

Observational Assessment of Glove Use Behaviors among Foodservice Workers in a University Dining Setting: Testing a Visual Intervention Tool

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ABSTRACT

This study assessed knowledge and behaviors related to glove use by college and university dining hall student workers (N = 32). Almost all participants were under the age of 25 (Generation Y/New Millennial); 58% were Caucasian and 75% were U.S. citizens. Control (N = 16) and treatment groups (N = 16) were administered a knowledge assessment (10 items, yes/no/don't know response options) and observed for a 2-hour work period to determine compliance with Food Code recommendations on glove behaviors (64 total person-hours of observation). An intervention flyer based on a social-marketing approach and limited-text, *I'm Gloving It!*, that addressed the *How*, *Why* and *When* of proper glove use was included in the training for the treatment group. Knowledge was fairly high, with 90% or more correct responses given for 6 of the 10 items. However, observational data showed non-compliance with Food Code recommendations in both groups, although non-compliance was lower in the treatment group, suggesting that the intervention was successful. Managers employing multiple generations and cultures in their workplaces should consider use of similar interventions to reach staff of diverse characteristics.

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INTRODUCTION

Every year, foodborne illness impacts millions of individuals in the United States (U.S.), leading to illness and death (7, 33, 34). According to the World Health Organization (41), the top five reasons for occurrences of most foodborne illnesses were improper cooking of food, temperature abuse of food, poor health and hygiene practices among food handlers, cross contamination between raw and cooked foods, and obtaining food from unsafe sources. Many reported foodborne illnesses have originated in foodservice establishments as a result of poor food handling practices by food workers (26). Cross contact of food allergens is also a concern, with food allergies affecting 2–4% of adults and 6–8% of children in the United States (13).

The 2005 U.S. *Food Code* was the first version that prohibited bare hand contact with Ready-to-Eat foods (RTE) (40), with requirements for use of tongs, deli tissues or gloves on clean hands when handling food that will not receive further heat treatment. Glove use to avoid bare hand contact with RTE foods should follow specific protocols outlined in the *Food Code* regarding when and how these should be used in retail kitchens. Gloves should be worn on clean hands and changed before handling different types of foods or changing tasks; after touching any surface that could contaminate gloved hands, such as refrigerator handles, or after coughing or sneezing into gloves; when gloves become ripped or torn; or at least every four hours when used for the same task.

Proper hand hygiene and glove use is the simplest method of preventing the transmission of microorganisms onto food (15) and cross contact of allergens (13). Proper hand hygiene includes effective hand washing followed by use of clean, disposable gloves to avoid bare hand contact with RTE foods (40). Using gloves on properly cleaned hands that directly handle food has been identified as an effective method of preventing contamination (23). However, mandatory glove use can result in the decline of overall hygiene and misuse of gloves among food handlers (6, 14, 22, 29). Thus, it is important for employees to understand how to wear gloves properly, why it is important to do so, and when to wear them and change them.

Observational research on handwashing has found that most employees in four different sectors of retail foodservices did not wash their hands properly prior to donning gloves (38) nor did food handlers in restaurant settings change gloves as required by the *Food Code* when they were busy with food production and service (15). It is possible that wearing gloves creates a false sense of security among food handlers. Food handlers may be unaware that using the same gloves for multiple tasks or for touching different foods and/or surfaces can result in cross-contamination, the same as if hands had not been washed (12). Focus group research has found that if communication to employees of why *Food Code* regulations are in place, such as those for handwashing and glove use, it would encourage better compliance (31). Much research has been conducted in foodservice settings regarding proper handwashing (1, 16, 38), yet little research has investigated glove use and even fewer studies have focused on university dining settings.

The changing demographics in the workforce have contributed to the need to assess and meet employees' training needs (24, 32). Variations in learning styles, culture, ethnic diversity, and work attitudes require some degree of customization of messaging by

management to accommodate generational differences. Different generational attitudes toward work have forced organizations to re-engineer training programs to be able to "explain why people need to learn X or Y" (4, 5). Trainers must communicate why employees should care about the information. One of the recommendations from the Strohbehn et al. (38) study was to design training "that includes reasons why proper handwashing and other safe food handling behaviors are important."

Although employees often know the correct behaviors to use, lack of motivation or other barriers may prevent correct actions from being followed (12, 18, 31, 36). Understanding the underlying reason for change is critical to adopting behavior changes. An intervention tool that specifically addressed the "When? Why? How?" of glove use was developed. The effect of this intervention on college and university student food workers' glove use was assessed through knowledge questionnaires and observations of actual glove use behaviors.

MATERIALS AND METHODS

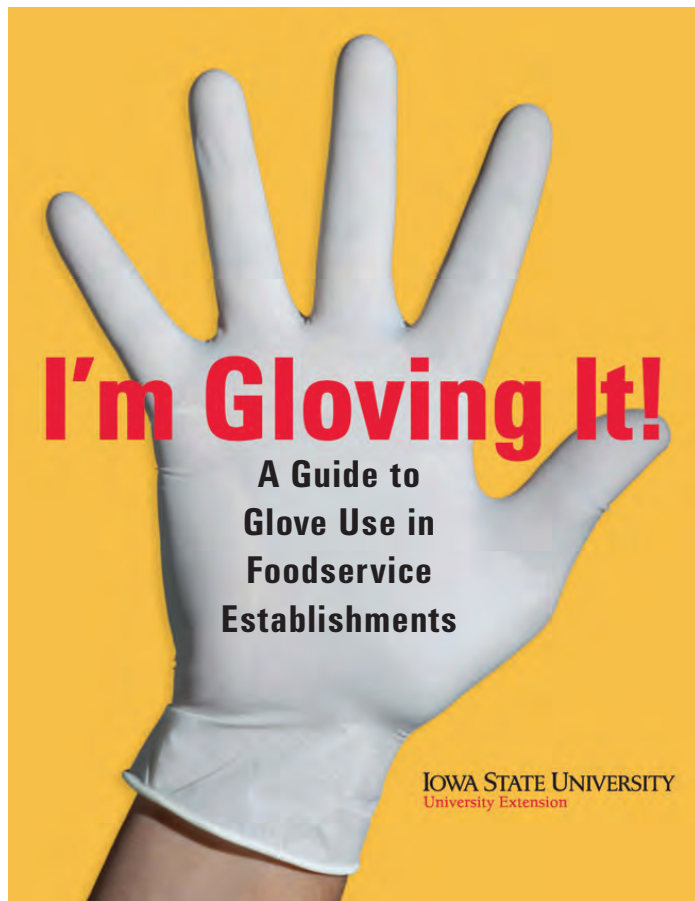
Instrument and questionnaire development

Research protocol and data collection tools were reviewed and approved by the university's Human Subjects Committee prior to data collection. All individuals involved in the development and evaluation of the training materials and observational tool had completed ServSafe® training and certification. The first step in this study was to develop the "I'm Gloving It!" flyer that provided information about glove use in accordance with the 2005 *Food Code* guidelines (40) (the current guidance for Iowa). The saying "I'm Gloving It!" was derived from the saying "I'm Loving It!" as an innovative and creative way of educating younger foodservice workers about proper glove use. The flyer used minimal text to convey the message of proper glove use in foodservice operations along with a brief rationale of *When? Why? and How?* (Fig. 1). The flyer was evaluated by two individuals with expertise in food safety and foodservice operations. In addition, students in an undergraduate food safety course (N = 55) evaluated the flyer for appropriateness for the target demographic — Generation Y and New Millennial foodservice workers. Feedback obtained from the evaluators was used to improve the flyer.

The second step was to develop a glove use knowledge questionnaire. A 10-item questionnaire with three response options (True/False/Don't Know) was developed to assess participants' general knowledge about glove use without the influence of intervention. Correct responses were based on recommendations in the *Food Code* (40) used by state health inspectors. Demographic information was also collected. The questionnaire was reviewed by two food safety experts with experience in food safety and foodservice operations for content validity. All participants completed the questionnaire prior to observation.

The third step was the development of a glove use observation tool modeled after the validated Handwashing Observation Tool developed by Paez, Strohbehn, and Sneed (27), available at www.extension.iastate.edu/foodsafety/. This tool lists all the conditions when gloves should be worn and/or changed and assesses whether those behaviors actually occurred. The tool was reviewed by two food safety experts

Figure 1. I'm Gloving It! flyer



I'm Gloving It!



Why wear gloves?

- Gloves provide a barrier between germs on hands and food



When do I wear gloves?

- When handling different types of foods
- When touching Ready-To-Eat foods



When do I change gloves?

- When gloves are ripped or torn
- After touching any new surface
- After four hours if working on the same task
- After coughing or sneezing into gloves



How are gloves worn?

- On clean hands—Wash hands with soap and water
- Dry hands with clean paper towel

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with experience in food safety and foodservice operations and was pilot-tested in an undergraduate quantity food production laboratory that simulated a retail foodservice operation. Two researchers observed the same individual for 2 hours and compared observational data to ensure inter-rater reliability. Observations made during pilot testing of the tool were used to improve the tool and identify best strategies for conducting observations. Data on behavior change were collected using observations because observations provide information about behaviors in the participants' natural settings (17). Information about the physical facility, such as location of the handwashing sink, type of faucet, availability of gloves, and ease of access to gloves, was also recorded during data collection. Information about handwashing facilities and frequency of handwashing was collected, even though the purpose was to observe glove use behaviors, because proper handwashing should precede glove use for safe food handling (40).

Sample and data collection

A convenience sample of student foodservice workers ($N = 32$) employed in university dining at a Midwestern university was selected from a population of all students ($N = 85$) working at the time of data collection. Each participant was observed for two hours, resulting in 64 hours of total observational data being collected. Observations were conducted at four different locations within university dining. The foods

handled in these locations were salads, made-to-order sandwiches, hot entrees (hamburgers, gyros, pizzas, pasta, and vegetables), made-to-order sautéed meats and vegetable entrees. These locations were chosen because they were similar to retail foodservice operations typically seen in the foodservice industry and that have been frequently associated with foodborne illnesses (19, 26). Therefore, it was hypothesized that food-handling behaviors in these establishments would be similar to those observed in commercial, for profit, retail foodservice establishments.

Participants spread across 4 locations were divided into two groups: control ($N = 16$) and treatment ($N = 16$). The control group did not receive any intervention (training) prior to observation, while the treatment group received training prior to observation. All participants provided informed consent and completed the glove use knowledge questionnaire prior to participation. A five-minute, one-on-one, verbal training session was conducted on location with all participants receiving the intervention. Participants were informed about the importance of handwashing and glove use to prevent contamination of food and cross-contact of allergens. The *I'm Gloving It!* flyer was used as a guide for the training, after which all participants were given a copy of the flyer. Observations were carried out during the lunch or dinner period at the chosen establishments during weekdays. One researcher observed one participant for two hours. Thus, 64 hours of

observational data were collected. Because proper handwashing is necessary prior to donning gloves if hand hygiene is to be effective, training on proper handwashing in accordance with the *Food Code 2005* guidelines was also provided as part of the 5-minute intervention. While participants in the treatment group were provided information about handwashing and glove use prior to observation, both groups were informed that observations of general food handling would be conducted; this was done in order to prevent socially desirable behaviors that might influence data collection. Participants were observed with the researcher being as discreet as possible to minimize influencing participant glove use behaviors. Observations were recorded using the protocol and glove use observation tool developed for this purpose, which helped reduce subjectivity during data collection.

RESULTS

Observations were conducted in establishments that were considered “quick service” locations, foods that did not require extensive preparation prior to service or required some “cooking to order” for foods such as burritos, quesadillas, and hamburgers. All operations had easy access to handwashing sinks equipped with soap, hot water, and paper towels; this was considered critical because proper handwashing should precede glove use for effective hand hygiene and safe food handling (11, 40). Most participants (81.3%) had easy access to the box of gloves. Easy access in this study indicated handwashing sinks and a box of gloves were within 5 feet of the workspace and were not blocked by equipment or personnel.

Demographic characteristics of participants

Participant demographic characteristics are shown in *Table 1*. The majority of the employees were female (62.5%); most were 21–24 years (68.8%) and were in their senior year of college (50.0%), and 18.8% were graduate students. Participants from all ethnicities were represented, with 56.3% of the participants being Caucasian. The majority were originally from the United States (75.0%), while 25% were international. Nearly 43.8% of participants had 24–38 months of total work experience in foodservice. Participants from various majors were represented in this study (hospitality management, culinary science, chemical engineering, history, and others). Most participants (68.8%) had received some sort of food safety training (ServSafe® or formal training from university dining), while six participants (31.2%) indicated they had not received any sort of formal food safety training but had viewed a PowerPoint™ presentation about safe food handling that all university dining foodservice workers were required to view at this institution.

Glove use knowledge

Glove use knowledge scores indicated that participants were knowledgeable about proper glove use behaviors (*Table 2*). All participants (100%) agreed that gloves can prevent contamination of food by hands. Twenty-five percent of participants indicated that gloves are more effective than handwashing to prevent contamination

from microorganisms, while 15.6% were unsure, indicating a lack of awareness about which method of food handling was safer. Some participants were of the opinion that gloves should be used when handling cash at the cash register (Yes = 12.5%; Don't Know = 6.2%), which is untrue, as this is not a requirement in the *Food Code (40)* and can result in food handlers touching food after handling the register with the same gloves. Only 78.1% of the participants agreed that using gloves can prevent allergen cross-contact. Around 71.9% considered it necessary to wear gloves when washing fruits and vegetables; this is not a requirement of the Food Code, and gloves can become uncomfortable to wear if water enters them. All participants (100%) agreed that gloves should be used when preparing raw fruits and vegetables, which is in accordance with the guidelines outlined in the *2005 Food Code (40)*.

Observed glove use practices

A summary of observed glove use practices is shown in *Table 3*. Glove use behaviors among employees varied and were not always in compliance with the requirements outlined in the *2005 Food Code (40)*. In the control group, when workers moved from handling one food item to another or handled multiple food items at the same time, gloves should have been changed 91 times but were changed only 38 times (Non-compliance = 58.2%). Cross contamination was the most frequent non-compliance behavior in both groups; in the control group, gloves should have been changed 348 times but were changed only 71 times (Non-compliance = 79.6%) and in the treatment group, non-compliance was 36.9%. Gloves should have been changed after coughing/sneezing one time, yet this was not done in the control group, but they were changed in the treatment group two of the three times they should have been. When raw meat and then RTE foods were handled, gloves were changed 9 of the 10 times they should have been by employees in the control (Non-compliance = 10.0%). However, slightly higher non-compliance was observed in the treatment group, as these staff did change gloves 9 of the 12 times they should have for this task (Non-compliance = 25.0%).

Employees in both the control and treatment groups changed gloves that were ripped/soiled/torn (20 of 21 times and 44 of 45 occasions, with non-compliance rates of 3.0 and 4.5%, respectively). Overall, glove use behaviors were higher among employees who received training about proper glove use. In the control group, it was observed that although gloves should have been changed a total of 474 times, they were changed only 140 times, for a non-compliance rate of 70.5%. Treatment group participants should have changed gloves 255 times, but did so 189 times, for a non-compliance rate of 25.9%. It was expected that the non-compliance would be much lower in the treatment group (less than 10.0%), but that was not the case. While these findings do suggest that the intervention flyer was effective in improving glove use behaviors, non-compliance is still a concern. York et al. (43) also found non-compliance with food safety practices both among foodservice workers who had received training and among those who did not receive any training, but a higher level of non-compliance was observed among those who had not received any training.

TABLE 1. Demographic characteristics of observed employees (N = 32)

CHARACTERISTICS	N	%
GENDER		
Male	12	37.5
Female	20	62.5
AGE		
18–20 years	7	25.0
21–25 years	24	68.8
26 years or older	1	6.3
ETHNICITY		
African-American/Black (Non-Hispanic origin)	3	12.5
Asian or Pacific Islander	12	25.0
Caucasian	16	56.3
Multi-racial	1	6.3
COLLEGE YEAR		
Sophomore	3	6.3
Junior	6	25.0
Senior	16	50.0
Graduate Student	6	18.8
CITIZENSHIP		
U.S.	21	75.0
International	11	25.0
WORK STATUS		
Part-time	30	87.5
Full-time	2	12.5
COMPLETED ANY FOOD SAFETY TRAINING		
Yes	26	68.8
No	6	31.3
WORK HOUR PER WEEK AT THIS FOODSERVICE FACILITY		
10–15	12	37.5
16–20	10	25.0
21–25	6	31.2
26 or more	4	6.3

TABLE 1. Demographic characteristics of observed employees (N = 32) (cont.)

CHARACTERISTICS	N	%
MONTHS EMPLOYED IN ALL FOODSERVICE		
11 or less	6	18.7
12–23	3	6.3
24–35	12	43.8
36–47	5	12.5
48 or more	6	18.7
MONTHS EMPLOYED IN THIS OPERATION		
11 or less	11	31.2
12–23	6	12.5
24–35	9	50.0
36 or more	6	6.3

TABLE 2. Glove-use knowledge scores of observed employees prior to intervention (N = 32)

ITEMS	%		
	YES	NO	DON'T KNOW
Gloves should be used when handling cash at the cash register	12.5	81.3 ^a	6.2
Gloves should be changed after 4 hours of working on the same task without interruptions	90.6 ^a	9.4	-
Gloves are more effective in preventing contamination from microorganisms than handwashing	25.0	59.4 ^a	15.6
Gloves should be changed before handling any foods that will not be cooked after touching	93.8 ^a	3.1	3.1
Use of gloves can prevent contamination of foods from hands	100.0 ^a	-	-
Gloved hands are viewed more favorably by customers than serving food with bare hands	96.9 ^a	3.1	-
Gloves should be changed if the gloves touch something other than food, even packages or refrigerator handles	93.8 ^a	6.2	-
Using gloves when handling foods can prevent allergen cross contact	78.1 ^a	15.6	6.3
Gloves need to be worn when washing fruits and vegetables	71.9	15.6 ^a	12.5
Gloves should be worn when preparing raw fruits and vegetables	100.0 ^a	-	-

^a indicates correct response

TABLE 3. Observed glove use practices among observed employees (N = 32)

TASK	GLOVE USE FREQUENCY			
	CONTROL ^a		TREATMENT ^a	
	A	B	A	B
Moving from one food item to another/handling multiple food items at the same time	91	38	25	22
After touching non-food surfaces	348	71	160	101
After coughing/sneezing	1	0	3	2
When handling Ready-to-Eat food	3	2	10	10
Handling raw meat and then handling Ready-to-Eat food	10	9	12	9
When gloves were ripped/torn/soiled	21	20	45	44
Total	474	140	255	189

^aGlove use behaviors as defined by the *2005 Food Code*

A = Number of times gloves should have been changed

B = Number of times gloves were changed

DISCUSSION

This study sought to gain insights into the glove use knowledge and behaviors of student foodservice employees working in university dining settings. Most participants represented in this study were under 25 years of age and were undergraduate or graduate students. This is not surprising, because this study was carried out in a university setting and targeted student foodservice workers; this sample reflects the demographics of today's workforce, in which 42.0% of the workers are under 25 years of age (39). Employees in this study had adequate knowledge about glove use, but observations of actual practices did not correlate with responses to knowledge questions. Previous research has shown that self-reported food safety practices (20, 30) or food safety knowledge (18, 28, 35, 36) does not always result in actual safe food handling practices. Hence, conducting observations to determine actual food safety practices is useful to gain a better picture of food handling among foodservice workers. Researchers have conducted observational research to assess food safety practices in restaurants and other retail foodservice settings (8, 10, 11, 16, 21, 38, 43). Observational studies of handwashing and glove use among foodservice workers have shown that actual practices were not in line with recommendations for food safety. Findings from this study show that glove use behaviors by

foodservice employees were not always in compliance with the 2005 *Food Code* guidelines.

Cross contamination, the most commonly observed violation, can result in microbial transfer to foods from other foods and/or non-food surfaces. Cross contamination was observed through contact between handling of multiple items with the same gloved hands and handling of food after touching non-food sources such as table surfaces, refrigerator door handles, and food packaging. Cross contamination has been identified as one of the top five reasons for foodborne illness (42). Findings from this study are similar to those reported by Strohhahn, Paez, Sneed & Meyer (37). While bare hand contact with RTE food was not a common practice in this study, employees in retail foodservice settings need to be aware that cooked food and RTE foods should not be handled with bare hands.

While over 90.0% of participants indicated correct knowledge to questions addressing bare hand contact and cross contamination, compliance of glove use behaviors was still lacking. While not tracked in this study, it was noted that compliance with recommended practices were higher when participants were not very busy and that higher rates of non-compliance were observed during increased customer

traffic. This barrier to practicing safe food handling behaviors has been noted by other researchers as well (2, 12). In addition, it was noted that inadequate/improper handwashing occurred before gloves were put on. This non-compliance could be because of the false sense of security that gloves provide; employees perceive there is a barrier between their hands and the food, not recognizing the food contact portion of the glove was contaminated by unclean hands as they were extracted from the package or as the workers put the gloves on. Montville, Chen and Schaffner (23) found that handwashing along with glove use was more effective in reducing cross contamination than just handwashing or glove use alone. In a study conducted by Chen, Jackson, Chea, and Schaffner (9), it was found that microbial transfer occurred when lettuce was handled after handling chicken, even though bare hands were washed, highlighting the need for glove use to provide an additional barrier between hands and food and prevent cross contamination, as handwashing may not completely eliminate microorganisms from hands. Participants in this study were aware that gloves should be changed before handling any foods that will not be cooked after touching (93.8%), but compliance was still not 100% in either the control (90.0%) or treatment groups (75.0%).

Green et al. (16) suggested reorganizing food preparation areas to reduce the need for frequent handwashing. In that study, the presence of a box of gloves close to the participant's workstation reduced non-compliance rates, which highlighted the need for providing foodservice workers the environment that encourages safe food handling behaviors. However, in this study, even when the participants had easy access to the box of gloves, non-compliance was observed (control group = 70.5%; treatment group = 25.9%). Because of the fast-paced nature of foodservice operations and the need for multi-tasking by a single individual to prepare a menu item, increases in non-compliance with food safety practices occurred even among the treatment group. Hence, it would be advisable for those in charge of retail foodservices to consider reconfiguration of work assignments, such as assigning specific tasks to individuals, to reduce the need for glove changes and thus reduce the chances of non-compliance. Those in charge of retail foodservices might also consider reorganization of workstations to ensure ready availability of hand hygiene supplies and access to handwashing facilities as additional strategies to reduce the possibility of causing illness.

Observations in this study were limited to 1 session per employee; thus, findings may be influenced by the Hawthorne effect. The Hawthorne effect describes positive behavioral results in intervention studies due to the awareness of being directly monitored (41). Because observations were conducted immediately after the intervention, additional observations of the same worker at a later date might have resulted in different findings; it is possible that after a certain point of time, the observers would have had no influence on the food handling behaviors of the participants because the participants had become habituated to their presence (44). York et al. (43) also observed that foodservice employees who received training and did not receive training had higher compliance with food safety practices during the first hour of observation than the last two hours of observation and concluded that observations should be conducted for more than one hour to obtain information about actual food handling behaviors and reduce the influence of socially desirable bias.

According to the U.S. Department of Labor (39), 42.0% of its workers are under age 25, and this demographic may prefer messages provided in a succinct manner more than do those belonging to older generations. The National Association of College and University Foodservices (25), the professional organization for college and university dining services, represents institutions that employ a wide age range of workers, as college student employees work alongside members of other generations. Most of the college student workers in this study were employed on an hourly and part-time basis. Given this scenario, it is reasonable to assume that over half of college and university dining employees are under the age of 25. Each academic season results in turnover, and the need to provide training efficiently and effectively to new student employees is critical. Thus, the intervention flyer that featured attributes appealing to Generation Y and New Millennials and that was presented using a social marketing approach was found to be effective as a training tool to positively influence proper glove use in this particular retail setting. Further work is needed to assess effectiveness of the intervention tool in other types of retail foodservices and among diverse work forces.

LIMITATIONS

One of the major challenges faced in this study was recruitment of participants. Some were hesitant to participate in this study because of discomfort with being observed and fear of possible impact on their employment status. Participants were assured that the results would be kept confidential and not be shared with their managers and that findings would be presented in summarized form only. Because of the dynamic nature of foodservice operations, some participants constantly switched tasks or food stations (i.e., handled food at a pizza station and then moved to the fried chicken station), which made accurate data collection very challenging. In addition, turnover occurred; of the 32 original participants, 3 were replaced, which impacted the data collection timeline.

Other limitations of this study were inherent to those associated with observational studies (3). Participants' glove use behaviors may have been influenced by the presence of the observers, as the participants' may have wanted to demonstrate behaviors that they knew to be correct. Efforts to mitigate the Hawthorne effect were made by researchers arriving at the location 30 minutes prior to the observation period and engaging in casual conversations with the participants, an approach that helped "break the ice" and develop comfort with the observers. Future research could also begin the observations by interacting with the audience and performing "mock" observations so that the participants are not uncomfortable by the presence of the observers. While the observers used the glove use observational tool, it was difficult to note all glove use behaviors because of the fast-paced nature of foodservice operations and the need for multi-tasking. Future observational studies could employ two observers to record behaviors for the same individual to ensure accurate data collection. In addition, a longer period of observation might mitigate these limitations.

CONCLUSIONS

This study provided evidence of knowledge about proper glove use and non-compliance of glove use behaviors among university foodservice student workers who received an intervention flyer entitled *I'm Gloving It*. While compliance with glove use behaviors was higher during the initial phase of the observation period and for certain tasks where high knowledge was noted, rates of non-compliance were high for other tasks were high, such as changing gloves after touching non-food surfaces. Compliance decreased during high customer traffic. Non-compliance with safe food handling practices can be addressed by provision of training, active managerial control, providing easy access to gloves, verbal reminders, non-verbal reminders (posters, easy-to-read visuals) in strategic locations within the foodservice establishment, and rewards for safe food handling to improve compliance rates. In this study, a short training session, which included an intervention tool of a flyer using a social marketing

approach in messaging proper glove use, appeared to be effective in that it resulted in higher overall compliance rates (70.5% versus 25.9%). Use of non-verbal reminders may be suited for younger foodservice workers, as it serves as an innovative and quick tool to convey critical food safety information. Posting of these flyers could serve as reminders of best practice and help instill a culture of safe food handling. Development of similar food safety messaging tools to address other high-risk practices that contribute to foodborne illness will be useful for training as new generation and more diverse workers enter the workforce.

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