

# Factors Impacting Food Workers' and Managers' Safe Food Preparation Practices: A Qualitative Study

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## SUMMARY

This study collected data on food workers' self-reported food safety practices and beliefs about factors that impacted their ability to prepare food safely. Eleven focus groups were conducted with food service workers and managers in which they discussed their current implementation of seven food preparation practices (handwashing, hot holding, etc.), and the factors they believed impacted their safe implementation of those practices. Some participants reported unsafe food preparation practices, such as inappropriate glove use and not checking the temperatures of cooked, reheated, and cooled foods. Most participants, however, reported safe practices (e.g., washing their hands after preparing raw meat). Participants identified a number of factors that impacted their ability to prepare food safely, including time pressure; structural environments, equipment, and resources; management and coworker emphasis on food safety; worker characteristics; negative consequences for those who do not prepare food safely; food safety education and training; restaurant procedures; and glove and sanitizer use. Results suggest that food safety programs need to address the full range of factors that impact food preparation behaviors.

## INTRODUCTION

Epidemiological research has indicated that the majority of reported foodborne illness outbreaks originate in food service establishments (15, 23), and case control studies have shown that eating meals outside the home is a risk factor for obtaining a foodborne illness (11, 16, 17, 19, 27). In addition, research on foodborne illness risk factors has indicated that most outbreaks associated with food service establishments can be attributed to food workers' improper food preparation practices (1), and observation studies have revealed that food workers frequently engage in unsafe food preparation practices (4, 14, 20). These findings indicate that improvement of restaurant workers' food preparation practices is needed to reduce the incidence of foodborne illness. Food worker intervention programs are needed to effect this improvement. However, health researchers have argued that an understanding of current practices and factors affecting those practices is necessary before behavior change efforts can be successful (7, 10).

In an effort to contribute to our understanding of food workers' food preparation behavior, the Environmental Health Specialists Network (EHS-Net) conducted this study on food workers' and managers' food safety practices. EHS-Net is a

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**TABLE I. Recommended food preparation practices discussed by participants<sup>1</sup>**

<b>Food Preparation Practice</b>	<b>Recommendation</b>
Handwashing	Food handlers should wash their hands frequently. For example, they should wash their hands after they use the restroom, before preparing food, and after they have handled raw meat or poultry.
Cross contamination prevention	Cross contamination from raw meat and poultry to other types of food should be prevented. Table tops, equipment, and utensils should be washed, rinsed, and sanitized after they have come into contact with raw meat and before they are used for anything else.
Glove use	To minimize hand-food contact, gloves should be worn when handling ready-to-eat food or raw food with your hands.
Determining food doneness	When cooking raw meat or poultry, a thermometer should be used to check that these foods have reached recommended temperatures at the end of the cooking process.
Holding	Hot foods should be held at 140 degrees or above, and cold foods should be held at 41 degrees or below. Additionally, the temperatures of held food should be checked periodically to ensure that the foods are being held at safe temperatures.
Cooling	Hot foods should be cooled from 140 degrees to 70 degrees within two hours and from 70 degrees to 41 degrees within four hours. The temperatures of cooling food should be checked periodically to ensure that the foods are being held at safe temperatures.
Reheating	Reheated food (food that has been previously cooked in the establishment and is being reheated for service) should be reheated to 165 degrees or higher. The temperature of reheated food should be checked at the end of the reheating process to ensure that the food reaches 165 degrees.

<sup>1</sup>Participants were asked to discuss the factors impacting their ability to implement these recommended food preparation practices.

network of epidemiologists and environmental health specialists from the Centers for Disease Control and Prevention (CDC), the US Food and Drug Administration (FDA), the US Department of Agriculture (USDA), and eight state public health agencies (in California, Colorado, Connecticut, Georgia, Minnesota, New York, Oregon, and Tennessee) that focuses on the investigation of environmental antecedents of foodborne illness. In this study, data were collected from food workers on their food safety practices and beliefs about the factors that impact their ability to prepare food safely. Focus groups were used to collect the data because they supply descriptive, qualitative data that can be difficult to acquire through other research methods.

## **MATERIALS AND METHODS**

Eleven focus groups were conducted with food service workers and managers from restaurants in the eight EHS-Net

states. Five groups were conducted with English-speaking food workers, four groups were conducted with English-speaking managers, and two groups were conducted in Spanish with workers whose primary language was Spanish. Twenty-six managers and 30 workers participated in the English-speaking focus groups; 14 workers participated in the Spanish-speaking groups. The focus groups were conducted through telephone conference calls, as they have been found to be effective in collecting information from participants who are difficult to recruit or who are scattered geographically (12, 26), as the participants of this study were. Evidence suggests that, compared with face-to-face focus groups, telephone focus groups generate as much information and provide more anonymity for participants (26).

To obtain participants, recruiters called restaurants randomly selected from purchased business lists to request participation from a kitchen worker or man-

ager. To be eligible for participation, workers had to have worked in a restaurant kitchen for at least three months and managers had to have worked as a kitchen manager for at least three months. Because of initial difficulty in recruiting Spanish-speaking participants, recruitment for Spanish-speaking participants was limited to areas within the EHS-Net states with relatively high proportions of Hispanic populations. Study participants received an incentive of 60 dollars for their participation.

Each focus group consisted of 4 to 8 participants who responded to questions posed by a group moderator. Participants discussed seven food preparation practices—handwashing, prevention of cross contamination, glove use, determining food doneness, hot and cold holding, cooling, and reheating. These practices were chosen for discussion because their improper implementation has been associated with foodborne illness in food service establishments (1, 9). In the worker

**TABLE 2. Practices described by worker participants**

Practice	Number of groups <sup>a</sup>	Practice	Number of groups <sup>a</sup>
<b>Handwashing</b>	<b>7</b>	<b>Determining food doneness</b>	<b>6</b>
Wash hands after visiting restroom	7	Use thermometer	6
Wash hands before preparing food	7	Use length of time cooking	6
Wash hands before preparing raw meat/poultry	7	Use appearance of food	3
Wash hands when changing tasks	7	Use feel of food	3
Wash hands periodically	7	Use thermometer with certain foods	2
Wash hands before putting on gloves/when changing gloves	4	Use thermometer when inexperienced/working with new food	2
Wash hands after handling money	4	<b>Holding</b>	<b>5</b>
Wash hands after sneezing/coughing	4	Use steam tables	4
Wash hands after eating/drinking	3	Use walk-in coolers	4
Wash hands after taking a break	3	Use sandwich/preparation tables	3
Wash hands after touching face, hair, or clothes	3	Use salad bars	2
Use sanitizer	5	Check temperatures of held foods	3
<b>Cross contamination prevention</b>	<b>7</b>	Record temperatures in temperature logs	3
Clean and sanitize work surfaces, utensils, equipment	7	Managers check/record temperatures	2
Sanitize (but not clean and rinse) work surfaces, utensils, equipment	3	Set shelf life for held food	3
Use gloves or utensils to prevent bare hand contact	6	Throw away foods held at improper time/temperature	3
Keep raw meat/poultry separate from other foods with separate storage areas	6	Stir held foods	2
Keep raw meat/poultry separate from other foods during preparation with separate work areas/surfaces	5	Cover held foods	2
Wash hands after preparing raw meat/poultry	5	<b>Cooling</b>	<b>5</b>
Use stainless steel equipment	2	Place cooling food in walk-in coolers	5
Work only with raw meat/poultry until task is complete	2	Place cooling food in shallow or small pans	4
Flip cutting boards after using one side	1	Use ice baths	4
<b>Glove use</b>	<b>7</b>	Use cooling wands/paddles	2
Wear gloves when in the kitchen or preparing food	6	Use blast chiller	1
Wear gloves when preparing raw meat/poultry	6	Check temperatures of cooling food	5
Wear gloves when hands have cuts or scratches	2	Do not check temperatures of cooling food	5
Wear gloves when preparing food don't want to touch directly	2	Record temperatures in temperature logs	2
Wash hands with every glove change	5	Follow improper cooling practices	4
Change gloves when changing tasks or products	5	<b>Reheating</b>	<b>3</b>
Change gloves after preparing raw meat/poultry	3	Reheat food prior to placing in holding	2
Change gloves when damaged or dirty	2	Do not reheat prior to placing in holding	2
Change gloves periodically	2	Discard foods rather than reheat/Reheat only once	2
Do not wear gloves	5	Check the temperatures of reheated foods	3
Do not wear gloves when cutting food	2	Record temperatures in temperature logs	1
Use gloves improperly	2	Have only experienced workers reheat	1

The numbers in bold in this column (column entitled 'Number of Groups') represent the number of groups in which participants were asked to discuss the topic (e.g., Handwashing, Glove Use). The non-bolded numbers in this column represent the number of groups in which the practice was mentioned by at least one participant.

groups, participants first discussed their current implementation of these seven practices and then discussed the factors that influenced their ability to engage in these practices according to recommendations. (These recommendations are based on FDA's 2001 Food Code [9] and are presented in Table 1). For example, participants were asked to describe when they washed their hands while at work. After this discussion, the moderator read the recommendations concerning handwashing, and participants were then asked to discuss what made it easier or more difficult for them to wash their hands according to the recommendations. In the manager groups, participants were not asked to discuss their current food preparation practices because of concerns about their willingness to discuss unsafe practices. Thus, managers discussed only factors that influenced their and their workers' ability to implement recommended practices. The focus group questions and recommendations were derived in part

from questions developed by Kendall, Melcher, and Paul (18).

Each focus group discussion was taped and transcribed. We systematically reviewed these transcripts and identified and categorized common themes among the responses.

This study was approved by CDC's Institutional Review Board (protocol # 3773).

## RESULTS

Described in this section are the themes identified in the workers' discussions of their current food preparation practices and in the workers' and managers' discussions of the factors that influenced their ability to engage in these practices according to recommendations. These themes are also presented in Tables 2 and 3 along with the number of groups that discussed each theme. The findings for all groups (English and Spanish-speaking worker groups and manager groups)

are discussed together. The practices of determining food doneness, holding, reheating, and cooling were not discussed in every focus group, either because time constraints prevented a topic from being discussed or because participants were unfamiliar with the practice (e.g., participants did not work in a restaurant that engaged in the practice or did not have responsibilities pertaining to the practice).

### Handwashing practices

When asked to describe when they washed their hands at work, some workers in every group said they washed their hands after visiting the restroom, before preparing food in general and raw meat or poultry specifically, and when they changed tasks, work stations, or items they were handling (e.g., changing from handling money to food) (Table 2). Some workers in every group also said they washed their hands periodically, either because their hands felt dirty, or because

**TABLE 3. Factors impacting food preparation practices discussed by worker and manager participants**

Factors impacting:	Number of groups <sup>1</sup>			Factors impacting:	Number of groups <sup>1</sup>		
	Workers	Managers	Total		Workers	Managers	Total
<b>Handwashing</b>	<b>7</b>	<b>4</b>	<b>11</b>	<b>Glove use (Continued)</b>	<b>7</b>	<b>4</b>	<b>11</b>
Sink accessibility	5	4	9	Adequate resources (e.g., gloves)	1	1	2
Time pressure/high volume of business/staffing	4	4	8	Time pressure/high volume of business/staffing	1	1	2
Management emphasis	4	4	8	Worker motivation/experience/age	1	0	1
Negative consequences	5	2	7	Coworker emphasis	1	0	1
Sanitizer use	3	3	6	<b>Use of thermometer for food doneness</b>	<b>7</b>	<b>4</b>	<b>11</b>
Glove use	2	3	5	Time pressure/high volume of business/staffing	4	3	7
Restaurant procedures	3	2	5	Type of meat	3	3	6
Worker motivation/experience/age	2	2	4	Restaurant procedures	3	2	5
Expectations of reciprocal treatment	3	1	4	Worker motivation/experience/age	3	1	4
Personal preferences	3	0	3	Health regulations and inspections	0	3	3
Food safety education and training	1	2	3	Thermometer sanitation	2	1	3
Coworker emphasis	2	1	3	Thermometer type	0	2	2
Concern with sanitary appearance	1	1	2	<b>Holding</b>	<b>5</b>	<b>4</b>	<b>9</b>
Effect on hands	0	2	2	Equipment/thermometers	3	4	7
Adequate resources (e.g., soap)	1	0	1	Management emphasis	3	2	5
<b>Cross contamination prevention</b>	<b>7</b>	<b>4</b>	<b>11</b>	Food safety education and training	2	2	4
Multiple, color-coded cutting boards	5	3	8	Time pressure/high volume of business/staffing	2	2	4
Glove and utensil use	6	2	8	Restaurant procedures	0	3	3
Sanitizer use	4	2	6	Negative consequences	0	2	2
Separation of work areas/tasks	3	3	6	Worker motivation/experience/age	1	0	1
Management emphasis	3	2	5	Space	0	1	1
Food safety education and training	2	2	4	Hours of operation	0	1	1
Time pressure/high volume of business/staffing	1	3	4	Quality of food	0	1	1
Pre-cooked or prepared meat	3	1	3	<b>Cooling</b>	<b>5</b>	<b>3</b>	<b>8</b>
Negative consequences	2	1	3	Time at which cooling occurs	2	2	4
Coworker emphasis	1	0	1	Worker motivation/experience/age	2	0	2
Language differences	0	1	1	Equipment/thermometers	2	0	2
<b>Glove use</b>	<b>7</b>	<b>4</b>	<b>11</b>	Management emphasis	0	2	2
Manager emphasis/requirement	5	2	7	Space	0	2	2
Negative consequences	4	2	6	Time pressure/high volume of business/staffing	1	0	1
Comfort and fit of gloves	4	2	6	<b>Reheating</b>	<b>3</b>	<b>3</b>	<b>6</b>
Type of work	2	3	5	Food safety education and training	2	1	3
Personal preferences	4	1	5	Thermometers	2	0	2
Allergies to glove materials	2	3	5	Time pressure/high volume of business/staffing	0	1	1
Concern about sanitary appearance	3	0	2				

<sup>1</sup>The numbers in bold in this column ('Number of Groups') represent the number of groups in which participants were asked to discuss the topic (e.g., Handwashing, Glove Use). The non-bolded numbers in this column represent the number of groups in which the factor was mentioned by at least one participant.

of a restaurant process that required handwashing (e.g., a bell rings every hour signifying that workers must wash their hands). To a lesser extent, workers also said they washed their hands before putting on gloves or when changing their gloves, and after handling money, sneezing or coughing, eating or drinking, taking a break, or touching their face, hair, or clothes. Workers also said they cleaned their hands with bottled hand sanitizer or cloths stored in sanitizer buckets.

**Factors impacting handwashing practices**

Workers and managers most frequently identified sink accessibility as a factor that impacted the ability to wash hands as recommended (Table 3). Some participants in all groups said that having too few sinks or sinks inconvenient

to the work area were barriers to handwashing, particularly when workers were experiencing time pressure. Time pressure, because of high volumes of business or inadequate staffing, was also frequently mentioned as a factor that negatively impacted proper handwashing. Participants indicated that they were not able to take the time to wash their hands when they had a large number of orders to prepare (e.g., “When your place is booming...only thing they’re worried about is those customers getting their food”).

Participants identified several factors they believed impacted handwashing positively. They said management and coworker emphasis on and attention to proper handwashing was a facilitator of handwashing (e.g., “If I forget to wash my hands, my supervisor speaks up.”). Negative consequences for improper

handwashing was also discussed as a handwashing facilitator (e.g., workers getting reprimanded or fired; customers getting sick). Other positive factors included restaurant procedures that encouraged handwashing (e.g., a bell rings every hour signifying that workers must wash their hands; logs in which workers were required to record every handwashing); worker motivation and food preparation experience (often associated with age, according to participants); expectations of reciprocal treatment from other food workers (e.g., “If I expect that of somebody else, I expect that of myself”); personal preferences for clean hands; food safety education and training on proper handwashing practices and their importance; concerns about appearing sanitary to customers (particularly in kitchens where workers can be seen by customers); and adequate re-

sources (e.g., soap). A few participants indicated that frequent handwashing sometimes made hands chapped and raw, which they believed could be a barrier to handwashing.

Some participants discussed sanitizer as a facilitator of clean hands. These participants said they sometimes used sanitizer in situations in which they did not feel they had the time to stop and wash their hands. Some workers said the use of sanitizer in place of handwashing was acceptable only in some situations (e.g., acceptable after making a sandwich but not after preparing raw meat). Even though these participants typically discussed sanitizer positively, comments suggested that sanitizer may actually negatively impact handwashing, as some participants seemed to be using sanitizer instead of washing their hands. Similarly, some participants said they used gloves to ensure the cleanliness of their hands. However, other participants expressed concern that glove use was a barrier to handwashing. These participants said that compared to workers who did not use gloves, some workers who used gloves washed their hands less, perhaps because they assumed that they did not need to wash their hands if they wore gloves.

### **Cross-contamination prevention practices**

When asked to describe how they handled raw meat or poultry, participants described several different cross-contamination prevention practices (Table 2). Workers in all groups said they cleaned and/or sanitized their work surfaces, utensils, and equipment after preparing raw meat or poultry. Some said they cleaned and sanitized; however, some participants' comments indicated that although they wiped their work surfaces with a sanitizer, they did not clean and rinse those surfaces first (e.g., "Every time you put raw meat on there [your work surface], you should wipe it down with a clean towel [from your sanitizer bucket]").

Workers said they used gloves and utensils to prevent bare hand contact with raw meat and poultry and kept raw meat and poultry separate from other foods or from other types of raw meat and poultry during storage and preparation. Workers mentioned two methods for keeping these foods separate during preparation: separate work areas (e.g., meat is cut in the cooler, vegetables are cut elsewhere); and separate work surfaces, examples of which typically included color-coded cutting boards for use with different kinds of food

(e.g., green boards for vegetables, yellow boards for chicken). Workers also said they washed their hands after preparing raw meat or poultry. Some workers reported using stainless steel bowls and work surfaces when working with raw meat or poultry, and a few said that when working with raw meat or poultry, they did nothing else until they completed the task. Finally, a few workers said that after getting one side of the cutting board dirty, they flipped the board over to its other side rather than cleaning it or getting a new one.

### **Factors impacting cross-contamination prevention practices**

When asked what factors impacted their ability to engage in practices to prevent cross contamination from raw meat and poultry to other foods, participants most frequently identified multiple color-coded cutting boards as a positive factor (Table 3). Multiple boards helped ensure that workers could get clean boards when they needed them, as opposed to re-using dirty boards, and color-coded boards helped ensure that workers used different boards for foods that needed to be kept separated. The use of gloves and utensils with raw meat or poultry was also mentioned as a facilitator of cross-contamination prevention. However, as with handwashing, some participants expressed concern that glove use could act as a barrier to cross-contamination prevention because glove wearers may not wash their hands as often as they should. Participants in most groups also said that using sanitizer (e.g., "bleach water") was a facilitator of cross-contamination prevention because it allowed them to sanitize their equipment (e.g., knives, cutting boards) quickly.

Other identified facilitators of cross-contamination prevention included: separation of work areas and tasks, to ensure that raw meat or poultry and other foods are kept apart; management and coworker emphasis on and attention to cross-contamination prevention (e.g., "We look out for each other, and we say things to each other if it's not being done"); food safety education and training on cross-contamination prevention and its importance (e.g., "If they don't know the reason why, they'll keep doing it"); pre-cooked or prepared meat, which allows minimal meat preparation; and negative consequences for lack of cross-contamination prevention (e.g., restaurant receiving violations; employee getting fined). Time pressure and language differences between managers

and workers (e.g., "Sometimes it's just really hard to relay the facts") were identified by some participants as barriers to cross-contamination prevention.

### **Glove use practices**

When asked when they used and changed gloves at work, workers in six groups said they wore gloves when in the kitchen or preparing food and when they worked with raw meat or poultry (Table 2). To a lesser extent, workers also said they wore gloves when they had cuts on their hands and when preparing food that they did not want to touch directly (e.g., food to which they had allergies or would make their hands smell). Some workers said they washed their hands with every glove change, and changed their gloves when they changed tasks or products (e.g., changing from making one sandwich to another), after preparing raw meat or poultry, and when their gloves were damaged or dirty. Several workers made comments that suggested their glove changing was not necessarily based on their food preparation activity; rather, they simply changed their gloves periodically throughout their shift. A few workers said they did not wear gloves at all (some of these said they used tongs or tissue paper when preparing some foods), and several workers said they did not use gloves when cutting food because gloves made the task more difficult. A few workers described unsafe glove practices, such as changing gloves without washing hands and washing hands with gloves on.

### **Factors impacting glove use practices**

Workers and managers identified several factors that positively impacted glove use when handling raw or ready-to-eat food (Table 3). These factors included management and coworker emphasis on and attention to glove use (including glove use requirements and managers wearing gloves appropriately as a model for proper glove use); negative consequences for not wearing gloves (e.g., workers getting suspended from work); personal preferences; allergies to glove materials; concerns about appearing sanitary to customers; adequate resources (e.g., gloves); and worker motivation and experience.

Participants said gloves were often uncomfortable or did not fit well, which they believed negatively impacted glove use. The type of work was also mentioned

as a factor that impacted glove use, as participants believed that gloves made some work more difficult. For example, participants said gloves interfered with cutting foods (because the gloves got in the way of the knife) and checking the doneness of meat with a finger. Time pressure was also mentioned as a barrier to glove use.

### **Determining food doneness practices**

Although some workers in all six groups that discussed determining food doneness practices said they sometimes used thermometers to check the temperatures of some cooked foods, many felt they did not need to use a thermometer because they had learned through experience to determine doneness by how long food cooked, the appearance of the food, and/or the feel of the food (Table 2). Workers were more likely to say they used thermometers with some types of food than with others (e.g., seafood versus steak; larger pieces of meat versus smaller pieces). Comments also suggested that those employees working with new foods, who were inexperienced, or who were training inexperienced workers were more likely to use thermometers.

### **Factors impacting determining food doneness practices**

When asked what factors impacted their use of thermometers to determine the doneness of cooked meat and poultry, workers and managers most frequently mentioned time pressure (Table 3). Participants said taking the temperature of every piece of meat would be too time consuming and possible only with additional staff. Participants also said the type of meat impacted the difficulty of checking temperatures with a thermometer; they believed it was easier and took less time to check the temperatures of some foods (e.g., large pieces of meat) than others (e.g., hamburgers). Restaurant processes such as temperature logs were seen as facilitators of using a thermometer to check temperatures, as were health regulations and inspections, as temperature logs were kept as documentation for health inspections. Worker experience was also identified as a factor that impacted thermometer use—participants said experienced staff did not need to check temperatures because their experience allowed them to use other factors (e.g., appearance and feel of food; length of cooking time) to determine when food was done. One participant said that check-

ing temperatures may be more likely with “fast” thermometers (e.g., infrared thermometers) than with other thermometers. Finally, a few workers said having to sanitize the thermometer between each use was a barrier to temperature checking.

### **Holding practices**

Participants indicated that holding of hot foods occurred in steam tables, and holding of cold foods occurred in walk-in coolers, in sandwich or preparation tables where food is kept in stainless steel inserts in the top of a table and cooled from below, or in salad bars where food items are set in ice that is kept cool from below (Table 2). Most workers said they periodically checked the temperatures of held food, although there was variation in how often temperatures were checked (from “every half-hour to hour” to every shift change). Temperatures were checked with probe thermometers or with thermometers built in to equipment that display the temperature continuously. Several workers said their restaurants used temperature logs to record temperatures of held food every time they were checked. Comments from participants suggested that managers were more likely to check and record temperatures than were workers. Some workers mentioned that they had “shelf lives” for products that were being held (e.g., two or three hours), particularly during busy times when holding lids were likely to be open for long periods of time. Others said they threw away food that had not been held at appropriate temperatures or was held too long. Some workers also indicated that they periodically stirred foods that were being held hot to ensure even temperatures, and kept held foods covered as much as possible.

### **Factors impacting holding practices**

Equipment was the most frequently mentioned factor impacting managers’ and workers’ ability to hold food at the proper temperatures and to check those temperatures periodically (Table 3). Workers and managers said that equipment problems, such as malfunctioning refrigerator blowers and heating elements, were barriers to proper holding, while properly maintained equipment and special kinds of equipment were facilitators of proper holding. Such equipment included hot-holding equipment that notified workers whenever the temperature drops below a set point and “ice blankets” that are placed on

top of cold-held food during busy times when lids were open. Participants also said having an adequate number of thermometers for checking temperatures was important. Other factors believed to positively impact proper holding included: management emphasis on and attention to proper holding (e.g., “[when it’s busy], ‘...the manager has got to remember to come back and grab them [temperatures]’”; food safety education and training; restaurant procedures (e.g., temperature logs); negative consequences for improper holding (e.g., being required by health inspector to throw out costly food because it was held improperly); worker motivation and experience; adequate space for all foods that need to be held (e.g., “He’s got limited space in his steam table, he will start jockeying things...to put something that he feels is more important to have hot”); and hours of operation that allow restaurants to close between lunch and dinner to check holding temperatures. Identified barriers to proper holding included time pressure and high volumes of business, which cause frequent opening of lids and doors of the holding equipment, and concerns regarding reduced quality of food (e.g., a small amount of hot-held cream soup easily burns).

### **Cooling practices**

Workers in most groups that discussed cooling described the following practices: placing cooling food in walk-in coolers; transferring cooling food to shallow or smaller pans; and using ice baths (Table 2). A few workers indicated that they used cooling wands or paddles to cool food, and one worker indicated that his establishment used a blast chiller to cool food. Some workers said they checked the temperatures of cooling foods and recorded them in a temperature log. However, at least some workers in each group said they did not take the temperatures of cooling foods, and some workers reported other unsafe practices, such as leaving cooling food out on counters and only checking the temperature of cooling food the morning after the food had been placed in a walk-in cooler.

### **Factors impacting cooling practices**

Workers and managers most frequently said the time at which cooling occurs, usually closing, was a barrier to proper cooling, as workers often did not take the time to cool properly (Table 3).

**TABLE 4. Factors impacting safe food preparation practices discussed by worker and manager participants**

Factor	Hand-washing	Cross contam.	Glove use	Food doneness	Holding	Cooling	Reheating
Time pressure/high volume of business/staffing	✓	✓	✓	✓	✓	✓	✓
Structural environment, equipment, resources	✓	✓	✓	✓	✓	✓	✓
Management/coworker emphasis	✓	✓	✓		✓	✓	
Worker characteristics	✓		✓	✓	✓	✓	
Negative consequences	✓	✓	✓		✓		
Education and training	✓	✓			✓		✓
Restaurant procedures	✓			✓	✓		
Gloves and sanitizers	✓	✓					

Note: A check mark indicates that the factor was mentioned by participants in discussions of that practice.

Similarly, a few participants said that time pressure caused by high volumes of business was a barrier to proper cooling. One worker believed that additional staff that could be responsible for cooling during busy times would help alleviate this problem. Facilitators of proper cooling described by participants included worker motivation, availability of thermometers and equipment such as cooling wands, management emphasis on and attention to proper cooling, and adequate space for cooling equipment, (e.g., space for multiple, shallow containers and quick chill equipment).

### Reheating practices

Several workers said they reheated food prior to placing it in hot holding, although one participant said workers in his establishment sometimes place food directly on the steam table without first reheating it to the proper temperature on the stove. Some participants indicated that their practice was to discard left-over food rather than reheat it or to reheat left-over food only once. Most, but not all, workers said they checked the temperatures of reheated food (Table 2), and some said they recorded temperatures of reheated food in temperature logs. One worker indicated that inexperienced workers were not responsible for reheating—only he and his manager reheated food.

### Factors impacting reheating practices

Workers and managers identified few factors during the discussions on reheating (Table 3). However, participants did say that food safety education and training were important for safe reheating practices, as were thermometers. A few also said time pressure could be a barrier because reheating can be time consuming and workers may take shortcuts.

### Consistencies in factors impacting practices

There are a number of consistencies in the factors participants identified as impacting their safe food preparation practices. Eight factors were mentioned in the context of two or more food preparation practices, and these factors are discussed below and presented in Table 4.

- *Time pressure/high volume of business/staffing.* The issue of time pressure was mentioned in the discussions of all seven food preparation practices. Participants said time pressure caused by high volumes of business and/or inadequate staffing made it difficult for them to wash their hands, change their gloves, clean their cutting boards, check the temperatures

of cooked and held food, and cool and reheat foods properly.

- *Structural environment, equipment, and resources.* Issues associated with the structural environment of the restaurant kitchen, equipment, and resources arose in the discussions of all seven practices. Participants said accessible sinks and adequate resources, such as soap and gloves, facilitated handwashing and glove use; multiple color-coded cutting boards and separate work areas for different types of food helped prevent cross contamination; and multiple thermometers, well-maintained equipment, and certain kinds of equipment (e.g., blast chillers and infrared thermometers) facilitated temperature control. Not having enough workspace, however, made cooling and holding foods at proper temperatures difficult.
- *Management/coworker emphasis.* Management and coworker emphasis on safe food preparation practices was discussed in relation to five food preparation practices. Participants said having managers and coworkers who emphasized safe food preparation and who paid at-

tention to others' food preparation practices facilitated food safety.

- *Worker characteristics.* Participants identified several characteristics of food workers that positively impacted five practices. These included experience, motivation, age, preferences for clean hands, concerns about appearing sanitary to customers, and expectations of reciprocal treatment from other food workers. A few said allergies to glove materials negatively impacted glove use practices.
- *Negative consequences.* In discussions of four practices, participants said workers were more likely to engage in safe practices when they knew there would be negative consequences if they did not. These negative consequences could be for workers, for the restaurants, or for the restaurants' customers.
- *Education and training.* Participants indicated in the discussions of four practices that they thought food safety education and training was important to safe food preparation. Several participants emphasized that workers should be taught *why* engaging in safe food preparation practices was important, not just how to engage in those practices.
- *Restaurant procedures.* In discussions of three practices, participants' comments suggested that some restaurant procedures facilitated safe food preparation. For example, some restaurants required workers to record handwashing activities and food temperatures in logs.
- *Gloves and sanitizers.* Some participants believed that gloves and sanitizers facilitated food safety because their use helped to prevent cross contamination and keep hands clean. However, comments indicated that use of these sanitary supplements may sometimes have a negative impact on food safety. For example, some participants said they sanitized their cutting boards without first cleaning them and used sanitizer instead of washing their hands, and

some participants expressed concern that glove use actually lowered handwashing rates because some workers used gloves incorrectly.

## DISCUSSION

Some food workers in this study reported unsafe food preparation practices. A few workers reported unsafe hand hygiene practices, such as not washing their hands when changing gloves and using sanitizers instead of washing their hands. Several workers said they sanitized but did not wash and rinse their equipment after working with raw meat and did not check the temperature of all the meat they cooked because they believed they could determine food doneness through other methods (e.g., appearance and feel of the food). Others said they did not check the temperature of food being reheated or cooled. Most workers, however, reported safe food preparation practices. For example, workers described a variety of situations in which they washed their hands and changed their gloves, and said they cleaned their work surfaces and equipment after preparing raw meat or poultry and checked the temperatures of held food. These findings indicate that our participants were aware of and engaged in multiple food safety practices.

Previous research, however, suggests that food workers (and consumers) report engaging in food safety practices more frequently than they actually engage in those practices (20, 24, 25). This phenomenon is likely the result of the social desirability bias, which is the tendency for people to report greater levels of socially desirable behavior (such as safe food preparation practices) than they actually engage in, or to report their best behavior rather than their typical or worst behavior. Although it is not possible to determine the extent to which our participants over-reported their safe food preparation practices, it is likely that they do not engage in these practices as frequently as they have reported.

Participants in this study identified a number of factors that impacted their ability to engage in safe food preparation practices. Time pressure and structural environments, including equipment and resources, were the two most consistently identified factors. Participants said time pressure had a negative impact on safe food preparation while structural environments, equipment, and resources supportive of food safety (e.g., accessible sinks, sufficient space for food safety procedures,

multiple cutting boards, equipment that facilitated food safety, availability of soap and gloves) had a positive impact on safe food preparation. Other factors consistently identified by workers as having positive impacts on safe food preparation included managers and coworkers who emphasized food safety; worker characteristics, such as age, experience, and preferences for clean hands; negative consequences for those who do not handle food safely; food safety education and training; and restaurant procedures that encouraged food safety. Participants also identified glove and sanitizer use as factors influencing safe food preparation practices. Although some participants believed that these sanitary supplements had a positive influence, other participants indicated that these supplements could have a negative influence if used incorrectly.

The few other studies on this topic have reported similar findings. Kendall, Melcher, and Paul's (18) and Clayton and Griffith's (3) studies with food workers identified several of the same barriers and facilitators reported here, including time shortages, inadequate staffing, education and training, sink accessibility, availability of properly working equipment, and management concern for and attention to food safety.

Many of these factors are heavily influenced by management. For example, although managers may not be able to control the customer "rushes" that often result in time pressure, managers can emphasize the importance of food safety over speed and attempt to ensure that staffing is adequate to meet the demand. Additionally, managers often directly impact whether workers have the equipment needed to prepare food safely; there are negative consequences for workers for unsafe food preparation practices; food safety training is provided to workers; and restaurant procedures support food safety. The findings reported here suggest that management plays a significant role in the extent to which food workers engage in safe food preparation practices. The findings also support FDA's contention that active managerial control – implementation and supervision of food safety practices by the person-in-charge — is important to food safety (8) and suggest that future food safety initiatives should ensure a significant focus on management and active managerial control.

Although the findings presented here suggest that a variety of factors impact safe food preparation practices, many of the current efforts in food safety are fo-



cused primarily on one factor—education. The findings from this study and others (5, 21) indicate that education is important for food safety. However, our results also suggest that providing food safety education to food workers is not enough to ensure that they will handle food safely, as a number of factors may impact their ability to implement that education. Other research supports this implication. Several studies have found that even when food workers demonstrate knowledge of safe food preparation practices, they do not always engage in those practices (2, 3, 14, 20). In order to be successful, food safety intervention programs must do more than provide food safety training; they must also address the full range of factors that impact food preparation behaviors. Other researchers have made similar arguments; for example, Clayton and Griffith (3) argued that programs designed to increase safe food preparation practices will be effective only if the resources and management systems are in place to enable and encourage food workers to implement those practices. Ehiri and Morris argued that food safety training would be more effective if it were founded on “principles which take into account employee motivations and other resource and environmental constraints...” (6).

Participants’ mixed beliefs concerning the influence of glove use on food safety reflects the ongoing glove use debate among food safety regulators, researchers, and industry representatives. Research indicates that proper glove use can decrease the transfer of pathogens from hands to food (22). However, there is also evidence that glove use may promote poor handwashing practices (12). More research is needed to determine the relationship between glove use, contamination, and handwashing.

The results presented here are qualitative and should not be generalized to a larger population in any statistical sense. However, these results can be useful for guiding future work in food safety. For example, future research might focus on determining which of the factors identified in this study have the greatest impact on food preparation practices.

The findings in this study have implications for food safety programs. Programs may wish to evaluate and modify their food safety activities in light of the findings provided here. For example, they could develop and implement activities that would contribute to a fuller understanding of the factors that impact food safety in food service establishments in their jurisdiction. They could then develop and test strategies designed to ad-

dress those factors and eventually incorporate successful strategies into their regular food safety activities. Such activities should improve the effectiveness of these food safety programs as well as contribute to our broader understanding of effective food safety strategies.

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