Handwashing frequency: current and desired handwashing practices in deli-type retail foodservice establishments

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Handwashing frequency: Current and desired handwashing practices in deli-type retail foodservice establishments

by

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A thesis submitted to the graduate faculty in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Foodservice and Lodging Management

Program of Study Committee:
Catherine Strohbehn, Major Professor
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Ames, Iowa
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This is to certify that the master's thesis of
Paola Paez
has met the thesis requirements of Iowa State University

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ABSTRACT

The safety of food served and the prevention of foodborne illness are major concerns of foodservice establishments. The purpose of this study was to develop and pilot test a handwashing observation form (HOF) to determine current and desired handwashing frequencies and methods used by employees in deli types of retail foodservice establishments in one Midwestern state. Handwashing benchmarks were proposed for production and service phases.

Two in-depth field observations were conducted in each of five deli foodservice operations. A HOF based on Food Code’s (FDA, 2001) recommendations for handwashing frequencies and methods as well as best practices was developed to record observed handwashing behavior. An informal interview with the site manager during one of the observation periods also was conducted.

A total of 15 employees was observed during the visits; 10 employees were observed during production and 12 during service. The mean average number of hours worked each week by employees was 16.5. All managers of these operations were male and half (n=2) had five or more years of work experience in the foodservice industry.

All operations had only one handwashing sink located in the sandwich assembly and service area. All operations met Food Code (FDA, 2001) requirements of provision of soap and available supply of disposable towels. Of the 5 operations, 3 had both hot and cold running water as required in Food Code.

Results from this study indicated that during production and service phases, employees in deli foodservice operations were not washing their hands at times required by
law (FDA, 2001). With the exception of two tasks, the percent of handwashing frequency for each specific task was very low (less than 50%) during production and service phases.

Most employees tended to use only one or two steps of the three-step handwashing process described in *Food Code* (FDA, 2001); such as rinsing hands with water only. Handwashing in-compliance with *Food Code* was observed only for two tasks during the service phase “before employees engaged in food preparation” and “before returning to the preparation area”. Benchmarks of handwashing frequencies based on observations for both production and service phases of when hands should be washed in deli foodservice operations were proposed.
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CHAPTER I. INTRODUCTION

Background

The safety of food served and the prevention of foodborne illness are major concerns for foodservice establishment managers because it is their responsibility to ensure the safety of food prepared and served to customers. Between 250 and 350 million Americans are estimated to suffer acute gastroenteritis annually, of which 25% to 30% is thought to be caused by foodborne illnesses (McCabe-Sellers & Beattie, 2004). It has been estimated that over 76 million illnesses and 5,000 deaths related to foodborne illnesses occur annually in the United States (Mead et al., 1999). This study indicated foodborne illnesses caused fewer deaths than previously thought. A decrease in the number of deaths related to foodborne illness is positive, but considering that illnesses continue to rise, food safety is still a major concern.

People at greatest risk for foodborne illnesses are the elderly, pregnant women, immune-comprised individuals, and young children. Gerba, Rose, and Haas (1996) mentioned that weakened immune systems in the elderly and other immune-comprised groups are due to aging, chronic illness, or increased medications. Children younger than five years are at a higher risk of death from diarrhea than older children and adults, with infants at the highest risk of death (Luby, Agboatwalla, Painter, Altaf, Billhimer, & Hoekstra, 2004).

Etiology of foodborne illnesses is complex. The majority of cases of foodborne diseases is from unknown causes, with viruses and bacteria as the most likely causative agents. It has been reported that Caliciviridae virus cases are more difficult to identify but represent the most common cause of known and probably unknown cases (Mead et al., 1999). Norwalk-like viruses (NLV), "a type of small round structured virus classified within
the Caliciviridae family, have been recognized since the 1970’s as being responsible for epidemic gastroenteritis” (Ferson, Ressler, Mclever, Isaacs, & Rawlinson, 2000, p. 342).

There are different types of bacterial pathogens that can cause foodborne illnesses. In 1988, 451 outbreaks involving 15,732 cases of foodborne diseases were reported to Centers for Disease Control and Prevention (CDC). Bacterial pathogens accounted for 139 of these outbreaks. Salmonella spp. was identified as the bacteria that caused most of the outbreaks, followed by Clostridium botulinum, and Staphylococcus aureus (CDC, 1996).

It is important to identify causes of foodborne illnesses but also recognize contributing practices in foodservice establishments. Bryan’s study (1988) concluded that poor personal hygiene was found to be the cause or a contributing factor in 24.2% of 660 outbreaks that resulted from mishandling of foods in foodservice establishments during 1973-1982. Collins (1997) noted that from 1983 to 1992, two practices of retail establishments most commonly reported as contributing to foodborne illness were improper holding or storage temperatures and poor personal hygiene among food handlers.

Handwashing is one hygiene practice that personnel from foodservice operations do not always follow. The Food and Drug Administration (FDA) (2003) stated that transmission of viruses, bacteria, and parasites from raw food or from ill workers to food by way of improperly washed hands continues to be one of several major factors in the spread of foodborne illness. In retail foodservice settings, foodborne pathogens are transmitted through the fecal-oral route from contaminated hands to food items (FDA, 2003). Inadequate handwashing by all workers is an important contributing factor to foodborne disease outbreaks in retail foodservice establishments (Alwood, Jenkins, Paulus, Johnson, & Hedberg, 2004). Infected food workers can transmit foodborne pathogens by touching food
or food contact surfaces with contaminated hands. Ignorance of the importance of handwashing and failure to do so are some of the key challenges to foodservice operators in prevention of foodborne illnesses. Proper handwashing is one of the most effective actions to prevent cross-contamination and minimize transfer of microorganisms to ready-to-eat foods in institutional kitchens (Chen, Jackson, Chea, & Schaffner, 2001).

According to Larson (1995), “handwashing is the removal of soil and transient microorganisms from hands” (p.257). Closely related to handwashing is hand antisepsis, defined as “a process for the removal or destruction of transient microorganisms” (Larson, 1995, p.257). Common sense indicates hands should be washed at least when visibly soiled, yet it is important to consider that pathogens can not be seen, thus making it important for foodservice personnel to wash their hands on a regular basis using proper methods as stated in the Food Code (FDA, 2001).

In 2003, FDA Regional and Retail Food Specialists collected data, using direct observations and discussions with managers and food workers in various sectors in foodservice to document establishments’ compliance status for 42 data items including proper and adequate handwashing (FDA, 2003). According to this study, the second foodborne illness risk factor in delis that needed attention was poor personal hygiene, with a 23.5% out-of-compliance rate (FDA, 2003).

Proper handwashing frequency and methods may vary from setting to setting depending on the type of foodservice establishment and menu items. Handwashing should be done after the following activities: cleaning equipment and utensils; handling unwrapped, single-service, and single-use articles; handling processed fresh produce; touching bare
human body parts other than clean hands and clean, exposed portions of arms; and using the toilet room (FDA, 2003).

Purpose of the Study

The purpose of this study was to develop and pilot test a handwashing observation form (HOF) to determine current and desired handwashing frequencies and methods used by employees in deli-type retail foodservice establishments in Iowa. These deli foodservice operations serve a variety of ready-to-eat foods that do not require a heat process (or cook step) after preparation; thus safe handling is important to prevent foodborne illnesses. Collected data was used as a basis for establishing benchmarks and training sessions for deli operations.

Specific objectives were to:

1. Develop and pilot test a handwashing observation form (HOF).
2. Determine frequency of handwashing by employees in each deli retail foodservice establishment during pre-preparation and service tasks.
3. Observe handwashing methods used by employees in deli retail foodservice establishments.
4. Compare the average number of times per day hands were washed by employees with the number of times per day each employee should have washed hands.
5. Propose handwashing frequency benchmarks for deli retail foodservice establishments.
Statement of the Problem

Food safety knowledge is important to prevent foodborne illness. Main causes of foodborne illnesses in foodservice establishments are improper cooling, inadequate reheating, improper hot holding, and employee hygiene. Improper handwashing has been identified as one employee hygiene practice that causes food contamination (Bryan, 1988). Limited research initiatives have focused on field studies to examine actual employee practices that contribute to cross contamination and, ultimately, foodborne illness. There is limited information about handwashing compliance but no information about handwashing benchmarks for different types of foodservice retail establishments.

In this study a handwashing observation form (HOF) to determine current and desired handwashing frequencies and methods used by employees in deli-type retail foodservice was developed and pilot tested. Benchmarks for this type of operations were proposed.

Definitions of Terms

For this study the following terms are defined:

Confirmed disease outbreak: foodborne disease outbreak in which laboratory analysis of appropriate specimens identifies a causative agent and epidemiological analysis, food is identified as the source of the illness (FDA, 2001).

Consumer: person who is part of the public, who is going to ingest food, is not functioning in the capacity of an operator of a food establishment, and does not offer the food for resale (FDA, 2001).
Contamination: presence of harmful substances in food or contact surfaces. Some contaminants occur naturally while others are introduced by humans or the environment (National Restaurant Association Educational Foundation, 2004).

Cross-contamination: “the transfer of microorganisms from one surface or food to another” (National Restaurant Association Educational Foundation, 2004, p. G3).

Foodservice employee: person having supervisory, or management duties, person on the payroll, person performing work under contractual agreement, or other person working in a foodservice establishment (Food Code, 2001).

Food Code: publication of the U.S. Food and Drug Administration (FDA) that provides guidance on food safety, sanitation, and a legal basis for regulating the retail and foodservice segment of the industry (Guzewich, & Ross, 1999b).

Food: raw, cooked, or processed edible substance, beverage, or ingredient used or intended for use or for sale in whole or in part for human consumption (FDA, 2001).

Foodborne illness outbreak: the occurrence of two or more cases of a similar illness resulting from the ingestion of a common food (FDA, 2001).

Foodservice establishment: facility that stores, prepares, packages, serves, or otherwise provides food for human consumption (FDA, 2001).


High-risk populations: “people susceptible to foodborne illness due to the effects of age or health on their immune systems. This group can include infants and preschool-age children, pregnant women, older people, people taking certain medications, and those with
certain diseases or weakened immune system” (National Restaurant Association Educational Foundation, 2004, p. G7).

**Personal hygiene:** habits that include keeping body, hair, and teeth clean, maintaining good health, wearing clean clothes, and washing hands regularly, especially when handling foods and beverages (National Restaurant Association Educational Foundation, 2004).

**Ready-to-eat food:** food that is in a form that is going to be consumed by the consumer without cooking after preparation, for example salads or sandwiches (FDA, 2001).

**Resident microorganism:** organism that normally reside on the skin, such as the skin of the hands (Guzewich & Ross, 1999b).

**Risk:** the likelihood that an adverse health effect will occur within a population because of a hazard presented in food (*Food Code*, 2001).

**Transient microorganism:** skin contaminants that are acquired from environmental sources and become attached to the outer epidermal skin layer (Guzewich & Ross, 1999b, p.13).
CHAPTER II. REVIEW OF LITERATURE

Introduction

Prevention of foodborne illnesses is one of the primary responsibilities of the foodservice industry (Cushman, Shanklin, & Niehoff, 2001). Retail foodservice operations often produce large quantities of different types of food in the same area, which creates a risk environment for outbreaks of foodborne disease.

Segments of the population at high risk of experiencing foodborne illness are the elderly, infants, young children, pregnant women, and those who are immune-comprised, such as patients undergoing chemotherapy and organ transplants. Elderly individuals are at high risk because of weakened immune systems (Buzby, 2002). Infants and young children have not yet fully developed their immune and digestive systems. During pregnancy, women’s immune systems are altered and they themselves may act as a source of infection for neonates. If immune systems are weakened or not yet fully developed, the body is less likely to fight pathogenic organisms such as bacteria or viruses (Gerba, Rose, & Haas, 1996).

Improper personal hygiene practices, including poor handwashing, have been identified as causes of foodborne illness (Guzewich & Ross, 1999a). People in charge of foodservice operations have the responsibility of training their employees about proper handwashing frequency and methods. Frequency of handwashing will depend on characteristics of the establishment, such as food items prepared and served. Guzewich and Ross (1999a) noted that foods such as salads, sandwiches, and miscellaneous hot food items that required extensive hand contact during preparation accounted for the majority of foods associated with outbreaks during the years 1975-1988. Strohbehn, Gilmore, and Sneed (2004) reported that some of the concerns about food safety held by registered dietitians and
dietary managers in assisted-living facilities and long term care operations were inexperienced employees, lack of knowledge about handwashing, and lack of handwashing practices.

For this study, previous research related to handwashing in retail foodservice establishments was reviewed. Literature was reviewed in areas of outbreaks of foodborne illness and causes, high-risk populations, retail foodservice establishments, and handwashing practices.

Outbreaks of Foodborne Illness and Causes

Causative Agents

Outbreaks of foodborne illness are a concern to health authorities in the United States (U.S.). Mead et al. (1999) estimated foodborne diseases cause approximately 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths in the U.S. each year. Causative agents of foodborne illness are viruses, bacteria, parasites, toxins, and metals. Symptoms of foodborne illness range from mild gastroenteritis to life-threatening neurological, hepatic, and renal syndromes. Among all illnesses caused by foodborne agents, it was estimated that viruses caused 67%, bacteria 30%, and parasites 3% (Mead et al, 1999).

Many cases of foodborne illnesses can be found in the literature. In Oklahoma in 1996, an outbreak of campylobacter enteritis involving 16-20 people occurred due to cross-contamination. The Centers for Disease Control and Prevention (CDC) (1998) developed a case control study and reported that lettuce and lasagna were statistically associated with the illness. All people included in the outbreak ate lettuce and 79% consumed lasagna. The researchers concluded that employees handled raw chicken improperly and probably
contaminated the lettuce or lasagna with *Campylobacter jejuni* from the raw chicken by not washing or inadequately washing their hands, cooking utensils, or the countertop (CDC, 1998).

Between January 1996 and November 2000, 348 outbreaks of Norwalk-like virus (NLV) gastroenteritis were reported to CDC. Of those, 39% occurred in restaurants, 29% in nursing homes and hospitals, 10% in vacation venues, and 9% in other settings (CDC, 2001). A report from Minnesota indicated that from 1981 to 1998, 295 outbreaks of foodborne disease occurred in that state (Deneen et al., 2000). Of these, 120 (41%) met the epidemiologic criteria of NLV gastroenteritis (outbreaks with median incubation period of 24-48 hours, vomiting in 50% or more of the cases, and conclusion of symptoms within 12-60 hours). Of this 41%, a high proportion was associated with consumption of cold food items that had been handled by ill food workers. Of the 75 confirmed foodborne outbreaks associated with fresh produce vehicles during this period, 44 were associated with NLV. As a result, authors concluded, “Norwalk-like viruses are important causes of illness in restaurants and illness associated with fresh produce items” (Deneen et al., 2000, p. 283).

Feline calicivirus (FCV), which is nonpathogenic to humans, has been used as a surrogate for NLV in several studies (Clark & Lambden, 2000; & Lin et al., 2003). Clark and Lambden (2000) noted FCV and NLV belong to the same virus family and share similar characteristics, thus FCV is a useful substitute in bench research.

**Transfer of Pathogens to Food**

Bean, Griffin, Goulding and Ivey (1990) reported delicatessens, cafeterias, and restaurants as the most common places where contaminated food was eaten. For each year from 1983 to 1987, improper storage and holding temperatures were the most frequently
listed food preparation practices contributing to foodborne illnesses, followed by poor personal hygiene practices of employees (Bean et al., 1990). A CDC report (1990) identified hands as one of the most likely means by which enteric viruses were transmitted to food.

Todd (1992) conducted a study using data of reported foodborne illnesses in Canada between 1975 and 1984. Of the 8,670 reported foodborne outbreaks, 53% occurred in foodservice establishments. In this category, half of these foodborne illnesses occurred in full-service restaurants and hotel foodservice operations. Quick-service restaurants and institutions accounted for 19% and 7% of the outbreaks reported, respectively. CDC (1996) reported that in the U.S. between 1988 and 1992, 46% of the 2,423 reported foodborne outbreaks occurred in foodservice establishments.

Two major Clostridium perfringens outbreaks were caused by improper food-handling practices. Beef and chicken tacos were the vehicle in one of the outbreaks with 700 cases occurring in a Missouri prison. Prime rib was the implicated food item in the other outbreak, with 204 cases identified in Wisconsin (CDC, 1996).

During the years 1988-1992, 2,432 nationwide outbreaks of foodborne disease in foodservice establishments were reported to the CDC and caused 77,373 persons to become ill. Of those reported outbreaks in which etiology was determined, bacterial pathogens caused the largest percent (79%) (Guzewich & Ross, 1999b). This report mentioned that factors contributing to foodborne diseases were inadequate food storage or other problems with preparation practices, including unsanitary food contact surfaces, cross contamination, and improper holding temperatures for foods. Improper holding temperature was reported as the food-preparation practice most commonly contributing to these foodborne outbreaks. The second most frequently reported practice concerned personal hygiene of food handlers.
(Guzewich & Ross, 1999c). This report provided evidence that food workers, especially ill food workers, can be the source of infection in foodborne outbreaks and that hand contact with food represented a mode by which contamination occurred.

In retail foodservice settings, foodborne pathogens are often transmitted through the fecal-oral route from contaminated hands to food items. Controlling the transmission of pathogens from contaminated hands is of particular concern because CDC estimated Norovirus (NLV) to be the leading cause of foodborne illness in the U.S. (FDA, 2003). FDA (2003) acknowledged that the type of activities in retail foodservices may lead to an increase of fatty and proteinaceous materials (often not visible) on workers’ hands. Soap, friction, and running water can remove these materials and reduce levels of pathogens. FDA (2003) concluded that “proper handwashing as described in Food Code continues to serve as a vital and necessary public health practice in retail foodservices” (p.2).

Food contamination by infectious foodhandlers is a frequent cause of NLV gastroenteritis outbreaks. Because of the low levels of NLVs required to cause contamination and the high concentration of this virus in fecal stools, even a contamination with small levels can result in outbreaks. Ready-to-eat foods requiring handling but no subsequent cooking (e.g., salads and deli sandwiches) pose greater risk of cross contamination than food that has a heating process after handling (CDC, 2001).

Sneed, Strohbehn, and Gilmore (2004) observed 40 assisted-living facilities and found that in 6 of the 40 facilities, appropriate handwashing by foodservice staff was not done. These researchers concluded, “although food safety knowledge scores were high, food-handling practices were not always consistent with accepted standards” (p. 1682). In the same study, microbiological analyses of swabbed food contact surfaces were conducted
(Sneed, Strohbehn, Gilmore, & Mendonca, 2004). Few facilities complied with standards established for aerobic plate count (APC), *Enterobacteriaceae*, and *Staphylococcus aureus*. Nearly three-fourths of the facilities failed to meet APC standards for clean, ready-to-use cutting boards, which can result in cross contamination problems. These researchers concluded that re-contamination of these surfaces, perhaps by employees’ hands, could result in cross contamination to food, and recommended attention be given to training and supervision of staff to ensure proper handwashing at correct points in time to minimize risks.

Henroid and Sneed (2004) observed food-handling practices in school foodservice operations and found problems with frequency and technique of handwashing. Improper sanitizing was also observed. Henroid, Mendoca, and Sneed (2004) assessed the effectiveness of cleaning and sanitation of food contact surfaces in school foodservice operations and found high count levels of *Enterobacteriaceae* and *Staphylococcus aureus* for handwashing sink handles.

*High Risk Populations*

Vulnerable populations for foodborne disease and subsequent death are the elderly, young children, pregnant women, and immune-compromised individuals (Gerba, Rose, & Haas, 1996). Olsen, MacKinnon, Goulding, Bean, and Slutsker (2000) reported that 40% of all deaths from *Salmonella enteritidis* were nursing home residents. This finding reflected the seriousness of a foodborne disease for immunocompromised individuals and the elderly, as acute gastroenteritis can cause dehydration (McCabe & Beattie, 2004).

Buzby (2002) noted that the CDC FoodNet 1999 Final Report established rates of infection for most pathogens were relatively high for children under age ten and relatively low for older adults, despite many risk factors that predispose older persons to foodborne
illnesses. Lower rates could be attributed to safer food handling and food consumption behavior. In the years 1995-1996, over 19,000 adults (all age 60 or older) in eight states were interviewed as part of the Behavior Risk Factor Surveillance System study (Buzby, 2002). Results showed that 13% of these respondents reported they did not wash their hands with soap after handling raw meat or chicken and the same percent did not wash cutting surfaces with soap or sanitize them with bleach after cutting raw meat or chicken.

A study was conducted to evaluate the effect of promoting household handwashing with soap among children at high risk of death from diarrhea (Luby et al., 2004). After eight weeks, results showed children living in households that received anti-bacterial soap and encouragement to wash their hands had a 53% lower incidence of diarrhea and a 50% lower prevalence of diarrhea than the control group.

Retail Foodservice Establishments

Classification of Foodservice Establishments

Foodservice establishments can be classified as commercial or nonprofit operations. Commercial foodservice operations include establishments “in which selling food for profit is the primary activity of the business” (Spears & Gregoire, 2004, p. 10). This segment includes restaurants (from limited-service to fine dining), lodging, and convenience stores. In 2004, commercial restaurant operations was the largest industry segment and accounted for 80% of the restaurant industry’s total food and drink purchases (National Restaurant Association, 2004).

The nonprofit segment provides food as a secondary activity for the business and includes hospitals, schools, college and universities, correctional facilities, and military
operations. K-12 schools, colleges, and universities often use students’ ID cards as part of the payment system. Thus, some food handling risks are minimized, as there is no money around the food.

Sneed and Henroid (2003) found that school foodservice directors who had implemented Hazard Analysis Critical Control Point Plan (HACCP) or were in the process of implementing it in their foodservice operations recommended development of a plan based on practical actions easy to monitor. Examples of such actions could be handwashing and temperature checking.

*Characteristics of Delis*

Deli foodservice operations typically are classified as a commercial foodservice, although some can be included as part of a nonprofit foodservice's operation, such as those located at universities (Sims-Bell, 2002). A deli foodservice establishment is typically a limited service restaurant that offers a small number of food items such as sandwiches, soups, and salads to the customer. Customers usually order their sandwich or other item at the counter and wait for it to be prepared, prior to paying for the item.

Deli foodservice operations may be independently owned or part of a chain or franchised unit. Independently owned foodservices are establishments owned by one person or a group. The owner is responsible for administration of the operation and establishment of policies. Chain or franchised operated delis share a common name and have similar menus, operation policies, and procedures in place at each establishment. Franchising is the process when an individual or group (franchisee) receives the right from the franchisor (another person or company) to market the company's concepts (Spears & Gregoire, 2004). The organizational structure of franchises is complex. The franchisor often provides an
established identity, image, financial advice and assistance, standard operating procedures, menu, and specifications (Spears & Gregoire, 2004).

The menu for most deli operations consists of foods that hold well and look good in a refrigerated case, and food items that can be made quickly. Most of the items are ready-to-eat foods that do not require a cook process after preparation. Deli foodservice operations often have a menu that consists of sandwiches made with a variety of breads, meats, cheeses, and vegetables toppings; salads; soups; chips; cookies; and desserts (Sims-Bell, 2002).

The variety of processed meats and cheeses served at deli operations are sliced on-site or can be purchased pre-sliced. When employees slice meat at the operation, an electric meat slicer typically is used, and employees are responsible for portioning the product. Operations also may serve fresh vegetables such as lettuce, tomatoes, cucumbers, and peppers. Fresh produce may be washed and processed for serving on-site or purchased already washed and chopped or sliced.

Because of the potential high use of ready-to-eat food in deli operations, personal hygiene of employees including handwashing procedures, is important to ensure these foods are not contaminated prior to serving. Handwashing frequencies and methods should be an important topic in handwashing training sessions of deli foodservice operations.

Handwashing Practices

Frequency of Handwashing

Contaminants on hands can be transferred to food, thus making that food a hazard for human consumption. Proper handwashing at times required by Food Code (FDA, 2001) may vary from setting to setting depending on the type of foodservice establishment and menu
items. FDA (2003) recommended handwashing “immediately before engaging in food preparation including working with exposed food; cleaning equipment and utensils, unwrapped single-service and single-use articles; after touching bare human body parts other than clean hands and clean, exposed portions of arms; after using the toilet room; after caring or handling service animals or aquatic animals; after coughing, sneezing, after using a handkerchief or disposable tissue; using tobacco; after eating or drinking; after handling soiled equipment or utensils; during food preparation, as often as necessary to remove soil and contamination and to prevent cross contamination when changing tasks; when switching between working with raw food and working with ready-to-eat food; before donning gloves for working with food; and after engaging in other activities that contaminate the hands” (p.61).

Dunsmore (1972) concluded frequency of handwashing could affect the number of bacteria on hands. Studies performed on dairy workers demonstrated the mean bacterial cell count was twice as high for workers who did not wash their hands than for workers who washed their hands four times during working hours. Black et al. (1981) evaluated the effect of handwashing programs in four day-care centers. The authors found the lowest incidence of diarrhea in those day cares where a handwashing program was used, mainly because of the reduced transmission of enteric organisms from person-to-person.

Scott and Bloomfield (1990) found that when contaminated surfaces come into even relatively brief contact with the fingers or utensils, significant numbers of organisms can be transferred. Their study emphasized the importance of good hand hygiene and adequate disinfection procedures for clothes, surfaces, and utensils. Chen, Jackson, Chea, and Schaffner (2001) investigated bacterial transfer rates between hands and other common
surfaces involved in food preparation areas in foodservice operations. Results indicated that contamination of hands and various surfaces in the food preparation area presented cross contamination problems. A greater variability rate existed for transfer rates from hands to surfaces compared with rates involving bacterial transfer from hands to utensils. This study emphasized that hands of foodservice employees contributed to the transfer of microorganisms to food and various surfaces of the kitchen.

In another study in hospitals, a five-phase observational study of handwashing frequency and self-reported practices, beliefs, and opinions about handwashing in one intensive care unit, showed handwashing compliance ranged from 38% (before invasive procedures) to 86% (for bare hand contact with potentially contaminated objects followed by a clean procedure) (Larson, Bryan, Adler, & Blane, 1997). There was a significant increase during an intervention phase (automated handwashing sinks were installed), which indicated handwashing frequencies and methods could be improved by technology with automated sinks. These authors concluded that handwashing occurred with varying frequency, depending on tasks employees were performing. In this study, additional interventions in education and feedback had minimal long-term effect on handwashing frequency. To ensure long-term effects, type of training and education characteristics of audiences should be considered.

In order to evaluate the frequency of handwashing, O’Boyle, Henly, and Larson (2001) developed a handwashing observation instrument used for recording actual hand hygiene frequency for specific tasks by nurses at four participating hospitals. Handwashing frequency was recorded whenever nurses washed their hands with soap and water. The study showed the most frequent tasks for handwashing were after completion of patient care,
before beginning patient care, and after removal of gloves. Nurses were least likely to wash their hands before touching any part of their faces with contaminated hands (O’Boyle, Henly, 

Cushman, Shanklin, and Niehoff (2001) developed an instrument to collect self-reported data from employees about personal hygiene practices (like handwashing) related to their workplace (university foodservice). A negative correlation was found between good personal hygiene practices and length of employment. As length of time employees worked in the facility increased, personal hygiene practices decreased. Washing hands after using the toilet and before helping in production or service areas were reported to be performed most frequently, opposite of what had been found in other studies (Green et al., 2005). In a study conducted with restaurant managers, Ghiselli, La Lopa, and Billy (2001) found two-thirds of the respondents were male, had close to 8 years of experience in the foodservice industry, and had worked for their employers over 5 years.

FDA (2004) conducted a study in retail and foodservice establishments and published the Report on the Occurrence of Foodborne Illness Risk Factors in Selected Institutional Foodservice, Restaurant, and Retail Food Store Facility Type. Results from this study showed that for deli-type of foodservices, foodborne illness risk factors with highest percent of non-compliance to standards were: improper holding/time and temperature (64.4%), poor personal hygiene (23.5%), contaminated equipment/protection from contamination (23.4%), and other/chemicals (21.9%). For the category of poor personal hygiene, the procedure with highest percent of non-compliance was proper and adequate handwashing (56.7%). Procedures in this category with lowest percent of non-compliance were availability and
accessibility of handwashing facility (22.9 %) and presence of a cleanser/drying device (19.4 %) (FDA, 2004).

Green et al. (2005) found foodservice (restaurant) workers commonly reported engaging in risky food handling practices. In this study, 25% of 16,435 interviewed participants said they did not always wash their hands and about a third said they did not always change gloves between touching raw meat or poultry and ready-to-eat foods. The researchers concluded failure to wash hands at appropriate times or improper handwashing procedures increased the risk of cross-contamination.

*Handwashing Methods*

The *Food Code* (FDA, 2001) established handwashing should be done by “vigorous friction on the surfaces of lathered fingers, finger tips, areas between the fingers, and arms (or by vigorously rubbing the surrogate prosthetic device for hands or arms) for at least 10 to 15 seconds, followed by thorough rising under clean, running warm water, immediately followed by the drying procedure using disposable towels, a continuous towel system that provides the user with clean towels, or a heated-air hand drying device” (p. 60). As defined by *Food Code*, the proper handwashing method involves three main steps: washing/lathering, rinsing, and drying.

In a study to evaluate three handwashing methods commonly used in the food processing industry, manual soap and water handwashing, an iodine dip, and an automated hand cleansing system were compared (Paulson, 1992). The author concluded the use of manual or automated machine wash methods was more effective than iodine dip in reduction of microorganisms. Paulson (1993) next evaluated the variability of these two handwashing methods. He concluded the automated handwashing method provided a more standardized
antimicrobial wash than the manual because this method was not dependent upon any
motivation of personnel. He noted establishment of a good handwashing regimen was
important, but success depended on personnel willing to follow it.

Emery (1990) investigated handwashing practices of the general public and food
handlers, and found knowledge of food safety did not correlate with proper handwashing
habits. When food handlers were asked about personal handwashing habits, only 75%
reported washing hands after using the toilet. In a study in Minnesota, only 52% of 123
persons in charge of retail foodservice establishments could describe the handwashing
procedure outlined in Food Code (Allwood, Jenkins, Paulus, Johnson, & Hedberg, 2004). In
a study in schools, Henroid and Sneed (2004) found food safety knowledge of employees
was high and school districts with managers and employees having food handler certification
had higher food safety practice scores, which included employee handwashing.

Snyder (1998) concluded foodservice workers who do not wash their hands properly
after using the toilet can spread foodborne illnesses by transmission of pathogens through
fecal matter that may contain bacteria, viruses, and parasites harmful to humans. Regulatory
agencies check to see if a properly working hand sink, soap, and towels are available for
employees to use, but it is difficult to determine during the inspection process whether
employees are washing their hands at appropriate times and in a correct way.

Bidawid, Farber, and Sattar (2000) developed a process to investigate amounts of
Hepatitis A Virus (HAV) transferred from artificially contaminated hands to lettuce, a ready-
to-eat food. These authors concluded washing of finger pads with just water or a topical
agent (i.e. soap), followed by water rinsing significantly reduced the amount of virus
remaining on finger pads, and resulted in a significant reduction of virus transferred to the lettuce.

The drying technique used after handwashing also is very important to consider. Pether and Gilbert (1971) showed that *Salmonella* spp. could survive for several hours on fingertips but that proper handwashing followed by hand drying with paper towels effectively reduced the risk of transmission of the bacteria to food.

In a study by Coates, Hutchinson, and Bolton (1987), *Campylobacter* spp. was effectively reduced from hands by washing them with either soap and water or water alone followed by drying with paper towels. This study demonstrated the effectiveness of hand drying to reduce transfer of these bacteria. Ansari, Sattar, Springhorpe, Tostowaryk, and Wells (1991) found that independent of the handwashing agent used, the drying method that produced the highest reduction of *Escherichia Coli* and rotavirus was electric air drying when compared to either disposable or cloth towels.

Michaels et al. (2004) investigated reports from 300 foodborne outbreaks attributed to ill food handlers in order to identify responsible hazards and factors, using the quantitative microbial risk assessment (QMRA) software package GoldSim®. Computer simulations showed relatively modest increases in hand hygiene frequency resulted in reduced transmission potential (Michaels et al., 2004). These authors concluded that proper handwashing frequency and methods can significantly reduce risks.

Bidawid, et al. (2004) investigated cross contamination of food and environmental surfaces with feline caliciviruses (FCV) by food handlers and found washing FCV-contaminated hands with just water or water and soap reduced the levels of virus compared to unwashed hands.
In a study investigating effectiveness of handwashing, washing hands for ten seconds removed transient bacteria from hands and resulted in decreased levels of organisms while washing hands for three minutes removed transient bacteria, but brought residual flora to the surface, thereby increasing microorganisms from hands (Guzewich & Ross, 1999a).

Use of Gloves

There is a perception that employees in foodservices who wear gloves when serving or preparing food can prevent the transfer of pathogenic microorganisms. While the use of gloves is recommended rather than bare hand contact with ready-to-eat foods, gloves cannot be effective if inappropriately worn or used. Food personnel using gloves to prepare and serve food must realize microorganisms adhere to the surfaces of gloves, which can cause cross-contamination. Therefore, gloves must be changed frequently and hands should be washed each time gloves are changed (Snyder, 1998). Some concerns are that employees in the foodservice industry may not been trained to wash their hands before wearing gloves, do not know when to change them, or may think gloves are a substitute for handwashing.

Fendler, Dolan, Williams, and Paulson (1998) performed a study under simulated foodservice conditions to define and support the most effective hand hygiene regimens for food protection and minimization of risk to customers. Subjects were assigned six different test configurations and performed a simulated foodservice task. Test configurations were: unwashed bare hands; unwashed gloved hands and no glove changes; bare hands washed hourly; bare hands with hourly washing and sanitizing; unwashed gloved hands with hourly glove changes; and washed gloved hands with hourly glove changes and handwashing between changes. Although microbiological values showed the use of gloves did not prevent all contamination, the level found in hands was lower when hands were washed and sanitized
hourly. The authors concluded “bare hands with a regimen of hourly handwashing and sanitizing provided significantly higher hand sanitization levels than any of the five other regimens, including those employing gloves” (p. 829).

As part of the FDA (2004) study in retail and foodservice establishments, adequate and proper handwashing continued to be primary concerns within the foodservice industry. Yet, results of this study showed a low non-compliance percent (9.6%) for preventing direct hand contamination with food in delis. While the high compliance is a positive finding, the low percent of direct hand contamination may be due to use of disposable gloves or tongs. However, the study did not verify if glove changes or handwashing occurred.

*Equipment in Handwashing Area*

Effective handwashing is essential in the prevention of cross contamination. It is important for operations to have properly equipped handwashing sinks to help ensure employees wash their hands. *Food Code* (FDA, 2001) require that “handwashing facilities are to be conveniently located, always accessible for handwashing, maintained so they provide proper water temperatures and pressure, and equipped with suitable hand cleansers, nail brushes, and disposable towels and waste containers, or hand dryers” (p. 305).

A handwashing sink should be located in food preparation, foodservice and dish washing areas. This sink should be accessible at all times for employees and should be used only for handwashing purposes. Each handwashing sink should be stocked with liquid, powder, or bar soap and individual disposable towels, a continuous system providing clean towels, or a heated-air hand drying device should be available. If disposable towels are used a trash can should be located in each sink. Each handwashing sink should have a sign or poster clearly visible that notifies foodservice employees to wash their hands (FDA, 2001).
Torok et al. (1997) investigated an outbreak of *Salmonella typhimurium* caused by intentional contamination of restaurant salad bars by a religious group. In one of the restaurants involved in the outbreak, they found direct contamination of foods by ill employees might have occurred because of the lack of soap and towels in the employees' restrooms. The importance of supervisory staff in controlling resources and helping employees practice correct personal hygiene practices was illustrated in this case.

This review of literature showed handwashing as part of personal hygiene practices is an important aspect to consider in reducing the level of contamination and risk of microbial transmission to foods leading to outbreaks of foodborne illness. Foodborne illness is a particular concern for those who have compromised immune systems. Past research has investigated handwashing practices focusing on frequencies or methods, but limited research can be found about proper handwashing frequencies and methods using standard procedures proposed by *Food Code* for foodservice establishments.
CHAPTER III. METHODOLOGY

A review of literature showed that limited information is available regarding handwashing frequency in retail foodservice establishments. The literature also underscored the importance of proper handwashing methods by retail foodservice employees in order to prevent foodborne illnesses. The purpose of this research was to develop and pilot test a handwashing observation form (HOF) to determine current and desired handwashing practices of employees in one specific type of retail foodservice establishment, delicatessens (delis). This chapter includes a description of the research design, sample population, data collection (including tools and procedure), and data analyses used in this study.

Research Design

Structured in-depth field observations were used to determine handwashing frequency and methods of employees in deli-type retail foodservice establishments. According to Krathwohl (2004) “in qualitative research an explanation grows out of data” (p.35). Observation is one method of qualitative research and with structured observation, every aspect of the research is planned before data are collected. Possible contamination of data due to the subjective judgment of the observer is minimized with structured observation. In order to obtain information about ownership of the facility, training provided to employees, and policies related to handwashing an informal interview with employees and an interview with site managers were conducted. Data collection forms were used to record handwashing behavior observed, and a structured interview form was used in interviews with each manager.
In this study, the dependent variable was frequency of handwashing by each employee observed. Independent variables were selected demographic profiles of the employees, such as gender, and characteristics of each deli retail foodservice establishment, such as ownership.

Sample Population

A convenience sample of 10 deli-retail foodservice establishments from one town in central Iowa was used for the study. To explain the project, a first recruitment contact with deli managers/owners was done by telephone using a script (Appendix A). However, most of the operations did not have an employee answer the phone or the person who did answer reported that it was too busy to talk at that moment. Because of the difficulty of getting responses by phone, a visit to each of 10 potential sites was made to explain the study and request participation. Managers/owners in five of the 10 operations agreed to participate. The manager or owner signed a consent form for participation (Appendix A) that explained the purpose of the study and the methodology to be used. After the contact visit, 2 three-hour visits to each of the five participating facilities were scheduled during a 2-month period of time (November – December 2005) to conduct observations. At each observation, the researcher first verbally requested participation from employees and asked them to sign a consent form of participation (Appendix A).

Deli retail foodservice operations were selected because a high number of foodborne illness outbreaks are attributed to restaurants, because these types of quick-service restaurants experience issues related to food handlers (i.e. high turnover, limited training, and limited English skills), and also because vulnerable populations eat in restaurants. The operations
were selected based on location (central Iowa) and ownership (independently owned and those part of a chain). Also, these operations served unprocessed fresh produce (such as lettuce or cucumbers), and ready-to-eat processed meats. Most of these food items did not receive heat treatment before service and required some handling by employees. Handwashing practices in each establishment were observed for three hours two times for a total of 10 observations or 30 hours, with one visit occurring during preparation and the other during service.

Participating operations received educational materials that included a Glo Germ™ Kit with a bottle of gel, a bottle of powder, and an ultra-violet lamp, for use during training sessions. The gel and the powder contain the plastic simulated germs and the lamp illuminates them to test the effectiveness of employees’ handwashing practices. A summary of results was sent to each operation.

Data Collection

Planning

Planning for data collection took place in summer 2005. Data collection and recruitment tools and procedures were developed during the planning phase after a review of literature. Faculty in the Hotel, Restaurant and Institutional Management and Food Science and Nutrition Programs of Iowa State University determined content validity of data collection tools. The research protocol and data collection tools were reviewed and approved by the Human Subject Research Committee of Iowa State University (Appendix B).
Data Collection Tools

Two data collection tools were developed: Handwashing observation form (HOF) and the manager interview form (Appendix C). The HOF listed all conditions when hands should be washed based on Food Code (FDA, 2001) and FDA (2003) recommendations and described methods used for handwashing. While it is understood that Iowa uses Food Code 1997, the 2001 Food Code was used to develop the HOF as this was the version used by FDA at the time this study was conducted. The number of times handwashing should have occurred and the number of times it did occur were marked on the form in the appropriate column. Of 11 columns on the form, the first listed tasks in which handwashing should occur. These tasks were divided into categories: personal hygiene, food preparation, cleaning, and other tasks. The second and third columns were used to record when people should have washed their hands and when hands were washed, respectively. In the last eight columns different steps of the handwashing procedure (soap used, all parts of hand lathered, friction on fingertips or nail brush used, friction on wrists, 10-15 seconds lathering or friction, drying disposable towel or heated air, and faucet turned off with towel) were described. The HOF also included a section where information about handwashing sinks and employees was recorded. The information gathered about handwashing sinks included observations about location, availability of nailbrush and soap, type of hand drying options, and supply of hot water. During the three-hour observation periods, the researcher conducted informal conversational interviews with each observed employee to determine gender, approximate age, length of time employed at the facility, length of time worked in foodservice, average hours worked per week, and type of training received. Employees' responses to these inquiries were voluntary.
The structured interview used with deli managers included 14 questions about ownership of the facility, training provided, and whether training content included handwashing. The manager also was asked about organizational policies related to handwashing, number of years he/she had worked in foodservice and at this location, and any certification or training held by the manager in food safety.

*Data Collection Procedures*

After obtaining consent from managers of the five deli retail foodservices, observations of handwashing frequencies and methods of employees in operations were conducted using the HOF over two, three-hour periods of time. One observation period focused on production and the other on meal service. The researcher observed employee activities and recorded the number of times handwashing should have occurred, the number of times handwashing did occur, and specific methods used at each occurrence. In each of the 10 observation periods, one to three employees were observed in each facility. A total of 15 different employees and 3 managers was observed during production and service. A total of 10 employees was observed during the five production visits and 12 employees were observed during the five service visits. During the first visit to each operation the researcher conducted an interview with the manager while most were working at the operation. Two of the operations were owned by the same person and this person also served as manager at one of these restaurants. All data were collected by one researcher.

*Data Analyses*

The researcher determined the average number of times during the day hands were washed per employee, and compared this to the number of times per day each employee
should have washed hands and presented a percent of handwashing frequency using the following formula:

\[
\text{% of handwashing frequency} = \frac{\text{Number of times employees did wash their hands} \times 100}{\text{Number of times employees should have washed their hands as defined in Food Code (FDA, 2001)}}
\]

An in-compliance percent that refers to the percent of handwashing by employees using the standard procedure defined by Food Code (FDA, 2001) was estimated using the following formula:

\[
\text{% In-compliance} = \frac{\text{Number of times employees did wash hands using appropriate methods defined in Food Code} \times 100}{\text{Number of times employees should have washed their hands}}
\]

Frequencies were calculated for employee characteristics and information gathered from the interview with the manager. Based on the results, handwashing benchmarks were proposed for deli-type of retail foodservice operations in production and service phases using the following formulas:

\[
\text{Benchmark per employee} = \frac{\text{Total number of times employees should have washed their hands}}{\text{Total number of observed employees}}
\]

\[
\text{Benchmark per employee hour} = \frac{\text{Benchmark per employee}}{15 \text{ hours of observation}}
\]
CHAPTER 4. RESULTS AND DISCUSSION

Introduction

The purpose of this study was to develop and pilot test a handwashing observation form (HOF). Ten in-depth field observations of employees at five deli-type foodservice establishments in Iowa were conducted to determine handwashing frequencies and methods. An interview was conducted with the manager at each operation. Findings are presented in three sections: description of operations, handwashing frequencies, and handwashing methods used by employees.

Description of Operations

Overview of Operations

The five deli-type foodservice operations that participated in this study served ready-to-eat processed meats and unprocessed fresh produce (such as peppers and lettuce). Most of these food items did not receive heat treatment before service and all required some handling by employees.

Ownership among operations varied. One of the operations was independently owned and has been in business approximately 20 years. The manager of this operation was the owner. As mentioned by Spears and Gregoire (2004), the owner of independently-owned foodservices is the person responsible for administration and establishment of policies. Three of the operations were part of a corporate-owned chain or a franchised chain. With this type of ownership, the chain establishes operational policies. One of the operations was part of dining services at a public university, a non-profit entity.

Hours of operation varied among the deli foodservice establishments. Four of the operations have a continuous operating schedule. These foodservices open in the morning
and close in the evening, two at 8:00 p.m. and two at 10:00 p.m. The fifth operation was open
for lunch service (a three-and-a-half hour period), closed for cleaning and restocking, and
then reopened for the dinner meal (two-and-a-half hours). The reported average number of
sandwiches sold by each operation was 178 per day. One of the operations reported sales
between 100 and 125 sandwiches per day, two reported sales between 176 and 200
sandwiches, and the other two, sales of more than 200 hundred sandwiches.

Disposable ware was used in 3 of the 5 deli foodservice operations. The deli affiliated
with university dining services served sandwiches in lined plastic baskets. Baskets were
cleaned and sanitized in a central dish room. The other operations (n=2) used plastic baskets
cleaned and sanitized manually.

Characteristics of Employees

A total of 15 employees was observed during the 10 visits to the operations. A profile
of all observed employees for the five deli-type foodservice operations is presented in Table
1. Most employees reported their ages as between 20 and 25 years. Only one of the
employees was older than 30 years. Of the 15 employees observed, 6 were males and 9 were
females. Most of the employees worked part time, as only two were full time employees. The
mean number of hours worked each week by employees was 16.5. The U.S. was country of
origin for all observed employees.

Nearly one-half (n=7) of the employees reported one to two years of work experience
in foodservice operations, while four had more than five years of work experience. However,
slightly less than one half (n=7) of the employees had worked less than one year for the
current employer, four employees had worked one to two years, and four employees had
worked more than three years. These findings illustrate the turnover of employees problem
within a commercial foodservice establishment. The length of time employees had worked with the organization can affect good personal hygiene practices (like handwashing). Cushman et al. (2001) reported a negative correlation between personal hygiene practices and length of employment in a facility.

**Table 1. Characteristics of Observed Employees in Five Deli Type Foodservice Operations (n=15)**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>6</td>
</tr>
<tr>
<td>Female</td>
<td>9</td>
</tr>
<tr>
<td><strong>Employment category</strong></td>
<td></td>
</tr>
<tr>
<td>Part Time</td>
<td>13</td>
</tr>
<tr>
<td>Full Time</td>
<td>2</td>
</tr>
<tr>
<td><strong>Years working in foodservice organizations</strong></td>
<td></td>
</tr>
<tr>
<td>Less than one</td>
<td>1</td>
</tr>
<tr>
<td>One to two</td>
<td>7</td>
</tr>
<tr>
<td>Three to four</td>
<td>3</td>
</tr>
<tr>
<td>Five or more</td>
<td>4</td>
</tr>
<tr>
<td><strong>Years with organization</strong></td>
<td></td>
</tr>
<tr>
<td>Less than one</td>
<td>7</td>
</tr>
<tr>
<td>One to two</td>
<td>4</td>
</tr>
<tr>
<td>Three to four</td>
<td>2</td>
</tr>
<tr>
<td>Five or more</td>
<td>2</td>
</tr>
</tbody>
</table>
Employees reported they had received organizational training on procedures such as food preparation, set up for service, or cleaning. However, not one of the employees mentioned food safety as an area of training provided by the organization.

**Characteristics of Managers**

Demographic information about the managers for the observed deli retail foodservice operations is presented in Table 2. Information for one manager could not be obtained because he was not present during the observation visits and unavailable for an interview.

**Table 2. Demographic Information of Managers for Deli Type Foodservice Operations (n=4)**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>4</td>
</tr>
<tr>
<td><strong>Origin</strong></td>
<td></td>
</tr>
<tr>
<td>International</td>
<td>1</td>
</tr>
<tr>
<td>Domestic</td>
<td>3</td>
</tr>
<tr>
<td><strong>Years with organization</strong></td>
<td></td>
</tr>
<tr>
<td>One to two</td>
<td>1</td>
</tr>
<tr>
<td>Three to four</td>
<td>1</td>
</tr>
<tr>
<td>Five or more</td>
<td>2</td>
</tr>
<tr>
<td><strong>Years working with foodservice organization</strong></td>
<td></td>
</tr>
<tr>
<td>One to two</td>
<td>1</td>
</tr>
<tr>
<td>Three to four</td>
<td>1</td>
</tr>
<tr>
<td>Five or more</td>
<td>2</td>
</tr>
</tbody>
</table>
All managers of these operations were male. Most managers (3 of 4) were from the U.S. Half of the managers had five or more years of work experience in the foodservice industry and had been working with the current organization for five or more years. The limited number of participants in this sample reflects the profile of the industry. In a study conducted with restaurant managers, Ghiselli, La Lopa, and Bai (2001) reported two-thirds of the respondents were male, had close to 8 years of experience in the foodservice industry, and had worked for their employers over 5 years.

Half of the managers interviewed in this study had earned ServSafe® Certification, which is a food safety program administered by the National Restaurant Association’s Educational Foundation. In this study, observation of three of the managers showed only one in-compliance with handwashing practices as defined in the FDA Food Code (FDA, 2001). This finding is consistent with the Allwood et al. (2004) study that found only half of persons in charge of retail foodservice establishments could accurately describe the handwashing procedure recommended in the Food Code.

Characteristics of Operations

Managers were interviewed about characteristics of their organizations and operations. Some characteristics of the deli foodservice operations are presented in Table 3. Of the five deli-type foodservice operations observed, four had written organizational policies about personal hygiene and handwashing in place. Three of those belong to a chain or franchise and one is independently owned. Three of the delis had in place a written organizational policy about training. Of these, two belong to a chain or franchise and one is independently owned.
Food safety certification was required by one independently-owned operation, but it only applied to full-time employees. These employees go to training sessions offered by the city’s Sanitation Department and are required to obtain certification prior to working with the operation.

Table 3. Characteristics of Deli Type Foodservice Operations (n=5)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written organizational policies in place</td>
<td></td>
</tr>
<tr>
<td>Personal hygiene</td>
<td>4</td>
</tr>
<tr>
<td>Handwashing</td>
<td>4</td>
</tr>
<tr>
<td>Training</td>
<td>3</td>
</tr>
<tr>
<td>Required food safety certification</td>
<td>1</td>
</tr>
<tr>
<td>Ownership of the facility</td>
<td></td>
</tr>
<tr>
<td>Independently-owned</td>
<td>1</td>
</tr>
<tr>
<td>Corporate-owned chain</td>
<td>2</td>
</tr>
<tr>
<td>Franchised chain</td>
<td>1</td>
</tr>
<tr>
<td>University facility</td>
<td>1</td>
</tr>
</tbody>
</table>

Menu Items

The observed deli foodservice operations offered a variety of menu items. Sub sandwiches with different types of breads, meats and cheeses, vegetable toppings as well as salads, desserts, and soups were menu items offered by the operations. This coincided with Sims-Bell (2002) menu description of deli operations.
Bread was baked on-site in two of the operations while the other three units bought baked bread. All breads were sliced for sandwich preparation on site. Two of the operations used pre-sliced meats and cheeses, thus minimizing handling by employees during production and service. Employees handled the product only for portioning. One of the operations sliced all meats and one type of cheese (provolone) on-site during production phase. A meat slicer was used in the sandwich assembly area. All the other types of cheeses were purchased pre-sliced.

Another operation sliced their deli meat on-site but cheeses were purchased pre-sliced. One of the operations sliced the type of meat and cheese upon customers' orders. This action took place in the service area where customers could observe the slicing process. The other two operations purchased all their meats and cheeses pre-sliced.

The vegetable toppings offered at operations were lettuce, tomatoes, cucumbers, green peppers, onions, black olives, pickles, and banana peppers. Tomatoes, green peppers, onions, and cucumbers were sliced by hand in all operations during the production phase. Pickles, banana peppers, and lettuce were sliced by hand in just one of the operations while the others purchased these items in convenience form (pre-washed, chopped, and/or sliced). Employees at two sites washed products before slicing, but at two of the operations, vegetables were not observed to be washed prior to slicing.

In one deli, the person responsible for sub preparation was not responsible for slicing the vegetables. Employees at this facility performed a variety of tasks during production and service, such as slicing meats and assembling sandwiches. This operation had an in-house centralized vegetable preparation area so deli foodservice employees were not involved in slicing vegetables.
A choice of dressings was offered in all operations. Dressings were purchased already prepared by all operations. Dressings were used on sandwiches or salads. Four of the operations offered salads prepared on-site. Four of the operations offered desserts items including cookies, pies, and cakes. Two baked cookies on-site from prepared dough. One of the delis offered cakes prepared on-site and served pies purchased already prepared. These were portioned upon customer request by the employee handling the money.

Four of the delis offered packaged chips and one deli portioned chips from bulk supply. Customers served themselves the chips from a large serving bowl using tongs. Two operations offered two different types of soup. Soups were purchased in frozen form. Employees defrosted the package, reheated, and the product was kept warm during service using crock pots or soup kettles.

Drinks were offered at deli operations in four of the five foodservices. In one of these four operations, employees were responsible for providing drinks to the customer. In the others, a beverage station was located in the facility with self-service operation. All of the operations that offered drinks used disposable cups, stacked inverted and wrapped straws. Guests were given a disposable cup by an employee. In three of the four operations, customers took lids as desired. In the operation where an employee (money handler) provided drinks, they gave the customer a lid only upon request.

Ice machines were available in the four delis that offered drinks. In the operation where an employee provided drinks, an ice machine was located close to the cash register. Employees asked the customer what they wanted to drink, and then filled the cup with ice using a scoop and served the drink. The ice machine used in this instance did not have a lid. In others, the beverage station contained an ice dispenser. Ice was produced in one of the
three dispensers. In the other two, employees used white containers to fill the machines manually. During observation, the white containers were used only for ice. The three ice dispensers each had lids to protect the ice from airborne contaminants.

In all deli operations, employees handled all products to set up the line. Four of the delis opened the operation and employees began preparing necessary product and setting up the line (production phase). Occasionally, customers came in and ordered sandwiches during production. The other deli operation had all products prepared before opening. After the operation opened, employees were involved only in service. When the customer ordered items, employees prepared the sandwiches by first selecting the bread, the meat and cheeses, and then the vegetables. Customers then went to the cash register and paid. In one of the independently owned operations, employees did not handle money as students used ID cards as the method of payment.

*Handwashing Facilities*

All operations had only one handwashing sink located in the sandwich assembly and service area. This met the regulation of *Food Code* (FDA, 2001) that at least one handwashing sink be located to allow convenient use by employees in food preparation, food dispensing, and dishwashing areas. Because disposable ware was used in three of the five operations, multiple handwashing sinks were not necessary in these operations. Of the two that did not use disposable ware, one had central ware washing and the other one used a three compartment sink for washing the plastic baskets each time and bowls used for sandwiches and salads. This facility had the handwashing sink close to the dishwashing sinks. Observed places had limited space for the operation, so the use of only one sink for all defined purposes was functional. FDA’s (2004) *Report on the Occurrence of Foodborne Illness Risk*
Factors in Selected Institutional Foodservice, Restaurant, and Retail Food Store Facility Types found that among deli foodservice operations, there was high compliance with availability and accessibility of the handwashing facility (77%).

Table 4 shows characteristics of handwashing sinks in the observed deli foodservice operations. Nailbrush and foot pedals on sinks were not available in any of the operations. Four of the operations had separate (hot and cold) faucet handles and one had an automatic faucet. This operation is part of newer construction in a public university. Of the four operations having separate handles, two had hot and cold running water. The other two did not have any hot water. Food Code (FDA, 2001) established handwashing sinks should have a hot water supply at a minimum temperature of 100°F. Only three of the five observed operations met this requirement. The two that did not were part of a chain.

Soap was available at all of the observed operations at the time of the visits. The type of soap used in each was liquid antibacterial soap. All operations met the Food Code (FDA, 2001) requirement of provision of liquid, powder, or bar soap. FDA (2004) found high compliance by deli operations for the presence of soap or drying devices (80.6%). Food Code established that handwashing facilities have individual disposable towels, a continuous towel system that supplied clean towels, or a heated-air hand drying device. All observed facilities had an available supply of disposable towels. In Food Code (FDA, 2001) it is required a trash can be available at each handwashing sink. Of the five deli operations, two met this requirement.
Table 4. Characteristics of Handwashing Sinks in Deli Type Foodservice Operations (n=5)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soap Available</td>
<td>5</td>
</tr>
<tr>
<td>Type of faucet handles available</td>
<td></td>
</tr>
<tr>
<td>Separate</td>
<td>4</td>
</tr>
<tr>
<td>Automatic</td>
<td>1</td>
</tr>
<tr>
<td>Drying unit available</td>
<td></td>
</tr>
<tr>
<td>Disposable</td>
<td>5</td>
</tr>
<tr>
<td>Hot water supply available</td>
<td>3</td>
</tr>
</tbody>
</table>

During the observation periods, the handwashing sink was used only for its intended purpose. Of the five facilities, two handwashing sinks were clean at the time of observations, and thus met the Food Code (FDA, 2001) requirement of keeping handwashing sinks clean. Food Code also required the presence of a sign at each handwashing sink notifying employees to wash their hands. A sign with this notice was seen in four of the five operations.

Keeping handwashing sinks in good operating condition and stocked with all necessary supplies is a good way to promote handwashing practices of employees. Torok et al. (1997) found that food contamination through ill employees might have occurred in one restaurant because of the lack of soap and towels in the employees’ restroom. One important role of supervisory staff is to ensure employees have the tools to practice good personal hygiene.
Handwashing Frequencies

Introduction

In this study, a HOF was developed and pilot-tested to assess handwashing frequencies and methods of all employees (15 employees and 3 managers (n=18)) in five deli-type foodservice operations during a three-hour observation period. Observations of tasks performed by employees during production and service phases of the operation were made. Task categories on the HOF were personal hygiene, food preparation, cleaning, and other.

Specific tasks in each category were those listed in Food Code (FDA, 2001) as requiring handwashing. In this study, handwashing frequency was defined as the number of times employees did wash their hands compared to the number of times they should have washed their hands when performing the observed tasks, as defined in Food Code (FDA, 2001). The percent of handwashing frequency was calculated using the following formula:

$$\text{% of handwashing frequency} = \frac{\text{Number of times employees did wash their hands}}{\text{Number of times employees should have washed their hands as defined in Food Code (FDA, 2001)}} \times 100$$

Observed methods used for handwashing and a discussion of compliance with the standard procedure recommended in Food Code (FDA, 2001) will be presented in the section on handwashing methods. Handwashing frequencies for tasks defined in Food Code during production and service referred to observation of employees’ handwashing efforts.

Handwashing Frequencies during Production

A tally of number of times hands should have been washed and number of times hands were washed by employees during production is shown in Table 5. Tasks specified as
sneezing into hands, coughing or sneezing into sleeve, after handling money, or using a handkerchief or disposable tissue.

Other tasks identified in *Food Code* (FDA, 2001) as requiring handwashing, such as “after touching bare human parts” (i.e. touching their nose and eyes), “when switching between working with raw food and ready-to-eat food”, “after slicing/handling potentially hazard food” (i.e. slicing meat), and “other tasks” (i.e. use of the phone) had 0% handwashing frequency in this study. These observations are similar to those of Larson, Bryan, Adler, and Blane, 1997, who found in a study with nurses in a hospital intensive care unit that handwashing occurs with varying frequency, depending on the tasks the employees were performing. Employees washed their hands more often for tasks performed during the category of food preparation. Specific tasks with the highest percent of handwashing were “before engaging in food preparation” (61%, or 11 of 18 observed times) and “before returning to preparation area” (50%, or 3 of 6 observed times).

Production tasks with a low percent of handwashing frequency were “before slicing/handling different food product” (i.e. slicing deli meat and then slicing lettuce, 7% or 1 of 15 observed times); “when changing tasks” (i.e. when touching the refrigerator handle to store or get product, 7% or 3 of 42 observed times); and “before donning gloves for working with food” (13% or 3 of 23 observed times). In these situations, cross contamination could occur if hands were not washed before putting on a pair of gloves, as the glove surface that comes in contact with food could become contaminated from hands. Cross-contamination also could occur when hands were not washed after changing tasks as refrigerator handles contain high microbial levels (Sneed, Strohbehn, Gilmore, & Mendonca, 2004; Henroid, Mendonca, & Sneed, 2004) and hands could become contaminated.
Table 5. Observations of Employees’ (n=10) Handwashing Frequency in Deli Type Foodservices during Production Phase

<table>
<thead>
<tr>
<th>Task</th>
<th>SWH&lt;sup&gt;a&lt;/sup&gt;</th>
<th>DWH&lt;sup&gt;b&lt;/sup&gt;</th>
<th>% of HW&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal Hygiene</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After touching bare human parts</td>
<td>23</td>
<td>0</td>
<td>0.0 %</td>
</tr>
<tr>
<td>After eating or drinking</td>
<td>20</td>
<td>3</td>
<td>15.1 %</td>
</tr>
<tr>
<td><strong>Food Preparation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before engaging in food preparation</td>
<td>18</td>
<td>11</td>
<td>61.1 %</td>
</tr>
<tr>
<td>Before returning to preparation area</td>
<td>6</td>
<td>3</td>
<td>50.0 %</td>
</tr>
<tr>
<td>Before slicing/handling different food product</td>
<td>15</td>
<td>1</td>
<td>6.7 %</td>
</tr>
<tr>
<td>When switching between working with raw food and ready-to-eat food</td>
<td>11</td>
<td>0</td>
<td>0.0 %</td>
</tr>
<tr>
<td>Before donning gloves for working with food</td>
<td>23</td>
<td>3</td>
<td>13.0 %</td>
</tr>
<tr>
<td>After slicing/handling potentially hazard food</td>
<td>7</td>
<td>0</td>
<td>0.0 %</td>
</tr>
<tr>
<td><strong>Cleaning</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After cleaning equipment and/or utensils</td>
<td>10</td>
<td>2</td>
<td>20.0 %</td>
</tr>
<tr>
<td>After handling soiled equipment or utensils</td>
<td>13</td>
<td>2</td>
<td>15.4 %</td>
</tr>
<tr>
<td><strong>Other tasks</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When changing tasks</td>
<td>42</td>
<td>3</td>
<td>7.1 %</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>0</td>
<td>0.0 %</td>
</tr>
</tbody>
</table>

<sup>a</sup> SWH is number of observed times employees should have washed their hands; <sup>b</sup> DWH is number of observed times employees did wash their hand; <sup>c</sup> % of HW is percent of handwashing frequency.
Findings from this study, although representing few observations, were troubling as outbreaks of foodborne illnesses from cross contamination have been reported in the literature. The literature (CDC, 1998) showed an outbreak of *Campylobacter jejuni* from contaminated lettuce and lasagna occurred because employees had not washed or had inadequately washed their hands, cooking utensils, or the countertop after handling raw chicken.

Observations from this study show that during production, employees in deli foodservice operations were not washing their hands at times required in *Food Code* (FDA, 2001). With the exception of two tasks, the percent of handwashing frequency for each specific task was very low (less than 50%). Results using the observation method of data collection were worse than previously reported in the literature. Green et al. (2005) found 25% of 16,435 foodservice workers reported not always washing their hands. They used interviews with foodservice workers and the present study relied on direct observations.

**Handwashing Frequencies during Service**

Observations of handwashing frequency during service are presented in Table 6. Tasks identified in *Food Code* (FDA, 2001) as requiring handwashing but not observed during service periods were “coughing or sneezing into hands”, “coughing or sneezing into sleeve”, “using a handkerchief or disposable tissue”. Most of these actions also were not observed during the production phase.

In this study, there were numerous observations (n=52) when employees should have washed their hands but did not do so. These observations included specific tasks in all categories: “after eating or drinking”, “before slicing/handling different food product” (i.e. slicing deli meat and then lettuce), “when switching between working with raw food and
ready-to-eat food”, “after slicing/handling potentially hazard food” (i.e. after handling deli meat like ham), and “after handling soiled equipment or utensils” (i.e. after handling soiled dishes or towels).

Tasks that had the lowest percent of handwashing compliance were “after touching bare human parts” (less than 16%, or 3 of 19 observed times), “after cleaning equipment or utensils” (24%, or 6 of 25 observed times), “when changing tasks” (less than 2%, or 3 of 189 observed times), and “after handling money” (16 %, or 19 of 118 observed times).

Three of the tasks in the category of food preparation had the highest percents of handwashing: “before engaging in assembly of sandwiches” (60 %, or 18 of 30 observed times), “before returning to assembly area” (about 52 %, or 11 of 21 observed times), and “before donning gloves for working with food” (about 32 %, or 13 of 40 observed times).

It is important to note that the high number of times hands should have been washed in the other task category “when changing tasks” (n=189) was inflated due to the system used in one of the operations to count the number of prepared sandwiches. A hand held counter was touched each time a sandwich was prepared. The hand held counter was not observed to have been cleaned or sanitized prior to production or during service. Thus, handwashing should have occurred after each time it was touched by the employee. If this one were omitted, employees washed their hands three times of the 86 times they should have washed, or 3%.
Table 6. Observations of Employees’ (n=12) Handwashing Frequency in Deli Type Foodservices during Service Phase

<table>
<thead>
<tr>
<th>Task</th>
<th>SWH</th>
<th>DWH</th>
<th>% of HW</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal Hygiene</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After touching bare human parts</td>
<td>19</td>
<td>3</td>
<td>15.8 %</td>
</tr>
<tr>
<td>After eating or drinking</td>
<td>12</td>
<td>0</td>
<td>0.0 %</td>
</tr>
<tr>
<td><strong>Food Preparation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before engaging in assembly of sandwiches</td>
<td>30</td>
<td>18</td>
<td>60.0 %</td>
</tr>
<tr>
<td>Before returning to assembly area</td>
<td>21</td>
<td>11</td>
<td>52.4 %</td>
</tr>
<tr>
<td>Before slicing/handling different food product</td>
<td>7</td>
<td>0</td>
<td>0.0 %</td>
</tr>
<tr>
<td>When switching between working with raw food and ready to eat food</td>
<td>2</td>
<td>0</td>
<td>0.0 %</td>
</tr>
<tr>
<td>Before donning gloves for working with food</td>
<td>40</td>
<td>13</td>
<td>32.5 %</td>
</tr>
<tr>
<td>After slicing/handling potentially hazard food</td>
<td>8</td>
<td>0</td>
<td>0.0 %</td>
</tr>
<tr>
<td><strong>Cleaning</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After cleaning equipment and/or utensils</td>
<td>25</td>
<td>6</td>
<td>24.0 %</td>
</tr>
<tr>
<td>After handling soiled equipment or utensils</td>
<td>23</td>
<td>0</td>
<td>0.0 %</td>
</tr>
<tr>
<td><strong>Other tasks</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When changing tasks</td>
<td>189</td>
<td>3</td>
<td>1.6 %</td>
</tr>
<tr>
<td>After handling money</td>
<td>118</td>
<td>19</td>
<td>16.0 %</td>
</tr>
</tbody>
</table>

*SWH is number of observed times employees should have washed their hands; DWH is number of observed times employees did wash their hand; % of HW is HW percent of handwashing frequency.*
No handwashing was observed after employees were seen eating or drinking. Of the 12 times employees were observed eating or drinking, they used a covered cup for their drinks. Food Code (FDA, 2001) established a food employee might drink from a closed container if the container is handled to prevent cross-contamination.

Findings from this study indicated a high potential risk of cross contamination during production and service phases because employees were not frequently observed washing their hands, even as required by Food Code (FDA, 2001). Scott and Bloomfield (1990) found that when contaminated surfaces come in contact with fingers or utensils, significant numbers of organisms could be transferred. Chen, Jackson, Chea, and Schaffner (2001) found contamination of hands and various surfaces in the food preparation area presented cross-contamination problems. During both phases, the category of tasks with highest percents of handwashing frequency was food preparation.

Most of the operations (four of the five) used gloves for serving food, yet employees did not always wash their hands before donning gloves, as hands were washed only 16 of the 63 times it should have occurred. This low percent represents a high risk for cross contamination. As mentioned by Snyder (1998), employees must realize that gloves should be changed frequently, and hands should be washed each time gloves are changed because microorganisms adhere to the surface of gloves, which can cause cross contamination.

Handwashing Methods Used by Employees.

Introduction

Handwashing methods used by employees in the deli style food service operations observed in this study tended to vary. Food Code (FDA, 2001) defined hand washing as a
procedure that involves three steps. The first step consists of lathering and washing, the second step involves rinsing, and the final step is drying. In the initial phase of this three-step process, washing and lathering should occur for at least 10 seconds and be followed by immediate rinsing and drying. Some of the 18 observed employees used the method described by Food Code (FDA, 2001), whereas others employees simply adhered to only one or two steps of the three-step process. For instance, some employees only rinsed their hands with water, used soap but lathered less than 10 seconds, or used a dirty towel to dry their hands.

In-compliance with Food Code (FDA, 2001)

For this study, in-compliance percent refers to the percent of handwashing by employees using the standard procedure defined by Food Code (FDA, 2001). The in-compliance percent was estimated using the following formula:

\[
\text{In-compliance} = \frac{\text{Number of times employees did wash hands using appropriate methods defined in Food Code}}{\text{Number of times employees should have washed their hands}} \times 100
\]

During the production phase, when the 16 different tasks specified on the HOF were performed, not once did employees wash their hands following the procedure established by Food Code (FDA, 2001). During the service phase, in-compliance with Food Code methods was found in tasks categorized as food preparation. In-compliance was observed for 3% of the times “before employees engaged in food preparation” and 5% “before employees returned to the preparation area”. When all other tasks specified in the HOF were performed, no employees were observed washing their hands following the defined procedure. In FDA’s (2004) Report on the Occurrence of Foodborne Illness Risk Factors in Selected Institutional
Foodservice, Restaurant, and Retail Food Store Facility Types, proper and adequate handwashing by employees in deli retail foodservice operations was the procedure with the lowest percent (40.4%) of in-compliance with Food Code (FDA, 2001) handwashing standards. It is important to note that a larger sample was used in FDA's study.

Despite the fact that a low percent of in-compliance was found in these five operations when performing different tasks, it is significant to note that employees did make an effort to use at least some of the steps described in Food Code (FDA, 2001) when washing their hands. These efforts are described below.

Non-compliance Methods

Efforts made by employees to wash hands, albeit not in-compliance with Food Code (FDA, 2001), were observed in this study. The design of some operations, the speed of work during peak hours, and the lack of knowledge about correct handwashing procedures perhaps made it difficult for employees to follow the procedure described in Food Code. In this study, non-compliance method refers to the use of at least one of the required steps defined by Food Code. The steps for handwashing efforts by employees were rinsing only (sometimes rubbing), washing with soap but lathering (this included friction on wrists and friction on fingertips) less than 10 seconds, or failure to use a recommended drying method. It is considered non-compliance because the procedure used did not follow the one described in Food Code. Figure 1 and Figure 2 show the number of times employees should have washed and did wash their hands using correct procedures for selected tasks. These included using soap but lathering less than 10 seconds or only rinsing.
Figure 1. Handwashing frequency and specific methods used for selected tasks during 15 hours of observation of the production phase in deli foodservice operations

Figure 2. Handwashing frequency and specific methods used for selected tasks during 15 hours of observation of the service phase in deli foodservice operations.
**Rinsing Only**

Even though all operations had soap available in the handwashing facility, some employees only rinsed their hands (sometimes with rubbing) as part of the process. During 15 hours of observing 10 employees during production, specific tasks when handwashing did occur with employees only rinsing their hands were: “before engaging in food preparation” (n=4), “before returning to the preparation area” (n=1), “before slicing/handling different food products” (n=1), and “before donning gloves to work with food” (n=3).

During 15 hours of observation of 12 employees during the service phase, employees rinsed their hands as the handwashing method “before engaging in food preparation” (n=2), “before donning gloves for working with food” (n=3), “when changing tasks” (n=2), and “after handling money” (n=1).

During the performance of these tasks, either during production or service phases, employees did not follow the handwashing procedure defined by Food Code (FDA, 2001), but an effort was made to rinse their hands. Studies have noted reduction in pathogens counts from just rinsing and friction. Coates, Hutchinson, and Bolton (1987) found *Campylobacter spp.* were effectively reduced from hands by washing them with soap and water or water alone with friction, followed by drying with paper towels. Bidawid, Farber, and Sattar (2000) found that washing of finger pads with just water or soap followed by rinsing water, reduced the amounts of Hepatitis A Virus.

**Washing with Soap for Less than 10 Seconds**

Some employees washed their hands with soap, but lathering did not occur for the full 10 seconds as required by Food Code (FDA, 2001). Employees were observed lathering
their hands for less than 10 seconds, sometimes under running water, so that by the time they were finished lathering there was no soap on their hands.

During observations of the production phase (15 hours with 10 employees), tasks when handwashing occurred and soap was used, but without 10 seconds of dedicated lathering were “after eating or drinking” (n=3), “before engaging in food production” (n=3), “before entering the food preparation area” (n=1), “after handling money” (n=4), “after cleaning equipment and/or utensils” (n=2), and “when changing tasks” (n=3).

Observation during the service phase (15 hours with 12 employees) found handwashing with soap, but without lathering for 10 seconds occurred “after touching bare human parts” (n=3), “before engaging in food production” (n=13), “before returning to the preparation area” (n=7), “before donning gloves” (n=8), “after cleaning equipment and/or utensils” (n=3), “when changing tasks” (n=1), “after handling money” (n=13), and “other tasks” (i.e. used of phone) (n=13).

Drying Methods

Food Code (FDA, 2001) identified use of disposable towels, clean cloth towels, or a heated-air drying device as correct drying procedures that should follow handwashing. All five operations participating in this study had disposable towels in the handwashing area. During production, when handwashing occurred, employees used disposable towels for hand drying when performing the following tasks: “after eating or drinking” (n=3), “before engaging in food preparation” (n=11), “before returning to the preparation area” (n=3), “after cleaning equipment and/or utensils” (n=2), and “when changing tasks” (n=3). Before donning gloves, disposable towels were used 2 of the 3 times employees washed their hands. After handling money, disposable towels were used 4 of the 5 times after handwashing.
occurred. After handling soiled equipment or utensils, employees did not use a disposable towel for drying their hands.

Employees were observed using disposable towels following handwashing, after these tasks specified on the HOF were performed during the service phase: “after touching bare human parts” (n=3), “before returning to the preparation area” (n=11), “before donning gloves to work with food” (n=13), “after cleaning equipment and/or utensils” (n=6), and “after handling money” (n=14). Two of the tasks when employees did not use disposable towels after handwashing were “before engaging in the food preparation” (17 of 18 times) and “when changing tasks” (2 of 3 times). In those cases at one operation, the drying method observed was a cloth towel, but not a clean towel. It was just one towel kept next to the handwashing sink and this same towel was used at different occasions for the entire observation period.

The majority of the time, a disposable towel was used as the drying method after handwashing in the five deli foodservices. This practice can reduce cross-contamination. Pether and Gilbert (1971) found that proper handwashing followed by hand drying with paper towels reduced the risk of transmission of bacteria to food. Coates, Hutchison, and Bolton (1987) demonstrated the effectiveness of handwashing followed by the use of disposable towels in the reduction of Campylobacter spp. on hands.

The Food Code (FDA, 2001) description of handwashing did not require faucets to be turned off with a towel, yet this practice will prevent recontamination of hands. Most of the observations found employees dried their hands with a disposable towel and on two occasions, one employee was observed using the same towel to turn off the faucet. Faucets of handwashing sinks could be a cross-contamination point because employees with dirty hands
touch it to turn it on. Proper training is needed, as hand faucets were standard in these facilities. Henroid, Mendonca, and Sneed (2004) found high level counts of *Enterobactericeae* and *Staphylococcus aureus* on handwashing sinks faucets.

Despite a low in-compliance percent with the *Food Code* (FDA, 2001) recommended methods, handwashing efforts were observed. No in-compliance for observed tasks during production phase and only 8% during service phase were found. Employees in the observed facilities did make an effort to wash their hands following some of the steps defined in *Food Code*. They used soap and a disposable towel for drying, which previous studies had demonstrated are good practices in preventing cross-contamination.

**Handwashing Benchmarks for Deli-type Foodservice Operations**

One purpose of this study was to propose handwashing benchmarks for deli type of foodservice operations. Benchmarks provide a reference to the number of the times hands should be washed in this type of operation when performing different tasks during either production or service. These were defined by estimating the amount of times handwashing should have been washed per employee-hour. The benchmarks were estimated using the following formula:

\[
\text{Benchmark per employee} = \frac{\text{Total number of times employees should have washed their hands}}{\text{Total number of observed employees}}
\]

\[
\text{Benchmark per employee hour} = \frac{\text{Benchmark per employee}}{15 \text{ hours of observation}}
\]
Based on 15 hours of observation of 10 employees engaged in food production and 15 hours of observation of 12 employees during service at five deli operations, the following general benchmarks are proposed:

Benchmark during food production per employee hour............................1.5
Benchmark during service per employee hour.........................................2.0

Based on typical deli menu offerings and characteristics of observed deli-type foodservice operations, each employee should wash hands at least 1.5 times per hour during production. During service, each employee should wash their hands at least 2 times per hour. Managers of deli foodservice operations should consider this guide when developing training programs for their employees.

When estimating benchmarks during the service phase, the 103 counts for category of “other tasks” was omitted, as this was a particular situation when the employees used the hand held counter. The proposed benchmark for service is higher than for production because during service, employees were busier and performed tasks requiring handwashing more frequently. Additionally, during service tasks such as handling money are present. It is also important to consider that in deli operations it is during the service phase that most of the preparation of sandwiches took place. In the observed deli foodservice operations customers ordered their sandwiches and employees prepared them during the service phase.
CHAPTER 5. CONCLUSIONS

This chapter consists of four sections. A summary of this study is presented, limitations are recognized, recommendations for future research are presented, and conclusions are made.

Summary of the Research

The purpose of this study was to develop and pilot test a handwashing observation form (HOF) to determine current and desired handwashing frequencies and methods used by employees in deli-type of retail foodservice establishments in one Midwestern state (Iowa). Handwashing benchmarks were proposed for production and service phases for this type of operations.

Two in-depth field observations were conducted in each of five deli foodservice operations during production and service phases. During each visit, handwashing frequencies and methods of handwashing were observed over 10 three-hour periods. A HOF based on Food Code (FDA, 2001) recommendations for handwashing frequencies and methods, as well as best practices was developed to record observed handwashing behavior. The number of times handwashing should have occurred and the number of times it did occur were marked on the form in the appropriate column. Other columns on the form noted the method of handwashing employees used (soap, all parts of hand lathered, friction on fingertips or nail brush used, friction on wrists, 10-15 sec. lathering or friction, drying with disposable towel or heated air, and faucet turned off with towel). Tasks when handwashing should have occurred were classified in categories of: personal hygiene, food preparation, cleaning, and other tasks. The HOF also included sections for recording information about handwashing sinks and
background information on employees, gathered through informal interviews during the three-hour observation period.

An informal interview with the site manager during one of the observation periods also was conducted. Information about ownership of the facility, training provided, organizational policies related to handwashing, number of years he/she had worked in foodservice and at this location, and any certification or training held by the manager in food safety was obtained.

A total of 15 employees and three managers was observed during the 10 visits to the operations; 10 employees were observed during production and 12 during service. Most of the employees worked part-time and the mean number of hours worked each week per employees was 16.5. Nearly one-half of the employees reported one to two years of work experience in foodservice operations, and less than half (n=7) of the employees had worked less than one year for the current employer. Previous research has shown that length of time employees had worked for an employer affected good personal hygiene practices (like handwashing). Training received by employees was reported to be related to organizational procedures. Employees did not mention food safety as part of their training. All managers in these operations were male and half (n=2) had five or more years of work experience in the foodservice industry. Those two had been working with the current organization for five years or more.

Ownership of operations varied. Two of the operations were independently owned (including public university) and the others were part of a corporate-owned or a franchised chain. With this type of ownership, the chain established operational policies. All delis were open during noon and evening meals. The reported average number of sandwiches sold by
the operations was 178 per day. Most of the operations (n=4) had written organizational policies about personal hygiene and handwashing in place, but only one had written policies about food safety training.

Observed deli foodservice operations offered a variety of menu items that included sub sandwiches with different types of breads, meats, cheeses, vegetable toppings, salads, desserts, soups, beverages, and chips. Chips were purchased in bulk in one operation while the others offered individual packages. Some of the operations sliced their meat and cheese on-site and others purchased the product pre-sliced. Vegetable toppings offered at operations were lettuce, tomatoes, green peppers, onions, black olives, pickles, and banana peppers. A choice of dressings used on sandwiches or salads was offered in all operations. Typically sandwiches were served cold. During production and service, many opportunities for cross contamination were observed.

All operations had only one handwashing sink located in the sandwich assembly and service area. Most of the operations had separate (hot and cold) faucet handles while one had an automatic faucet. All operations met the Food Code (FDA, 2001) requirement of provision of soap and available supply of disposable towels. Less than half of the operations had a trash can at each handwashing sink. Of the five operations, three had both hot and cold running water as required in Food Code (FDA, 2001).

Results from this study indicated that during production and service phases, employees in deli foodservice operations were not washing their hands at times required by law (FDA, 2001). With the exception of two tasks, the percent of handwashing frequency for each specific task was very low (less than 50%) during production and service phases.
During both phases, the category of tasks with highest percents of handwashing frequency was food preparation.

Handwashing methods used by employees in the deli style foodservice operations observed in this study varied. Most employees tended to use only one or two steps of the three-step handwashing process described in *Food Code (FDA, 2001)*. Handwashing incompliance with *Food Code* was observed only for two tasks by a small number of employees during the service phase “before employees engaged in food preparation” and “before returning to the preparation area”. Even though most employees did not completely follow the handwashing method defined by *Food Code (FDA, 2001)* efforts to use at least some of the required steps, like rinsing only or using soap but lathering less than 10 seconds, were seen. During both phases, when employees did make an effort to wash their hands, disposable towels were used most of the time. Benchmarks were proposed based on observation for both the production and service phase.

**Limitations**

Some limitations should be considered when reading this study. This study was limited to one type of retail foodservice operation in one Midwestern state. A small convenience sample of operations participated. Findings may not be generalized to all foodservice establishments in the United States or even all deli operations. Findings of this study should be considered preliminary. The handwashing observation form (HOF) developed and used in this study provided a helpful guide in data collection. Experience with the instrument indicated the need for some changes for use in future studies.
In-depth field observations were used to collect data. There might have been observer effects on the handwashing behavior as individuals were conscious of being observed and were aware of the purpose of the study. Because more than one employee was observed at a time, this might have caused some inconsistency in data collection. However, size of operations was very small and only one handwashing sink was present in each establishment, thus it is assumed missed observations were few in number.

Three of the observations were conducted during the early part of Thanksgiving Break. The study was conducted in a college town, where workers and customers are students. During the break many students left town so this reduced the number of people working in each operation and the number of customers visiting, which resulted in employees assuming more responsibilities.

**Future Research**

Further research should be conducted to establish employees’ handwashing frequencies and methods in other sectors of the foodservice industry to compare differences between types of foodservice establishments and determine the type of training appropriate for these. The updated HOF could be used to assess handwashing frequencies and methods in different sectors of the foodservice industry, with comparisons made by type of foodservice, menu items served, ownership structure, size of operation, as well as demographic characteristics of employees and managers. This study was limited to a small sample. A larger sample should be used in future research in order to compare differences between handwashing frequencies and methods by characteristics of operations, employees, and managers.
A survey of foodservice managers and employees to evaluate knowledge about handwashing frequencies and methods would be useful as managers are typically in charge of training for employees. If they have the knowledge of proper handwashing frequencies and methods, they are in a better position to train and supervise their employees. Effectiveness of a training session about handwashing to deli employees also could be conducted as the potential of contamination from hands was repeatedly observed in this study.

In addition, a research study to compare reduction rates of bacteria and other pathogens on hands using methods of handwashing could be conducted. Past research has been unclear as to effectiveness of methods, such as rinsing only, and has not been conducted in a foodservice setting.

Applications

Findings from this study indicated that employees in deli foodservice operations were not washing their hands at the appropriate times and using recommended methods, thus the risk of cross-contamination was high. In deli operations where many menu items are not heat treated prior to service, this is essential. Managers need to consider giving initial and continuous training to employees about when and how to wash hands, and the importance of good handwashing practices. Proposed benchmarks during production and service phases could help managers develop training sessions and monitor performance during operational hours.

Some operations did not have handwashing sinks in good condition. Keeping handwashing sinks clean and in good condition with all the necessary supplies is a
responsibility of the manager, to promote and facilitate proper handwashing practices by their employees.

When using the HOF, a task in the category of personal hygiene to be added is “after touching clothes”, as employees were continuously observed touching their clothes or aprons while working. The tasks “after coughing or sneezing into hands” and “after coughing or sneezing into sleeve” could be expressed as one task “after coughing or sneezing” because, in either case, employees should wash their hands. The task “before returning to the preparation area” could be better understood if expressed as “upon entering the preparation area”. The column of should wash hands should be wider than the column of did wash hands to allow for more notations. It is also suggested the HOF includes observations for signs with a must wash hands message posted near the handwashing sinks and information about the availability of trash cans.

The purpose of this study was to develop and pilot test a handwashing observation form (HOF) to determine current and desired handwashing frequencies and methods used by employees in deli-type of retail foodservice establishments. The HOF was a complete and useful guide for data collection. A protocol explaining number of employees that should be observed, period of time of observations, and things needed for each observation, should be developed for future use. Application of the HOF in larger operations would require tracking of handwashing frequencies and methods for each employee by the researcher during a set period of time.
REFERENCES


APPENDIX A. RECRUITMENT INSTRUMENT AND CONSENTS FORMS
Good morning or afternoon. My name is Paola Paez. I am a Master's student in the Foodservice and Lodging Management Program of Iowa State University. My thesis project is to observe Deli foodservice operations and assess cross-contamination risks. I am asking for your help. Information observed and that you provide will be pooled with data from other similar operations. We can provide your operation with some educational materials, useful for training staff and technical assistance. You will also be presented with a summary of our findings. Your participation is voluntary. Are you interested in participating?

Your participation will mean letting me make two visits to the operation and observe employees over the age of 18, during three hours of service, using an observation form based on Food Code. I will also ask the manager (you) some questions about training of employees and general information related to the operation. Our conversation should take no more than 20 minutes of your time. No discomfort to you or your employees is expected, I will simply be observing normal procedures in your operation. All information will be kept in a locked cabinet and observation tools will be destroyed after data are analyzed. Observations and information gathered during the site visit will be kept strictly confidential. Results will be presented in summary form only. I appreciate your cooperation.
Consent Form for Managers

You have agreed for your foodservice to participate in an observational study about cross-contamination risk factors in Deli operations (Handwashing frequency: Current and desired handwashing practices in Deli Types retail foodservice establishment). As indicated in our phone conversation, your participation in this study is completely voluntary. Withdrawal from the study can occur at any time without prejudice to you.

Observations will be made of employees 18 years of age or older during normal operating procedures. Two visits to your restaurant during lunch or evening service hours will be scheduled, each lasting approximately three hours. There is no risk or discomfort expected for you or your employees. Observations and information gathered during the site visit will be kept confidential. Results will be presented in summary form only.

We need your signed consent if you are willing to participate. Any name associated with the experiment will be deleted upon completion of the study. Any question regarding your right as a participant in this research project can be directed to Paola Paez (515-294-4636), Catherine Strohbehn (515-294-7306), or to the Institutional Review Board at Iowa State University (515-294-4566).

If you agree to participate in the study, please sign the consent form below, and return in the enclosed postage-paid envelope. A copy is enclosed for your records.

I have read the consent form statement and agree to participate in the study, with the understanding that I can withdraw from the study at any time without prejudice to me.

Name ___________________________ Signature ___________________________

__/___/___

Date
Consent Form for Employees

You have agreed to participate in an observational study about cross-contamination risk factors in Deli operations (Handwashing frequency: Current and desired handwashing practices in Deli Types retail foodservice establishment). Your participation in this study is completely voluntary. Withdrawal from the study can occur at any time without prejudice to you. Information you provide, or that I will gather through observation will not be shared with your employer. All information will be pooled and presented in summary form only.

Observations will be made of employees 18 years of age or older during normal operating procedures. Two visits to the restaurant during lunch or evening service hours will be scheduled, each lasting approximately three hours. There is no risk or discomfort expected for you. Observations and information gathered during the site visit will be kept confidential. Results will be presented in summary form only.

We need your signed consent if you are willing to participate. Any name associated with the experiment will be deleted upon completion of the study. Any question regarding your right as a participant in this research project can be directed to Paola Paez (515-294-4636), Catherine Strohbehn (515-294-7306), or to the Institutional Review Board at Iowa State University (515-294-4566).

If you agree to participate in the study, please sign the consent form below.

I have read the consent form statement and agree to participate in the study, with the understanding that I can withdraw from the study at any time without prejudice to me.

Name ___________________________ Signature ___________________________

_____/_____/____
Date
APPEDIX B. HUMANS SUBJECTS APPROVAL
DATE: October 27, 2005

TO: Paola Paez  
FROM: Human Subject Research Compliance Office

RE: IRB ID # 05-465  
STUDY REVIEW DATE: October 26, 2005

The Institutional Review Board has reviewed the project, "Handwashing Frequency: Current and desired handwashing in practices in Deli types retail foodservice" requirements of the human subject protections regulations as described in 45 CFR 46.101(b)2. The applicable exemption category is provided below for your information. Please note that you must submit all research involving human participants for review by the IRB. Only the IRB may make the determination of exemption, even if you conduct a study in the future that is exactly like this study.

The IRB determination of exemption means that this project does not need to meet the requirements from the Department of Health and Human Service (DHHS) regulations for the protection of human subjects, unless required by the IRB. We do, however, urge you to protect the rights of your participants in the same ways that you would if your project was required to follow the regulations. This includes providing relevant information about the research to the participants.

Because your project is exempt, you do not need to submit an application for continuing review. However, you must carry out the research as proposed in the IRB application, including obtaining and documenting (signed) informed consent if you have stated in your application that you will do so or required by the IRB.

Any modification of this research must be submitted to the IRB on a Continuation and/or Modification form, prior to making any changes, to determine if the project still meets the Federal criteria for exemption. If it is determined that exemption is no longer warranted, then an IRB proposal will need to be submitted and approved before proceeding with data collection.

cc: HRIM  
Catherine Strohbehn
APPENDIX C. DATA COLLECTION FORMS
Handwashing Frequency in Retail Foodservice Operations
Interview with Manager

Date: __________________________________________
Facility Code: ____________________________________
Name of Manager: _________________________________
Phone Number: __________________________________

1) Gender: ____ Male  ____ Female

2) _____ Domestic  ____ International

3) What type of training in personal hygiene is provided by the operation to new employees:

____________________________________________________________________________________

____________________________________________________________________________________

4) Is there a written organizational policy about personal hygiene? _____ Yes _____ No

5) Is there written organizational policy about handwashing? _____ Yes _____ No

6) Is there a written organizational policy about training? _____ Yes _____ No

7) If yes, does the policy specify type or length of training? _____ Yes _____ No
   What is specified? ____________________________________________________________
   ____________________________________________________________

8) How would you describe ownership of this facility?
   _____ Independently owned
   _____ Corporate-owned chain
   _____ Franchised chain
   _____ Other

9) What is the average number of sandwiches sold per day:_________________________
   ____________________________________________________________

10) Does this organization require food safety certification? _____ Yes _____ No

11) How many years have you worked at this restaurant:___________________________

12) How many years have you worked in foodservice operations:___________________
13) Do you have any type of food safety certification for managers?  ____Yes  ____No

14) If yes, what type of certification?  ____________________________________________
### Handwashing Frequency in Retail Foodservice Operations

**Handwashing Observation Tool**

<table>
<thead>
<tr>
<th>Task</th>
<th>Should Wash Hands</th>
<th>Did Wash hands</th>
<th>Soap used</th>
<th>All parts of hand lathered</th>
<th>Friction on fingertips or nail brush used</th>
<th>Friction between lathered fingers</th>
<th>Friction on wrists</th>
<th>10-15 sec. lathering or friction</th>
<th>Drying disposal towel or heated air</th>
<th>Faucet turned off w/towel</th>
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<td>After using a handkerchief or disposal tissue</td>
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<td>Before returning to preparation area</td>
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<td>Before slicing/handling different food products (meat, cheese, vegetables)</td>
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<td>When switching between working with raw food and working with ready-to-eat food</td>
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<td>Before donning gloves for working with food</td>
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<td>After slicing/handling potentially hazard food (meat/cheese)</td>
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<td>After handling soiled* equipment or utensils</td>
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*Soiled refers to items, utensils, and dishware no longer in use.
Facility Code: ____________________________
Date and time of observation: ____________________________

Handwashing Sink Location:
Nail Brush Available: _____ Yes _____ No
Foot Pedal: _____ Yes _____ No
____ Single Handle _____ Separate Handles
Single Faucet: _____ Yes _____ No
Soap Available: _____ Yes _____ No
Temperature of Water: ____________________________
Drying Method: _____ Disposable _____ Heated Air
_____ Other

Handwashing Sink Location:
Nail Brush Available: _____ Yes _____ No
Foot Pedal: _____ Yes _____ No
____ Single Handle _____ Separate Handles
Single Faucet: _____ Yes _____ No
Soap Available: _____ Yes _____ No
Temperature of Water: ____________________________
Drying Method: _____ Disposable _____ Heated Air
_____ Other

General Information:
Employee 1 _____ FT _____ PT
____ Domestic _____ International
Gender: _____ M _____ F
Estimated range age: ____________
Years with the organization: ____________
Years working with foodservice operations: ____________
Average hours worked per week: ____________
Type of training received: __________________

Employee 2 _____ FT _____ PT
____ Domestic _____ International
Gender: _____ M _____ F
Estimated range age: ____________
Years with the organization: ____________
Years working with foodservice operations: ____________
Average hours worked per week: ____________
Type of training received: __________________