: identifying specific pest infestations; controlling these infestations with short-term solutions including pesticides and; reducing or eliminating the causes of infestation with long- term solutions such as structural modification. IPM methods must be safe and cost-effective. The critical components of IPM programs include cleaning, solid waste management, structural maintenance, pesticide application, and occupant education.

Attributes of IPM Programs

Old-fashioned pest control tended to ignore the reasons why a pest problem existed, and instead reacted and temporarily removed a small part of the infestation with chemicals. Although IPM also includes an immediate corrective response that may employ pesticides, it is mainly a preventive maintenance process that controls pests by reducing their food, water, harborage, and entry points. Hence, it is imperative that IPM begins with the structural planning and design process.

Old-fashioned pest control relied on the "exterminator" to solve pest problems often without a Pest Management Professional determining what services were needed and the type of control desired. Lasting solutions usually depend on coordinated initiatives to upgrade sanitation, housekeeping and repair.

Old-fashioned pest control consisted of routine pesticide application whether pests were present or not. IPM consists of routine inspection and monitoring, and treatment only when pests are actually present. Scheduled, repetitive pesticide treatment without regard for pest population dynamics is ineffective, and environmentally unsound. IPM can reduce the potential for liability resulting from ecological insults or adverse effects on human health.

Non-chemical control alternatives should always be considered before the use of pesticides (least toxic treatment). Old-fashioned pest control included the application of excessive amounts of pesticides to exposed areas far from where needed. Baseboard spraying and room fogging is still widely practiced by some of the pest control industry. These techniques are not very effective for killing cockroaches and other insects that are living deep within furniture, equipment, or structural elements. IPM requires that pesticides, when needed, be applied with precision and restraint. It emphasizes that only the safest compounds, formulations, and methods of application are appropriate. Insecticide baits are usually preferable to sprays. Sprays, when necessary, should be limited strictly to "crack and crevice" applications. Space sprays or "fogging" are reserved for unusual situations where no other solution is practical.

Old-fashioned pest control technicians did little except operate compressed air sprayers, although this trend is shifting toward more IPM services. IPM requires a much higher standard of in-house and contractor expertise to be successful. It is essential that management have informed technical guidance on all aspects of the pest control effort.

In-house or commercial pest control services that still employ old-fashioned methods, primarily scheduled spraying, cannot be relied on to provide service or advice that is in the DoD's best interests. To ensure that pest control in DoD buildings meets the highest standards of safety and effectiveness, the Pest Management Consultant (PMC) at major command or regional level serves as the installation advisor on pest management. The PMC's office functions as an information center on pest biology and identification, pest control technology, pest control contract administration, and pesticide law. The installation environmental coordinator, pest management coordinator, pest control supervisor and other installation personnel are encouraged to use this resource as part of their "team". The major command or regional PMCs are available to prepare pest management plans, review installation programs on-site, conducting training workshops for installation personnel, and consultation for special problems.

Getting Started: The Six Steps of the IPM Process

The IPM process is mostly common sense. The challenge to making it work is having enough patience and skill to gradually replace old attitudes and habits with common sense. Each pest problem, great or small, usually presents the pest controller with six basic tasks:

1) Understanding and Educating the facility manager. Most pest control in and around buildings is a service to the occupants and is performed at their request. The IPM process therefore typically begins with people rather than pests. Customer relations are always a two-way street. Educating the customer about pest management is essential, but it is much more effective if the pest controller first understands customer concerns and expectations. Education begins by explaining whether or not the concerns are warranted and the expectations attainable. As in any service occupation, the ability to listen to and communicate with people is absolutely necessary.
2) Analyzing the Pest Problem. It is fairly simple to identify most pests and why they are present, but a thorough understanding of structural engineering and design may be needed to determine the source of an infestation.
3) Taking Short-Term, Corrective Action. Although IPM emphasizes a "preventive maintenance" approach to pest problems, the real world often demands immediate corrective action. In many cases, the use of pesticides for this purpose is unavoidable. However, all concerned must understand that every corrective action will employ the least toxic method.
4) Implementing Long-Term, Preventive Action. Ongoing, "built-in" control actions indirectly reduce pests by minimizing their food, harborage, and access. These actions are the heart of the IPM process and a fundamental measure of its success. Sanitation and exclusion may be difficult to plan, coordinate, and execute, but are critical for success. Pest prevention, the "applied facilities management" aspect of IPM, requires that the pest controller have as thorough a knowledge of building operations as of pest biology. For IPM to work, those responsible for sanitation and building maintenance must cooperate with the pest controllers.
5) Monitoring, Documenting, and Evaluating Results. DoD pest control reporting systems include options for non-chemical control. Accurate record keeping is necessary to document IPM successes.
6) Getting Back to the Customer. Measurement of customer satisfaction is easy to ignore, but critical for program viability. The pest controller's own performance evaluation may not totally coincide with the opinion of others who are more directly affected by the pest problem. Customer satisfaction is a prerequisite for program support.

INSPECTION

Most pest problems in a building are discovered and reported by the occupants. Installation and contractor inspection of specific areas where pests have been reported should provide answers to three questions. First, how are the pests getting in, and can this access be reduced or eliminated? Second, what food source or other attractant has drawn the pests and can this source be reduced or eliminated?   Finally, where exactly are the pests living, and can these sites be physically altered, removed, or treated with traps or chemicals?

CONTROL TECHNIQUES

The following paragraphs describe common pest problems in DoD buildings and the techniques for dealing with them. These general guidelines can be used when preparing contract specifications. Special circumstances may arise that require alternate or modified approaches. Consult a PMC for additional information. Pest management information bulletins should be distributed to tenants with questions about the pest control program.

Rats

Rats dig burrows around foundations, in earthen banks and in planting beds. They are attracted to debris and food in unsecured waste storage containers. Rat problems originate outside the building. Rodents usually stay at ground level and below, but if they gain access to wall voids, may climb to upper floors. Rat control starts with three principal operations that do not involve the pest control contractor; sanitation, housekeeping and structural maintenance are generally more important than trapping and poisoning.

Since trash may contain food scraps attractive to rats, all collected waste must be stored for pickup in ratproof containers or kept in a ratproof room constructed of materials that cannot be easily gnawed. Rats can penetrate gaps greater than 1/2 inch. Compactors should be of a self-contained design and equipped with protective doors that close over the charge box.

Building grounds, loading docks, and interior space at street level and below should be kept as free as possible of debris that rats can use for shelter. Anything soft, such as rolled carpeting, insulation, or padded furniture, is particularly attractive to rats.

Rats commonly enter buildings through open doors and windows, under doors with greater than one-half inch clearance, holes gnawed through the weather stripping of rolling doors, unscreened vents, holes where utilities enter the building, and cracks in masonry. Pest controllers should report these conditions to facilities maintenance or public works. Contract specifications should require contractors to notify the contracting office when conditions contributing to pest problems are observed.

Rodenticide baitboxes are normally effective only if there is little alternative food for the rats. Sanitation, therefore, is a prerequisite for baiting. Although pest control contractors often place bait boxes around building exteriors, their use on DoD property is not recommended unless other control measures have failed or are impractical. All bait boxes on DoD property should conform to the following EPA guidelines: 1) the box must be anchored in place so that it cannot be picked up, 2) the box lid must be secured with a fastener or locking tie, 3) the box must be of a "tamper-resistant" design, with a protected feeding chamber and constructed of a sturdy material, 4) the bait must be placed only in the feeding chamber (not placed in box entrance or inserted into burrows), and 5) the box must be labeled with name of rodenticide and the last date of service.   All pesticides must be used in strict accordance with the label directions. Using a pesticide in a manner inconsistent with its label directions is a violation of Federal law.

Tracking powder applied deeply into burrows with a hand-operated duster is one of the most effective ways of poisoning rats. This may be the only way of poisoning of bait-shy rats. Treatment with tracking powders is most effective in dry weather.

Indoor control of rats can also be accomplished with snap traps and large glue boards. Either may be used outdoors in protected locations. Care must be taken to place traps in safe locations and out of the public view, and to check them regularly.

Mice

Mice may enter buildings from the outside, but many mouse problems originate indoors. Although large numbers can build up in food service areas or trash rooms, small numbers can survive practically anywhere. Mice generally nest within 15 feet of their food source and frequently spread through a structure along pipes, cables, and ducts. The increased use of raised flooring for electric cables in telecommunications and computer facilities has greatly increased potential mouse harborage in public and commercial buildings.

A practical control measure for limited areas is blocking access routes into occupied spaces by sealing entry points, utility openings or chases. Young mice can squeeze through cracks just wider than one-quarter inch. Entry points can be sealed with caulk, copper mesh, steel wool, or polyurethane foam. Large, open office areas or rooms in older buildings may have so many potential access points that sealing is impractical.

Sanitation for mouse control is similar to that required for controlling cockroaches. All food and refuse should be stored in sealed containers. Surfaces, crevices and containers should be free of food residue. Refuse should be removed daily. Strict attention to cleanliness is essential for mouse control in food service areas. However, it is often difficult to achieve a level of office sanitation that actually makes a difference for a scattered, low-level mouse infestation.

Rodenticide bait or tracking powder is generally not recommended for mouse control inside buildings because of the potential odor from dead mice behind walls. In addition, there is always the chance that tracking powder applied to out-of-the-way locations could be disturbed during future renovation work.

Glue boards and snap traps are usually the most effective devices for controlling small numbers of mice. Extreme care must be taken to conceal traps in order to avoid adverse occupant reaction. Windup, multiple-catch traps can be useful for controlling large infestations in kitchens or unoccupied spaces, provided the necessary sanitation and sealing measures are also carried out.

Small Cockroaches

Two species are responsible for most pest complaints and pesticide use in public and commercial buildings in the United States. They are the "German" and the "brown-banded" both of which are smaller than three-quarters inch in length. Although it is widely believed that these insects can never be eradicated from the workplace, it is possible to totally eliminate them from a limited area such as an office. However, the degree of success depends not only on control measures, but on occupant attention to detail when it comes to cleanliness and housekeeping. Cockroaches and their egg capsules are continually reintroduced on custodial trash carts, and with packaged food. These invaders will not survive and multiply if they cannot find enough to eat.

Cleanup to reduce cockroaches must focus mainly on food residue in and around equipment, microwave ovens, refrigerators, trashcans, and areas where exposed food is stored. Surfaces on which food is prepared or consumed should be kept clean at all times. Removal of corrugated cardboard is especially important since it provides excellent harborage for cockroaches. The most effective cockroach control technique for food service areas and trash rooms is regular steam cleaning or pressure washing of all possible structural crevices and equipment.

Permanent reduction of cockroach populations may be achieved by eliminating harborage. A caulking gun is probably the most appropriate symbol of modern pest control. Care must be taken to completely seal the entire crevice so that cockroach access is totally eliminated. Types of space where caulk or grout are most effective include foodservice areas, restrooms, and janitor's closets. The most common types of cracks to eliminate include; where sinks and fixtures are mounted to the wall or floor, around all types of plumbing, baseboard molding and corner guards, where shelves and cabinets meet walls or door frames, and any cracks on or near food preparation surfaces. Care must be taken to clean surface areas around the crack before applying the caulk. Dirt on the surface can reduce the adhesion ability of the caulking material.

Containerized paste or gel baits should be the standard insecticide treatments for cockroaches in most occupied spaces. The small, plastic bait containers should be placed as close as possible to the dark, concealed spots where cockroaches are actually living, preferably adjacent to edges and corners. The most common mistakes in using containerized bait are failure to eliminate nearby alternate food, and failure to use enough containers. For example, at least 2 - 3 bait stations should be placed in infested desks. Containers should be replaced after 3 months or sooner at the beginning of a baiting program if cockroaches are very numerous. The newer transparent bait stations facilitate checking baits for consumption. Paste or gel baits are most effective when applied in many small dabs, preferably with a syringe-like dispensing tool. Abamectin bait is safe and highly effective, but must be carefully injected into crevices.

Spraying is sometimes the most practical and effective way to apply pesticide in food service areas, restrooms, and trash rooms. Spray must be precisely applied in small amounts only to cracks and crevices. A "crack and crevice" treatment implies that the stream of insecticide is never visible during the spraying process.

Many types of cardboard or plastic sticky traps are available to help the pest control technician or installation personnel pinpoint sources of cockroach infestation, or monitor areas where occupants have complained but no infestations can be visually detected. Sticky traps are not intended for control, but rather to guide and evaluate control efforts as part of the inspection process.

Large Cockroaches

Several types of cockroaches grow to over an inch and a half long, and are commonly called "waterbugs" in many localities and "palmetto bugs" in Florida. These insects may wander along pipes throughout a building; they live mainly at ground level or below in temperate climates. Treatment should focus on warm, moist areas such as basements, boiler rooms, pipe chases, sumps, and sewer shafts. In warm climates, even attics and mulched outdoor planting beds may be infested with large cockroaches.

One of the most effective ways to control large cockroaches in buildings is to reduce moisture by fixing leaks, improving drainage, and installing screened vents to increase airflow. Cockroach access routes from wall voids into occupied spaces can be blocked with caulk or grout applied around plumbing and electrical fixtures. Caulk should be applied according to procedures previously discussed. Basement floor drains should be fitted with screens or basket inserts which are cleaned regularly.

In addition to eliminating food residue, reducing clutter is critical for large cockroach control. Large cockroaches like to hide in stacked boxes, cartons, rolled carpeting and any stored paper or cardboard materials, particularly in dark, damp locations. As with the small cockroaches, pesticide control should emphasize the use of baits rather than sprays. Consult the PMC for current recommendations.

Ants

Most species of indoor pest ants come from nests located outside the building or inside wall voids. Therefore, the most effective control typically entails sealing up cracks (usually around windows and other locations on exterior walls) where the ants are entering. Close observation on the outside often can help pinpoint these access crevices. Vegetation in contact with the building exterior, such as tree limbs or climbing ivy, should be removed. Containerized, slow acting bait is usually the most effective type of pesticide treatment for temporary control. Permanent control requires that the nest be located and destroyed.

Many types of ants produce winged queens and males that swarm at certain times of the year. Large numbers of swarmers may pour out of crevices into a room, even in locations that never had a problem with crawling ants. Swarming ants can severely disrupt operations, and often result in occupant demands for "spraying." In cases where the ants are relatively concentrated, such as at windows, they may be vacuumed and disposed of in an outdoor trash receptacle. However, in some cases, a space spray with a pyrethroid insecticide may be the only practical response. Winged ants emerging inside a building usually die quickly or disperse, so spraying tends to be of little value if not done immediately. Rooms should be unoccupied during a space spray treatment, all electronic equipment should be well covered, and the space should be ventilated for at least several hours before reoccupation. The standard procedure to prevent future swarming is to locate the ants' entry points (and the nest itself, if possible), inject a pesticide into these crevices, and seal up entry points afterwards.

There are three species of ant problems that require a special response after positive identification:

1) Pharaoh Ants - Pharaoh ants are tiny yellowish-brown to reddish-brown ants that can nest in almost any hollow place inside a building. In an office, for example, these ants could come from inside a table leg or room divider, behind a baseboard or switch plate, above the ceiling or under the floor. In warm climates, colonies may be located outside. It is important that sprays not be used for control attempts. Colonies stressed by sprays often respond by dividing. If spray is continually applied, this dividing process results in many widely scattered colonies that infest an increasingly greater area. Bait specifically labeled for pharaoh ants must be used.

2) Fire Ants - In warmer climates, fire ants can be a stinging hazard on building grounds, and sometimes indoors. Use of pesticides for fire ant control is usually unavoidable. Treatment often combines injection of spray into individual mounds with use of bait formulations broadcast over broader areas. Consult the PMC for current recommendations.

3) Carpenter Ants - Carpenter ants are large ants that tunnel in wood. Small numbers in a building may simply be invaders from an outdoor nest that can be controlled by sealing up their point of entry. Large numbers inside typically indicate a nest within the building. Carpenter ants generally prefer wood that is moist, and are considered to be an "early warning signal" of structural leaks or drainage problems. Control consists of locating the nest, injecting pesticide directly into it, replacing the damaged wood, and eliminating or reducing any source of moisture.

Fruit flies

These tiny flies are introduced into buildings many times a day during warm weather, usually as nearly invisible eggs, larvae or pupae (imatures) on or in fruit. Since large numbers of these immatures can develop into adult flies within several days, and since one female fruit fly can then lay several hundred eggs, infestations build up rapidly when sanitation is not rigorous. Adult flies are easily dispersed throughout a structure by the air handling system and by hitchhiking on trash pickup carts. Although fruit flies are totally harmless and cannot bite, they are considered to be an intolerable nuisance by many people.

Fruit fly breeding sources are often difficult to find but eliminating the breeding sources is essential. Fruit fly larvae (maggots) require moist, fermenting material in which to develop. Typical sites that generate large numbers of flies include trash rooms and trash pickup carts, can and bottle recycling areas, and any space where food is routinely prepared, dispensed, and consumed. However, there may be dozens of smaller, local sources throughout a building that contribute to the problem. These include leaks under refrigerators, dirty mops, clogged drains, or peels and rinds left in trash receptacles.

Fruit fly problems can be greatly reduced by the use of traps. There are many different trap designs, but all work by using bait to attract the flies into a container. Two of the most effective baits are ripe banana and vinegar. Some traps lure the flies through a funnel or similar "one-way" openings, while others rely on the collected flies eventually drowning in a liquid bait. Homemade traps can be easily fashioned from mason jars fitted with paper funnels, but several inexpensive plastic models are commercially available. Traps are remarkably effective, but problems can arise when either too few are deployed or servicing (removing flies and renewing bait) is too infrequent. An increasing number of pest control contractors are using traps as part of their normal service for fruit fly infestations.

Space sprays are not recommended for fruit fly control since the potential for adverse occupant reaction to the pesticide usually exceeds any short-term benefit. However, in cases where very large numbers of flies are severely disrupting operations, a space spray with a pyrethroid-based insecticide may be the only practical response. Rooms should be unoccupied during the treatment, all electronic equipment should be covered, and the space should be adequately ventilated. If the breeding source is not discovered and corrected, sprays will only give temporary relief.

Miscellaneous Crawling Pests

The preferred control of crawling insects is sealing entry points and vacuuming intruders. Tight seals around windows, doors, utility access holes, and weather-stripping will usually reduce crawling insects. Residual insecticides sprayed on surfaces near potential entry points may be effective; microencapsulated formulations should be considered.

Spiders

Although fear of spiders is common, poisonous species are not commonly encountered in most general use buildings. Harmless, crawling spiders are occasionally a nuisance in basements or warehouses. Spiders that build webs in secluded corners or in outdoor locations such as eaves, lights, can be removed with a vacuum.

Crickets

These insects commonly invade basements and crawl spaces seeking dark, cool, moist spaces. They are harmless to humans but may be annoying, particularly at night. They feed on organic matter and sometimes cause damage by feeding on woolen, silk and cotton clothing and other fabrics. Field crickets usually invade buildings late in the summer when vegetation becomes scarce. Closing gaps under doors and loose fitting windows and vents to the exterior may keep crickets out. Indoor controls should include such things as moisture reduction, sticky traps and if necessary a residual insecticide can be used.

Centipedes

Most species of centipedes are harmless. To avoid contacts with centipedes, two physical control methods are recommended: general clean up of debris to eliminate their hiding places, and maintaining close fitting doors and screening.

Termites

Termites damage wooden structures and incidental wood in steel and concrete buildings, such as trim or molding, panelling, furring strips, or door and window frames. Files, stacked books, or any other cellulose material, such as fiberboard sheathing or insulation panels, may also be attacked. Most termite problems in large office buildings involve subterranean colonies that persist for years on buried scrap wood and constantly explore upwards for new sources of food. These colonies are often a nuisance because of the periodic emergence of large numbers of winged "swarmers" that find their way into occupied space. Swarming termites should be controlled with a vacuum cleaner. A space spray may be unavoidable in rare circum stances. All comments describing ant swarming apply to swarming termites as well.

In masonry buildings with minor termite damage or localized swarming, satisfactory control can often be accomplished with pressurized injection of insecticide directly into the wood, or into the crevices from which the swarmers are emerging. If possible, the crevices should then be caulked or otherwise sealed.

Subterranean termite problems that cannot be solved with spot injection and sealing must be treated with far more extensive insecticide application. Standard techniques involve pumping the chemical into holes drilled through the building's slab and/or into the soil around the building's foundation. In warm climates, severe infestations of certain types of termites that live in dry wood above ground (including furniture) may have to be controlled with fumigation. These types of termite treatments require specialized contractor expertise and are beyond the scope of this chapter. Consult the PMC for additional information.

Birds

Three species of birds, pigeons, starlings and English sparrows are serious pests when they roost and nest on or in buildings. Their excrement is unsightly, harbors microorganisms that can cause severe illness, and corrodes structural materials. Their nests may block air intakes, damage the building surface by holding water against it, and contain parasites that can become indoor pests. Bird control is difficult and highly specialized. Consult the PMC or the installation Natural Resources Office for additional information on buildings registered under the Historic Preservation program.

There are three primary requirements that must be met by a bird control program:
1) Maximum Effectiveness - In addition to providing long-term protection against pest birds, cost effectiveness must also be considered. The utility and appearance of some exclusion devices deteriorate more rapidly than others.
2) Minimal Damage to Structure - Permanent physical and aesthetic damage to any structure should be avoided in bird control work, particularly in historical buildings, and repellent systems must be harmless to building materials and finishes; must be reversible so that if it is eventually removed the building can be returned to its original state; and must be inconspicuous to passers-by.
3) Public Relations - Even the perception that birds are being harmed is likely to draw considerable criticism from individuals, special interest groups, and the media. Bird control efforts, therefore, should always be as humane and as discreet as possible.

Bird Management Methods

Several lethal bird management methods in widespread use for many years represent a last resort. Although they may be appropriate in restricted or specialized circumstances, they are not recommended for large-scale projects, historic structures, or high-visibility sites. Bird management options include:
1) Shooting. Shooting is an effective way to reduce European Starlings and pigeons in large buildings such as hangers and warehouses. A pellet rifle, or a .22 rifle with cb caps, is an effective tool for this effort. Shooting is species specific, (no non-target kills), and has no secondary toxic effects. While no federal permit is required, it is imperative that the individual marksman is trained and experienced in bird identification. To reduce adverse public reaction, the effort should be conducted during non-duty hours by a minimum number of personnel. All dead birds should be carefully handled so as not to attract attention later. Public affairs personnel should be advised prior to the effort to prepare them in the event adverse attention is created. While reducing the population with lethal methods reduces the immediate problem, the potential for birds returning is high (an open niche will be filled). Periodic shooting may be required to maintain birds at an acceptable level.
2) Toxic Baiting and Toxic Perches. Control by avicides (bird poisons), either added to feed or incorporated into special perches, is undesirable for most situations - there are always more birds to take the place of those killed and adverse public reaction may result.
3) Porcupine Wire. There are several anti-roosting products consisting of wire spikes or coils that stick up from ledges to prevent birds from landing. Although usually effective against pigeons if precisely installed, these materials are unacceptable in appearance for sites in the public view.

Their attachment to historic structures also produces an unacceptable risk of damage to the masonry. Furthermore, smaller birds such as sparrows often use the wire as convenient anchoring points for their nests, adding to its unpleasant appearance. Porcupine wire is most useful for relatively concealed applications on utilitarian structures, such as overhead pipes and beams in garages.

4) Repellent Gels. Sticky gels that birds find unpleasant can be applied to ledges with caulking guns. These gels are not recommended in most circumstances due to their eventual discoloration by dust and other air pollution, potential staining or even spalling of the underlying masonry. Additional objections to sticky gels are the mess that often accompanies application, and their temporary effectiveness.

5) Electrical Wire. "Shock wire" systems are not recommended in most circumstances as they are prone to shorting out because of water or ice, airborne debris or maintenance work on a building's exterior. Since these systems are typically "zoned" for large areas of a structure, a single break or short can disable hundreds of feet of wire. Like the spikes of porcupine wire, the insulators of electric systems are conspicuous and often aesthetically displeasing. Unless installed exclusively on mortar joints, with no damage to adjacent masonry, they would be automatically prohibited on historic structures.

6) Scaring Devices. Plastic owls and snakes, balloons with eye patterns, brightly-colored objects that turn in the wind, and dozens of other "scarecrow" variations are intended mainly for temporary protection of crops, and are almost always ineffective for protecting buildings. Falcon silhouettes, may be used to frighten migratory birds from flying into large windows. Recorded distress calls can effectively repel starlings when used by an expert. Various noisemakers including pyrotechnics, may also be used to repel pest birds.

7) Screening. Barriers and cages of hardware cloth or other wire screen are often the most efficient way to keep birds off and out of limited areas on utilitarian structures that are not in the public view. A 3/4-inch mesh is the largest size that will eliminate sparrows and starlings. Horizontal nesting areas such as window air conditioners can be eliminated by the use of aesthetic structural materials affixed above at a 45 degree angle.

8) Tensioned Netting and Pin and Wire Systems. Two relatively new types of systems are the current recommended solutions for Birdproofing on a large scale, on historic structures, or on any high-visibility site. "Pin and Wire" installations consist of spring-tensioned stainless steel wires strung at different heights along projecting elements such as ledges, lintels, sills, and stringcourses. The wires are attached to slender, stainless steel pins inserted into mortar joints. Tensioned netting installations consist of various types of net fabrics stretched taut across recessed elements such as niches, colonnades, and the coffered ceilings of porticos. Wires or cables threaded through the net edges provide an even tension that can be adjusted by turnbuckles. The cables run through hooks or screw eyes that are attached to the building only at mortar joints. When correctly installed, both of these systems are effective, durable, and inconspicuous.

9) Dangling Filaments. Migratory swallows can be deterred form entering nesting areas such as under roof areas by an easy-to-use and inexpensive system. A 1/4-inch, 4x8 foot CDX plywood sheet is cut into strip slats 1 inch wide. Holes .063- inch in diameter are drilled into the slats at random 8, 10, and 12-inch intervals. Four-foot sections of 60-pound monofilament line are knotted at one end and then drawn through the holes to be left dangling. The slats are nailed onto wood or spot glued onto concrete and steel using construction adhesive and installed so that the monofilament presents itself into the flight path of the swallow.

When areas behind the monofilament line are bright, the line is nearly invisible to the birds. As the birds try to land at the area, they contact the monofilament line. The line acts like netting, interrupting their flight pattern. Within 48 hours, such surprising contact stresses the birds to such an extent that they leave the area.

Removing Bird Excrement. Microorganisms that can cause serious illness live in bird droppings. However, infection typically occurs by inhaling these pathogens through the nose and mouth. Therefore, bird excrement is dangerous mainly when it is dry and subject to becoming airborne as a fine dust, particularly when disturbed by sweeping or scraping. Germicides are sometimes applied to accumulated excrement prior to cleaning. Thorough saturation with water and the use of a respirator, however, are sufficient protective measures. Many disinfectants are oil-based formulations that may permanently stain building materials. The following concepts should be incorporated in bird excrement removal on building exteriors. If possible, cleaning efforts should be coordinated with the installation of a modern birdproofing system and the removal of any old, ineffective systems that are in place.

Worker Protection. All personnel working with accumulated bird excrement should wear a full face respirator with a High Efficiency Particulate Air (HEPA) filter for screening particles of 0.3 micron size. Dust and particle masks are better than nothing, but they will not give complete protection. In addition, all personnel should wear protective coveralls, gloves, boots, and hats.

Application of Water. Droppings are usually easier to clean when they are dry and crusted. Nevertheless, prior to removal, all excrement must be saturated with water to prevent the debris from becoming airborne. If a hose is used on the exterior of buildings, water pressure should low. A hand-held compressed air sprayer filled with water is also satisfactory, and will reduce runoff. Higher pressures may be used for hosing small amounts of excrement off sidewalks and pavement.

Non-Metallic Tools. On historic structures, only non-metallic tools (such as plastic spatulas and brushes with natural fiber or nylon bristles) should be used to remove the excrement. Tools that can easily damage building surfaces, such as coarse wire brushes, should not be used under any circumstances.

Disposal. Removed excrement should be collected in plastic bags, sealed, and disposed of at a sanitary landfill.

Public Protection. Bird excrement removal on public buildings should not be performed during normal working hours and should be scheduled for weekends, if possible. All work should be performed from the outside of the building. Barricades and signage must be provided to keep the public clear of the work site during all operations.

The Role of Management

The most common mistake of management is to automatically request a pesticide treatment, and thereby become liable in the event occupants experience adverse reactions to the chemical. Management must treat all concerned with sympathy and respect, but emphasize that pesticide treatment cannot be undertaken without positive confirmation that a pest problem exists.

An inspection of the affected area should be carried out by a pest control professional that understands that pests may not be involved. Usually when real parasites are present, they are abundant and readily seen. The most common types in office buildings are mites coming from bird nests or from concealed infestations of rodents. Occasionally fleas living on guard or seeing-eye dogs will bite people who work in the vicinity. If a thorough investigation fails to produce any specimens, a non-pest cause is probably responsible. Nevertheless, it is standard procedure to monitor the area with sticky traps. In addition, occupants should be instructed to capture anything they suspect is biting them on a piece of clear adhesive tape. The PMC will identify all such samples submitted from installations. Even a single parasite specimen is justification for pesticide treatment. However, the captured items are typically bits of debris or tiny, harmless insects that are commonly present in buildings. When it is reasonably certain that there are no biting insects in the affected space, the pest control program is no longer involved.

PUBLIC RELATIONS

Old fashioned pest control did not require much understanding or support from customers. Pesticides were expected to overwhelm pests. Sometimes this happened; other times it did not. But the pest control effort operated more-or-less independently. Urban IPM has the potential to provide long- range, effective control with much reduced reliance on pesticides. Cooperation is required, however, because urban IPM often depends on structural modifications and sanitation performed by others. Customers must also support on-going surveillance programs and often must tolerate slow acting controls and occasional low-level pest sightings. Pest management professionals and activity pest management personnel should educate, sell or otherwise "convert" potential customers through a comprehensive public relations (PR) effort. They should thoroughly educate supervisors and others up through the chain of command, such as base civil or facilities engineers and installation commanders, to gain cooperation, the linchpin of success.

Easy to use, long-lasting baits and pheromone traps are often safer and more effective than sprays, but may not eliminate certain pest infestations, such as Pharaoh ants or grain moths, for several weeks. Many IPM techniques may fall into the category of slow- acting controls. The servicing technician must be able to convince the occupants/customers to resist the urge to "reach for the spray" even when occasional sightings occur. Occasional sightings are common with baits and traps because, unlike "quick knock-down" agents, insects and animals frequently may be observed returning to their nest with the newfound food that the baits provide.

Sometimes the need for structural modifications impose the greatest constraints on a successful pest management program -- particularly if the customers and suppliers, outside of the pest management shop, are not educated on the absolute value of these modifications. These two groups of people are often the key to ensuring that such modifications are completed, however, they can balk at the cost or effort involved in this "extra" work.

Educating facility users involves pointing out the pest "expressways, freeways, and hideouts" and discussing the connection to their pest problem. What one lives with on a daily basis may not necessarily be what one sees. Discussing, and more importantly demonstrating, the ease of caulking, taping, and repairing small, medium and large cracks and holes, while pointing out how they will aid in further exclusion will go a long way towards helping to decrease your overall use of chemicals.

Although pest managers place and retrieve survey devices, it is the occupants who must live with them. The pest manager should install survey devices with an explanation, taking the time to discuss the importance of surveillance - why it is often essential to proper control and should precede actual pesticide application. For example, cockroaches sighted by workers may emanate from the attic, from basements or from outdoors. A full-scale application of pesticides in the working spaces will eliminate only a handful of the pests, but not the source of the problem. Understanding this as a building manager helps with the management of a surveillance program. Occupants must protect the survey devices and maintain their positions, not move them around or throw them away. They must also be willing to accept sightings, whether in or near the traps themselves. Most of all, they must accept new methods of doing business.

Lastly, successful cooperation also depends on a prompt and accurate servicing schedule by the pest management technician and the correct follow-up actions once surveillance techniques reveal the problem. In essence, traps and baits must not be placed only to be ignored.

Scheduled, preventive chemical control will preclude most flare-ups in pest populations. However, this method is costly, introduces unnecessary pesticides, and accelerates resistance to the chemical in use or occasionally to ones not yet introduced. Also, food service managers and others may sometimes "sacrifice" cleaning, to save money and manpower, when they expect the pest control service to come in and take care of the pest problems. And if chemicals are expected to do the trick, managers may delay or postpone the actual long-term repair and renovation efforts absolutely necessary for proper pest management.

The best intended control programs will fail if facility managers do not eliminate food sources. Prerequisite cleaning must be emphasized as the essence of the control program. Saving money on cleaning by neglecting good sanitation immediately increases the costs of pest management, and does not save the government money over the long term. Roach baits cannot out-compete grease, leftover food and standing water; rodent bait cannot out-compete uncovered garbage; full pet food bowls will probably be more enticing than a smaller, containerized bait station. Good sanitation is the best method of pest control. Most workers within a facility don't enjoy working around a bevy of cockroaches. They just need to be convinced that they can make a difference in helping to decrease the populations. Your pest management professional and activity personnel (pest control supervisors, QAE's and others) should be proactive in educating you on their role in IPM.

CHAPTER 10 - FIELD FEEDING

The three most critical factors that can influence success or failure on the battlefield are ammunition, food, and water; each is equally important. Historically, in every conflict involving the U.S., only 20 percent of all hospital admissions have been from combat injuries; the other 80 percent have been from diseases and non-battle injuries (DNBI). During the Vietnam War, nearly half of the U.S. troops deployed had one or more significant bouts with diarrhea during their first four months in country. What might the impact be on the mission if a unit is 40% combat ineffective due to diarrhea, dysentery, or other diseases? Commanders are responsible for protecting and preserving Army personnel and equipment against injury, damage, or loss that may result from food-, water-, and arthropod-borne diseases, as well as environmental injuries and occupational hazards. As junior leaders in the food service community, your actions play a key role in maintaining unit readiness. Food service supervisors must employ sanitation and safety standards to protect food and water from contamination.

Field Food Safety and Protection

Field operations present a tremendous challenge to leaders when it comes to protecting soldiers from illness or injuries. Food- and water-borne illnesses are key contributors to the disease and non-battle injury (DNBI) statistics. Approximately 80 percent of all hospital admissions during armed conflict are attributed to DNBI.

The principles of food safety -- layers of protection -- remain the same when we move from garrison to the field. What changes are the sanitary conditions, the equipment, and the type of subsistence used. Leadership considerations to protect food during storage, preparation, and remote feeding, coupled with providing and maintaining disinfected drinking water are of paramount importance to maintaining good health and morale.

Food Protection Issues

Feeding operations must be located at least 100 yards upwind from latrines and 30 meters from waste disposal or collection areas. This will help to keep flies that transport bacteria away from food. Subsistence must be protected during transport and storage. Field equipment and supplies should not be transported with rations in the same vehicle. If a common vehicle is used, the bed of the truck must be washed with hot, soapy water before use and rations must be palletized during transport. A separate ration tent should be provided at the field site to protect rations from insects, animals, and contamination. Storing rations in the sanitation center is not a safe option as chemical contamination may occur from concentrated detergents and sanitizing agents and spilled wash water.

Food must also be protected from vermin. The first step in protecting food from insects and animals is to ensure an adequate field site is selected for your unit or operation. The next step is to control pests that enter the area by maintaining proper sanitation practices and storage of food. Flies and cockroaches are capable of transmitting disease organisms to food from contaminated soil, human and animal feces, and contaminated water. Rodents can also contaminate food by urinating on products as they gnaw their way into packages. A ration tent with closed flaps will provide some protection as will the use of pallets to keep subsistence off of the ground. Covering garbage cans when not in use will also reduce the number of flies that enter the area. Garbage cans must be lined with plastic bags and bags should be securely tied when they become two-thirds full. Spilled food products must be policed as soon as possible to prevent attracting pests into the area.

Maintain proper time and temperature control over all potentially hazardous foods in the UGR menus. Careful consideration should be given to cold storage, thawing practices, and remote feeding using insulated food containers.

In Bosnia in 1996, there was an outbreak of *Salmonella* that resulted in 100 casualties. The incident occurred after cooks prepared eggs that were stored in an unrefrigerated container express (CONEX) for several days. A mechanism for verifying product and/or equipment temperature was not in place.

Temperature Standards

Frozen and chilled potentially hazardous foods should be stored in ice chests or refrigeration units at 40^{o} F or below. Hot food items from the UGR-A must be cooked to an internal product temperature of 165^{o} F regardless of the product type. For example, raw steaks, raw chicken, and steamed vegetables must all be cooked so that the internal product temperature reaches 165^{o} F and is held there for at least 15 seconds.

Insulated Food Containers

When IFC inserts are not properly sanitized or stored, foods can become contaminated. The IFC can also become an incubator for bacteria when the internal product temperature of contaminated food drops into the temperature danger zone. IFC inserts should be cleaned and sanitized immediately prior to use to ensure no residual contamination is present. When packing the IFC for remote-site feeding, supervisors must ensure that hot foods are at 140^{o} F or above and chilled foods are at 40^{o} F or below before they are placed in the inserts. IFC inserts must be pre-heated or pre-chilled regardless of the type of IFC used (Cambro or Mermite). This may contradict the recommendation made by the Cambro manufacturer, however, it is a requirement of TB MED 530. Failure to pre-heat or pre-chill IFCs has resulted in an increased cooling rate of food products during transport; thereby, increasing the potential of bacterial growth and foodborne illness.

Once the IFC is filled it must contain a label indicating the item name, food internal temperature when filled, number of servings, and the date and time the food was placed in the inserts. When serving, hot foods should still be at or above 140^{o} F. The IFC is designed to keep foods hot for 3 to 5 hours and cold for 3 to 4 hours if managed properly. TB MED 530 states that potentially hazardous foods can only be held for a maximum of 4 hours in the IFC and then must be discarded.

All foods, including tray packs and canned items, must be removed from their original containers and placed directly in the IFC inserts prior to distributing for remote-site feeding. There exists a greater potential for contamination when foods are handled and served by non-food service workers. Items packed in the IFC are better protected from residual dust/dirt that may contaminate the lids/covers of tray packs and cans. Exceptions to this requirement apply to individually packaged items served in its packaged form (i.e., pastries, cookies).

Defining Potentially Hazardous Foods

In review, potentially hazardous foods are those foods that promote the rapid growth of bacteria. Certain physical and environmental characteristics must exist in order to promote bacterial growth. Using the acronym ***TAN POT***, we know that foods high in protein type ***n**utrients, **a**vailable water and **o**xygen content,* and a somewhat neutral ***pH*** will enable bacteria to grow when left in the ***t**emperature danger zone* for a sufficient amount of ***time*** in the product. Generally speaking, all foods prepared in the field can become potentially hazardous when product conditions are altered. Obvious potentially hazardous foods include raw and cooked meats, fish, pork, poultry, eggs, and dairy products. Other potentially hazardous foods include liquid pasteurized eggs; cooked can or fresh vegetables; cut raw fruits and vegetables (including ready-to-eat packaged salads); and cooked pasta and rice. Remember, there are many bacteria associated with foodborne illness that are naturally found in the soil. This means fruits, vegetables, and most grain products are probably contaminated. Some of these bacteria, such as *Bacillus cereus* and *Clostridium botulinum*, produce heat-stable spores that are not destroyed during canning (retort) processes and may remain dormant in packaged or fresh foods until optimum environmental conditions arise.

Applying Risk Management to Field Feeding

Employing food and safety risk management processes in your field feeding operations can prevent a tragedy from occurring. During a training exercise, a unit movement was scheduled for early morning. Because there would be no time to set up equipment and prepare breakfast after the movement, the commander ordered the cooks to prepare the next morning's meal the evening prior. Eggs, sausage, bacon, and potatoes were cooked and packed into IFCs, held overnight, then served after the unit movement the next morning. The end result was 39 soldiers became sick, 14 were hospitalized, and one died.

Another example is that many shortcuts are taken when conducting remote-site feeding. Food and personal safety issues arise when vegetables are heated in their original, unopened can, then distributed for remote-site feeding. These cans were not designed to be heated unopened and may explode due to pressure build-up. Additionally, excessively dusty or muddy conditions contaminate the surface of cans and trays during transport and between serving intervals. UGR-H&S rations are also subject to contamination during remote-site feeding and require placement in IFC inserts prior to distribution. Opened UGR-H&S trays are considered a potentially hazardous foods and must be held at 140^{o} F or higher, or 40^{o} F and below. (UGR-H&S Cakes are an exception).

One myth commonly shared among food service workers at a major Army installation is that the temperature of hot foods will continue to rise when placed in the IFC; therefore, foods will continue to cook in the IFCs. In a true instance, this logic resulted in 20 soldiers being hospitalized after eating undercooked eggs and French toast that were prepared in garrison and packed in IFCs for field feeding. Individuals who prepared the breakfast items rationalized their actions by stating eggs turn green in the Mermite cans because they continue cooking. Food service supervisors must recognize questionable or hazardous food handling practices and have the professional courage to change such practices or inform key leaders of the risks associated with execution of these practices.

Ensuring proper IFC preparation and handling procedures are enforced and spot-checking cooking and holding temperatures of potentially hazardous foods will significantly reduce the potential of foodborne illness in feeding operations. Annotating the time on the label at which all food in the IFC must be served or discarded will further promote food safety awareness during handling.

Sanitizing all fresh fruits and vegetables (FFV) with an approved food-grade disinfectant or a 100-ppm total chlorine solution prior to preparation or offering for service is one action that can be taken to prevent foodborne illnesses from occurring.

Equipment Cleaning & Sanitizing

Equipment Cleaning and Sanitizing. Enforcing standards for cleaning and sanitizing food service equipment and utensils in the field is very important as sanitary condition become more challenging than in a garrison environment. The sanitation center provides an effective means of maintaining sanitation standards, in addition to protecting sanitized equipment during storage. Units not equipped with the modern sanitation center must employ the pot and pan wash line (PPWL). The PPWL consists of four 32 gallon corrugated cans, three with immersion heaters, and one used for waste products. Both systems are based on the 3-compartment sink method for manual cleaning operations.

Cleaning and sanitizing standards are the same in the field as in garrison when using the sanitation center. Hot water in the sanitizing rinse must be clear and at a temperature of 171^{o} F or above. Items being sanitized must be completely immersed for a minimum of 30 seconds. Water temperature must be monitored throughout sanitizing processes to ensure it does not fall below 171^{o} F. When thermometers are not available in the field to monitor water temperature, the water in the sanitizing sink should be at a boil to ensure an adequate temperature is achieved. The sanitizing rinse water must be changed when it becomes cloudy due to soap residues or a visible grease film appears at the surface.

Standards for using the pot and pan wash line requires the fourth can to be used as the sanitizing rinse. Immersion heaters cannot be adjusted to control water temperature; either the heater is on, or it is off. Because of this, immersion heaters must remain on and the water must be boiling to ensure sufficient heat for sanitizing.

When immersion heaters, M2 burners, or the MBU fail to maintain required water temperatures for sanitizing, chemical sanitizers must be used. When using chlorine bleach, the water temperature must be 75^{o} F and the chlorine concentration must be 100-ppm. Contact time for chemical sanitizing is a minimum of 15 seconds. Commercial food-grade sanitizers may be used IAW the manufacturers' recommended concentration. To ensure effective sanitizing practices, supervisors must periodically monitor water temperature and sanitizing agent concentrations. Concentrations of chlorine in excess of 200-ppm and commercial sanitizing agents that exceed the maximum manufacturers' recommendation require an additional clear water rinse to remove residues from high chemical concentrations. Failure to remove excess chemical residuals may result in a chemical contamination of food. [Note: Chlorine Test Paper NSN 6630-01-012-4093]

Equipment and utensils that have been cleaned and sanitized must be air-dried and protected from contamination during storage. Consideration should be given to clean and sanitize equipment and utensils immediately prior to use to ensure any residual contamination incurred during storage is removed.

Chapter 11 - FOODBORNE OUTBREAK EPIDEMIOLOGY

Epidemiology is the science devoted to investigating population-level and environmental factors that cause, prevent, mitigate, or otherwise influence diseases and injuries. In practice, its scope includes determining disease risk factors and testing the efficacy of interventions to reduce or eliminate threats to the health of a given population. The Epidemiology Program applies its practice to Army healthcare beneficiaries, especially active duty soldiers. To support MEDCOM Regions and subordinate CHPPM commands, services range from quick-response outbreak investigations to consultations on sentinel diseases and clusters of undetermined etiology.

Investigation Guidance

Investigator kits with proper equipment should be maintained to facilitate immediate investigation of foodborne outbreaks. Carey-Blair tubes should be readily available as part of the investigation kit. These tubes provide a transport medium that will help preserve the environmental and food swabs. If an alert or complaint indicates a large outbreak, inform your servicing laboratory immediately that samples will probably be collected and give the approximate time they are expected to arrive at the laboratory. This will assist laboratory managers planning work schedules, equipment and supplies.

Each region/district may have individuals specifically trained in epidemiological investigations who can provide advice on investigations. Interviews of health professionals, hospital personnel, or consumers who may report suspected cases of foodborne illness will provide information to begin an investigation. Regardless of the source of the report, the diagnosis must be verified by a thorough case history and, if possible, by examination of appropriate food samples and clinical specimens. Public health professionals do this verification.

Upon contacting the affected person, identify yourself and explain the purpose of the visit or call. Neat attire, pleasant manner of speech, professional attitude and confidence in discussing epidemiology and control of foodborne illnesses are important in developing rapport with an affected person or family. Exhibit a genuine concern for persons affected, and be sincere when requesting personal and confidential information. Communicate a sense of urgency, and emphasize the positive contribution already made by the complainant toward the control and prevention of foodborne illness.

Set your level of communication based on the person being interviewed. Tact is essential. Phrase your questions so the person(s) interviewed will describe their illness, and the foods and events that they feel were associated with it, in their own way. Never suggest answers by the way you phrase your questions.

Ask specific questions to clarify the affected person's comments. Realize people are sometimes sensitive to questions about age, gender, special dietary habits, ethnic group, excreta disposal and housing conditions. Phrase questions thoughtfully. Some information may usually be deduced from observations, but if doubt remains, confirm your hypothesis by asking questions. Information on recent travel, gatherings, or visitors may indicate common sources or events.

Gather information about all meals and snacks eaten seventy-two hours before onset of illness. The food, even the meal, which precipitated the illness, might not be obvious. The type of illness will sometimes give a clue. If the first and predominant symptoms are nausea and vomiting, concentrate questions on foods eaten recently. If the first and predominant symptoms are diarrhea and abdominal cramps, foods eaten six to twenty hours before onset of illness are suspect. If diarrhea, chills and fever predominate, foods eaten twelve to seventy-two hours before onset of illness are suspect. Remember that these suggestions relate to common foodborne illnesses. The more unusual illnesses often present different clinical patterns. For instance, some illnesses such as Typhoid Fever and Hepatitis A, have incubation periods greater than 72 hours.

Use this detailed interview approach with every person identified in the initial complaint or alert, even though some may not have been ill, until you have sufficient information to determine if there is a foodborne disease outbreak. Physicians' and hospitals' records can be useful in verifying reported signs, symptoms and other clinical data and can sometimes rule out the possibility of foodborne illness.

SAMPLING

CAUTION: Never taste any of the food products, and handle all samples with caution to prevent accidental ingestion of even minute amounts of the contaminated or suspect product.

Sample Collection

During investigations of foodborne diseases, cooperate with other health officials in collecting samples of items that may be associated with the outbreak. Use a menu or data from an attack-rate table to determine which of the foods from the implicated meal are most suspect, and collect samples of them. Check storage areas for items that may have been overlooked. Check garbage for discarded foods or containers. Suspect foods often are discarded by an operator if he thinks someone may have become ill as a result of eating in his establishment. Because one of the primary tasks of the investigator is to prevent further illness, take appropriate action to prevent distribution or serving of any suspect food until it has been proven safe. If no foods remain from the suspect meal or lot, try to collect samples of items prepared subsequently to the suspect lot, but in a similar manner. Collect ingredients or raw items used in the suspect food. Determine supplier, distribution, and code information on ingredients and packaged foods to aid any investigation of the same lot in distribution channels.

Collect samples aseptically. If foods are to be examined for organophosphate pesticides or heavy metals, do not use plastic containers. Use glass jars with foil lined lids because substances from the plastic can leach into the food and interfere with analysis.

The following are examples of articles normally collected: remaining portions of all suspect foods; parent stocks of suspect foods; insecticides, rodenticides, or other poisons which may be involved. Suspect food containers such as cans, bottles, etc.; utensils or materials used in the preparation and storage of the suspect food; table scrapings and food residues from equipment such as slicing machines, cutting boards, etc.

Clinical specimens such as vomitus, stools, swabs of nasal and throat passages or open sores or lesions of food workers are collected by local, state, or CDC health officials or private physicians.

Sample Size

Where only small amounts of items remain, such as bits of left-overs, empty containers with adhering particles, etc., collect all or as much as possible by scraping from utensils, equipment or containers. When large amounts of food remain, collect at least 8 samples throughout the food in 25-gram (minimum) increments or more. It may also be necessary to collect the empty food container(s).

Sample Handling

Record the temperature of the room, refrigerator, or warmer in which the food was stored, and record the temperature of the food that remains after a sample is collected. Inform the laboratory of the type and number of samples, and discuss methods to preserve and transport samples, time of arrival, and the person who will receive the shipment.

Samples of products frozen at the time of collection should be maintained frozen until analyzed. Samples of perishable foods, which are not frozen at the time of collection, should be cooled rapidly to a temperature of 4.4^{o}C (40^{o}F) and maintained at this temperature if they can be analyzed within eight hours. If analysis cannot be started within eight hours, and you suspect microbial contamination, contact your servicing microbiology laboratory for proper handling procedures.

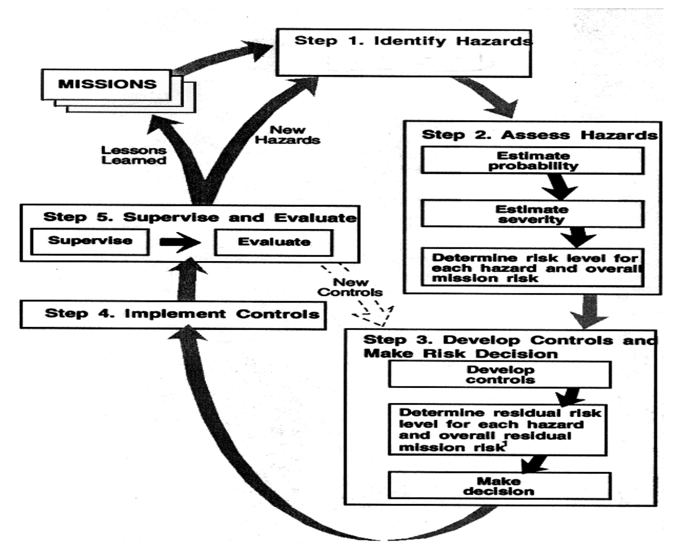
Transport refrigerated or frozen samples to the laboratory in insulated containers, packed with an appropriate refrigerant to maintain the desired temperature during transit. Send samples to the laboratory by the most expeditious means. Clearly mark: "PERISHABLE FOOD SAMPLE FOR MICROBIAL EXAMINATION - RUSH," "PRIORITY." Label specimens according to applicable regulations governing transport of hazardous material.

If the suspect food is a commercial product, examine the original package or container for coding information to identify the place and time of processing. You should notify all agencies responsible for regulating the products alleged or suspected to have caused the illness. Collect additional packages bearing the same code number for analyses for microorganisms, toxins, seam defects, vacuum, leaks, or other conditions. Be as specific as possible in requesting the type of analysis.

Epi Info

Epi Info is a series of programs that can be downloaded free from www.cdc.gov for Microsoft Windows 95, 98, NT, and 2000. Public health professionals conducting outbreak investigations, managing databases for public health surveillance and general database and statistics applications, would find it useful. With Epi Info and a personal computer, physicians, epidemiologists, and other public health and medical workers can rapidly develop a questionnaire or form, customize the data entry process, and enter and analyze data. Epidemiologic statistics, graphs, and tables are produced and a component called Epi Map displays geographic maps with data from Epi Info.

CHAPTER 12 – Vulnerability Assessments and Risk Communications



Risk Management Cycle

Introduction

Terrorist threat or actual attacks against the food supply can seriously impact an installation's mission and overall quality of life of the community at large. This chapter introduces commanders and their staff to the processes and tools needed to identify, evaluate and manage risks posed by these hazards. An effective Risk Management process includes a risk assessment, as well as risk communication process.

Personnel can be deliberately exposed to harmful levels of contaminants such as toxic chemicals, radiation, or biological agents. Harmful levels include high-level exposures that result in immediate health effects and/or significant impacts to mission capabilities. Harmful levels also may include low-level exposures that may result in delayed and/or long-term health effects that would not ordinarily have a significant immediate impact on the installation.

Army risk management doctrine is detailed in Field Manual (FM) 100-14, *Risk Management* (RM) (available at <http://www.adtdl.army.mil/atdls.htm>), and provides commanders with methods to evaluate and manage the risks posed by hazards to the military community. This framework is an iterative process that is integrated into planning and decision-making at all levels. Leaders manage risk by evaluating hazards and implementing RM options during course of action (COA) development.

The Risk Management Cycle is a five-step process. Steps 1 and 2 together comprise the risk assessment. Steps 3 through 5 are the essential follow through actions to effectively manage risk. This approach compliments the military decision-making process (MDMP) described in Appendix J of FM 101-5, *Staff Organization and Operations* (available at http://www.adtdl.army.mil/atdls.htm).

Planning

Installation/Field commanders have primary responsibility for ensuring implementation of necessary protective measures to counter terrorist threats to military food supplies. Commanders are encouraged to conduct a systematic review and assessment of food supplies and food operations and to develop and implement a food security program.

Process

First, a comprehensive list of food assets, including personnel, transportation systems, storage facilities, and preparation and serving resources, and supply systems must be developed. Procedures must also be put into place to receive credible threat assessments from intelligence personnel (MI, CID, FBI, etc.). The threat assessments would be based on availability of agents (biologic, chemical, radiological, physical) and aggressors (terrorists, criminals, subversives, etc.). Utilize the RM approach to identify, analyze, and control potential biological, chemical, radiological, and physical hazards to the food supply and destruction of food, from procurement, transportation, and distribution, to storage, preparation, and consumption. RM can be used to identify hazards, and conduct risk assessment and risk management for effective food security.

A comprehensive list of important points of contact, with telephone numbers, websites, and email addresses (e.g., FBI, FDA, CDC, CHPPM, VETCOM, etc.) should also be assembled and updated as necessary. Personnel should also receive regular training in risk communication, to include care/consensus/crisis risk communication.

The format for installation food safety and security programs will vary depending on installation type, location, size, distribution chain, and personnel involved. Unique conditions of each food system should be considered during development of a program. Food supply and distribution systems should be examined for current safety and security operations. After initial procedures are developed, periodic reviews should be accomplished to ensure that vulnerabilities are correctly characterized and to verify and update the program and all its assumptions, guidelines, and restrictions.

Performing the Vulnerability Assessment

Assessment Process

Initially, identify all food and water assets. Describe the installation food procurement sources and the distribution from their sources. Develop flow diagrams that describe the processes for each asset. The purpose of a flow diagram is to provide a clear, simple outline of the steps involved in the process. The scope of the flow diagram must cover all of the steps in the process. A schematic of the facilities involved is useful in understanding and evaluating process flow. If a process flow diagram does not already exist, the FSAT must construct one based on their knowledge of the process. Each food asset, to include supply, distribution, storage, retail sale or preparation and serving should be studied to provide the insight to comprehensively understand the actual process and identify vulnerable areas. This diagram will provide the foundation for the hazard analysis and must be detailed and complete. It must depict all of the steps in the process.

Video cameras or digital cameras can be used in gathering and conveying information to the team as assessments are carried out. Potential threats are systematically identified, located, and assessed based on the information provided by other team members and an analysis of the current threat situation.

Step 1 – Identify Hazards

Personnel may be exposed to harmful agents from the intentional actions of perpetrators. Exposure can occur from intentional contamination of food, bottled water, ice, physical destruction or disruption of equipment including storage facilities, or a combination of these sources. The degree with which exposure to one or more materials will result in harm to the soldier and/or the mission will depend on many things, but primary considerations include types of hazards; sources of exposure; concentration, toxicity or virulence of the chemical, biological or physical agents; frequency and duration of exposure; and finally, natural human variability in susceptibility to these conditions.

Step 2 — Assess Hazards

In terms of food systems surveillance and risk assessment, this RM step examines each hazard in terms of probability and severity to characterize risks of health threats and medical threats posed by intentional food contamination hazards. Risk characterization estimates risk levels and describes their role in the context with installation activities. Three steps are involved during the assessment phase:

Evaluate Hazard Probabilities. Determine the hazard probabilities for all selected hazards. (FM 100-14, Sub step A).

Evaluate Hazard Severities. Determine the hazard severities for all selected hazards (FM 100-14, Sub step B).

Risk Characterization. Synthesize the estimates of hazard probabilities and severities. Risk levels for all food hazards and the overall mission are determined and described in a public health context.

Evaluate Hazard Probabilities.

(1) Hazard probabilities for all selected hazards must be determined. Probability levels estimated for each hazard may be based on the current threat or frequency of a similar event. Or, for food specific hazards, the magnitude, frequency and duration of exposure of community personnel to health threats integrated with the expected incidence of exposure within the installation relative to guideline levels.

(2) Determining food hazard probability is a subjective evaluation of where food asset data are assessed to determine the degree of exposure to the hazard. The estimation of hazard probability involves three primary considerations:

(a) Comparability of the installation's exposure profile (exposure factors, frequencies, and durations) to the standard exposure profile used in the derivation of the exposure guideline(s) of concern.

(b) Proportion of the installation that is likely to experience exposures relative to the specific exposure guidelines.

(c) Confidence in the available data, given the sources of uncertainty and variability. When these determinations are made, a hazard probability category must be selected for each food hazard. FM 100-14 provides the following hazard probability categories; they should be evaluated within the context of the considerations as previously mentioned. The general categories of hazard probability are:

- FREQUENT - occurs very often, continuously experienced.
- LIKELY - occurs several times.
- OCCASIONAL - occurs sporadically.
- SELDOM - remotely possible; could occur at some time.
- UNLIKELY - can assume will not occur, but not impossible.

Evaluate Hazard Severities

Hazard severities for all selected food hazards must be determined. Hazard severity is a function of the consequence of exposure (e.g., nature of probable effect) and the predicted distribution of that impact on the installation. The estimation of hazard severity involves three primary judgments:

(1) Proportion of the installation that is likely to exhibit effects.
(2) Nature of the health effect(s) associated with exposures.
(3) Confidence in the available data, given the sources of uncertainty and variability.

When these determinations are made, a hazard severity category must be selected for each food hazard. FM 100-14 provides the following hazard severity categories; they should be evaluated within the context of the considerations above.

CATASTROPHIC - loss of ability to accomplish the mission or mission failure.
CRITICAL - significantly (severely) degraded mission capability or readiness.
MARGINAL - degraded mission capability or readiness.
NEGLIGIBLE - little or no adverse impact on mission capability or readiness.

Risk Characterization

Once the food hazard probability and severity estimates are determined, they are synthesized in this step. Risk levels for all selected hazards are described in the context of the current threat situation. The risk level is defined using the probability and severity information from the previous sections combined with command judgments regarding acceptable risk levels for the installation.

The primary objective is to apply the FM 100-14 Risk Assessment Matrix in a way that is consistent with command guidance so that these risks can be put in the same context with other identified risks. This idea must remain central to the planning perspective — food threats must be clearly communicated to the commander and the staff. This must occur so that the commander can make decisions based on credible information.

Risk Assessment Matrix

HAZARD SEVERITY	HAZARD PROBABILITY: Frequent (A)	Likely (B)	Occasional (C)	Seldom (D)	Unlikely (E)
Catastrophic (I)	Extremely High	Extremely High	High	High	Moderate
Critical (II)	Extremely High	High	High	Moderate	Low
Marginal (III)	High	Moderate	Moderate	Low	Low
Negligible (IV)	Moderate	Low	Low	Low	Low
	RISK ESTIMATE				

Risk characterization should be designed to facilitate the selection of risk control strategies that are associated with risk levels that are greater than an installation-specified rate (as determined by the commander). The following table presents the RM risk levels.

Risk Level Definitions

Risk Level	Consequence
Extreme	Expected loss of ability to accomplish the mission, or serious workforce or community impact (either on- or off-post).*
High	Expected significant degradation of mission capabilities in terms of the required mission standard, inability to accomplish all parts of the mission, or inability to complete the mission to standard if hazards occur during the mission, or significant workforce or community impact (either on- or off-post).*
Moderate	Expected degraded mission capabilities in terms of the required mission standard will reduce mission capability if hazards occur during mission, or minor workforce or community impact (either on- or off-post).*
Low	Expected losses have little or no impact on accomplishing the mission, and little or no impact on the community (either on- or off-post).*

*<u>To assess the mission, workforce, or community impact, the psychological consequences of an event must be considered</u>.

Following a food terrorism event, fear and panic can be expected. Psychological responses following the event may breed unrealistic concerns for personal safety and for the safety of family members. A terrorism event that affects family members, especially infants and children, may affect the soldier's psychological stability and ability to perform his/her mission. For this reason, child development centers, schools and other community accessible food operations and retail stores will be given a higher rating of hazard severity even if there is minimum illness or death. This can adversely affect unit readiness without casualties. Force protection plans should include the availability of mental health support personnel to assist in the event of a terrorist attack. Appropriate risk communications information should be developed as questions and answers and coordinated with the public affairs office. There should be a single point of contact to relay information and answer personal and press inquiries.

Determine Confidence in Risk Estimate

A confidence level should be assigned following the derivation of the risk estimate. The degree of confidence in the risk estimate will be particularly important when determining a course of action. Confidence levels should be simple categories that can be rationally explained (e.g., high, medium, low). The confidence level assigned to a risk estimate should integrate uncertainty associated with each of the elements of the risk assessment. Key areas of uncertainty that should be considered include: sampling or field data quality, actual exposures of personnel, personnel attributes (e.g., demographics, activity patterns), comparability of standard guideline assumptions (e.g., exposure duration and frequency) to expected exposure patterns, expected symptoms of exposure (i.e., hazard severity), including consideration of exposure to multiple hazards, other uncertain, or missing, information relevant to the process and whether the predicted health outcome is plausible, given weight of evidence or real-world experiences

The following table provides example criteria for determining a risk estimate confidence level. The final determination of confidence must be based on the well-reasoned judgment of the FSAT members conducting the risk assessment.

Example Criteria for Assigning Confidence Levels

Confidence Level	Criteria
High	Sampling data quality is good. * Activity patterns are well known. True exposures are reasonably approximated. Knowledge of the symptoms of exposure relative to guideline is well known. No important missing information. The predicted health outcome is plausible or already demonstrated. *(Note: Food microbiological, chemical and physical sampling is very difficult and time consuming.)
Medium	Data quality is good. Exposures are likely to be overestimates of true exposures due to incomplete data coverage relative to actual exposure durations. Detailed information is lacking regarding true personnel activity patterns. Symptoms are well known for each individual hazard, but some scientific evidence suggests that the combined effects of all hazards may exacerbate symptoms. Predicted health outcome is plausible.

Low	Important data gaps and/or inconsistencies exist. Exposure conditions are not well defined. Personnel activity patterns are basically unknown. Predicted health outcome is not plausible because it is not consistent with real-world events/experience.

Risk Management

Step 3 — Develop Controls and Make Risk Decisions

Implementing this RM task involves developing one or more controls to minimize or eliminate the risks of the evaluated vulnerabilities posed by food and water hazards. Determinations are made whether developed controls are sufficient and acceptable. Residual risks are characterized using the same process described previously.

The information is communicated to the commander, and risk decisions are made. These tasks are completed during the MDMP: COA development, COA analysis, COA comparison, and COA approval. Risks are managed by incorporating risk management controls into normal operations. Hazard control for food vulnerabilities can be divided into three basic categories: educational controls, physical Controls, and avoidance.

A key element of risk decision is determining if the risk is justified. The commander must compare and balance the risk against community expectations. He/she alone decides if controls are sufficient and acceptable and whether to accept the resulting residual risk. If he/she determines the risk level is too high, he/she directs the development of additional controls or alternate controls, or he/she modifies, changes, or rejects the control measures.

Step 4 — Implement Controls

Controls are implemented at all levels, and as a result must be clear and simple enough to be understood and executed by all affected activities. The other key component of Risk Management – Risk Communication – will play a crucial role in this step because in order for controls to be implemented as directed, they must be communicated in a clear and concise manner. Add to that the likelihood that soldiers, their dependants, civilian employees, contractors, media and the general public will be highly concerned/interested in the safety of the food. Risk communication skills become more important than the controls being implemented.

Leaders and their staff ensure that controls are integrated into standing operating procedures (SOPs), written and verbal directives, and briefings. The critical check for this step, with oversight, is to ensure that controls are converted into clear, simple instructions that can be understood at all levels. Leaders must explain how supervisors will implement controls.

Step 5 - Supervise and Evaluate

Controls are monitored and surveillance continues for new hazards. All staff must ensure that the risk management process was effective. All levels of the command must understand the information and controls. Constant surveillance of the situation ensures that hazards that may have been missed and new hazards are identified and controlled during the operation.

As the directives or operations are executed, responsible personnel observe and evaluate the risk management procedures set in place. This information further provides data on the effectiveness of current procedures and assists in future planning. This allows for constant evaluation of the risk level and the efficacy of the controls in place.

During preparation and execution, facility managers must ensure that their subordinates understand how to execute risk controls. Managers continuously assess risks during daily operations. Managers maintain situational awareness and guard against complacency to ensure risk control standards are not relaxed or violated. To gain insight into areas needing improvement, managers must continuously evaluate their subordinates and facility's effectiveness in managing risks.

As with all aspects of the installation food safety program, the installation commander has the ultimate responsibility for determining if/when information about the program is shared with people outside of the FSAT. Although a risk communication specialist/public affairs officer (PAO) should be member of this team, no information about any phase of this effort (planning, vulnerability assessment/ findings/ selected controls) is to be shared without specific prior approval of the installation commander.

At the same time, academic research has found that implementing a risk communication process **before** the 'unexpected' occurs helps minimize public concerns, and garners public support in the event of a crisis. Including risk communication experts early in the planning process of any project, to include food safety, is as important as the technical work that needs to be accomplished. This means that the Commander, and all members of the FSAT and auxiliary staff must place a high priority on risk communication considerations from the planning stage on, and should attend risk communication training on a regular basis. The USACHPPM Health Risk Communication Program can help with training outlines and support materials.

In any situation where the potential for concern is high, such as with food and water safety, risk communication efforts are essential in the overall RM process. If information is not provided clearly without raising alarm, the information itself is useless.

Within the scientific study of the risk communication process, there are 3 basic types: care communication, consensus communication, and crisis communication. Care communication generally applies to situations where risks are known and accepted by most people, and the dangers are generally recognized. This phase involves providing very general information for a specific purpose. Consensus communication applies to situations where groups are encouraged to work together to reach a decision, or encouraged to learn how to access, manage, or reduce/prevent risk. This phase involves bringing people together to collaborate on a specific issue/project. Crisis communication applies to situations where there is extreme or sudden danger (real or perceived). This phase involves telling people very specific information in a way that addresses concerns while maintaining an appropriate level of vigilance. Care and crisis communication skills should be incorporated into the overall RM process for a food safety program.

As with any long-term effort, the risk communication process involves a logical sequence of events: identify the goal or purpose of the risk communication program, identify stakeholder groups and prioritize them, develop communication methods appropriate to each stakeholder group, develop an overall risk communication plan, to include a crisis communication plan, and finally, evaluate the effectiveness of the overall risk communication effort.

Crisis Communication

If or when a crisis occurs within the food safety program, the risk communication team members must take the lead in implementing a crisis risk communication plan. This will occur only after the installation commander makes the decision that the crisis communication plan should be implemented. Applying basic risk communication principles throughout the crisis response phase will increase the likelihood that panic and concern will be kept to a minimum.

Research and evaluation of crisis communication efforts, especially since the September 2001 terrorist events, have identified four key steps in any crisis risk communication plan:

1. **Tell people what you know.** People will be concerned, and will expect to hear all the facts about the situation, both good and bad. They need this information in order to make personal choices as to what actions they will take in response to the threat. Your key messages must address underlying concerns; be short (10 - 15 words), as positive as possible, clear and understandable (free of jargon and acronyms); and be simple (6th-8th grade level).

2. **Tell people what you don't know.** In crisis scenarios, research indicates that people understand and accept that you don't know everything right away. By sharing information about what you don't know, you demonstrate that your crisis risk communication process is transparent, and that you're being as open with details as possible. At the same time, telling them what you don't know provides the opportunity to share your plan of action, which demonstrates your commitment to their continued health and safety.

3. **Tell people what you're planning to do to find out and *when* you'll provide that information.** This step is critical to reaffirm that you're "in it for the long haul," and that you are committed to keeping people informed as new information is developed. This step also demonstrates your commitment to follow through on promises, and that you recognize that *when* you provide the information is just as important as the information itself.

4. **Tell people what they need to do to protect themselves and what you need from them.** Again, these messages should follow basic risk communication principles (see #1 above) so that your goal of changing behavior (e.g., practice certain safety measures) is accomplished, and that people recognize the importance of providing you with the information you deem critical.

CHAPTER 13 – HACCP REVISITED

The basics of HACCP were previously discussed in Chapter 3 and hopefully by now you have a clear understanding of why and how food protection is important. Now the task of applying HACCP is at hand. The following are examples of pieces of a HACCP Sanitary Sanitation Operating Procedure might look like for a typical cook/chill type operation.

STANDARD SANITATION OPERATING PROCEDURES

Good hygiene demands effective and regular cleaning of the Cook-Chill production kitchen facility and equipment to remove food residues and dirt, which may contain foodborne pathogens and spoilage microorganisms and act as a source of food contamination. This cleaning process may where necessary be followed by, or associated with, sanitizing to reduce the number of any micro-organisms remaining after cleaning to a level which will not cause harmful contamination of food.

Management has established cleaning and sanitizing procedures after consultation with production, maintenance personnel and detergent manufacturers. Procedures have been established for cleaning and sanitizing of the equipment which is, itself used for cleaning, e.g. mops, swabs, buckets, etc. There will be adequate supervision by management to ensure that the procedures set down are carried out in an effective manner at the specified intervals of time.

The Cook Supervisor is responsible for developing and implementing cleaning and sanitizing procedures and for supervision. Industrial detergents and sanitizers require careful handling. Alkaline and acidic products will not be mixed. Hypochlorite solutions will not be mixed with acidic products, as chlorine gas will be released. Employees handling strongly alkaline or acid products will wear protective clothing and goggles and have been thoroughly instructed in handling techniques. Containers in which such substances are kept are clearly marked and stored separately from food and packaging materials. Employees will receive instructions and training in proper usage and handling. Material Safety Data Sheets (MSDS) will be accessible to all employees on all operating shifts.

Cleaning Procedures

Cleaning procedures will require the removal of gross debris from surfaces by brushing, scraping of deposits or other methods where necessary will be followed by the application of water in compliance with TB Med 530 and the FDA Model Food Code 1999.
Cleaning will be carried out by the separate or combined use of physical methods, e.g. scrubbing or turbulent flow, and chemical methods, e.g. the use of detergent

Soil will be removed by scrubbing in the presence of a detergent solution. For removable parts of cook-Chill equipment and for small parts, soaking in a detergent solution in a separate receptacle is necessary to loosen the soil prior to the scrubbing process. The cleaning of stationary Cook-Chill equipment including kettles, agitators and pipe runs with water and detergent solution, without dismantling the equipment or pipe runs, is necessary for some components. Parts of equipment which cannot be satisfactorily cleaned by this method must be dismantled for cleaning to prevent build up of contamination.

Cleaning and Sanitizing Cook/Chill Equipment

At the end of the production period, the equipment is to be cleaned and sanitized. All stationary parts of the equipment should be cleaned with a low sudsing detergent and with high-pressure hot water rinse. Using a nylon bristle kettle brush, food debris should be removed form food contact parts. All removal parts should be cleaned and sanitized using a mechanical ware washer or a three-compartment Pot, Pan and Utensil washing sink.

Upon completion of the cleaning process, the equipment is to be reassembled. A final sanitizing should be accomplished using an unscented chlorine-sanitizing agent at a concentration of 5.25%. Equipment sanitizing should be done with 100 ppm chlorine water for at least 15 seconds at a temperature between 75° F and 115° F. The sanitizer concentration has been verified by use of a test strip to assure proper concentration. The equipment will be allowed to air dry.

Before Kettle use at the start of a new production cycle, the Kettle should be filled with 180 gallons of water and 42 ounces of bleach. Water temperature should be set at 100° F. A test strip should be dipped into the diluted chlorine bleach solution. Match the test strip at once to the color chart provided with the test strips. The color match should read 100 ppm. Agitate for several minutes. Pump water out of the Kettle through the Pump Fill Station. This will sanitize the Pump Fill hose and pump assembly. Other kettles need only empty the sanitizing solution to drain and rinse.

Between Kettle batches, rinse the Kettle. Adding water, pump at the highest speed until the water runs clear.

At the end of the production day, disassemble and clean the system.

Kettles – remove and clean the scrapper blades, blade holders, drop down valve and outlet fitting. Clean Kettle using a high pressure hose spray and use kettle brushes to remove food particles adhering to the Kettle walls. Do not use steel scrub pads or other materials, which may scratch the Kettle surface. Reassemble Kettle.

Between Kettle batches, rinse the Kettle. Adding water, pump at the highest speed until the water runs clear.

Kettle Cooking Procedure Start Up

This form details the sanitizing process required prior to the start of each production day. In addition, it details the requirements for joint sanitizing with the Pump Fill Station as part of the process.

Kettle Washing Procedure

This form details the equipment and the process that is required at the end of the production day to properly clean the kettles.

Kettle Sanitizing Procedure

This Form details and documents the process required to sanitize the kettles at the end of the production day and after the kettles have been cleaned.

Food Transfer Hose- disassemble, clean, using high-pressure hose. Remove to washing sink and use hose brush to remove all food particles inside the hose. Submerge hose in sanitizing solution for one minute. Reassemble hose.

Pump Fill Station

Disassemble entire pumping path. Disassemble pump and remove rotors, pump body and seals. Clean pump components and sanitize in a chlorine solution, which has been tested for proper concentration with a test strip. Clean the top shelf, clipper and side of the Pump Fill Station. Sanitize all food contact surfaces with chlorine solution. Reassemble, placing new paper gasket on rotor housing. Reattach Pump Fill Station to Kettle. Fill Kettle with water, set temperature to 100° F, set agitator and add sanitizing solution with 180 gallons of potable water and 42 ounces of bleach. Bring to temperature to 100° F for one minute. Pump contents of Kettle through Pump Fill Station at high speed. Allow system to air dry.

Pump Fill Station Close Down

This form details the equipment and the procedures required to correctly dismantle the pump fill station at the end of the production day for cleaning and sanitizing. In addition, it details the correct method of reassembling the pump fill station and establishes procedures to check and verify the reassembly.

Tumble Chiller – Set system to clean. Set water to 100 gallons and add chlorine solution. A final sanitizing should be accomplished using an unscented chlorine-sanitizing agent at a concentration of 5.25%. Equipment sanitizing should be done with 100-ppm chlorine water for at least 15 seconds at a temperature between 75° - 110° F. The Tumble Chiller should be filled with 100 gallons of water and 23 ounces of bleach. A test strip should be dipped into the diluted chlorine bleach solution. Match the test strip at once to the color chart provided with the test strips. The color match should read 100 ppm. At the end of the cleaning cycle, dump water. Allow system to air dry.

Casing Cooler Start Up/Close Down

This form is used to control both the opening process as well as to control and document the close down at the end of the day.

Temperature Recorder Verification

This form is utilized to document the routine testing of temperature recording devices for accuracy.

Cook/Chill Food Safety and Sanitation Form

The Cook Supervisor WS13 conducts a monthly inspection of the Cook/Chill unit to detect and/or correct found deficiencies.

Refrigerator Temperature Recording Chart

The temperature recording charts are maintained in a manual fashion. Temperatures are monitored and recorded at the beginning of the production day and at the end of the production day. Temperatures are recorded on the chart. NOTE: The temperature monitor accuracy will be verified on a monthly basis with the use of a general use temperature standard thermometer permanently accurate to 1° F. The thermometer will be placed into a strategic location at or near the refrigeration thermometer. The thermometer will be allowed to equalize for at least ten - (10) minutes. This temperature will be compared with the temperature recorded on the thermometer attached to the refrigerator wall. Discrepancies will be evaluated and corrected.

Verification of Cleaning Process

A bio-luminescence test process is used on selected equipment to verify the cleaning process. The results of each test are recorded on the Luminator Tests Chart. In addition, the Luminometer is tested monthly for control verification. The results are recorded on the chart. Procedures for use of the Luminometer are found in the Standard Sanitation Operating Procedures Section.

Cleaning and Sanitizing of Removable Cook-Chill Parts

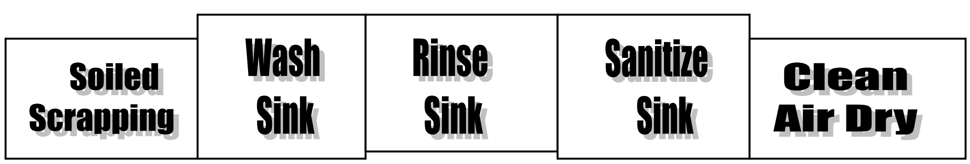
3 - Step Manual Cleaning

The removed part is first washed in a detergent solution to remove all grease and food particles. It is then rinsed with clean, hot potable water to remove the soap residue. Finally it is sanitized in a special solution consisting of sanitizer and 75°-100° F water. It is then allowed to air dry.

The 3-step cleaning process involves the use of a 3-compartment sink. In setting up the sink, the first compartment is filled with the detergent solution; the second (or middle) compartment is filled with hot water for rinsing, and the third compartment is filled with sanitizer solution.

The detergent and sanitizer solutions in the sink must be changed several times daily to maintain sanitary conditions. Three-step cleaning consists of the following in order: scrape, pre-rinse, wash, rinse, sanitize and air dry.

Manual Washing And Sanitizing of Cook-Chill Parts, Utensils and Wares using a three - compartment sink:



Clean all sinks; clean and sanitize all drain boards. Pre-scrape (if needed, pre-soak) items to remove gross food particles. Water in all sinks will be changed frequently

Washing

Items will be soaked in warm water in the first sink compartment sink in soap or detergent solution (compounded according to the instruction label). The solution shall be maintained between 110° F and 120° F (unless a different temperature is specified on the instruction label) and shall be kept clean throughout the process.

Rinsing

Items will be rinsed free of suds in the second sink

Sanitizing

Items will be sanitized in the third sink containing a covered heater and all other substances in clear water maintained at a temperature at 180° F or above.

Chemical Sanitizing as an Alternative to Hot Water Sanitizing

Items will be totally immersed in the third sink compartment in a tested (with a sanitizer test strip) chlorine solution at necessary concentrations (100 ppm), temperatures (75°-100° F) and times (one minute) as specified by the chemical manufacturer, TB Med 530 and the 1999 FDA Food Code or in a quaternary ammonium sanitizer equivalent.

Drying

Items will be inverted on drain boards or will be maintained in sanitized racks to permit air-drying.

SETTING UP THE SINK

Supplies: Heavy-duty detergent
Sanitizer

Clean and sanitize the sinks. Drain

Fill the sink with hot water to the designated level.

Prepare the detergent solution. Prepare and dilute the cleaning chemical according to the chemical-cleaning chart.

Leave the middle sink compartment empty.

Prepare the sanitizer solution. Prepare and dilute the sanitizing chemical according to the chemical-cleaning chart. Test sanitizer for proper concentration with a test strip.

END OF THE DAY

Small wares: brush

Supplies: Detergent solution
Sanitizer solution
Towel

1. Fill inset or other container with sanitizer solution from sanitizer (tested with sanitizer strips) compartment of sink.
2. Drain and rinse away the sanitizer solution from the sanitizer compartment.
3. Drain and rinse away the detergent solution from the wash compartment.
4. Rinse sink compartments and faucets with hot water.
5. Empty sanitizer solution in sink, allow container to air-dry overnight.

Mechanical Washing and Sanitizing of Removable Cook-Chill Parts, Utensils and Wares

Mechanical warewashing machines (and their auxiliary components) shall be operated in accordance with the manufacturer's instructions, to include the use of detergents and sanitizers, temperatures and pressures of wash, rinse and final rinse water, and speed of conveyor belt (if included) or time of each cycle.

Sprays/jets, moveable parts and surfaces will be cleaned daily

Prewash, wash, rinse and/or final rinse recycling water will be changed at least one daily or more frequently depending on gross soil contamination of water.

A wash with detergent temperature between 140° F and 150° F will be maintained.

Final rinse will occur at a temperature of 170° F - 180° F for approximately 2 minutes.

Cleaned serviceware and utensils should be permitted to air dry.

Monitor final rinse temperature of warewasher by using a temperature sensitive test strip thermal label set for 160° F prior to the start of the workday. Record results. An alternative method is to place a waterproof thermometer into the warewasher chamber for completion of a wash and rinse cycle. Immediately upon completion of the rinse cycle, remove the thermometer and record the temperature. If the surface temperature of the utensil washed does not exceed 160° - 165° F and the water temperature does not equal 180° F, increase the final rinse temperature until 180° F or higher is achieved.

General Cook-Chill Area Cleaning

Double Pail Mopping

The mopping system requires the use of a double pail process to clean the whole floor areas of the outlet. In the double pails mopping, you are required to use two pails: one pail for detergent solution and the other pail for hot water. The advantage of this mopping system is that the detergent solution will last longer and the floor will look cleaner. The hot water helps to clean the mops of dirt and also help to dry up the floor faster.

When mopping the floor, first dip the mop in the detergent solution, then wring out excess water, and finally start mopping a section of the floor. When the mop is dirty, wash with hot water followed by wringing out the mop before dipping into the detergent solution. Wring out the mop and continue mopping another section of the floor.

The detergent solution must be changed once the solution is dirty, when suds disappear and/or when the solution no longer demonstrates effect cleaning and grease cutting capabilities, while the hot water must be discarded each time the detergent is changed. The following procedures explain how to set up the mop bucket.

PROCEDURE
SETTING UP THE MOP BUCKET (DETERGENT SOLUTION)

Small wares: Mop bucket
Mop press/wringer
Mop head and handle
Supplies: Heavy-duty detergent

1. Rinse the mop bucket with clean hot water.

2. Refill with sufficient hot water in a clean mop bucket.
3. Mix recommended detergent solution with water in bucket. Mix according to the ratio shown on the chemical-cleaning chart.

2. Change the detergent solution once the solution is dirty, when suds disappear and/or when the solution no longer demonstrates effect cleaning and grease cutting capabilities.

4. Empty and clean mop bucket after each cleaning period.
5. Rinse thoroughly with hot water to remove all dirt.
6. Wring excess water from mop, empty the mop bucket, rinse and store upside down to promote draining and drying.
7. Hang mop with mop head down to air dry.

Procedures for Use of the Luminometer

1. Definitions
PocketSwab – a self-contained, single service (Charm Sciences, Brand) device designed to detect ATP on surfaces
ATP – Adenosine Triphosphate
RLU – Relative Light Unit

2. Procedure
The pocket swab is a self-contained single service test unit. A 6" swab is pre-moistened with a biofilm agent.

a. Storage of Swabs
1. Sealed pocket swabs are stable at room temperatures (59°-77° F) for up to one week.
2. Refrigeration (35.6°- 42.8° F) is recommended to maintain the recommended shelf life expiration date printed on the Pocket Swab zip lock bags.
3. Pocket Swabs will withstand higher temperatures (up to 95° F) for at least 48 hours.

Step One
1. Withdraw the swab by gently pulling and twisting the handle out of the swab body.
2. Swab an area about 4" x 4", rotating the handle to achieve full swab contact with the surface.

Step Two
1. Hold the swab nearly upright with the micro tube pointing down for the remainder of the test.
2. Reinsert the swab by gently pushing down and twisting to engage threads.
3. Reinsert the handle down, taking about 2 to 3 seconds to reach the bottom. The swab tip will puncture the seals and start the reaction.

To hold the pocket swab for later counting, do not twist down or puncture the micro tube seal.

The swab is stable for up to six hours.

Step Three

1. Shake the Pocketswab Plus down hard with a wrist snap (like a thermometer).
2. Completely dispense the tablet. If necessary, tap on a hard surface to break the tablet.
3. **Within one minute** inset the PocketSwab into the chamber of the LUM-T and depress gently until fully seated.
4. Press ENTER to read on (LUM assay) channel. Note count and result on LUM-T display. Remove PocketSwab from analyzer and discard.

3. Interpretation of LUM-T Results
   a. The LUM-T count is in relative light units
   b. 5,000 RLU or less indicates an acceptably clean surface.

NOTE: The definition of clean is based on an acceptable standardized procedure, set by the preventive medicine or veterinary support personnel. A clean and sterilized stainless steel surface reads zero (0) RLU with factory-calibrated settings.

Porous surfaces – for example, floors, conveyors, nylon, and wooden or plastic surfaces – may be acceptably clean yet have detectable levels of ATP. The LUM-T may be adjusted to read zero at these levels of ATP.

   c. The higher the RLU count, the poorer the cleanliness of the surface.
   d. Sites reading higher than 5,000 RLU should be recleaned and retested. If the RLU does not decrease after recleaning, the cleaning process may need review.

4. Disposal
   a. Used PocketSwabs contain no glass or hazardous substances and may be discarded in ordinary waste containers.

Meat Loaf

Assembly Date: ______________________ **Equipment: Rack Oven/Blast Chiller**
Production Date: _____________________ **Yield: 26-29 – 4.5 Lb Loaves**

Ingredient Name	Quantity	Assembly	Preparation	CCP Monitor
Ground Beef Ground Veal Ground Pork	60 Lbs 20 Lbs 20 Lbs	Add blended meat to mixer and mix with paddle.	Preheat oven temperature to 350° F.	
Bread Crumbs Salt Black Pepper Parsley Flakes Onions, Diced Water Eggs, Whole Liquid	20 Lbs 12 Ounces 2 Ounces 4 Cups 1 Lbs 2 Gal 1 Gal	Scale dry ingredients and place into covered, labeled container. Scale eggs and place in covered, labeled container.	Add all remaining ingredients to mixer. Blend thoroughly. Scale at 4.75 pounds and shape into a loaf. Coat the outside of the loaf with water to prevent cracks. Bake immediately until the interior temperature reaches 165° F and the juices run clear.	**Monitor and record final product cooking temperature with test thermometer. Record here** _______________
Pre-chill Blast Chiller. Place meat loaves into blast Chiller and place the probes in selected loaves. Set recorder. Place meat loaves into the Chiller. When the internal temperature reaches less than 40° F remove the meat loaves. When product is below 40° F, remove and place immediately into the Food Bank refrigerator.				**Monitor and record chilled product temperature with test thermometer. Record here** _______________

MEAT LOAF OPERATIONAL STEPS AND CONNECTING FUNCTIONS

Ingredient Assembly Thaw ground beef, veal and pork in refrigerator Add ground meat to cleaned and sanitized mixer Sanitize tops of containers Decant, scale ingredients based on recipe Add ingredients into mixer and blend thoroughly Shape into loaf pan	**Cooking** Cook meat loaf immediately in a preheated 350° F oven Check that internal temperature reaches 165° F or higher Remove from oven and immediately place into the Blast Chiller
Refrigeration Maintain Food Bank between 28.5° F and 31° F Record temperature Immediately place chilled bags into Food Bank upon completion of chilling	**Blast Chilling** Place probes into center of selected meat loaf samples Set chiller to record Chill until internal temperature reaches 40° F or lower Remove, label and cover with shrink film Place into Food Bank

As you can see, all steps of different processes are included in detail for each procedure. The key to setting up a good HACCP program, is to understand each process completely, and document what is exactly to happen, and who specifically will monitor critical control points. It is imperative that every employee knows what these critical limits are, and that ANY employee can take corrective action if a limit has been reached or exceeded.

Remember, these SSOP's are living, working documents and change as things or procedures in the establishment change. Just because they are in place as is now doesn't mean that they cannot be changed or improved upon. Equipment changes, recipes or meal changes may necessitate a change or complete rewrite of a particular SSOP.

REFERENCES/SOURCES OF INFORMATION

FDA Bad Bug Book
Control Of Communicable Diseases in Man
Technical Bulletin, Medical 530
US Army Quartermaster Center and School, Fort Lee VA
US Army Center for Health Promotion and Preventive Medicine, Aberdeen Proving Grounds, MD

USEFUL LINKS FOR MORE INFORMATION

U.S. Army Center for Health Promotion and Preventive Medicine
http://chppm-www.apgea.army.mil/

U.S. Army Veterinary Command

Centers for Disease Control and Prevention (CDC)
1600 Clifton Rd.
Atlanta, GA 30333
(800) 311-3435
Internet: www.cdc.gov
Food Safety Internet page: www.cdc.gov/foodsafety/
Disease information: www.cdc.gov/ncidod/diseases/index.htm
Environmental Health Services Branch: www.cdc.gov/nceh.ehserv/

U.S. Food and Drug Administration
1-888-INFO-FDA (1-888-463-6332)
In emergency situations, such as a case of foodborne illness or drug product that may have been tampered with call the 24-hour emergency number, 301-443-1240.
www.fda.gov

U.S. Department of Agriculture
Food Safety and Inspection Service
U.S. Department of Agriculture
Washington, DC 20050-3700
For help with meat, poultry, and egg products, call the Meat and Poultry Hotline 1-800-535-4555. (24-7 emergency operations number 202-720-5711)
Internet: www.fsis.usda.gov/index.htm
Foodborne Illness Education: www.nal.usda.gov/fnic/foodborne/foodborn.htm
National Agricultural Library:
www.nal.usda.gov/services.htm

Food and Nutrition Center:
www.nal.usda.gov/fnic

Food Safety & Applied Nutrition and HACCP Information
This site includes a variety of useful links to food safety and HACCP issues.
Internet: http://vm.cfsan.fda.gov/
Foodborne Illness: http://vm.cfsan.fda.gov/~mow/foodborn.htm
Food Safety Initiative: http://vm.cfsan.fda.gov/~dms/fs-toc.html

Food Safety Risk Analysis Clearinghouse
www.fodriskclearinghouse.umnd.edu/

Government Food Safety Information
www.foodsafety.gov

Food Safety Information for the Food Service Worker
http://www.foodservice.com/food_safety/

Fight Bac
www.fightbac.org

Food Safety Training and Education Alliance
www.fstea.org

Food Safety Network
http://www.foodsafetynetwork.ca/

Food Safety Today
http://www.foodsafetytoday.com/

World Health Organization Food Safety Program
www.who.int/fsf/

Environmental Protection Agency
http://www.epa.gov/ebtpages/ecounterterrorism.html

Federal Emergency Management Agency
http://www.fema.gov/

Army Environmental Center
http://aec.army.mil/

Johns Hopkins University Center for Civilian Biodefense Studies
http://www.hopkins-biodefense.org/

Center for Disease Control and Prevention (CDC)
www.cdc.gov