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Food-handling Behaviors of Student Volunteers in a University Food Recovery Program

ABSTRACT

Organizations dedicated to hunger relief have grown in recent years to increase their capacity to reach more food insecure populations; for example, Feeding America served 11% more meals in 2016 than in 2015. One barrier to ensuring food safety during the diversion and donation of food is lack of effective training for volunteers. Some programs are affiliated with universities and as such rely on student volunteers. Students have been shown to have risky practices in food-handling environments and can create situations in which food distributed by hunger-relief organizations can be at risk for unintentional contamination. Using a food recovery program at a large, land-grant university, food-handling behaviors of student volunteers were observed in-person and compared to self-reported behaviors and self-identified training needs gathered via a survey. Commonly observed behaviors were improper handwashing, inconsistent record keeping, and the use of unclean or contaminated equipment. For example, during deliveries only 13% of volunteers were observed washing their hands at least once, while 69% self-reported doing so. Training volunteers is necessary in view of the vulnerability to foodborne illness of those receiving recovered food. Trainings developed specifically for this audience should include unique handling scenarios adapted to food handler best practices.

INTRODUCTION

In 2015, approximately 15.6 million households in the United States were "uncertain of having, or unable to acquire, enough food to meet the needs of all their members because they had insufficient money or other resources for food," defined as food insecure *(35, 36, 37)*. National and regional organizations dedicated to hunger relief have increased their capacity in order to reach more food insecure households *(9, 15, 32)*. For example, Feeding America has worked within local networks to distribute 4 billion (B) meals to 46 million Americans during 2016, an increase from 3.6B in 2015 *(13, 14)*. Approximately 30–40% of the total food in the U.S. that would otherwise be discarded is available for reclamation; this food includes gleaned produce from growers and gardeners as well as food donated by processors, retailers and restaurants that does not meet quality standards but is still safe for consumption *(18, 38, 39)*. Many of these producers are hesitant to donate excess food into hunger-relief organizations because of the liability involved should

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it be linked to foodborne illness *(22)*. This risk of foodborne illness is heightened by the fact that those who utilize hunger-relief organizations possibly have insufficient access to healthcare *(7)*. In 1996, the Bill Emerson Good Samaritan Food Donation Act was passed, which removed the liability associated with illness linked to consumption of food donated in good faith to a hunger-relief organization *(3, 22)*. However, absence of liability does not negate the need for safe food-handling during the reclamation process.

One of the barriers to ensuring food safety during the donation and food recovery process is finding people who can safely divert and transport food to local hunger-relief agencies. For many businesses, this would result in paying employees to divert and transport food without earning any revenue. Colleges and universities provide a unique opportunity for service learning where there is leftover, unserved food available at on-campus dining facilities, as well as student volunteers willing to divert and deliver the food as a part of their educational experience and local hunger-relief agencies in need of additional food *(9, 17, 28, 32)*.

Although well intentioned, the use of students to divert, transport and serve recovered food may impact the efficacy of these programs. It has been documented that the food-handling behaviors of young adults can be risky *(1, 5, 6, 10, 16, 31)*. Young adults have high confidence in their ability to handle food safely; however, many lack appropriate training and engage in unsafe behaviors. Safe food-handling and preparation behaviors of students have generally been measured in situations in which they were handling food for themselves, with other studies focused on food handlers in foodservice *(1, 5, 6, 8, 10, 23, 29)*. Food recovery programs present additional safe food-handling educational challenges, because their intricacies may be difficult to cover in current food safety educational programs and because of the high rate of volunteer turnover *(7, 12)*.

To our knowledge, no studies have examined food-handling behaviors of young adults working in food recovery programs. The objective of this study was to collect observational data on food-handling behaviors of student volunteers in an on-campus food diversion program. Observed behaviors were compared with students' self-reported food-handling behaviors. The primary goals of the study were to identify key training needs and develop a strategy for educating these volunteers.

MATERIALS AND METHODS

Student volunteers handling food as part of an on-campus food diversion program at a public, land-grant university were used for this case study. Two data collection methods were used. First, volunteers participated in an observational study in which their food-handling behaviors were observed during volunteer shifts. After being observed, volunteers completed an online survey to assess their self-reported behaviors and self-identified training needs. All parts of this study were approved through the Virginia Tech Institutional Review Board (IRB #17-133).

Observational data collection

Three different types of student volunteer shifts that were part of the on-campus food diversion program were included in this study: (1) diversion, (2) cooking and (3) delivery. All three shifts were observed for varying time frames. Volunteers received shift-specific safe food-handling training based on their role in the program. A description of each shift type, along with training requirements and the key training concepts for each, are outlined in *Table 1*.

Two days prior to each shift observation, volunteers registered for that shift were contacted via e-mail to inform them that a researcher would be attending the shift to observe and record their behaviors. On the day of the observation, one researcher met the participants to inform them that the purpose of the observation was to better understand their experiences so improvements could be made for future shifts. This was to avoid bias so that their food-handling behaviors would not be adjusted *(29)*. Willing volunteers completed a consent form, followed by a 7-question demographic survey to record their gender, age, status at the university, previous experiences with the program, previous food safety-related trainings, type of shift being observed, and whether they were experiencing any symptoms of illness that would prevent their participation. Once the shift started, behavioral observations were recorded on paper kept in a folder so participants could not view what was being written. The observer focused on all volunteers during each shift, as they would all be working together on the same task in a common space. The total time elapsed for the shift and number of volunteers present were also recorded.

Online survey

At the end of each shift, all volunteers received a link to the survey via e-mail to be completed at their convenience. The survey began with the same seven demographic questions used in observation data collection, in order to describe this sample of respondents. Participants were asked in which volunteer shift they most recently participated, so they could be asked shift-specific questions. Participants were asked the following number of questions based on their shift: diversion (11 questions), cooking (11 questions), and delivery (9 questions). Participants were then asked an additional 12 questions related to their training experiences and self-identified training needs.

Data collection and analysis

Data were aggregated in order to preserve anonymity. Observations were organized and analyzed by use of a rubric to identify behaviors related to the top five factors associated with foodborne illness: (1) Improper hot/cold holding temperatures of time/temperature control for safety (TCS) food; (2) Improper cooking temperatures of foods;

TABLE 1. A description of the types of student volunteer shifts and training requirements that are part of an on-campus food diversion program

Shift type	Job description of shift	Student role	Training required	Key concepts within training
Diversion	Unserved food from on-campus dining facilities is collected at a dining facility, repackaged for donation, and repurposed in a cooking shift or held at the facility overnight for delivery	Volunteer[a]	Receive food safety training developed and implemented by the on-campus dining program	• Terms and definitions (i.e., cross-contamination, potentially hazardous foods, etc.) • Food allergies and intolerances • Handwashing and glove use • Personal hygiene • Time and temperature control • Cleaning and sanitizing
Cooking	Diverted food is repurposed to make value-added foods for donation (ex.: casseroles)	Volunteer[b]	Receive food safety information developed by the program via E-mail after signing up; to also be reviewed at the start of the shift	• Personal hygiene (i.e., proper attire, not serving after experiencing symptoms of illness within 72 hours, etc.)
		Shift Leader[a]	ServSafe® Manager certification *(27)*	
Delivery	Diverted and cooked foods are transported from campus to a community hunger-relief organization	Volunteer[b]	Receive food safety information developed by the program via E-mail after signing up; to also be reviewed at the start of the shift	• Personal hygiene (i.e., proper attire, not serving after experiencing symptoms of illness within 72 hours, etc.)
		Shift Leader[a]	Receive food safety information via training and delivery guide developed internally by the program	• Handwashing and glove use • Personal hygiene • Cleaning and sanitizing

[a]Volunteers are those who participate in a shift, either on a weekly basis for an entire semester or as they are available.
[b]Shift Leaders are those who coordinate the work of volunteers during a shift on a weekly basis for an entire semester.

(3) Dirty and/or contaminated utensils and equipment; (4) Poor volunteer health and hygiene; (5) Food from unsafe sources, as well as any additional observations that did not fit the other categories *(40)*. The survey was conducted via the Campus Labs "Baseline" online survey platform (Buffalo, NY; https://www. studentvoice.com). All data was organized into Microsoft Excel for analysis (Redmond, WA). The data were primarily descriptive and analyzed for frequency of occurrences and responses.

RESULTS

Observations were conducted over the course of three weeks with a total of 50 volunteers (41 undergraduate students, 4 graduate students, and 1 self-identified "other")

across 17 shifts. One half of those 50 volunteers (25) completed the online survey (21 undergraduate students, 3 graduate students, and 1 self-identified "other"). Because volunteers were able to participate in multiple shifts of the program, there could be multiple observations of the same individual. Observed volunteers reported completing the following food safety trainings: ServSafe Manager® (17%) (27); through the dining service (18%); through the recovery program (16%); another training, without specification (4%); some combination of the specific trainings (19%); or no training (26%). All shifts were scheduled for two hours, but the average time for each shift was: 44 min for diversion, 100 min for cooking, and 96 min for delivery. Comparisons between selected observed and self-reported behaviors are detailed in *Table 2*, and additional observations made that could not be compared to self-reported behaviors are detailed in *Table 3*.

Diversion shifts

All participants in diversion shifts were volunteers; there were no designated leaders. During the diversion process, an employee from the dining service escorted the student volunteers to a refrigerated cooler, from which they removed all unserved food, which they moved to a workstation to

TABLE 2A-C. Comparison of observed and self-reported behaviors (broken into the top five risk factors associated with foodborne illness) based on type of volunteer shift (A. Diversion, B. Cooking, and C. Delivery) in a food recovery program. Percentages are based on total number of volunteers observed and total number of respondents to the survey for each shift

A) Diversion

Type of Food Safety Action	Specific behavior[a]	% Observed (n = 11)	% Self-Reported (n = 5)
Temperature Control[b]	Monitored temperature control in coolers prior to storing food	0	0
	Monitored temperature of food during diversion	0	0
Personal hygiene[c]	Proper handwashing prior to handling food	100	100
	Proper handwashing in between tasks	0	40
	Wearing gloves while handling ready-to-eat foods	100	100
	Experiencing symptoms of foodborne illness that would have precluded them from handling food	0	0
	Wore specified uniform (visibly clean clothes, closed-toe shoes, pants)	100	100
Collection of food from unsafe sources[d]	Completion of documentation form as provided by the on-campus dining service	100[e]	100

[a]In the survey, each specific item would have been worded in the form of a question or statement. For example: "How many times did you wash your hands during the volunteer shift?" or "Temperatures of foods were checked while diverting food."

[b]Includes both risk factors: Holding TCS foods at incorrect temperatures and improper cooking temperatures (failing to cook foods correctly).

[c]Includes both risk factors: Improper handwashing and participation in shifts having experienced symptoms of illness.

[d]Includes risk factor: Improper documentation of foods handled by program volunteers.

[e]Reported on a per-observation basis (n = 7).

repackage it. Using a combination of spoons, tongs, or their hands, depending on the item, food was repackaged into new food-grade plastic bags. While volunteers wore gloves while handling food, they failed to wash their hands when changing gloves between tasks. Forty percent of the survey respondents self-reported washing hands between glove changes, while no participants were observed doing so *(Table 2A)*. Although volunteers were instructed by an employee of the dining service to document the food items each bag contained, the date the item was prepared, and the date food was diverted for the community partner's records, they did so inconsistently. In one of the dining facilities, volunteers diverted food directly from the self-service salad bar before repackaging any other unserved, stored food. Volunteers repackaged the food into new food-grade plastic bags with gloved hands but would do so with the same tongs and spoons that customers had previously used and without changing their gloves in between foods. The dining service staff required the volunteers to document, for their internal records, the types and amounts (either by count or total weight) of foods being diverted. While wearing the same gloves used during diversion, most volunteers would calculate total weight by hand, using paper and pen, with one using the calculator app on a cell phone. The volunteers would take the food to another refrigerated cooler for storage until delivery. The temperature of the cooler was not checked by volunteers before they left the food for storage.

Cooking shifts

An on-campus kitchen managed by an academic department as a food preparation lab space was used for these shifts. According to the SOPs set by the department, the kitchen was cleaned and sanitized by its last user; therefore, at the start of each cooking shift it was assumed that the kitchen had previously been fully sanitized, although there was no documentation of this. The shift leader reviewed the recipes and assigned volunteers to specific tasks. During this shift, soups and casseroles were prepared. The soups were prepared from a "just-add-water" mix supplemented with canned vegetables acquired during a food drive for the program. After the soups were cooked, they were placed into new, unlabeled food grade, freezer quality plastic bags and stored in the freezer at the end of the shift. The casseroles were a mix of previously diverted food supplemented with canned vegetables (also obtained through a food drive), which were mixed in metal pans provided by the community partner and which did not receive any additional cooking. Following preparation, casseroles were stored in the refrigerator overnight for delivery the next morning; casseroles were not cooked prior to delivery. Observations reflect that the temperature of foods prepared during the shift and during cooling were not monitored, however, 50% and 75% of survey respondents reported each action taking place, respectively *(Table 2B)*.

One of the most common observations was of volunteers not washing their hands between handling food items or when changing tasks, although 75% of survey respondents self-reported engaging in this behavior *(Table 2B)*. Eight volunteers also used their clothing to dry their hands after washing. Additionally, four volunteers used cell phones without washing their hands before returning to their task. Following preparation, the foods prepared were labeled and stored for delivery. All foods prepared during the shift were intended to be reheated by the recipient, although instructions were not provided. The kitchen was cleaned at the end of the shift according to the kitchens' specific SOPs; observations reflect that chemical cleaner was sprayed onto countertops on which uncovered food was located.

Delivery shifts

At the start of the delivery shift, the shift leader would provide a brief explanation of what volunteers should expect during the shift. Using insulated carriers (which had been cleaned and sanitized at the end of the previous shift), volunteers would pick up diverted and cooked food from dining facilities and transport it directly to community hunger-relief organizations. Delivery volunteers would often receive additional items diverted by employees at the time of closing of the facility the night before. They used unwashed bare hands to load the pre-packaged food into insulated carriers, without inspecting it for any leakages or physical contamination; however, 50% of survey respondents self-reported doing so *(Table 2C)*. Upon arrival to the community partners, volunteers would unload the food. At one facility, this consisted of transferring the pre-packaged food, using unwashed bare hands, into insulated boxes for storage. At another facility, this included dividing large quantities of bakery items into smaller quantities for distribution, using gloved, but unwashed, hands. This task was completed on work surfaces that were not cleaned or sanitized before or after use.

During one delivery observation, dining employees found food available for delivery that had not been diverted the night before. The volunteers then repackaged the identified food, using washed and gloved hands, into unmarked plastic bags for the community partner.

While transporting food from campus into the community, 21 volunteers used personal cell phones, and one used a laptop computer. Volunteers at both facilities recorded the total weight of food so that the community partner could report that weight to the regional food recovery network. Upon return to campus, shift leaders and volunteers were instructed to clean and sanitize the insulated carriers for the next shift, a process that was never observed during any shift, although 44% of survey respondents self-reported doing so *(Table 2C)*.

TABLE 2A-C. Comparison of observed and self-reported behaviors (broken into the top five risk factors associated with foodborne illness) based on type of volunteer shift (A. Diversion, B. Cooking, and C. Delivery) in a food recovery program. Percentages are based on total number of volunteers observed and total number of respondents to the survey for each shift

B) Cooking

Type of Food Safety Action	Specific behavior[a]	% Observed (n = 9)	% Self-Reported (n = 4)
Temperature Control[b]	Monitored temperature control in refrigerator prior to using food	0	0
	Monitored temperature of food during shift	0	50
	Monitored temperature control in refrigerator prior to storing food	0	0
	Monitored temperature of food during cooling	0	75
Personal hygiene[c]	Proper handwashing prior to handling food	100	100
	Proper handwashing between food items/when changing tasks	0	75
	Experiencing symptoms of foodborne illness that would have precluded them from handling food	0	0

[a]In the survey, each specific item would have been worded in the form of a question or statement. For example: "How many times did you wash your hands during the volunteer shift?" or "Prior to the start of the cooking shift, safe food-handling information was reviewed by the cooking shift coordinator."

[b]Includes both risk factors: Holding TCS foods at incorrect temperatures and improper cooking temperatures (failing to cook foods correctly).

[c]Includes both risk factors: Improper handwashing and participation in shifts having experienced symptoms of illness.

Desired training information

The survey portion of the study included questions about how volunteers believed their trainings could be improved. Twenty-four percent of respondents believed training was not necessary for their work, while 44% believed that there was not enough time during their shift to review safe food-handling procedures. Specific topics identified by respondents for future trainings include: proper handwashing (16%), proper cooking temperatures (20%), how to take temperatures of foods (28%), how to monitor and record temperatures (12%), recognizing the temperature "danger zone" (28%), correct temperatures for reheating (16%), calibrating equipment (24%), procedures for cleaning and sanitizing (36%), volunteer sick policy (16%), allergens and labeling (16%), and cross-contamination (24%).

When given the opportunity to share comments about their training experiences and how they are supported in their work, one respondent shared that "having a flow chart of…bathrooms and what not for shift participants would be useful" and "I think that there needs to be [something] for people who are riding along…so I don't have to remind [them] not to wear [flip-flops] and then to wash their hands and to do this or that."

DISCUSSION

Unsafe food-handling behaviors were observed across all shifts, including potential time and temperature abuse, lack of hand washing and safe glove use, use of technology while handling food, inconsistent record keeping, and use of potentially unclean equipment. Data collected in this study supports the current understanding of unsafe food-handling behaviors of young adults and the need to have specific interventions for this audience. For example, Abbot et al. and Byrd-Bredbenner et al. both found that young adults preformed less than 50% of recommended safe food-handling behaviors, specifically those related to cross-contamination,

TABLE 2A-C. Comparison of observed and self-reported behaviors (broken into the top five risk factors associated with foodborne illness) based on type of volunteer shift (A. Diversion, B. Cooking, and C. Delivery) in a food recovery program. Percentages are based on total number of volunteers observed and total number of respondents to the survey for each shift

C) Delivery

Type of Food Safety Action	Specific behavior[a]	% Observed (n = 30)	% Self-Reported (n = 16)
Temperature control[b]	Monitored temperature control in coolers prior to removing food	0	0
	Monitored temperature of food upon arrival to community partner	0	0
Personal hygiene[c]	Proper handwashing at least once during the shift	13	69
	Experiencing symptoms of foodborne illness that would have precluded them from handling food	3	0
Use of dirty/contaminated equipment[d]	Insulated delivery bags were cleaned and sanitized at the start of the shift	0	81
	Insulated delivery bags were cleaned and sanitized at the end of the shift	0	44
	Food packaging was checked for leakages or physical contamination	0	50
Collection of food from unsafe sources[e]	Completion of documentation form as provided by the on-campus dining service	78[f]	75

[a]In the survey, each specific item would have been worded in the form of a question or statement. For example: "How many times did you wash your hands during the volunteer shift?" or "After delivery, the transport bags were cleaned (removing any food, sanitized, etc.)."

[b]Includes both risk factors: Holding TCS foods at incorrect temperatures and improper cooking temperatures (failing to cook foods correctly).

[c]Includes both risk factors: Improper handwashing and participation in shifts having experienced symptoms of illness.

[d]Includes risk factor: using uncleaned or unsanitized equipment while handling food.

[e]Includes risk factor: Improper documentation of foods handled by program volunteers.

[f]Reported on a per-shift basis (n = 9).

proper temperature control, and good personal hygiene *(1, 5, 6)*. Because of the unique food-handling aspects of these programs, educational interventions designed for consumers or those working in the food industry are not applicable without adaptation *(25)*. The following considerations should be kept in mind when developing educational materials for food recovery programs.

Time and temperature control

Across all shifts, there was a lack of monitoring temperatures in controlled and uncontrolled environments. Programs should develop tools for volunteers to record the temperatures of both environments, the food stored within them, and the amount of time. While the amount of time elapsed during the shifts when food could be in the danger zone and

remain safe for consumption is within the four-hour guidance of the 2013 Food Code, if any element of the shifts were to run longer than expected, this could become an issue *(34, 40)*. During the diversion shifts, all food was taken out at the same time. Instead, volunteers could take one food item out at a time to repackage. After weighing that food, it could be taken back to the cooler for storage while the next food is retrieved for repackaging. This lessens the amount of time food remains out of a temperature controlled environment. During delivery, volunteers could include frozen ice- or gel-packs with the food in the insulated coolers to maintain an appropriate temperature until it reaches the community partner *(23)*.

Volunteer health and hygiene

Varying levels of health and hygiene awareness across all shifts were observed. While only one volunteer self-reported feeling symptoms of foodborne illness that would have precluded them from handling food, no volunteers were asked about that during the shift. This could have been due to an assumption that a volunteer would have already known not to arrive if they were unwell, or the shift leaders were not trained to know the potential impact on those who receive the food and did not remember to ask. The former assumption presents a higher level of risk to the program, given that some volunteers could be participating for course credit. They may value receiving credit more than their overall health or potential impact on the recipient of the food. Handwashing was observed to differing degrees throughout the shifts. In diversion, the lack of handwashing between using pairs of gloves presents a risk of contamination through bacterial contamination of hands when taking gloves off and contamination of the new gloves when putting the next pair on *(26, 30, 33, 41)*. There was an overall lack of handwashing observed in food-handling situations when it was already packaged. While the food is protected by the package from contamination, bacteria already on their hands can remain on the outer packaging. When the hunger relief organization volunteer goes to remove the food from the packaging, they could contaminate their hands and then the food *(2, 21)*.

Collection of food from unsafe sources

Recovering food directly from the salad bar creates the risk for contaminated food to be recovered and distributed through the program. It has been documented that food served through a salad bar or similar self-serve stations can be contaminated with pathogenic bacteria *(11, 19, 21)*. This is a result of improper hot/cold holding temperatures as well as consumer behaviors such as not properly utilizing serving utensils, coughing or sneezing onto the food, or cross-contaminating food while serving themselves *(11, 19, 21)*. Programs should determine whether it is worth the risk to recover salad bar items, or whether volunteers should recover only unserved items handled by those trained in food-handling. Utilizing previously used serving utensils keeps a potential source of contamination in the recovery process. Instead, volunteers should utilize unused, cleaned, and sanitized serving utensils to recover each food.

Record keeping

This program is not inspected by a state health agency and is not required to maintain the same records as inspected facilities (e.g., time/temperature logs, HACCP plan documentation, etc.) *(40)*. Lack of requirement does not equate to lack of need. Records should be maintained for the program, with examples of relevant data outlined in *Table 4*. These records would provide validation for safe food-handling practices and would be vital should any food handled by the program be recalled or if anyone became ill after consumption. These records could also include specific behaviors (e.g., handwashing, cleaning and sanitizing practices) to reinforce their completion during shifts.

Use of technology

The prevalence of cell phones and computers during diversion, cooking, and delivery shifts presents both challenges and opportunities. Cell phones have been shown to be vectors for transmitting pathogens and causing illness *(4, 20, 24)*. Given previous discussion about lack of adequate handwashing when handling food, collection of food from unsafe sources, and the potential impact on recipients of recovered food, the use of this technology introduces a risk to the food safety of these programs. An approach to lessening this risk would be to eliminate the use of technology during shifts. However, this does not seem feasible and could also become a barrier to volunteer recruitment and retention. Technology use could be allowed under certain circumstances, such as requiring that cell phones be cleaned and sanitized prior to the start of each shift. Additionally, volunteers could be asked to wash their hands ahead of any food-handling. Technology (i.e., cell phones) could also become a tool for record keeping. Using an online survey or application, information could be recorded in real time without having to maintain and store paper records.

Volunteer onboarding and continuing education

Given that this program is not regulated by a health agency, there are no required safe food-handling trainings for volunteers to complete in order to serve *(40)*. All volunteers were provided with some level of role-specific safe food-handling information, making it a shared responsibility. However, this also created multiple levels of accountability. While information needs to be shared with the volunteers as to what they should wear and under what conditions they should/should not volunteer (e.g., illness), the shift leaders and semester-long volunteers should be trained in how to make volunteers aware of safe food-handling behaviors throughout the shift. The latter group should be informed

TABLE 3. Summary of observed behaviors without self-reported comparisons among volunteers in a university food recovery program

Shift Type	Observed Behaviors
Diversion (n = 11)	• During 100% of shifts, there was no monitoring of temperature control after repackaged food was stored in the cooler[a] • During 100% of shifts, workstations were not cleaned or sanitized prior to use[a] • During 86% of shifts, workstations were cleaned and sanitized after use[a] 36% of volunteers changed their gloves in between hand contact with food items but did not wash their hands
Cooking (n = 9)	• No safe food-handling information was reviewed at the start of the shift • 100% wore either a hat/hairnet for the entirety of the shift • 11% were observed using their hands to measure temperature while cooking without a thermometer
Delivery (n = 30)	• During 100% of shifts, delivery bags were not cleaned or sanitized after it ended[b]

[a]For percentages based per shift, n = 7.
[b]For percentages based per shift, n = 9.

TABLE 4. Suggested points of documentation to maintain records of food safety, either electronically or physically, for recovery programs

Diversion	Cooking	Delivery
• Specific foods diverted • Total weight of food • Date the food was prepared • Date the food was diverted • Temperature of food and refrigerators were being monitored • Names of volunteers	• Specific food prepared • Total weight of food • Date the food was prepared • Final endpoint temperature of food • Refrigerator temperature • Names of volunteers	• Specific foods delivered • Total weight of food • Date the food was delivered • Temperature of food • Temperature of transport bags • Names of volunteers

about how they might observe unsafe behaviors throughout the shift and provide them with tools to correct it. Given that this program is rooted in service-learning, a leader needs to learn how to communicate that something unsafe has occurred, what corrective action should be taken, and why it is necessary to take corrective action in terms of potential impact on recipients of recovered food. Additionally, volunteers should be trained across roles in case they are asked to fill in for another volunteer or asked to do something outside the scope of their shift (i.e., delivery volunteers diverting food during their shift, a diversion volunteer leading a delivery shift if the scheduled leader is ill), given the unique tasks each shift entails. Continuing education should also be incorporated into the program, such as providing demonstrations and offering time to discuss unsafe food-handling behaviors observed during recent shifts as learning opportunities.

Limitations and recommendations

Because of the exploratory nature of this study, the sample size is too small for the results to be generalizable for all food recovery programs. Most elements of the program observed are reflected in similar food recovery programs nationwide, except that this program does not directly serve recovered food to people. Instead, that work is left to community hunger-relief organizations. The same observer collected all data presented in this project because of resource limitations and the exploratory nature of the project. There is also the

possibility that participants could have been influenced by the Hawthorne effect, meaning they were more aware of their food-handling behaviors, which could lower the number of risky behaviors observed *(29)*. There were also limitations in the literature used to analyze this data, such as the risks related to the use of technology in food-handling situations. Further research into food recovery programs, to include all programs that supply food to hunger relief organizations, should be conducted to inform educational interventions specifically developed for this audience, with special attention to addressing limitations of this study.

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