

FOOD SAFETY PRACTICES IN CHILDCARE CENTERS IN KANSAS

by

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Abstract

The Centers for Disease Control and Prevention estimated that one in six Americans become ill, 128,000 are hospitalized, and 3,000 die each year due to foodborne illness. Children are at a higher risk of acquiring foodborne illness than adults for several reasons, including: an immune system that has yet to fully develop, limiting their ability to fight infections; a lack of control over the food they consume because their meals are usually provided by others; and the lack of awareness of food safety risks. Thus, it is critical to ensure that childcare center employees practice safe food handling. The purpose of this study was to explore the food safety knowledge, practices, and barriers to safe food handling practices of childcare center employees. Observations were conducted in 10 childcare centers in Manhattan, Kansas. Each childcare center was observed for two days during lunch preparation and service. Observations of foodservice employees were conducted in the kitchen using a structured observation form. Teacher observations were conducted in the classroom using detailed notes. A questionnaire was used to collect demographic, food safety training, and food safety knowledge information. SPSS (v. 20.0) was used to analyze data. Childcare center employees had high average scores on the safety knowledge assessment. The majority of employees received some type of food safety training. Time pressures, availability of equipment, and small food preparation space were found as the main barriers to implementing safe food handling. Childcare center foodservice workers and teachers were knowledgeable about handwashing and time/temperature control, but failed to utilize on the job. Results of this study will help childcare educators to develop materials to improve food safety practices and encourage owners/managers of childcare centers to enhance their food safety behaviors.

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Dedication

I would like to dedicate this thesis to my parents, Zuojun Fan and Cuiyan Lin, who are firm believers in hard work and have impacted me on my academic career. Their unconditional love and support have helped me to become a stronger person.

Chapter 1 - Introduction

According to The Centers for Disease Control and Prevention (2011a) (CDC), one in six Americans become ill, 128,000 are hospitalized, and 3,000 die each year of foodborne illnesses. In 2008, norovirus was responsible for 49% of all the foodborne illnesses, the majority of which was caused by contaminated food from improper food preparation (CDC, 2011b).

Unsafe food handling can increase foodborne risks, especially for vulnerable populations such as children, the elderly, pregnant women, and individuals with weakened immune systems (USDA, 2011a). Children under the age of five are at a higher risk of acquiring a foodborne illness than adults due to their less developed immune systems, low weight, and lack of control over the food served to them (Buzby, 2001; Haffejee, 1995).

Between 1998 and 2010, there have been over 50 foodborne illness outbreaks in childcare centers, causing 1,972 illnesses and 78 hospitalizations (CDC, 2012a). *Salmonella enteric* and norovirus were the pathogens that caused the most outbreaks. Because children are at higher risk of foodborne illness and there is a large population of children receiving full-time childcare, it is important to ensure that foodservice employees and teachers follow safe food handling practices to reduce the chances that children will get sick.

There has been limited food safety research in childcare centers, although studies have been conducted in other retail environments (Bean & Griffin, 1990; Clayton, Griffith, Price, & Peters 2002; U. S. FDA, 2000, 2004, & 2009a; Howells et al., 2008; Howes, McEwen, Griffiths & Harries, 1996; Manning & Snider, 1993; Roberts et al., 2008). For example, studies in restaurants, healthcare, and schools have reported that food workers' food safety practices are directly associated with the most common causes of foodborne illness: improper holding/time and temperature, poor personal hygiene, and contaminated equipment/protection from

contamination (U.S. FDA, 2000, 2004, & 2009a). Other studies have shown that training and intervention can improve employees' knowledge and overall food safety behavior (Bean & Griffin, 1990; U.S. FDA, 2000, 2004, & 2009a; & Roberts et al. 2008). Common barriers in implementing safe food handling among foodservice workers include: time constraints, inconvenience, and inadequate training and resources (Baş, Y üksel, & Çavuşođlu (2007; Howells et al., 2008; Youn and Sneed 2002). In addition, studies have also identified gaps between employees' self-reported food safety knowledge and actual behavior (Clayton, Griffith, Price, & Peters 2002; Howes, McEwen, Griffiths & Harries, 1996; Manning & Snider, 1993).

Justification

Approximately three million children attend childcare centers regularly (Laughlin, 2010). In addition, half of the young children whose mothers are employed full-time spend at least 35 hours per week in childcare centers where meals and snacks are prepared (Capizzano & Main, 2005; Swank, Sigman-Grant, Benedict, & Martin, 2007). Given that children are at a higher risk of contracting a foodborne illness than adults, it is critical to ensure that childcare employees practice safe food handling. Very few studies have been conducted on childcare center employees' food safety knowledge and behavior.

Purpose of Study

The purpose of this study was to explore the food safety knowledge, food safety practices, and barriers to safe food handling practices of childcare center foodservice employees and teachers. Exploring food-handling practices for childcare center employees will identify the gaps between employee knowledge and behavior. Results will help educators develop materials to improve employee knowledge and behaviors.

Research Questions

The following research questions were developed based on the purpose:

1. What is the food safety knowledge of employees in childcare centers?
2. Do employees in childcare centers follow proper food handling practices in the kitchen and classroom to assure safe food is served to the children?
3. What current food safety training is provided to childcare center employees?
4. What are the barriers to safe food handling practices in childcare centers?

Significance of the Study

Research exploring food safety practices of employees has been done in a multitude of settings, including restaurants, healthcare, and schools. However, limited research has been conducted in childcare centers, a segment serving a population highly susceptible to foodborne illness. Because children are at an increased risk of foodborne illness, it is important to discover current food safety practices in this environment. Based on research with other populations, gaps have shown between self-reported knowledge and actual food safety behavior. The results of this study showed that childcare center employees are knowledgeable about food safety, but failed to utilize this knowledge on the job.

Results will help to determine their knowledge of food safety, the baseline performance of employees on food handling, and the barriers that childcare center foodservice employees and teachers face regarding safe food handling. Childcare directors, foodservice employees, educators, and researchers will be provided with an understanding about the strengths and deficiencies of safe food handling in childcare centers.

This research will determine the gaps in knowledge and practices so educational materials can be developed to target knowledge improvement and behavior change. Future

researchers who wish to explore food safety practices in childcare centers could modify these instruments for use in their research.

Limitations of the Study

This study was limited to childcare centers in Manhattan, Kansas and the observations were limited to ten centers. Findings from this study cannot be generalized to other childcare centers outside of Manhattan, Kansas. In addition, these results cannot be generalized to foodservice operations such as restaurants, university foodservice, schools, and healthcare.

Definition of Terms

Campylobacter: A major cause of foodborne diarrheal illness in humans and the most common bacteria that causes gastroenteritis worldwide. Babies under 1 year, teens, and young adults are most commonly affected (WHO, 2011; Children’s Hospital Colorado, 2009).

Centers for Disease Control and Prevention (CDC): A part of the U.S. Department of Health and Human Services, it is the primary Federal agency for conducting and supporting public health activities in the United States (CDC, 2012b)

Childcare center: a childcare facility in which care and educational activities are provided for 13 or more children two weeks to 16 years of age for more than three hours and less than 24 hours per day including day time, evening, and night-time care, or which provides before and after school care for school-age children (Kansas Department of Health and Environment, 2012).

Clostridium perfringens: a spore-forming gram-positive bacterium that is found in many environmental sources as well as in the intestines of humans and animals. It is commonly found on raw meat and poultry and can survive in conditions with very little or no oxygen. It produces a toxin that causes illness (CDC, 2011c).

***Escherichia coli* 0157:H7:** A kind of *Escherichia coli* that can cause bloody diarrhea and can sometimes cause kidney failure and even failure by making a toxin called Shiga toxin and known as a Shiga toxin-producing *Escherichia coli* (STEC). (FoodSafety. Gov, 2013).

Foodborne Illness: Diseases that are usually either infectious or toxin in nature, caused by agents that enter the body through the ingestion of food (WHO, 2007).

Norovirus: a contagious virus that can be transferred from an infected person, contaminated food or water, or by touching contaminated surfaces (CDC, 2012c).

Salmonella: A bacteria that cause diarrhea, fever, or abdominal cramps. It is usually transmitted to humans by eating foods contaminated with animal feces. Contaminated foods are often of animal origin, such as beef, poultry, milk, or eggs, but any food, including vegetables, may become contaminated. Children under five years of age are mostly likely to be contaminated with *Salmonella* (CDC, 2010).

Chapter 2 - Review of Literature

Introduction

Proper food safety practices are important in preventing foodborne illness in childcare centers. This section will explore previous research related to the prevalence of foodborne illness in the United States, young children and foodborne illness, food safety practices and foodborne illness, food safety training, and barriers to safe food handling.

Prevalence of Foodborne Illness

Foodborne illness is a critical health issue in the United States and has become one of the largest preventable public health problems (Lee, 1994). Many foodborne illnesses can be prevented if safe food handling is maintained. Bacteria, viruses, and parasites cause the majority of foodborne illnesses in the United States (CDC, 2011a). Pathogens such as norovirus, *Salmonella*, *Clostridium perfringens*, *Campylobacter* spp., *Bacillus cereus*, *Escherichia coli* 0157:H7, and *Staphylococcus aureus* are the leading causes of foodborne illnesses (McCabe-Sellers & Beattie, 2004; Mead et al., 1999, Scallan, Griffin, Angulo, Tauxe, and Hoekstra, 2011). Other causes include toxins, unconventional agents, persistent organic pollutants, and metals (WHO, 2009).

Scallan et al. (2011) analyzed laboratory-confirmed foodborne illnesses in the United States and estimated that 31 major pathogens cause approximately 9.4 million illnesses yearly. Specifically, viruses caused the most illnesses (5.5 million), followed by bacteria (3.6 million illnesses), and parasites (2.0 million illnesses). Scallan et al. noted that norovirus, nontyphoidal *Salmonella* spp., *Clostridium perfringens*, and *Campylobacter* spp. are the main pathogens that caused foodborne illness. Nontyphoidal *Salmonellas* spp., norovirus, *Campylobacter* spp., and

Toxoplasma gondii were the pathogens found to cause the majority of the 55,961 hospitalizations due to foodborne illnesses. However, nontyphoidal *Salmonella* spp., *T. gondii*, *Listeria monocytogenes*, and norovirus caused the majority of the 1,351 deaths.

Only 20% of total foodborne illnesses are attributed to these 31 known pathogens. Approximately 72,000 hospitalizations and 1,686 deaths resulted from unspecified agents transmitted by food. Scallan et al. (2011) estimated that 80% of foodborne illnesses are caused by unspecified agents due to insufficient data, unidentified causes, or unproven substances (Scallan et al., 2011).

Utilizing the number of known and unknown sources, the CDC (2011a) estimated that 48 million Americans fall ill, 128,000 are hospitalized, and 3,000 die each year due to foodborne illness. The cost of foodborne illness is also significant. The USDA Economic Research Service (2004) estimated that the total cost from five foodborne pathogens including *Campylobacter*, nontyphoidal *Salmonella*, *E. coli* O157, *E. coli* non-O157 STEC, and *Listeria monocytogenes* exceeded \$6.9 billion in 2000. The cost was estimated based on the number of cases, hospitalizations, and deaths caused by these five pathogens in 1999. Hoffmann, Batz, and Morris (2012) estimated the annual cost of 14 pathogens, including medical costs and productivity losses due to long-term health outcomes. Their figures showed an annual societal cost to average \$14 billion, with a range between \$4.4 billion and \$33 billion yearly.

Young Children and Foodborne Illness

Young children are at a higher risk than the general population for foodborne illnesses. Their immune systems have yet to develop fully, limiting their ability to fight infections. Secondly, a reduced dose of a pathogen will cause illness due to lower body weight. Due to reduced stomach acid production, children have a decreased capacity to mitigate harmful

bacteria once it enters their digestive system (Buzby, 2001; Haffejee, 1995). In addition, children do not have control or awareness of food safety risks because their meals are prepared by others (Buzby, 2001).

The CDC reported that between 1990 and 2004, 43 foodborne illness outbreaks affecting 1,276 children in childcare centers were confirmed in the United States (CDC, 2012a). Some foodborne illnesses are more common in children than others. For example, *Salmonella* and *E. coli* 0157:H7 infections occur most among children 10 years of age and under (Buzby, 2001). *Campylobacter* occurs most among children from ages one to nine (CDC, 2009).

Because children are at higher risk for foodborne illness, special care needs to be taken to prevent foodborne illness. Kendall, Medeiros, Hillers, Chen, and Dimascola (2003) studied food handling behaviors and methods to decrease foodborne illness risks among highly susceptible populations using a Delphi process. The population groups included those with weakened immune systems, such as pregnant women, infants, young children, and the elderly. Forty-one food safety experts, epidemiologists, microbiologists, food safety educators, and policy makers participated in the web-based Delphi process. Results revealed behaviors that should be focused on include drinking only pasteurized milk and fruit juices, avoiding the consumption of sprouts, thoroughly rinsing fresh fruits and vegetables under running water prior to consumption, and cleaning food preparation surfaces with hot water and soap after they come into contact with raw meat, poultry, and seafood.

Making sure that food is handled safely is critical to reduce foodborne illnesses. Pathogens that cause foodborne illness can spread easily among children by sharing foods, toys, toilets, and mats. Therefore, in order to reduce the opportunities for illness in childcare centers, not only do foodservice employees need to know about food safety, but teachers need to be

familiar with food safety as they often come into contact the food served to children (New York State Department of Health, 2001).

Currently, several food safety programs are provided for childcare facilities. For example, The Childcare Division of the Oregon Employment Department provides a free *Food Safety Training Manual for Child Care Providers* (Oregon Employment Department, 2004) and the Florida Department of Health Bureau for Child Care Food Programs provides *Food Safety in the Child Care Food Program: Guidance for Child Care Providers* (Florida Department of Health, 2010). These programs provide information and guidance on food safety practices. Childcare center providers and foodservice employees can use these guidance documents as a source of implementing safe food handling in their centers.

As of June 2011, there was a total of 594 childcare centers with a capacity of 44,466 children in Kansas (Kansas Department of Health and Environment, 2011). Between 2009 and 2010, over seven million breakfasts, eight million lunches, 600,000 suppers, and 10 million snacks were served in Kansas childcare centers and home daycares (Child & Adult Care Food Program Statistics, 2010). Safe food handling guidelines for these providers have been promoted through the *Administrative Handbook for Child Care Centers and Homes* for Kansas childcare employees. The guidelines were based on the principle of *Keeping Hot foods Hot and Cold Foods Cold* (Administrative Handbook for Child Care Centers and Homes, Part 1, Chapter 3, 2010).

Food Safety Practices and Foodborne Illnesses

A limited number of studies have examined food safety risks in childcare facilities. Researchers of Iowa State University and Kansas State University have conducted observations in childcare centers to assess risk factors of cross-contamination and to determine handwashing

frequencies and procedures (Strohbehn, Paez, Sneed, & Meyer, 2011; Strohbehn, Sneed, Paez, & Meyer, 2008;). More studies have been conducted in other retail environments, including restaurants, healthcare, and schools, and with consumers.

In 2000, 2004, and 2009, the U.S. Food and Drug Administration (U.S. FDA) reported the occurrence of foodborne illness risk factors in the foodservice industry. The goal of these studies was to improve food safety practices in order to prevent foodborne illness outbreaks. These studies focused on certain food safety areas, including safety of food sources, personal hygiene, cooking, improper holding/time and temperature, and protection of food from contamination.

Results of these studies showed that the most common risk factors across hospitals, elementary schools, and restaurants were improper holding/time and temperature, poor personal hygiene, and contaminated equipment/protection from contamination. However, results were different throughout the years and among the facilities. Table 2.1 illustrates the out-of-compliance percentages for the three risk factors in hospitals, elementary schools, and restaurants selected from the U.S. FDA 2000, 2004, and 2009 report.

Specific observation items with high out-of-compliance percentages were found in all three U.S. FDA reports. Items such as “potentially hazardous food held cold at 41 °F or below” and “ready-to-eat, potentially hazardous food date marked after 24 hours” both included in the improper holding/time and temperature category had high out-of-compliance rates when compared to other risk factors throughout the years. Similarly, proper and adequate handwashing and good personal hygiene practices contributed to high out-of-compliance rates for overall poor personal hygiene percentages. Furthermore, surface/utensils clean/sanitized were responsible for high out-of-compliance percent for contaminated equipment/protection from contamination.

Table 2.1: Out-of-compliance Observations for Selected Commercial Foodservice Operations

Risk Factor	Percentage (%) of Out-of-compliance Observations ^a											
	Hospital			Elementary School			Fast Food Restaurant			Full Service Restaurant		
	2000	2004	2009	2000	2004	2009	2000	2004	2009	2000	2004	2009
Improper Holding/Time & Temperature	39.6	40.3	36.2	39.5	30.7	29.2	49.2	41.7	38.2	63.2	63.8	54.7
Poor Personal Hygiene	18.7	17.5	17.1	25.8	20.2	16.0	36.6	31.2	24.2	53.4	41.7	40.9
Contaminated Equipment/Protection from Contamination	16.3	18.9	17.6	11	20.4	16.8	14.6	21.9	17.4	43.6	37.3	35.0

Note. Adapted from “Report of the FDA retail food program database of foodborne illness risk factors,” by Food and Drug Administration, 2000. Available at <http://www.fda.gov/downloads/Food/FoodSafety/RetailFoodProtection/FoodborneIllnessandRiskFactorReduction/RetailFoodRiskFactorStudies/ucm123546.pdf>, “FDA Report on the Occurrence of Foodborne Illness Risk Factors in Selected Institutional Foodservice, Restaurant, and Retail Food Store Facility Types,” by Food and Drug Administration, 2004. Available at <http://www.fda.gov/Food/FoodSafety/RetailFoodProtection/FoodborneIllnessandRiskFactorReduction/RetailFoodRiskFactorStudies/ucm089696.htm>, and “FDA Report on the Occurrence of Foodborne Illness Risk Factors in Selected Institutional Foodservice, Restaurant, and Retail Food Store Facility Types,” by Food and Drug Administration, 2009. Available at <http://www.fda.gov/downloads/Food/FoodSafety/RetailFoodProtection/FoodborneIllnessandRiskFactorReduction/RetailFoodRiskFactorStudies/UCM224682.pdf>

^a Total observations for each facility and practice varied from a low of 339 to a high of 557 observations

In the hospital segment, the 2000 U.S. FDA report indicated that approximately 40% of the observations were out-of-compliance for improper holding/time and temperature, which was the highest out-of-compliance percentage of all the criteria (Table 2.1). Specifically, 61% of potentially hazardous food was not held below 41 °F. In 2004, improper holding/time and temperature still remained about the same. The 2009 report indicated an overall decrease in out-of-compliance rate for all risk factors. However, the out-of-compliance rate for improper holding/time and temperature remained the highest among the three factors.

In the observations for elementary school, U.S. FDA's 2000 report identified similar results to what was found in hospitals. Improper holding/time and temperature accounted for the highest overall out-of-compliance rate (39.5%), the next highest was poor personal hygiene (25.8%), followed by contaminated equipment (11%). Specific items that were identified as troublesome included improper and inadequate handwashing and cold holding temperature control of potentially hazardous foods, with out-of-compliance rates of 47% and 45%, respectively. According to the 2004 report, elementary school employees had increased handwashing performance, although overall time and temperature control showed an increased out-of-compliance rate and 50% of the observations in schools found that date marking of commercially processed, ready-to-eat potentially hazardous foods was out-of-compliance. In 2009, the out-of-compliance rate for improper holding/time and temperature, poor personal hygiene, and contaminated equipment declined when compared to the 2004 levels.

Overall, restaurants had higher out-of-compliance percentages than hospitals and elementary schools. For fast food restaurants, the 2000 U.S. FDA report indicated nearly half (49.2%) of the observations were out-of-compliance for holding/time and temperature, and over 80% out-of-compliance for potentially hazardous food and cold holding control. In the 2004

FDA report, fast food restaurants' highest out-of-compliance rate items were date marking (57.6%), PHF cold holding (56.5%), and improper handwashing (53.8%). In addition, cold holding of potentially hazardous food was poor in the 2009 report, but overall out-of-compliance rates for other items had significantly decreased since 2004.

In full service restaurants, the 2000 U.S. FDA report showed 63.2% of observations were out-of-compliance for holding/time and temperature. Over 80% of the observations were out-of-compliance for cooling of potentially hazardous food and cold holding control. In addition, 81% of observations in full service restaurants were out-of-compliance for proper and adequate handwashing. Full-service restaurants also performed poorly on date marking, hand contamination, surface cleanness and sanitizing, and raw food separation, which all had out-of-compliance rates over 50%. In the 2004 U.S. FDA report, the out-of-compliance rates for cold holding of potentially hazardous food (77.8%) and cooling control (77.3%) remained high for full service restaurants, but decreased from the 2000 report. Out-of-compliance rates also remained high for improper handwashing (72.7%) and cleaned/sanitized surfaces and utensils (56.6%). The 2009 U.S. FDA report indicated that high out-of-compliance rates remained for full-service restaurants for cooling of potentially hazardous food (78.6%), cold holding control (71.9%), and improper handwashing (75.8%). Assuring the cleanliness of work surfaces and utensils was also an important issue for full-service restaurants.

Green and Selman (2005) conducted a study to explore the factors that affect food workers' and managers' safe food preparation practices in restaurants. Focus groups were conducted with 44 workers and 26 managers from eight states. Participants discussed seven food preparation practices including handwashing, preventing cross-contamination, glove use, determining food doneness, holding, cooling, and reheating. Results showed that most workers

reported safe food preparation practices and the workers were knowledgeable about proper food handling. Unsafe personal hygiene practices such as failing to wash hands when changing gloves and using sanitizers instead of handwashing were reported by some of the food workers. In addition, workers also reported factors that negatively affect their engaging in safe food preparation practices, such as the lack of time to wash hands due to high business volume, inconvenient location of handwashing sinks, not having enough sinks for handwashing, and gloves being uncomfortable or the cause of allergic reactions. Positive factors that impact safe food preparation identified include a structured environment, equipment that helps facilitate food safety such as colored cutting boards for different types of food, and supportive food safety resources. The study also suggested that education is not sufficient to ensure that employees handle food safely.

Olsen, Mackinon, Goulding, Bean, and Slutker (2000) reviewed the 1993 - 1997 foodborne illness outbreak data compiled by the CDC. Results indicated that almost half of the foodborne illnesses came from unsafe food handling. Each year, the most frequently reported cause of foodborne illness was improper holding temperature (34% on average). Contaminated equipment (26% on average) and poor personal hygiene (18% on average) were also implicated as frequent causes of foodborne outbreaks. The results of the Olsen et al. (2000) study were similar to U.S. FDA's report on risk factors in 2000, 2004, and 2009. Improper food handling was identified as the most frequent cause of foodborne outbreaks.

Trepka, Murunga, Cherry, Huffman, and Dixon (2006) conducted five focus groups among 32 consumers and found a general lack of knowledge concerning the importance of safe food handling practices and risks associated with foodborne illnesses. In this study, consumers also indicated foodborne illness was not a major issue. They also did not believe poor food

handling at home could cause foodborne illness. Regardless of whether the research is focused on the foodborne illness outbreaks and practices of foodservice employees or consumers, three practices (cross-contamination, handwashing, and time/temperature control of food) are commonly linked to foodborne illnesses.

Cross Contamination

Cross contamination is responsible for 14% of total foodborne outbreaks (Linton, 1996). It occurs when food is not handled properly and harmful bacteria transfers to food from other foods, persons, cutting boards, utensils, etc. (USDA, 2010). When handling raw meat, poultry, and seafood, it is critical to make sure that these foods and their juice are kept separate from cooked, ready-to-eat foods and fresh produce (USDA, 2010; U.S. FDA, 2012).

According to the U.S. FDA (2012), food can be contaminated in many ways. During the processing of food, foodborne microbes can be transferred to meat and poultry carcasses if the meat comes into contact with the animals' intestinal contents. Likewise, fresh fruits and vegetables can be contaminated by being washed in water that was contaminated with animal manure or human sewage (U.S. FDA, 2012).

Foodhandlers are a key factor in preventing cross contamination. *Shigella*, Hepatitis A, and norovirus can be passed from foodhandler to food, if the foodhandler fails to properly wash their hands. An experiment conducted by Bidawid et al. (2004) studied norovirus cross-contamination. Using a surrogate virus, the researchers explored how to stop virus transfer between hands and selected foods and environmental surfaces. Results indicated that foods could be easily contaminated with norovirus if touched by soiled hands. However, the transfer of the virus from hands to food can be significantly reduced by washing hands with running water and soap or applying an alcohol-based hand sanitizer prior to touching.

Humphrey, Martin, and Whitehead (1994) conducted a study on the contamination of hands and work surfaces by preparing food using eggs artificially inoculated with *Salmonella enteritidis*. After cracking and mixing the eggs, the participants' hands and the work surfaces were tested. Results showed that even though cleaning procedures were practiced, *Salmonella enteritidis* was still present on 21% of the sampled hands and bowls. Contamination of surrounding surfaces using two mixing methods (hand vs. electric mixer) also was tested. Results indicated that using an electric mixer created more contamination than hand mixing. The authors suggested that foodhandlers should carefully handle foods that require refrigeration and further processing of raw food, such as eggs, in order to effectively prevent cross contamination.

An observation of food preparation practices was conducted during food preparation in the United Kingdom (Redmond, Griffith, Slader, & Humphrey, 2004). Closed circuit video cameras were used to record the participants' food safety behaviors when they prepared chicken and pasta salad dishes in a model domestic kitchen. Swabs were taken of the bowls that were used to contain eggs and work surfaces at the end of the experiment to test for *Salmonella* and *Campylobacter*. Results indicated that all participants displayed unsafe food handling behaviors that transfer *Campylobacter* and *Salmonella* to ready-to-eat foods.

Graves et al. (1998) investigated a foodborne outbreak in Oklahoma and found that 14 people contracted *Campylobacter jejuni* from eating lasagna and lettuce contaminated with raw chicken. Investigators suggested that the contamination occurred because the cook did not adequately wash his/her hands after handling raw chicken. In addition, because it was not clear if the countertop was properly sanitized after handling raw chicken, investigators suggested that the contamination could also come from contacting the unclean countertop.

Handwashing

Hand hygiene is the most important factor of personal hygiene (Florida Department of Health, 2010). The U.S. FDA Food Code (2009b) requires that hands be washed immediately before contact with ready-to-eat food or clean equipment and utensils, after touching bare human body parts, after using toilet, or when switching between touching raw food and ready-to-eat food. Keeping hands clean by washing under clean, running water for 20 seconds with soap can effectively reduce the risk of getting sick and spreading germs to other people (U.S. FDA, 2010).

However, studies have shown that food workers do not perform adequate handwashing. Strohbehn, Sneed, Paez, and Meyer (2011) observed employees' handwashing practice in a total of 16 facilities including living facilities for elderly, childcare centers, restaurants, and school districts. In childcare centers, only 60 instances of handwashing were performed out of the 199 occasions when handwashing needed to occur during food production. A similar finding was revealed during the service period where employees only performed 36% of handwashing practices. Specifically, employees performed poorly on handwashing after eating or drinking. In addition, of the 99 times employees touched equipment, utensils, or dishware, only 17 instance of handwashing occurred during the cleaning period. Overall, of the 572 times when handwashing should have been performed in childcare centers, only 171 (30%) occurred.

Green et al. (2006) observed the handwashing behavior of 321 restaurant food workers over a three-month period. The researchers found the food workers only attempted to wash their hands during 32% of the 532 work activities that required handwashing. Only 27% of the workers performed proper handwashing. Snyder (1998) discovered that only 60% of the food workers washed their hands frequently or properly. The U.S. FDA (2000, 2004) reported the

handwashing out-of-compliance rate among employees had increased by 20% between 2000 and 2004.

Studies have found that handwashing could significantly reduce virus transfer among children (Master, Hess, Longe, & Dickson, 1997). In a childcare center setting, handwashing is particularly critical for toddlers or younger aged children, who are likely to eat food with their hands without understanding that hands should be washed before and after eating (Florida Department of Health, 2010). Kotch et al. (2007) studied diarrheal illness among infants and toddlers from 46 childcare centers in North Carolina. Twenty-three centers were used as intervention centers where new high-quality diapering, handwashing, and food-preparation equipment were installed and the other 23 centers were assigned to a control group. Both groups were trained with the *Keep It Clean* program for seven months. Results showed a 40% decrease of diarrhea related absents and 55% less sick days after the new equipment was installed. In addition, all staff hygiene and sanitation behaviors in both intervention and control centers improved after the *Keep It Clean* training.

Early et al. (1998) studied the effectiveness of a handwashing intervention to decrease diseases in public schools. Researchers visited six elementary school bathrooms and observed the handwashing facilities, including general tidiness, running water, soap availability and type, and drying equipment. Observations of elementary children's handwashing frequency also were conducted before lunch or after using the bathroom. The handwashing intervention included an educational program, poster of hand wipes in bathrooms, combination of education and hand wipe posters, and a comparison to schools that did not conduct the intervention. Bathroom observations showed that 66% of the 129 sinks neither had functional soap dispensers nor sufficient soap. Results of handwashing behaviors indicated that the overall occurrence of

handwashing increased from 58% to 67% between pre- and post-interventions. This study found that the combination of handwashing education and the hand wipe posters were the most effective way to improve the frequency of handwashing.

Guinan, McFuckin, and Ali (2002) observed handwashing behavior among 290 elementary students for three months. Students were divided into control and test groups. Education on handwashing and hand sanitizers was provided to the test group. The number of absences due to illness was observed and recorded by teachers for each student over the three-month period. Students' absences due to sickness from the test group were 50% lower than the control group. In addition, cost data associated with teacher and nurse time, hand sanitizers, and handwashing training materials were also analyzed. This study indicated that even though there was an additional cost of \$775 for nurse in-service time, hand sanitizers, and study materials; because of reduced teacher time, the test group resulted in a saving of over \$6,075 when compared to the control group. Researchers suggested absenteeism due to sickness and cost associated with hand hygiene can be decreased by providing hand hygiene education and hand sanitizers in the classroom. By decreasing absenteeism, it was estimated that a total cost of \$24,300 (\$6,075 quarterly) could be saved over the course of a year.

Aiello, Coulborn, Perez, and Larson (2008) conducted a meta-analysis of handwashing research to determine the effectiveness of hand hygiene procedures on handwashing methods and diseases control. The authors analyzed articles published between 1960 and 2007. A total of 602 intervention studies were selected after excluding articles that did not meet the selection criteria and 30 studies were included in the meta-analyses. Results indicated that 31% of gastrointestinal illnesses were prevented with hand hygiene interventions.

Temperature and Time Control

Storing and cooking food to the appropriate temperatures and correctly using thermometers are significant steps in preventing foodborne illnesses. According to the USDA (2011b), bacteria can multiply to harmful levels if food is left in the temperature danger zone (41 °F to 135 °F) for greater than four hours. Making sure that food is at safe temperatures includes assuring the proper end-point cooking temperature has been met, and that proper holding and storage temperatures are achieved.

The USDA (2011b) has recommended safe end-point cooking temperatures for commonly consumed food. For example, ground meats should be cooked to a minimum internal temperature of 160 °F, ground chicken and turkey should be cooked to 165 °F, and all whole meat cuts are to be cooked to 145 °F.

Holding temperatures are important because bacteria and other microorganisms can grow rapidly if food is maintained between 40 °F and 135 °F, often resulting in a foodborne illness (U.S. FDA, 2009b). Thus, food needs to be cooked, held, and stored at the proper temperatures to prevent the growth of microorganisms (USDA, 2011b). Studies have indicated that temperature abuse is a serious issue in foodservice operations. The 2000, 2004, and 2009 U.S. FDA reports found that the out-of-compliance rate of improper holding/time and temperature is the highest out of all identified risk factors for hospitals, nursing homes, elementary schools, restaurants, and retail food stores.

Henroid and Sneed (2004) observed school foodservice employee to evaluate their food-handling practices, knowledge, and attitudes towards food safety in 40 Iowa schools. An informal interview and food safety knowledge and attitude assessment were used in each observation during a three-hour period. In order to measure temperatures of food, refrigerators

and freezers, dish machines, digital thermometers and thermal strips were used. Results indicated that 40% to 50% of the participants were not knowledgeable about the reheating temperature of complex foods, or the final rinse temperature for thermal dish machines. In addition, the majority of the operations misinterpreted temperature measuring and recording. For example, 70% of the schools did not check and record temperatures prior to service, over half of the schools did not use calibrated thermometers to check temperatures, and over 85% of the schools did not record freezer, refrigeration, and milk refrigeration temperatures as appropriate. In addition, temperatures of cold food taken by the researchers showed that 45% of the food was over the recommended 41 °F.

Kim and Shanklin (1999) studied time and temperature control for three elementary schools in a Midwest school district where the food production system shifted from centralized conventional to a centralized cook-chill system. Both systems were compared, and time and temperature abuse was observed in both systems. However, there was more time and temperature abuse performed in the cook-chill system than in the conventional system. For example, within the conventional system, average temperatures of spaghetti and meat sauce were between 118 °F and 139 °F, below the minimum hot holding temperature (140 °F). However, in the cook-chill system, one of the schools achieved a 143 °F average holding temperature, while the rest of the schools resulted in a temperature range between 137 °F and 138 °F. Factors that impacted time and temperature control in this study included standardized reheating procedures and limited holding time.

Roberts et al. (2008) examined restaurant employees' knowledge of time and temperature (use of thermometers). Questions related to holding and reheating temperature, properly checking end-point cooking temperature, and thermometer calibration were included in a food

safety assessment completed by 177 employees. Observations of food safety behaviors were also conducted. Results indicated that restaurant employees' knowledge was poor. For example, over 30% of the employees did not correctly interpret the holding temperature for hot food. For observed behaviors, only 14.7% of the employees correctly measured end-point cooking temperatures at the completion of cooking and 13.3% correctly measured end-point cooking temperatures at the completion of reheating. Conversely, Green et al. (2006) found that 47% of employees self-reported using a thermometer to check the end-point cooking temperature of food.

Pilling, Brannon, Roberts, Shanklin, and Howells (2009) assessed restaurant employees' beliefs about food safety and found that the employee-identified barriers to checking end-point cooking temperature of food were lack of time, thermometers, and training. Studies have shown that there are major concerns associated with time and temperature control for foodservice operations and employees. According to Trepka et al. (2006), using thermometers was the hardest food safety practice to follow. Four out of the five focus group participants showed lack of knowledge about proper cooling of food, two focus group participants did not know how long food should be left out of the refrigerator.

Food Safety Training

Because food handling practices are directly associated with food safety risks, it is critical to ensure that employees are knowledgeable about food safety and are able to safely prepare food. Studies have identified that food safety training improves sanitation inspection scores (Cotterchio, Gunn, Coffill, Tormey, & Barry, 1998; Kneller & Bierma, 1990), food safety behaviors (Anding, Boleman, & Thompson, 2007), and the microbiological quality of food (Cohen, Reichel, and Schwartz, 2001). Foodservice managers have access to several food safety

certification and training programs. For example, state or local food safety programs, ServSafe[®], and Serving It Safe.

Pre- and post-training inspection scores for 94 restaurants were compared by Cotterchio et al. (1998) using routine health inspection records. Results indicated increased inspection scores (14.7 points) for the restaurants in which the managers were mandated to attend a training and verification program. The authors concluded that training and certification programs decrease foodborne illness for restaurants by improving sanitary conditions.

Anding et al. (2007) explored the self-reported change in food safety behaviors among managers after completing a *Food Safety: Its' Our Business* course. Of the 189 respondents, 88% reported a significant increase in the total number of behaviors practiced prior to the course. In addition, the majority of respondents had increased the food safety training time for their employees from 5.6 hours to 9.4 hours.

Other studies have identified that food safety training has a positive impact on the microbiological quality of food. Cohen et al. (2001) explored the microbiological quality of food before, during, and after the food safety training of employees. A sanitation training program was implemented in seven departments in one catering company. A total of 774 food samples (339 samples before, 88 samples during, and 349 samples after the training) were collected over a seven-month period to compare the food quality. Results indicated that the ratio of samples to be categorized as high quality increased from 76.1% before implementing the training to 87.0% after the training.

A study conducted by Hine et al. (2003) examined the importance of employee food safety training. Restaurant managers from three states were surveyed with questions regarding external and internal training programs, financial incentives, and satisfaction with food safety

training. The majority of managers indicated that employee training decreased their overall concern for food safety within their establishment and 72% of managers indicated they would like to hire employees with previous food safety training.

However, other studies have revealed that it is common to observe unsafe food handling practices during preparation, even after food safety training has occurred (Green & Selman, 2005; Manning & Snider, 1993; Oteri & Ekanem 1989; Redmond & Griffith, 2003). Researchers have supported that food safety training can improve knowledge, but behavior and compliance with food-safety guidelines does not improve based on knowledge alone (Roberts et al., 2008; York et al., 2009).

Lynch, Elledge, Griffith, and Boatright (2005) surveyed managers to measure their knowledge of fundamental food safety principles. Results indicated that the managers' food safety knowledge was affected by source of training, certification, and experience. The study also indicated that increased training hours did not improve the managers' food safety knowledge.

York et al. (2009) evaluated the effectiveness of food safety training with an intervention addressing perceived food safety barriers and negative attitudes about food safety. Thirty-three restaurant employees completed a ServSafe® training course, completed the self-administered questionnaire, and were observed for food safety behaviors. Results suggested that food safety training was effective in improving knowledge, but training alone did not improve most behaviors. The only exception to this was handwashing, which improved after training. A combination of intervention and education was the most effective at improving overall food handling behaviors.

Barriers to Safe Food Handling

In a foodservice environment, such as schools and restaurants, where a large number of people are served, it is important to ensure that foods served to the customer are safe.

Foodservice operators, managers, and employees play an important role in preventing foodborne illness. Proper food handling is critical to decrease foodborne illnesses and outbreaks. However, it may be difficult for foodservice employees to follow safe food handling recommendations.

Previous studies have provided insight into the barriers that impede foodservice employees from practicing safe food handling behaviors.

Studies have been conducted to identify barriers to implementing food safety practices in school foodservice operations (Giampaoli, Sneed, Cluskey, & Koenig, 2002; Youn and Sneed, 2002). One of barriers for employees to follow food safety practices was lack of employee food safety training and training materials. Results indicated that 40% of the school districts provide food safety training each year, however the lack of time and money was identified as barriers to providing this training. Baş, Y üksel, and Çavuşođlu (2007) found similar results in Turkey.

These researchers identified lack of knowledge, time, staff turnover, employee motivation, and training as major barriers associated with implementing proper food safety practices.

Howells et al. (2008) examined perceived barriers to implementing food safety practices in the restaurant setting. Inadequate training, time constraints, inadequate resources, and inconvenience to practice proper food safety practices were identified as barriers in this study.

The authors believed that training should be provided to the employees regarding these barriers.

In addition, most of the employees felt adequately knowledgeable about food safety, thus knowledge was not often identified as a barrier to following proper food safety practices.

Summary

Many people are affected by foodborne illness each year. Children are at a higher risk of foodborne illness and an increasing number of children are attending child care centers, therefore it is extremely important to make sure safe food handling is performed to reduce the risk of children being affected by foodborne illness.

Several studies have identified the most common issues associated with practicing safe food handling was improper holding/time and temperature, poor personal hygiene, and contaminated equipment/protection from contamination in foodservice operations. Other studies have indicated there is a gap between foodservice employees' knowledge of food safety and their actual behaviors. Food safety training has been recognized as an effective way to help employees improve food safety knowledge, but other methods are needed to improve overall food safety behaviors. Moreover, several studies have provided evidence of barriers to implementing safe food handling behaviors in the workplace setting; however, very few of them have focused on child care centers.

Literature has suggested the importance of food safety practices, but there is a paucity of research related to food safety practices in childcare centers. This study will explore the food safety practices of childcare center employees. An assessment of food safety knowledge of childcare center foodservice employees and teachers will also be conducted in this study.

Chapter 3 - Methodology

Introduction

The purpose of this study was to explore the food safety knowledge, food safety practices, and barriers to safe food handling practices of childcare center staff. This chapter discusses methods that were used to accomplish the study objectives, including population and sampling, data collection, observation, questionnaire, pilot study, and data analysis.

Population and Sampling

The population for this study was childcare centers in Manhattan, Kansas. Convenience sampling was utilized. Employees of ten childcare centers were included in the study.

Development of Instruments

Qualitative and Quantitative Observation Forms

Qualitative observations were conducted during classroom observations for teachers. The observer recorded descriptive details of the teachers' food handling behavior in each childcare center (Appendix A). Observation of teachers focused on behaviors regarding handwashing, sanitation, and use of gloves.

Quantitative observations were conducted in the kitchen for foodservice employees. A food safety observation form, based on the research of Roberts et al. (2008), was utilized for this study (Appendix A). This observation form contained general food safety practice items. There were four categories of activities based on the FDA Food Code (2009b) included in the form. The first section was handwashing. Specific times for handwashing observed were and included items such as if the employees wash hands before food preparation, between switching gloves,

after touching body parts, etc. Each item was recorded as “employee observed washing hands when required and properly”, “employee observed washing hands improperly”, or “employee observed failing to wash hands when required”.

The second section, employee food handling, included items such as checking food temperatures, using thermometers correctly, sanitizing food contact surfaces, etc. These items were recorded as in- or out-of-compliance.

The third section of the observation form related to cleaning and sanitizing of work surfaces, including properly sanitizing dishes and utensils, changing sanitizing solutions as needed, separating wiping cloths for food and nonfood surfaces, etc. These items were recorded as in- or out-of-compliance.

The last section of the observation form included items related to the overall facility. Handwashing facilities and supplies, hot/cold holding equipment, and protection from contamination of food were items in this category. Comments and notes were recorded in the observation form for all items.

The observation form was reviewed for content validity by three experts who are experienced with food safety. Their suggestions and recommendations were incorporated prior to conducting observations.

Questionnaire

A questionnaire to collect demographic and food safety training information was completed by foodservice employees and teachers (Appendix B). A short assessment of safe food handling knowledge was included in the questionnaire. The assessment was developed based on previous studies exploring foodservice employees’ food safety knowledge as conducted by Roberts et al. (2008). A total of nine food safety questions were included in the assessment.

There were six answers provided for each question and participants were asked to circle all that apply. A correct answer was coded as 1 and an incorrect answer was coded as 0. A total possible composite score was 54. The questions were categorized as cross contamination (food handling and work surfaces), time and temperature abuse (use of thermometers), and personal hygiene (handwashing behaviors). Each category included three questions, resulting a possible score of 18. The questionnaire was reviewed by three experts and changes were made as needed.

Data Collection

Childcare center directors were contacted to solicit their participation in the study. A handout that explained the objectives and procedures of the study was sent to each director (Appendix C). Each childcare center was observed during lunch preparation and service hours for two days during a typical workweek (Monday through Friday). Observations occurred between 6:00 a.m. and 1:30 p.m. and ranged from one-half hour to four and half hours depending on food production style and size of the facility. The more complicated the food production was, or the larger the center's census was, the longer it took for foodservice workers to prepare the meals. For example, a few centers warmed up lunch in a microwave which resulted less than 30-minute preparation time. Other centers cooked lunch from scratch or prepared a large number of lunches resulting over four hours preparation time. The average observation period was 1 hour and 51 minutes. Observations included two parts: an observation of the foodservice employees in the kitchen during meal preparation and an observation of teachers in the classroom setting during the lunch period.

Observation Procedure

Observations of foodservice employees' food handling behaviors and preparation in the kitchen began when foods were being prepared in the kitchen and ended when the food was delivered to the classrooms. If food was delivered from another site, the observation started when food arrived on-site and ended when delivered into each classroom. Observations of teachers' food handling behaviors began when the food arrived in the classroom and continued until the majority of the children finished lunch.

At the completion of the observation period, the observed employees were asked to complete a questionnaire that addressed demographic and food safety training information. A short assessment of food safety knowledge was also included in the questionnaire.

In this study foodservice workers were defined as the personnel who were involved in food preparation. If an employee prepared food and served lunch, he/she was classified as a foodservice worker. Teachers in this study did not perform any food production activities.

Data Analysis

SPSS (v.20. 0) was used to analyze data. To summarize the data, descriptive statistics including frequencies, percentages, means, and standard deviations were calculated for observation and questionnaire items, as appropriate. Comments, open-ended questions, and notes were compiled.

Research Compliance

Before collecting any data, approval from the Kansas State University Institutional Review Board (IRB) was obtained. The Approval letter is included in Appendix D.

Chapter 4 - Food Safety Practices in Childcare Centers in Kansas

Introduction

Foodborne illness is a critical issue in the United States. Each year, foodborne illness causes 48 million illnesses, 128,000 hospitalization, and 3,000 deaths according to the Centers for Disease Control and Prevention (CDC, 2011). Leading pathogens that cause foodborne illness include norovirus, *Salmonella*, *Clostridium perfringens*, *Campulobacter* spp., *Bacillus cereus*, *Escherichia coli*. 0157:H7, and *Staphylococcus aureus* (McCabe-Sellers & Beattie, 2004; Mead et al., 1999; Scallan et al., 2011).

Foodborne illness can affect anyone, especially vulnerable populations such as children, the elderly, pregnant women, and individuals with weakened immune systems (USDA, 2011). Young children are at a higher risk for foodborne illness than the general population because of their less developed immune systems, which limits their ability to fight infections; their lower body weight which means a reduced dose of pathogen can make them sick; and they lack control or awareness of food safety risks because their meals are prepared by others (Buzby, 2001; Haffejee, 1995). Pathogens such as *Salmonella*, *E. coli* 0157:H7, and *Campylobacter* infections occur most among children age 10 and under (Buzby, 2001). Between 1990 and 2004, there were 43 confirmed foodborne illness outbreaks in childcare centers, affecting 1,276 children (CDC, 2012a).

There are approximately three million children who attend childcare centers regularly and a large proportion of these children spend at least 35 hours per week in the center, where meals and snacks are prepared and served (Capizzano & Main, 2005; Laughlin, 2010; Swank, Sigman-Grant, Benedict, & Martin, 2007). Foodborne pathogens can easily spread among children by

sharing foods, toys, toilets, and mats (New York State Department of Health, 2001). Therefore, it is critical to ensure that childcare center employees handle food safely to avoid infecting children, among whom illness could spread very quickly.

Strohbehn, Paez, Sneed, and Meyer (2011) conducted observations in childcare centers in Midwestern states to assess cross contamination risk factors and to determine handwashing frequencies and procedures. Results showed that of the 199 occasions when handwashing was required, only 60 instance of handwashing were performed during preparation. Poor handwashing was also observed during the service period where employees washed their hands for only 36% of work activities when handwashing was required.

The majority of food safety studies focus on retail environments, such as restaurants, healthcare, and schools, or consumers. The U.S. Food and Drug Administration reports on foodborne illness risk factors in the foodservice industry showed that the most common risk factors in hospitals, elementary schools, and restaurants were improper holding/time and temperature, poor personal hygiene, and contaminated equipment/protection from contamination (U.S. FDA, 2000, 2004, & 2009a). Similar finding were presented in the study conducted by Olsen, Mackinon, Goulding, Bean, and Slutker (2000) where the researchers reviewed CDC and Prevention foodborne illness outbreak data from 1993 to 1997. Improper holding temperature, contaminated equipment, and poor personal hygiene were identified as the most frequent causes of foodborne outbreaks in their study.

Because improper food handling behaviors can increase food safety risks, it is critical to ensure that employees are knowledgeable about proper food safety practices and are able to safely prepare food. Studies have identified that food safety training improves sanitation inspection scores (Cotterchio, Gunn, Coffill, Tormey, & Barry, 1998; Kneller & Bierma, 1990),

food safety behaviors (Anding, Boleman, & Thompson, 2007), and the microbiological quality of food (Cohen, Reichel, and Schwartz, 2001). However, other studies have revealed that it is common to observe unsafe food handling practices during preparation, even after food safety training has occurred (Green & Selman, 2005; Manning & Snider, 1993; Oteri & Ekanem 1989; Redmond & Griffith, 2003; Roberts et al., 2008). Roberts et al. (2008) conducted a study to exam the effect of food safety training for 160 employees in 31 restaurants. Researchers assessed employees' food safety knowledge and behavior regarding cross contamination, personal hygiene, and time/temperature control through a pre- and post-training food safety knowledge assessment and observations. Employees then received four-hour ServSafe® training, and then completed a food safety knowledge assessment. Pre- and post-training results indicated that overall food safety knowledge and behavior improved after training. However, an increase in knowledge did not yield an increase in behaviors (Roberts et al., 2008).

York et al. (2009) evaluated the effectiveness of food safety training with an intervention addressing perceived food safety barriers and negative attitudes about food safety. Results indicated that food safety training was effective at improving knowledge, but training alone did not improve most behaviors. The only exception to this was handwashing, which improved after training. The study suggested that a combination of intervention and education was the most effective to improve overall food handling behaviors.

The purpose of this study was to explore the food safety knowledge, practices, and barriers to safe food handling of childcare center employees. Exploring food handling practices for childcare center employees identified the gaps between employee knowledge and behavior.

Methodology

Sample

The population for this study was childcare centers in Manhattan, Kansas. Convenience sampling was utilized. Employees of ten childcare centers were included in the study.

Development of Instruments

A food safety observation form, based on the research of Roberts et al. (2008) was utilized for this study. The observation form listed four categories that are highly associated with foodborne illness risks: handwashing, food handling, cleaning and sanitizing, and appropriate use of facility (CDC, 2012b). The first section of the observation form was handwashing. Specific items observed included, if the employees washed their hands before food preparation, between switching gloves, after touching body parts, etc. Each item was recorded as employee observed washing hands properly and when required, employee observed washing hands improperly, or employee observed failing to wash hand when required.

The second section, employee food handling, included items such as checking food temperatures, using thermometers correctly, sanitizing food contact surfaces, etc. These items were recorded as in- or out-of-compliance based on FDA Food Code (2009b)

The third section of the observation form, cleaning and sanitizing work surfaces, included properly sanitizing dishes and utensils, changing sanitizing solutions as needed, separating wiping cloths for food and nonfood surfaces, etc. These items were recorded as in- or out-of-compliance based on FDA Food Code (2009b).

The last section of the observation form included items related to the overall facility. Handwashing facilities and supplies, hot/cold holding equipment, and protection from

contamination of food are examples of the items in this category. Comments and detailed notes were also recorded on the observation form for all items.

The observation form was reviewed for content validity by three experts who are experienced with food safety. Their suggestions and recommendations were incorporated prior to conducting observations.

Questionnaire

A questionnaire to collect demographic, knowledge, and food safety training information was completed by foodservice employees and teachers. A 54-item food safety knowledge assessment was used to measure knowledge. The assessment was developed based on previous studies exploring foodservice employees' food safety knowledge (Roberts et al., 2008). The questions were categorized as cross contamination (food handling and work surfaces), time and temperature abuse (use of thermometers), and personal hygiene (handwashing behaviors) and each category included three questions. There were six answers provided to each question and participants were asked to circle all that apply. The total possible composite score was 54 and each category had a possible score of 18. The questionnaire was reviewed by three experts and changes were made as needed.

The foodservice employees and teachers were asked to complete the questionnaire at the end of the observation period. Questionnaires were returned to the researcher before leaving the observation site.

Data Collection

Childcare center directors were contacted to solicit their participation. A total of 19 childcare center directors were contacted. A handout that explained the objectives and procedures of the study was sent to each director. Each childcare center was observed during

lunch preparation and service hours for two days during a typical workweek (Monday through Friday). Observations occurred between 6:00 a.m. and 1:30 p.m. and ranged from one-half hour to four and half hours depending on food production style and size of the facility. The more complicated the food production was, or the larger the center's census was, the longer it took for foodservice workers to prepare the meals. For example, a few centers warmed up lunch in a microwave which resulted less than 30-minute preparation time. Other centers cooked lunch from scratch or prepared large number of lunch resulting over four hours preparation time. The average observation period was 1 hour and 51 minutes. Observations included two parts: an observation of the foodservice employees in the kitchen during meal preparation and an observation of teachers in the classroom setting during the lunch period.

Observations of foodservice employees' food handling behaviors and preparation in the kitchen began when foods were being prepared in the kitchen and finished when food was delivered to the classrooms. During the observation, the observer focused on the four categories (Handwashing, food handling, cleaning and sanitizing, and facility) listed on the observation form and recorded whether those behaviors were correctly performed. Additional findings were recorded in the notes section.

Observations of teachers' food handling behaviors began when the food arrived in the classroom and continued until the majority of the children finished their lunches. Observations of this section were recorded in detailed notes. The observer focused on teachers' food handling behaviors including handwashing, sanitation, and use of gloves.

In this study foodservice workers were defined as the personnel who were involved in food preparation. If an employee prepared food and served lunch, he/she was classified as a foodservice worker. Teachers in this study did not perform any food production activities.

Results and Discussion

Demographic Characteristics

Of the 19 childcare centers contacted, 10 childcare centers agreed to participate in the study. Each center was observed for two days during lunch preparation and service, resulting in 20 total observations. A total of 19 employees, 13 foodservice workers, and six teachers completed the questionnaire.

Different sizes of Childcare centers were included in the study. Regular attendance of these centers range from 10 to approximately 200. The majority of the centers (7 of 10) had lunch prepared on site while the remaining had meals delivered. In operations that prepared lunch on site, four centers cooked meals from scratch and three of them reheated pre-cooked food. It was common to observe more unsafe handling behaviors among employees who prepared from scratch. Foodservice workers' food handling behaviors vary significantly among the childcare centers. Some of the employees were well trained and were able to properly practice the majority food handling procedures safely.

The characteristics of employees who completed the questionnaire are presented in Table 4.1. The majority of the employees were female (18 of 19), over age of 45 (8 of 19), held a bachelor's degree (9 of 19), and work equal or more than 40 hours per week (13 of 19). Most of the employees have had some type of food safety training (11 of 19). A total of five employees had a food safety certification (Foodhandler certification or Food Safety certification), where two of them have both certifications.

Table 4.1. Demographic Characteristics of Childcare Center Employees (n= 19)

Characteristic	n	Characteristic	n
Age		Education	
25 years or younger	3	Less than a high school	0
26-35 years	5	High School Graduate	3
36-45 years	3	Some College	2
45 years or older	8	Associate or two year college	4
Gender		Bachelor's Degree	9
Female	18	Master's Degree	1
Male	1	Doctorate Degree	0
Years of Experience in Foodservice		Received Food Safety Training**	
Less than 1 year	4	Yes	11
1 – 5 years	5	Local Health Department training	4
6 – 10 years	1	ServSafe® Manager	2
11 – 15 years	1	Serving-it-Safe	1
16 – 20 years	1	SerSafe® Handler	1
Greater than 20 years	1	Other	5
None*	6	No	8
Years in Current Position		Employees Food Safety Credential ***	
Less than three months	1	None	13
3 - 6 months	3	Foodhandler Certification	5
7 months – 1 year	6	Food Safety Certification	3
2 – 5 years	5	Hours Worked/Week	
6 – 10 years	2	Less than 20	1
11 – 15 years	1	20 – 39	5
Greater than 15 years	1	40 – 59	13
		60 – 79	0
		80 or more	0

^a Percentages may not add up to 100% if respondents did not answer the question.

* Teachers who do not involve in cooking or preparation.

** Total exceeds 100% due to respondents having more than one type of trainings.

*** Total exceeds 100% due to respondents having more than one credentials.

Food Safety Knowledge

Table 4.2 summarizes the food safety knowledge scores for childcare center employees. In the food handling, cleaning and sanitizing work surfaces category, the correct mean score of the employees who believed floors should be cleaned and sanitized when working in food

preparation area was only 42.6% for foodservice workers and only 66.7% for teachers. When responding to the questions related to handling raw foods, the majority of the respondents understood ready-to-eat food should not come in contact with raw food, but the mean correct percentage was only 53.9%. For questions related to usage of thermometers, the mean correct percentage for employees and teachers correctly answered that food should be reheated to 165 °F was 46.2% and 33.3%, respectively.

In response to handwashing questions, both foodservice workers and teachers had perfect scores on most of the items related to drying hands. All foodservice workers also answered the question related to sanitizing cutting surfaces and hands correctly. All teachers knew that raw food should not come into contact with ready-to-eat food and cold food needs to be held at 41 °F or below. However, the average percentage of correct responses to the item pertaining to drying hands using an air dryer after washing was only 53.9% for foodservice workers and 33.3% for teachers.

Overall food safety knowledge scores are presented in Table 4.3. Foodservice workers' overall score of food safety knowledge was 43.3 of 54 (80.2%) and teachers' scored 42.5 of 54 (78.7%). The highest mean score of all three categories was handwashing. Foodservice workers and teachers resulted in 15.7 of 18 (87.2%) and 14.8 of 18 (82.2%), respectively. Overall scores showed that both foodservice workers and teachers had a good knowledge of food safety. Especially for handwashing, employees seem to know when and how to wash hands properly.

Table 4.2. Food Safety Knowledge Scores of Childcare Center Employees in Kansas (n=19)

Questions ^a – Food Handling, Cleaning and Sanitizing Work Surfaces	Mean % Correct ±SD	
	Foodservice Employee (n=13)	Teacher (n=6)
1. Which of the following should be cleaned and sanitized when working in the food preparation area?		
a. Cutting surfaces*	100.0 ±0.0	83.3 ±0.4
b. Hands*	100.0 ±0.0	83.3 ±0.4
c. Utensils*	92.3 ±0.3	83.3 ±0.4
d. Countertops*	100 ±0.0	100.0 ±0.0
e. Floors*	46.2 ±0.5	66.7 ±0.5
f. Stovetops*	84.6 ±0.4	83.3 ±0.4
2. Food surfaces should be cleaned and sanitized at which of the following times?		
a. Before preparing foods*	92.3 ±0.3	83.3 ±0.4
b. When switching from one food preparation task to another*	84.6 ±0.4	83.3 ±0.4
c. Between each food preparation task*	100.0 ±0.0	83.3 ±0.4
d. When they become contaminated*	76.9 ±0.4	83.3 ±0.4
e. When only working with ready-to-eat foods	84.6 ±0.4	100.0 ±0.0
f. Every 2 hours when performing the same food preparation task	69.2 ±0.5	66.7 ±0.5
3. Raw foods that will be cooked before serving should not come into contact with which of the following?		
a. Ready-to-eat foods*	84.6 ±0.4	100.0 ±0.0
b. Floor*	61.5 ±0.5	66.7 ±0.5
c. Utensils	61.5 ±0.5	66.7 ±0.5
d. Other raw foods*	53.9 ±0.5	83.3 ±0.4
e. Countertops	46.2 ±0.5	66.7 ±0.5
f. Bare hand	46.2 ±0.5	50.0 ±0.6
Questions^a – Use of Thermometers		
4. Which of the following temperatures are correct for food preparation?		
a. Cold food is held below 41 °F *	76.9 ±0.4	100.0 ±0.0
b. Food is reheated to 165 °F *	61.5 ±0.5	33.3 ±0.5
c. Baked goods are held above 70 °F	76.9 ±0.4	66.7 ±0.5
d. Beverages are held below 50 °F	69.2 ±0.5	66.7 ±0.5
e. Hot food is held above 135 °F	76.9 ±0.4	66.7 ±0.5
f. Ice must be below 0 °F *	53.9 ±0.5	50.0 ±0.6

^aRespondents were asked to circle all responses that were correct for each question.

*Denotes that the item was correct if circled.

4.2. Food Safety Knowledge Scores of Childcare Center Employees in Kansas (n=19)
(Continued)

	Mean % Correct \pm SD	
	Foodservice Employee (n=13)	Teacher (n=6)
5. To properly check the temperature of food, which of the following should be done?		
a. Taste it to see if it is hot enough	92.3 \pm 0.3	100.0 \pm 0.0
b. Use a calibrated, sanitized thermometer*	100.0 \pm 0.0	83.3 \pm 0.4
c. Touch it to see that it is hot enough	100.0 \pm 0.0	100.0 \pm 0.0
d. Look at it to make sure it is the right color	61.5 \pm 0.5	100.0 \pm 0.0
e. Check the center of the food rather than the surface*	84.6 \pm 0.4	66.7 \pm 0.5
f. Make sure it has been cooking for the correct amount of time	46.2 \pm 0.5	66.7 \pm 0.5
6. When should a thermometer be used to check the temperature of food?		
a. At the completion of cooking*	84.6 \pm 0.4	83.3 \pm 0.4
b. Prior to cooking	100.0 \pm 0.0	100.0 \pm 0.0
c. After reheating*	76.9 \pm 0.4	66.7 \pm 0.5
d. On the hotline*	69.2 \pm 0.5	66.7 \pm 0.5
e. On the coldline*	69.2 \pm 0.5	66.7 \pm 0.5
f. At the midpoint in cooking	76.9 \pm 0.4	100 \pm 0.0
Questions^a – Handwashing		
7. After handwashing, hands should be dried:		
a. With a single use paper towel*	92.3 \pm 0.3	100.0 \pm 0.0
b. On pants	100.0 \pm 0.0	100.0 \pm 0.0
c. With an apron	100.0 \pm 0.0	100.0 \pm 0.0
d. With a common towel	100.0 \pm 0.0	100.0 \pm 0.0
e. By shaking vigorously	100.0 \pm 0.0	100.0 \pm 0.0
f. With an air dryer*	53.9 \pm 0.5	33.3 \pm 0.5
8. Which of the following are necessary for proper handwashing?		
a. Soap*	92.3 \pm 0.3	83.3 \pm 0.5
b. 20 seconds*	92.3 \pm 0.3	83.3 \pm 0.5
c. 15 seconds	100.0 \pm 0.0	100.0 \pm 0.0
d. Hot water*	38.5 \pm 0.5	16.7 \pm 0.4
e. Warm water*	53.9 \pm 0.5	33.3 \pm 0.5
f. Hand sanitizer	84.6 \pm 0.4	100.0 \pm 0.0
9. Hands should be washed in which of the following circumstances?		
a. After going to the restroom*	100 \pm 0.00	83.3 \pm 0.4
b. Before work*	92.3 \pm 0.3	66.7 \pm 0.5
c. After touching body parts*	100.0 \pm 0.0	83.3 \pm 0.4
d. When switching food preparation tasks*	100.0 \pm 0.0	100.0 \pm 0.0
e. Before putting on gloves*	69.2 \pm 0.5	66.7 \pm 0.5
f. Before going to the bathroom	100.0 \pm 0.0	83.3 \pm 0.4

^aRespondents were asked to circle all responses that were correct for each question.

*Denotes that the item was correct if circled.

Table 4.3. Food Safety Knowledge Composite Scores

Category	Mean Correct \pm SD ^a	
	Foodservice Employee (n=13)	Teacher (n=6)
Cross Contamination	13.9 \pm 1.7	14.3 \pm 3.4
Handwashing		
When to wash hands	5.6 \pm 0.5	4.8 \pm 1.6
How to wash hands	10.1 \pm 1.4	9.5 \pm 1.3
Use of thermometers	13.8 \pm 1.8	13.8 \pm 2.1
Overall Knowledge Scores	43.3 \pm 3.2	42.5 \pm 7.0

a Mean Number of Items Correct \pm Standard Deviation

a perfect score would be 54, or for each practice (cross contamination, handwashing, or use of thermometers) 18. For when to wash hands, a perfect score was 6, for how to wash hands 12

Foodservice Employee Observations

Employee Handwashing Behavior Observations

Handwashing observations for foodservice workers were recorded each time handwashing was supposed to happen during preparation. A total of 291 handwashing observations were recorded. Results of employee handwashing behaviors are present in Table 4.4. Foodservice employees only washed their hands properly and when required 87 (29.9%) times during food preparation. Fifty-four (18.6%) of the observations showed that employees improperly washed their hands. Common practices of improper handwashing including washing for less than 20 seconds, not using soap, or failing to dry using a paper towel or air dryer. Moreover, foodservice employees failed to wash hands over 150 (51.5%) instances when required.

The highest out-of-compliance frequency (41 of 49) was handwashing after touching body parts, coughing/sneezing, blowing nose, or eating and drinking. In this category only six observations showed that handwashing properly practiced when required, two attempts were observed, where the employees did not follow the correct handwashing procedure. This finding is similar to the previous research of school foodservice employee handwashing behavior (Sneed, Roberts, Sauer, Kwon, & Shanklin, 2013; Strohbehn et al., 2011).

Table 4.4. Compliance with Handwashing Practices of Foodservice workers in Childcare Centers in Kansas

Observed Activity	Total Obs.	Washing hands properly and when required	Washing hands improperly	Wash hands when required
Employees handwashing practices	N	n	n	n
Immediately before engaging in food prep	61	30	10	21
Switching between handling raw animal foods and ready-to-eat foods	6	2	1	3
After soiling hands during food prep or service activities	81	26	21	34
Before donning new gloves or changing gloves	52	11	11	30
After touching body parts, coughing/sneezing; blowing nose; eating or drinking	49	6	2	41
After handling soiled equipment, dishes or utensils	42	12	9	21
Total Observations	291	87	54	150

Obs.= Observations

A high out-of-compliance frequency also was found in handwashing when switching between handling raw animal foods and ready-to-eat foods (3 of 6), before donning new gloves or changing gloves (30 of 52) and after handling soiled equipment, dishes, or utensils (21 of 42). Employees tended to wash hands after they took off gloves, but failed to wash hands after touching other things in the kitchen. Additional unsafe behaviors related to handwashing behaviors including failed to wash hands after talking on the phone, not wearing gloves, or wearing the same gloves for the entire preparation period, and picking-up clean and sanitized dishes with soiled hands.

Employee Food Handling Practices

Results of observations of foodservice workers’ food handling practices are presented in Table 4.5. Employees of four of the 10 childcare centers cooked raw meat (chicken and

Table 4.5. Compliance with Selected Food Safety Practices of Foodservice workers in Childcare Centers in Kansas

	Total Obs.	In Compliance	Out-of-Compliance
Employee food handling practices	N	n	n
Wash, rinse, sanitize, and air-dry thermometers before and after use	23	7	16
Check internal temperature of food by inserting the thermometer stem or probe into the thickest part of the product	28	19	9
Employee uncovered beverages and foods excluded from the food production area	20	19	1
Check temperature of food at the completion of cooking	9	5	4
Check temperature of food at the completion of reheating	13	7	6
Employees do not contact ready-to-eat foods with bare hands	31	8	23
Raw animal products are cooked to required temperatures	4	4	0
TCS food that is cooked and cooled on premises is rapidly reheated to 165F for 15 seconds for hot holding	0	0	0
Cleaning and Sanitizing Work Surfaces			
Sanitizing solutions are changed as needed	15	15	0
Separate wiping cloths are used for food and nonfood surfaces	19	15	4
Dishes/Utensils washed & sanitized using proper manual procedure	20	16	4
Dishes/Utensils washed & sanitized using properly operated dish machine	18	15	3
Food contact surfaces and utensils are clean to sight and touch and sanitized before use	44	32	12
Handwashing facilities conveniently located and accessible for employees	22	17	4
Handwashing facilities supplied with hand cleanser / disposable towels / hand drying devices	22	18	4
All food product stored is 6" off the floor	22	10	12
Dry storage areas maintained between 50 F – 70 F	22	14	8
Refrigerated storage at 41 F or below	31	25	6
Frozen storage at 0 F or below	32	21	11
Hot food held at 135°F or higher (Hot entrée, note product and temp)	39	31	8

Obs.= Observations

4.5. Compliance with Select Food Safety Practices of Foodservice workers in Childcare Centers in Kansas (Continued)

Facility	Total Obs.	In Compliance	Out-of-Compliance
	N	n	n
Cold food held at 41°F or less (Deli sandwich, chilled protein or protein salad, mixed salad [coleslaw, potato salad, etc], fresh cut produce [tomatoes, melons, etc]) (note product and temp)	21	6	15
Milk stored at 41°F or less	20	16	4
Only foods and items used in food production are located within cold and dry storage areas (no personal belongings)	20	11	9
No evidence of pests	20	20	0
Food is covered when transported off property	17	14	3
Food is protected from environmental contamination / cross-contamination	23	3	20
Food is covered and labeled properly before holding or storing	20	12	8

Obs.= Observations

ground beef) during the observation periods, all of them cooked meat to the required temperature. The majority (19 of 20) of the employees excluded uncovered beverages and foods from the food production area. This result was similar to the other findings in school foodservice operations (Sneed, et al., 2013).

Over half of the employees checked the internal temperature of food correctly (19 of 28) and correctly checked the food temperature at the completion of reheating (7 of 13) and cooking (5 of 9). In the majority of the observations (16 of 23), employees failed to wash, rinse, sanitize, and air-dry thermometers before and after use. Employees tended to only sanitize the thermometers when switching to another food item or after using. Another activity high in out-

of-compliance frequency was that employees handling ready-to-eat food with bare hands. This occurred numerous times when employees were tasting food.

Cleaning and Sanitizing Work Surfaces

The results of foodservice workers cleaning and sanitizing practices are summarized in Table 4.5. Sanitation solutions were changed in all facilities changed during observations. However, some employees were not provided with any sanitizer solutions so employees cleaned counter tops with water only. The majority of employees (15 of 19) used separate wiping cloths for food and nonfood surfaces. Most employees washed and sanitized dishes/utensils using the proper manual procedure (16 of 20) and properly operated the dish machine (15 of 18). In most instances (32 of 44) the food contact surfaces and utensils were clean to sight and touch and sanitized before use.

Facility Observations

Facility observations (Table 4.5) showed that the majority (17 of 22) of handwashing facilities were conveniently located and accessible for employees. The observer noted that some of the handwashing facilities were not accessible because items such as a trash can, chair, or cleaning equipment were located very close to the paper towel dispensers where employees could not access paper towels without touching those items. The majority (18 of 22) of handwashing facilities were supplied with hand soap and disposable towel/hand drying devices. However, one of the childcare centers did not provide soap or hand drying equipment. Another facility was temporarily out of disposable hand towels.

For food storage, over half (12 of 22) of the observations found food items not stored 6” off the floor. The most common scenario was food items or food packages lying on the floor in the dry storage room. One facility had lunch delivered and set on the floor before it was served to

the children. The majority (14 of 22) of the dry storage areas was between 50 °F – 70 °F. Some of the childcare centers did not have a dry storage area and food was stored in the kitchen cabinet. When the kitchen temperature was above 70 °F during cooking, the facility was out-of-compliance for proper dry storage temperature. Close to half (9 of 22) of the dry storage areas kept nonfood production item such as a trash can or cleaning equipment next to the food. Some of the dry storage areas were used to store personal belongings such as coats, purses, and cell phones. Some facilities stored sanitizer in the dry storage area.

Most of the refrigerated (25 of 31) and frozen storage areas (21 of 32) were at the required temperature (41 °F or below for refrigerated storage, 0 °F or below for frozen storage). This result was similar to the findings in school foodservice operations (Sneed et al., 2013).

The majority (31 of 39) of the hot food was held at 135°F or higher and most (16 of 20) milk was stored at 41°F or less. But only a small number (6 of 21) of observations found cold food held at or below 41°F.

None of the childcare centers had evidence of pests during the observation periods. Most (14 of 17) facilities covered food when transferred off property. These two findings were similar to the results of the school foodservice operations (Sneed, 2013).

A high out-of-compliance frequency (20 of 23 observations) was found in protection of environmental or cross contamination. For example, one facility did not sanitize food contact surfaces after handling raw chicken. The observer noted that it was common to see employees with long hair who were not wearing a hairnet. In some observations, lunch was unprotected from other individuals who came in the kitchen and were doing non-foodservice related activities around food. The majority of items (12 of 20) food was properly covered and labeled before storing.

Teacher Observations

Observations of the six teachers were recorded in detailed notes. Observations of teachers' food handling behaviors began when lunch was delivered to the classroom and ended when most of the children finished their lunches. Observations focused on teachers' handwashing, sanitation, and use of gloves practices.

The observer noted that the majority of the teachers failed to, or improperly, washed their hands before setting-up tables (placing dishes, cups, utensils, and napkins on the tables). Although all of the teachers assisted or reminded children to wash their hands before eating lunch, most teachers failed or improperly washed their hands. All six teachers were observed failed to or improperly washed their hands when required at least once during the service period. Poor handwashing was also performed after the teacher talked on the phone or touched other personal items. It was common to observe that a teacher picked up a fork or a spoon dropped by a child and then replaced a new one without handwashing.

Reusing of disposable gloves was common observed during service. For example, teachers wore gloves when serving food to the children then took them off and placed them by the food container. The same gloves were then used when refilling food items. Although some of the teachers changed gloves, no handwashing was observed before donning new gloves. Most of the tables were cleaned and sanitized during the observation. However, two of them were not sanitized.

In addition, teachers from two of the childcare centers placed reused plastic name tags on the sanitized tables to help children find their seats. The name tags were touched by children while eating their lunch. However, none of the teachers cleaned or sanitized the name tags before and after use. The name tags were picked up during or after lunch and put directly back into the original container.

Conclusion and Application

This study explored the food safety knowledge, food safety practices, and barriers to safe food handling of childcare center employees. Gaps between employees' food safety knowledge and actual behaviors were identified.

Employees Food Safety Knowledge

This study measured food safety knowledge of childcare center foodservice employees and teachers. Overall results of this study found that employees have a thoroughly understanding of food safety knowledge. Foodservice workers and teachers scored 80.2% (43.31 of 54) and 78.7% (42.5 of 54) on overall food safety knowledge, respectively. Childcare center employees were most knowledgeable about handwashing.

Employee Food Handling Behaviors

Although the food safety knowledge assessment results showed that foodservice employees have good knowledge about food safety, there was a gap between employees' actual food handling behaviors and their knowledge. This finding supported the results from the study conducted by Roberts, et al. (2008) that knowledge does not always improve behaviors.

Results of employees' food handling behaviors in childcare centers were similar to the U.S. FDA reports (2000, 2004, & 2009) where high out-of-compliance rates were identified in personal hygiene and time/temperature control. For handwashing behaviors, the majority of the employees knew when and how to properly wash hands. However, observations showed that only 29.9% of the handwashing was performed properly. A gap was also identified in time and temperature control. All employees correctly answered that a calibrated, sanitized thermometer should be used to check the temperature of food. However, observations found that only seven of 23 instances when the thermometer was used properly.

Observations also found that teachers lacked proper food handling practices. The most common activity was improper or no handwashing when setting up the tables and serving food to the children. Teachers were also found to reuse disposable gloves when serving lunch. None of the six teachers had experience with foodservice and only two of them had food safety training, which could explain why they had poor performance on handwashing.

In some of the childcare centers, employees showed very minimal safe food handling practices. Examples of extreme behaviors including, failed to wash hands for the entire food production, failed to use soap and drying devices during handwashing, only used water to cleaned food-contact surfaces after handling raw meat, and touched ready-to-eat food with bared hands because disposable gloves were not provided.

Barriers to Safe Food Handling

Previous studies on safe food handling indicated that there were barriers to safe food handling due to varies reasons such as time pressure, lack of space, and lack of training (Baş, Yüksel, & Çavuşoğlu 2007; Howells et al., 2008; Youn & Sneed, 2002). This study also found similar barriers to implementing safe handling in childcare centers.

Although greater than half of the foodservice workers (11 of 19) had some type of food safety training, only five of them have food safety credentials. Of the employees who had food safety training, five of them were in the “other” category which included training from the childcare center director, college classes, or three-hour food safety training. The observer noted that even though training was conducted for the employees, employees performed minimal safe food handling behaviors in some of the facilities.

Other barriers found were associated with equipment. A few of the food preparation areas were not provided with gloves, several of the handwashing facilities were not provided with soap

and paper towel/drying devices, and some of the facilities were not provided with sanitizer solutions. Lack of space was another common barrier for the childcare centers. Some of the childcare centers did not really have a kitchen or food preparation space. In this case, employees prepared lunch would on a small counter or over the sink while doing other activities. In addition, it was common to observe that employees were under time pressures when preparing food. As the pressures increased, employees' improper food handling behaviors increased as well. No significant barriers for teachers to implementing food safety practice were observed.

Results of this study indicated that childcare center employees were knowledgeable about food safety. Foodservice employees did well on some of the food handling behaviors, such as handling raw meat and keeping working surfaces clean and sanitized. However, employees' food safety knowledge did not always reflect in the actual food handling procedure. Gaps between food safety knowledge and actual food handling behaviors were identified in handwashing and time and temperature control. Based on the observations, time pressure, lack of equipment, and limited space were identified as main barriers to implementing safe food handling.

Implications for future research

Several studies have been conducted to examine foodservice employees' food safety knowledge, food handling behaviors, and barriers to implementing safe food handling. However, limited studies have reviewed childcare center employees. This study provides childcare directors, employees, and educators a general overview of childcare center employees' performance on food safety knowledge and behaviors. Because young children are at a higher risk of getting foodborne illnesses than adults, special attention should be paid to ensure that foodservice employees and teachers handle food safely.

During the interviews with the childcare providers, directors showed an interest in learning how their employees were performing on the food safety knowledge assessment and expressed willingness to know how they could improve their food handling practices. All of the directors requested a summary of the study upon completion to provide guidance on what can be done to improve the employees' safe food handling behaviors. Childcare providers and educators should take advantage of the participants' desire and seek the potential needs of enhancing food safety education and training. Based on the results of this study, childcare educators can further adjust the food safety training focus on improve handwashing and time/temperature control behaviors for their employees.

Further research should investigate what strategies can be used to improve employee food handling behaviors and adapt their food safety knowledge to actual practices. This study did not ask employees' attitudes and beliefs about food safety. Attitudes and beliefs might affect how they perform on the job. Future research can focus on the relationship between employees' attitudes and beliefs regarding food safety and their behaviors. Furthermore, this study focused on childcare centers. Childcare educators and researchers could apply this study in other types of childcare such as home day-cares and after-school programs.

Although teachers did not practice complex food production procedures in the study, safe food handling practices such as handwashing, sanitation, and use of gloves are critical during service time. Future research should also focus on developing food safety trainings and strategies that target teachers and encourage them to practice safe food handling.

This study included a variety of food production in different childcare centers. For example, some facilities have lunch delivered or had simple preparation procedures such as reheating precooked meals in the microwave. The preparation time for this type of facility was

less than 30 minutes. Other facilities cooked everything from scratch, which required a preparation time of more than four hours. Thus, employees from the facilities with simple preparation may result in less out-of-compliance frequencies due to less complexity of food handling. It does not necessarily mean they performed better than the employees from other facilities. Future researchers could focus on similar lunch preparation methods and compare food handling behaviors.

The food safety assessment and observation form used in this study could be utilized by childcare educators and providers to examine their employees' food safety knowledge and food handling behaviors. The results could help the childcare educators and providers learn how their employees perform on food safety knowledge, and if they practice safe food handling. Further training and intervention could be established based on the results.

Limitations and recommendations

This study was limited to childcare centers located in Manhattan, KS. Results of this study may not represent childcare centers outside Manhattan, KS. Future researchers can approach a larger sample in order to generalize the results to a larger population. All observations occurred during lunch preparation and service periods. Most of the childcare centers serve breakfast and snacks. Further research could exam all meal periods.

Because most employees knew the purpose of the observations, they may have changed their behaviors. Future research can use other methods such as video cameras to record employees during meal preparation and service.

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Chapter 5 - Summary and Conclusions

Although a number of studies have been conducted to examine foodservice employees' food safety knowledge and behaviors, yet limited studies have focused on childcare center employees. The purpose of this study was to explore the food safety knowledge, food safety practices, and barriers to safe food handling practices of childcare center employees. Gaps between employees' knowledge and behaviors were also identified.

Ten childcare center directors in Manhattan, KS agreed to participate in the study and all of them were observed during lunch preparation and service. Each facility was visited for approximately two hours on two days, resulting in total of 20 observations. Observations of foodservice employees were conducted using a structured observation form, while classroom observations of teachers were recorded in detailed notes. At the end of each observation, observed employees completed a questionnaire that included demographic and food safety training information and food safety knowledge assessment. A total of 19 employees, 13 foodservice employees and six teachers, completed the questionnaire. If an employee prepared food and served, he/she was classified as a foodservice employee. Teachers in this study did not perform any food production activities.

Of the 19 employees observed, most of them were females (18 of 19), about half (8 of 19) were 45 years or older, and half (9 of 18) held a bachelor's degree. Thirteen of the employees work full-time (40-59 hours/week).

Major Findings

Food Safety Knowledge

RQ 1. What is the food safety knowledge of employees in childcare centers?

This study measured food safety knowledge of childcare center foodservice employees and teachers. Results of this study found that employees have a good understanding of food safety. Foodservice workers scored an average of 80% (43 of 54) and teachers scored an average of 79% (42.5 of 54) on the food safety knowledge assessment. Overall scores showed that childcare center employees were most knowledgeable about handwashing (83%) and least knowledgeable on the use of thermometers (77%). In responding to the questions regarding drying hands after washing, both foodservice workers and teachers scored 100% on most items.

Food Handling Behaviors

RQ 2. Do employees in childcare centers follow proper food handling practices in the kitchen and classroom to assure safe food is served to the children?

The observation results showed poor handwashing behaviors among teachers and foodservice workers. Out of 291 observations when handwashing was required, foodservice employees properly washed their hands 87 (29.9%) times during food preparation. In over half (51.5%) of the observations, foodservice employees failed to wash their hands. Of the times employees performed improper handwashing (18.6%), not washing long enough (less than 20 seconds), not using soap, or failing to dry using a paper towel or air dryer were the practices most often observed.

Raw meat (chicken and ground beef) was cooked in four of 10 childcare centers during the observation periods and all of them cooked meat to the required temperature. The majority (19 of 20) of the employees excluded uncovered beverages and foods from the food production

area. In over half of the observations (19 of 28), employees checked the internal temperature of food items, but sometimes forgot to check all food items or only checked the hot food. In the majority of the observations, 16 of 23 employees failed to wash, rinse, sanitize, and air-dry thermometers before and after use. Employees tended to only sanitize the thermometers when switching from one food item to another. Another activity with a high out-of-compliance frequency was employees contacting ready-to-eat food with bare hands.

None of the employees exhibited symptoms of illness or had an unprotected wound. All facilities that had sanitizer, changed the solution during the observations. However, some facilities were not provided with use any sanitizing solution, so employees cleaned countertops with water only. The majority of the employees (15 of 19) used separate wiping cloths for food and nonfood surfaces. Some employees were observed using wiping cloths intended for food contact surfaces to dry hands. Most employees washed and sanitized dishes/utensils using the proper manual procedure (16 of 20) and/or a properly operated dish machine (15 of 18). Most (32 of 44) of the times the food contact surfaces and utensils were clean to sight and touch and sanitized before use.

Related to facilities, most of the items had low out-of-compliance frequencies except for cold holding temperature (15 of 21) and protection from contamination (20 of 23). Most of the cold food was held above 41 °F. The majority of the facilities failed to protect food from environmental or cross-contamination. For example, a lot of the employees with long hair did not use hair nets. Hair coming into contact with ready-to-eat food was observed several times. In one facility, employees failed to sanitize the counter top after handling raw chicken.

Observations of teachers focused on handwashing, sanitation, and use of gloves practices. The observer noted that the majority of the teachers failed to, or improperly, washed their hands

before setting-up tables (placing dishes, cups, utensils, and napkins on the tables) or before eating. All six teachers observed failed to or improperly washed their hands when required at least once during the service period. Poor handwashing was also performed after activities such as talking on the phone or touching other personal items. It was common to observe a teacher picking up a fork or a spoon dropped by a child and replacing it with a new one without handwashing.

Reuse of disposable gloves was observed often during service. For example, teachers wore gloves when serving food to the children then took them off and placed them by the food container. The same gloves were then used when refilling food items. Although some of the teachers changed gloves, no handwashing was observed before donning new gloves. Majority tables were cleaned and sanitized during observation. Two observations showed teachers failed to sanitize the tables.

Employee Food Safety Training

RQ 3. What current food safety training is provided to childcare center employees?

Of the 19 employees completing the questionnaire, 11 of them (nine foodservice workers and two teachers), received some type of food safety training. Four employees received local health department training and one also received ServSafe® Food Handler and Serving-it-Safe trainings. Two of the employees received ServSafe® Manager training, and five of them received “other” trainings. The training in the other category included school system training, training within center by food director, college classes on health and nutrition for young children, and Arizona Food Handlers and Safety training.

Barriers to Safe Food Handling

RQ 4. What are the barriers to safe food handling practices in childcare centers?

Previous studies on safe food handling indicated that there were barriers to safe food handling due to reasons such as time pressure, lack of space, and lack of training (Baş, Yüksel & Çavuşoğlu 2007; Howells et al., 2008; Youn & Sneed, 2002). This study found similar barriers to implementing safe handling. Although over half (11 of 19) of the foodservice workers had some type of food safety training, only five of them had food safety credentials. The observer noted that in some of the childcare centers, employees had minimal knowledge of food safety. It was common to observe that employees were under time pressure when trying to get food ready. Generally, as the pressure to serve food increased proper food handling would decrease.

Other barriers were associated with equipment. A few employees were not provided with gloves. Several of the handwashing facilities were not provided with cleansers and paper towel/drying devices, and some of the facilities did not have sanitizing solutions. Lack of space was another common barrier, especially for the center employees who did not prepare food on site. Some of the childcare centers did not have a kitchen or food preparation space. In this case, lunch would be laying on a small counter top while other activities such doing dishes, handwashing, throwing away trash were all happening around the food. Because of lack of space, it was observed several times that cleaning equipment such as broom, mop, and dustpan were stored in the food preparation area or shared the same room as dry storage. No significant barriers for teachers to implementing food safety practice were observed.

Gaps Between Employee Food Safety Knowledge and Behaviors

Although the food safety knowledge assessment showed that foodservice employees have good knowledge about food safety, observations found that there was a gap between employees'

actual food handling behaviors and their knowledge. This finding supported the results from Roberts et al. (2008) that knowledge does not always improve behaviors.

Results of employees' food handling behaviors in childcare centers were similar to the FDA reports (2000, 2004, & 2009) where high out-of-compliance rates were identified for personal hygiene and time/temperature control. For handwashing behaviors, most of the employees knew when and how to properly wash hands based on food safety knowledge assessment scores. Actual behaviors showed the majority (51.5%) of times employees failed to wash their hands when they should have. All employees provided the correct answer on handwashing after touching body parts. However, in the majority of observations (41 of 49), employees failed to wash their hands. A gap was also identified in time and temperature control. All employees answered correctly on using a calibrated, sanitized thermometer to check the temperature of food. However, observations found only seven of 23 instances when the thermometer was used properly.

Observations also found that teachers lacked proper food handling practices. The most common activity was improper or failure to wash hands when setting-up the tables and serving food to the children. Teachers also were found to reuse disposable gloves when serving lunch. None of the six teachers had experience with foodservice and only two of them had food safety training, which could explain why they had poor performance on handwashing.

Conclusions

A total of 20 observations were conducted with 19 childcare center employees from 10 childcare centers in Manhattan, KS completed this study. Eleven of the employees (nine foodservice workers and two teachers) had received some type of food safety training.

Results of this study indicated that childcare center employees were knowledgeable about food safety with the highest mean score on handwashing knowledge. However, employees' food safety knowledge did not always reflect their actual food handling procedures. Gaps between food safety knowledge and actual food handling were identified in behaviors related to handwashing and time and temperature control. Employees performed better in the food safety knowledge assessment than actual practices. Based on the observations, barriers to implementing safe food handling were identified during preparation. Time pressures, lack of equipment, and lack of space were observed as the most common barriers. This study provided baseline data for childcare center employees' food safety knowledge, food safety practices, and barriers to safe food handling through food safety assessment and structured observations.

Implications

Several studies have been conducted to examine foodservice employees' food safety knowledge, food handling behaviors, and barriers to implementing safe food handling in restaurants, schools, and health care environment. However, limited studies have examined childcare center employees. This study provides childcare directors, employees, and educators a general overview of childcare center employees' performance on food safety knowledge and behaviors. Because young children are at higher risk of getting foodborne illnesses than adults, special attention should be paid to ensure that foodservice employees and teachers handle food safely.

During the interviews with the childcare directors, all of them showed interests in learning how their employees were performing on the food safety knowledge assessment and expressed willingness to know how they could improve their food handling practices at the center. All of the directors requested a summary of the study to provide their direction on what

can be done to improve the employees' safe food handling behaviors. Childcare providers and educators should take advantage of the participants' desire and seek the potential needs for enhancing food safety education and training. Based on the results of this study, childcare educators can further adjust the food safety training for their employees.

Further research should investigate what strategies can be used to improve employee food handling behaviors and adapt their food safety knowledge to actual practices. This study did not examine employees' attitudes and beliefs about food safety. Attitudes and beliefs might affect how they perform on the job. Future researches can focus on the relationship between employees' attitudes and beliefs regarding food safety and their behaviors. Furthermore, this study focused on childcare centers. Childcare educators could apply this study in other types of childcare centers such as home day-cares and after-school programs.

Although teachers do not practice complex food production procedures, safe food handling practices such as handwashing, sanitation, and use of gloves are critical during service time. Future research could focus on developing food safety trainings and strategies that encourage teachers to practice safety food handling.

This study included a variety of food production in different childcare centers. For example, some facilities have lunch delivered or had simple preparation procedures such as reheating precooked meals in the microwave. The preparation time for this type of facility was less than 30 minutes. Other facilities cooked everything from scratch, which resulted a preparation time of more than four hours. Thus, employees from the facilities with simple preparation may result in less out-of-compliance frequencies due to less complexity of food handling. It does not necessarily mean they performed better than employees from other facilities. Future researchers could focus on similar lunch preparation methods and compare the behaviors.

The food safety assessment and observation form used in this study could be utilized by childcare educators and providers to examine their employees' food safety knowledge and food handling behaviors. The results could help the childcare educators and providers learn how their employees perform on food safety knowledge, and if they practice safe food handling. Further training and intervention could be established based on the results.

Limitations and Recommendations

This study was limited to childcare centers from Manhattan, KS only. Results of this study may not represent childcare centers outside Manhattan. Larger samples are needed in order to generalize the research findings to a larger population. All observations occurred during lunch time and most of the childcare centers serve breakfast and snacks. Further research can approach all meal times.

Because most employees knew the purpose of the observations, they may have changed their behaviors. Future research can use other methods such as video cameras to record employees during meal preparation and service.

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Appendix A - Observation Instrument

Food Safety Observation Form

CHILDCARE CENTER INFORMATION		
School Sample Code Number:	Date:	Number of employees observed:
Time Period:	Type of Observation:	Total Number of Employees:

Observation Activity	Employee observed washing hands properly and when required	Employee observed washing hands improperly	Employee observed failing to wash hand when required
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I. Handwashing

Employees wash their hands after the following activities:

Immediately before engaging in food prep			
Switching between handling raw animal foods and ready-to-eat foods			
After soiling hands during food prep or service activities			
Before donning new gloves or changing gloves			
After touching body parts, coughing /sneezing; blowing nose; eating or drinking			
After handling soiled equipment, dishes or utensils			
Other (describe in comment section below)			

Comments:

II. Employee Food Handling Practices

	In-Compliance	Out-of-Compliance	Not applicable
Wash, rinse, sanitize, and air-dry thermometers before and after use			
Check internal temperature of food by inserting the thermometer stem or probe into the thickest part of the product			
Employee uncovered beverages and foods excluded from the food production area			
Check temperature of food at the completion of cooking			
Check temperature of food at the completion of reheating			
Employees do not contact ready-to-eat foods with bare hands.			
Raw animal products are cooked to required temperatures. <i>If observed, what was the product and end-point-cooking temperature?</i>			

TCS food that is cooked and cooled on premises is rapidly reheated to 165 °F for 15 seconds for hot holding.			
Comments:			

III. Cleaning and Sanitizing Work Surfaces	In- Compliance	Out-of- Compliance	Not applicable
No food employees exhibiting illness symptoms or having an unprotected wound requiring exclusion or restriction observed in the food preparation areas of the facility			
Sanitizing solutions are changed as needed			
Separate wiping cloths are used for food and nonfood surfaces			
Dishes / Utensils washed & sanitized using proper manual procedure			
Dishes / Utensils washed & sanitized using properly operated dish machine			
Food contact surfaces and utensils are clean to sight and touch and sanitized before use			
IV. Facility	In- Compliance	Out-of- Compliance	Not applicable
Handwashing facilities conveniently located and accessible for employees			
Handwashing facilities supplied with hand cleanser / disposable towels / hand drying devices			
All food product stored is 6" off the floor			
Dry storage areas maintained between 50 °F – 70 °F			
Refrigerated storage at 41 °F or below			
Frozen storage at 0 °F or below			
Hot food held at 135°F or higher (Hot entrée, note product and temp)			
Cold food held at 41°F or less (Deli sandwich, chilled protein or protein salad, mixed salad [coleslaw, potato salad, etc], fresh cut produce [tomatoes, melons, etc]) (note product and temp)			
Milk stored at 41°F or less			
Only foods and items used in food production are located within cold and dry storage areas (no personal belongings)			
No evidence of pests			
Food is covered when transported off property			
Food is protected from environmental contamination / cross-contamination			
Food is covered and labeled properly before holding or storing			
Did you see any cooling of products? If so, which products and did they maintain any records?			

GENERAL COMMENTS:

Food Safety Qualitative Observation Form

CHILDCARE CENTER INFORMATION

School Sample Code Number:	Date:	Number of employees observed:
Time Period:	Type of Observation:	Total Number of Employees:

Appendix B - Questionnaire

Dear Childcare Center Employee,

Employee safe food handling practices are critical in childcare centers to ensure children's health. In order to meet the needs in childcare centers, we are conducting a study to explore the food safety practices of childcare center staff. The data will be used to determine the baseline performance of employees on food handling, their knowledge of food safety, and the challenges that childcare center employees and teachers face regarding safe food handling.

You will be asked to respond to questions about your background and knowledge in food safety; ***it should take you less than 10 minutes to complete the questionnaire.*** Please carefully read each question and do not leave any items blank. By returning the questionnaire you indicate your consent. Your participation is voluntary, refusal to participate will involve no penalty, and you may discontinue participation at any time without penalty. Individual responses will be completely anonymous. Please be assured that all data will be reported as group data.

Your response is very important to the success of this study and to the quality of future food safety education. Should you have any questions about the study, please contact myself, Diana Fan at (785) 317-0841 or Dr. Kevin Roberts at (785) 532-2213. If you have any questions about the rights of individuals in this study or about the way it is conducted, you may contact the University Research Compliance Office at (785) 532-3224. Thank you for your time and assistance.

Cordially,

Diana Fan
Graduate Research Assistant

Kevin R. Roberts, PhD
Assistant Professor and Director
Undergraduate Program in Hospitality Management

Section I: Demographics

Please answer each of the following questions by circling the letter that best describes you. Please read each question carefully.

1. What is your age?

_____ years old

2. What is your gender?

- A. Male
- B. Female

3. How many hours do you work per week?

_____ hours

4. Have you been received any formal food safety training?

- A. Yes
- B. No



1a. If yes, what training was received?

- A. ServSafe® Manager (with certification again)
- B. ServSafe® Food Handler (with no certification again)
- C. Serving-it-Safe
- D. Local Health Department training
- E. Other, please describe:

5. What is your highest level of education completed?

- A. Less than a high school diploma
- B. High school diploma or GED
- C. Some college
- D. Associate or two year degree
- E. Bachelor's Degree
- F. Master's Degree
- G. Doctorate Degree

6. Which of the following credentials do you have? (Please circle all that apply)

- A. Food Safety Certification (ServSafe, Certified Food Safety Manager, Certified Professional Food Manager)
- B. Foodhandler Certification (State or local health department)
- C. School Nutrition Association Certification
- D. School Nutrition Specialist
- E. Registered Dietitian
- F. Licensed Dietitian
- G. Certified Dietary Manager
- H. Dietetic Technician, Registered
- I. None of the above
- J. Others: _____

7. How long have you been employed in your current position?

- A. Less than three months
- B. 3-6 months
- C. 7 months -1 year
- D. 2 - 5 years
- E. 6 - 10 years
- F. 11- 15 years
- G. Greater than 15 years

8. How many years have you been employed in foodservice?

- A. Less than 1 year
- B. 1 - 5 years
- C. 6 - 10 years
- D. 11 - 15 years
- E. 16 - 20 years
- F. Greater than 20 years

Section II: Food Safety

Please read each question carefully and select all answers that are correct by circling the letter next to the answer. You may select as many as you wish as there may be more than one correct answer for some questions.

- 1. Which of the following should be cleaned and sanitized when working in the food preparation area?**
 - a. Cutting surfaces
 - b. Hands
 - c. Utensils
 - d. Countertops
 - e. Floors
 - f. Stovetops

- 2. Food surfaces should be cleaned and sanitized at which of the following times?**
 - a. Before preparing foods
 - b. When switching from one food preparation task to another
 - c. Between each food preparation task
 - d. When they become contaminated
 - e. When only working with ready-to-eat foods
 - f. Every 2 hours when performing the same food preparation task

- 3. Raw foods that will be cooked before serving should not come into contact with which of the following?**
 - a. Ready-to-eat foods
 - b. Floor
 - c. Utensils
 - d. Other raw foods
 - e. Countertops
 - f. Bare hand

- 4. Which of the following temperatures are correct for food preparation?**
 - a. Cold food is held below 41 °F
 - b. Food is reheated to 165 °F
 - c. Baked goods are held above 70 °F
 - d. Beverages are held below 50 °F
 - e. Hot food is held above 135 °F
 - f. Ice must be below 0 °F

- 5. To properly check the temperature of food, which of the following should be done?**
- Taste it to see if it is hot enough
 - Use a calibrated, sanitized thermometer
 - Touch it to see that it is hot enough
 - Look at it to make sure it is the right color
 - Check the center of the food rather than the surface
 - Make sure it has been cooking for the correct amount of time
- 6. When should a thermometer be used to check the temperature of food?**
- At the completion of cooking
 - Prior to cooking
 - After reheating
 - In hot holding
 - In cold holding
 - At the midpoint in cooking
 -
- 7. After handwashing, hands should be dried:**
- With a single use paper towel
 - On pants
 - With an apron
 - With a common towel
 - By shaking vigorously
 - With an air dryer
- 8. Which of the following are necessary for proper handwashing?**
- Soap
 - 20 seconds
 - 15 seconds
 - Hot water
 - Warm water
 - Hand sanitizer
- 9. Hands should be washed in which of the following circumstances?**
- After going to the restroom
 - Before work
 - After touching body parts
 - When switching food preparation tasks
 - Before putting on gloves
 - Before going to the bathroom

Appendix C - Recruitment Handout

Exploring Food Safety Practices in Childcare Centers in Kansas

Objectives:

- Explore food safety knowledge of employees in childcare centers.
- Determine employees' current food handling practices while preparing food for children.
- Identify current food safety training provided to childcare center employees.

Procedure:

- Observation of foodservice employees' and teachers' food handling behaviors during lunch preparation hours for a total of four hours for two days (observation hours varies depend on each facility's schedule).
- Employees will be asked to complete a questionnaire regarding demographic and food safety training information and a short food safety knowledge assessment.

Follow-up:

- A summary of the results of all childcare centers observed will be shared with the childcare center director if requested.



Appendix D - Institutional Review Board (IRB) Approval Letter

TO: Kevin Roberts
HMD
106 Justin Hall

Proposal Number: 6538

FROM: Rick Scheidt, Chair 
Committee on Research Involving Human Subjects

DATE: 02/07/2013

RE: Approval of Proposal Entitled, "Exploring Food Safety Practice in Childcare Centers in Kansas."

The Committee on Research Involving Human Subjects has reviewed your proposal and has granted full approval. This proposal is **approved for one year from the date of this correspondence, pending "continuing review."**

APPROVAL DATE: 02/07/2013

EXPIRATION DATE: 02/07/2014

Several months prior to the expiration date listed, the IRB will solicit information from you for federally mandated "**continuing review**" of the research. Based on the review, the IRB may approve the activity for another year. **If continuing IRB approval is not granted, or the IRB fails to perform the continuing review before the expiration date noted above, the project will expire and the activity involving human subjects must be terminated on that date. Consequently, it is critical that you are responsive to the IRB request for information for continuing review if you want your project to continue.**

In giving its approval, the Committee has determined that:

- There is no more than minimal risk to the subjects.
 There is greater than minimal risk to the subjects.

This approval applies only to the proposal currently on file as written. Any change or modification affecting human subjects must be approved by the IRB prior to implementation. All approved proposals are subject to continuing review at least annually, which may include the examination of records connected with the project. Announced post-approval monitoring may be performed during the course of this approval period by URCO staff. Injuries, unanticipated problems or adverse events involving risk to subjects or to others must be reported immediately to the Chair of the IRB and / or the URCO.

Appendix E - Contact Tracking Form

Calling Track Form

Date: _____ Name of the facility: _____

Hello. This is Diana Fan from Kansas State University. May I please speak to xxx (Director)?

- Hi xxx. I am a graduate student from the Hospitality Management and Dietetics Program at K-State.
- I am conducting a study to explore the food handling practices of employees in childcare centers in Kansas.
- All data collected will be confidential and will only be shared with the director in summary form.

Date	Time	Resulte
		<ul style="list-style-type: none"> • NA UNA WR REF NF OC PC WN DISC Notes:
		<ul style="list-style-type: none"> • NA UNA WR REF NF OC PC WN DISC Notes:
		<ul style="list-style-type: none"> • NA UNA WR REF NF OC PC WN DISC Notes:
		<ul style="list-style-type: none"> • NA UNA WR REF NF OC PC WN DISC Notes:
		<ul style="list-style-type: none"> • NA UNA WR REF NF OC PC WN DISC Notes:
		<ul style="list-style-type: none"> • NA UNA WR REF NF OC PC WN DISC Notes:
		<ul style="list-style-type: none"> • NA UNA WR REF NF OC PC WN DISC Notes:

Abbreviations:

NA = No Answer UNA = Unavailable
 WR = Will return (When, who is being called back – NAME!?!?)
 REF = Refused (when, why, at what point)
 NF = Not a foodservice establishment
 OC = Observation Completed PC = Partially Completed WN = Wrong Number