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Abstract:

Grocery store associates in deli-bakery departments prepare and serve an increasing number of ready-to-eat foods and full meals. The shift to more convenience foods and take-home meals highlights the need for effective food safety training programs in retail grocery establishments to prevent foodborne illness. Through qualitative and quantitative methods, food safety knowledge, training preferences, needs, and current practices of grocery stores deli-bakery food handlers in Southwest and Southern Virginia were explored. Deli employees (n=78) completed a 34 question survey eliciting information on demographics, food safety training needs, preferences and knowledge. In an additional phase of this project, a subset of the surveyed staff (n=15) were observed for food handling practices, approximately six hours per person. Observational data collection focused on cross-contamination, glove use and hand washing. Most grocery store food handlers reported wanting frequent hands-on, interactive one-on-one training less than two hours in length. The target audience's largest knowledge gaps included correct temperatures for cooking, reheating and cooling foods. Observed behaviors did not correlate with food safety knowledge. For example, greater than 95% of participants reported using correct hand washing techniques; however, observational behavior data showed less than 50% of hand washing events observed were correct. Additionally, food handlers were observed not washing hands prior to putting gloves on; as well as practicing bare hand contact with ready-to eat foods. The creation of short, hands-on or interactive trainings for retail grocery food handlers that focuses on changing food handling and preparation behaviors may enhance the food handler's safe food handling practices.

Keywords: food safety training, education, food handler, grocery, observations, retail

1. Introduction

Approximately 48 million Americans get sick with foodborne illness annually (Scallan et al., 2011a; 2011b). It is estimated that between 52 and 70% of these illnesses come from foods prepared outside of the home including restaurants, delicatessens, cafeterias and hotels (Jones & Angulo, 2006; Klein & Smith Dewaal, 2008; Olsen, MacKinnon, Goulding, Bean & Slutsker, 2000). There are five factors identified by the Center for Disease Control and Prevention (CDC) as contributing significantly to foodborne illness (Bean, Goulding, Lao & Angulo, 1996). These are: food from unsafe sources, poor personal hygiene, inadequate cooking, improper holding time/temperatures, and contaminated equipment (Bean Goulding, Lao & Angulo, 1996; FDA, 2000; 2009). Four of these can be tracked directly to the practices of the food handler. The Food and Drug Administration (FDA) National Retail Food Team conducted a 10 year study measuring the occurrence of these contributing factors in various sectors of the retail food setting including retail deli departments (FDA, 2010). Through this study it was demonstrated that over the 10 year period, most risk factors improved, but improper holding time/temperature, poor personal hygiene and contaminated equipment continued to have the least compliance (FDA, 2010). For grocery deli departments, the actions with the lowest compliance consistently were improper holding/time-temperature and hands being cleaned and properly washed when and as required (Chapman, Eversley, Filion, MacLaurin & Powell, 2010; Lubran, et al., 2010; FDA, 2010).

With Americans increasingly pressed for time, there is a higher demand for ready-to–eat (RTE) or convenience foods that require little preparation in the home (Binkley & Ghiselli, 2005). Grocery store deli-bakery departments are serving and preparing an increasing number of ready-to-eat foods and full meals including fried chicken, rotisserie chicken, entrée salads, subs,

and many side dishes. This trend is expected to continue, according to a Packaged Facts (2010) survey, prepared and ready to eat foods sold in grocery stores was expected to grow by more than 7% in 2010; and 64% of adults purchase ready to eat foods and heat to eat foods from grocery stores monthly.

To decrease the number of illnesses caused by foods annually, it is essential for food handlers, to use safe food handling and preparation practices. Grocery store food handlers preparing RTE meals, which are produced with the same processes used in food service settings require food safety training that is at least comparable to training received by other commercial food handlers in order to prevent foodborne illness (Binkley & Ghiselli, 2005). However, knowledge gained from trainings is not always translated into correct food handling practices (Roberts et. al, 2008; Arendt & Sneed, 2008). Food safety education and training is only one component in training food handlers to prepare foods safely (Green & Selman, 2005). Other factors that play a role in safe food preparation include food safety culture factors including restaurant procedures, time pressure, equipment and resources, management and coworker emphasis on food safety and worker characteristics (Powell, Jacob & Chapman, 2011; Roberts et al., 2008; Sneed & Strohbehn, 2008). For food safety training to be effective, it must influence knowledge gain and ultimately improve food handling practices. Research has been conducted to examine what factors influence change and result in food handlers' adoption of training practices and good food safety habits in food service and restaurant operations (Mitchell, Fraser & Bearon, 2007; Roberts et al, 2008). Time pressures, management involvement, and accountability have been found to influence change (Chapman, Eversley, Filion, MacLaurin & Powell, 2010; Clayton, Griffith, Price & Peters, 2002; Green & Selman, 2005, Howells et al., 2008).

The objectives of this research were to examine the current food safety practices of frontline deli/bakery food handlers in retail food outlets; supplemented with the studied group's food safety knowledge, attitudes, training needs and preferences. The needs were assessed using a survey tool and food safety practices were evaluated through direct observation in the workplace. Results will help identify gaps in food safety knowledge, behavior of these individuals and help provide data to help design future food safety educational training materials for grocery store deli-bakery associates.

2. Materials and methods

This research was completed in two phases. Phase I consisted of a written survey (described in 2.1) and phase II consisted of an observational study (described in 2.2). Survey and observational procedures were approved through Virginia Tech's institutional review board (IRB #09-584).

2. 1 Phase I

2.1.1 Sampling and Data Collection

A list of grocery/supermarket stores in Southwest and Southern Virginia was compiled from Virginia Department of Agriculture and Consumer Services (VDACS). To qualify for inclusion in the study the grocery store needed to have a full service deli/bakery area, slice deli meats and cheese, and prepare ready-to-eat products like chicken tenders, chicken salad, or sandwiches.

Qualified stores were contacted via email, phone or an in-person visit to determine their willingness to participate in this study. Upon agreement, arrangements were made for the investigator to visit store locations and conduct a written survey with grocery food handlers in

the deli and bakery departments. Each store was kept confidential and for survey purposes a randomly selected number was denoted to each store as the store code, to maintain anonymity.

As per the IRB requirements, upon arrival at a store, the investigator notified management and all deli and bakery food handlers present were invited to take the survey. If willing to take the survey, each individual was required to sign a consent form; and were given the option to take ~~it~~ this survey on paper with written responses, or to have questions read aloud to them and respond verbally. Seventy-eight deli and/or bakery food handlers from 20 different locations completed the survey. All individuals surveyed had contact with food during their shift. Seventy one percent of those surveyed were female. Fifty percent were full-time associates and 72% had 2 years or greater experience working in the food industry.

2.1.2 Survey instrument

The survey contained 34 questions and consisted of questions related to background/demographics (8), training and education preference (11), safe food handling and preparation knowledge questions (13), and open-ended opinion questions (2). Prior to initiating the study, the survey tool was piloted with college students working at a catering business and changes were made to clarify any questions as suggested.

Completion of the survey took approximately 15 minutes or less if the grocery food handler filled the survey out on paper; and between 15-30 minutes if the investigator read the survey to the participants and recorded the answers. An iPod (Apple; Cupertino,CA) with a TuneTalk™ stereo (Belkin, Playa Vista, CA) was used to record the verbal responses to ensure accuracy.

2.1.3 Data Analysis

All survey responses were entered into Virginia Tech's "VT survey" (www.survey.vt.edu) data collection tool and imported into Microsoft Excel (2007; Microsoft Corporation, Redmond, WA). Descriptive statistics were performed for the demographics, training and educational needs, and knowledge-based questions (which coded in accordance with 2009 FDA Model Food Code). Open-ended questions were analyzed using content analysis and were sorted into themes for comparison.

2.2 Phase II

2.2.1 Sampling and Data Collection

Of the 20 stores that participated in phase I, 15 agreed to participate in further analysis, considered phase II. For phase II, one grocery food handler from each of the fifteen stores (fifteen total individuals) was observed. Each food handler was observed for three hours and thirty minutes on two separate occasions for approximately seven hours of total observation. To minimize any affect that the observer may have on the behaviors of those being observed, during the first 30 minutes of observation, no data was collected (Clayton & Griffith, 2004). This gave the food handler time to become comfortable with the observation. During the observation period, standardized forms, adapted from Mathiasen & Powell (2004) were used to collect the data.

Notational analysis was used to record actions and their frequencies. Notational analysis is a generic tool used to collect observed events and place them in an ordered sequence (Hughes and Franks, 1997). Notational analysis has been used track food safety behaviors, enabling the recording of specific details about events in the order in which they occur, which is especially useful in investigating the complex process of cross-contamination (Chapman, Eversley, Filion, MacLaurin & Powell, 2010; Clayton & Griffith, 2004; Green et al., 2006; Lubran et al., 2010).

Practices the study focused on included glove use, cross-contamination, and hand washing. The instrument was pre-tested in a pilot retail grocery store (data not included) and improvements were made prior to use in this study. Observational periods were never more than three weeks apart. Store manager notification prior to each observational session was completed as outlined in phase I (2.1.1) by the investigator.

To reduce the Hawthorne effect (need a citation and a footnote or summary of this effect), employees were told that the goal of the project was to use observed behaviors to develop materials and programs ~~which~~ to enhance their work experience. Upon completion of the second observational period, the purpose of the study (safe food handling and hygiene) was revealed to each employee and a second form was signed agreeing for use of the data.

2.2.2 Coding and Data Analysis

Coding trees were developed for the following events and the lead investigator defined examples of: (i) hand washing attempts, (ii) correct hand washing outcomes, (iii) direct cross-contamination event, (iv) indirect cross-contamination event., (v) correct glove use and (vi) incorrect glove use. Notational analysis was used to organize actions and their frequencies along a timeline. Frequencies in each of the eighteen practices were calculated for the observational data. Each associate's individual data was also analyzed looking to see how many of the eighteen practices he/she performed incorrectly. This was completed using Microsoft Excel.

Safe food handling recommendations outlined in the 2009 Food Code (FDA, 2009) ~~was used~~ to assess compliant versus non-compliant observations.

3. Results

All participation in this research was confidential and anonymous. Of the 20 stores used in this research, 18 were associated with regional or national chains (91%) and two were

independent (9%). No study participants were minors. There were a total of 30 observational periods for a total of 89.05 hours of observation (5,343 minutes). Seven of the thirty observational periods were less than two hours and fourty-45 minutes due to employee breaks, employees leaving early, and inclement winter weather. (do we need to say why this particular amount of time was chosen?)

3.1. Phase I

3.1.1. Current Training and Preferred Training

The majority of the grocery food handlers surveyed received general food safety training conducted primarily (78%) in house by training classes using computers, videos or CD presentations. The frequency of this training is most often once a year to a few times a year (56%). According to the survey, grocery food handlers would prefer to receive one on one training in the work place (78%), group setting (46%), or using computers (62%) in English (96%). However, 46% did not feel like they needed more training. There were several food safety topics where participants wanted more training including: calibration of thermometers (26%), allergens and labeling (24%), recognizing the temperature danger zone (21%), proper cooking temperatures (21%), cross contamination (18%) and sick employee policy (18%).

3.1.2 Grocery Food Handlers Knowledge

3.1.2.1 Temperature control of foods for safety

Deli-bakery food handlers had a high level of knowledge related to cooking temperatures. Thirty-eight percent knew the correct temperature to cook raw chicken or turkey (165°F), but 87% answered within the safe range (165°F or greater) (Table 1). Furthermore, 96% knew to keep hot foods at least 135 degrees or higher. There was also a high degree of understanding of

cooling and working with cold foods. Eighty-seven percent of those surveyed knew the correct temperature to keep cold foods stored and 97% knew how to properly cool a hot food (Table 1).

3.1.2.2 Personal hygiene and sanitation

Ninety-two percent of respondents said they should not work while ill with a contagious disease, but 8% said they could work anytime if they felt okay (Table 2). One participant reported knowingly working while ill due to ~~economics~~ the need for personal income and pressure not to miss shifts.

Grocery food handlers had a good understanding of when to utilize gloves (94% reporting compliance with FDA Model Food Code recommendations; FDA, 2009) and proper hand washing techniques (99%).

3.1.2.3 Additional comments

Associates were encouraged to discuss or write ~~out any~~ additional comments concerning safe food handling practices and food safety training. Comments ~~on remarks~~ were made concerning ~~the~~ confusion about food safety expectations. When asked about barriers associated with understanding safe food handling 71% reported that discrepancies between what rules to follow were confusing. For example, food handlers were confused about different expectations, stating that store management, health, inspectors, and corporate management all give different instructions on correct food safety procedures. Management's role in food safety practices was influential. Ninety percent of food handlers felt that they were being observed or assessed by a supervisor regularly, and 32% felt that they were rewarded for showing safe food handling practices. It was perceived that disciplinary action would be taken upon failure to handle food safely (36%).

3.2 Phase II

Observed food handler actions focused on glove use, hand washing and cross-contamination. Twenty specific practices were observed (Tables 3 and 4). Four associates incorrectly performed five or more of the twenty practices. Additionally, four associates incorrectly performed two or less total unsafe food handling practices.

3.2.1. Glove Use

Bare hand contact with ready to eat foods was infrequent. There was 100% compliance with gloves use when slicing deli meats and cheeses. However, 13 times grocery food handlers had bare hand contact with a ready-to-eat product (one bare hand contact event every 6.85 hr). Five grocery food handlers used bare, unwashed hand contact with food items such as ready-to-eat chicken products, cakes, cupcakes, and icing. Ready-to-eat rotisserie chicken products were often handled with bare hands when associates had trouble fitting them into the package. Bare hand contact occurred primarily with the inside of icing baggies used for icing baked goods and chicken baggies prior to placing the ready-to-eat products into these containers. Associates placed their hands into these baggies to help open the baggies to make placing the food into them easier. Gloves were commonly taken off to answer the phone, but the same gloves were reused after hanging up the phone.

3.2.2 Hand washing

Over the course of 89.05 hours, there were only 44 hand washing attempts. This averages to one hand washing attempt every 2.02 hours (121 minutes). Of these, only 21(%) were fully successful in meeting all the requirements for a proper hand washing. Grocery food handlers failed to wash for the recommended time in 29% of hand wash attempts and 15% of the time did not use soap. When foot pedals were not present, it is recommended that associates turn off water using paper towels to prevent recontamination (FDA, 2009); however this practice was

only observed 40% of the time (Table 4). In the 30 observational periods, 10 had no hand washing attempts at all. During only one of these periods was this considered acceptable, the associate was cleaning and stocking packaged food, never having direct contact with food. The most frequent improper hand washing practice observed were associates not washing their hands prior to putting on gloves (Table 3). This practice was seen in 29 of the 30 observation periods and occurred 111 times.

3.2.3. Cross-Contamination

Overall, throughout the study many cross contamination events were recorded. Three employees handled raw chicken being used for rotisserie meals. In these instances, the raw chicken was handled with the same gloves that were used to work with ready-to-eat food. Additionally, chicken juice/ blood was splattered or dripped onto clean utensils, counters and dishes on two occasions. These incidents occurred when the liquid was being poured out of the box into the sink as well as from liquid dripping from the raw chicken~~/~~box containing raw chicken. Five incidents of gloves or hands touching a potentially contaminated surface and then a ready-to-eat item and five incidents of contaminated utensils touching a ready-to-eat food were observed (Table 3).

Other indirect cross-contamination events occurred, including associates use of cell phones during work creating dirty/contaminated gloves~~;~~, touching the tip of the thermometer before placing it into a food product, and picking up items from the floor. In each of these instances the ~~participant~~associate did not wash their hands. Tongs, a thermometer, and a deli meat label were picked up off the floor and then placed into contact with ready-to-eat items without being cleaned by three associates. One associate touched the floor with gloved hands after having bent down to the floor to get something out of the bottom cabinet. She needed to

push up off the floor with her hands to get up and was wearing gloves" This associate~~d~~ then proceeded to touch and serve customers ready-to-eat chicken products with the same gloves.

4. Discussion

Research evaluating the preferences and needs in food safety training as well as food safety practices and behaviors in retail grocery stores is limited. Many grocery store deli and bakery departments are preparing, holding, and serving food to customers similar to food handlers in restaurants or other food service operations (Binkley and Ghiselli , 2005). With the amount of food preparation that takes place in many of today's retail grocery chains, food safety training programs for these food handlers are a necessity. Attention needs to be paid to ~~ensure a~~ conducting successful food safety education programs ~~is in place~~. This program needs to take into consideration the learning styles and preferences of employees, and take a risk-based approach to encourage and sustain behavior changes following training (Clayton, Griffiths, Price & Peters, 2002; Egan et al., 2007). Due to deli bakery employees having ~~such~~ a wide array of responsibilities at work, ~~it is important to~~ educating ~~e them~~ on general food safety as well as ~~include~~ repetitive reinforcement of specific tasks to meet particular needs for their job responsibilities is important (Egan et al. 2007; Soon, Baines & Seaman, 2012).

4.1. Knowledge barriers related to safe food handling practices

Grocery food handlers answered basic food safety questions to determine their knowledge of general safe food handling and preparation. Answers to these questions showed that grocery food handlers' understanding of food safety items were subject dependant. For example, employees did not seem familiar with the term "potentially hazard food" (PHF) or "temperature danger zone". However, when told that a PHF was a food that required time and temperature control for safety, most employees were able to recognize that deli meats/cheese and

prepared salads fell into this category, but only half stated that cut melons and strawberries were a PHF.

Twenty percent of respondents felt that it was okay to work with food if they had a fever and/or diarrhea within the last 24 hours. It is well known that food handlers working when ill can transfer contamination to food during preparation (Olsen et al., 2001; Kimura et al., 2005). A study conducted by EHS-Net reported that 5% of food service workers surveyed had worked while sick (Green et al., 2005). It is essential that grocery food handlers gain a better understanding of when and why they are not allowed to work with food as well as why in order to reduce the risk of foodborne outbreaks.

4.2. Barriers associated with management and inspection requirements

Associates reported feeling as though they needed to follow different safe food handling practices depending on who was observing them. For example, store management had one set of required practices, but the health inspector often had a different set of expectations. Management involvement and accountability can greatly influence employee behaviors (Chapman, Eversley, Filion, MacLaurin & Powell, 2010; Clayton, Griffith, Price & Peters, 2002; Green & Selman, 2005). Employees perceive that some of the barriers associated with cleaning and sanitizing practices and thermometer use in restaurants include having management not care about or not monitoring the activity as well as managers being bad examples (Howells et al., 2008). Food service environments where the managers and co-workers emphasize the importance of food safety and hand washing as well as include consequences for not following procedures positively impact safe food handling and preparation behaviors (Green & Selman, 2005; Arendt & Sneed, 2008). This provides further evidence regarding the importance of

management creating an effective food safety culture within the food establishment (Clayton, Griffith, Price & Peters, 2002; Powell, Jacob & Chapman, 2011).

4.3. Hand washing and glove-use knowledge and behaviors:

Improper hand washing or glove usage can lead to cross-contamination and is one of the most commonly observed improper practices among food handlers (Green et al., 2005; Green et al, 2006; Mitchell, Fraser & Bearon, 2007). Eighty nine percent of foodborne outbreaks implicated by food handlers resulted from pathogen transmission from worker's hands (Guzewich & Ross, 1999). In our study, participants (99%) understood the need to use soap and water for proper hand washing and that gloves were required for handling baked or fried chicken (94%) as well as handling or slicing deli meats (100%) or cheeses (99%)~~,~~. ~~h~~However, their behaviors did not reflect this knowledge. During ten observational periods there were no hand washing attempts. Only 21 of the 44 hand washing attempts ~~that were~~ observed were successful in meeting all the proper requirements. Previous studies have reported a general lack in hand washing~~ when appropriate~~. A retail deli observation study reported that food handlers washed their hands only 17% and 5% of the recommended times at chain and independent stores respectively (Lubran et al., 2010). Sixty percent of food service workers self-reported that they did not wear gloves when handling RTE foods and 23% and 33% did not wash hands or change gloves after handling raw meat (Green et al., 2006). An observational study conducted by Green et al. (2006) found that food workers ~~only attempted~~ washed~~ing~~ their hands 32% of the time~~s in~~ while~~ch they~~ perform~~ed~~ing an activity where hand washing would be recommended. Only 27% of the recommended hand washing w~~ere~~as done correctly (Green et al., 2006). Hand washing was significantly less when gloves were worn, which was also seen in our study. Often the safe food handling and preparation practices of observed food service workers do not reflect their

knowledge (Clayton, Griffith, Price & Peters, 2002; Egan et al., 2007; Howes, McEwen, Griffiths & Harris, 1996). (I think this is ok)

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4.3. Cross-contamination:

There were specific observed activities where food handlers followed poor practices. When chicken products (rotisseries, fried chicken pieces) did not easily fit into their packaging employees ~~would~~ pressed the product into packaging with their bare hands. This issue could be resolved by simply wearing gloves or packaging items with tongs. Alternately, this could be caused by not having proper packing which ~~is what~~ Mitchell, Fraser & Bearon (2007) would call an enabling factor~~,~~. ~~and t~~Therefore altering the package may prevent this behavior.

Bare hand contact with ready-to-eat products was most commonly observed by food handlers preparing cakes and pastries. Grocery food handlers wore gloves when handling bread, but not other baked goods. These employees were usually working alone and off to the side of the bakery, so other employees and managers were not watching their food safety practices. These employees may be encouraged to wear gloves and practice more consistent hand washing if integrated into ~~more populated areas of the~~ the central food preparation area. It is clear from previous studies that management and employees can influence food safety behavior (Arendt & Sneed, 2008; Howells et al., 2007).

Lastly, ~~grocery~~deli food handlers were observed texting and using their cell phone while wearing gloves or while working. These employees then used the same gloves to touch a ready-to-eat product. Most retail food service facilit~~y~~ies have policies ~~which exclude~~prohibiting cell phones and other personal devices from food preparation areas, however if the culture in the establishment is to not enforce this policy, the use of cell phones could be risky. While there is

no research supporting this to date, a personal cell phone may contribute to cross contamination and should not be allowed in the processing area.

5. Conclusion

These results could be used to help retail food stores develop a food safety training program that caters to the needs and desires of their employees while at the same time enhancing food safety. By listening to ~~these~~ grocery food handlers preferences, a more engaging, effective and interesting training curriculum and program could be developed. These results can also help managers understand ~~some of the~~ barriers to achieving safe food handling practices. Learning about common unsafe practices is also helpful for training~~, which can be developed~~ to address these issues and help employees understand why the practices are not allowed. Focus for training~~s~~ needs to be not only on increasing grocery food handlers' knowledge ~~but on getting them~~ to practice safe food handling and correctly apply that knowledge at all times, creating an effective food safety culture. Some ~~methods that have been~~ effective ~~in~~ training~~s are the~~ methods use ~~of~~ food safety information sheets a~~s well as~~nd ~~hands on~~ experiential activities like GloGerm™ demonstrations that have ~~been shown to~~ significantly improved ~~the employees'safe~~employees 'safe handling behaviors (Roberts et al, 2008; Chapman et al., 2010). Additionally, a food safety education program focusing on the preferences of the store grocery food handlers with more frequent, shorter training sessions should be pilot tested. If these training sessions are more effective, ~~then possible~~ changes to ~~the way~~ training~~s~~ mentods~~ are held~~ in retail and foodservice firms could ~~help~~ increase safe food handling practices.

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Table 1. Grocery store food handler's knowledge of temperature control of foods for safety

	Total N=78	Percentage
Which of the following are considered a potentially hazardous food (PHF)? (Requires time and temperature control for safety)		
I don't know	4	4%
Bakery products – i.e. bread	8	10%
All of the above	13	13%
Cut melons and strawberries *	44	56%
Prepared potato or chicken salad *	57	73%
Deli meats/cheeses *	61	78%
Raw chicken and turkey must be cooked to what temperature?		
145°F	2	3%
155°F	3	4%
Other	21	27%
Don't know (4), 160 (1), 180 or higher (16)		
175°F**	22	28%
165° F*	30	38%
Hot foods that are being kept warm for serving should be kept at temperatures greater than …?		
Other	5	6%
160 (1), Don't Know (4)		
150°F**	6	8%
135°F*	8	10%
165°F**	12	15%
140°F**	47	60%
When reheating leftovers or previously prepared hot food, they must reach what temperature?		
41 ° Fahrenheit or below	0	0%
No Response	1	1%
70°F or above	3	4%
Other	9	12%
Do not reheat (6), Don't know (2), Blank (1)		
140°F or above	27	35%
165°F or above*	38	49%
To properly cool a hot food, it must reach 41 ° Fahrenheit or below within …		
No longer than 8 hours	2	3%
6 hr*	15	19%
4 hr**	21	27%
2 hr**	40	51%
The correct temperature to hold cold prepared foods is:		
140°F or above	1	1%
Other	1	1%
Don't know (1)		

No Response	2	3%
165°F or above	2	3%
70°F or below	4	5%
41°F or below*	68	87%

* Denotes correct answer

** Denotes an answer in the safe range (ex. Higher cooking temperature than recommended)
Percentages do not add up to 100% as associates could choose more than one answer for some questions

Table 2. Grocery store food handler's knowledge of hygiene and sanitation

	Total N=78	Percentage
You should NOT work with food if you have: [a]		
I can work anytime as long as I feel okay	6	8%
None of the above	1	1%
Have a hangover	21	27%
Had diarrhea within 24 hours *	61	78%
Had a fever within 24 hours *	62	79%
Vomited within 24 hours *	66	85%
A contagious disease *	72	92%
For which activities are gloves required? [a]		
Not necessary, I can use other things – tongs or deli tissues	3	4%
Handling fried/baked chicken *	73	94%
Handling deli meats *	77	99%
Slicing deli meat and cheeses *	78	100%
Proper hand washing techniques require:		
I don't need to wash my hands if I am wearing gloves	0	0%
Drying your hands on your pants	1	1%
The use of water only before preparing foods	5	6%
Always using soap and water *	77	99%
When slicing deli meats and cheeses in the same slicer, how often should you clean and sanitize the slicer? [a]		
Only once, at the end of the day	1	1%
No Response	1	1%
Every hr	11	14%
Every 4 hr *	15	19%
In between slicing cheeses and meats *	24	31%
In between each different meat or cheese type *	26	33%
Disinfecting refers to:		
Rinsing the equipment food prep areas with water during the day	0	0%
No Response	1	1%
Other Sanitize every time done with task (1)	1	1%
Using detergent and water to remove bacteria from equipment and food prep areas	8	10%
Using a chemical sanitizer to kill bacteria on the equipment and food prep areas*	68	87%
What is the difference between cleaning with a detergent and using sanitizer on the equipment and food preparation areas?		
There is no difference between using a detergent and using a sanitizer	1	1%
I don't know	6	8%
Cleaning kills bacteria and sanitizing removes bacteria	10	13%
Cleaning removes bacteria and sanitizer kills bacteria*	61	78%

* Denotes correct answer

[a] Percentages do not add up to 100% as associates could choose more than one answer for some questions

Table 3. Grocery store food handler's glove usage practices observed

Observation	Total Number of Occurrences	Number of Associates Viewed N=15	Number of Observation Periods Practice was Observed N =30
Glove usage			
Bare Hand Contact with Ready-to-Eat (RTE) Foods	13	5	6
Gloves Not Worn Preparing or Packaging Food	8	4	4
Gloves Not Replaced After Touching Face, Hair or Clothing	5	5	4
Gloves Not Worn When Packaging Bakery Products	2	1	1
Gloves Not Worn when Serving Ready-to-Eat Items	0	0	0
Gloves Not Worn When Slicing Deli Meat or Cheese	0	0	0
Hand washing practices			
Not washing hands prior to putting gloves on	111	15	29
Not washing hands after touching hair, skin or clothing	6	4	5
Not washing hands prior to preparing food	3	2	3
Not washing hands after coughing or sneezing	1	1	1
Cross contamination practices			
Glove/hand touched contaminated surface, then a RTE item	5	5	5
Contaminated utensil touch RTE item	5	4	4
Associated touched raw item prior to a RTE item	1	1	1
RTE item in contact with contaminated surface	1	1	1

There were a total of 15 associates observed in this study for 89.05 hours (5,343 minutes)

Table 4 Evaluation of grocery store food handler's hand washing attempts observed

Action	Times Performed Correctly	Total Times Performed*	Correct Percentage
If Applicable, Turn Off Water with Paper Towel*	2	5	40%
Wash for at Least 10 seconds	30	42	71%
Wash All Hand Surfaces	30	38	79%
Use Soap	35	41	85 %
Rinse Well	38	38	100%
Dry with Paper Towel OR Air Dryer	40	40	100%

There were a total of 15 associates observed in this study for 89.05 hours (5,343 minutes)
*Total times performed are not the same due to store layout blocking the investigator's view
**The low number of times this activity was performed was due to the inclusion of foot pedals at many of the establishments