AN ABSTRACT OF THE THESIS OF

Lori A. Gray for the degree of Master of Science in Environmental Health Management presented on May 8, 1997. Title: An Evaluation of the Use of Menu Risk Assessment as a Tool in Food Service Protection Programs.

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Despite the increase in information on the causes of foodborne disease, outbreaks continue to be a major preventable public health problem. Current food service establishment inspection programs, however, are not designed to assess the potential of risk for foodborne disease and do not focus prevention efforts where food service problems are more severe. The purpose of this study was, therefore, to first, compare mean inspection scores, mean number of critical violations, and mean risk index values for high risk, moderate risk and low risk food service establishments in Marion County, Oregon. Second, the study determined if menu risk assessment can be used to identify facilities that are considered to be “high risk” facilities. The data included most recent routine inspection results that had been previously collected by local sanitarians and data collected from a Menu Risk Assessment Survey which was developed by the Virginia Department of Health. The Menu Risk Assessment Survey was administered using a stratified random design, to 400 food service managers/owners between October 1993 and December 1993. The results showed that high risk establishments had lower mean inspection scores, higher mean number of critical violations, and a smaller mean risk index value than moderate or low risk establishments. The differences were attributed to lack of manager food safety
education, menu items served, and operational practices observed in the establishment. The results also showed that there were statistically significant differences (p<.05) in the mean inspection score and the mean number of critical violations of “high risk” establishments and “low risk” establishments when responses to the Menu Risk Assessment Survey were compared. For example: 1) Establishments whose managers do not have food handler’s training demonstrate more critical violations than establishments with trained managers, 2) Critical violations and lower inspection scores were more likely to occur in establishments that prepared and served potentially hazardous foods, 3) Food service establishments that handle extensive amounts of potentially hazardous food and serve larger populations were more likely to have lower inspection scores and increased numbers of critical violations. Based on the results found in this research, local health departments may find the Menu Risk Assessment Survey to be a useful tool in determining high, moderate, and low risk food service establishments to focus prevention efforts where the problems are more severe and are of greater public health risk.
An Evaluation of the Use of Menu Risk Assessment
as a Tool in Food Service Protection Programs

by

Lori A. Gray

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APPROVED:

Major Professor, representing Environmental Health Management

Chair of Department of Public Health

Dean of Graduate School

I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

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Lori A. Gray, Author
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An Evaluation of the Use of Menu Risk Assessment as a Tool in Food Service Protection Programs

1. INTRODUCTION

As the number of meals eaten away from home increases, the task of preventing foodborne disease grows more challenging. Foodborne diseases are of economic importance and of interest to the general public, public health and agricultural agencies, and to those concerned with the production, processing, storage, marketing, and serving of food (FAO, 1984). Despite the increase in information on the causes of foodborne disease, outbreaks continue to be a major preventable public health problem (Manning & Snider, 1993; MMWR, 1990). Also, the risk of foodborne disease may be increasing worldwide (Donnelly, 1990; Manning & Snider, 1993; Ryer & Marth, 1989).

A foodborne disease outbreak is defined as an incident in which two or more persons experience a similar illness after ingestion of a common food, and epidemiological analysis implicates the food as the source of illness. A few exceptions exist: one case of botulism or chemical poisoning constitutes an outbreak (MMWR, 1990).

The United Nations estimates that as many as 3 million children die each year as a result of diarrheal diseases, 70 percent of which are the result of food poisoning (Puzo, 1993). The U.N. Food and Agriculture Organization, however, reports that even these estimates are vastly underestimated. It is believed that in industrialized
countries only ten percent of all foodborne disease cases are reported, while in
developing countries not more than one percent are reported (Puzo, 1993).

The annual incidence of foodborne disease in the U.S. is estimated to range
from 12.6 million to 81 million cases (Archer & Kvenberg, 1985; El-Gazzar & Marth,
1992; Todd, 1989). From 1983-1987, there were 2,397 outbreaks of foodborne
disease or 91,678 cases reported to the Centers for Disease Control (CDC). Bacterial
pathogens caused the largest number of outbreaks (66%) and cases (92%) among the
outbreaks in which the etiology was determined. Chemical agents caused 26% of the
outbreaks and 2% of the cases. Parasites caused 4% of the outbreaks and less than 1%
of the cases, and viruses caused 5% of the outbreaks and 5% of the cases. The
etiologic agent was not determined in 62% of the outbreaks (MMWR, 1990).

The number of foodborne disease outbreaks reported represents only a small
fraction of the outbreaks that occur (Jacob, 1989; MMWR, 1990). The likelihood of
an outbreak being reported varies considerably depending on consumers’ and
physicians’ awareness and interest, and disease surveillance activities of state and
local health and environmental agencies. Also, sporadic cases of foodborne disease,
with the exception of botulism and a few chemical exposure diseases, are not usually
reported to the CDC surveillance system even though sporadic cases are far more
common than cases associated with outbreaks. For example, incidents that have a
higher likelihood of coming to the attention of health authorities are foodborne
diseases with short incubation periods, large outbreaks, interstate outbreaks,
restaurant-associated outbreaks, and outbreaks involving serious illness, hospitalizations, or deaths (MMWR, 1990).

The annual cost of foodborne disease in the U.S. is estimated to be $7.7 to $8.4 billion. These costs are accrued by ill persons, the food industry, and the national economy (El-Gazzar & Marth, 1992; Kvenberg & Archer, 1985; Todd, 1989). For example, economic losses associated with 17 incidents of foodborne disease, in the U.S. and Canada were studied by Todd (1989) who reported that food was mishandled in restaurants, hotels, catering establishments, hospitals, and homes. Average costs per incident ranged from $16,690 to more than $1 million. The economic impact of foodborne illness was generally greater for restaurants, hotels and institutions than for catering establishments. The major factors in the costs of the outbreaks were loss of business, lawsuits, and loss of income for victims and infected food handlers (El-Gazzar & Marth, 1992).

Disease from foodborne sources is generally preventable. Any money spent on research, surveillance, and public education would be only a small fraction of the cost otherwise borne by the economy when disease occurs (El-Gazzar & Marth, 1992). The most frequently found problem in foodborne disease outbreaks is a critical error in food handling that allows bacterial contamination and growth (Eidson, McLauchlin, Gutierrez, Nims & Graves, 1990). The six factors most often implicated in bacterial foodborne disease outbreaks are:

- Improper cooling of potentially hazardous foods;
• Improper cold holding (keeping potentially hazardous foods refrigerated at temperatures over 45° F);
• Failure to cook potentially hazardous foods thoroughly;
• Infected persons who practice poor personal hygiene handling food;
• Improper hot holding (keeping foods in heating trays at temperatures under 140° F);
• Inadequate reheating of cooked potentially hazardous foods.

Statement of the Problem

Traditionally, food service facilities have been routinely inspected in order to maintain a reasonable standard of sanitation (Bader, Blonder, Henriksen & Strong, 1978). Routine inspections of food service facilities may help to ensure that food is prepared in a clean environment, but inspections often cannot control other factors that contribute to foodborne disease (Jacob, 1989). For example, Stevenson (1987) identifies important factors that the inspection report does not take into consideration:

• It does not measure the extent of food handling and protection problems in a restaurant;
• It does not give meaningful information on the establishment’s inspection record over time;
• There is little or no ability to assess the potential of, or probability for, foodborne illness outbreaks;
Rating scores do not provide enough information to restaurants so they can develop goals and objectives for their own food protection program.

Another concern about the usefulness of the traditional inspection program is that health agencies have not been able to increase their surveillance activities due to budget and personnel cuts that are occurring at the same time that more restaurants are serving the public (Bryan, 1982; Wodi & Mill, 1985). Because health agencies are faced with limited resources, it has been suggested that regulatory agencies adopt variable inspection frequencies rather than rely on the traditional approach of inspecting food service facilities an arbitrary number of times annually (Bryan, 1982; Kaplan & El Ahraf, 1979; Wodi & Mill, 1985). This newer approach would focus prevention efforts where the problems are more severe and are of greater public health risk.

One way to determine how many times food service facilities should be inspected annually is to rank facilities according to hazards. This approach allows health agencies to focus their efforts on facilities that pose the greatest risk to the public by increasing their surveillance of these high risk facilities and decreasing their surveillance of low risk facilities. Environmental Health Specialists spend time, inspect, and educate more in establishments that present the greatest potential for foodborne illness (Kaplan & El Ahraf, 1979; Collins, 1995).

The education of food handlers in safe food handling practices is another widely used preventive measure that is used to prevent foodborne disease (Jacob,
1989). Although the need for food service education has been well established, there has been little research evaluating the effectiveness of certifying personnel in order to achieve compliance with food service sanitation codes (Kneller, Phillip, Bierman & Thomas, 1990). For example, it is not known how different types of educational programs offered by county health departments influence inspection scores of food service establishments.

Purpose and Objectives of the Study

The purpose of this study was twofold. First, this study compared mean inspection scores, mean number of critical violations, and mean risk index values for high risk, moderate risk and low risk food service establishments in Marion County, Oregon. The second purpose of this study was to determine if menu risk assessment can be used to identify facilities that are considered to be “high risk” facilities. If there is any relationship between menu risk assessment and inspection scores and number of critical violations, then recommendations could be made to health departments to adopt this technique in their food protection programs, in order to focus prevention efforts on high risk establishments.

The following research questions were addressed:

1. How do the mean inspection scores, mean number of critical violations, and mean risk index values compare for high risk, moderate risk, and low risk food service establishments in Marion County?
2. Is there a significant relationship between risk category of food service establishments, as identified by responses to the ten individual questions of the Menu Risk Assessment Survey, and mean inspection scores; and, is there a significant relationship between risk category of food service establishments, as identified by responses to the ten individual questions of the Menu Risk Assessment Survey, and mean number of critical violations?

The objectives of this study were as follows:

1. To perform a literature review regarding these areas: foodborne disease; federal, state and local regulation of the food service industry, with emphasis on Oregon’s local regulations; Hazard Analysis Critical Control Point concept; and Marion County’s food protection program.

2. To survey a representative sample of food service facilities in Marion County, through use of a previously tested questionnaire.

3. To compute a mean risk index value from analysis of questionnaire data obtained from each food service facility surveyed in Marion County.

Limitations

Any generalization and inferences made as a result of this study should take into consideration the following limitations:

1. Results from this study are limited to conditions found in food service facilities in Marion County and may not be generalizable to facilities elsewhere.

2. Individual sanitarian bias may have affected inspection results.
3. Historical events such as well publicized foodborne illness outbreaks may have affected inspection results.

**Definition of Terms**

Acute - having rapid onset, severe symptoms, and a short course; not chronic (Tortora & Anagnostakos, 1984).

Aerobic plate count - used as an indicator of potential flavor, odor, or appearance defects (Solberg et al., 1990).

Carrier - a person in apparently good health who harbors a pathogenic microorganism (Pelczar, Chan & Krieg, 1986).

CDC - Centers for Disease Control and Prevention, Atlanta, GA. This agency is charged with protecting public health by providing leadership and direction in the prevention and control of disease (Nadakavukaren, 1990).

Chronic - long-term or frequently recurring; applied to a disease that is not acute (Tortora & Anagnostakos, 1984).

Close - is to summarily stop the operation of a restaurant pursuant to ORS 624.085 (OAR, 1991).

Communicable - a disease whose causative agent is readily transferred from one person to another (Pelczar, Chan & Krieg, 1986).

Complete inspection - the evaluation of all items on the inspection form, during any inspection, that is conducted by the licensing agency (OAR, 1991).
Critical violations - are those items weighted four or five points on the inspection form (OAR, 1991).


Enteric - pertaining to the intestines (Pelczar, Chan & Krieg, 1986).

Enterotoxin - a toxin specific for cells of the intestine (Pelczar, Chan & Krieg, 1986).

Environmental Health Specialist - an environmental health specialist is required to have a Bachelor's degree in environmental health, microbiology, public health or a related science and has an extensive background in biology, microbiology, and chemistry.

Fomites - inanimate objects that carry viable pathogenic organisms (Pelczar, Chan & Krieg, 1986).

Food - any raw, cooked, or processed edible substance, beverage or ingredient used or intended for use in whole, or in part, for human consumption (OAR, 1991).

Food service facility/establishment - a restaurant or any place where food is prepared and intended for individual portion service. This includes the area where individual portions are provided. This refers to any place regardless of whether consumption is on or off the premises and regardless of whether there is a charge for the food. The term also includes delicatessen-type operations that prepare food intended for individual portion service. The term does not include private homes, where food is prepared or served for individual family

Gastroenteritis - inflammation of the mucosa of the stomach or intestine (Pelczar, Chan & Krieg, 1986).

Hot holding units - equipment such as steam-tables, bainmaries, crockpots, and shaams designed to hold cooked and reheated food at 140 degrees or higher (SM:AFHG, 1992).

Incubation period - the elapsed time between the exposure to an infection and the appearance of disease symptoms (Pelczar, Chan & Krieg, 1986).

Inspection form - the report of inspection results written on a form approved by the Division (OAR, 1991).

Jaundice - yellowing of the skin and the whites of the eyes and other symptoms resulting from infection of the liver (Collee, 1989).

Microbe - range of microorganisms, including viruses, bacteria, fungi, and protozoa that can cause foodborne disease (Collee, 1989).

Non-critical violations - are those items weighted one or two points on the inspection form.

OAR - Oregon Administrative Rules, of the Health Division, Chapter 333, Food Sanitation Rules.

ORS - Oregon Revised Statutes 603, 616, 621, 622, 624, 625, 636 and the administrative rules written thereunder.
Pathogen - an organism capable of producing disease (Pelczar, Chan & Krieg, 1986).

Plankton - a collective term for the passively floating or drifting flora and fauna of a body of water, consisting largely of microscopic organisms (Pelczar, Chan & Krieg, 1986).

Potentially hazardous food - any food that consists in part or in whole of milk or milk products, eggs, meat, poultry, fish, shellfish, edible crustacea or other ingredients, in a form capable of supporting rapid and progressive growth of infectious or toxigenic microorganisms (OAR, 1991).

Recheck inspection - an inspection to determine whether specified corrections have been made and alternative procedures maintained for violations identified in previous inspections. They may be conducted on either pre-announced dates or unannounced (OAR, 1991).

Registered Sanitarian - after one to two years of public health experience, the Environmental Health Specialist may qualify to use the title “Registered Sanitarian” by passing a state or national registry examination.

Regulatory authority - the state and/or local enforcement authority or authorities having jurisdiction over the food service facility (OAR, 1991; SM:AFHG, 1992).

Repeat violation - a non-critical violation of a requirement which occurs in at least two consecutive semi-annual inspections (OAR, 1991; SM:AFHG, 1992).

Semi-annual inspections - unannounced complete inspections conducted twice during the calendar year; one in each half of the year, but not less than 90 days or more than 270 days apart (OAR, 1991).

Violation - any condition which fails to meet any requirement of ORS Chapter 624 or OAR 333-150-000 through 333-168-020 adopted pursuant to ORS 624.100 (OAR, 1991).
2. REVIEW OF THE LITERATURE

The review is presented in the following sections: foodborne disease; bacterial contamination; factors that contribute to foodborne disease outbreaks; reporting of foodborne disease outbreaks; investigation of foodborne disease outbreaks; federal regulation of the food service industry; state and local regulation of the food service industry; regulation of the food service industry in Oregon; approaches used to reduce the risk of foodborne disease; food protection programs; Marion County's food protection program; and the Hazard Analysis Critical Control Point Approach. A discussion of each of these topics follows.

Foodborne Disease

Public health officials are concerned with the increased risk of foodborne disease that arises when more people eat outside the home and also with the tremendous growth of the food service industry in the United States (Nadakavukaren, 1990). A foodborne disease is any illness which is caused by eating contaminated food. Contamination can occur during the production, processing, transportation, storage, or service of foods and beverages (Bryan et al., 1987; El-Gazzar & Marth, 1992; Food Handlers' Handbook, 1993). To result in foodborne illness, a pathogen must contaminate the food, survive until the food is ingested, and be ingested in sufficient quantities by a susceptible individual to cause illness (Bryan, 1988). Symptoms of foodborne illness range from slight discomfort to severe reactions that
can lead to death (Bryan et al., 1987; El-Gazzar, 1992). Differences between individuals may also determine the severity of the illness. Those whose immune systems are impaired, pregnant women, young babies, the elderly, and those individuals taking drugs to suppress their immune systems are much more susceptible to foodborne illness (Collee, 1989).

Foodborne diseases are classified as either a food intoxication or food infection (Bryan et al., 1987; El-Gazzar, 1992; Food Handlers’ Handbook, 1993).

**Food Intoxication**

A food intoxication occurs when a microbe multiplies in the food, producing a toxin, which poisons the person consuming the food. Food intoxications can also be caused by harmful chemical substances being added to food or by toxic substances that naturally occur in some foods (Collee, 1989; Food Handlers’ Handbook, 1993). Several of the more common food intoxications are caused by *Staphylococcus aureus*, and *Clostridium perfringens*.

*Staphylococcus aureus*

One of the most common types of food intoxication is caused by *Staphylococcus aureus*. It has been estimated that *Staphylococcus aureus* causes 75%-95% of all foodborne diseases. This toxin-producing bacteria is commonly found in the intestinal tract, the throat, and on the skin and hair of people and animals (Food Handlers’ Handbook, 1993). The organisms are also present in boils, pimples,
hang nails, postnasal drip after colds, and wound infections. These organisms are readily transmitted to foods where they grow best at temperatures of 50°-120°F. The bacterial growth does not alter the appearance or flavor of the food, and the toxin produced by this bacteria is not destroyed by cooking temperatures. The enterotoxin causes inflammation and irritation of the stomach and intestine, which causes vomiting and diarrhea. The incubation period is 1-8 hours (Food Handlers’ Handbook, 1993; Koren, 1991).

The foods involved in staphylococcal outbreaks are diverse, but proteinaceous foods are most frequently implicated (Longree & Armbruster, 1987; Minor & Marth, 1972). Some examples of implicated items are custards, meats and meat products, roast turkey and dressing, chicken salad, fish and fish products, milk, cheese, butter, ice cream and other dairy products. Menu items frequently involved are those that have been handled a great deal and, therefore, have had a chance of becoming contaminated with the bacteria from human hands and unsanitary equipment (Longree & Armbruster, 1987). For example, an outbreak of Staphylococcus aureus occurred in New Mexico during March 1986. Sixty-seven persons reported being ill with diarrhea, nausea or vomiting after eating from a buffet at a New Mexico country club. Three food items (turkey, dressing and gravy) were associated with illness. The investigation revealed that the turkey had cooled for three hours at room temperature after cooking, which is sufficient time and temperature for bacterial proliferation and toxin production. It was also reported that the same utensils were used for all three
implicated food items both before and after cooking (Eidson, McLauchlin, Gutierrez, Nims & Graves, 1990).

*Clostridium perfringens*

Another type of bacteria that causes food intoxication is *Clostridium perfringens*. These organisms are present everywhere, but are commonly found in the intestinal tract of man and animals, in soil, and fecal material. These organisms can be circulated through the air or by the hands of food-service personnel to contaminate food. Foodborne disease is caused by the consumption of large quantities of these organisms in food. The incubation period is 6-24 hours (Food Handlers’ Handbook, 1993; Koren, 1991). Symptoms include nausea, intestinal cramps, and diarrhea, which is seldom fatal (Longree & Armbruster, 1987).

*Clostridium perfringens* can exist in a vegetative or spore form. The vegetative form is usually killed by cooking but the spore form is extremely hardy and can survive extreme temperatures. Bacteria growing from these spores multiply rapidly in foods that have been improperly cooled, reheated, or stored (Food Handlers’ Handbook, 1993; Koren, 1991). The control of this organism in food service relies mostly on preventing its multiplication by strict time-temperature control and sanitary care of equipment, utensils, and workers’ hands (Longree & Armbruster, 1987).

Foods that have been implicated in foodborne disease outbreaks believed to be caused by *Clostridium perfringens* are meats, items with meat as an ingredient, gravy,
vegetables, dairy products, and eggs. An example of an outbreak caused by
*Clostridium perfringens* is one that was associated with a “Meals on Wheels” program
in California (Longree & Armbruster, 1987; MMWR, 1981) in which chicken was
implicated as the cause. The chicken had been cooked six days before service, frozen,
thawed, refrigerated, and then reheated on a steam table (Longree & Armbruster,
1987).

**Food Infection**

Food infections are caused when disease-producing organisms are present in
food and continue to multiply once the food is ingested. Some of these organisms
include bacteria, viruses, and worms (Collee, 1989; Food Handlers’ Handbook, 1993;
Koren, 1991). In some cases the organisms die off after the clinical disease is over,
and in others, the infected individual may continue to be a carrier for a period of time,
passing off live organisms in their feces (Koren, 1991). Several of the more common
types of food infections are caused by *Salmonella*, Hepatitis A, *Escherichia coli*, and
*Campylobacter*.

**Salmonella**

The most common type of bacterial foodborne disease is caused by *Salmonella*
(MMWR, 1990). Salmonellosis is a highly communicable disease in the United States
and an estimated two to four million cases occur annually (Koren, 1991;
Nadakavukaren, 1990). The severity of the disease depends on the strains of
*Salmonella* involved, the individual's susceptibility to the organisms, and the total number of bacteria ingested with the food. The symptoms include: nausea, vomiting, abdominal pain, diarrhea, headache, chills, watery and foul-smelling stools, muscular weakness, faintness, drowsiness, and thirst. The incubation period varies from 3 to 72 hours, with an average of 12-24 hours (Longree & Armbruster, 1987).

Menu items frequently implicated in *Salmonellosis* are proteinaceous foods such as beef, pork, poultry, eggs or dairy products that have become contaminated through improper food handling by infected food service workers or through improper processing of foods from infected animals (Food Handlers' Handbook, 1993; Longree & Armbruster, 1987). Other factors associated with *Salmonella* outbreaks are: poor personal hygiene of food handlers; presence of rodents, flies, and cockroaches; long holding of food at warm temperatures; slow cooling of food due to refrigeration of large batches; and cutting boards used for raw as well as cooked meats and poultry (Longree & Armbruster, 1987). For example, an outbreak which involved six persons occurred in Los Angeles County, California during January 1993. Five of the six persons had consumed an egg-based dish. The investigation revealed that egg salad contaminated with *Salmonella enteritidis* was stored at an improper holding temperature of 60°F, a temperature that allows growth of *Salmonella* (MMWR, 1993).

A second outbreak involving twenty-three persons occurred during February 1993, in San Diego County, California. Eighteen of the twenty-three persons had
eaten an entree served with hollandaise or bernaise sauce that was prepared with raw egg yolks. The investigation revealed that the sauce had been held hot under a heat lamp for up to three and a half hours at an improper temperature of 100°-120° F (MMWR, 1993). A third outbreak involving twenty-two persons occurred during March 1993, in Santa Clara County, California. All twenty-two persons had eaten at a local sandwich shop. Eggs were again implicated and had been purchased from the same distributor that had provided eggs to the two restaurants in the outbreaks described above (MMWR, 1993).

Foodborne salmonellosis outbreaks associated with fruits or other produce are not as common. One reported outbreak that involved watermelon occurred in June 1991, in Michigan, in which twenty-six cases were identified among household contacts of cases. The watermelon was served at a school party and the leftover watermelon was served at a birthday party. The source of contamination of the watermelon was unknown (Blostein, 1993).

**Hepatitis A**

Hepatitis A is a virus that causes food infections. This virus is transmitted through the fecal-oral route and causes an inflammation of the liver ranging from mild to severe. Hepatitis A is spread through ingestion of fecally contaminated food or water, shellfish harvested in fecally contaminated water or other fecal-oral contact (Food Handlers’ Handbook, 1993; Koren, 1991). For example, a person infected with Hepatitis A can get the virus on their hands after a bowel movement. If their hands
are not properly washed, the virus will contaminate any food or other item they may touch and be transmitted to another person ingesting the food.

A person with Hepatitis A is highly infectious and may show no sign of symptoms for 15 to 50 days during which they may infect a large number of people before they are diagnosed with this virus. Most hepatitis cases continue to be infectious for about two weeks after symptoms have begun. Early symptoms are flu-like and may include: fever, muscle aches, fatigue, headache, nausea, vomiting, an enlarged tender liver, dark urine and clay colored stools. A secondary symptom may be jaundice, a yellowing of the skin and/or whites of the eyes (Cliver, 1979).

Foodborne Hepatitis A outbreaks are most often caused by contamination of food during preparation by an infected food handler. An important method of prevention is good personal hygiene, especially frequent handwashing during all phases of food preparation (Longree & Armbruster, 1987). Menu items frequently implicated in outbreaks are: cold cuts and sandwiches, fruits and fruit juices, milk and milk products, vegetables, salads, shellfish, and iced drinks. Water, shellfish, and salads are the most frequent sources. An example of a foodborne Hepatitis A outbreak occurred in April 1991, in Milwaukee, Wisconsin. A food handler employed at three different restaurants was diagnosed with acute Hepatitis A in April and by May there were 230 persons diagnosed with outbreak-related Hepatitis A. The infected food handler was reported to have poor personal hygiene (MMWR, 1993).
**Escherichia coli**

*Escherichia coli* (*E. coli*) is another example of a bacteria that causes food infections. *E. coli* is a common inhabitant of the intestinal tract of man and warm-blooded animals (Longree & Armbruster, 1987). There are thousands of strains of *E. coli* that are harmless, but one strain known as *E. coli* 0157:H7 can cause foodborne illness.

There are four methods of transmission of *E. coli* 0157:H7.

1. Contamination of meat may occur as part of the slaughtering process of cattle (Hamburg, 1993). The bacteria is killed when meat is thoroughly cooked, but it may survive in meat that is rare or inadequately cooked.

2. The bacteria may be present in dairy cows, and drinking raw unpasteurized milk or eating products made from unpasteurized milk may also cause illness.

3. Other foods can become contaminated with *E. coli* 0157:H7 bacteria through cross-contamination from raw meat.

4. Secondary infection or transmission of the bacteria from an infected person to a person who has not eaten contaminated food is also possible. This type of transmission occurs through the fecal-oral route because of inadequate handwashing (Koren, 1991).

The organism is easily killed by pasteurization and cooking temperatures over 155° F (Longree & Armbruster, 1987).
The consumption of *E. coli* 0157:H7 contaminated food can cause a gastrointestinal infection due to toxins that are secreted by the bacteria. An incubation period of 2-4 days is most common, but may be as long as 9 days. At first the infected person might seem to have an intestinal flu but the flu should not cause the sort of severe stomach pains or cramping associated with this illness. Infected persons may experience abdominal pain, cramps, mild fever, and watery diarrhea. Vomiting and nausea are also common. On approximately the fourth day of illness, painful bloody diarrhea is common. Complications may occur especially in children and the elderly (Longree & Armbruster, 1987).

*E. coli* 0157:H7 was first identified as a cause of foodborne illness in 1982 after people fell ill in White City, Oregon, and Traverse City, Michigan (Hill, 1993). The majority of foodborne disease outbreaks linked to this organism have been associated with undercooked ground beef. Although other foods such as cantaloupes and mayonnaise have also been implicated (Hamburg, 1993). For example, during March 1993, about 150 people reported symptoms of food poisoning to the Josephine County Health Department after eating at two Sizzler restaurants in Grants Pass and North Bend, Oregon. Mayonnaise contaminated with *E. coli* 0157:H7 bacteria was the probable cause of this outbreak (Green, 1993).

This pathogenic bacteria was also responsible for a foodborne disease outbreak in Washington and other Western states in January of 1993. At least two children died and more than 500 people became ill after eating contaminated hamburgers at
Jack in the Box restaurants (Foster, 1993). The hamburgers were not cooked at a temperature high enough to kill *E. coli* 0157:H7 bacteria (MacVean, 1993).

**Campylobacter Enteritis**

One of the most common causes of gastroenteritis in humans is caused by *Campylobacter* species (Longree & Armbruster, 1987; Mandal, Demal & Butzler, 1984). *Campylobacter jejuni* and *Campylobacter coli* are an important cause of diarrheal disease in all parts of the world and in all age groups (Koren, 1991). Symptoms of *Campylobacter* infection, include fever, headache and muscle pain, followed by diarrhea, stomach pain and nausea. The incubation period varies from 2 to 10 days. The symptoms may last from 2 to 7 days (Doyle, 1984; Longree & Armbruster, 1987).

Campylobacteriosis can be transmitted person to person, through fecal contamination of food, or through direct contact with infected animals, frequently puppies and kittens. It can also be spread through animal products such as unpasteurized milk or undercooked meat or meat products. Factors that perpetuate the condition are unhygienic food handling and storage practices, environmental contamination from animal wastes and other sources, spreading the organism during animal slaughtering and processing and concentrating animals in brooding houses and feedlots (Franco, 1989).

Foods that have been implicated in *Campylobacter* outbreaks are beef, poultry, pork or lamb, unpasteurized milk or eggs, and unchlorinated water (Koren, 1991;
Longree & Armbruster, 1987). One reported outbreak that involved chicken occurred during September 1979, in Iowa, in which three persons became ill. Two of the three persons recalled eating chicken that was not well cooked. *Campylobacter jejuni* was implicated in this outbreak (MMWR, 1979).

**Bacterial Contamination**

Bacterial contamination is the most common cause of foodborne disease and can be prevented by care in the production and handling of food. Usually food has been mishandled in such a way as to boost the growth of bacteria in it (Collee, 1989). For example, according to the CDC, outbreaks frequently involve food that was prepared well in advance of service and held at temperatures that promoted bacterial multiplication (Longree & Armbruster, 1987). Given the right conditions, bacteria will divide into two every 20 to 30 minutes, so that one organism can develop into many millions within 12 hours (Hobbs & Roberts, 1990).

Certain factors affect the growth of bacteria:

1. **Food**: the various properties of foods, such as pH, water activity, and salt or sugar content either encourage or discourage the growth of microorganisms. For example, most pathogenic bacteria will not grow in foods with a pH of less than 4.5, a low moisture content, or a high salt or sugar concentration (Waites & Arbuthnott, 1991). Many of the bacteria responsible for foodborne diseases thrive in food items of a proteinaceous nature (Longree & Armbruster, 1987).
2. **Temperature:** the bacteria responsible for most foodborne disease outbreaks multiply most rapidly within a temperature range referred to as the "Danger Zone"—between 45°-140° F (Nadakavukaren, 1990).

3. **Time:** when food and temperature provide favorable conditions for bacterial growth, time is needed for multiplication to take place (Hobbs & Roberts, 1990).

4. **Moisture:** is necessary for active growth, but most bacteria can survive indefinitely when dry, as in powdered food (Hobbs & Roberts, 1990).

5. **Oxygen:** most bacteria require oxygen to grow actively but some multiply only in the absence of oxygen or a reduced level of oxygen (Hobbs & Roberts, 1990).

According to the CDC, improper holding temperature is the leading cause of bacterial foodborne disease outbreaks in the U.S. (Blostein, 1993). Other time-temperature abuses of foods are also leading factors that contribute to bacterial foodborne disease outbreaks. Some examples of these are: keeping cooked foods at room temperature; storing large volumes of foods in large containers in refrigerators; failure to thoroughly cook foods; failure to reheat cooked foods to temperatures that kill vegetative pathogenic bacteria; and preparing foods a half day or more before serving (Bryan, 1984).

**Reporting of Foodborne Disease Outbreaks**

Gastroenteric outbreaks caused by food have been reported to governmental agencies for over 50 years. Beginning in 1923, summaries of gastrointestinal illness attributed to milk, were published by the Public Health Service. In 1938, summaries
of waterborne and foodborne outbreaks were added to their surveillance reports because of concern over the high morbidity and mortality rates due to outbreaks of typhoid fever and infantile diarrhea (Longree & Armbruster, 1987; MMWR, 1990). These earlier reports indicated that food, milk, and water were often the cause of intestinal illness, and provided the rationale for the beginnings of the Public Health Service's waterborne and foodborne disease surveillance system (MMWR, 1990).

Due to these early surveillance efforts a number of important public health measures were enacted that profoundly decreased the incidence of enteric diseases, particularly those transmitted by milk and water (MMWR, 1990). For example, the U.S. Public Health Service Ordinance and Code, which supervised all aspects of safe production, processing, transportation and handling of milk, was published in 1924. The code was widely adopted by cities and counties, and served as a guide for the milk laws later enacted in many states (Longree & Armbruster, 1987).

From 1951-1960, reports of foodborne disease outbreaks were reviewed and published annually, by the National Office of Vital Statistics, in Public Health Reports. In 1961, this function was assumed by the Centers for Disease Control (CDC)-then the Communicable Disease Center. From 1961-1965, CDC publication of annual reviews was discontinued but pertinent statistics and detailed individual investigations were reported in the Morbidity and Mortality Weekly Report (MMWR) (MMWR, 1990).
The present system of surveillance of foodborne and waterborne diseases began in 1966, when all reports of enteric disease outbreaks attributed to microbial or chemical contamination of food or water were incorporated into an annual summary. Beginning in 1978, and due to increasing interest and activity in waterborne disease surveillance, foodborne and waterborne disease outbreaks were reported in separate annual summaries (MMWR, 1990).

The CDC has a standard form for reporting foodborne disease outbreaks. Specific foodborne diseases that are required to be reported in most states on a weekly basis are botulism, brucellosis, Hepatitis A, salmonellosis, shigellosis, trichinosis, and typhoid fever (Longree & Armbruster, 1987). Reports are received from state and local health departments, from federal agencies such as the Food and Drug Administration (FDA), the U.S. Department of Agriculture (USDA), the U.S. Armed Forces, and occasionally from private physicians (MMWR, 1990). These reports are compiled by the CDC and published in MMWR. This report compares incidence for a number of diseases, and it contains summaries of outbreaks and other epidemiological information of national concern. Furthermore, the CDC publishes an annual Summary of Foodborne and Waterborne Disease Outbreaks (Longree & Armbruster, 1987).

**Investigation of Foodborne Disease Outbreaks**

When a local health department is informed of a possible foodborne disease outbreak it can perform most of the epidemiological investigation itself or it may seek
assistance from an appropriate state health department or from the Centers of Disease Control and Prevention (Longree & Armbruster, 1987).

The objectives of the investigation of foodborne disease outbreaks are to:

1. Determine the responsible meal;
2. Determine the responsible item within the meal;
3. Determine the nature and source of the contaminants;
4. Determine the circumstances leading to contamination of and growth in the food; and,
5. Establish, in case of food infections, proof that the pathogen has infected the patient.

Once these are determined, control measures can be implemented to prevent future outbreaks (Longree & Armbruster, 1987).

Information about the possible outbreak is gathered by interviewing both ill and healthy persons who ate the suspected meal; and by interviewing the food service staff and acquiring detailed information on the source of the suspect food, storage condition, length of storage, preparation, holding, and other pertinent information in connection with the history of the suspect meal and its components. The health of the employees and the sanitary conditions of the premises are also surveyed. Samples of suspect food items are collected and are subjected to chemical and microbiological analyses. The investigative team interprets all the information gathered and
determines the etiology and source of the agent which caused the outbreak. For many outbreaks however, the etiology is never determined.

Federal Regulation of the Food Service Industry

Consumers often rely on governmental agencies to help protect the integrity of their food supply (McSwane, Mitter, Palmer & Vilardo, 1988). Federal agencies have traditionally assumed responsibility for ensuring the safe production, processing, and distribution of foods, and state and local agencies have focused their efforts on regulating food prepared by the restaurant industry (McSwane et al., 1988).

The restaurant industry is regulated by over 4,000 different city, county and state health agencies as well as federal agencies (Simpson, 1983). The two federal agencies that have major responsibilities for food protection are the U.S. Food and Drug Administration (FDA) and the U.S. Department of Agriculture (USDA) (Longree & Armbruster, 1987).

The Food and Drug Administration

The FDA is an agency of the Public Health Service and directs its efforts toward protecting the public from unsafe and impure foods, unsafe drugs and cosmetics, and other potential hazards. It administers the Food, Drug and Cosmetic Act, the Fair Packaging and Labeling Act, the Tea Act, and the Import Milk Act (Longree & Armbruster, 1987).
The activities of the FDA that are involved with food protection are carried out by the Center for Food Safety and Applied Nutrition. Food related activities of the Center are divided into food sanitation and quality control; chemical contamination and pesticides; food additives; interstate travel, nutrition and nutrition labeling; and food service, shellfish, and milk safety (Longree & Armbruster, 1987; Read, 1982).

The FDA makes periodic inspections of and takes samples at food-processing and storage facilities; enforces regulations that specify the kinds and quantities of microbial contaminants, additives, and pesticides allowable in foods; checks foods imported to the U.S.; cooperates with state and local agencies in the inspection of and removal from the market of foods contaminated in the course of disasters; requests recalls of foods known or suspected to be injurious to human health; and assists industry in voluntary compliance with the Federal Food, Drug, and Cosmetic Act (Longree & Armbruster, 1987).

Since the FDA is responsible for interstate travel sanitation, federal inspectors check on the sanitary conditions of food service on public conveyances such as trains, planes, buses and ships (Longree & Armbruster, 1987).

The U.S. Department of Agriculture

The USDA establishes, administers, and enforces a number of food standards through the branch agency known as the Food Service and Inspection Service (FSIS). This office aids in making the national food marketing operation more orderly, efficient, and economical. Several of the regulations that the FSIS enforces are The
Meat Inspection Act, The Poultry Products Inspection Act, and The Egg Products Inspection Act. A considerable part of the research effort and regulatory activity of this agency is devoted to the goal of reducing the incidence of pathogenic and otherwise harmful bacteria in livestock, poultry, and food products. For example, through the efforts of the cooperative poultry improvement programs, *Salmonella pullorum* was practically eradicated from poultry flocks (Longree & Armbruster, 1987).

**State and Local Regulation of the Food Service Industry**

Although the overall safety of the food products used by the food service industry is controlled by the FDA and the USDA, the actual foodhandling operations are controlled through state and local health agencies (Longree & Armbruster, 1987). State statutes provide the legal basis for the adoption of regulations by state and local health agencies. These statutes provide the authority to adopt codes and regulations concerning the preparation, service, display, vending and provision or sale of food to the public (McSwane et al., 1988).

In general, state and local agencies have adopted food sanitation codes that are fashioned after the regulations or recommendations set up by federal agencies (Longree & Armbruster, 1987). For example, in the 1930s, the FDA developed model food codes and ordinances, called the FDA Model Ordinance, upon which state and local laws and regulations were based. The FDA Model Ordinance was updated in 1943, 1962, 1976, and most recently in 1993 (Harrington, Brown & Ethier, 1987;
Simpson, 1983). Some states have adopted the FDA Model Ordinance. Others have adopted a similar ordinance (Simpson, 1983).

The following basic elements have been suggested for obtaining compliance with food codes and ordinances (FDA-FSSM, 1976; McSwane et al., 1988):

- issuance of permits granting permission to operate retail food service facilities;
- review and approval of facility plans and specifications;
- inspections and the requirements for correction of violations;
- procedures for the examination, holding, and destruction of food;
- appropriate action where food handlers are suspected of having a communicable disease;
- administrative action, including permit suspension or revocation, against non-complying operators; and
- court action to seek the imposition of criminal or civil penalties or injunctive relief against non-complying operators.

**Regulation of the Food Service Industry in Oregon**

The Oregon Health Division of the Department of Human Resources is responsible for setting sanitation standards and licensing requirements for food service facilities in Oregon, but the actual inspections are routinely done by county sanitarians. These services are currently "contracted out" in 24 of the 36 Oregon counties. The Health Division provides program services either directly or through
contract to the other 12 rural less populated counties (Food Service Facilities Licensing and Inspections (FSFLI), 1990).

The Health Division establishes sanitation standards, minimum requirements for attaining compliance with those standards and the placarding system (public notice sticker) as designated in the Oregon Administrative Rules (FSFLI, 1990). Counties that manage their own programs are required to enforce the laws and sanitation and safety rules of the Health Division, which apply to food service facilities (FSFLI, 1990). At the present time, the Health Division is at an impasse on the resolution of several issues including:

1. a requirement for mandatory food handlers' certification;
2. licensing and sampling of products from frozen dessert machines in establishments licensed by the Division; and
3. a uniform statewide fee schedule (FSFLI, 1990).

**Licensing of Food Service Facilities in Oregon**

A food service facility is required to be licensed in Oregon. The licensing process involves a written application, a fee submitted to the regulatory agency, and successfully passing a routine inspection. After receiving an application and fee, the regulatory authority will inspect the facility to insure compliance with the provisions of the Food Sanitation Rules, which are outlined by the Oregon Administrative Rules (OAR) and the Oregon Revised Statutes (ORS). When a license is issued, it must be posted in the food service facility. Licenses expire on December 31 of each year and

**Inspection of Food Service Facilities in Oregon**

Oregon statutes require that food service facilities have a minimum of two unannounced, complete inspections annually to ensure compliance with the Oregon Administrative Rules. One inspection is conducted in each half of the year, and cannot be less than 90 days apart, or more than 270 days apart (OAR, 1991; SM:AFHG, 1992). Sanitarians employed by the regulatory agency may enter any food service facility at any time, and as often as necessary to conduct inspections (SM:AFHG, 1992).

The inspection results are recorded on an inspection form approved by the Health Division, and a sanitation score is issued. The inspection form summarizes 44 Food Sanitation Rules requirements and sets a weighted point value or number of demerits for a particular violation. The 44 items summarized apply to the following categories: food supplies; food protection; personnel; food equipment and utensils; cleaning and sanitizing; water, sewage, and plumbing; restroom and lavatory facilities; garbage, insects, and rodents; floors, walls, and ceilings; lights and ventilation; and housekeeping. The severity of the violation determines the number of demerits for a particular violation. Critical violations are those violations with demerits rated at four or five points (OAR/ORS, 1991; SM:AFHG, 1992) and pertain to the wholesomeness of food, source of food, temperature of potentially hazardous foods, water supply,
hygienic practices and health status of personnel, etc., all of which have direct impact on disease transmission and are considered detrimental to public health (Zaki et al., 1977). Non-critical violations are those violations with demerits rated at one or two points.

To obtain a sanitation score, the sanitarian subtracts demerit points, from a perfect score of 100, for each violation. At the completion of the inspection, a copy of the inspection form is furnished to the owner or person in charge. The completed inspection form is a public document which is made available to any person who requests it according to law (OAR/ORS, 1991; SM:AFHG, 1992). A sign stating the facility has met sanitation standards is posted if the sanitation score issued is between 70 and 100. This informs the public of compliance with sanitation regulations (OAR/ORS, 1991; SM:AFHG, 1992).

A failed to comply sign will be posted at the facility if the sanitation score is below the minimum score of 70 (OAR/ORS, 1991; SM:AFHG, 1992). If a restaurant obtains a sanitation score of less than 70 percent upon an unannounced complete inspection, the operator or person in charge shall be notified that the restaurant will be closed, if the score of another inspection within thirty days is not 70 percent or above. If the facility is reinspected, within thirty days, and the sanitation score is not 70 percent or above, a closure notice will be posted. The facility may then not be operated until:

1. The operator submits a plan for correction of the violations;
2. The plan receives approval of the regulatory authority; and,

3. An inspection of the facility produces a sanitation score of 70 percent or above (OAR/ORS, 1991; SM:AFHG, 1992).

An inspection report form specifies a reasonable period of time for the correction of any violations that are found. Critical violations must be rectified immediately. Non-critical violations must be corrected by the next inspection or within a time specified by the regulatory agency (OAR/ORS, 1991; SM:AFHG, 1992).

In the state of Oregon, demerit points may be doubled when a repeat non-critical violation is observed on consecutive inspections. Each one point item can accumulate to four points and each two point item can accumulate to eight points (OAR/ORS, 1991; SM:AFHG, 1992).

The regulatory authority may revoke, suspend, or refuse to issue a license if it is determined that: a critical violation of any rule or regulation exists in a facility, the violation is a potential danger to public health; or if a violation is not corrected within a reasonable time (no longer than 14 days). When a violation is corrected the regulatory authority may reinstate a license that has been revoked or suspended (OAR/ORS, 1991; SM:AFHG, 1992).

**Approaches Used to Reduce the Risk of Foodborne Disease**

Different approaches have been used to reduce the risks of foodborne diseases. These approaches can be classified into six categories (Bryan, 1986, 1992):
• Surveillance of foodborne diseases;
• Surveillance of foods;
• Surveillance and training of people who handle foods;
• Surveillance of facilities and equipment used for production or preparation of food;
• Surveillance of food operations; and
• Education of the public.

The usefulness of each of these approaches varies with time, place, and type of food operation (i.e. production, processing, preparation, storage, or distribution) (Bryan, 1992).

For years, surveillance of milk and water samples through the use of microbiological standards has been successful (Anderson, Rutenberg & Bowen, 1989; Federal Register 38, 1973; USDHHS, 1980). For example, guidelines have been established to assess the microbiological condition of milk during processing, distribution, and marketing. These guidelines determine when there are microbiological problems that require attention and thus leads to the reduction of risks associated with foodborne disease. Establishing standards for food is more difficult because of conditions that affect the plate count of the food sampled. For example, the microbial quality of the food received by the consumer may be influenced by: transportation, storage conditions, processing methods, handling by restaurant workers and the microbial quality of the other ingredients used in the final product (Anderson
et al., 1989). Anderson stated that perhaps repeated sampling of food at specific points of preparation might provide a basis upon which guidelines for food service facilities can be established.

The predominant approach used to reduce the risk of foodborne disease in food service facilities is through the establishment of food protection programs that may combine several of the approaches identified by Bryan (1986, 1992).

**Food Protection Programs**

Several different goals or objectives of food protection programs are identified in the literature. For example, according to the FDA's Food Service Sanitation Manual, the broad objective of a food service sanitation program is protection of the consumer's health (FDA: Food Service Sanitation Manual, 1976; Simpson, 1983).

The trade industry's main objective is to "protect everyone's health by operating clean, safe and sanitary premises" (Simpson, 1983). This objective should be met through teaching food service managers and personnel about the importance of sanitation, and the fundamentals about bacterial growth, foodborne illness, personal hygiene, temperature control, etc. (Longree & Armbruster, 1987).

Local county health department goals are similar to those expressed by the trade associations, and federal and state agencies. The most widely identified goal of a health department food protection program is to eliminate, or at least minimize, the risk of foodborne illness at food service facilities (McSwane, Palmer & Vilardo, 1992).
One strategy that has been recognized as generally being successful in solving foodborne disease problems is food service employees education in safe food handling practices (Irwin, Ballard, Grendon & Kobayashi, 1989; Manning & Snider, 1993). Historically, health departments have used food safety education programs and/or routine inspections to prevent foodborne disease (Kneller & Bierma, 1990). One reason training programs for food service employees have not always produced the desired results is because of rapid employee turnover (Kneller & Bierma, 1990; Longree & Armbruster, 1987).

Studies have suggested that routine inspection scores be used as an indicator of higher risk of foodborne disease in certain facilities and that these scores be used to alert environmental health professionals of the need to direct additional educational resources to these facilities. For example, a study of restaurants in Seattle-King County, indicated that restaurants with poor inspection scores were five times more likely to have outbreaks than restaurants with better inspection scores. It was also found that restaurants with violations of proper temperature controls of potentially hazardous foods were ten times more likely to have outbreaks than restaurants without temperature control violations (Irwin, Ballard, Grendon & Kobayashi, 1989).

Inspections alone cannot guarantee prevention of foodborne disease outbreaks. For example, an outbreak of acute gastrointestinal illness occurred among persons who attended a restaurant buffet lunch in Alabama in 1992. The restaurant had passed
four public health inspections, during 1992, including a routine inspection two days before the buffet (Penman, Webb, Woernle & Currier, 1996).

Another educational approach that has been recognized as successful in solving foodborne disease problems is manager certification. Manager certification was developed to upgrade management knowledge of food sanitation and to emphasize the need to train and supervise employees in proper food handling (Kneller & Bierma, 1990). In 1971, a conference was conducted by the FDA, the Public Health Association, and representatives of the food service industry. The purpose of this conference was to scrutinize existing food protection programs. The consensus was that food service management personnel should become more knowledgeable in sanitation and sanitary food handling practices (Longree & Armbruster, 1987).

In 1973, the Ohio Department of Health developed the first statewide food service manager training and certification program in the United States. Since then the concept of food service manager training and certification has spread rapidly (Longree & Armbruster, 1987) and is another strategy used by local county health departments to solve foodborne disease problems. This approach seems to have merit because the manager turnover rate is lower than the employee turnover rate and managers have the authority and the ability to provide on-going training for their employees (Wright & Fuen, 1986).

In 1984, Penninger reported that food safety training and certification of food service managers improved sanitary conditions of facilities (Burch & Sawyer, 1991).
Additionally, Marth reported on a study of the short term and long term effects on the food handling practices of employees working under a trained manager. A positive correlation was noted between the length of time since the manager was trained and the incidence of poor food handling practices by his/her employees (Burch & Sawyer, 1991).

A study of food service facilities in McLean County, Illinois, indicated that certifying personnel resulted in an improvement in total inspection scores and reduced the number of violations of a critical, procedural, or procedural/structural nature (Kneller & Bierma, 1990).

Both supervision and education of food workers and consistent adherence by food workers to good hygienic practices are critical and perhaps neglected elements in control and prevention of foodborne disease (Penman, Webb, Woernle & Currier, 1996).

However, the effectiveness of both educational approaches can be questioned given foodborne disease outbreak data which indicates that foodborne disease continues to be a major public health problem (Irwin et al., 1989; Manning & Snider, 1993; MMWR, 1990).

It is believed that for food protection programs to become truly foodborne disease prevention programs, a significant shift of emphasis in inspections must be made. Specifically factors that epidemiological investigations have shown to influence contamination, survival, and/or growth of foodborne pathogens must be
sought out and given priority (Bryan, 1979; 1972; 1974; 1975; 1978). A second concern is that inspection forms are not properly designed. For example, with the current design there could be numerous critical violations observed during an inspection, but if these violations are in the same category, the score would be the same as an establishment with only one critical violation. A sanitation score that does not include all of the violations observed during an inspection cannot be considered a measure of the overall sanitation level found in a food establishment (Emanuel, 1995). Many health jurisdictions feel that inspection forms should be altered to provide an inspection score that is a more reliable measure of sanitation by reflecting the frequency or repetitiveness of violations and expanding certain categories of violations to permit greater distinction among violations (Emanuel, 1995). If this approach were adopted, the violations noted would more accurately reflect the gravity of the risk involved with violation of these critical conditions (Bryan, 1979; FSSM, 1962, 1976).

It has also been reported that the time spent on unnecessary inspections could better be used for more frequent inspections of food service facilities with poor sanitation records or with large complex operations (Bader, et al., 1978).

**Marion County's Food Protection Program**

The Marion County Environmental Health Department has a voluntary food handler’s program that has been established to provide an atmosphere of general understanding and voluntary compliance concerning the county’s codes and

A voluntary foodhandler’s class is offered to county food service personnel. The class is taught by county sanitarians and consists of a lecture, a series of slides and discussion of the Sanitation Manual: A Food Handler’s Guide (SM:AFHG). This manual was developed by the Marion County Health Department and the Chemeketa Community College Hospitality Systems Department, for persons working in the food service industry and by those persons needing training and orientation in the area of sanitation and safety (SM:AFHG, 1992). Food service personnel completing the class are required to pass an exam to obtain a food handler’s card, which is valid for three years from date of issue.

Four sanitarians are responsible for routine inspections of food service facilities in Marion County. The inspection form includes the 44 Food Sanitation Rules established by the Oregon Health Division. A copy of the inspection form is included as Appendix A.

The Hazard Analysis Critical Control Point Approach

One approach that is being used to reduce the risk of foodborne disease is the Hazard Analysis Critical Control Point (HACCP) concept. The HACCP concept was developed in the 1960s by the Pillsbury Co., the U.S. Army Research and Development Laboratories, and the National Aeronautics and Space Administration in
their collaborative effort for development of foods for the space program (Sperber, 1991).

Pillsbury first described the HACCP concept in detail at the first Food Protection Conference in 1971 (Archer 1990; ICMSF, 1987; Simonsen et al., 1987; Sperber, 1991; WHO/ICMSF, 1982). It was first applied, successfully, to low-acid canned foods (Archer, 1990; Bryan, 1988).

The HACCP approach has been adopted by several food companies and also has begun to receive attention from others in the food industry and by government regulatory agencies (Sperber, 1991). HACCP has been recommended by Dr. Frank Bryan of the CDC, the Second National Food Protection Conference, and the National Research Council-Food and Nutrition Board-Subcommittee on Food Protection as the approach to be used in all food service facilities (Bryan, 1992; Guzewich, 1986; WHO/ICMSF, 1982).

The HACCP concept is a systematic approach that seeks to identify, assess and control hazards to ensure the safety of foods (Bryan, 1992). The HACCP approach differs from most traditional inspection programs because it focuses on factors that have been shown to cause foodborne disease outbreaks, rather than on factors that relate to aesthetics (Bryan, 1985, 1992).

The HACCP system combines several of the approaches identified above by Bryan (1986, 1992), (in particular, surveillance of diseases, foods, and operations, and education) into a program that will identify and reduce the hazards associated
with any stage of food production, processing, or preparation, assess the related risks, and determine the operations where control procedures will be effective. Control procedures can then be directed at specific operations that pose the greatest source of potential public health risk rather than at aesthetic problems (Bryan, 1985, 1992).

HACCP consists of the following six successive elements identified by Bryan (1992):

1. Hazard identification and assessment of their severity and risk to a raw material or food product (hazard analysis), and an evaluation of all procedures that are associated with their growth, harvesting, processing, manufacture, distribution, marketing, preparation and use.

   - **Hazard** is unacceptable contamination, growth or survival in food of microorganisms that may affect food safety or lead to spoilage, and/or the unacceptable production or persistence in foods of products such as toxins, enzymes or histamines of microbial metabolism (Bryan, 1988, 1992).

   - **Severity** is the magnitude of the hazard, or the seriousness of the possible consequences that can result when a hazard exists (Bryan, 1988, 1992).

   - **Risk** is an estimate of the probability of a hazard occurring (Bryan, 1992).

2. Determination of critical control points (CCPs) at which the identified hazards can be prevented or controlled.
A Critical control point (CCP) is an operation (practice, procedure, process, or location) or a step of an operation, at which control can be exercised over one or more factors to eliminate, prevent or minimize a hazard (Bryan, 1988, 1992).

3. The specification of criteria, at each CCP, that will indicate whether a process is under control at that CCP. Some examples of factors to be monitored at the CCP are: time and temperature for thermally processed foods; water activity of certain foods; and depth of product in trays to be chilled.

Criteria are limits or characteristics of a physical (e.g., time or temperature), chemical (e.g., concentration of salt or acetic acid), biological or sensorial nature (Bryan, 1988, 1992).

4. The monitoring of each CCP's criteria through the establishment and implementation of procedures to ensure that it is under control. Five main types of monitoring are employed: observation, sensory evaluation, measurement of physical properties, chemical testing and microbiological examination.

Monitoring involves the systematic observation, measurement and/or recording of the significant factors for prevention or control of the hazard. The monitoring procedures chosen must enable action to be taken to rectify an out-of-control situation, either before or during an operation (Bryan, 1988, 1992).

5. When criteria are not met, at a CCP, it is necessary to implement appropriate corrective action.
6. The final step in the HACCP system is the verification that all hazards and CCPs have been identified, the specified criteria are appropriate, and the established monitoring procedures are effective in evaluating operations.

- **Verification** involves the use of supplemental tests or review of previous monitoring records to determine that the HACCP system is in place and functioning as planned (Bryan, 1988).

Although an initial hazard analysis will generally take more time than a traditional inspection, follow-up inspections to monitor CCPs will take less time and provide greater assurance of food safety. This approach will also allow inspections to be made at times when high risk operations are being performed to determine whether CCPs are being effectively monitored (Bryan, 1985).

Many health agencies are implementing a modified HACCP approach into their routine inspections to reduce the risk of foodborne illness in an establishment. A modified HACCP approach is used to follow the flow of food from the time it is delivered until it is served, ensuring it is handled safely through all these procedures to prevent a foodborne illness. Many health agencies use HACCP to monitor Critical Control Points to prevent foodborne illness. Examples of Critical Control Points that are monitored are:

- Handwashing;
- Cooling time and temperature;
- Cooking and reheating time and temperatures;
• Hot holding temperatures;
• Cold holding temperatures; and
• Prevention of cross-contamination.

The frequency and type (standard 44-point or HACCP) of food service establishment inspection can be based on whether an operation is categorized as high, moderate, or low risk (Collins, 1995). Risk category assignments can be based on certain criteria including:

• Food property risks—those which may cause food to become a vehicle for, or source of, foodborne illness including time-temperature relationships, pH, water activity, and common microflora associated with the product (Collins, 1995).

• Population at risk—specific populations such as the young, elderly, and immunocompromised are predisposed to illness or may have increased severity of illness (Collins, 1995).

• Food service establishment history—evaluate inspection history and complaints (Collins, 1995).

• Food service operational risks—those which exist due to process or procedures that influence survivability of microorganisms (e.g., cooking, handling, cooling, storage, training, etc.) (Bryan, 1982; Collins, 1995).
3. METHODS

Data Collection

The data included most recent routine inspection results that had been previously collected and data collected from a Menu Risk Assessment Survey which was administered, by the researcher, to 400 food service managers/owners between October 1993 and December 1993.

Survey Development

The Menu Risk Assessment Survey was developed by the Virginia Department of Health. The survey is also currently being used by the Washington County Environmental Health staff in Hillsboro, Oregon. The survey was approved by the Oregon State University Committee for the Protection of Human Subjects. A copy of the survey is included as Appendix B.

Menu risk assessment was developed, as a tool, to predict outcomes and/or identify problem facilities to maximize resources and provide an effective and cost efficient food service protection program. Frequency of food service establishment inspections may be based on whether an establishment is categorized as a high, moderate, or low risk food service establishment.

Risk categories of high, moderate, or low risk for food service establishments are determined through the Menu Risk Assessment Survey which consists of ten questions related to a food service establishment’s operational style. Responses (yes
or no) to each question are assigned numeric values that are based on whether that response is a high potential risk for foodborne illness or a low potential risk for foodborne illness. These ten response values are averaged together to establish a risk index. A high risk index value represents low risk for potential foodborne illness in an establishment and a low risk index value represents high risk for potential foodborne illness in an establishment. Each category is characterized by the following:

- **High Risk Food service Establishment:** An establishment that through: amount of manager/employee education, menu items served, operational practices or population served presents an above average risk for potential foodborne illness. To be categorized as a High Risk Food service Establishment, an establishment must receive a risk index value of less than 0.9 on the Menu Risk Assessment Survey.

- **Moderate Risk Food service Establishment:** An establishment that through: amount of manager/employee education, menu items served, operational practices or population served represents an average risk for potential foodborne illness. To be categorized as a Moderate Risk Food service Establishment, an establishment must receive a risk index value of 0.9 to 1.1 on the Menu Risk Assessment Survey.

- **Low Risk Food service Establishment:** An establishment that through: amount of manager/employee education, menu items served, operational
practices or population served presents a below average risk for potential foodborne illness. To be categorized as a Low Risk Food service Establishment, an establishment must receive a risk index value greater than 1.1 on the Menu Risk Assessment Survey.

The sample population to be surveyed in Marion County was determined as follows:

1. A list of the 567 currently licensed food service facilities in Marion County was obtained from the Marion County Environmental Health Department. Each food service facility was categorized, by the health department, into one of five categories based on seating. The five categories are as follows:
   - Restaurant with 0-15 seats;
   - Restaurant with 16-50 seats;
   - Restaurant with 51-100 seats;
   - Restaurant with 101-250 seats; and
   - Restaurant with 251 plus seats.

2. Consultation with the Oregon State University Statistics Consulting Service determined that a simple, stratified random sample of 400 facilities would represent the estimate to be accurate within 5% of the actual proportion. It was also determined that a representative proportion of facilities needed to be selected from each of the five strata of categories based on seating capacity.
3. The proportion of facilities to be selected from each strata was determined by dividing the total number of facilities in each strata by the total number of facilities in Marion County, and multiplying by the sample size of 400 with the following results:

- Strata 1 (Restaurant with 0-15 seats): 76 facilities to be surveyed;
- Strata 2 (Restaurant with 16-50 seats): 108 facilities to be surveyed;
- Strata 3 (Restaurant with 51-100 seats): 112 facilities to be surveyed;
- Strata 4 (Restaurant with 101-250 seats): 96 facilities to be surveyed;
- Strata 5 (Restaurant with 251 plus seats): 8 facilities to be surveyed.

4. A random sample was selected from each strata using random number tables, for a total of 400 facilities.

5. The researcher went to each facility and asked to speak with the manager/owner. The researcher identified herself as an Oregon State University graduate student and informed the manager/owner of the nature of the study, indicated their facility was selected through a random sample, and advised them that participation in the survey was voluntary. The researcher completed the survey during the meeting with the manager/owner. The researcher explained terms and questions that may not have been easily understood by the manager/owner. The researcher also looked at the establishment’s menu to compare answers received during the interview and menu items served. If there were inconsistencies, the researcher discussed them with the manager/owner and amended survey answer if necessary.
6. Facilities without a manager/owner present were revisited later that same day or the following day.

7. Survey completion generally took place between 8:00 am and 5:00 pm weekdays.

8. Recent inspection scores of the 400 randomly selected facilities were also obtained from the Marion County Environmental Health Department.

**Data Analysis**

Data collected from the survey administered in Marion County was described using mean inspection values, mean number of critical violations, mean risk index values, and p values. The p values were obtained by using paired t tests. The researcher analyzed the data collected in Marion County using Excel Version 5.0.
4. RESULTS

Results are presented in the following sections: results of research question one and results of research question two.

Results of Research Question One

Research Question One addressed: How do the mean inspection scores, mean number of critical violations, and mean risk index values compare for high risk, moderate risk, and low risk food service establishments in Marion County?

Data from high risk, moderate risk, and low risk food service establishments in Marion County were analyzed to determine mean inspection score, and the standard deviation; mean number of critical violations, and the standard deviation; and mean risk index value, and the standard deviation.

The results show that the mean inspection score for high risk food service establishments was 78.7 points out of a possible 100 points, the mean inspection score for moderate risk food service establishments was 85.2 points out of a possible 100 points, and the mean inspection score for low risk food service establishments was 90.2 points out of a possible 100 points (See Table 4.1). This shows that restaurants that turned out to be high risk also had lower inspection scores.

The results show that the mean number of critical violations for high risk food service establishments was 1.4, the mean number of critical violations for moderate risk food service establishments was 0.69, and the mean number of critical violations
for low risk food service establishments was 0.37 (See Table 4.1). High risk establishments, therefore, had a greater mean number of critical violations than did moderate or low risk establishments.

Table 4.1. Comparison of mean inspection score and standard deviation, mean number of critical violations and standard deviation, and mean risk index value and standard deviation for high risk, moderate risk, and low risk food service establishments in Marion County.

<table>
<thead>
<tr>
<th>Variable</th>
<th>High Risk Food Service Establishments¹ (n=31)</th>
<th>Moderate Risk Food Service Establishments² (n=269)</th>
<th>Low Risk Food Service Establishments³ (n=100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Inspection Score and Standard Deviation</td>
<td>78.7; 5.14</td>
<td>85.2; 6.92</td>
<td>90.2; 6.38</td>
</tr>
<tr>
<td>Mean Number of Critical Violations and Standard Deviation</td>
<td>1.4; 0.99</td>
<td>0.69; 0.78</td>
<td>0.37; 0.58</td>
</tr>
<tr>
<td>Mean Risk Index Value and Standard Deviation</td>
<td>0.84; 0.03</td>
<td>1.00; 0.07</td>
<td>1.21; 0.08</td>
</tr>
</tbody>
</table>

¹Have a risk index value of less than 0.9 as determined by the Menu Risk Assessment Survey.
²Have a risk index value of 0.9-1.1 as determined by the Menu Risk Assessment Survey.
³Have a risk index value of greater than 1.1 as determined by the Menu Risk Assessment Survey.

The results also show that the mean risk index value for high risk food service establishments was 0.84, the mean risk index for moderate risk food service establishments was 1.00, and the mean risk index for low risk food service
establishments was 1.21 (See Table 4.1). This means that low and moderate risk food service establishments are considered to be less of a risk for foodborne illness than high risk food service establishments.

Results of Research Question Two

Research Question Two had two parts relating to Marion County facilities:

(1) Is there a significant relationship between risk category of food service establishments, as identified by responses to the ten individual questions of the Menu Risk Assessment Survey, and mean inspection scores; and, (2) Is there a significant relationship between risk category of food service establishments, as identified by responses to the ten individual questions of the Menu Risk Assessment Survey, and mean number of critical violations?

The responses to each survey question were compared to the mean inspection score, and the mean number of critical violations. A “Yes” or “No” response to each survey question determines potential risk for foodborne illness. For some survey questions high potential risk may be a “Yes” response and for others a “No” response means high potential risk. The paired t test was used to determine if there was a statistically significant difference between high and low risk establishments with regard to inspection score and critical violations.
Analysis of Survey Question One

Survey question one inquired: Does the establishment’s manager have a food handler’s card? Potential risk for foodborne illness is defined as high if an establishment’s manager did not have a food handler’s card (answered no to this question).

The mean inspection score of high risk defined restaurants was 3.7 points lower than for low risk defined restaurants. There were significant differences in mean inspection scores between “low” risk and “high” risk establishments (p=.0004) (See Table 4.2). This means that establishments whose managers do not have a food handler’s card are more likely to have a lower inspection score than establishments whose managers do have a food handler’s card.

Table 4.2: Differences in mean inspection scores and mean number of critical violations for establishments that do have a manager with a foodhandler’s card and those that do not.

<table>
<thead>
<tr>
<th>Does Manager Have A Food Handler’s Card?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scores</td>
</tr>
<tr>
<td>-----------------------------------------</td>
</tr>
<tr>
<td>Mean Inspection Score and Standard Deviation</td>
</tr>
<tr>
<td>Mean Number of Critical Violations and Standard Deviation</td>
</tr>
</tbody>
</table>

*Significant difference at p<.05
The mean number of critical violations of high risk defined restaurants is 0.10 points higher than for low risk defined restaurants. There were significant differences between “low” risk and “high” risk establishments (p=.0001) (See Table 4.2). This means that establishments whose managers do not have a food handler’s card are more likely to have more critical violations than establishments whose managers do have a food handler’s card.

**Analysis of Survey Question Two**

Survey question two inquired: Are potentially hazardous food items served? Potential risk for foodborne illness is defined as high if a restaurant serves potentially hazardous food (answered yes to this question).

Table 4.3: Differences in mean inspection scores and mean number of critical violations for establishments that do serve potentially hazardous food items and those that do not.

<table>
<thead>
<tr>
<th>Are Potentially Hazardous Food Items Served?</th>
<th>Yes (n=380)</th>
<th>No (n=20)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Inspection Score and Standard Deviation</td>
<td>85.9; 7.22</td>
<td>87.8; 8.58</td>
<td>.002*</td>
</tr>
<tr>
<td>Mean Number of Critical Violations and Standard Deviation</td>
<td>0.92; 0.80</td>
<td>0.63; 0.68</td>
<td>.005*</td>
</tr>
</tbody>
</table>

*Significant difference at p<.05
The mean inspection score of high risk defined restaurants was 1.90 points lower than for low risk defined restaurants. There were significant differences in mean inspection scores between “low” risk and “high” risk establishments (p=.002) (See Table 4.3). This means establishments that serve potentially hazardous food items are more likely to have a lower inspection score than establishments that do not serve potentially hazardous food items.

The mean number of critical violations of high risk defined restaurants was 0.29 points higher than for low risk defined restaurants. There were significant differences in mean number of critical violations between “low” risk and “high” risk establishments (p=.005) (See Table 4.3). This means establishments that serve potentially hazardous food items are more likely to have more critical violations than establishments that do not.

**Analysis of Survey Question Three**

Survey question three inquired: Are potentially hazardous foods prepackaged, cooked to order or not served at all? Potential risk for foodborne illness is defined as high if a restaurant serves potentially hazardous food other than foods that are prepackaged or cooked to order (answered no to this question).

The mean inspection score of high risk defined restaurants was 3.3 points lower than for low risk defined restaurants. There were significant differences in mean inspection scores between “low” risk and “high” risk establishments (p=.0003) (See Table 4.4). This means establishments that serve potentially hazardous food other
than foods that are prepackaged or cooked to order are more likely to have a lower inspection score than establishments that serve potentially hazardous foods that are prepackaged, cooked to order or not served at all.

The mean number of critical violations of high risk defined restaurants was 0.37 points higher than for low risk defined restaurants. There were significant differences in mean number of critical violations between “low” risk and “high” risk establishments (p=.001) (See Table 4.4). This means establishments that serve potentially hazardous food other than foods that are prepackaged or cooked to order are more likely to have more critical violations than establishments that serve potentially hazardous foods that are prepackaged, cooked to order or not served at all.

Table 4.4: Differences in mean inspection scores and mean number of critical violations for establishments that serve potentially hazardous foods that are prepackaged, cooked to order or not served at all and those that serve potentially hazardous foods that are not prepackaged or cooked to order.

| Are Potentially Hazardous Foods Prepackaged, Cooked To Order Or Not Served At All? |
|----------------------------------|-----------------|-----------------|-----------------|
| Scores                           | Yes (n=16)      | No (n=384)      | p Value         |
| Mean Inspection Score and Standard Deviation | 89.1; 7.97      | 85.8; 7.23      | .0003*          |
| Mean Number of Critical Violations and Standard Deviation | 0.55; 0.62      | 0.92; 0.80      | .001*           |

*Significant difference at p<.05
Analysis of Survey Question Four

Survey question four inquired: Are potentially hazardous foods served from a buffet or salad bar? Potential risk for foodborne illness is defined as high if a restaurant serves potentially hazardous foods from a buffet or salad bar (answered yes to this question).

Table 4.5: Differences in mean inspection scores and mean number of critical violations for establishments that serve potentially hazardous foods from a buffet or salad bar and those that do not.

<table>
<thead>
<tr>
<th>Are Potentially Hazardous Foods Served From A Buffet Or Salad Bar?</th>
<th>Yes (n=48)</th>
<th>No (n=352)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Inspection Score and Standard Deviation</td>
<td>85.0; 7.81</td>
<td>86.1; 7.21</td>
<td>.001*</td>
</tr>
<tr>
<td>Mean Number of Critical Violations and Standard Deviation</td>
<td>0.93; 0.89</td>
<td>0.70; 0.78</td>
<td>.0002*</td>
</tr>
</tbody>
</table>

*Significant difference at p<.05

The mean inspection score of high risk defined restaurants is 1.10 points lower than for low risk defined restaurants. There were significant differences in mean inspection scores between “low” risk and “high” risk establishments (p=.001) (See Table 4.5). This means establishments that serve potentially hazardous foods from a buffet or salad bar are more likely to have a lower inspection score than
establishments that do not serve potentially hazardous foods from a buffet or salad bar.

The mean number of critical violations of high risk defined restaurants is 1.16 points higher than for low risk defined restaurants. There were significant differences in mean number of critical violations between "low" risk and "high" risk establishments (p=.0002) (See Table 4.5). This means establishments that serve potentially hazardous foods from a buffet or salad bar are more likely to have more critical violations than establishments that do not serve potentially hazardous foods from a buffet or salad bar.

**Analysis of Survey Question Five**

Are potentially hazardous foods cooked, held and reheated? Potential risk for foodborne illness is defined as high if a restaurant cooks, holds, and reheats potentially hazardous food (answered yes to this question).

The mean inspection score of high risk defined restaurants was 2.0 points lower than for low risk defined restaurants. There were significant differences in mean inspection scores between "low" risk and "high" risk establishments (p=.003) (See Table 4.6). This means establishments that cook, hold, and reheat potentially hazardous food are more likely to have a lower inspection score than establishments that do not.
Table 4.6: Differences in mean inspection scores and mean number of critical violations for establishments that cook, hold and reheat potentially hazardous foods and those that do not.

<table>
<thead>
<tr>
<th>Are Potentially Hazardous Foods Cooked, Held and Reheated?</th>
<th>Yes (n=250)</th>
<th>No (n=150)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Inspection Score and Standard Deviation</td>
<td>84.9; 7.25</td>
<td>86.9; 7.21</td>
<td>.003*</td>
</tr>
<tr>
<td>Mean Number of Critical Violations and Standard Deviation</td>
<td>1.02; 0.85</td>
<td>0.77; 0.73</td>
<td>.003*</td>
</tr>
</tbody>
</table>

*Significant difference at p<.05

The mean number of critical violations of high risk defined restaurants is 0.25 points higher than for low risk defined restaurants. There were significant differences in mean number of critical violations between “low” risk and “high” risk establishments (p=.003) (See Table 4.6). This means establishments that cook, hold, and reheat potentially hazardous food are more likely to have more critical violations than establishments that do not.

Analysis of Survey Question Six

Survey question six inquired: Are potentially hazardous foods prepared from raw, non-frozen ingredients? Potential risk for foodborne illness is defined as high if
a restaurant prepares potentially hazardous foods from raw, non-frozen ingredients (answered yes to this question).

The mean inspection score of high risk defined restaurants was 5.3 points lower than for low risk defined restaurants. There were significant differences in mean inspection scores between “low” risk and “high” risk establishments (p=.0004) (See Table 4.7). This means establishments that prepare potentially hazardous foods from raw, non-frozen ingredients are more likely to have a lower inspection score than establishments that do not.

Table 4.7: Differences in mean inspection scores and mean number of critical violations for establishments that prepare potentially hazardous foods from raw, non-frozen ingredients and those that do not.

<table>
<thead>
<tr>
<th>Are Potentially Hazardous Foods Prepared From Raw, Non-frozen Ingredients?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scores</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>Mean Inspection Score and Standard Deviation</td>
</tr>
<tr>
<td>Mean Number of Critical Violations and Standard Deviation</td>
</tr>
</tbody>
</table>

*Significant difference at p<.05

The mean number of critical violations of high risk defined restaurants is 0.27 points higher than for low risk defined restaurants. There were significant differences
in mean number of critical violations between “low” risk and “high” risk establishments (p=.0002) (See Table 4.7). This means establishments that prepare potentially hazardous foods from raw, non-frozen ingredients are more likely to have more critical violations than establishments that do not.

**Analysis of Survey Question Seven**

Are potentially hazardous foods prepared and held before service? Potential risk for foodborne illness is defined as high if a restaurant prepares potentially hazardous foods and holds them (hot or cold) before service (answered yes to this question).

The mean inspection score of high risk defined restaurants was 4.1 points lower than for low risk defined restaurants. There were significant differences in mean inspection scores between “low” risk and “high” risk establishments (p=.0003) (See Table 4.8). This means establishments that prepare and hold potentially hazardous foods before service are more likely to have a lower inspection score than those that do not.

The mean number of critical violations of high risk defined restaurants is 0.54 points higher than for low risk defined restaurants. There were significant differences in mean number of critical violations between “low” risk and “high” risk establishments (p=.001) (See Table 4.8). This means establishments that prepare and hold potentially hazardous foods before service are more likely to have a higher number of critical violations than those that do not.
Table 4.8: Differences in mean inspection scores and mean number of critical violations for establishments that prepare and hold potentially hazardous foods before service and those that do not.

<table>
<thead>
<tr>
<th>Are Potentially Hazardous Foods Prepared And Held Before Service?</th>
<th>Scores</th>
<th>Yes (n=296)</th>
<th>No (n=104)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Inspection Score and Standard Deviation</td>
<td>84.9; 7.09</td>
<td>89.0; 6.98</td>
<td>.0003*</td>
<td></td>
</tr>
<tr>
<td>Mean Number of Critical Violations and Standard Deviation</td>
<td>1.3; 0.84</td>
<td>0.76; 0.56</td>
<td>.001*</td>
<td></td>
</tr>
</tbody>
</table>

*Significant difference at p<.05

**Analysis of Survey Question Eight**

Are potentially hazardous foods extensively handled during preparation?

Potential risk for foodborne illness is defined as high if a restaurant extensively handles potentially hazardous foods during preparation (answered yes to this question).

The mean inspection score of high risk defined restaurants was 9.6 points lower than for low risk defined restaurants. There were significant differences in mean inspection scores between “low” risk and “high” risk establishments (p=.0001) (See Table 4.9). This means establishments that extensively handle potentially
hazardous foods during preparation are more likely to have a lower inspection score than establishments that do not.

The results show that the mean number of critical violations of high risk defined restaurants was 0.30 points higher than for low risk defined restaurants. There were significant differences in mean number of critical violations between “low” risk and “high” risk establishments (p=.001) (See Table 4.9). This means establishments that extensively handle potentially hazardous foods during preparation are more likely to have more critical violations than establishments that do not.

Table 4.9: Differences in mean inspection scores and mean number of critical violations for establishments that extensively handle potentially hazardous foods during preparation and those that do not.

<table>
<thead>
<tr>
<th>Are Potentially Hazardous Foods Extensively Handled During Preparation?</th>
<th>Scores</th>
<th>Yes (n=316)</th>
<th>No (n=84)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Inspection Score and Standard Deviation</td>
<td>83.1; 6.46</td>
<td>92.7; 2.88</td>
<td>.0001*</td>
<td></td>
</tr>
<tr>
<td>Mean Number of Critical Violations and Standard Deviation</td>
<td>1.1; 0.83</td>
<td>0.80; 0.49</td>
<td>.001*</td>
<td></td>
</tr>
</tbody>
</table>

*Significant difference at p<.05
Analysis of Survey Question Nine

Survey question nine inquired: Are the average number of meals served per day 500 or more? Potential risk for foodborne illness is defined as high if a restaurant serves 500 or more meals per day (answered yes to this question).

Table 4.10: Differences in mean inspection scores and mean number of critical violations for establishments that serve an average number of meals per day of 500 or more and those that serve fewer than 500 meals.

<table>
<thead>
<tr>
<th>Are The Average Number Of Meals Served Per Day 500 Or More?</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Scores</td>
<td>Yes (n=17)</td>
<td>No (n=383)</td>
<td>p Value</td>
</tr>
<tr>
<td>Mean Inspection Score</td>
<td>84.3; 7.07</td>
<td>86.5; 7.51</td>
<td>.0002*</td>
</tr>
<tr>
<td>Mean Number of Critical Violations</td>
<td>0.96; 1.01</td>
<td>0.74; 0.78</td>
<td>.0001*</td>
</tr>
</tbody>
</table>

*Significant difference at p<.05

The mean inspection score of high risk defined restaurants is 2.2 points lower than for low risk defined restaurants. There were significant differences in mean inspection scores between “low” risk and “high” risk establishments (p=.0002) (See Table 4.10). This means establishments that serve 500 or more meals per day are
more likely to have a lower inspection score than establishments that serve fewer than 500 meals per day.

The mean number of critical violations of high risk defined restaurants is 0.22 points higher than for low risk defined restaurants. There were significant differences in mean number of critical violations between “low” risk and “high” risk establishments (p=.0001) (See Table 4.10). This means establishments that serve 500 or more meals per day are more likely to have more critical violations than establishments that serve fewer than 500 meals per day.

**Analysis of Survey Question Ten**

Survey question ten inquired: Is a critical population served? Potential risk for foodborne illness is defined as high if a restaurant serves a critical population (answered yes to this question).

The mean inspection score of high risk defined restaurants was 0.90 points lower than for low risk defined restaurants. There were no significant differences in mean inspection scores between “low” risk and “high” risk establishments (p=.129) (See Table 4.11). This means establishments that serve a critical population (i.e. child-care, elder-care, school, jail, or hospital) are not more likely to have a lower inspection score than those that do not serve these critical populations. There were only four establishments that serve a critical population which could be why there was not a significant difference between “low” risk and “high” risk establishments.
Table 4.11: Differences in mean inspection scores and mean number of critical violations for establishments that serve a critical population and those that do not serve these critical populations.

<table>
<thead>
<tr>
<th>Is A Critical Population Served?</th>
<th>Scores</th>
<th>Yes (n=4)</th>
<th>No (n=396)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Inspection Score and Standard Deviation</td>
<td>85.0; 3.44</td>
<td>85.9; 7.31</td>
<td>.129</td>
<td></td>
</tr>
<tr>
<td>Mean Number of Critical Violations and Standard Deviation</td>
<td>0.80; 0.45</td>
<td>0.91; 0.80</td>
<td>.351</td>
<td></td>
</tr>
</tbody>
</table>

The mean number of critical violations of high risk defined restaurants is 0.11 points lower than for low risk defined restaurants. There were no significant differences in mean number of critical violations between “low” risk and “high” risk establishments (p=.351) (See Table 4.11). This means establishments that serve a critical population (i.e. child-care, elder-care, school, jail, or hospital) are not more likely to have more critical violations than those that do not serve these critical populations.
5. DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

The discussion is presented in two sections. The first section addresses the first research question, and the second section addresses the second research question, which includes responses from the ten survey questions.

Discussion of Research Question One

How do the mean inspection scores, mean number of critical violations, and mean risk index values compare from high risk, moderate risk, and low risk food service establishments in Marion County?

Data from high risk, moderate risk, and low risk food service establishments were compared and the results indicate that high risk establishments have lower mean inspection scores, higher mean number of critical violations, and a smaller mean risk index value than moderate or low risk establishments due to amount of manager education, menu items served, and operational practices observed in the establishment (See Table 4.1). These results support the idea of adopting variable inspection frequencies based on potential risk of foodborne disease rather than rely on the traditional approach of inspecting food service facilities an arbitrary number of times annually (Bryan, 1982; Kaplan & El Ahraf, 1979; Wodi & Mill, 1985). Currently, Oregon statutes require that food service facilities have a minimum of two unannounced, complete inspections annually to ensure compliance with Oregon Administrative Rules (OAR, 1991; SM:AFHG, 1992). This means that restaurants that
may have routinely lower inspection scores still may be visited only twice during the year by sanitarians. Variable inspection frequencies would focus prevention efforts where the problems are more severe and are of greater public health risk. This would address the concern that health agencies have not been able to increase their surveillance activities due to budget and personnel cuts that are occurring at the same time that more restaurants are serving the public (Bryan, 1982; Wodi & Mill, 1985). It has also been reported that the time spent on unnecessary inspections could better be used for more frequent inspections of food service facilities with poor sanitation records or with large complex operations (Bader, et al., 1978). These results support previous findings that prevention efforts should be focused on establishments where the potential for foodborne illness is of greater risk in an effort to protect public health.

The results also support previous studies which suggest that food service facilities may be ranked according to hazards, to determine inspection frequency. This approach allows health agencies to focus their efforts on facilities that pose the greatest risk to the public by increasing their surveillance of these high risk facilities and decreasing their surveillance of low risk facilities. Environmental Health Specialists can then spend time, inspect, and educate more in establishments that present the greatest potential for foodborne illness (Kaplan & El Ahraf, 1979; Collins, 1995).
In addition, the findings demonstrate that high risk establishments had lower mean inspection scores than either moderate or low risk establishments. Although the Menu Risk Assessment Survey is not currently used in food protection programs, this research suggests that the Menu Risk Assessment Survey may be used as a tool in identifying how high, moderate, and low risk food service establishments will perform on routine inspections. This agrees with studies which have suggested that routine inspection scores can be used as an indicator of higher risk of foodborne disease in certain facilities and that these scores can be used to alert Environmental Health professionals of the need to direct additional educational resources to these facilities (Irwin, Ballard, Grendon & Kobayashi, 1989).

Although this study did not investigate the link between risk ranking, inspection scores, and disease outbreak, a study of restaurants in Seattle-King County indicated that restaurants with poor inspection scores were five times more likely to have outbreaks than restaurants with better inspection scores. It was also found that restaurants with violations of proper temperature controls of potentially hazardous foods were ten times more likely to have outbreaks than restaurants without temperature control violations (Irwin, Ballard, Grendon & Kobayashi, 1989).

Discussion of Research Question Two

Research Question Two had two parts relating to Marion County facilities:

(1) Is there a significant relationship between risk category of food service establishments, as identified by responses to the ten individual questions of the Menu
Risk Assessment Survey, and mean inspection scores; and, (2) Is there a significant relationship between risk category of food service establishments, as identified by responses to the ten individual questions of the Menu Risk Assessment Survey, and mean number of critical violations?

High risk or low risk categories were determined through the Menu Risk Assessment Survey which consists of ten questions related to amount of manager education, menu items served, and operational practices in the establishment. Responses (yes or no) to each question determined potential risk for foodborne illness. For some survey questions high potential risk was a “Yes” response and for others a “No” response meant high potential risk. A high potential risk response by an establishment placed the food service establishment into the “high risk” category, and a low potential risk response by an establishment placed the food service establishment into the “low risk” category.

Results of the statistical analysis of responses to the Menu Risk Assessment Survey Questions one through nine, indicated that there were statistically significant differences in the mean inspection score and the mean number of critical violations of “high risk” establishments when compared to “low risk” establishments. Question ten did not show a statistically significant difference in the mean inspection score and the mean number of critical violations of high risk establishments (food service establishments that serve a critical population) as compared to low risk establishments. This might be because only 4 of the 400 establishments were
identified as high risk by this question. The usefulness of this question for menu risk assessment therefore, is questionable, even though there is a general consensus that establishments that do serve a critical population should be considered to be a “high risk” establishment because those individuals that they are serving are much more susceptible to foodborne disease (Collee, 1989).

These results show that high risk facilities as identified by all other questions on the Menu Risk Assessment Survey did have lower inspection scores and a higher number of critical violations than low risk facilities.

The statistical analysis of question number one (Does manager have a food handler card?) of the Menu Risk Assessment Survey also gave strength to the assumption that establishments with certified personnel perform better on routine inspections (See Table 4.2). These results agree with previous findings that establishments with certified personnel perform better on routine inspections. For example, Penninger (1994) reported that food safety training and certification of food service managers improved sanitary conditions of facilities (Burch & Sawyer, 1991). Additionally, Marth reported on a study of the short term and long term effects on the food handling practices of employees working under a trained manager. Burch & Sawyer (1991) noted a positive correlation between the length of time since the manager was trained and the incidence of poor food handling practices by his/her employees. Another study of food service facilities in McLean County, Illinois, indicated that certifying personnel resulted in an improvement in total inspection
scores and reduced the number of violations of a critical, procedural, or procedural/structural nature (Kneller & Bierma, 1990).

Historically, health departments have used food safety education programs and/or routine inspections to prevent foodborne disease (Kneller & Bierma, 1990). The education of food handlers in safe food handling practices is a common preventive measure used to prevent foodborne disease (Jacob, 1989) because it is believed that inspections alone cannot guarantee prevention of foodborne disease outbreaks. For example, an outbreak of acute gastrointestinal illness occurred among persons who attended a restaurant buffet lunch in Alabama in 1992. The restaurant had passed four public health inspections, during 1992, including a routine inspection two days before the buffet (Penman, Webb, Woernle & Currier, 1996).

Another educational approach that has been recognized as successful in solving foodborne disease problems is manager certification. Manager certification was developed to upgrade management knowledge of food sanitation and to emphasize the need to train and supervise employees in proper food handling (Kneller & Bierma, 1990). The consensus of a conference conducted by the FDA, the Public Health Association, and food service industry representatives was that food service management personnel should become more knowledgeable in sanitation and sanitary food handling practices (Longree & Armbruster, 1987). The concept of food service manager training and certification has spread rapidly (Longree & Armbruster, 1987) and is another strategy used by local county health departments to solve foodborne
disease problems. This approach seems to have merit because the manager turnover rate is lower than the employee turnover rate and managers have the authority and the ability to provide on-going training for their employees (Wright & Fuen, 1986).

The statistical analysis of question number two (Are potentially hazardous foods served?) gave strength to the assumption that “high risk” establishments that serve potentially hazardous foods do not perform as well on routine inspections as those that do not serve potentially hazardous foods (See Table 4.3). These “high risk” establishments may be more of a risk for foodborne illness because of the type of food that is served. For example, proteinaceous foods or potentially hazardous foods are most frequently implicated in bacterial foodborne disease outbreaks (Longree & Armbruster, 1987; Minor & Marth, 1972). Many of the bacteria responsible for foodborne diseases thrive in food items of a proteinaceous nature (Longree & Armbruster, 1987). Menu items frequently implicated in Salmonellosis outbreaks are proteinaceous foods such as beef, pork, poultry, eggs or dairy products (Food Handlers’ Handbook, 1993; Longree & Armbruster, 1987). Foods that have been implicated in Campylobacter outbreaks are beef, poultry, pork or lamb, unpasteurized milk or eggs, and unchlorinated water (Koren, 1991; Longree & Armbruster, 1987). The foods involved in staphylococcal outbreaks are diverse, but proteinaceous foods are most frequently implicated (Longree & Armbruster, 1987; Minor & Marth, 1972).

The statistical analysis of questions number three (Are potentially hazardous foods prepackaged, cooked to order or not served at all?), number four (Are
potentially hazardous foods served from a buffet or salad bar?), number five (Are potentially hazardous foods cooked, held and reheated?), number six (Are potentially hazardous foods prepared from raw, non-frozen ingredients?), and number seven (Are potentially hazardous food prepared and held before service?) demonstrate that "high risk" establishments that prepare menu items requiring temperature controls do not perform as well on routine inspections as those that do not serve menu items requiring temperature controls (See Table 4.4, Table 4.5, Table 4.6, Table 4.7, and Table 4.8). Preparing menu items that require temperature controls is a high risk practice because of their potential to cause foodborne illness. These results agree with previous studies that show improper holding temperature is the leading cause of bacterial foodborne disease outbreaks in the U.S. (Blostein; 1993). Other time-temperature abuses of foods are also leading factors that contribute to bacterial foodborne disease outbreaks. Some examples of these are: keeping cooked foods at room temperature; cooling large volumes of foods in large containers in refrigerators; failure to thoroughly cook foods; failure to reheat cooked foods to temperatures that kill vegetative pathogenic bacteria; and preparing foods a half day or more before serving (Bryan, 1984).

The six factors most often implicated in bacterial foodborne disease outbreaks are: improper cooling of potentially hazardous foods, improper cold holding, improper hot holding, failure to cook potentially hazardous foods thoroughly, infected persons who practice poor personal hygiene handling food, inadequate reheating of cooked potentially hazardous foods. Usually food has been mishandled in such a way
as to boost the growth of bacteria in it (Collee, 1989). For example, according to the CDC, outbreaks frequently involve food that was prepared well in advance of service and held at temperatures that promoted bacterial multiplication (Longree & Armbruster, 1987).

The bacteria responsible for most foodborne disease outbreaks multiply most rapidly within a temperature range referred to as the “Danger Zone” - between 45° and 140° F (Nadakavukaren, 1990). When food and temperature provide favorable conditions for bacterial growth, time is needed for multiplication to take place (Hobbs & Roberts, 1990).

Bacteria growing from Clostridium perfringens spores multiply rapidly in foods that have been improperly cooled, reheated, or stored (Food Handlers’ Handbook, 1993; Koren, 1991). The control of this organism in food service relies mostly on preventing its multiplication by strict time-temperature control and sanitary care of equipment, utensils, and workers’ hands (Longree & Armbruster, 1987).

Some factors associated with Salmonella outbreaks are long holding of food at warm temperatures; slow cooling of food due to refrigeration of large batches; and cutting boards used for raw as well as cooked meats and poultry (Longree & Armbruster, 1987). For example, an outbreak which involved six persons occurred in Los Angeles County, California during January 1993. Five of the six persons had consumed an egg-based dish. The investigation revealed that egg salad contaminated with Salmonella enteritidis was stored at an improper holding temperature of 60° F, a
temperature that allows growth of Salmonella (MMWR, 1993). A second outbreak involving twenty-three persons occurred during February 1993, in San Diego County, California. Eighteen of the twenty-three persons had eaten an entree served with hollandaise or bernaise sauce that was prepared with raw egg yolks. The investigation revealed that the sauce had been held hot under a heat lamp for up to three and a half hours at an improper temperature of 100°-120° F (MMWR, 1993).

The statistical analysis of question number eight (Are potentially hazardous foods extensively handled during preparation?) shows that “high risk” establishments in this study that extensively handle potentially hazardous foods do not perform as well on routine inspections as those that do not (See Table 4.9). These “high risk” establishments are more of a risk for foodborne illness because of the extensive handling of potentially hazardous foods. For example, menu items that are extensively handled are a potential factor of foodborne disease. This is because items that are extensively handled have a chance of becoming contaminated with microorganisms from human hands and unsanitary equipment, and are frequently involved in foodborne disease outbreaks (Longree & Armbruster, 1987). Foodborne Hepatitis A outbreaks are most often caused by contamination of food during preparation by an infected food handler (Longree & Armbruster, 1987).

The statistical analysis of question number nine (Are the average number of meals served per day 500 or more?) suggests that “high risk” establishments are more of a risk for foodborne illness because of the large number of meals served (See Table
4.10). It is of general consensus that the more meals that are prepared the more likely it is that the food might be mishandled. The only evidence of this, however, is that publicized foodborne disease outbreaks that come to the attention of health authorities usually involve large populations rather than smaller populations.

The research presents evidence that strongly advocates the use of HACCP in food protection programs because the Menu Risk Assessment Survey identifies possible Critical Control Points and risk was determined on the basis of these.

Conclusions

As discussions above have indicated, when data from high risk, moderate risk, and low risk food service establishments were compared, the results indicated that high risk establishments had lower mean inspection scores, higher mean number of critical violations, and a smaller risk index value (which indicated increased risk of foodborne illness) than moderate or low risk establishments. The differences were attributed to lack of manager education, menu items served, and operational practices observed in the establishment. The Menu Risk Assessment Survey, therefore, may be useful as a tool in identifying how high, moderate, and low risk food service establishments will perform on routine inspections. The Menu Risk Assessment Survey can also be used as a tool to predict outcomes and/or identify problem facilities to maximize resources and provide an effective and cost efficient food service protection program. Using this strategy, frequency of food service
establishment inspections may be based on whether an establishment is categorized as a high, moderate, or low risk food service establishment.

The study highlights areas of food protection that are the focus of the HACCP approach and that are based on identifying and controlling hazards to ensure the safety of foods. For example:

1. Establishments whose managers do not have food handler’s training demonstrate more critical violations than establishments with trained managers.

2. Critical violations and lower inspection scores were more likely to occur in establishments that prepared and served potentially hazardous foods.

3. Food service establishments that handle extensive amounts of potentially hazardous food and serve larger populations were more likely to have lower inspection scores and increased numbers of critical violations.

In each of these situations, the conditions that exist are more likely to pose a threat to public health. The Menu Risk Assessment Survey is more discriminating than inspection scores.

Recommendations

Based on the results found in this research, several recommendations are made that may be helpful for a local health department’s food protection program in reducing the incidence of foodborne disease. It is recommended that local health departments adopt variable inspection frequencies rather than inspecting all food service establishments the same number of times annually. The emphasis could be
redirected to inspecting high and moderate risk establishments more frequently than low risk establishments. Local health departments may find the Menu Risk Assessment Survey a useful tool in determining high, moderate, and low risk establishments to focus prevention efforts where the problems are more severe and are of greater public health risk.

A second recommendation is that either a food handler education or manager certification program should be required as part of a local health department’s food protection program. Both a food handler education program and a more in depth manager certification program are recommended. These education programs could help to resolve the foodborne disease problem.

A third recommendation is to categorize food service establishments by using the term priority rather than risk. For example, high risk food service establishments would be called high priority establishments.

A fourth recommendation is that further research might be done to evaluate trends relating to food protection programs. For example, are health departments moving toward manager certification and away from food handler education or are they using a combination of both educational programs? Another question that may be raised is whether inspection criteria are developed according to a risk-based approach rather than aesthetic values.
A fifth recommendation is that future studies compare food service establishments that are of the same type. For example, compare a fast food business with other fast food establishments.
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APPENDIX A
### Marion County Food Service Inspection Form

<table>
<thead>
<tr>
<th>Violation Description</th>
<th>Score</th>
<th>Required Correction &amp; Time Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>T/R 15 Non-food contact surfaces</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 18 Food protected from contamination</td>
<td>2 points</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 27 Wash, rinse water: clean and proper temperature</td>
<td>2 points</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 31 Water supply protected from backflow, back-siphonage</td>
<td>5 points</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 32 Storage, handling of clean equipment</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 33 Storage in toilet rooms</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 34 Hands washed in utensil or food sink</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 35 Detergents, sanitizers</td>
<td>3 points</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 36 Hands washed in utensil or food sink</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 37 Drainage of waste water</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 38 Disposal of garbage, waste, trash</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 39 Ventilation</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 40 Cleaning of floors, walls, ceilings</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 41 Equipment installation</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 42 Equipment maintenance</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 43 Separation of living/sleeping quarters</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 44 Separation of cooking, storage areas</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 45 Equipment installation</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 46 Clean-rip exhaust fan</td>
<td>1 point</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**FOOD SERVICE & PLUMBING**

<table>
<thead>
<tr>
<th>Violation Description</th>
<th>Score</th>
<th>Required Correction &amp; Time Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>T/R 21 Water supply protected from backflow, back-siphonage</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 22 Detergents, sanitizers</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 23 Storage, handling of clean equipment</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 24 Disposal of garbage, waste, trash</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 25 Ventilation</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 26 Cleaning of floors, walls, ceilings</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 27 Equipment installation</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 28 Equipment maintenance</td>
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<td>N/A</td>
</tr>
<tr>
<td>T/R 29 Separation of cooking, storage areas</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 30 Separation of living/sleeping quarters</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 31 Equipment installation</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 32 Clean-rip exhaust fan</td>
<td>1 point</td>
<td>N/A</td>
</tr>
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</table>

**PERSONNEL**

<table>
<thead>
<tr>
<th>Violation Description</th>
<th>Score</th>
<th>Required Correction &amp; Time Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>T/R 15 Non-food contact surfaces</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 18 Food protected from contamination</td>
<td>2 points</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 27 Wash, rinse water: clean and proper temperature</td>
<td>2 points</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 31 Water supply protected from backflow, back-siphonage</td>
<td>5 points</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 32 Storage, handling of clean equipment</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 33 Storage in toilet rooms</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 34 Hands washed in utensil or food sink</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 35 Detergents, sanitizers</td>
<td>3 points</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 36 Hands washed in utensil or food sink</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 37 Drainage of waste water</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 38 Disposal of garbage, waste, trash</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 39 Ventilation</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 40 Cleaning of floors, walls, ceilings</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 41 Equipment installation</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 42 Equipment maintenance</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 43 Separation of living/sleeping quarters</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 44 Separation of cooking, storage areas</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 45 Equipment installation</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 46 Clean-rip exhaust fan</td>
<td>1 point</td>
<td>N/A</td>
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**FOOD EQUIPMENT & UTENSILS**

<table>
<thead>
<tr>
<th>Violation Description</th>
<th>Score</th>
<th>Required Correction &amp; Time Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>T/R 15 Non-food contact surfaces</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 18 Food protected from contamination</td>
<td>2 points</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 27 Wash, rinse water: clean and proper temperature</td>
<td>2 points</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 31 Water supply protected from backflow, back-siphonage</td>
<td>5 points</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 32 Storage, handling of clean equipment</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 33 Storage in toilet rooms</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 34 Hands washed in utensil or food sink</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 35 Detergents, sanitizers</td>
<td>3 points</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 36 Hands washed in utensil or food sink</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 37 Drainage of waste water</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 38 Disposal of garbage, waste, trash</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 39 Ventilation</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 40 Cleaning of floors, walls, ceilings</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 41 Equipment installation</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 42 Equipment maintenance</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 43 Separation of living/sleeping quarters</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 44 Separation of cooking, storage areas</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 45 Equipment installation</td>
<td>1 point</td>
<td>N/A</td>
</tr>
<tr>
<td>T/R 46 Clean-rip exhaust fan</td>
<td>1 point</td>
<td>N/A</td>
</tr>
</tbody>
</table>
DESTRUCTION AND EMBARGO – 333-160-000

DESTRUCTION OF FOOD UNIT FOR HUMAN CONSUMPTION

333-160-000 DESTRUCTION AND EMBARGO OF MIS­
HANDED, ADULTERATED OR SPOILED
FOOD AND BEVERAGE

Whenever the Division finds food or beverage for which there is probable cause to believe is adulterated, mis­
handled, spoiled, or otherwise potentially dangerous to health, the Division shall immediately notify the person in charge that the product is hazardous; and shall request
health, the Division shall immediately notify the person in
charge agrees, the food or beverage shall be destroyed or
immediate destruction of the product. If the person in
charge agrees, the food or beverage shall be destroyed or
removed in a manner specified by the Division.

(1) If the person in charge will not agree to destruction, an embargo order shall be placed on the food or
beverage. The order shall include:

(a) A statement of the reasons for the embargo;
(b) A description of the products, their location and
the amount of product embargoed;
(c) The date and time of day when the order is
issued, and the signature of the inspecting
sanitarian.

(2) The product shall be marked, sealed, isolated, and
otherwise identified as required by the Division to
ensure that it remains off sale and is not moved prior
to final disposition of the embargo.

OTHER AREAS

- Employees certified in First-Aid for choking victims (ORS 624.13).
- Smoking Areas comply with Indoor Clean Air Act (ORS 433.845).

At four and five point critical violations must be rectified immediately with an approved alternative procedure and must be
corrected within the designated time period. Previously cited one and two point items which have not been corrected are
candidates for repeat violations. They will accumulate one and two penalty points respectively for a maximum of four and eight points respectively each time they are observed on semi-annual inspections. Failure to correct critical violations as described above or
two consecutive complete inspection sanitation scores below 70% may result in the closure of the restaurant or the revocation,
suspension or denial of the license. One and two point items shall be corrected at least by the next routine semi-annual
inspection.

APPROVED CORRECTIVE PROCEDURES

01. Discontinue use of food from questionable source until
approval is confirmed.

02. Sold food contact surfaces must be cleaned and sani­
tized before the next use and after each subsequent use.

03. If the food was in the danger zone for more than 4
hours, destroy the food or remove from the premises. If less
than 4 hours, thaw in microwave or under refrigera­
tion, under cold cold less, or, if possible, cool in frozen state. (Products greater than 3
lbs. must be thawed before cooking.

04. If readily perishable food has not been held in the danger
zone for 4 hours or more, remove it from faulty hold­
ing or refrigeration equipment and place in properly
functioning equipment as appropriate. Use shallow con­
tainers for refrigeration.

05. Where self-service food is not protected from contamina­
tion guard, provide adequate protective devices or
procedures or discontinue self-service (may provide employee service of unprotected items).

06. Unwrapped re-served foods to be destroyed.

07. Where self-service food is not protected from contamina­
tion guard, provide adequate protective devices or
procedures or discontinue self-service (may provide employee service of unprotected items).

08. If the order of embargo does not include a notice of
hearing; within 48 hours of the placement of the
embargo, the person in charge shall be notified in
writing that a hearing on the embargo order will be
held if requested in writing within ten (10) days of the
delivery of the notice.

09. If a hearing is requested, it shall be held in accor­
dance with ORS 183 and the model rules of the
Atmosphere General for contested cases.

10. If no hearing is requested as provided in Section 4, a
default order for destruction shall be issued to the per­
sion in charge.

11. Sick personnel restricted to non-food contact, non-utensil
contact work such as general office work, cleaning and
maintenance.

12. Hands must always be washed when reporting to work,
preparation of one food product to another, after smoking,
or any other time the hands are soiled.

13. If physically possible, correct situation; i.e., remove hoses
or fixtures creating back siphonage potential.

14. If the offending fixture is non-essential, it may be isolated
by turning off the water. Prohibit non-air gapped sinks for
food preparation.

15. If the interior is affected, pumping septic tanks as needed
is sufficient. If the water supply is non-community approved, alterna­
tive closure is required.

16. Ice shall come from an approved source.

17. Smoking Areas comply with Indoor Clean Air Act (ORS 433.845).

18. Where there is no water, immediate correction is required
or the facility shall be closed.

19. If a community, municipal or public utility water supply is
teleologically or chemically contaminated, the Health Division
may prescribe remedial action. If none is specified, imme­
diate closure is required.

20. If the water supply is non-community approved, alterna­
tive procedures may include public notices, bottled water, and the use of single-service items. Such procedures
shall be appropriate to the type of water problem and food service operation, and must ensure safe water is
available for all necessary water uses.

21. Use of single-service items.

22. Sick personnel restricted to non-food contact, non-utensil
contact work such as general office work, cleaning and
maintenance.

23. As a temporary measure portable chemical toilets may be
approved if approved by the Health Division.

24. Use of single-service items. Such procedures
may include public notices, bottled water,
and the use of single-service items. Such procedures
shall be appropriate to the type of water problem and food service operation, and must ensure safe water is
available for all necessary water uses.

25. Repair or replace lavatory fixtures and/or faucets.

26. Insect and Rodent Control Policy and provide assurances
that such contamination will not occur.

27. Where contamination of food and food contact surfaces has
occurred, destroy, food, clean and sanitize food contact
surfaces. Provide assurances that such contamination
will not re-occur. Follow CDHIS Insect and
Rodent Control Policy. If rodent or insect population is
high, closure is required until controlled.

28. Remove from the facility or destroy home-canned foods,
game meats, or food from confirmed unsupervised source.

29. Clean and sanitize all food contact surfaces and utensils
each time there is a change in processing from raw

30. Food products must be removed from the danger zone
or immediately refrigerate at 45° F or less in shallow
containers.

31. If readily perishable food has not been held in the danger
zone for 4 hours or more, remove it from faulty hold­
ing or refrigeration equipment and place in properly
functioning equipment as appropriate. Use shallow con­
tainers for refrigeration.

32. Where self-service food is not protected from contamina­
tion guard, provide adequate protective devices or
procedures or discontinue self-service (may provide employee service of unprotected items).

33. Unwrapped re-served foods to be destroyed.

34. If the order of embargo does not include a notice of
hearing; within 48 hours of the placement of the
embargo, the person in charge shall be notified in
writing that a hearing on the embargo order will be
held if requested in writing within ten (10) days of the
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35. If a hearing is requested, it shall be held in accor­
dance with ORS 183 and the model rules of the
Atmosphere General for contested cases.

36. If no hearing is requested as provided in Section 4, a
default order for destruction shall be issued to the per­
sion in charge.

37. Sick personnel restricted to non-food contact, non-utensil
contact work such as general office work, cleaning and
maintenance.

38. Hands must always be washed when reporting to work,
preparation of one food product to another, after smoking,
or any other time the hands are soiled.

39. If physically possible, correct situation; i.e., remove hoses
or fixtures creating back siphonage potential.

40. If the offending fixture is non-essential, it may be isolated
by turning off the water. Prohibit non-air gapped sinks for
food preparation.

41. Use of single-service items. Such procedures
may include public notices, bottled water,
and the use of single-service items. Such procedures
shall be appropriate to the type of water problem and food service operation, and must ensure safe water is
available for all necessary water uses.

42. If a community, municipal or public utility water supply is
teleologically or chemically contaminated, the Health Division
may prescribe remedial action. If none is specified, imme­
diate closure is required.

43. If the water supply is non-community approved, alterna­
tive procedures may include public notices, bottled water, and the use of single-service items. Such procedures
shall be appropriate to the type of water problem and food service operation, and must ensure safe water is
available for all necessary water uses.
Menu Risk Assessment Survey

Establishment I.D. Number ___________________________ Date __________

1. Does manager have a food handler’s card?
   Yes____ (1.5)  No____ (0.5)

2. Are potentially hazardous food (PHF) items served?
   Yes____ (0.5)  No____ (1.5)

3. Are PHF prepackaged, cooked to order or not served at all?
   Yes____ (1.5)  No____ (0.5)

4. Are PHF served from a buffet or salad bar?
   Yes____ (1.0)  No____ (1.5)

5. Are PHF cooked, held and reheated?
   Yes____ (0.5)  No____ (1.5)
   Answer yes if any PHF’s are cooked, held (hot or cold holding) then reheated
   for service on a different day.

6. Are PHF prepared from raw, non-frozen ingredients?
   Yes____ (1.0)  No____ (1.5)

7. Are PHF prepared and held before service?
   Yes____ (0.5)  No____ (1.5)
   Answer yes if any PHF’s are prepared/cooked then held (hot or cold) prior to
   service (i.e. steam table or hot wells of soups, chili, barbecue, entrees).

8. Are PHF extensively handled in preparation?
   Yes____ (1.0)  No____ (1.5)
   Answer yes for processes requiring significant slicing, chopping, breading,
   forming, or mixing of PHF ingredients.

9. Is the average number of meals or patrons served per day 500 or more?
   Yes____ (0.5)  No____ (1.5)

10. Is a critical population served?
    Yes____ (0.5)  No____ (1.5)