

Assessment of Food Safety Practices of Food Service Food Handlers (Risk Assessment Data): Testing a Communication Intervention (Evaluation of Tools)

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ABSTRACT

Globally, foodborne illness affects an estimated 30% of individuals annually. Meals prepared outside of the home are a risk factor for acquiring foodborne illness and have been implicated in up to 70% of traced outbreaks. The Centers for Disease Control and Prevention has called on food safety communicators to design new methods and messages aimed at increasing food safety risk-reduction practices from farm to fork. Food safety infosheets, a novel communication tool designed to appeal to food handlers and compel behavior change, were evaluated. Food safety infosheets were provided weekly to food handlers in working food service operations for 7 weeks. It was hypothesized that through the posting of food safety infosheets in highly visible locations, such as kitchen work areas and hand washing stations, that safe food handling behaviors of food service staff could be positively influenced. Using video observation, food handlers ($n = 47$) in eight food service operations were observed for a total of 348 h (pre- and postintervention combined). After the food safety infosheets were introduced, food handlers demonstrated a significant increase (6.7%, $P < 0.05$, 95% confidence interval) in mean hand washing attempts, and a significant reduction in indirect cross-contamination events (19.6%, $P < 0.05$, 95% confidence interval). Results of the research demonstrate that posting food safety infosheets is an effective intervention tool that positively influences the food safety behaviors of food handlers.

The World Health Organization (WHO) reports that up to 30% of individuals in developed countries acquire illnesses from the food and water consumed annually (37). This estimate is supported by U.S., Canadian, and Australian public health data (20, 22, 26, 35). U.S. estimates put the societal cost of foodborne illness at \$1.4 trillion annually (32). The WHO has identified five factors that contribute to these illnesses: improper cooking procedures, temperature abuse during storage, lack of hygiene and sanitation by food handlers, cross-contamination between raw and fresh ready-to-eat foods, and acquiring food from unsafe sources (36). Four of five of these practices are related directly to food service food handler behavior (acquiring foods from unsafe sources is the exception). Eating in food service establishments is a risk factor for acquiring foodborne disease in North America (15). Although there are wide variances in reported data, it has been estimated that up to 70% of foodborne illnesses are linked to food prepared through food service outside of the home (17, 18, 25). In 2007, Canadian food service sales totaled an estimated Can\$53.4 billion and represented 41.4% of the market share of food sales (4).

Food handlers carrying pathogens (such as hepatitis A, *Salmonella*, and *Escherichia coli* O157:H7) have been

associated with outbreaks of foodborne illness (23, 24). Research on health behaviors has suggested that individuals make rational decisions about risk-reduction behaviors when they are aware of, and have some knowledge about, the risks associated with particular actions (19, 28). Prior to 2004, the United States documented 8 years of decrease in rates of foodborne illness, but the decrease in illnesses has stalled, leading to a recommendation by the Centers for Disease Control and Prevention (CDC) to develop enhanced and measures more focused for food safety education (5). New food safety messages and mediums need to be experimented with and evaluated to encourage safe food handling behaviors and effective reduction in the incidence of foodborne illness (27). Past evaluations of food handler training interventions have relied solely on assumed behavior indicators such as inspection results or changes in knowledge with, differing conclusions about efficacy (8, 31). Interventions most likely to be deemed effective are those where behavioral change can be demonstrated, although difficult to measure, as actual changes in practice represents the greatest return on investment (9).

Food safety infosheets, consisting of relevant and timely food safety narratives culled from media sources and produced weekly to supplement traditional food safety training, have previously been evaluated for appropriateness, but not effectiveness (6). The objective of this research was to evaluate the efficacy of food safety infosheets as a training tool by assessing behavior change. It was hypothesized that through the posting of properly designed

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FOOD SAFETY NETWORK INFORMATION SHEET
September 6, 2007

BIZARRE LAWSUIT SETTLED -- INVOLVING NASA, NASTY FOOD, & chef "Dirty Finger Al"



DIRTY FINGER AL

POOR PERSONAL HYGIENE

A former fellow chef for Lackmann was quoted as saying that "Dirty Al" was "grotesque in his hygiene because of filthy hands and fingers and open, oozing sores while cooking." from healthinspections.com

"I WILL NOT MAKE ANY COMMENTS," MOTTA SAID. WITH THAT, HE HUNG UP.

A federal lawsuit that claimed outdated, spoiled food was served at NASA's Kennedy Space Center, has been settled. The case began several years ago when a former employee of Lackmann (the food service provider for the Center) was fired after she reported food handling problems.

Leaked from this lawsuit was information about the chef who helped run the Space Center's kitchen. Apparently he lacked basic food safety knowledge. Al Motta, also referred to in culinary circles around Orlando as "Dirty Finger Al", allegedly used weeks-old outdated food, including rancid chicken and rotten vegetables, to feed customers at the center.

Other employees told attorneys that whenever health inspectors were in the area, restaurants would spread the word so that kitchen employees in the Space Center and in other facilities could clean up their act.

The original complaint claimed Lackmann Food Services used weeks-old outdated food, usually disguised in spicy dishes like chili or barbecue. The company denied the allegation at the time, saying it actually does about six times better than average in its state inspections.

www.foodsafety.ksu.edu
foodsafetyinfosheets.ksu.edu

Food safety know-how

Dirty Finger Al stumbled over some basic questions from attorneys during pre-trial interviews, even though he's spent most of his life in the food industry.

For example, Motta said that cold food has been kept below 70 degrees to avoid bacteria growth, when it actually has to be kept 41 or below.

Don't be a Dirty Finger Al



FIGURE 1. Example of food safety infosheets.

food safety infosheets, using storytelling to generate dialogue in highly visible locations such as kitchen work areas and hand washing stations, that safe food handling behaviors of food service staff could be positively influenced. Behavior change, especially affecting the WHO's food handling risk factors, can result in fewer foodborne illnesses (36).

Given the discrepancies between individuals' recall, reporting, and actual behavior, the use of self-reported data sets to evaluate intervention effectiveness are not ideal, especially if the aim of the intervention is to change behavior (19, 29). However, in a review of food safety education evaluation methods, Redmond and Griffith (28) reported that most published evaluations typically focus solely on measuring knowledge and intended changes through self-reported data collection. In determining the effectiveness of a food safety intervention, such as a training program, direct measurement of behavioral change, as conducted in this study, is advocated (10, 11, 21).

Nonparticipant video observation, conducted by utilizing cameras to capture behavior, has advantages over participant observation, where observers are positioned in the situation being studied. Nonparticipant video observation generates valid and reliable data. Video observation may be less intrusive, and observed participants may be more likely to forget that they are taking part in a study. Recording behavior provides researchers with the ability to manipulate the speed of actions as well as allow for

INTERNATIONAL FOOD SAFETY NETWORK
INFOSHEET
SEPTEMBER 17, 2007

South Reno Nevada restaurant Jazmine reopens after Salmonella outbreak

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14 cases of Salmonella illness traced to Asian restaurant; ill food handler likely source



South Reno restaurant Jazmine is trying to bounce back and regain its footing less than a month after being hit by a food safety scare.

Jazmine was ordered closed by the Washoe County District health Department on Aug. 23 after it tested positive for Salmonella.

The restaurant, which serves popular Asian fare such as pot stickers, dim sum dumplings, pork ribs and sushi, re-opened its doors for dinner on Aug. 29.

Despite receiving a clean bill of health, the restaurant is still struggling to get back customers who have stayed away following the incident.

"Business has dropped tremendously," said manager and co-owner David Tran. "We've lost more than half of our business right now."

The health department hasn't been able to trace the source of the outbreak to any particular food in the restaurant, suggesting that the source of the outbreak was an infected food handler.

Two Jazmine employees tested positive for Salmonella. Following the incident, Tran said he and co-owner Quoc Nguyen have stressed to their employees to skip work if they're showing signs of a foodborne illness.

adapted from the Reno Gazette-Journal

"Business has dropped tremendously."
— David Tran, Jazmine owner

"It only takes one person to trigger an outbreak."
—Randall Todd, health department



What you can do to keep poop out of the food you make or serve

- Always wash your hands after using the restroom. Salmonella can be passed on by some people even if they aren't feeling sick.
- Call in sick when you are ill with diarrhea or vomiting.
- Wash your hands after handling raw meats, eggs or vegetables.
- Sanitize any utensil, equipment, or food contact surface after it has been in contact with raw foods, especially meat or eggs.

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rewinding and re-viewing of actions, thus saving researchers' time and allowing for a focus on specific actions. Video observation also allows multiple observers to view the same actions to reduce coding bias. Video observation by using multiple cameras also allows observers to record many angles, food handlers, and tasks concurrently. This is especially important in food service settings, as many participants at various stations can be responsible for contributing to one meal.

MATERIALS AND METHODS

Actual food handler behaviors were captured through video observation and analyzed to evaluate the effectiveness of food safety infosheets as a tool for behavior change. Baseline food safety behaviors of food handlers were compared with behavior after the introduction of food safety infosheets to food handlers in real-life working food service operations.

Food safety infosheets intervention. Food safety infosheets (www.foodsafetyinfosheets.com (6)) are standalone communication tools directed at food handlers, designed to be specific to food handler information needs and generate dialogue among food handlers (Fig. 1). Throughout this study, food safety infosheets contained a media story about an outbreak of foodborne illness, graphics, and prescriptive information. The text of food safety infosheets focused on consequences and food handler behaviors. Stories were supplemented with surprising or humorous graphics (either created or found with Google image searches [http://images.google.com/]). Food safety infosheets also contained a section usually

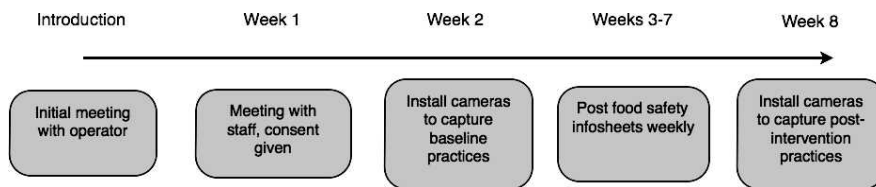


FIGURE 2. Framework for testing the effectiveness of food safety infosheets in food service facilities.

entitled “What You Can Do” to connect the outbreak story with behaviors that food handlers could employ during their tasks. Food safety infosheets were created with iWork Pages (Apple, Inc., Silicon Valley, CA), and reviewed by researchers at Kansas State University (Manhattan) and the University of Guelph (Ontario, Canada).

Study group. An international food service company collaborated with the researchers for the evaluation of the food safety infosheets. The company operates institutional food service facilities across North America, serving thousands of meals daily. Thirteen locations across southern Ontario, Canada, were selected for potential participation by corporate management, and the final decision to participate was left to on-site operators. Eight of the 13 sites were included in the study. The company provided unfettered access to the 8 sites and personnel. In accordance with the institutional research ethics board, all staff members (food handlers and management) were provided with study objectives and were told that recording of the site was being undertaken to conduct research on food flow, efficiency, food handler practices, and teamwork. All participants were informed of the proposed video observation, and consent was required before inclusion in the study. A generic description of the intent of the study (to view food handlers’ actions) was provided, but food safety behaviors were not explicitly mentioned until after food safety infosheets had been introduced and the second observation had taken place. When provided with the opportunity to be excluded from the study, three potential food handler participants elected to do so, citing privacy concerns. These food handlers were reassigned to tasks outside of the camera’s capture field for the duration of the study.

Posting. Current food safety infosheets designed to reflect food safety issues relevant to the study group were provided to the target audience weekly and passively posted in five high-visibility areas defined by each site’s operator. Food safety infosheets were placed in plastic protective coverings and physically posted by researchers each week for 7 weeks.

Data collection. Nonparticipant observation of practices was used to collect the food safety behaviors of food handlers. Because observation can capture actual behavior in context, data obtained through this methodology often yields valid and reliable information upon which further interventions can be developed, and more accurate risk assessment calculations can be made (1).

The framework established for the evaluation of food safety infosheets was measure baseline behaviors, introduce food safety infosheets, and record postintervention behaviors (Fig. 2.). Not reported in this publication are the results of in-depth interviews conducted with food handlers after the initial observations and prior to introducing the food safety infosheets. The total data collection cycle at each site was approximately 8 weeks.

Observation equipment. Food handling practices were recorded at eight sites and split into two occasions, pre–food safety infosheet introduction and post–food safety infosheet introduction. For each of these occasions 2 consecutive days were recorded. Cameras were placed in strategic positions to capture

three stations: grill, deli, and preparation. The size and placement of the cameras allowed them to be seen by participants, but were carefully placed so as not to intrude on preparation areas. Equipment was installed in the evening before the observation occasion commenced, and it was completed in 2 h.

MacBook laptop computers (Apple, Inc.) and QuickCam Pro 5000 surveillance cameras (Logitech International S.A, Romanel-sur-Morges, Switzerland) were used to capture participant’s food preparation behavior. Software required for the video capture of food safety behaviors included Security Spy (<http://www.bensoftware.com/ss/>, Ben Software, London, UK) and Sleepless (<http://www.alxsoft.com/mac/sleepless.html>, ALXSoftware, Moscow, Russia). Security Spy, developed as a remote video capture package, enables timed recording, multiple camera angles, and small video data storage requirements. Security Spy also has a movement wakeup function (where cameras are shut down until the software detects movement in the observation site). This conserves memory storage space. Sleepless—a program that allows MacBooks to operate while the screen is closed—was added to the laptop for a less intrusive instrument and allowed for equipment to be better hidden.

Coding behaviors. After the full cycle of recording baseline behaviors, intervention posting and recording postexposure behaviors, three individuals were charged with coding defined behaviors from the video recordings by using a detailed observational decision tree. Coding of behaviors was developed using definitions from the CDC’s identified risk factors for foodborne illness, coupled with WHO’s factors leading to foodborne illness (5, 36). These definitions were supported by a review of scientific literature that focused on risky food safety practices (1, 3, 7, 11, 30).

Hand washing. Poor personal hygiene of food handlers is a demonstrated risk factor for foodborne illness. Effective hand washing steps include running water, soap, lather, rinse, and drying with paper towel (34). Length of time of a wash was not factored into coding a correct hand washing event, as it has not been demonstrated as a critical pathogen reduction factor (34). Both the attempt to hand wash and an incorrect or incomplete hand washing event were noted and coded.

Cross-contamination. Although there is little published research on the cross-contamination actions of food service food handlers, observations of consumers’ food preparation behaviors have indicated that food hygiene practices are often poorly carried out, and the potential for cross-contamination is much greater than outbreak investigation data suggest (7, 14, 38). Two methods for cross-contamination were defined in this study: (i) direct cross-contamination (where a ready-to-eat food is potentially contaminated through direct contact with a contaminant or raw food containing a contaminant), and (ii) indirect cross-contamination (where contaminants are passed to ready-to-eat foods through intermediate objects such as equipment, food contact surfaces or hands).

TABLE 1. Number of work stations, food handlers, observation hours, and camera angles per site

Site	Stations	Food handlers (n)	Hours recorded per observation occasion	Total camera angles used
1	Deli, grill, preparation	7	24	6
2	Prep	5	22	8
3	Deli, grill, preparation	7	26	8
4	Deli, grill, preparation	4	24	4
5	Deli, grill, preparation	10	22	7
6	Deli, grill, preparation	8	20	8
7	Preparation	3	18	5
8	Deli, grill, preparation	3	18	5
Total		47	174	51

Coding trees were developed for the following events and researchers trained on each: (i) hand washing attempts, (ii) correct hand washing outcomes, (iii) direct cross-contamination event, and (iv) indirect cross-contamination event.

The lead researcher and two assistants first independently viewed and coded, and then simultaneously reviewed and coded 6 h of video to establish intercoder reliability. Differences identified in coding were discussed, and agreements were made concerning the descriptions of the behaviors of interest to improve further the uniformity of the coding of the data. During a pilot of this research, 15 actions were selected by the primary researcher and provided to the other coders to conduct an intercoder reliability test. Initial agreement was arrived at in coding 13 of the 15 actions; both of the disagreed actions were indirect cross-contamination. Discrepancies were resolved by reviewing the actions. Similar methods have been reported in the literature (1, 16). Notational analysis was used to organize actions and their frequencies along a timeline. Notational analysis is a generic tool used to collect observed events and place them in an ordered sequence, especially useful for following cross-contamination (7, 13).

Data analysis. The coded observation data were analyzed using the Statistical Package for the Social Sciences 16.0 (SPSS Inc, Chicago, IL) for descriptive statistics, and paired sample Student's *t* tests determined whether there was a difference in mean events between pre- and post-food safety infosheet introduction.

RESULTS

A total of 47 food handlers were observed for 2 days on each occasion (occasion 1, pre-food safety infosheet introduction; occasion 2, post-food safety infosheet introduction), resulting in the capture of 4 days of individual food handlers' behaviors. A total of 174 h of video recordings were taken on each occasion, resulting in a total of 348 h of data analyzed (Table 1). Participants were on-camera for a mean of 13.43 h of actual food handling pre-food safety infosheet introduction and 13.55 h post-food safety infosheet introduction. As hours of operation varied between sites, it was decided that recording would commence 30 min prior to the first scheduled employee's start time and end 30 min after the site's staff were scheduled to leave.

A paired sample Student's *t* test was conducted on the means of coded food handler behaviors. Significant differences were found in food handler behaviors between pre- and post-food safety infosheet introduction (Table 2). During observation occasion 1, prior to introducing food safety infosheets, food handlers were recorded demonstrating a mean of 21.09 hand washing attempts (an average of 1.57 hand washing attempts per hour) with 2.38 of attempts coded as correct (Table 3). The most common factor leading to an incorrect hand washing event (93% of incorrect hand washing events) was the lack of proper hand drying with a paper towel. Many observed participants used common-use dry rags, aprons, or other garments to dry their hands. Indirect cross-contamination (mean = 15.70 events per observation occasion) was found to be more prevalent than direct cross-contamination was (mean = 1.89 events per observation occasion) (Table 3). The mean number of hand washing attempts and correct hand washing events increased significantly after the introduction of the food safety infosheets (Table 3). The mean number of indirect and direct cross-contamination events decreased significantly after the introduction of the food safety infosheets (Table 3).

When analyzed by hour, indirect cross-contamination rates appeared to follow a pattern. More indirect cross-contamination events, which would result in greater risk of

TABLE 2. Results of paired-sample Student's *t* tests for observed food handling behaviors for both pre- and post-food safety infosheet posting

Pair	Event	Paired differences					<i>t</i>	df	<i>P</i> value (two-tailed)
		Difference in mean events	SD	SEM	95% CI of the difference				
					Lower	Upper			
1	Total hand washing attempts, pre- and postintervention	-1.426	4.338	0.633	-2.699	-0.152	-2.253	46	0.029 ^a
2	Total correct hand washing outcomes, pre- and postintervention	-1.638	2.506	0.336	-2.374	-0.903	-4.482	46	0.000 ^a
3	Total indirect cross-contamination events, pre- and postintervention	2.574	6.006	0.876	0.811	4.338	2.939	46	0.005 ^a
4	Total direct cross-contamination events, pre- and postintervention	0.851	2.147	0.313	0.221	1.481	2.718	46	0.009 ^a

^a*P* < 0.05, 95% CI.

TABLE 3. Relative changes in mean food safety risk events per food handler per observation occasion^a

Event	Pre-food safety infosheet introduction	Post-food safety infosheet introduction	Change	% change
Hand washing attempts	21.09	22.51	1.42 ^b	6.7
Correct hand washing events	2.38	4.02	1.64 ^b	68.9
Indirect cross-contamination	15.70	13.13	-2.57 ^b	-19.6
Direct cross-contamination	1.89	1.04	-0.85 ^b	-81.7

^a Number of food handlers was 47.

^b $P < 0.05$, 95% CI.

foodborne illness, occurred during breakfast- and lunch-serving times (Fig. 3). Mean indirect cross-contamination events between 7 a.m. and 9 a.m. ranged from 0.6 to 2.0 events per hour. These events dipped below 0.5 events per hour between 10 a.m. and 11 a.m., and rose to over 3.16 events during 12 p.m. and 1 p.m. While there were improvements post-food safety infosheet introduction, the incidence of indirect cross-contamination followed the same pattern, increasing during traditional busy meal service times. From frequency of the evaluation of behaviors, direct cross-contamination made up less than 11% of total cross-contamination events, signifying that indirect cross-contamination events are much more likely to happen, and it highlights the complexity of the food service kitchen situation.

DISCUSSION

Results indicate that the introduction of food safety infosheets had significant positive influence on the risk-reduction practices of food handlers participating in this study. While significant improvements were seen, a drastic improvement or elimination of risky behaviors was not seen. Time of day, especially during busy times during traditional meal times of the food service operation, affected the food handling behaviors more than did the introduction of food safety infosheets. A recommendation could be the re-engineering of some food service operational behaviors to reduce potential food safety risks quickly, such as the addition of quick-use, alcohol-based hand sanitizer at workstations. Schaffner and Schaffner (33) demonstrated effectiveness of this intervention, even on visibly soiled

hands, and the introduction of the tool may increase compliance resulting in a public health affect.

The prevalence of indirect cross-contamination seen throughout this study, confirming Jay and colleagues (14), suggests that prevalence of cross-contamination is a hidden problem for food service, as food handlers acting in a multi-user environment may not see themselves as part of a team. Many of the recorded indirect cross-contamination events occurred when multiple food handlers used common food contact surfaces, utensils, or equipment. The team-like nature of a food service system should be highlighted, built upon, and it is currently missing from national food safety training packages such as ServSafe (<http://www.nraef.org>) and TrainCan (<http://www.traincan.com>). Development of cross-contamination demonstration techniques as well as showing food handlers how they influence their coworkers' food safety behaviors is an area where further investment is needed. This result supports Beegle's (2) findings on the team-like aspect of food handlers. Food handler training currently focuses solely on an individual's actions, not how they influence others.

A move to a more even-paced, commissary-like system where meals are preprepared, portioned, and packaged prior to arriving on-site, and the food handlers are left to do little more than reheat and plate, may reduce the affect of busy, intense meal times and be practical at some types of food service operations. This is especially supported in the literature (7, 12), where lack of time was reported as a major factor in not always carrying out proper food handling techniques. While such an approach may counter building a

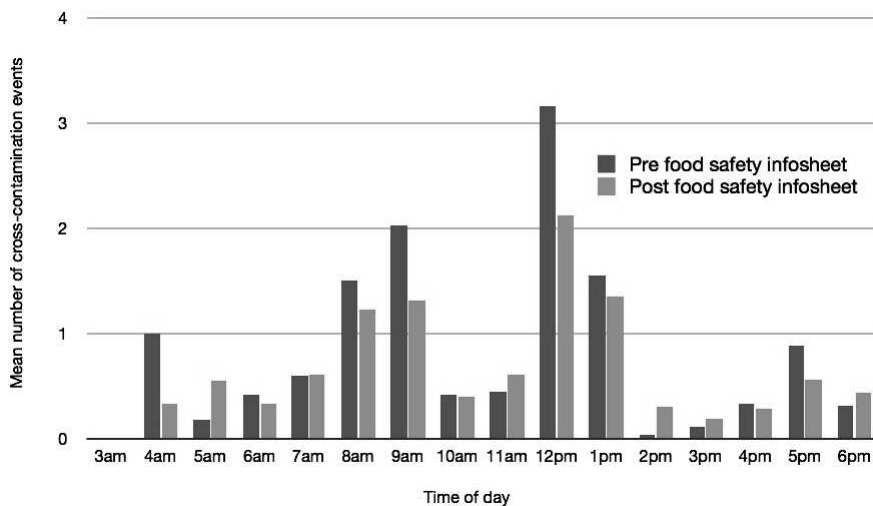


FIGURE 3. Mean indirect cross-contamination events per hour for all eight food service research observation sites (n = 47 food handlers).

connection between patrons and the production of their meals (an increasingly prevalent marketing option), preparing foods in an even-paced environment may be safer than the traditional meal rushes are.

The lack of use of paper towels when hand washing was attempted to complete a correct hand washing event suggests that while some risk-reduction steps were taken (to attempt hand washing), further concentration should be placed on providing evidence of control to food handlers. As Beegle (2) and Clayton and Griffith (7) have indicated, hand drying is a risk-reduction step as important as using soap, lathering, and rinsing. Food service operators could track paper towel usage as an indicator of incorrect hand washing, and create a culture within the organization where all components of hand washing are valued.

Two additional factors (outside of posting the food safety infoshets) may have influenced food handlers' behaviors throughout this study: the utilization of video capture as an observation method and the in-depth interviews focusing on food safety knowledge, attitudes, and intentions. While these factors may be responsible, at least in part, for the significant change in behaviors of food handlers in this study, the study did, however, result in increased risk-reduction behaviors. Future research comparing different behavior capture methods can help reduce the potential ambiguity of results.

While food safety infoshets are effective in positively influencing food handlers' behaviors, they did not provide a solution for risk reduction alone. Food safety infoshets integrated within the organizational culture of a food service operation, where the understanding of risk, risk-reduction behaviors and why they are important, can lead to safer food handling behaviors.

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