PEER-REVIEWED ARTICLE

The Impact of Food Safety Training on Employee Knowledge of Food Safety Practices for Hot/Cold Self-serve Bars

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ABSTRACT

Increasing availability of foods offered by grocery stores in hot/cold self-serve bars has created new food safety training challenges. The objectives of this study were to determine if providing managers with food safety training improved their employees' knowledge of food safety practices and to determine if the food safety training provided addressed all the food safety needs associated with operating and maintaining hot/cold self-serve food bars. Three retail chains, 15 stores per chain, were observed by the investigators pre- and post-food safety training at set-up, lunch, and closing of the hot/cold bar to collect information on food safety practices. After pre-training observations, managers from eight stores per chain attended an eight-hour food safety training course (training group), while managers from the remaining seven stores received no additional training (control group). Managers from the training group were encouraged to train their employees with the knowledge they had gained. Following the training, post-training data were collected for all stores. The data showed that prior to training there was a strong correlation ($r = 0.68$) between manager knowledge and employee knowledge, but post-training the correlation was only moderate ($r = 0.356$). This suggested that after the training session, knowledge wasn't transferred from the managers to the employees. The information gained from the post-training performance and knowledge scores was used to determine the food safety training needs. These scores indicated that training materials covering practices related to food temperature, utensil usage, product handling, proper cleaning/sanitizing, and general food safety principles should be developed.

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INTRODUCTION

The influence of the American consumer has caused a dramatic increase in the number of restaurants and fast food establishments in the United States (U.S.) as well as an increase in the variety of food products available *(13)*. The U.S. Bureau of Labor Statistics reported that in 2010, Americans spent an average of $2,505 per capita annually on food outside the home *(3)*. Because of this trend, grocery stores have upgraded their frozen meal selection, their bakeries now serve breakfast, and their delis sell lunch/dinner items and side dishes *(13)*. On top of these changes, many grocery stores have added salad, pizza, and coffee bars to their establishments *(13)*. In 2010, the Food Marketing Institute (FMI) reported that 55% of grocery store shoppers are interested in ready-to-eat (RTE) foods and 37% of shoppers are interested in hot/cold self-serve bars (14). This increase in RTE and self-service foods has introduced new challenges related to food safety risks in grocery stores *(1)*, including foodborne illnesses and outbreaks. Several studies have found an association between the increased frequency of eating in restaurants and the increased risk of foodborne disease *(18, 21, 22)*. One study conducted by the Centers for Disease Control and Prevention (CDC) from 1998 to 2004 determined that of the 9,040 foodborne outbreaks reported, 52% were associated with restaurants or delicatessens *(17)*. In 2011, the CDC released a report stating that even though the number of foodborne illness is declining in the U.S., the amount of outbreaks associated with eating at restaurants and delis remains constant at 52% *(6)*.

One method for combating these food safety risks is through food safety training *(8)*. Researchers have confirmed that adequate food safety training of all employees can have a positive impact on health inspection scores and on some food safety behaviors, such as hand washing, in the retail food industry *(2, 17)*. Many food safety professionals have agreed that employee training and implementation are essential in preventing foodborne illness *(7, 8, 19, 20, 25, 26)*. Even though food safety training is fundamental to prevention of foodborne illness, training does not always lead to behavioral changes. Roberts et al. *(23)*, in a study that measured employee food safety knowledge as well as behavior compliance, determined that even though training significantly increased employee knowledge, it did not positively impact behaviors related to cross-contamination prevention and thermometer use. Another study analyzed health inspection reports from eight states in order to determine the effectiveness of food safety certification. This study determined that although certified managers had a higher understanding of food safety practices overall, certification did not ensure transfer of food safety knowledge to employees *(10)*. It has also been reported that to prevent foodborne illness, establishments need to go beyond just training employees; there is a need to create a positive food safety culture within the establishment *(22)*. A food safety culture would include food safety training and good organization, which would promote the sharing of information among managers, employees, and customers as well as removing behavioral barriers within the workplace *(12)*.

Many studies have concluded that the most common form of food safety training is on-the-job training *(5, 20)*. On-the-job training is often performed by the manager, which implies that managers have the skills needed to train their employees adequately *(23)*, although one study reported that 40% of employees do not receive adequate food hygiene training from their managers *(23)*. When the managers of this study were asked about the type of training they provided their employees, 40% of managers admitted that they did not provide their employees with any food hygiene training *(23)*. This statistic, as well as the current statistics on foodborne illness and outbreaks, implies that on-the-job training might not be a highly effective training method. It has also been suggested that food safety training needs to involve more than just educational content *(16)*, that this knowledge also needs to result in a behavioral change in the employees. The purpose of this study was to determine if training food service managers impacted their employees' knowledge of food safety practices and principles as well as to determine if there were any aspects of the food safety training that did not directly address the needs of operating and maintaining hot/cold self-serve food bars.

MATERIALS AND METHODS

Selection of participants

Three grocery store chains, both regional and national, were recruited and agreed to participate in this study. Chains are described by the FMI as having 11 or more stores operating under a similar name under the same corporate ownership *(15)*; for this study, each chain had at least 15 stores. Each grocery chain selected fifteen stores to participate in this study. The researchers performed audits and observations on at least one food service manager and at least two food service employees per store present during the pre- and post-visits for all 45 stores. The fifteen stores in each chain were randomly divided into control and trained groups prior to the first observational visit.

Instruments

An audit and observation form and a food safety questionnaire were used to collect information pertaining to the food safety knowledge and practices associated with grocery store managers and employees working with hot/cold self-serve bars. These instruments were reviewed and approved by the researchers and the Needs Assessment Committee (NAC), an advisory board comprised of academics, industry executives, food safety professionals and trainers, and state and local health officials. All instruments were field tested at a grocery store that was not participating in the study. Appropriate changes were made when needed.

The *Food Safety Audit Form* for this study was developed from a previously funded United States Department of Agriculture (USDA) project that examined hand hygiene compliance in restaurants *(4)*. The form was then adapted for grocery stores to be used as an instrument for auditing the food service areas (kitchen, food storage, and food preparation stations) and used as a third-party audit for each store. The form was redesigned using health inspection forms from the participating cities used in this study and the advisement of food safety experts from the industry and was then reviewed and accepted by the NAC. The audit form was divided into eight sections that were associated with procedures such as preparation, maintenance, and cleaning and sanitizing of the food service areas of the grocery store, including the hot/cold self-serve bars. The sections included such topics as reviewing temperature logs as well as manually taking temperatures of the food on the bars; reviewing personal hygiene standards; examining food containers to determine if First In First Out (FIFO) product rotation was being used, as well as proper dating and

labeling; reviewing food preparation areas to determine how the work stations were maintained, whether employees followed recipes, and whether proper thawing techniques were followed; checking if facilities and equipment were properly maintained; checking to see if foods were stored properly, and reviewing the type of ware washing facilities used and checking to see if the sanitizer solution was at the proper concentration *(24)*.

The items in each section were scored on how many proper procedures were followed, indicated by checked "yes" boxes on the audit sheets. If a "yes" box was checked, this indicated that the proper procedure was observed; if a "no" box was checked, the proper procedure for that question was not observed. The final score was calculated based on the number of "yes" boxes checked, and a percentage of correct procedures was calculated.

The *Food Safety Observation Form* was used by researchers as a way to record the practices related to employee behaviors while setting up, maintaining, and tearing down the hot/cold self-serve bars. This form was created, reviewed and accepted by the NAC.

The set-up section was separated into two subgroups. The first subgroup examined the general set-up of both the hot and cold bars, which included the time when the bar was set up for the day, cleaning prior to set-up, and whether temperatures of the products were measured and recorded during set up; whether the napkins, to-go containers, and plastic ware clean and stored in a clean area prior to set-up; whether the serving utensils were placed in the food pans with the handles extending out of the food, whether the signs were clean and placed by the correct food item, whether FIFO was used when filling the pans, and whether the pans were clean and dry prior to use by employees. The second subgroup focused on the soup bar and examined whether soup was transferred properly in clean containers and whether the soup was at the correct temperature when it was placed on the bar.

The maintenance section was divided into five subgroups. Subgroup number one centered on the cold bar and determined if products on the bar were being properly rotated and refilled, how often temperatures were being taken, and the holding temperature for the products on the bar. The second subgroup examined how often the utensils were replaced, whether utensils were kept in the same container after each use, how frequently the to-go packages were restocked, and whether the signs on the salad bar correctly identified the foods to which they corresponded. The third subgroup examined the rotation, refilling, and temperature aspects of the hot bar. The fourth subgroup, applicable only to stores that had a coffee bar, observed the refrigeration temperature, the temperature of the cream, and whether the ice scoop was kept outside of the ice machine. The last subgroup collected information on whether employees were following proper personal hygiene policies.

The tear-down section observed how the food was handled during tear down to see where and how the food was stored, if the containers were dated and labeled, and if proper procedures were being used to clean and sanitize the bar and the sneeze guards.

The observational data was scored the same as the audit data. If a "yes" was recorded for a question on the observation data, this indicated that the procedure was followed correctly. If a "no" was recorded, the procedure was inadequately completed. The final score was calculated based upon the number of "yes" boxes checked and a percentage of correct procedures was calculated.

The content in the *Food Safety Questionnaire* was divided into five sections. Online and paper versions of the questionnaire were created to meet the needs of the stores. The stores that chose the paper form (because no internal intranet was available in the stores) were given their questionnaires at the beginning of the visit. The questionnaires were then collected during the last observation of the day. The stores that chose to respond to the questionnaires online were emailed the questionnaire link after the researcher had completed their visit. Each of these versions was also available in Spanish. Within each version of the questionnaires were two different forms, one designed for managers and the other for employees. Although the questionnaire was primarily used to determine food safety knowledge, some demographic questions were included to aid in identifying the stores and participants. Each store was asked to have at least one manager and two employees complete the *Food Safety Questionnaire*.

The first section of the questionnaire asked about current food safety practices being utilized. The questions in this section concerned the procedures used for taking temperatures of products, thermometer calibration, and the frequency of taking temperatures. The second section measured the food safety knowledge of managers and employees. These questions, selected because they were determined to be essential knowledge needed by managers and employees associated with operating the hot/cold self-serve bars by the NAC, were based on the SafeMark training program. For this section, a score was calculated as the number correct out of the answers to the 16 questions or a correct percentage of answers. Section three evaluated the managers' and employees' personal beliefs concerning food safety, based on their level of agreement with five food safety related statements. The fourth section contained questions concerning current training procedures and certification requirements. Managers were also asked questions regarding weekly sales, average number of employees, and hours of operation for the hot/cold self-serve bars. This is the only section where the manager and employee questionnaires differed. The final section contained demographic questions on past experience in the industry as well with the current company, food safety certifications received, gender, current position and highest level of education earned.

Training of researchers

Five food safety researchers were involved in the data collection process. Each researcher had taken, and received certification from, the SafeMark train-the-trainer course prior to the start of the study. The SafeMark training is offered by the FMI and specifically designed for the grocery industry. Prior to the start of the study, the food safety researchers were required to shadow a local health inspector during an inspection of a grocery store. The researchers observed the health inspector as they audited the food service section of the store, including the hot/cold self-serve bars. Then, as a group, the researchers performed an audit as well as an employee observation (to verify that instrument) during the tear down of a cold bar at a local grocery store. None of the stores that were visited were participating in the study. This process was completed to gain consistency and consensus on how to evaluate the stores. It was found that the inter-rater reliability between the researchers was 96%. Several items on both the audit and observation forms were discussed within the group to ensure

consistency during the actual audits and observations, and needed changes were made.

Pre-training audits and observations

Each store was visited during three time periods: set-up, peak hours (lunch), and tear down of the hot/cold self-serve bars, all within the same day. During the set-up of the hot/cold self-serve bars, researchers observed employee(s) and procedures involved in preparing products for the food bars as well as stocking the food bars for the day. Researchers returned to the stores during peak hours (when the self-serve bars had the highest customer traffic) to observe how the food bars were being maintained. The researchers made their final return to the stores during the tear- down process of the hot/cold self-serve bars to observe how the foods were removed and stored as well as what cleaning and sanitizing procedures were utilized.

Training of foodservice managers

All the foodservice managers who participated had received food safety training from their corresponding store prior to the study. All managers that participated were also informed of the parameters and the purpose of the study and understood that food safety knowledge as well as employee behavior would be measured. Following the initial visit to the stores, the managers from the stores in the training group attended an eight-hour food safety training session using the SafeMark training program and taught by certified SafeMark trainers. Immediately following the training session, each manager was given a certification test. Managers who scored a 75% or higher on the exam received the SafeMark certification certificate. Overall, 90% of the managers who took the certification exam passed with a 75% or above. After the training session, the managers were encouraged to take the information gained and educate their employees via on-the-job training. The managers were also given SafeMark training materials to use in their stores.

Post-training audits and observations

Researchers waited four to six weeks after the completion of the manager training session to revisit each of the stores. They followed the same procedures employed during the first visit. The researchers used the information gathered in the post-training audits and observations as well as data from the food safety questionnaires to determine the efficacy of the training session.

Statistical analysis

The data were analyzed using the Statistical Package for Social Sciences (SPSS) 16.0 computer program. The descriptive data collected for the three store chains were coded into nominal scales, with 0 = no and 1 = yes. Correlation research was conducted using Pearson product-moment correlations coefficients to investigate the relationship between the stores' performance on the audit and observational categories. Relationship strength was reported using the following designations: negligible (0-.09), low (.1–.29), moderate (.3–.49), substantial (.5–.69), high (.7–.99) and perfect (1.0) (9). Differences in pre- and post-data were identified by examining the means and standard deviations. Means were compared using an independent t-test. Descriptive statistics were used to define the sample. Statistical significance was determined based on a P-value < 0.05.

RESULTS AND DISCUSSION

From the demographic information collected ***(Table 1)***, it was determined that the average age of the managers who participated in the study was 39 years ($SD = 9.2$) and the average age of the employees was 38 ($SD = 13.8$). With regard to the number of years of experience in the industry, on average, managers had worked 10 years in the retail food industry, which was four more years of experience than their employees had. The average number of years of service with the current employer was eight years for managers and five for employees. The gender information from the questionnaire showed that 50.5% of the managers were female, 45.5% were male, and 4% chose to not disclose their gender ***(Table 1)***. The majority of the employees (68.1%) were female, 28.4% were male, and 3.5% chose to not disclose their gender.

In comparing the type of food safety training the managers and employees had previously had, a dramatic difference between the two groups was seen ***(Table 1)***. The majority of the managers (82.8%) reported that the most common form of food safety training they had received was classroom, while the majority of the employees (67.2%) reported they had received on-the-job training. When asked about what type of training certificate(s) they had received, the managers reported that they had state/city certification (48.8%) and/or the NRA (ServSafe®) certification, whereas the majority of the employees (48.3%) reported that they had received another form of certification or no certification. A majority of managers (52.5%) also reported that the average amount of time they had spent on training was two to three days, while the majority of employees (33.3%) reported that they had received less than 5 hours of training. This information shows that even though employees are primarily responsible for food preparation, the majority of them had received only on-the-job training, and few had actually earned a food safety certification. In addition, the majority of the managers (52.5%) had at least 2–3 days of training, while the majority of the employees (33.3%) had less than 5 hours. These percentages raise possible concerns regarding not just the knowledge, but also the actual behavior of the employee with regard to food safety, and whether employees are being properly trained.

The *Food Safety Questionnaire* was used not only to determine not only the level of manager food safety knowledge, but also to see if this knowledge was transferred to the employees ***(Table 2)***. The managers in the control group scored 71.3% pre-training and 75.9% post-training. A similar increase in post-training score was observed with the managers in the treatment group (pre-training 74.8% and post-training 79.3%). This showed that regardless of training, both groups of managers increased their post-training knowledge scores. The average knowledge scores were lower for the employees than for the managers; pre-training scores were 67.2% for the employee control group and 62.5% for the employee treatment group. Following the training session, the control group employee scores were 66.4% and the treatment group employees scores were 62.4%. Prior to training, there was a strong significant correlation ($r = 0.68$) between manager knowledge and employee knowledge. The post-training correlation had decreased to a significant moderate relationship ($r = 0.356$), which suggests that after the training session, knowledge was not transferred from the managers to the employees.

TABLE 1. Managers' and employees' gender and experience with food safety training and certification

CHARACTERISTIC	% MANAGERS (n=99)	% EMPLOYEES (n=201)
GENDER		
Male	45.5	28.4
Female	50.5	68.1
Undisclosed	4.0	3.5
METHOD OF TRAINING*		
Classroom	82.8	51.7
On-the-job	45.5	67.2
Textbook	36.4	28.4
Video	35.4	44.8
Computer-based	29.3	29.4
Company-web	13.1	12.4
Internet	7.1	4.0
TRAINING CERTIFICATION*		
State/City certification	48.8	23.9
NRA (ServSafe®)	44.3	20.9
Company certification	26.8	24.4
SafeMark	10.3	1.5
Other or no certification	28.8	48.3
TIME SPENT TRAINING*		
More than 3 days	18.2	12.9
2–3 days	52.5	28.4
1 day	9.1	16.9
6–12 hours	10.1	8.5
Less than 5 hours	10.1	33.3

*** Participants were instructed to check all options that applied**

To investigate why knowledge was not transferred in the treatment group post-training, a mean score was used to compare pre- and post-training manager food safety knowledge scores *(Table 3)*. The mean pre-training score was 11.5 correct out of 16 and the mean post-training score was 10.4 correct out of 16, which indicated that there had not been a significant gain in knowledge. The lack of new information may have prevented the managers from transferring knowledge to their employees. It is also possible that there were no incentives for the managers to train their employees; training takes time, and unless lack of training leads to a cost of lost production or quality to the store, some managers may feel that training is not necessary.

Since the managers' food safety knowledge scores had not significantly increased after training for the treatment group, because of the insignificant changes in knowledge following the training session, the manager and employee knowledge scores for the treatment group were combined to calculate a score that would represent the store as a whole. The summated score was based on the correct answers from both the employee and manager surveys, for a total of 32. *Table 2* represents the stores' mean scores, both pre- and post-training. The mean scores for the pre- and post-training were compared using an independent t-test and were determined to be very similar (22.5, 22.7 out of 32), which confirmed that the stores in the treatment group collectively did

TABLE 2. Comparison of food safety knowledge scores for managers and store employees pre- and post-training

KNOWLEDGE SCORES	PRE-TRAINING %		POST-TRAINING %	
	*C	T	C	T
MANAGERS' SCORES	71.3	74.8	75.9	79.3
EMPLOYEES' SCORES	67.2	62.5	66.4	64.2

*C = Control Group, T = Treatment Group

TABLE 3. Comparison of pre- and post-training knowledge from the treatment group to determine impact of food safety training on knowledge

KNOWLEDGE	*MEAN*	*SD*
MANAGERS' PRE-TRAINING KNOWLEDGE[a]	11.5	2.24
MANAGERS' POST-TRAINING KNOWLEDGE[a]	10.4	2.13
STORES' PRE-TRAINING KNOWLEDGE[b]	22.5	3.79
STORES' POST-TRAINING KNOWLEDGE[b]	22.7	2.22

[a]Manager knowledge range: 0–16, (N = pre-training 56 and post-training 43)

[b]Store knowledge range: 0–32 (16 for managers, 16 for employees), (N = pre-training 113 and post-training 88)

not gain any significant additional information from the training. It was determined that, cumulatively, each store understood approximately 70% of the essential food safety knowledge needed to adequately operate and maintain a hot/cold self-serve bar. However, even though overall no additional knowledge was gained during the training, it appears that the stores' knowledge became less varied. The observed decrease in standard deviation on the post-training measure represents a higher collective level of agreement among stores.

The food safety training did not increase the managers' food safety knowledge, which correlated to the lack of knowledge being transferred to employees. The knowledge scores and correlations values suggest that imparting knowledge to managers is not enough to ensure knowledge transfer. Even though managers did not gain any new knowledge, employee knowledge should still have been positively impacted by the manager training session. Current training methods do not equip managers with the tools they need to train their employees. Food safety training presents managers with information on how to keep food safe and prevent foodborne illness, but it does not give sufficient instruction on how to train employees or how to promote positive behavioral changes.

The researchers for this study decided that for the knowledge questions on the post-training surveys, those that were answered correctly less than 75% of the time would indicate areas where new food safety training materials were needed. The knowledge questions were categorized as either general food safety knowledge and principles (category I) or performance related knowledge (category II).

Table 4 lists the food safety knowledge questions that were answered correctly less than 75% of the time by managers and employees from both control and trained groups. This percentage was chosen because that is the score need to pass the SafeMark certification

TABLE 4. The percentage of responses for each food safety knowledge question missed more than 75% of the time for all participants both pre- and post-training

QUESTION	MANAGER CONTROL		MANAGER TRAINED		EMPLOYEE CONTROL		EMPLOYEE TRAINED	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST
I-A. FOODS THAT REQUIRE PROPER TEMPERATURE CONTROL TO ASSURE FOOD SAFETY ARE REFERRED TO AS – *TIME/ TEMPERATURE CONTROL FOR SAFETY FOODS*	13.8	40.7	37.0	25.0	38.6	41.7	39.3	25.0
I-B. FOODBORNE ILLNESS OUTBREAK OCCURS – *WHEN 2 OR MORE PEOPLE EXPERIENCE A SIMILAR ILLNESS AFTER INGESTING A COMMON FOOD*	51.7	55.6	63.0	81.2	43.9	31.2	44.6	35.0
I-C. MOST EFFECTIVE WAY TO CONTROL THE GROWTH OF BACTERIA IN A RETAIL FOOD ESTABLISHMENT IS BY CONTROLLING – *TIME AND TEMPERATURE*	96.6	88.9	85.2	100.0	80.7	87.5	66.1	75.0
I-D. ACCORDING TO HACCP PRINCIPLES, WHAT ARE CRITICAL LIMITS – *MAX AND MIN VALUES THAT MUST BE CONTROLLED TO MINIMIZE THE RISK OF FOOD SAFETY HAZARD*	31.0	40.7	44.4	50.0	22.8	12.5	12.5	25.0
I-E. NUMBER ONE CONTRIBUTING FACTOR TO FOODBORNE ILLNESS IN RETAIL ESTABLISHMENTS – *CROSS-CONTAMINATION*	65.5	70.4	85.2	100.0	49.1	62.5	50.0	67.5
I-F. FOCUS FOR FOOD SAFETY MANAGEMENT PROGRAMS – *CONTROL TIME AND TEMPERATURE, PRACTICE GOOD HYGIENE, PREVENTING CROSS-CONTAMINATION*	100.0	96.3	96.3	93.8	93.0	56.2	87.5	57.5
II-F. FOUR STEPS TO EFFECTIVE CLEANING AND SANITIZING – *WASH, RINSE, SANITIZE, AND AIR DRY*	31.0	70.4	37.0	12.5	43.9	45.8	37.5	22.5
II-G. GENERAL RULE FOR CLEANING FREQUENCY OF FOOD CONTACT SURFACES – *ANY TIME AFTER CONTAMINATION MAY HAVE OCCURRED*	31.0	22.2	44.4	50.0	26.3	20.8	14.3	35.0

exam. These scores were compared to identify the impact of the study and the training session on the knowledge questions. The comparison of pre-training and post-training knowledge scores, for both managers and employees, aids in explaining what areas of knowledge were impacted by the training session, impacted by the study itself, or not impacted. The results indicated that questions with scores below 75% pre-training were also missed post-training *(Table 4)*. The managers in the trained group did show some improvement in knowledge after training, where their knowledge increased on questions I-A (foods that require proper temperature control to assure food safety are referred to as__?) and II-A (time/temperature control for safety foods should not be in the temperature danger zone more than __?). When investigating how the managers' knowledge compared to their employees' knowledge, it was interesting that in category I the employees and managers from the control and trained groups missed questions I- A (foods that require proper temperature control to assure food safety are referred to as__?), I-B (defining foodborne illness), and I- E (number one contributing factor to foodborne illness) pre-training. The data showed that after the training, not only did the employees and managers continue to miss these questions, but the employees also missed question I-F (focus for food safety management programs¬). This indicates that the training had a negative impact on the employees' understanding of this topic.

There was more variation in the answers that were missed in category II *(Table 4)*, performance related knowledge, by the managers and employees. The managers from the control group missed questions II-A (time/temperature control for safety foods should not be in the temperature danger zone more than __?), II-C (holding temperature for hot foods), and II- H (general rule for cleaning frequency of food contact surfaces) before and after the training. The managers in the trained group also missed these questions before the training, but after the training they had improved their knowledge on question II-A. In the control group, pre-training, employees missed questions II- B (maximum temperature for most refrigerated foods), II-F (four steps to effective cleaning and sanitizing), and II-G (general rule for cleaning frequency of food contact surfaces), and after the training they continued to miss questions II-F and II-G. A similar trend was seen in the knowledge scores for the employees from the trained group. Employees from this group, pre-training, incorrectly answered questions II-C (holding temperature for hot foods), II-D (bacteria grow best within the narrow range of temperatures known as temperature danger zone), II-F (four steps to effective cleaning and sanitizing), and II-G (general rule for cleaning frequency of food contact surfaces). After the training they continued to miss questions II-F and II-G, which showed that after the training, both employee groups continued to miss the same questions in category II.

Overall, the data from the surveys showed that training did improve the knowledge for the managers in the trained group on questions I-A and II-A, but their knowledge on questions I-A, I-B, I-D, I-E, I-F, II-F and II-G was not sufficiently transferred to their employees.

The audits and observations were also used to identify food safety training needs for the hot/cold self-serve food bars. The researchers decided that an audit or observation category with a post-training score of 75% or above would indicate that the current food safety training practices sufficiently met the needs of that category and that post-training scores below 75% were areas where new food safety training materials were needed. The 75% score was also used because this was the score needed to pass the certification test at the end of the training session. From the eight audit categories, only categories one (food temperature) (65.8%), and eight (warewashing) (64.9%), had post-training scores below 75% *(Table 5)*. Three of the four observational categories, one (food temperature) (60.24%), two (utensil usage) (74.2%) and three (product handling) (62.0%), had post-training scores below 75% *(Table 5)*.

When the knowledge scores were compared to the audit and observation scores, it became evident that food safety knowledge *(Table 4)* did not transfer to better food handling behaviors *(Table 5)*. The audit and observational data indicated that employees (regardless of treatment group) did not follow proper procedures related to ensuring proper food temperatures. When the knowledge scores were examined, employees scored less than 75% (41.7% of the control group, 25% of the trained group got the questions correct) on only one of the seven food safety knowledge survey questions from category I (I-A, foods that require proper temperature control to assure food safety are referred to as__?), but they continued to follow improper practices pertaining to temperature control. The knowledge scores on time and temperature control questions indicated that employees knew the frequency at which temperatures of foods should be taken, the temperatures at which hot and cold foods should be held, and the temperatures associated with the temperature danger zone, yet the observational and audit data indicated that the knowledge was not being applied. The researchers noted that during many of the visits employees failed to take and record temperatures properly, that many of the food products were not being held at the appropriate temperature, and that prep work was not being done so as to prevent food from being in the temperature danger zone.

A similar trend was observed when the knowledge on utensil usage was compared to the practices observed. For utensil usage, the stores were observed to use and change utensils properly only 74.2% of the time, even though the employees from both groups collectively answered question II-J (how to use utensils on a self-service food bar) correctly more than 75% of the time (100% of the control group, 95% of the trained group). The correct response on question II-J implies that employees knew how to place utensils on the bar, but researchers noticed that utensils were not kept in the same pan after use and that utensils were placed on top of the food instead of inside the food pan with the handle above the rim of the pan. These observations indicated an area where knowledge did not alter employee behavior.

The stores' low percentage of the observational category of ware washing (64.9%) and for product handling (62%) may have been influenced by employees' lack of food safety knowledge on these practices. The food safety knowledge data showed that question II-F (four steps to effective cleaning and sanitizing) was not answered correctly more than 75% of the time (45.8% of the control group and 22.5% of the trained group) by the employees post-training *(Table 4)*. It is possible that the lack of knowledge regarding the proper procedure for cleaning and sanitizing could explain why researchers noted that many of the ware washing facilities were not accurately set up, the sanitizer solution was not at the proper concentration, and the facilities were not stocked with test strips.

Employee's behavior regarding the category of product handling may have been influenced partly by a lack of food safety knowledge, as shown by scores on Question II-G (general rule for cleaning frequency of food contact surfaces). Post-training employees scores on this question

TABLE 5. The stores' performance scores (% performed correctly) on the Food Safety Audit and Observation instruments post-training

AUDIT CATEGORY	N	% PERFORMED CORRECTLY	SD
1: FOOD TEMPERATURE	45	65.8	1.274
2: PERSONNEL	45	89.3	0.630
3: FOOD HANDLING	45	91.0	0.533
4: FOOD PREPARATION	45	85.0	1.123
5: FACILITY	45	91.8	1.109
6: EQUIPMENT	45	90.5	0.958
7: STORAGE	45	96.9	0.707
8: WAREWASHING	45	64.9	1.383
OBSERVATION CATEGORY			
1: FOOD TEMPERATURE	45	60.2	24.793
2: UTENSIL USAGE	45	74.2	13.124
3: PRODUCT HANDLING	45	62.0	19.316
4: CLEANING AND SANITATION	45	81.2	14.338

(20.8% of the control group, 35.0% of the trained group) showed that employees did not understand when and how often they should clean a food contact surface. This lack of knowledge could explain why researchers observed a variety of methods used to maintain the hot/cold food bars. Some employees would wipe the food off the sides of the food bars with a paper towel or a dry rag. There were also instances in which food that had fallen out of the pan and onto the bar was picked up by the employee and placed back into its corresponding food pan. In several cases, food was left on the food bars and not cleaned up for hours. Therefore, the lack of knowledge on II-G may have had an impact on the employees' behavior and thus the stores' performance score on this category.

Another aspect of product handling dealt with employees' behavior related to hand washing. Question II-E indicated that a majority of employees (81.2% of the control group, 92.5% of the trained group) understood that hand washing was a part of good personal hygiene, but the observational data indicated that they did not understand how and when to wash their hands. Many employees would change their gloves, switch from one task to another, and touch items such as trashcans and door handles and then food items without washing their hands. When employees were observed washing their hands, many did not follow proper procedures, and in some stores, very little hand washing was even observed.

The results of this study determined that managers did not gain any additional knowledge after the SafeMark certification training. In addition, managers did not transfer information to their employees after training, and current food safety training methods may not promote employee behavioral changes. This leads to the suggestion that there is a need for new food safety training materials. Because of time restrictions and high employee turnover, any training materials created to meet the food safety needs associated with operating and maintaining hot/cold self-serve bars should be created in a manner that will allow managers to effectively train their employees on-site.

Suggestions for training materials

Training materials need to be developed specifically for employees who operate and maintain the hot/cold self-serve bars in grocery stores. It is important that these training materials not only improve employee knowledge, but also provide employees the needed behavior-based learning to change their actions to properly set up and maintain these bars. This program must include the areas of time and temperature controls, proper utensil usage, proper product handling practices, proper cleaning and sanitizing (warewashing), and general food safety knowledge principles (such as time and temperature control, good personal hygiene, and cross contamination). Employees should be given not only knowledge on these topics, but also knowledge of why these topics are important as a preventative measure to control foodborne illnesses. These topics are especially important, since they were found to be out of compliance most often in this study as well as in another study that examined deli departments *(12)*. The program should be created so that it not only is interactive, but also incorporates different teaching techniques to reach a variety of learning styles. Different teaching methods and tools that could be used in this training program are non-verbal demonstrations, pictures, videos, simulations, and interactive activities (e.g., games). These training methods could be used to engage a variety of learning styles as well as overcome language barriers, which were found to be a problem in almost all of the 45 stores in this study. Because of the high turnover rate in the retail grocery industry, it is imperative that these training materials be created so as to be easily accessible, easy to use, and able to provide employees with consistent training. This can be accomplished by either using online training or developing products that can easily be used with use of computers. Research has shown that online training is not only cost effective but also helps ensure that employees receive consistent on-site training *(11)*. Online training would also ensure that all employees were given access to the same information. Most managers (82.8%) in this study reported that they received classroom training. Although this type of training does give managers consistent information, often employees (because of high turnover rate) are not given this opportunity. A majority of the employees (67.2%) in this study indicated that they received on-the-job-training, usually conducted by a manager or a senior employee. This type of training is not always consistent and can vary in length of time.

Several restaurants have started to use online training for topics such as food safety, technical skills, and menu/restaurant knowledge because such training gives employees consistent information and the employees seem to learn faster *(11)*. One restaurant has seen positive results with online training and has reported a 45% decrease in complaints about employee errors *(11)*. A recent study determined that employees who participated in the online training had a more consistent understanding of the content, compared with those in the face-to-face training *(26)*. The same study also determined that participants who took the online training completed their training in one-third the time it took those participating in the face-to-face training *(26)*.

CONCLUSION

The information gained from the audits, observations, and knowledge surveys indicated that there is a need to create food safety training materials that not only cover practices related to food temperature, utensil usage, product handling proper cleaning and sanitizing, and general food safety principles, but also address the need for a program that provides a consistent, on-site training medium. Creating a system of food safety culture can also enhance the ability of the managers and employees to better understand the food safety risks within their establishments and promote an effective food safety system *(22)*. Further research needs to be conducted to assess whether incorporating an online, on-site training program would increase employee knowledge as well as improve store performance related to these food safety practices.

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