OBSERVATION OF FOOD SAFETY BEHAVIORAL PRACTICES IN FOODSERVICE EMPLOYEES AFTER TRAINING AND EXAMINATION

A Thesis

presented to

the Faculty of the Graduate School

at the University of Missouri

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

---

by

LERIN DIRKS

Dr. James Groves, Thesis Supervisor

DECEMBER 2010

The undersigned, appointed by the dean of the Graduate School, have examined the thesis entitled

OBSERVATION OF FOOD SAFETY BEHAVIORAL PRACTICES IN FOODSERVICE EMPLOYEES AFTER TRAINING AND EXAMINATION

presented by Lerin Dirks,

a candidate for the degree of Master of Science,

and hereby certify that, in their opinion, it is worthy of acceptance.

Dr. James Groves, Food Science (HRM)

Dr. Dae-Young Kim, Food Science (HRM)

Dr. Mark Ellersieck, Statistics

ACKNOWLEDGEMENTS

This has been a journey I would not have been able to accomplish without the support supplied by many special and gracious people. I would like to take the time to express my appreciation by thanking each of you for all you have assisted me with.

First and foremost, I would like to thank my Advisor, Dr. James Groves for accepting me as his advisee during my graduate career. Your guidance and insight during this process has greatly assisted me with the completion of my Masters. I would also like to extend my appreciation to the individuals who served as my committee members: Dr. Dae-Young Kim and Dr. Mark Ellersieck. Thank you Dr. Kim for your support and advice. Thank you Dr. Ellersieck for your invaluable assistance and patience with the statistical analysis of my research; you are a great educator and was an incredible help.

I would also like to thank my family. I have always been very grateful to have them and they have truly been my foundation in the pursuit of higher education. They encourage me to be my best and from that I realized without perseverance and passion, none of this would have been possible. Mom, Dad, Courtney, Bryant, Grandma, and Grandpa: You are who I dedicate my thesis to- thank you so much.

Lastly, my friends should not go unrecognized and I would like to extend my gratitude and special thanks to them. They kept me sane by being extremely supportive, listened with compassion, provided insight, and extended a hand when I needed it.

TABLE OF CONTENTS

LIST OF FIGURES

Figure Page

LIST OF TABLES

CHAPTER ONE

INTRODUCTION

1.1 Background

Convenience foods and restaurants have become an integral part of the lives of Americans since everyday routines demand a significant amount of time. The number of diners continues to escalate and so has the number of food borne illness outbreaks as a result of food prepared in commercial foodservice operations. Unfortunately, only a small proportion of food borne illnesses is reported and the Center for Disease Control estimated one in four Americans may experience some form of food borne illness each year (Medeiros, Hillers, Kendall, & Mason, 2001). In 2007 a total of 1097 food borne illness outbreaks were reported to the Center for Disease Control, which resulted in 21,244 cases of food borne illness and 18 deaths (Liu, 2010).

The causes of food borne illness can be viral, bacterial, parasitic, or chemical. The two leading causes are viral and bacterial, and in 2007 of the 18 deaths that occurred, 11 were attributed to *Salmonella* alone; the remaining seven deaths were caused by either *Listeria monocytogenes, E coli o157:H7, Norovirus, Clostridium botulinum*, or mushroom toxin (Liu, 2010). Public exposure to unsafe food handling practices is likely to increase as the popularity of dining out and "take out" grows (Mitchell, Fraser, & Bearon, 2007). This changing consumer lifestyle emphasizes the need for better and more effective ways of controlling food hygiene (Baş, Ersun, & Kivanç, 2006). Food borne illness outbreaks are on the rise and food safety continues to be a major concern

since food borne illnesses have potential to attack patrons through a variety of ways (Cushman, Shanklin, & Niehoff, 2001). In a study conducted by Hedberg, Smith, Kirkland, Radke, Jones, & Selman (2006) to investigate differences between outbreak and non-outbreak restaurants, researchers found:

> *Norovirus*, an RNA virus known for gastroenteritis outbreaks and is transmitted faecally was confirmed or suspected in 42% of all restaurant food borne illness outbreaks. Bacteria *Salmonella* and *Clostridium perfringens* were the next common microorganisms found in outbreaks that accounted for 19% of identified outbreaks and suspected in 28% of outbreaks. The contributing factors of these outbreaks were infected employees who handled food and bare-hand contact with food (Hedberg, Smith, Kirkland, Radke, Jones, & Selman, 2006).

The reasons for outbreaks include: epidemiological selection (outbreaks involving several people are more likely to be traced back to the source than to individual cases), lack of quality assurance in foodservices, and most importantly a failure of food handlers to follow critical behaviors that mitigate the potential for food borne illness (McCabe-Sellers & Beattie, 2004). According to Motarjemi and Kaferstein's (1998) study of how Hazard Analysis Critical Control Point (HACCP) plays a role in preventing food borne illness, they included several outlets that influence the occurrence of food borne illness:

- Mass production and distribution of food that leads to opportunity for contamination and much larger food borne illness outbreaks
- Booming food service establishments where food handlers do not have training in food hygiene

- Increase in number of vulnerable groups (elderly, immunocompromised individuals, and pregnant women)
- Increase of food consumption outside the home with an increase in the number of foodservice establishments
- Lack of time and attempt to increase economic profits
- Lack of training and education of food handlers
- Weakness in investigation and surveillance of food borne diseases such as inability to evaluate the impact of food safety interventions and the magnitude of consequences food borne diseases have

As a result of the different outlets for food borne illness outbreaks, food-related scares have led to an increase of interest in improving food safety practices in food-service operations as well as communicating the importance of sanitation to food workers. Food will remain safe as long as critical behaviors are observed in food handling (McCabe-Sellers & Beattie, 2004).

Food borne illness is a serious issue in the United States and an implementation of food safety educational programs that focus on procedures to prevent food borne illnesses are necessary (CDC, 1998). The major element which will ensure a lasting and growing benefit throughout the food industry, is without a doubt the requirement for its workforce to receive food hygiene awareness training (Smith, 1994) because human error is one of the largest driving forces behind food borne illness outbreaks. This recognition of the important role food handlers have in food borne illness outbreaks has lead to a realization. The key to preventing food borne disease is to educate and train food handlers (Clayton & Griffith, 2008). Training and certification programs have been

introduced to educate restaurant managers in sanitary food handling practices; due to the cost of training programs, an evaluation of their efficacy is crucial (Cotterchio, Gunn, Coffill, Tormey, & Barry, 1998). Less than 20% of managers in the foodservice industry have been trained in the supervisory role of food safety; therefore the lack of training is damaging and restricts their ability to assess food safety risks and convey proper hygiene training to their staff (Egan, Raats, Grubb, Eves, Lumbers, Dean, & Adams, 2006). More shockingly, a study that uncovered food handlers and managers' perceptions of hygiene training, found the majority (80% of individuals interviewed) of untrained food handlers indicated their managers had not discussed nor provided food hygiene training during their early stages of employment (Seaman & Eves, 2009). Reasons for the lack of training are costs of training programs, a lack of course availability particularly free food safety courses, and a time for when the food handlers would be trained. Even high employee turnover can mean a loss of food safety practice as soon as the food handler is trained (Hume, 2005).

When food handlers are provided formal food safety training during their employment, the concern then becomes the fact that food safety knowledge does not always transfer into practice (Clayton & Griffith, 2004). The implied theoretical framework behind most training programs is an increased knowledge about sources of contamination and appropriate responses will result in improved food safety behavior (Mitchell et al., 2007). Training has been used as the primary means of promoting food safety and according to Mitchell et al. (2007):

> Training typically focuses on the presentation of science-based facts and in some cases, competency-based training about specific behaviors; unfortunately, this

> training is narrow in focus and inattentive to the factors that influence transfer of training. Knowledge of food contamination risks does not always result in safe food handling behavior (p. 11).

Knowledge evolves and so should training education to convey and imprint the most recent information in food handlers. Implementing knowledge gained from training requires a change in behavior and communicating food safety basics must be continual (Hume, 2005).

As an example, a study in Wales concluded that 95% of its respondents had received food safety training however only 63% admitted they did not carry out safe food handling practices in the instances they knew would be appropriate (Clayton, Griffith, Price, & Peters, 2002). Unfortunately, the review of the effectiveness of food safety training is predominately through self-report and survey methods; observational studies would prove a more powerful research design to validate effectiveness of food safety training (Mitchell et al., 2007).

1.2 Statement of Problem

A gap exists between the knowledge and practice of food safety by food handlers. There is an issue with the transference of food safety training from cognitive being into actual behavior performance. A problem potentially lies within the presentation of food safety material to food handlers. Several studies state training is essential to minimize food borne illness in foodservice establishments and even more, studies have discovered that active, “hands-on” training has resulted in a significant improvement of certain food safety behaviors in foodservice establishments. There has been little research conducted

on the improvement of the actual behavior of foodservice employees before and after food safety training (Roberts, Barrett, Howells, Shanklin, Pilling, & Brannon, 2008). Unfortunately, the majority of these studies utilized questionnaires to analyze the data, but behavioral observations would allow the identification of behaviors in need of the most improvement (Pilling, Brannon, Shanklin, Howells, & Roberts, 2008) since food safety training programs seem to be ineffective at significantly improving all behaviors simultaneously in the personal hygiene, cross-contamination, and time-temperature control categories. Does training have a visible impact on the total number of correctly practiced food safety behaviors and is food safety being practiced at the correct instances in a foodservice establishment? What specific behaviors need to be significantly improved upon?

1.3 Statement of Purpose

The purpose of the study was to evaluate the effectiveness of a food safety training program on employee food safety behaviors.

1.4 Research Objectives

The objectives of the study were:

1. To examine changes in the number of correctly practiced food safety hand hygiene behaviors that occurred pre- and post-food safety training program.

a. To evaluate the frequency of correctly practiced hand washing pre- and post-food safety training program through observation.
b. To evaluate the frequency of correctly practiced hand maintenance pre- and post-food safety training program through observation.
c. To evaluate the frequency of correctly practiced no bare-hand contact with ready-to-eat food pre- and post-food safety training program through observation.

2. To examine changes in the number of correctly practiced food safety cross-contamination prevention behaviors that occurred pre-and post-food safety training program.
    a. To evaluate the frequency of correctly practiced sanitizing surfaces and utensils after cutting raw food pre- and post-food safety training program through observation.
    b. To evaluate the frequency of correctly practiced separate preparation of ready-to-eat and raw food pre- and post-food safety training program through observation.
    c. To evaluate the frequency of correctly practiced storage of raw food below produce and ready-to-eat food in walk-in pre-and post-food safety training program through observation.

3. To examine changes in the number of correctly practiced food safety time-temperature behaviors that occurred pre-and post-food safety training program.
    a. To evaluate the frequency of correctly practiced acceptable methods of thawing food pre- and post-food safety training program through observation.
    b. To evaluate the frequency of correctly practiced monitoring internal temperature of held food pre- and post-food safety training program through observation.
    c. To evaluate the frequency of correctly practiced acceptable food cooling methods pre- and post-food safety training program through observation.
4. To examine the overall change in the number of correctly practiced food safety behaviors pre- and post-food safety training program.

1.5 Significance of the Research

Research has found foodservice managers and employees receiving training on proper food handling practices and obtaining adequate food safety knowledge does not always translate into improved behaviors (Roberts et al., 2008). Employees must have a firm understanding of food safety and more importantly, employees must be obligated to actively practice sanitation in the workplace at all times. The most common source of contamination is humans (Green & Selman, 2005). However, little research has been conducted in exploring actual behavior of foodservice employees before and after food

safety training (Roberts, et al., 2008). The discrepancy between food safety training and actual food safety practices in the workplace needs to be examined. The lack of practiced sanitation procedures could be due to the inadequate sanitation teaching methods conveyed by the instructor. Another possibility could be dependent on the food handler and their attitudes towards actively practicing sanitation or stem from the environment where food handler is required to practice sanitation. Most food safety interventions provide knowledge to food workers with the expectation that workers will translate this knowledge into practice (Green, 2008).

1.6 Definitions of Observed Food Safety Behaviors

Food Safety Behavior	Definition
Hand washing	Wet hands with warm running water, lather with soap, and vigorously wash hands and arms for 10-15 seconds. Rinse thoroughly under running warm water then towel-dry hands and arms (NRAEF, 2004).
Hand maintenance	Fingernails are short and clean with no fingernail polish, cover all open wounds with bandages/finger cots and gloves, rings other than one plain wedding band are not to be worn, and no watches or bracelets are permitted (NRAEF, 2004).

Bare-hand contact with ready-to-eat (RTE) food	Food handlers are required to wear gloves when they are directly working with ready-to-eat (RTE) food items. RTE items are food items ready for consumption and receive no further cooking (NRAEF, 2004).
Sanitization of work surfaces	Work surfaces and utensils must be sanitized after prepping raw meats and as work surfaces become soiled (NRAEF, 2004).
Separate preparation of food	Raw foods must be prepped on separate cutting boards, on separate surfaces, and with separate utensils, then stored in separate containers from RTE food items (NRAEF, 2004).
Storage of food	Raw meats must be stored below RTE food items, produce, dairy products, or fully-cooked items. Fully-cooked can be defined as food items prepped and cooked then cooled; food is no longer in a raw state (NRAEF, 2004).

Proper thawing methods	Acceptable thawing methods can be defined as placing frozen items in walk-in refrigerator of 41ºF or below to thaw, submerging food under continuous flow of cold water, microwaving with immediate usage of food, or thawing food as part of the cooking process as long as food reaches specified minimum internal temperature (NRAEF, 2004).
Internal temperature of held food	Food held in hot wells and food warmers must have its internal temperature checked to ensure food has reached its minimal internal temperature and to ensure food is being held at a minimum internal temperature of 135 ºF (NRAEF, 2004).
Proper cooling methods	Food may be cooled with an ice paddle, separate large quantities into several smaller quantities to help food cool, or with an ice-water bath (NRAEF, 2004).

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter will review the literature on personal hygiene, primarily hand washing, hand maintenance, and bare hand contact with food, cross-contamination, and time-temperature abuse. The chapter will also review training involved in conveying these major issues of food safety to foodservice employees with an emphasis of the transfer of food safety education presented to foodservice employees. The literature review will focus on the following areas:

1. The personal hygiene food safety behaviors with a concentration on RTE food.
2. The cross-contamination food safety behaviors with an emphasis on sanitization of areas utilized for prepping raw food, the separate preparation of ready-to-eat foods and raw foods, and the storage of foods in a refrigerated walk-in storage unit.
3. The time-temperature control food safety behaviors with a concentration on properly thawing foods, monitoring internal temperatures of held food, and the proper procedures for cooling food in preparation for storage.
4. The training of food safety conducted for food service employees in relation to how effective this training has transferred to the employees and has appeared in their active practice of food safety.

2.2 Hand Hygiene

Any establishment that handles the public's food has potential for the development of food borne illnesses to occur within their operations. The prevention of food borne illness through being aware and practicing food safety and sanitation must be stressed by the establishment to their employees. The three most significant contributors to food borne illnesses in restaurants include time-temperature abuse, personal hygiene, and cross contamination (Pilling et al., 2008). Due to these factors, populations such as the elderly, young children, people who are ill, people taking medication, and pregnant women are highly susceptible and more likely to contract a food borne illness from unsafe food. The importance of good hand hygiene practices has been corroborated in the laboratory where it has been show that if food handlers become infected and/or equipment becomes contaminated with enteric pathogens, poor hand hygiene could transmit pathogens to customers (Daniels, Bergmire-Sweat, Schwab, Hendricks, Reddy, Rowe, Fankhauser, Monroe, Atmar, Glass, & Mead, 2000). Establishments that handle food must be knowledgeable and adhere to sanitation guidelines and practices; it begins with the employees and their own personal hygiene. Good hygiene is the foundation for preventing the spread of food borne illness.

2.2.1 Hand Washing

The most common source of contamination is humans (Green & Selman, 2005), more specifically food contact with hands (Anonymous, 1985). If a food worker is not clean, the food can become contaminated (McSwane, Rue, & Linton, 2003). Food workers may transmit pathogens to food with hands that are contaminated with organisms

from their gastrointestinal tract; therefore hand contact with RTE food represents a potentially important mechanism by which pathogens may enter the food supply (Guzewich & Ross, 1999). RTE foods are edible items safe to eat without further cooking (Green, Selman, Radke, Ripley, Mack, Reimann, Stigger, Motsinger, & Bushnell, 2006). Because the transmission of pathogens from food worker hands to food is a significant contributor to food borne illness outbreaks, improvement of food worker hand washing practices is critical (Green et al., 2006).

Therefore, personnel must be shown how to properly wash hands and at the appropriate instances of when to wash their hands. Simply touching human skin can transfer *Staphylococcus aureus*, a dangerous bacteria causing Staph infection, from one surface to another; as a result of touching human skin then handling RTE food, this simple action can pass *Staphylococcus aureus* from skin to food making food potentially hazardous.

> According to the National Restaurant Association Educational Foundation (2004), to ensure proper hand washing you must wet your hands under running water of at least 100ºF, apply soap, vigorously scrub hands and arms for at least 20 seconds, clean under fingernails and between fingers, rinse thoroughly under running water of at least 100ºF, then dry hands and arms with single-use paper towels. (p. 4-5)

Personnel should not be allowed at any time to think or be given the impression that gloves and gel hand sanitizer are adequate substitutes for washing one's hands with soap and hot water. Foodservice workers should wash their hands frequently and in the proper manner. Shockingly, research has shown that as many as 60% of food handlers do not wash their hands properly or often enough (Roberts, 2008). In a study that conducted

research on catering food safety, hand hygiene malpractice occurred more frequently than malpractice for cleaning surfaces and equipment as well as malpractice of washing utensils (Clayton & Griffith, 2004, p. 218).

Clayton & Griffith's (2004) study also found that:

> Hand washing was poorly carried out after food handlers touched their face/hair and on entering the kitchen. These actions were performed adequately only on 9% of occasions where food handlers touched their face/hair and 14% of required occasions where food handlers entered the kitchen. There were 1,096 attempts to carry out a hand hygiene action, of which 332 were judged to be adequate. (p. 219-220)

Food handlers must be aware of the appropriate instances in which they need to wash their hands.

> The FDA Food Code (2009) stated food employees should immediately wash their hands before engaging in food preparation and working with ready-to-eat food, clean equipment, and clean utensils. Food employees should wash hands after touching bare human body parts other than clean hands and clean, exposed portions of arms, after using the restroom, after caring for or handling service animals or aquatic animals, after coughing, sneezing, using a handkerchief or disposable tissue, using tobacco, eating or drinking, after handling soiled equipment or utensils, during food preparation when removing soil and contamination to prevent cross contamination when changing tasks, when switching between working with raw food and working with ready-to-eat food, before putting on gloves for working with food, and lastly, after engaging in other

activities that contaminate the hands.

As simple as the act of hand washing may seem, the development and supervision of this behavior is detrimental in the prevention of food borne illnesses in foodservice establishments. Managers must train food handlers when and how to wash their hands properly, and then must monitor hand washing frequency (NRAEF, 2004, p. 4-5). Vigorous hand washing with soap, performed consistently at appropriate intervals, is necessary to control the spread of all enteric pathogens (CDC, 1990).

2.2.2. Hand Maintenance

Food workers must also consider hand care in conjunction with proper hand washing to help prevent the transmission of microorganisms. A food worker should have short, clean fingernails and false fingernails should never be worn. False or acrylic fingernails trap debris and could become a physical hazard as they may lose their adhesiveness and break off into the food being prepared, thus contaminating the food. Physical hazards are objects in food that may cause injury if eaten (WSDH, 2005). False and acrylic fingernails can harbor significant types and amounts of bacteria. A 2007 study on public health implications of false fingernails in the food service industry found that artificial fingernails housed *Staphylococcus aureus*, *Escherichia coli*, *Proteus sp.*, and *Pseudomonas aeruginosa*. The study stated out of 350 subjects, *Staphylococcus aureus* was found in 41.7% of participants, 7.4% of participants were found with *Escherichia coli,* 1.7% housed *Proteus sp.*, and 1.4% was found with *Pseudomonas aeruginosa* (Wachukwu, Abbey, Ollor, & Obilor, 2007). Another physical hazard that could contaminate food is nail polish. Nail polish is also forbidden as it can disguise dirt

under the nails and may flake off into food (NRAEF, 2004, p.4-8).

Food workers must also be aware of cuts and abrasions since they are sources of bacteria (Anonymous, 1985). Any food worker who has infected wounds on the hands should not work with food, touch utensils, or equipment as this can transfer harmful bacteria such as *Streptococcus A* and *Staphylococcus aureus* from the infected wound to food or equipment. An epidemiological study discovered a food handler at a restaurant, who had been examined for severe cellulitis of the left hand, had prepared egg salad for a group of people. The pus pimples from the cellulitis were exposed to the mayonnaise and vinegar ingredients of the egg salad, thus causing a group A, type 25, beta hemolytic streptococcus outbreak in 60 out of 86 individuals who ingested the egg salad (Farber & Korff, 1958). Food workers who have wounds or sores on the hands must wear finger cots or bandages to contain the wounds then place clean gloves on their hands to cover the bandages and protect food from any transfer of dangerous bacteria.

2.2.3 Bare Hand Contact with RTE Food

A food worker must never touch RTE food with their bare hands since this can place the food in direct contact with a surface that contains dangerous microorganisms. RTE foods are edible items safe to eat without any further cooking. If food workers are handling RTE foods, there must be a barrier between the food workers' hands and the RTE foods. Gloves are commonly used as barriers in food service establishments, and anecdotal evidence suggests that glove use for this purpose may be increasing (Green, Radke, Mason, Bushnell, Reimann, Mack, Motsinger, Stigger, & Selman, 2007). Gloves should always be utilized for single-use and never be washed then re-used. Proper glove

use can decrease the transfer of pathogens from hands to food (Michaels, Keller, Blevins, Paoli, Ruthman, Todd, & Griffith, 2004).

Food handlers should wear gloves when in the kitchen or preparing food, when preparing raw meat or poultry, when hands have cuts or scratches, and when preparing RTE foods (Green & Selman, 2005). Food handlers should change their gloves as soon as they become soiled or torn, before beginning a different task, every four hours during continual use or more often when necessary, after handling raw meat and before handling RTE food (NRAEF, 2004, p.4-9), and wash hands with every glove change (Green & Selman, 2005).

Gloves also should never be the primary way to keeping food safe from bacteria on hands. Many food workers consider gloves to be more sanitary than washing hands since they are not directly touching RTE food with their bare hands. Researchers argue whether glove use has led to less hand washing practices in food handlers. Studies have suggested that glove use might be counterproductive because workers might wash their hands less frequently when gloved (Lynch, Phillips, Elledge, Hanumanthaiah, & Boatright, 2005). In an observation study of hand hygiene actions, only 30% in the instances observed did food handlers correctly perform proper hand washing and washing their hands at the appropriate times in which they should have washed their hands (Clayton & Griffith, 2004). Due to this false sense of security, food handlers might not change gloves as often as necessary therefore managers must reinforce the habit of proper hand sanitation with food handlers (NRAEF, 2004, p.4-9).

2.3 Cross-Contamination

Microorganisms move easily around in a kitchen and cross-contamination can occur at any point in operation (NRAEF, 2004, p.5-3). When raw food products come in contact with any surface, piece of equipment, utensils, or even the foodservice employees' hands, those surfaces become contaminated with microorganisms. Cross-contamination is defined as the point where microorganisms are transferred from one surface to another (Roberts, 2008). If RTE food comes in contact with the surfaces contaminated by raw food products, the RTE food is now contaminated and could potentially cause food borne illness if consumed. A food borne illness can result if cross-contamination is allowed to occur in any of the following ways:

- Raw contaminated ingredients added to food that receives no further cooking
- Food-contact surfaces not properly cleaned
- Raw food-contact surfaces are not sanitized before touching cooked or RTE food
- Raw food allowed to touch or drip fluids onto cooked or RTE food

(NRAEF, 2004, P. 1-11).

Cross-contamination can be fairly easy to prevent as long as food handlers are properly trained to recognize where microorganisms lie and how microorganisms are transferred.

2.3.1 Sanitization of Areas Utilized for Prepping Raw Food

Work stations, utensils, and equipment used for food preparation must be cleaned and sanitized before they become in contact with RTE foods. In food safety, the term clean is defined as free of visible soil and the term sanitary is defined as the number of

microorganisms on the surface has been reduced to safe levels (NRAEF, 2004, p.1-13). Every time work areas, utensils, and equipment are used by a food handler, it must be cleaned and sanitized to prevent cross-contamination. Food can become contaminated through direct or indirect contact with pathogenic food items. A direct food-contact surface includes any equipment or utensil surface that normally touches food and an indirect food-contact surface is a surface food might drain, drip, or splash onto during preparation (NRAEF, 2004, p. 1-13). A food borne illness outbreak investigation in Oklahoma found that 14 out of 25 people had contracted *Campylobacter jejuni* from cross-contaminated food item of lasagna, which was prepared after a cook had cut raw chicken and inadequately washed the work area and utensils (Graves et al., 1998). After cutting up raw chicken, it is not enough to simply rinse the cutting board and knife; food handlers must wash, rinse, and sanitize cutting boards and utensils in a three-compartment sink or run them through a warewashing machine (NRAEF, 2004, p. 5-3).

2.3.2 Separate Preparation of RTE Foods and Raw Foods

Cross-contamination of produce and raw meat is more common in produce (McCabe-Sellers & Beattie, 2004). Raw foods and RTE foods should never be prepared next to each other nor should the same equipment be used to prepare raw food then be used immediately to prepare RTE food. Foodservice establishments will designate specific areas of the kitchen to prepare raw foods and RTE foods in. This minimizes the chance for microorganisms from raw food to contaminate RTE food. If an establishment is limited on space in the kitchen and raw foods and RTE foods must be prepped on the same table, RTE foods should be prepped first. The area and equipment used to prep

RTE foods must be cleaned and sanitized, and then the food handler may use the same area to prep raw food items. Foodservice establishments may also assign specific pieces of equipment or color coded equipment to prepare only raw foods or only RTE foods with. Manufacturers produce colored cutting boards so foodservice establishments may use red for prepping red meats, yellow for prepping poultry, and green for prepping vegetables or fruits. Even though this may help food handlers use only particular equipment for preparation of particular food items, this does not prevent cross-contamination from occurring due to the microorganisms that lie on the surfaces from where the foods were prepped. Food handlers still need to follow proper practices of cleaning then sanitizing the surface after they finish food preparation (NRAEF, 2004, p. 5-3).

2.3.3 Storage of Food

Different food items must be stored in a particular order in walk-in refrigeration units or stand-up refrigeration units in the kitchen. Food handlers must be aware of where they are placing particular food items when storing them in the refrigerator. There are two different types of bacteria that are found in refrigerated foods. Pathogenic bacteria induce food borne illnesses and spoilage bacteria cause food to deteriorate and develop bad odors, tastes, and textures (USDA, 2010). Due to pathogenic bacteria in food, food items must be placed in the refrigeration unit in a particular order. Food handlers must store cooked or RTE foods above raw meat, poultry, and fish if these items are stored in the same unit (NRAEF, 2004, p. 7-6). Cooked and RTE food items are stored about raw items to prevent cross-contamination of indirect food-contact if in the

instance that the raw items potentially drip. Raw meat, poultry, and fish should be stored in the following top-to-bottom order in the refrigeration unit: Whole, fish, whole cuts of beef and pork, ground meats and fish, whole and group poultry (NRAEF, 2004, p. 7-6). Foods are stored in this top-to-bottom order since it is based on the minimum internal cooking time of these foods.

2.4 Time-Temperature Control

Microorganisms grow fastest between temperatures of 41°F to 135°F, therefore when heating, cooling, or holding foods prior to or during service, the potential for bacterial growth is increased if not heated to the proper temperature, held at the proper temperature, or if held too long at unsafe temperatures (NRAEF, 2004, p. 1-11). There are specific guidelines that state foods must be heated to particular temperatures, held at certain temperatures if food is set out for a long period of time, as well as the proper techniques for cooling food for storage. Foods must be kept at certain temperatures to achieve the safest potential for consuming and to control food temperatures is an effective way of limiting and preventing the multiplication and production of toxins in the food. Time-temperature control will not prevent food from becoming contaminated. Acute awareness of cross-contamination prevention methods and proper hand washing are the best prevention methods for food contamination, however time-temperature control will assist with controlling the level of bacteria in foods to the point of safe consumption. Food borne illnesses are caused by time-temperature abuse. Time-temperature abuse is food that has been allowed to remain too long at temperatures favorable to the growth of food borne microorganisms and illness may result from any of

the following ways:

- Not being held or stored at required temperatures
- Not cooked or reheated to temperatures that kill microorganisms
- Improperly cooled

(NRAEF, 2004, p. 1-11).

2.4.1 Proper Methods for Thawing Food

The improper thawing of frozen food leads to a greater survival of microorganisms, when can grow to unsafe levels (Jay, Loessner, & Golden, 2005). Food handlers should only thaw the amount they need to prepare for service. The four acceptable ways of thawing potentially hazardous food are as follows:

- Thaw food in a refrigerator that holds internal temperature of 41ºF (5ºC) or lower
- Submerge food under continuously running water of a temperature of 70ºF (21ºC) or lower
- Thaw food in a microwave oven only if it will be cooked immediately after
- Thaw food as part of the cooking process as long as product reaches minimum internal cooking temperature

(NRAEF, 2004, p. 8-3,4).

2.4.2 Monitoring Internal Temperatures of Held Food

Potentially hazardous food is defined as a food that is natural or synthetic and requires temperature control because it is in a form capable of supporting:

- The rapid and progressive growth of infectious or toxigenic microorganisms

- The growth and toxin production of *Clostridium botulinum*; or
- In raw shell eggs, the growth of *Salmonella Enteritdis*

(FDA, 2009).

The following are examples of foods that are potentially hazardous:

- Animal food (a food of animal origin) that is raw or heat-treated
- Food of plant origin that is heat-treated or consists of raw seed sprouts
- Cut melons
- Garlic-in-oil mixtures that are not modified in a way resulting in mixtures that do not support bacterial growth

(FDA, 2009).

Potentially hazardous foods must be prepared and held with caution. Even though some foodservice establishments cook-to-order and food reaches the consumer at appropriate internal temperatures, some foodservice establishments such as buffet restaurants or catering companies must have equipment that hold hot and cold food at the appropriate safe internal temperature. Potentially hazardous hot food must be held at an internal temperature of 135ºF (57ºC) or higher whereas potentially hazardous cold food must be held at an internal temperature of 41ºF (5ºC) or lower (NRAEF, 2004, p. 9-4). All of the equipment used to support these foods must be able to hold foods at a constant appropriate temperature. Foodservice businesses that do not have the facilities or equipment to hold hot or cold food at their required minimum internal temperature must attain the minimum internal temperature of the food before serving it and the food must be sold, served, or discarded within four hours of time of service (NRAEF, 2004, p. 9-4).

Hot or cold food that is being held in foodservice establishments must be checked.

Food handlers should check internal temperatures of held food every four hours, however an alternative would be for food handlers to check food every two hours to allow time for corrective measures (NRAEF, 2004, p. 9-3).

2.4.3 Proper Procedures for Cooling Food

Clostridium perfringens has been found in many food borne illness outbreaks from improper cooling of cooked meats since this organism is significantly heat tolerant and can survive the cooking processes (Juneja, Marks, & Thippareddi, 2008). Food handlers must be aware of the correct methods for cooling food in preparation for food storage. Many food handlers operate under the misconception that refrigerators are designed to cool hot food. Refrigerators are designed for storage and to keep food cool. Placing hot food in refrigerators or freezers will rapidly raise the temperature inside the refrigerator or freezer and may make food more unusable (Minnesota Department of Health, 2010). Food handlers should use the Two-Stage Cooling process as a rule of thumb when practicing methods for cooling food for storage. The steps of the Two-Stage Cooling process are cooling food from an internal temperature of 135ºF to 70ºF within two hours and then cooling food from an internal temperature of 70ºF to 41ºF within four hours. Food must pass through this temperature range quickly during cooling to minimize the growth of microorganisms; if food does not reach the internal temperature of 70ºF within two hours, the food must be reheated to internal temperature of 165ºF and cooled again or discarded (NRAEF, 2004, p. 8-18, 19). The safest methods for properly cooling food are:

- Reducing the quantity or size of the food being cooled

- Utilizing ice-water baths to bring food temperature down quickly
- Use blast chillers to cool food before refrigerating it
- Steam-jacketed kettles can be used to cool food by running cold water through the jacket
- Stirring food with clean utensils or cold paddles while it cools
- Add ice or cool water as an ingredient

(NRAEF, 2004, p. 8-19, 20).

2.5 Training of Food Safety

Observation studies have revealed that food workers frequently engage in unsafe food preparation practices which indicates that the improvement of restaurant workers' food preparation practices is needed to reduce the incidences of food borne illness (Green & Selman, 2005). Food safety training attempts to improve employees' food safety practices (Pilling et al., 2008). Since poor personal hygiene, cross-contamination, and time-temperature abuse are the three main causes of food borne illness, there is a need for food safety and sanitation training to be conducted and maintained on a regular basis in foodservice establishments. When food workers are given sanitation training, the knowledge, attitudes, and skills gained from the training should be present in the behaviors they exhibit in the kitchen. However, increased knowledge does not always transfer into improved behaviors. A study in Oklahoma County found that there was no significant difference between the number of hours of training and improvement of food safety practice (Lynch, Elledge, Griffith, & Boatright, 2005). Employees must have a firm understanding of food safety and more importantly employees must be obligated to

actively practice sanitation in the workplace at all times. There is a need to develop training methods that bestow food handlers with knowledge, but more importantly, methods that are proven to change behavior (Egan et al., 2006).

2.5.1 Conveyance of Food Safety Training to Food Handlers

Training is the factor which most effectively raises the food handler's personal hygiene standards and the public's expectation of reliable food safety (Smith, 1994). Managers should ensure that employees receive food safety training and concentrate on conveying the consequences of improper food safety practices (Howells, Roberts, Shanklin, Pilling, Brannon, & Barrett, 2008). Although training appears to be an important component of food safety, training alone does not ensure implementation of safe food handling practices the result in safe food (Arendt & Sneed, 2008). While written performance does not necessarily indicate how food handlers will perform on the job, it does indicate whether they know the correct protocol (Lillquist, McCabe, & Church, 2005). A more effective way to achieve objectives for behavioral-skill development in food safety is to provide learners with opportunities to observe demonstrations of behaviors and then have hands-on practice (Wallerstein & Weinger, 1992). A previous study compared three groups in which each group received food safety training in a different manner. Group one took a food safety examination and was used as the control of the study, group two took the food safety examination and received a lecture and video training, and group three took the food safety examination and participated in a hand washing training activity. Results of the study stated that active hand washing demonstrated higher retention than the lecture and video, therefore hands-

on training appears to be necessary for food handlers to understand and perform hand washing procedures correctly (Lillquist, McCabe, & Church, 2005).

2.5.2 Effectiveness of Food Safety Training

Effective training programs assess whether the participants acquire new skills during the training and whether they transfer their newly acquired skills to their job setting (Rodríguez & Gregory, 2005). Not only do foodservice employees need food safety training, their supervisors and managers should know the dangers of food borne illnesses, how they originate, and preventative measures. Management can then continuously provide basic food safety training for food handlers. The effectiveness of training is dependent on both management attitude and their willingness to provide the resources and systems for food handlers in implement food practice (Egan et al., 2006). In a study on food handlers' perspectives of barriers of hand washing, participants stated that they liked when their managers took an active "coaching-style" approach to promoting hand washing and believed "hands-on" hand washing training would be more effective (Pragle, Harding, & Mack, 2007). The support given by managers both in pre and post training is an important element to motivate food handlers to enact the safe food handling practices learnt during training (Seaman & Eves, 2009). Studies for testing effectiveness of hygiene education pointed out that hygiene knowledge alone was not sufficient to improve hygiene attitude and practices of food handlers (Park, Kwak, & Chang, 2010) and a discrepancy exists between hygiene knowledge and practices (Tokuç, Ekuklu, Berberoğlu, Bilge, & Dedeler, 2009). One explanation for the discrepancy between food safety knowledge and practice are the barriers present in the foodservice

establishment. These barriers and problems may prevent food handlers from implementing good hand washing practices in accordance with other food safety practices in restaurants (Green & Selman, 2005). For hand washing alone, problems with availability of supplies and accessibility of sinks, time pressure, high volume of business, stress, lack of accountability, type of restaurant, insufficient training, and inadequate food handler training were all barriers mentioned more frequently by participants in a previous study (Pragle, Harding, & Mack, 2007). In another study on food handlers' self-reported practice of food safety behaviors, the main barrier to practicing proper food safety was time (Clayton, Griffith, Price, & Peters, 2002).

Foodservice establishments must adapt to these emerging issues of barriers to active food safety to narrow the gap between food safety knowledge and practice. Food safety training therefore needs to incorporate strategies to eliminate the barriers to proper handling practice in order to improve compliance and reduce the incidence of food borne disease outbreak (Pragle, Harding, & Mack, 2007). The traditional educational method of lecturing about food safety needs to be re-developed and food safety instructors should utilize more activities to impact food handlers' attitudes so the transfer of this training appears in their food safety behaviors. Training is useless unless it comes through in the food handler's performance. Transference of training should not be overlooked when a food safety instructor conducts training to food handlers. The transfer of training is a core issue that links individual change to an organization's requirements, therefore if a difference is to be made in individual and organizational performance, it must be understood of how to support this transfer of training so knowledge transitions into practice (Yamnill & McLean, 2001). Moreover, transfer of training must be continual in

which this responsibility lies on the managers of the food handlers. The food handler is likely to forget the information they have learned, therefore the training can no longer be practiced in the workplace and the need for management support after food safety training is detrimental to reinforce the adoption of safe food handing behaviors (Seaman & Eves, 2009).

2.6 Summary

This chapter presented the literature review on personal hygiene, primarily hand washing, hand maintenance, and bare hand contact with food, cross-contamination, time-temperature abuse as well as the training involved in conveying these major issues of food safety to foodservice employees with an emphasis of the transfer of food safety education presented in training to foodservice employees.

CHAPTER THREE

PROCEDURES AND METHODOLOGY

3.1 Introduction

This chapter will address the procedures and methodology used to examine the purpose of the study and to explore the objectives presented in chapter one. Section two will discuss the design of the study. Section three will present the instrumentation utilized for the study. Section four will discuss subject selection, addressing the population chosen for examination, the procedures for sampling from population, and the description of the sample itself. Section five will present the method of data collection. Section six will present the procedure of the study. Section seven will present the statistical analysis method.

3.2 Research Design

This section will address the research design for the study. One-group pretest-posttest design was utilized to examine behavioral changes which occurred pre- and post-food safety training program. The one-group pretest-posttest design administered a pretest that measured the dependent variable(s), applied the experimental treatment to the subjects and then administered a posttest, which again measured the dependent variables (Ary, Jacobs, Razavieh, & Sorensen, 2006). The pretest in this study was the observation of three categories of food safety behaviors by the researcher before a food safety training program was administered. The posttest in this study was the observation of the same

three categories of food safety behaviors by the researcher after a food safety training program was administered. The difference in the observed behavioral changes pretest and posttest were evaluated by comparing the frequencies of each behavior.

The pretest was used as a baseline for comparing behaviors observed by the researcher. This baseline was used as the control for the study to compare the posttest data to. The independent variable was the food safety training program administered between the pretest and the posttest. The dependent variables were the three categories of food safety behavioral occurrences observed by the researching during the posttest.

The three categories of food safety were hand hygiene, cross-contamination, and time-temperature control. Three specific behaviors in each category were selected for observation. The nine food safety behaviors were hand washing, hand maintenance, bare hand contact with RTE food, sanitizing after cutting raw food or after working on any surface, RTE food and raw food are prepped separately, raw food stored below produce and RTE food in walk-in, food is properly thawed using acceptable thawing methods, internal temperature of held food is checked, and lastly, food is properly cooled by various acceptable cooling methods.

Another control the study employed was the same participants had to be present during pre-training observations, the food safety training and examination portion of the study, and during post-training observations. If any individuals were hired during the course of the study, they would have been excluded from observation and their behavioral instances would not have been documented. The supervisors and managers were asked to make researcher aware of any new employees during the course of the study.

3.2.1 Unit of Observation

The researcher chose to use the food safety behavioral instances as the sample to collect data from instead of collecting data on a group of individuals and tracking every food safety behavioral instance performed by each individual. The information sought in this study was to discover if overall number of food safety behavioral instances is being collectively improved in the buffet kitchen after a food safety training program. The individual improvement of correctly practiced food safety behaviors over the course of the study is not being evaluated in this study.

3.3 Instrumentation

A behavior observation checklist (Appendix A) was developed by the researcher as the means for collecting data. The behavior observation checklist was comprised of three categories which each category contained three specific food safety behaviors for a total of nine food safety behaviors to be observed in this study as shown Fig. 1.

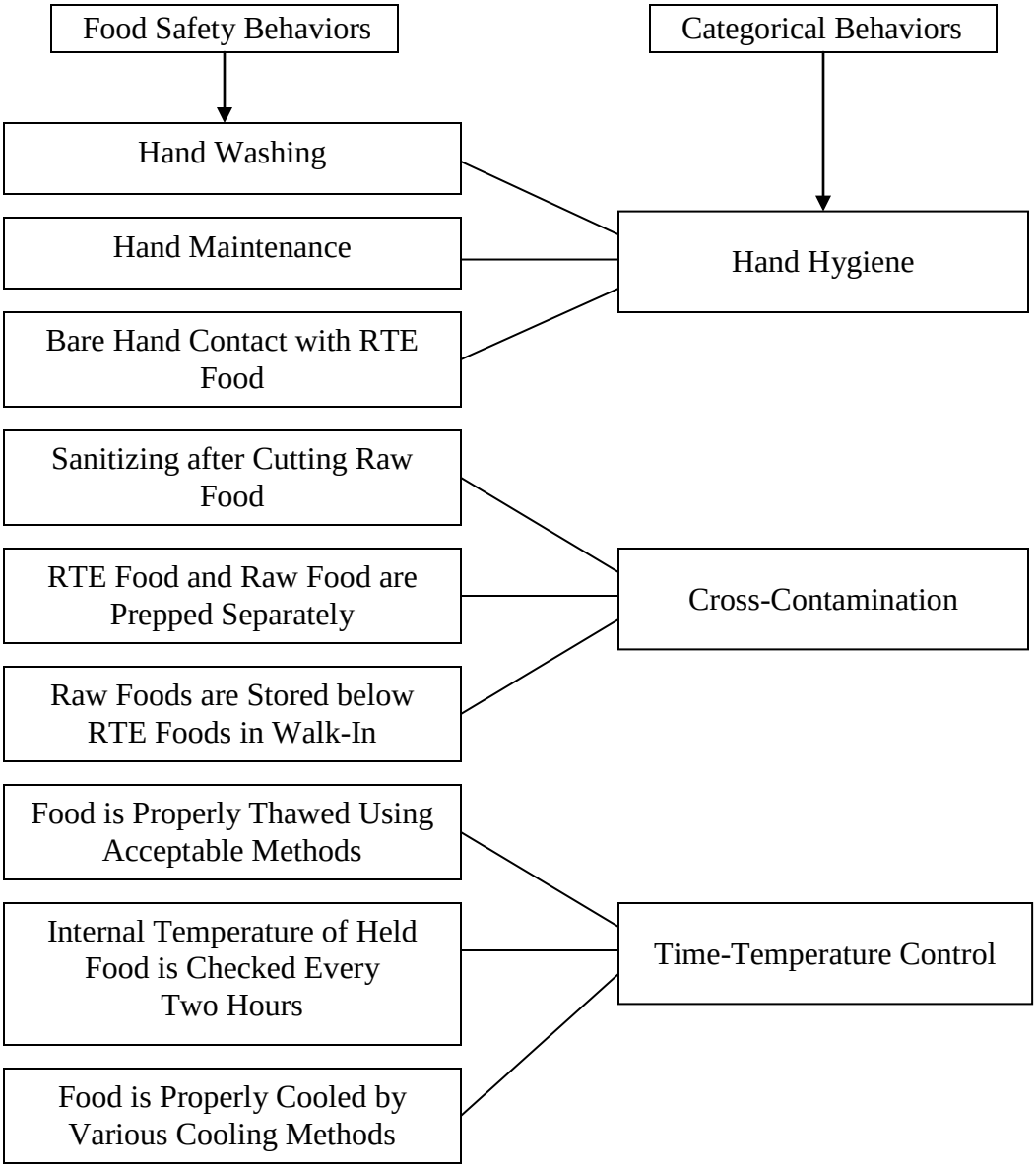

Figure 1. Research Dimensions and Variables

Each specific food safety behavior had boxes for the observer to check "yes" or "no." If one of the food safety behaviors on the checklist was witnessed being correctly performed, then the observer would mark "yes" on the checklist. If one of the food safety behaviors on the checklist was witnessed being performed incorrectly or not completely performed, the observer would mark "no" on the checklist. An example of the usage of the behavioral checklist that occurred in the study was the researcher observed a cook who was handling raw meat with bare hands. The cook walked to the hand washing station, used soap and vigorously scrubbed and rinsed hands all for a total of five seconds. The researcher checked "no" under the hand washing behavior on the observation checklist instrument since the cook did not follow correct hand washing procedure. The purpose of marking "yes" or "no" was to record the frequency of correctly or incorrectly performed food safety behaviors since this study examined changes in the number of correctly performed foods safety instances that occur between the pre-training and post-training observations.

A demographic questionnaire (Appendix A) was developed to describe the population for the sample selected for this study which consisted of seven questions inquiring age, gender, job title, years employed in the foodservice industry, level of education, and if the participant had received any prior food safety training. The demographic question regarding age gained information on the age range of participants employed at the buffet restaurant. The demographic question regarding gender gained information on the ratio of male to female participants. The demographic question regarding job title gained information on what level of job positions were present at the buffet restaurant. The demographic question regarding years employed in the

foodservice industry gained information on how long these individuals have been employed in any kind of foodservice environment. The demographic question regarding level of education gained information on what level of education the individuals had completed. The demographic question regarding food safety training gained information on how many individuals had previous food safety and sanitation education prior to the execution of this study. The population held an N=55 and according to the formula of determining sample size, if N= 55, then s= 48 (Krejcie & Morgan, 1970).

The study was sent to the University of Missouri-Columbia Campus Institutional Review Board for Exempt Approval status on July 20th 2009. The Campus Institutional Review Board needed clarification on three areas of the study. Clarification involved a revision of the permission letter (Appendix A) for the researcher to conduct the study at the company, a clarification of the level of deception involved in the study (which there was no deception in the study; the subjects were aware of who the researcher was and what the researcher was during each observation session), an explanation of the confirmation that the demographic questionnaire would not be linked to individuals, and how to minimize the risk so businesses or the public would not come into contact with the private information of the study, and how to prevent the business from coming into contact with data so foodservice employees would not face employment risks. A response was formulated and addressed each concern. Acceptance as Exempt Approval was granted by the Campus Institutional Review Board with an acceptance notification (Appendix A) on July 29th, 2009.

3.3.1 Validity Procedure

Validity is defined as the extent to which an instrument measured what it claimed to measure (Ary et al., 2006, p. 243). The instrument was evaluated under face validity and content validity by a panel of experts comprised of three faculty member and two graduate students, all of whom have backgrounds in food safety. Face validity determined if the instrument appears to be valid for its intended purpose and content validity determined that the instrument is appropriate for measuring what it is suppose to measure (Ary et al., 2006, p. 439-440). Individuals were asked to critique the instrument for clarity, observer user ability, clarity of instructions, and behavior definitions.

Based on suggestions from the panel, the original format of the checklist was adjusted to make it more user-friendly for the observer by adding boxes to check for "yes" and "no," created more concise and comprehensive behavior descriptions, and included a notes section for documentation of specific behaviors the observer witnessed.

3.4 Subject Selection

3.4.1 Population

The nature of the study concerned the practice of accurate food safety behaviors therefore employees in a foodservice operation were sought as participants for this study. The population selected was appropriate for the intent of this study due to the interest of how actively and accurately food safety behaviors were collectively being performed among all foodservice employees. All employees handled food at some stage of the flow of food through the foodservice establishment; therefore every foodservice employee must be knowledgeable of and exhibit ability and intent to implement such knowledge

into practice to ensure the safest management and production of food for public consumption. The content and duties the foodservice employees' positions entailed made this particular population congruous to this study. Individuals employed for a Midwestern buffet restaurant were selected as the population for this study and there were 55 participants in the population. The intent of the study must be reiterated since the study was to observe the number of correctly practiced food safety instances between pre- and post-training. Though there were only 55 participants in the population, the sample size was much larger since the sample size was behavioral instances, not individual participants.

3.4.2 Sampling Procedures

The sample of this study was the instances of correctly practiced food safety behaviors. The frame for selecting the instances of correctly practiced food safety behaviors sample was specifically chosen from kitchen employees in a Midwestern buffet restaurant. Kitchen employees were a crucial tool in the study since they were the individuals who performed food safety behaviors. The kitchen employees would not be individually observed by the researcher; the researcher observed only behavioral instances as the instances occurred in the environment and were not recorded as being committed by certain participants.

The researcher obtained a list of kitchen employees from the Human Resource department at this foodservice establishment. The process for obtaining a list of kitchen employees was performed by initiating contact with an upper-level management employee of this establishment. The proposal of conducting this study at the buffet

restaurant was presented to an upper-level management employee and was approved by this individual. Upon approval of this study by the upper-level management employee, a summary of the study, its purpose, and benefits along with the consent forms (Appendix A) were sent to all management level employees in the kitchen to inform their employees of the study, what the study would entail, and if the employees would be willing to participate. The employees were asked to sign a statement of study participation letter (Appendix A) which stated their jobs would not be jeopardized as a result of their participation in the study. A non-probabilistic sampling method was utilized based on the design of the research and participant selection; probabilistic sample methods were not feasible for the study since the sample was deliberately selected and not chosen by chance or a random act. The procedure used in this study to select participants was the utilization of the convenience sample. The sample was selected using the non-probabilistic method of convenience sampling herein generalization of the sample to Midwestern restaurants was weak; it was not an accurate representation of the population. Convenience sample was an appropriate way to gain participants for the study since convenience sampling was inexpensive and a quick accumulation of data.

3.4.3 Sample

The sample in this study was the instances of practiced food safety behaviors by kitchen employees. The researcher was only concerned with observing the food safety behaviors as the behavioral instances occurred during each observation session. An interest of the study was discovering if there was an improvement in the collective practice of correct food safety behaviors post-training by all kitchen employee

participants. Participants were not individually observed to discover if there was an individual improvement in their practice of food safety behaviors post-training.

The reason for studying a collective improvement of behavioral instances rather than individual improvement of behavioral instances was to evaluate how safe the flow of food operating procedures was. The flow of food is a complex dynamic where one food item is rarely handled by one individual; a food item is passed through several individuals' hands and is usually collaborated with other food items, which have most likely been handled by other individuals, before the final product is achieved and served. One individual may consistently practice food safety with the food items he or she handles, however once the food item passes to another individual, the item may become contaminated or reach dangerous internal temperatures at that stage of production.

Out of the 55 participants employed as kitchen staff for the Midwestern buffet restaurant that consented to volunteer in this study, 20 individuals completed the Back-of-the-House Employee Demographic Questionnaire. Most individuals did not wish to complete the questionnaire and their supervisors did not stress the importance of completing the questionnaire to the individuals despite the request of the researcher.

Table 1. *Demographic Characteristics of Participants (N=20[1])*

Characteristics	n	%
Age (n=20)		
18 and under	6	30
19-29	8	40
30-39	4	20
40-49	0	0
50 and over	2	10
Gender (n=20)		
Female	9	45
Male	11	55
Education level (n=20)		
Some high school	5	25
Graduated high school (Grade 12)	6	30
Some college	1	5
Vocational/technical school/trade School	5	25
Post-graduate degree	3	15
Year(s) employed in the hospitality industry		
Less than 1 year	4	20
1-2 years	9	45
3-4 years	1	5
5-6 years	1	5
7-10 years	1	5
More than 10 years	4	20
Completion of food safety training		
Yes	11	55
No	9	45
Completion of ServSafe courses		
Yes	5	25
No	15	75

1. Number of completed and useable questionnaires.

The data showed 90% of the participants were between 18 and 39 years of age; 10% of the participants were at or over the age of 50. Gender disbursement of participants showed 45% were female and 55% were male. Education levels expressed a

majority of participants either had some high school education or had graduated high school (Grade 12), where 5% of participants attended vocational, technical, or trade school, and 40% of the participants had some college education or completed a two or four year college degree. Less than 20% of participants had been employed in the foodservice industry for less than one year where 45%of participants had worked in the foodservice industry between one and three years. Ten percent of the participants had been employed in the foodservice industry between three and seven years. Five percent of the participants had worked in the foodservice industry between seven and ten years, and the remaining 20% of participants have been employed more than ten years in the foodservice industry. The following is a list of the job titles participants held during the study: Head cook, utility, preparation cook, team member, attendant, supervisor, restaurant manager, front-of-the-house manager, food runner, or stocker.

3.5 Data Collection

3.5.1 Development of Observational Study

The structure of the study was a pre- and post-test method where a series of pre-training observations were conducted, followed by the administration of a food safety training program, and then a conduction of post-training observations. This study used quantitative observations as the means of collecting behavioral data. Quantitative observations use checklists and behavior observation tools developed prior to the observation to record or document observed behaviors (Ary et al., 2006, p. 474). A checklist of nine food safety behaviors was developed and used by the researcher to collect the food safety instances observed in the buffet kitchen. The purpose of the pre-

training observations was to develop a baseline of behavioral data to establish a point of reference for comparing to post-training observations. The purpose of post-training observations was to identify if there was a change in food safety behaviors by comparing the post-training data to the pre-training data.

This study was based on observational research. The researcher chose direct observations over unobtrusive observations to avoid any issue with invasion of privacy. Direct observation is the determination of the extent to which a particular behavior(s) is present by watching (Ary et al., 2006, p. 234). The participants who volunteered in the direct observation study were aware they were being watched by the researcher. Direct observation was used during every data collection observation session. Participants were given an informed consent letter which stated the purpose and length of the study as well as being notified they were going to be watched by an individual.

The researcher also applied a time allocation to the method of data collection. A time allocation involved the researcher randomly selecting a time to conduct an observation and recorded what the participants were doing when participants were first seen and before participants realized the researcher was watching (Brown, 2010). The observer role the research undertook during the data collection period of the study was as a naturalistic observer. A naturalistic observer simply observe and record events as instances naturally occur as no attempt is made to alter the situation in any way (Ary et al., 2006, p. 475). The purpose of developing the study with the elements of a direct observation coupled with time allocation and taking on a naturalistic observer role was even though the subjects are aware they are being watched, time allocation assisted in alleviating the participants' knowledge of when the researcher would be watching their

actions and being a naturalistic observer allowed the researcher to watch the participants in their environment without upsetting their daily routines or job duties.

Naturalistic observations were an advantage to the study since the participants were being watched in surroundings they were comfortable in and they performed their food safety behaviors in real-life situations; it aided the researcher in collecting the food safety behavioral data needed. The collection of data clearly reflects the constraints of the participants' normal environment, especially since participants may respond differently under laboratory conditions (Psychology 202Q Lab: Naturalistic Observation, n.d.). The disadvantages of conducting an observational study were reactivity and observation bias. Reactivity is the influence that an observer has on the behavior under observation even though the behavior influenced by an observer may not be representative of the behavior when an observer is not present (Shaughnessy, Zechmeister, & Zechmeister, 2002).

This section must take note that the study evaluated the instances of correctly practiced behaviors which occurred collectively in the foodservice environment, not individual instance performance. The focus on direct observation is important to mention because direct observation protected the privacy of the participants and that conduction of naturalistic observations was crucial to the design of the study since participants were already accustomed and comfortable in their work environment; however the study observed behavioral instances that occurred in general, not behavioral instances which occurred by each individual.

3.5.2 Disadvantages of Observational Study

Reactivity was likely to occur in the study since the researcher was not an employee of the buffet restaurant and spent multiple hours in the kitchen observing food safety behavioral instances conducted by the participants. Since the participants were aware that an unknown individual was watching their actions, it was very likely that the participants became more conscious of their food safety actions and performed food safety more accurately as well as at the right instances. Managers might have become more sensitive about the level of food safety being evaluated in the buffet kitchen by an unknown individual, which could have caused supervisors and management level employees to be more alert in practice of food safety by their subordinates, therefore corrected their subordinates in their food safety actions or fixed the food safety error before it occurred. In addition to managers becoming more aware of food safety within the establishment, reactivity could have also been heightened by co-workers watching out for fellow co-workers in the instances of correcting each other's food safety behaviors or fixing them before the errors occurred.

As for observation bias, it can occur when the observer's expectations about behavior lead to systematic errors in identifying and recording behavior as well as when the researcher's biases determine which behaviors they choose to observe. Observation bias was controlled by having specific definitions for each behavior that was being observed so that the researcher would not deviate from what was being observed and record something other than what was listed in the definition for each behavior.

3.6 Procedure

The researcher conducted the observations in the kitchen at the buffet restaurant and spent a maximum of two hours at each observation session. The data was recorded on a behavioral observation checklist developed by the researcher, which listed the nine behaviors that were selected for observation. Each time one of the behaviors on the checklist was observed by the researcher, whether it was correctly performed, incorrectly performed, or was not completely followed through, the behavior was recorded on the checklist under the appropriate behavior. If the behavior was correctly performed, it was marked "yes" under the appropriate behavior on the checklist. If the behavior was incorrectly performed or not completely followed through, it was marked "no" under the appropriate behavior on the checklist. The only exception to marking "yes" or "no" for correctly/incorrectly performed behaviors on the checklist was "bare-hand contact with RTE food." If the participants did have bare contact with RTE food, then the instance was marked "yes" every time it occurred since this is a wrong food safety action. If the participants used serving utensils or latex gloves to handle ready-to-eat food, the instances were marked as "no" every time the instance occurred. The researcher did not inform the participants when the next observation session would be conducted; the researcher would select different times and days during the week to conduct observation sessions in avoidance of a pattern that could alert the participants when the researcher would perform the next observation. The researcher completed 12 observation sessions within the pre-training observation period. As part of the research design, there were 55 participants during the pre-training observation sessions.

The completion of pre-training observations induced the second stage of the study

of food safety training where all 55 participants completed a 60-90 minute online interactive program. The food safety training program encompassed material on personal hygiene, cross-contamination, time-temperature control, basic food safety, allergens, and cleaning and sanitation. The online program used workforce language, visual cues to help learners instantly recognized right and wrong practices, provided real-world scenarios, and was available in either English or Spanish. Participants were required to complete a 40-question examination on their knowledge and comprehension of the material. The food safety training and examination took three months for all the participants to complete due to varied work schedules, availability of testing space, and how busy the buffet restaurant establishment was on certain days. Management stated that 97% of the 55 participants who trained and completed examination, passed. The 3% of participants who failed examination were re-trained and tested; the individuals passed upon completion of their retest.

The post-training observations were initiated and were conducted in the same manner as the pre-training observations. Behavioral instances were recorded on the behavioral observation checklist each time any of the nine behaviors were witnessed being correctly or incorrectly performed. The post-training observations lasted three months and the researcher completed 12 observation sessions within the post-training observation period. As part of the research design, the same 55 participants who volunteered in pre-training and food safety training were present during the post-training observation sessions.

3.7 Statistical Analysis Method

The study utilized three types of descriptive statistics. The Cumulative frequencies were computed on the pre-and post-training individual and categorical behavioral data. Cumulative frequency of individual and categorical data of pre- and post training was divided by the total frequency. Total frequency was the data from both pre- and post training. The row by column chi square statistic was performed on the individual behavioral instances observed pre- and post-training data. Row by column chi square is employed to find a significance of differences between proportions of subjects, objects, events, and so forth by comparing observed frequencies and frequencies expected (Ary et al., 2006, p. 211). Least means square is the group means after having controlled for a covariate (Deng, 2009). Odds ratio is a comparison whether the probability of a certain event is the same for two groups. Simon (2008) stated:

> An odds ratio of one implies that event is equally likely to happen in both groups. An odds ratio greater than one implies the event is more likely to occur in Group A than Group B. An odds ratio of less than one implies the event is less likely to occur in Group A than Group B.

Chi square, least means square, and odds ratio were computed by using the Statistical Analysis System (SAS) to generate results from collected observational data. Specifically for odds ratio, the generalized linear model (GENMOD) program in SAS was utilized to compute the categorical data to compare pre- and post-training observations. The GENMOD is applicable to a wider range of data analysis problems; it was appropriate in the analysis of date in this particular study since statistical inference about parameters estimates could be made (SAS Publishing, 1999).

3.8 Summary

This chapter addressed the procedures and methodology used to examine the purpose of the study. The first section of this chapter introduced the purpose of the study and the objectives of the study. The second section of this chapter discussed the design of the study. The third section discussed subject selection, addressing the population chosen for examination, the procedures for sampling from population, as well as the description of the sample itself. The fourth section of this chapter presented the method of data collection, which included the unit of observation, development of the observational study, and disadvantages of an observational study. The fifth section presented instrumentation used to collect data as well as addressing the validity and reliability issues. The pilot study was included in the fifth section as well as a discussion of the pilot study results. The sixth section presented the procedures of how the study was conducted. Lastly, the seventh section presented the statistical analysis method used to analyze the data collected during the observation sessions.

CHAPTER FOUR

ANALYSIS AND RESULTS

4.1 Introduction

The section two of this chapter will review the objectives that were set for this study. Section three will present the descriptive statistics and a summary of the statistical results.

4.2 Review of Study Objectives

The objectives of the study were:

1. To examine changes in the number of correctly practiced food safety hand hygiene behaviors that occurred pre- and post-food safety training program.
    a. To evaluate the frequency of correctly practiced hand washing pre- and post-food safety training program through observation.
    b. To evaluate the frequency of correctly practiced hand maintenance pre- and post-food safety training program through observation.
    c. To evaluate the frequency of correctly practiced no-bare hand contact of RTE food pre- and post-food safety training program through observation.

2. To examine changes in the number of correctly practiced food safety cross-contamination prevention behaviors that occurred pre-and post-food safety training program.
    a. To evaluate the frequency of correctly practiced sanitizing surfaces and utensils after cutting raw food pre- and post-food safety training program through observation.
    b. To evaluate the frequency of correctly practiced separate preparation of ready-to-eat and raw food pre- and post-food safety training program through observation.
    c. To evaluate the frequency of correctly practiced storage of raw food below produce and ready-to-eat food in walk-in pre-and post-food safety training program through observation.
3. To examine changes in the number of correctly practiced food safety time-temperature behaviors that occurred pre-and post-food safety training program.
    a. To evaluate the frequency of correctly practiced acceptable methods of thawing food pre- and post-food safety training program through observation.
    b. To evaluate the frequency of correctly practiced monitoring internal temperature of held food pre- and post-food safety training program through observation.

c. To evaluate the frequency of correctly practiced acceptable food cooling methods pre- and post-food safety training program through observation.

4. To examine the overall change in the number of correctly practiced food safety behaviors pre- and post-food safety training program.

4.3 Summary of Descriptive Statistics

As Table 2 presents, the variables showed frequencies for every instance in which they were observed being correctly practiced. These frequencies were derived from the number of correctly practiced behaviors being divided by the total number of instances that the particular behavior was observed being correctly and incorrectly practiced.

Table 2. *Pre- and Post-Training Frequencies for Correctly Practiced Individual Behaviors*

Behaviors[1]	Before Training T[2]	C[3]	%[4]	After Training T	C	%
Hand Hygiene						
Hand washing	115	7	6.09	114	18	15.79
Hand maintenance	69	47	68.12	111	85	76.58
Bare hand contact with RTE food[5]	85	64	75.29	136	129	94.85
Cross-Contamination						
Sanitizing after cutting raw food or after working on any surface	25	11	44.00	51	32	62.75
RTE food and raw food are prepped separately	43	26	60.47	45	39	86.67
RTE foods are stored below produce and RTE foods in walk-in	78	53	67.95	135	101	74.81
Time-Temperature Control						
Food is properly thawed using acceptable methods	24	21	87.50	34	32	94.12
Internal temperature of held food is checked	35	12	33.33	40	3	7.50
Food is properly cooled by acceptable methods	33	10	30.30	58	16	27.59

Note:

1. Behaviors referred to the overall number of behavioral instances which occurred and were observed in the kitchen during each observation and did not refer to the number of behavioral instances per subject.
2. T= The total number of correctly and incorrectly behaviors witnessed.
3. C= The number of correctly practiced behavioral instances witnessed.
4. %= The percentage of correctly practiced behavioral instances witnessed.
5. The data collected for the bare hand contact with RTE food behavior was observed in the manner of which marking “yes” implied the behavior was an unsafe act of sanitation and the subject was witnessed touching RTE food with bare hands. “No” implied the behavior was performed as a safe act of sanitation and the subject was witnessed touching RTE food with gloves or food safe utensils. In Table 2, the data marked as “no” is found here since it implied the behavior was a safe act of sanitation.

The significant behaviors to note in Table 2 were hand washing, bare hand contact with RTE food, food is properly thawed using acceptable methods, and internal temperature of held food is checked. During observation of hand hygiene behaviors, seven of 115 instances of hand washing were performed correctly before training and 18 of 114 instances of hand washing were performed correctly after training. Before training, 6.09% of hand washing instances were observed being performed in the correct manner and after training, 15.79% of hand washing instances were observed being correctly performed; overall, of all correctly and incorrectly hand washing behavioral instances observed in both pre- and post-training observations, 10.92% represented correct hand washing instances.

Bare hand contact with RTE food was correctly practiced 64 of 85 of the instances this behavior was observed before training. This behavior was correctly practiced 129 of 136 of the instances observed after training. Before training the bare hand contact with RTE food was performed correctly with a 75.29% rate and after training this behavior increased, correctly performed 94.85% of the instances observed, which resulted in 87.33% average of this behavior correctly being performed.

Food properly thawed using acceptable methods were correctly practiced 21 of 24 instances this behavior was observed before training. This behavior was correctly practiced 32 of 34 of instances observed after training. Before training, this behavior was performed correctly at a rate of 87.50% and after training this behavior increased in correct performance to 94.12%, which resulted in 91.38% average of this behavior being correctly performed.

Internal temperature of held food is checked was correctly practiced 12 of 35

instances this behavior was observed before training. This behavior was correctly practiced 3 of 40 of instances observed after training. Before training, this behavior was performed correctly at a rate of 33.33% and after training this behavior decreased in correct performance to 7.50%, which resulted in 28.57% average of this behavior being correctly performed.

Objective 1

Table 3. *Results of Chi Square Analysis to Examine Changes in Hand Hygiene Behaviors Pre- and Post-Training*

Behaviors[1]	Df	Chi Square Value	Probability	P-Value
Hand washing	1	5.5416	0.02*	0.05
Hand maintenance	1	1.5575	0.2	0.05
Bare hand contact with RTE food	1	8.0851	< 0.01*	0.05

Note:

1. Behaviors referred to the overall number of behavioral instances which occurred and were observed in the kitchen during each observation and did not refer to the number of behavioral instances per subject.
2. $p \leq 0.05$
3. * = significant

The results for hand washing indicate that chi square with one degree of freedom= 5.5416 and p= 0.02, were statistically significant. Hand maintenance did not show significance in its results. The food safety behavior of hand maintenance had a chi square with one degree of freedom= 1.5575 and p= 0.2, which was lower than the value found at 0.05. The objective for the bare hand contact with RTE food behavior with relation to its objective of evaluating a change of instances between the pre- and post-training observations was proven significant with one degree of freedom= 18.0851 and p= <0.01.

Objective 2:

Table 4. *Results of Chi Square Analysis to Examine Changes in Cross-Contamination Behaviors Pre- and Post-Training*

Behaviors[1]	Df	Chi Square Value	Probability	P-Value
Sanitizing after cutting raw food or after working on any surface	1	2.3995	0.12	0.05
RTE food and raw food are prepped separately	1	7.8195	0.01*	0.05
Raw foods are stored below produce and RTE foods in walk-in	1	1.1637	0.28	0.05

Note:

1. Behaviors referred to the overall number of behavioral instances which occurred and were observed in the kitchen during each observation and did not refer to the number of behavioral instances per subject.
2. $p \leq 0.05$
3. * = significant

The results of the sanitizing after cutting raw food or after working on any surface behavior with a chi square one degree of freedom= 2.3995 and p= 0.12 was not statistically significant in the occurrence of the number of behaviors pre- and post-training observations. RTE food and raw food being prepped separately showed significance in the change of instances concerning this specific behavior between the pre- and post-training observations. RTE food and raw food being prepped separately had a chi square with one degree of freedom= 7.8195 and p= 0.01. The raw foods being stored below produce and RTE foods in walk-in did not prove significant with its chi square of one degree of freedom= 1.1637 and p= 0.28.

Objective 3:

Table 5. *Results of Chi Square Analysis to Examine Changes in Time-Temperature Control Behaviors Pre- and Post-Training*

Behaviors[1]	Df	Chi Square Value	Probability	P-Value
Food is properly thawed using acceptable methods	1	0.7821	0.38	0.05
Internal temperature of held food is checked	1	7.9821	0.01*	0.05
Food is properly cooled by acceptable methods	1	0.0761	0.78	0.05

Note:

1. Behaviors referred to the overall number of behavioral instances which occurred and were observed in the kitchen during each observation and did not refer to the number of behavioral instances per subject.
2. $p \leq 0.05$
3. * = significant

Food properly thawed using acceptable methods behavior was not significant and did not support its objective. Food properly thawed using acceptable methods had a chi square with one degree of freedom= 0.7821 and p= 0.38. The time-temperature control behavior of internal temperature of held food is checked did result in significance in a change of instances in which it was witnessed during pre- and post-training observations. The internal temperature of held food is checked behavior had a chi square with one degree of freedom= 7.9821 and p= 0.01. The food is properly cooled by acceptable methods was not significant with a chi square of one degree of freedom= 0.0761 and p= 0.78.

Objective 4:

Table 6. *Results of Least Square Means and Chi Square Analysis to Examine Changes in Categorical Behaviors Pre- and Post-Training*

Categorical Behavior[1]	Df	LSM[2]	Odds Ratio	Probability	P-Value
Hand Hygiene	1	0.17	1.19	0.54*	0.05
Cross-Contamination	1	-0.24	0.78	0.44*	0.05
Time-Temperature Control	1	0.38	1.46	0.59*	0.05

Note:
1. Categorical behavior referred to the three behaviors grouped.
2. Least Square Means
3. $p \leq 0.05$
4. * = significant

Hand hygiene categorical data expressed a 0.17 logit which resulted in a 1.19 odds ratio. Hand hygiene contained the following individual food safety behaviors: Hand washing, hand maintenance, and bare-hand contact with RTE food. An odds ratio of 1.19 was interpreted as correctly practiced hand hygiene instances were more likely to occur after the food safety training program than incorrectly practiced hand hygiene instances. Collectively, the three behaviors within the hand hygiene category resulted in being statistically significant with a chi square of one degree of freedom= 4.26 and p= 0.54. Cross-contamination categorical data expressed a logit of -0.24 which resulted in a 0.78 odds ratio. The 0.78 odds ratio was interpreted as correctly practiced cross contamination instances were less likely to occur after the food safety training program than incorrectly practiced hand hygiene instances. Cross-contamination contained the following individual food safety behaviors: Sanitizing after cutting raw food, RTE food and raw food are prepped separately, and raw food is stored below RTE foods in walk-in. Collectively, the three behaviors within the cross-contamination category resulted in being statistically significant with a chi square of one degree of freedom= 5.19 and p=

0.44. Time-temperature control categorical data expressed a 0.38 logit which resulted in a 1.46 odds ratio. The 1.46 odds ratio was interpreted as correctly practiced time-temperature control instances were more likely to occur after the food safety training program than incorrectly practiced time-temperature control instances. Time-temperature control contained the following individual food safety behaviors: Food is properly thawed using acceptable methods, internal temperature of held food is checked every two hours, and food is properly cooled by various cooling methods. Collectively, the three behaviors within the hand hygiene category yielded statistically significant with a chi square of one degree of freedom= 7.41 and p= 0.59.

4.4 Summary

This chapter provided statistical reference to the data collected from the observational study. The first section of this chapter reviewed the objectives that were designed for this study. The second section presented the descriptive statistics and their results.

CHAPTER FIVE

DISCUSSION AND CONCLUSION

5.1 Introduction

This chapter will discuss the findings of the study. Section two provides a summary of the study. The third section summarizes the results of the objectives and offers implications for the results. The fourth section presents applications of the study. Finally, the last section provides limitations of the study as well as suggestions for the development of similar studies in the future.

5.2 Summary of the Study

Research has found that foodservice managers and employees receiving training on proper food handling practices and obtaining adequate food safety knowledge does not always translate into improved behaviors (Roberts et al., 2008). Employees must have a firm understanding of food safety and more importantly, employees must be obligated to actively practice sanitation in the workplace at all times. The most common source of contamination is humans (Green & Selman, 2005) and consequently, food-borne related illnesses cause approximately six to 76 million illnesses, 325,000 hospitalizations, and approximately 5,000 deaths each year in the United States (CDC, 1990). However, little research has been conducted in exploring actual behavior of foodservice employees before and after food safety training (Roberts, et al., 2008). The discrepancy between food safety training and actual food safety practices in the workplace needs to be

examined. Most agree that food safety interventions provide knowledge to food workers with the expectation that workers will translate this knowledge into practice (Green, 2008). The lack of practiced sanitation procedures could be due to the inadequate sanitation teaching methods conveyed by the instructor. Another possibility is it could be dependent on the person and their attitudes towards actively practicing sanitation The discrepancy between food safety knowledge and practice could also be dependent on the environment and environmental factors where the person is suppose to practice sanitation. One environmental factor would be management itself as it is seen by researchers that the continual support and coaching of food handlers by management on the subject of food safety is a key component of the reduction of food borne illness.

There were four main objectives of the study that were examined. First, it was stated that the number of correctly practiced food safety hand hygiene behaviors, more specifically in hand washing, hand maintenance and bare hand contact with RTE food, were examined pre- and post-food safety training program. Second, the behaviors of sanitizing after cutting raw food or preparing food on any surface, separate preparation of raw and RTE food, and the storage of raw foods below produce and RTE food in the walk-in were examined. These behaviors that surround cross-contamination were examined to uncover if there were any changes in the number of their correct practiced pre- and post-food safety training. Lastly, time-temperature control was examined and more specifically the following behaviors: Properly thawing using acceptable methods, internal temperature of held food was checked, and food was properly cooled by acceptable methods. The changes in the correct practice of each of the time-temperature control behaviors between pre-and post-food safety training were examined.

5.3 Results Summary and Implications of Statistically Significant Behaviors

Hand washing yielded statistically significant after the training program with chi square analysis. This was an indication of a change in the number of behaviors which occurred pre- and post-training observations. The chi square analysis results paired with the frequencies for hand washing showed a change in the number of correctly practiced hand washing behavioral instances observed between the pre-training and post-training. Hand washing had slightly improved by 9.70% after the training program, however the 10.92% indication of how often food handlers practiced correct hand washing is extremely poor. The reason for poor practice of hand washing before training and the slight improvement in practice of correct hand washing after training may be contributed to the lack of a food safety training program at this company. Employees simply did not have knowledge of the proper procedure to wash hands and lacked awareness of the importance of hand washing. However, it must be stated that even though the baseline data collected for hand washing was low (6.09%), there was a 9.70% improvement in hand washing after training. It must also be noted that the 9.70% increase in correctly practiced hand washing may be the result of the participants learning that gloves should never replace hand washing. The participants were constantly reminded by supervisors and management to wear gloves at all times. The participants must have believed hand washing was not necessary as long as they wore gloves as a barrier between food and their skin.

There was no significant difference in the number of correctly performed hand maintenance behaviors therefore the training program had no improvement on the food handlers practice of good hand maintenance. Improvement for the bare hand contact with

RTE food behavior proved statistically significant. This behavior had a 19.56% increase in correctly practiced instances after the training program. When data was collected during pre-training, the baseline data for this behavior was already high (75.29%). Post-training, the data increased to 94.85% correctly practiced instances. The cause for high number of correctly practices instances, then increased number after training may be the result of supervisors and management heavily stressing glove usage when handling food; the participants wore and changed gloves constantly during observations. The training program may have clarified points of glove usage, such as the appropriate instances when to wear gloves, change gloves, and when to wash hands then put on gloves. Overall, there were 87.33% of behavioral instances witnessed during the pre- and post-training observations that were correct practices of bare hand contact with RTE food.

There was no change in the number of instances observed pre- and post-training of the sanitizing after cutting raw food or after working on any surface behavior. Chi square resulted in 2.3995 and there was a 18.75% difference in frequencies of pre- and post-training observations. Training seemed ineffective on sanitizing after cutting raw food or after working on any surface.

An improvement occurred in the correctly performed behavior of separate preparation of RTE food and raw food. Training had a 26.20% improvement in the increased number of this behavior by food handlers. Again, this was another behavior that entertained high baseline data then increased in correctly practiced instances after training. The kitchen where observations took place had designated preparation areas pre-study, so participants only prepped certain food items in particular areas around the kitchen. The designated preparation areas could be why the baseline data for separate

preparation of RTE and raw food was high (60.47%). During times of high customer volume at the buffet restaurant pre-training, these designated areas were utilized to prep whatever needed to be made at that instant; cross-contamination occurred the most at those times. However, the training seemed to increase awareness of separate preparation and its importance, since the improvement of this behavior increased 26.20%.

Raw foods being stored below produce and RTE foods in walk-in did not show any statistical significance in the number of correctly practice instances due to the food safety training. There was only a 6.86% increase in the number of times this behavior was correctly practiced between the pre- and post-training observations.

Two of the three behaviors in the time-temperature control behavioral category proved statistically non-significant with regards to the food safety training program. Food being properly thawed using acceptable methods was not significant with a chi square value= 0.7821 and only a 6.62% improvement in the observation of correctly practiced instances. Food properly thawed using acceptable methods behavior had high frequencies pre- and post-food safety training program. Pre-training, the acceptable thawing methods behavior was being correctly practiced 87.50% of the time of observation by the researcher and after the training program; the behavior had a frequency of 94.12% in correctly practiced instances in which it was observed.

The behavior of internal temperature of held food being checked was statistically significant. Interestingly, the frequencies for this behavior resulted in a decrease in the number of correctly practiced instances for this behavior after the training program. Correctly practiced instances decreased from 33.33% pre-training to only 7.50% post-training, which signal a major concern. Even though the correct practice of this behavior

was low pre-training, the participants still practiced this behavior more than after the training. There are several possibilities for why this occurred. During the baseline data collection, some participants who were responsible for using thermometers seemed knowledgeable in how to properly use thermometers and some participants did not. After all participants completed the training and examination, there were several job changes that occurred. Participants who were dishwashers were transferred to work at the fryer station. Participants who worked as utility were transferred to work at the grill and oven station. In the fryer and grill/oven stations, employees are frequently temping food and are responsible for gauging internal temperatures of the food being held on buffet line. These participants did not have previous experience with thermometers and did not know how to properly use a thermometer. All of the time-temperature and thermometer training they gained was through the online training program and examination. Information about time-temperature control and abuse, minimum internal temperatures of various types of food, minimum internal temperature of hot held foods, and minimum internal temperatures of reheating food are all pieces of important information one needs to be knowledgeable in for the proper utilization of a thermometer, and consequently, one of the keys to controlling the safety of food. The training may simply have been overwhelming to the participants. Participants did not engage in hands-on training and were not familiar with correct utilization and application of thermometers. Also, since food safety training was not continuously reviewed; the participants more than likely to forget what they learned.

Food properly cooled using acceptable cooling methods proved statistically insignificant. Food properly cooled using acceptable cooling methods behavior also

showed a decrease in the number of correctly practiced instances post-food safety training. Before the training program, the behavior yielded a 30.30% frequency of correctly practiced instances. After the training program, the behavior decreased to a 27.59% frequency. Although this is a 2.71% decrease in the number of correctly practiced instances the behavior was witnessed, it needs to be noted since there was a decrease in the number of times this behavior was correctly practiced, especially after a food safety training program where this behavior was addressed. This could also be contributed to the transfer of employees to different positions in the kitchen, since these employees were again responsible for properly cooling food, and they did not understand the acceptable methods of cooling food. The behavior only had a 28.57% correct practice frequency out of the total number of instances of both pre- and post-training observations.

5.4 Applications of the Study

If foodservice workers are not practicing sanitation with regards to personal hygiene, cross-contamination, and time-temperature control when handling food, there is an allowance of microorganism growth to reach unsafe levels thereby risking a contamination of the product, endangering the consumer's life, as well as harming the reputation and life of the establishment. It is necessary to determine the factors that prohibit foodservice employees from practicing food safety. If the lack of behavioral practices is a result of inadequate instruction, then different teaching methods need to be implemented. Baldwin and Ford's Transfer of Training Model (TpB) involves training inputs such as training design and work environment, training outputs such as learning and retention, and conditions of transfer which are the generalization and

maintenance of training (Yamnill & McLean, 2001). Learning is an internal behavior, this knowledge in relation to the Transfer of Training Model should put a significant amount of emphasis on training outputs with regards to performance, not solely learning. If sanitation behavioral practices are inhibited by the foodservice employees' attitudes or work environment, then TpB can be used to examine factors that influence behavior (Roberts, 2008).

Since there are high levels of foodborne illness outbreaks in the United States every year, active practice of food safety by foodservice employees needs to be improved upon. Groups that can use the knowledge gained from this study are establishments in the foodservice industry, more specifically individuals such as owners, general managers, and managers in these foodservice operations. It is the management's responsibility to gather the necessary information concerning food safety and convey the information to their employees. Management must also take an active role in the preservation of food safety knowledge their food handlers have acquired. Food safety is best learned, retained, and practiced if the training sessions are conducted on a regular basis. New instructional materials such as improved videos or sanitation demonstrations can be developed. Through the demonstration of sanitation, the instructors can use active training sessions to assess the current performance of the foodservice employees and then modify their misapplications. The applications this study contains can strongly contribute to the improvement of the industry by detecting the poor sanitation practices that are most frequently exercised by foodservice employees, then determining the reason for why foodservice employees practice poor sanitation. Once these behavioral reasons have been determined, this information can be used to develop more effective sanitation

training programs or train the food safety instructors more effectively on ways to convey the importance of sanitation to foodservice employees in the industry.

5.5 Limitations of the Study and Suggestions for Future Study

Reactivity was likely to occur in the study since the researcher was not an employee of the buffet restaurant and spent multiple hours in the kitchen observing food safety behavioral instances conducted by the participants. Reactivity is a phenomenon that occurs when individuals alter their performance or behavior due to the awareness that they are being observed (Ary et al., 2006). Participants were aware that an unknown individual was watching their actions and it was very likely the participants would become more conscious of their food safety actions and perform food safety more accurately as well as in the right instances. Managers might have become more sensitive about the level of food safety being evaluated in the buffet kitchen by an unknown individual, which could have caused supervisors and management level employees to be more alert in practice of food safety by their employees, therefore correcting their employees in their food safety actions or fixing the food safety error before the error occurred. In addition to managers becoming more aware of food safety within the establishment, reactivity could have also been heightened by co-workers watching out for fellow co-workers in the instances of correcting each other's food safety behaviors or fixing them before the errors occurred. Reactivity is commonly known due to the famous Hawthorne Effect study. Factory workers improved their productivity when they were aware a group of researchers were observing them. After the study concluded, the factory workers' productivity decreased.

Observation bias can occur when the observer's expectations about behavior lead to systematic errors in identifying and recording behavior as well as when the researcher's biases determine which behaviors they choose to observe. Observation bias was controlled by having specific definitions for each behavior that was being observed so that the researcher would not deviate from what was being observed and record something other than what was listed in the definition for each behavior.

Another limitation is the study cannot be generalizable to the population. The researcher must demonstrate that the sample correctly represents the population and utilize a sample that allows so (Ary et al., 2006). The food handler of which their behaviors were studied, were selected out of a convenience sample which does not allow generalizations to be made to all food handlers in the United States.

The selection of the population sought for the study was limited because of several obstacles. One considerable factor that narrowed the selection of the population was the unwillingness of the population to participate in the study. Populations were unwilling to partake in the study since they felt it could be damaging to the reputation of the company if customers thought the foodservice establishment was not taking precautions with the production of food. Also, populations were unwilling to partake in the study with concern for their employees. Employees might speculate that their recorded behaviors witnessed by the researcher could be used to expose their food safety neglect and terminate their employment with the company. Another notable limitation factor was the lack of funding for travel. The researcher was only permitted to travel a distance of 30 miles for the study. Last, another limitation factor of the selection of the population was the amount of data collection time allowed for researcher.

5.6 Summary

The first section provided a summary of the study then the second section presented the results and implications. The third section supplied applications of the study. Finally, the last section presented the limitations of the study and provided suggestions for future similar studies.

APPENDIX A

CAMPUS INSTITUTIONAL REVIEW BOARD EXEMPT APPROVAL LETTER

Dear Investigator:

Your human subject research project entitled The Observation of Food Safety Behavioral Practices in Foodservice Employees After Food Safety Training and Examination was reviewed and APPROVED as "Exempt" on July 29, 2009 and will expire on July 29, 2010. Research activities approved at this level are eligible for exemption from some federal IRB requirements. Although you will not be required to submit the annual Continuing Review Report, your approval will be contingent upon your agreement to annually submit the "Annual Exempt Research Certification" form to maintain current IRB approval. You must submit the "Annual Exempt Research Certification" form by June 14, 2010 to provide enough time for review and avoid delays in the IRB process. Failure to timely submit the certification form by the deadline will result in automatic expiration of IRB approval. (See form: http://irb.missouri.edu/eirb/ <http://research.missouri.edu/cirb/>)

If you wish to revise your activities, you do not need to submit an Amendment Application. You must contact the Campus IRB office for a determination of whether the proposed changes will continue to qualify for exempt status. You will be expected to provide a brief written description of the proposed revisions and how it will impact the risks to subject participants. The Campus IRB will provide a written determination of whether the proposed revisions change from exemption to expedite or full board review status. If the activities no longer qualify for exemption, as a result of the proposed revisions, an expedited or full board IRB application must be submitted to the Campus IRB. The investigator may not proceed with the proposed revisions until IRB approval is granted.

Please be aware that all human subject research activities must receive prior approval by the IRB prior to initiation, regardless of the review level status. If you have any questions regarding the IRB process, do not hesitate to contact the Campus IRB office at (573) 882-9585.

Campus Institutional Review Board

INFORMED CONSENT FOR STUDY PARTICIPATION

Researcher:
Lerin Dirks
Hotel and Restaurant Management
University of Missouri-Columbia

Advisor:
Dr. James Groves
Associate Professor
Hotel and Restaurant Management
University of Missouri-Columbia

Project Title: The Observation of Food Safety Behavioral Practices in Foodservice Employees after Training and Examination

YOU ARE BEING ASKED TO VOLUNTEER TO PARTICIPATE IN A RESEARCH PILOT STUDY.

You are being asked to volunteer to participate in a research pilot study which is being conducted to help develop training methods and to decrease the number of unsafe food practices that occur in back-of-the-house operations. You have the right to be informed about the procedures and your role in the study in order to decide whether you would like to participate. Please feel free to ask the researcher about any words or procedures that you do not understand. Your participation is **voluntary**; you do not have to be in the study if you wish not to and you may stop your participation in the study at any time.

The purpose of the pilot study is to discover if a food safety training program has any impact on the overall number of actively practiced food safety behaviors throughout a back-of-the-house operation. The study is expected to last from September 14th, 2009 until October 14th, 2009. There will be a series of pre-training observations and a series of post-training observations. You only have to perform the normal daily tasks associated with your position. You will not be asked to do anything more.

Your participation in this study will benefit the contribution to an increasing body of knowledge on the impact that training has on practiced food safety behaviors as well as helping modify your practice of food safety behaviors and becoming more aware of your actions as you work. There are no potential risks for you to be exposed to from your participation in this study other than what you will encounter daily as you work during your shift.

Even though all that will be studied and documented in this study are **only behaviors among all participants and not certain individuals**, there will be nothing documented to connect you to the specific behaviors you will perform in the kitchen. Your identity, participation, and practiced behaviors in the kitchen will all remain confidential. Informed Consent is an ongoing process that requires communication between the researcher and participants. You will be informed of any changes or new information discovered during the study that might influence your willingness to be in this study.

Please contact **Lerin Dirks** if you have questions about the research. Additionally, you may ask questions, voice concerns, or complaints to her advisor**, Dr. James Groves**.

Researcher Contact Information:
Lerin Dirks
122 Eckles Hall
Columbia, Missouri 65211
(Contact information has been omitted to protect privacy of researcher)

The Campus Institutional Review Board approved this study. If you have questions about your rights, concerns, complaints, or comments about the research, you may contact the Campus Institutional Review Board. You can contact the Campus Institutional Review Board directly by telephone or email.

Campus Institutional Review Board
483 McReynolds Hall
Columbia, Missouri 65211
573.882.9585
E-Mail: umcresearchcirb@missouri.edu
Website: http://www.research.missouri.edu/cirb/index.htm

A copy of this Informed Consent form will be given to you before you participate in the research.

I have read this consent form and my questions have been answered. My signature below means that I do want to be in the study. I know that I can remove myself from the study at any time without problems.

_____	_____
Your signature	Date
_____	_____
Legal Guardian/Advocate/Witness Signature	Date
_____	_____
Additional Signature	Date

Behavioral Observation Instrument PILOT STUDY

Date: _____

Observation Time: _____ until _____

Area Observed: _____

Mark "yes" if behavior was conducted correctly and at appropriate instances.
Mark "no" if behavior was conducted incorrectly, not conducted at appropriate instances, or not fully conducted.
Record the time instance occurred on the line next to check-marked box.

I. PERSONAL HYGIENE

1.) Hand washing

YES:

❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____

NO:

❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____

2.) Hand maintenance

YES:

❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____

NO:

❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____

3.) Bare-hand contact with ready-to-eat food

YES:

❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____

NO:

❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____

NOTES:

II. CROSS-CONTAMINATION

1.) Sanitize work surfaces and utensils after cutting raw food

YES:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

NO:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

2.) Ready-to-eat food and raw food are prepped separately

YES:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

NO:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ___
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

3.) Raw foods are stored below ready-to-eat foods in walk-in

YES:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

NO:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

NOTES:

III. TIME-TEMPERATURE CONTROL

1.) Food is thawed using acceptable methods

YES:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

NO:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

2.) Internal temperature of held food checked every two hours

YES:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

NO:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

3.) Food is cooled using acceptable cooling methods

YES:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

NO:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

NOTES:

LETTER OF PERMISSION FROM PARTICIPATING COMPANY

July 21, 2009

University of Missouri-Columbia
Hotel and Restaurant Management
Association of College of Agriculture,
Food, and Natural Resources

To Whom It May Concern:

Per Ms. Dirks' request, the (*name of company has been omitted to protect privacy of establishment*) approves Lerin Dirks of the Hotel and Restaurant Management Graduate Program, to conduct the Observation of Food Safety Behavioral Practices in Foodservice Employees after Food Safety Training and Examination study at our property.

The observation study is being conducted to discover if a food safety training program has any impact on the overall number of actively practiced food safety behaviors in the kitchen. Lerin Dirks will hold an informational meeting to explain to our foodservice employees the purpose of her study, field any questions, and to ask for their participation. She will be obtaining written consent as well as asking the employees who wish to participate to fill out a demographic questionnaire, which is also voluntary. There will be a series of pre-training observations, followed by the food safety training session and exam, and then a series of post-training observations. The observations will take place in our kitchen and each observation will last a maximum of two hours. Lerin Dirks will be using a checklist with nine different food safety behaviors she is looking for the employees to engage or not engage in.

We understand that this is a study where Lerin Dirks will be conducting on-site pre-training and post-training observations of our foodservice employees; even though we are requiring our foodservice employees to attend the food safety training session and examination, it is not mandatory for the employees to partake in the observations required for the study. The foodservice employees' participation in the observation study is entirely voluntary.

All parties agreed that any foodservice employee who wishes to participate in the study, that their behaviors observed will not contribute to any kind of performance review or termination of their position. None of the information from the demographic questionnaire or from the observation checklist will have employees' names listed on it nor will any distinguishing characteristics that may describe or distinguish a person in any way. The employees will be made aware at the informational meeting that their

participation in Lerin Dirks' study will have no impact on their employment at the (*name of company has been omitted to protect privacy of establishment*) as well as no impact on their performance reviews and in no way can the behaviors they perform in the kitchen be linked to their names. The employees' participation in this study will not place them at any risk.

All parties agreed that names, pictures of employees or guests, and any other proprietary information obtained through the study will not be published or released to the public.

If you have any questions, please contact Laura Pfeiffer, Director of Human Resources and Community Development at (*phone number has been omitted to protect privacy of establishment).*

Sincerely,

Laura Pfeiffer, Director
Human Resources and Community Development

INFORMED CONSENT FOR STUDY PARTICIPATION

Researcher:
Lerin Dirks
Hotel and Restaurant Management
University of Missouri-Columbia

Advisor:
Dr. James Groves
Associate Professor
Hotel and Restaurant Management
University of Missouri-Columbia

Project Title: The Observation of Food Safety Behavioral Practices in Foodservice Employees after Training and Examination

YOU ARE BEING ASKED TO VOLUNTEER TO PARTICIPATE IN A RESEARCH STUDY.
You are being asked to volunteer to participate in a research study which is being conducted to help develop training methods and to decrease the number of unsafe food practices that occur in back-of-the-house operations. You have the right to be informed about the procedures and your role in the study in order to decide whether you would like to participate. Please feel free to ask the researcher about any words or procedures that you do not understand. Your participation is **voluntary**; you do not have to be in the study if you wish not to and you may stop your participation in the study at any time.

The purpose of the study is to discover if a food safety training program has any impact on the overall number of actively practiced food safety behaviors throughout a back-of-the-house operation. The study is expected to last from July 25, 2009 until May 12, 2010. There will be a series of pre-training observations, a food safety training program, and a series of post-training observations. You, as a participant if you choose to partake in the study, will be asked by mandatory request of your employer, (*name of company has been omitted to protect privacy of establishment*) to engage in a food safety training program, followed by an examination on what you have learned. You will also be asked to fill out a demographic questionnaire that will only be used to describe the population being studied. Besides the food safety training program and demographic questionnaire, you only have to perform the normal daily tasks associated with your position. You will not be asked to do anything more.

There will be 55 people asked to participate in this study at the (*name of company has been omitted to protect privacy of establishment*) and your participation in this study will benefit the contribution to an increasing body of knowledge on the impact that training has on practiced food safety behaviors as well as helping modify your practice of food safety behaviors and becoming more aware of your actions as you work. There are no potential risks for you to be exposed to from your participation in this study other than what you will encounter daily as you work during your shift.

Even though all that will be studied and documented in this study are **only behaviors among all participants and not certain individuals**, there will be nothing documented to connect you to the specific behaviors you will perform in the kitchen. Your identity, participation, and practiced behaviors in the kitchen will all remain confidential. Your name and information will not be given to anyone outside the research team. The information collected from the demographic questionnaire, which is anonymous, will only be used to describe the population being studied. The behavior data will be shared with the researcher's committee and when the study is published, the employer's name, (*name of company has been omitted to protect privacy of establishment*) will be omitted from the published copy to protect the employer's and subjects' privacy.

Informed Consent is an ongoing process that requires communication between the researcher and participants. You will be informed of any changes or new information discovered during the study that might influence your willingness to be in this study.

Please contact **Lerin Dirks** if you have questions about the research. Additionally, you may ask questions, voice concerns, or complaints to her advisor**, Dr. James Groves**.

Researcher Contact Information:
Lerin Dirks
122 Eckles Hall
Columbia, Missouri 65211
(Contact information has been omitted to protect privacy of researcher)

The Campus Institutional Review Board approved this study. If you have questions about your rights, concerns, complaints, or comments about the research, you may contact the Campus Institutional Review Board. You can contact the Campus Institutional Review Board directly by telephone or email.

Campus Institutional Review Board
483 McReynolds Hall
Columbia, Missouri 65211
573.882.9585
E-Mail: umcresearchcirb@missouri.edu
Website: http://www.research.missouri.edu/cirb/index.htm

A copy of this Informed Consent form will be given to you before you participate in the research.

I have read this consent form and my questions have been answered. My signature below means that I do want to be in the study. I know that I can remove myself from the study at any time without problems.

_____ _____
Your signature Date

_____ _____
Legal Guardian/Advocate/Witness Signature Date

_____ _____
Additional Signature Date

STATEMENT OF STUDY PARTICIPATION

You are being asked to participate in the Observation of Food Safety Behavioral Practices in Foodservice Employees after Training and Examination research study. This study will in no way cause physical, social, economic, legal, or psychological harm to you and there is minimal to no risk associated with this study. This study will have no impending effect on your employment with the (*name of company has been omitted to protect privacy of establishment*). Your participation in this study will not affect any job performance review you will receive while being employed at the (*name of company has been omitted to protect privacy of establishment*) nor will it contribute to any termination of a position with this place of employment.

I, _____, on the month and day of

_____ in the year of _____ have read the statement above and understand that any performance review I receive or termination of my position at the (*name of company has been omitted to protect privacy of establishment*) during the length of this study is not a result of my participation in the Observation of Food Safety Behavioral Practices in Foodservice Employees after Training and Examination study.

Hotel and Restaurant Management Program
University of Missouri-Columbia

Back-of-the-House Employee Demographic Questionnaire

Directions: Please read each question and check the appropriate response.

1. What is your age? *Please check one.*
   - ❍ 18 and under
   - ❍ 19 – 29
   - ❍ 30 – 39
   - ❍ 40 – 49
   - ❍ 50 and over

2. What is your gender? *Please check one.*
   - ❍ Female
   - ❍ Male

3. What is the last grade of school you completed? *Please check all that apply.*
   - ❍ Some high school
   - ❍ Graduated high school (Grade 12)
   - ❍ Vocational/technical school/trade school
   - ❍ Some college
   - ❍ Graduated college
   - ❍ Post-graduate degree

4. What is your job position? _____

5. How long have you been working in the foodservice industry? *Please check one.*
   - ❍ Less than 1 year
   - ❍ 1- 2 years
   - ❍ 3-4 years
   - ❍ 5-6 years
   - ❍ 7-10 years
   - ❍ More than 10 years

6. Have you completed any course and/or training in food safety and sanitation? *Please check one.*
   - ❍ Yes
   - ❍ No

7. Have you completed any ServSafe courses (ServSafe Food Safety or ServSafe Alcohol) prior to this training session? *Please check one.*
   - ❍ Yes
   - ❍ No

This is the end of the questionnaire.
I would like to THANK YOU for your participation in this study!!!

Behavioral Observation Instrument

Date: _____

Observation Time: _____ until _____

Area Observed: _____

Mark "yes" if behavior was conducted correctly and at appropriate instances.
Mark "no" if behavior was conducted incorrectly, not conducted at appropriate instances, or not fully conducted.
Record the time instance occurred on the line next to check-marked box.

I. PERSONAL HYGIENE

1.) Hand washing

YES:

❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____

NO:

❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____

2.) Hand maintenance

YES:

❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____

NO:

❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____

3.) Bare-hand contact with ready-to-eat food

YES:

❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____

NO:

❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____
❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____ ❒ ____

NOTES:

II. CROSS-CONTAMINATION

1.) Sanitize work surfaces and utensils after cutting raw food

YES:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

NO:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

2.) Ready-to-eat food and raw food are prepped separately

YES:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

NO:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ___
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

3.) Raw foods are stored below ready-to-eat foods in walk-in

YES:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

NO:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

NOTES:

III. TIME-TEMPERATURE CONTROL

1.) Food is thawed using acceptable methods

YES:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

NO:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

2.) Internal temperature of held food checked every two hours

YES:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

NO:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

3.) Food is cooled using acceptable cooling methods

YES:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

NO:

❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____
❒ ____ ❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____❒ ____ ❒ ____

NOTES:

REFERENCES

Anonymous. (1985). *Applied foodservice sanitation* (3rd ed.). Hoboken, NJ: John Wiley and Sons.

Arendt, S.W., & Sneed, J. (2008). Employee motivators for following food safety practices: Pivotal role of supervision. *Food Protection Trends, 28* (10), 704-711. Retrieved from http://www.nxtbook.com/nxtbooks/trilix/fpt_200810/index.php?startid=698

Ary, D., Jacobs, L.C., Razavieh, A., & Sorensen, C. (2006). *Introduction to research in education* (7th ed.). Belmont, CA: Thomson Wadsworth.

Baş, M., Ersun, A.S., & Kivanç, G. (2006). The evaluation of food hygiene knowledge, attitudes, and practices of food handlers' in food businesses in Turkey. *Food Control, 17* (4), 317-322. doi: 10.1016/j.foodcont.2004.11.006

Brown, L. (2010). *Observational field research.* Retrieved from http://www.socialresearchmethods.net/tutorial/Brown/lauratp.htm

Centers for Disease Control and Prevention. (1998). Multistate surveillance for food-handling, preparation, and consumption behaviors associated with foodborne diseases: 1995-1996 BRFSS food safety questions. *Morbidity and Mortality Weekly, 47* (SS-4), 33-54. Retrieved from http://www.cdc.gov/mmwR/preview/mmwrhtml/00054714.htm

Clayton, D.A., & Griffith, C.J. (2004). Observation of food safety practices in catering using notational analysis. *British Food Journal, 106* (3), 211-227. doi: 10.1108/00070700410528790

Clayton, D.A., & Griffith, C.J. (2008). Efficacy of an extended theory of planned behaviour model for predicting caterers' hand hygiene practices. *International Journal of Environmental Health Research, 18* (2), 83-98. doi: 10.1080/09603120701358424

Clayton, D.A., Griffith, C.J., Price, P., & Peters, A.C. (2002). Food handlers' beliefs and self-reported practices. *International Journal of Environmental Health Research, 12,* 25-39. doi: 10.1080-09603120120110031

Cotterchio, M., Gunn, J., Coffill, T., Tormey, P., & Barry, M.A. (1998). Effect of a manager training program on sanitary conditions in restaurants. *Public Health Reports,113,* 353-358. Retrieved from http://www.ncbi.nlm.gov/pmc/articles/PMC1308396/pdf/publichealthrep00033-0071.pdf

Cushman, J.W., Shanklin, C.W., & Niehoff, B.P. (2001). Hygiene practices of part-time student employees in a university foodservice operation. *The Journal of the National Association of College and University Food Service*, 37-43.

Daniels, N.A., Bergmire-Sweat, D.A., Schwab, K.J., Hendricks, K.A., Reddy, S., Rowe, S.M., Fankhauser, R.L., Monroe, S.S., Atmar, R.L., Glass, R.I., & Mead, P. (2000). A foodborne outbreak of gastroenteritis associated with Norwalk-like viruses: First molecular traceback to deli sandwiches contaminated during preparation. *The Journal of Infectious Diseases, 181*, 1467-1470. Retrieved from EBSCOhost database.

Deng, C. (2009, April 5). On biostatistics and clinical trials. Retrieved from http://onbiostatistics.blogspot.com/2009/04/least-square-means-marginal-means-vs.html. (14 October 2010).

Egan, M.B., Raats, M.M., Grubb, S.M., Eves, A., Lumbers, M.L., Dean, M.S., & Adams, M.R. (2006). A review of food safety and food hygiene training studies in the commercial sector. *Food Control, 18*, 1180-1190. doi: 10.1016/j.foodcont.2006.08.001

Farber, R.E., & Korff, F.A. (1958). Foodborne epidemic of group a beta hemolytic streptococcus. *Public Health Reports, 73* (3), 203-209. Retrieved from http://www.ncbi.nlm.gov/pmc/articles/PMC1951538/pdf/publichealthreporig00015-0015.p df

Graves, T.K., Bradley, K.K., & Crutcher, J.M. (1998). Outbreak of campylobacter enteritis associated with cross-contamination of food-Oklahoma, 1996. *JAMA, 279* (17), 1341. doi: 10.1001/jama.279.17.1341

Green, L.R. (2008). Behavioral science and food safety. *Journal of Environmental Health*, 71 (2), 47-49. Retrieved from http://www.foodprotect.org/media/positionreport/CDC%20-%20JEH%20Sept%2008.pdf

Green, L.R., Radke, V., Mason, R., Bushnell, L., Reimann, D.W., Mack, J.C., Motsinger, M.D., Stigger, T., & Selman, C.A. (2007). Factors related to food worker hand hygiene practices. *Journal of Food Protection, 70*, (3), 661-666. Retrieved from http://www.cdc.gov/nceh/ehs/EHSNet/Docs/JFP_Food_Worker_Hand_Hygiene.pdf

Green, L.R., & Selman, C. (2005). Factors impacting food workers' and managers' safe food preparation practices: A qualitative study. *Food Protection Trends, 25* (12), 981-990. Retrieved September 23, 2008, from http://www.ophp.oregon.gov/DHS/ph/foodsafety/snet/snetworkerarticle.pdf

Green, L.R., Selman, C.A., Radke, V., Ripley, D., Mack, J.C., Reimann, D.W., Stigger, T., Motsinger, M., & Bushnell, L. (2006). Food workers hand washing practices: An observation study. *Journal of Food Protection, 69* (10), 2417-2423. Retrieved from http://www.cdc.gov/nceh/ehs/EHSNet/Docs/JFP_Hand_Hygiene.pdf

Guzewich, J., & Ross, M.P. (1999). Evaluation of risks related to microbiological contamination of ready-to-eat food by food preparation workers and the effectiveness of interventions to minimize those risks. Retrieved from http://www.fda.gov/Food/FoodSafety/RetailFoodProtection/ucm210138.htm

Hedberg, C.W., Smith, S.J., Kirkland, E., Radke, V., Jones, T.F., & Selman, C.A. (2006). Systematic environmental evaluations to identify food safety differences between outbreak and nonoutbreak restaurants. *Journal of Food Protection, 69* (11), 2697-2707. Retrieved from http://www.sanjamar.com/html/PDFs/Outbreak.pdf

Howells, A.D., Roberts, K.R., Shanklin, C.W., Pilling, V.K., Brannon, L.A., & Barrett, B.B. (2008). Restaurant employees' perceptions of barriers to three food safety practices. *Journal of American Dietetic Association, 108*, 1345-1349. doi: 10.1016/j.jada.2008.05.010

Hume, S. (2005). Basics training. *Restaurants and Institutions*, 85-86. Retrieved from EBSCOhost database.

Jay, J.M., Loessner, M.J., & Golden, D.A. (2005). Effect of thawing. In Google Books. *Modern Food Microbiology* (7th ed.). Retrieved from http://books.google.com/books?id=C0sO1gNFWLAC&pg=PA403&lpg=PA403&dq=importance+of+properly+thawing+food&source=bl&ots=moDyH7gBTr&sig=U4a-6okeCAIJ7MHuCz-n86XB2mQ&hl=en&ei=cwFGTPKyBJKRnwfgguX5Aw&sa=X&oi=book_result&ct=result&resnum=9&ved=0CCwQ6AEwCDge#v=onepage&q&f=false

Juneja, V.K., Marks, H., & Thippareddi, H. (2008). Predictive model for growth of clostridium perfringens during cooling of cooked ground chicken. *Innovative Food Science and Emerging Technologies, 10*, 260-266. doi: 10.1016/j.ifest.2008.11.008

Krejcie, R.V., & Morgan, D.W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement, 30*, 607-610.

Lillquist, D.R., McCabe, M.L., & Church, K.H. (2005). A comparison of traditional handwashing training with active handwashing training in the food handler industry. *Journal of Environmental Health, 67* (6), 13-16.

Liu, D. (2010). Foodborne illness: What you need to know. *Foodconsumer*. Retrieved from http://www.foodconsumer.org/newsite/Safety/foodborne_illness_1508100343.html

Lynch, R.A., Elledge, B.L., Griffith, C.C., & Boatright, D.T. (2005). A comparison of food safety knowledge among restaurant managers, by source of training and experience, in Oklahoma County, Oklahoma. *Journal of Environmental Health, 66* (2), 9-13. Retrieved from EBSCOhost database.

Lynch, R.A., Phillips, M.L., Elledge, B.L., Hanumanthaiah, S., & Boatright, D.T. (2005). A preliminary evaluation of the effect of glove use by food handlers in fast food restaurants. *Journal of Food Protection, 68* (1), 187-190.

McCabe-Sellers, B.J., & Beattie, S.E. (2004). Food safety: Emerging trends in foodborne illness surveillance and prevention. *Journal of the American Dietetic Association, 104*, 1708-1717. doi: 10.1016/j.jada.2004.08.028

McSwane, D., Rue., N., & Linton, R. (2003). *Essentials of food safety and sanitation* (3rd ed.). Chicago, IL: National Restaurant Association Educational Foundation.

Medeiros, L., Hillers, V., Kendall, P., & Mason, A. (2001). Evaluation of food safety education for consumers. *Journal of Nutrition Education, 33* (1), S27-S34. Retrieved from EBSCOhost database.

Michaels, B., Keller, C., Blevins, M., Paoli, G., Ruthman, T., Todd, E., & Griffith, C.J. (2004). Prevention of food worker transmission of foodborne pathogens: Risk assessment and evaluation of effective hygiene intervention strategies. *Food Service Technology, 4* (1), 31-49. doi: 10.1111/j.1471-5740.2004.00088.x

Minnesota Department of Health. (2010). Food safety. *Food Safety Center: Food Businesses.* Retrieved from http://www.health.state.mn.us/divs/eh/food/fs/poweroout.html

Mitchell, R.E., Fraser, A.M., & Bearon, L.B. (2007). Preventing food-borne illness in food service establishments: Broadening the framework for intervention and research on safe food handing behaviors. *International Journal of Environmental Health Research, 17* (1), 9-24. Retrieved from EBSCOhost database.

Motarjemi, Y., & Kaferstein, F. (1998). Food safety, hazard analysis and critical control point and the increase in foodborne diseases: A paradox? *Food Control, 10*, 325-333. Retrieved from http://toxicolgy.usu.edu/endnote/Foodsafety-HACCP-pardox.pdf

National Restaurant Association Educational Foundation. (2004). Servsafe coursebook (3rd ed.). Chicago, IL: Wiley.

Park, S.H., Kwak, T.K., & Chang, H.J. (2010). Evaluation of the food safety training for food handlers in restaurant operations. *Nutritional Research and Practice, 4* (1), 58-68. doi: 10.4162/nrp.2010.4.1.58

Pilling, V.K., Brannon, L.A., Shanklin, C.W., Howells, A.D., & Roberts, K.R. (2008). Identifying specific beliefs to target to improve restaurant employees' intentions for performing three important food safety behaviors. *American Dietetic Association, 108* (6), 991-997. doi:10.1016/j.jada.2008.03.014

Pragle, A.S., Harding, A.K., & Mack, J.C. (2007). Food workers' perspective on handwashing behaviors and barriers in the restaurant environment. *Journal of Environmental Health, 69* (10), 27-32.

Psychology 202Q lab: Naturalistic observation. (n.d.). Retrieved from http://www.sp.uconn.edu/~ps202vc/PDF/NaturalisticObservation.pdf

Roberts, K.R. (2008). Using the theory of planned behavior to explore restaurant manager's support for employee food safety training (Doctoral dissertation, Kansas State University, 2008). *K-State Research Exchange*. Retrieved November 10, 2008, from http://hdl.handle.net/2097/591

Roberts, K.R., Barrett, B.B., Howells, A.D., Shanklin, C.W., Pilling, V.K., & Brannon, L.A. (2008). Food safety training and foodservice employees' knowledge and behavior. *Food Protection Trends, 28* (4), 252-260. http://krex.k-state.edu/dspace/Bitstream/2097/806/1/RobertsFPTApr2008.pdf

Rodríguez, C.M., & Gregory, S. (2005). Qualitative study of transfer of training of student employees in a service industry. *Journal of Hospitality and Tourism Research, 29* (1), 42-66. doi: 10.1177-1096348004270753

SAS Publishing. (1999). The GENMOD procedure. In *SAS/STAT User's Guide, Version 8*. Retrieved from http://www.okstate.edu/sas/v8/saspdf/stat/chap29.pdf

Seaman, P., & Eves, A. (2009). Perceptions of hygiene training amongst food handlers, managers and training providers- a qualitative study. *Food Control, 21* (7), 1037-1041. doi: 10.1016/j.foodcont.2009.12.024

Shaughnessy, J.J., Zechmeister, E.B., & Zechmeister, J.S. (2002). Observation. *Research Methods in Psychology* (Chapter 3). Retrieved from http://www.mhhe.com/socscience/psychology/shaugh/ch03_concepts.html

Simon, S. (2008, July 8). Stats: What is an odds ratio. Retrieved from http://www.childrens-mercy.org/stats/definitions/or.htm

Smith, R. (1994). Food hygiene training: The chance to create a coherent policy. *British Food Journal, 96* (7), 41-45.

Tokuç, B., Ekuklu, G., Berberoğlu, U., Bilge, E., & Dedeler, H. (2009). Knowledge, attitudes and self-reported practices of food service staff regarding food hygiene in Edirne, Turkey [Abstract]. *Food Control, 20* (6), 565-568.

United States Department of Agriculture. (2010). Refrigeration and food safety. *Safe Food Handling*. Retrieved from http://www.fsis.usda.gov/fact_sheets/Refrigeration_&_Food_Safety/index.asp

United States Food and Drug Administration. (2009). Management and personnel. *FDA Food Code 2009* (Chapter 2). Retrieved from http://www.fda.gov/Food/FoodSafeTy/RetailFoodProtection/FoodCode/FoodCode2009/ucm181242.htm

Wachukwu, C.K., Abbey, S.D., Ollor, A.O., & Obilor, N.L. (2007). Public health implication of artificial finger nails used by health workers and food handlers in Port Harcourt, Nigeria. *Journal of Applied Sciences 7* (22), 3580-3583. Retrieved from http://scialert.net/qredirect/php?doi=jas.2007.3580.3583&linkid=pdf

Wallerstein, N., & Weinger, M. (1992). Health and safety education for worker empowerment. *American Journal of Industrial Medicine, 22*, 619-635.

Washington State Department of Health. (2005). Food safety is everybody's business: Your guide to preventing foodborne illness. Washington State Food and Beverage Worker's Manual. Retrieved from http://www.co.whatcom.wa.us/health/pdf/food_handlers_manual.pdf

Yamnill, S., & McLean, G.N. (2001). Theories supporting transfer of training. *Human Resource Development Quarterly, 12* (2), 195-208.