PEER-REVIEWED ARTICLE

Food Protection Trends, Vol 39, No. 3, p. 218–224

6200 Aurora Ave., Suite 200W, Des Moines, IA 50322-2864

Ellen Thomas Shumaker,[1*] Irene Doherty,[1] Samantha Sifleet,[1] Benjamin Chapman,[2] Andre Pierce,[3] Melissa Ham[4] and Barbara Kowalcyk[1,5]

[1]RTI International, Research Triangle Park, NC 27709, USA
[2]Dept. of Youth, Family, and Community Sciences, North Carolina State University, Raleigh, NC 27607, USA
[3]Wake County Health Department, Raleigh, NC 27602, USA
[4]North Carolina Department of Health and Human Services, Raleigh, NC 27699, USA
[5]The Ohio State University, Columbus, OH 43210, USA

Risk Factors for Foodborne Illness in Temporary Eating Establishments in North Carolina

ABSTRACT

Food service at temporary eating establishments such as those found at festivals, fairs and carnivals is a large part of the American diet. The food safety requirements of such establishments generally align with "brick and mortar" establishment requirements, which are specified by the FDA in the model food code and adopted by states. The primary difference relates to allowing for the use of domestic equipment. These temporary establishments face unique food safety challenges, including the simple challenge of planning an inspection during operation, because of their restricted time of operation. Little literature exists on risk factors to help these establishments and the agencies that regulate them set priorities on where to focus intervention and mitigation strategies. To help fill this gap, this study measured the occurrence of food safety risk factors at temporary eating establishments in North Carolina. Of the 59 establishments, 88% were out of compliance for at least one of the relevant risk factors. A total of 73 observed actions were out of compliance with regard to employee hygiene, while 41 were out of compliance with regard to proper holding temperature, and 35 events were identified as practices that could result in cross-contamination. Given the increased number of temporary eating establishments throughout the U.S., identifying trends in food safety behaviors at such establishments is important to the development of intervention strategies.

INTRODUCTION

Over the past decade, temporary food establishments (a category defined on a state-by-state basis that generally includes foodservice operations at outdoor festivals, sporting events, traveling fairs and carnivals, multi-cultural celebrations, special interest fundraising events and restaurant food shows) have increased in popularity and frequency throughout the United States *(1)*. At the time of this study, the Food Code defined a temporary food establishment as "a food establishment that operates for a period of no more than 14 consecutive days in conjunction with a single event or celebration" *(9)*. Since then, North Carolina legislation has changed to allow for an increase to 21 operating days *(6)*. Food preparation in these settings can pose significant haz-

*Author for correspondence: Phone: +1 919.541.1282; Fax: +1 919.541.7155; Email: eschumaker@rti.org

ards because of limited physical facilities and equipment *(5)*. The lack of proper storage and preparation space, inadequate refrigeration and hot holding units, inadequate hand washing facilities, and absence of a supply of hot and cold potable water are some of the factors often present in temporary food establishment operations that may contribute to cross-contamination, inadequate holding temperatures and contamination of food by infected food handlers. Many large events use volunteers who may have little food handling experience or have not received any food safety training because of time limitations. Although studies have been published about the rates of safety violations for other types of retail eating establishments, little literature exists on the food safety violations that occur most frequently in temporary food establishments.

The Food and Drug Administration (FDA) publishes a model food code quadrennially to provide state and local health authorities charged with regulation of food retail facilities with the best available science *(9)*. To inform resource allocation, intervention development and policy evaluation, the FDA conducted retail food risk factor studies in 1998, 2003 and 2008 to measure compliance with food safety behaviors and practices outlined in the food code in institutional foodservice, restaurants, and retail food stores *(8)*; temporary food establishments were not included in any of the studies. Although improvements occurred over the 10-year period, the FDA reported that improper holding/time and temperature, poor personal hygiene, contaminated equipment and inadequate protection from contamination were three areas still in need of significant improvement *(8)*.

A 2014 California EHS-Net study identified risk factors specific to mobile food trucks in six counties in California. Nearly 95% of the 95 food trucks visited had at least one critical risk factor. The most frequently observed risk factor was improper or lack of handwashing (n = 84), followed by inadequate or lack of sanitation solution for sanitizing surfaces (n = 65). Other risk factors observed included cross-contamination with ready-to-eat foods (n = 57), refrigeration temperatures above 45°F (n = 42), internal food temperatures above 41°F (n = 34), and refrigeration units that were not operating (n = 23) *(3)*.

Numerous outbreaks have been associated with temporary food establishment environments that are in close proximity to petting zoos, such as state fairs, including outbreaks caused by *Salmonella, Cryptosporidium,* and *E. coli* O157 *(2)*. It was confirmed that 27 individuals became ill with *E. coli* O157:H7 infection after visiting the petting zoo at the 2011 North Carolina state fair *(4)*. This was not the first outbreak of *E. coli* O157:H7 at the state fair, as three people had become ill from food purchased from a food stand in 2006, and 108 petting zoo attendees had become ill in 2004 *(4)*. The proximity of food vendors to sites that have a high likelihood of harboring potentially harmful bacteria also contributes to the high risk for these types of temporary eating establishments. Investigating such outbreaks is difficult because of the transient nature of the events associated with the temporary food establishments, and attendees have often sampled many different foods and beverages.

The purpose of this study was to replicate the methodology used in the FDA retail food risk factor study, with a focus on temporary food establishments in North Carolina.

MATERIALS AND METHODS

Using the food safety retail risk factor codes established by the FDA in their studies, North Carolina public health officials collected risk factor data during non-regulatory visits at temporary food establishments in North Carolina. In October 2014, three data collectors observed and documented, at 59 temporary eating establishments, the establishment conditions and employee food handling and hygiene behaviors for 42 operational compliance elements associated with foodborne illness. The 42 elements were divided into categories with respect to risk factors, including, (1) proper food temperature (cooking and holding), (2) cross-contamination, (3) hygienic practices, and (4) other topics (such as obtaining food from an approved source or chemical contamination) *(Table 1)*. Hygienic practices included instances of handwashing, avoidance of bare hand contact, and employee health. Some compliance items did not pertain to all establishments; for example, some compliance requirements relate to handling shellfish, so if the establishment did not handle shellfish, it was not rated on that item. The goal of establishing categories was to detect patterns in rates of compliance related to the factors that commonly contribute to foodborne illness, because such patterns could help to inform decisions on risk management activities. Each observed factor was recorded by the data collector as in compliance, out of compliance, not observed, or not applicable.

A total of 59 establishments were randomly selected out of 147 permitted establishments at one multi-day event in North Carolina, using the FDA standardized data collection instrument. Sample size was determined on the basis of FDA guidelines *(7)*. Because the county health department issues permits for temporary food establishments, their staff has right of entry for any permitted facility to routinely make visits to check food safety compliance and take action when necessary. In this case of non-regulatory visits, the data collectors introduced themselves and asked to be allowed to conduct the visit; there were no refusals. Data collectors then progressed through the data collection instrument and marked the observed factors as appropriate.

Descriptive statistics were generated for each eating establishment to determine the extent of non-compliance within establishments. The mean and standard deviation for the observed factors and factors out of compliance were calculated for the 59 eating establishments. The results were further analyzed by calculating the distributions of non-compliance by the following categories: cooking/holding temperature, cross-contamination, hygiene, and other

TABLE 1. North Carolina Food Code Compliance items observed in study *(6)*

Category	Compliance Items Assessed	Total
Approved Sourcing and Record Keeping	1A. All food from Regulated Food Processing Plants/No home prepared/canned foods (In/Out) 1B. All Shellfish from NSSP listed sources. No recreationally caught shellfish received or sold (In/Out/NA) 1C. Game, wild mushrooms harvested with approval of Regulatory Authority (In/Out/NA/NO) 2A. Food received at proper temperatures/protected from contamination during transportation and receiving/food is safe, unadulterated (In/Out) 3A. Shellstock tags/labels retained for 90 days from the date the container is emptied (In/Out/NA/NO) 3B. As required, written documentation of parasite destruction maintained for 90 days for Fish products (In/Out/NA/NO) 3C. CCP monitoring records maintained in accordance with HACCP plan when required (In/Out/NA)	7
Cooking Time-temperature	4A. Raw shell eggs broken for immediate service cooked to 145°F (63°C) for 15 seconds. Raw shell eggs broken but not prepared for immediate service cooked to 155°F (68°C) for 15 seconds (In/Out/NA/NO) 4B. Comminuted Fish, Meats, Game animals cooked to 155°F (68°C) for 15 seconds (In/Out/NA/NO) 4C. Roasts, including formed roasts, are cooked to 130°F (54°C) for 112 minutes or as Chart specified and according to oven parameters per (In/Out/NA/NO) 4D. Poultry; stuffed fish, stuffed meat, stuffed pasta, stuffed poultry, stuffed ratites, or stuffing containing fish, meat, poultry or ratites cooked to 165°F (74°C) for 15 seconds (In/Out/NA/NO) 4E. Wild game animals cooked to 165°F (74°C) for 15 seconds (In/Out/NA/NO) 4F. Raw animal foods cooked in microwave are rotated, stirred, covered, and heated to 165°F (74°C). Food is allowed to stand covered for 2 minutes after cooking (In/Out/NA/NO) 4G. Ratites, injected meats are cooked to 155°F (68°C) for 15 seconds (In/Out/NA/NO) 4H. All other PHF cooked to 145°F (63°C) for 15 seconds (In/Out/NA/NO)	8
Holding Time-temperature	5A. PHF that is cooked and cooled on premises is rapidly reheated to 165°F (74°C) for 15 seconds for hot holding (In/Out/NA/NO) 5B. Food reheated in a microwave is heated to 165°F (74°C) or higher (In/Out/NA/NO) 5C. Commercially processed ready to eat food, reheated to 135°F (60°C) or above for hot holding (In/Out/NA/NO) 5D. Remaining unsliced portions of roasts are reheated for hot holding using minimum oven parameters (In/Out/NA/NO) 6A. Cooked PHF is cooled from 135°F (60°C) to 70°F (21°C) within 2 hours and from 135°F (60°C) to 41°F (5°C) or below within 6 hours (In/Out/NA/NO) 6B. PHF (prepared from ingredients at ambient temperature) is cooled to 41°F (5°C) or below within 4 hours (In/Out/NA/NO)	14

TABLE 1. North Carolina Food Code Compliance items observed in study *(6)* (cont.)

Category	Compliance Items Assessed	Total
Holding Time-temperature	6C. Foods received at a temperature according to Law are cooled to 41°F (5°C) within 4 hours (In/Out/NA/NO) 7A. PHF is maintained at 41°F (5°C) or below, except during preparation, cooking, cooling or when time is used as a public health control (In/Out) 8A. PHF is maintained at 135°F (60°C) or above, except during preparation, cooking, or cooling or when time is used as a public health control (In/Out/NA/NO) 8B. Roasts are held at a temperature of 130°F (54°C) or above (In/Out/NA/NO) 9A. Ready-to-eat PHF held for more than 24 hours is date marked as required (prepared on-site) (In/Out/NA/NO) 9B. Discard RTE PHF and/or opened commercial container exceeding 7 days at < 41°F (5°C) or 4 days at < 45°F (7°C) (In/Out/NA/NO) 9C. Opened Commercial container of prepared ready-to-eat PHF is date marked as required (In/Out/NA/NO) 9D. When time only is used as a public health control, food is cooked and served within 4 hours as required (In/Out/NA/NO)	14
Separation/ Cross-contamination	10A. Food is protected from cross contamination by separating raw animal foods from raw ready-to-eat food and by separating raw animal foods from cooked ready-to-eat food (In/Out/NA/NO) 10B. Raw animal foods are separated from each other during storage, preparation, holding, and display (In/Out/NA/NO) 10C. Food is protected from environmental contamination – critical items (In/Out) 10D. After being served or sold to a consumer, food is not re-served (In/Out) 11A. Food-contact surfaces and utensils are clean to sight and touch and sanitized before use (In/Out)	5
Personal Hygiene	12A. Hands are clean and properly washed when and as required 13A. Food Employees eat, drink, and use tobacco only in designated areas/do not use a utensil more than once to taste food that is sold or served/do not handle or care for animals present. Food employees experiencing persistent sneezing, coughing, or runny nose do not work with exposed food, clean equipment, utensils, linens, unwrapped single-service or single-use articles (In/Out/NO) 14A. Employees do not contact exposed, ready-to-eat food with their bare hands (In/Out/NA/NO) 15A. Handwash facilities conveniently located and accessible for employees (In/Out) 15B. Handwash facilities supplied with hand cleanser/sanitary towels/hand drying devices (In/Out) 17A. Written Employee Health Policy or Person Can Verbally State Policy to Notify PIC when Experiencing Foodborne Illness Symptoms (In/Out)	6
Chemical Contamination	16A. If used, only approved food or color additives. Sulfites are not applied to fresh fruits & vegetables intended for raw consumption (In/Out/NA) 16B. Poisonous or toxic materials, chemicals, lubricants, pesticides, medicines, first aid supplies, and other personal care items are properly identified, stored and used (In/Out)	2

(source and chemical contamination). A 95% confidence interval was calculated for each category. This helped to characterize the top risk factors seen in temporary eating establishments that are known to be the most common factors that contribute to foodborne illness.

RESULTS

Of the 59 temporary establishments visited, the majority (91.5%) were out of compliance for at least one risk factor. The number of observed compliance items per eating establishment varied, because not all compliance items were relevant for all temporary establishments. The number of risk factors relevant for any particular establishment ranged from 12 to 21, with a mean of 16.3 *(Table 2)*. The mean number of items out of compliance within establishments was 2.4, with a range of 0 to 8. The rate of non-compliance varied considerably, ranging from 0% to 50%, with a mean of 16%.

Across the 59 establishments, 961 applicable codes/risk factors were observed, and 154 (16%) were non-compliant *(Table 3)*. Items were placed into separate categories for analysis: (1) proper food temperature (cooking and holding), (2) cross-contamination, (3) hygienic practices, and (4) other (such as obtaining food from an approved source or chemical contamination) *(Table 1)*. The distribution of observed risk factors and non-compliance varied by category. Separation, hot holding of foods, and proper handwashing rank as the top 3 risk factors associated with non-compliance *(Fig. 1)*.

DISCUSSION

Given the increase in temporary eating establishments throughout the United States and because of their transient nature, identifying the top risk factors that contribute to foodborne illness in these facilities is critical to developing intervention strategies and evaluating policy. In this study, nearly all establishments were out of compliance for at least one risk factor. The two categories with the highest rate of non-compliance were those related to cooking/holding temperature and employee hygiene.

The results of this study are consistent with the FDA Retail Risk Factor Study, which found poor personal hygiene, improper holding of food, and contaminated food surfaces and equipment as risk factors requiring significant improvement *(8)*. Given the high rate of non-compliance related to hand hygiene, lack of effective employee training in temporary establishments emerges as a significant problem. Creating a positive food safety culture in a temporary

TABLE 2. Distribution of non-compliance of food safety risk factors for 59 temporary eating establishments[a]

	Mean	Standard deviation	Minimum	Maximum
Observed factors	16.3	2.1	12	21
Out of compliance	2.4	1.9	0	8
Percent out of compliance	16.0%	11.4%	0%	50%

[a]91.5% of establishments were out of compliance for at least one risk factor.

TABLE 3. Distribution of non-compliance at temporary eating establishments. All 59 establishments were observed for each category unless otherwise noted

Category	Number applicable codes	Number non-compliant	Percent non-compliant	(95% CI)
Cooking/Holding temperature	151	37	24.5%	(17.9, 32.2)
Cross-contamination	245	35	14.3%	(10.2, 19.3)
Hygiene[a]	284	56	19.7%	(15.3, 24.8)
Other	281	11	4.0%	(2.0, 7.9)
Total	961	154	16%	(12.2, 16.8)

[a]A total of 49 establishments had events related to hygiene that were observed or applicable.

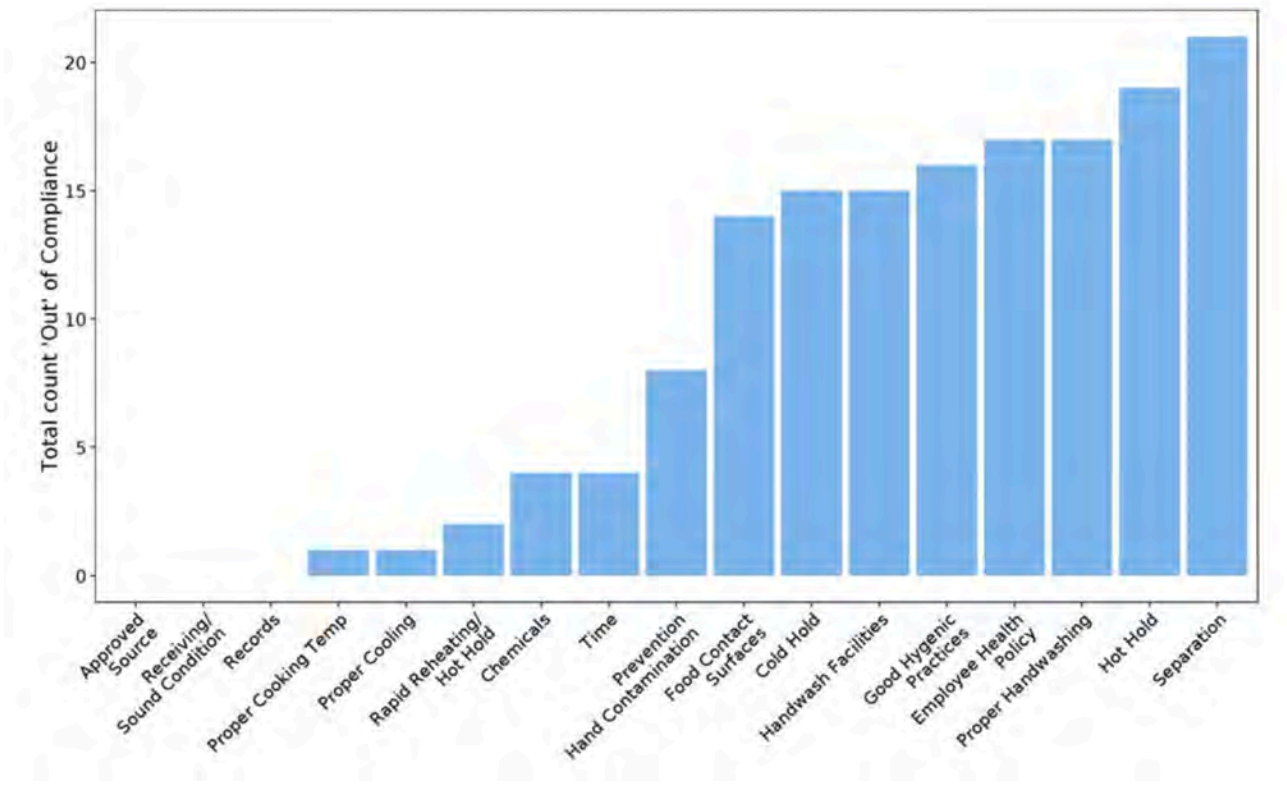

FIGURE 1. Total count out of compliance by category

establishment presents challenges, given the limitations of time and practical factors; however, eye-catching signage and other forms of outreach to promote proper hand hygiene could serve as interventions.

The results highlight challenges related to equipment and space issues in temporary establishments, as lack of adequate hand sinks may have been another contributing factor to poor hand hygiene. Limited space also increases the likelihood that contaminated equipment or surfaces will come into contact with non-contaminated food, surfaces, or equipment. In addition to space limitations, temporary eating establishments may be located at state fairs or festivals in close proximity to petting zoos and soil, introducing further opportunity for contamination when handwashing stations may not be easily accessible or used.

There are several limitations to the present study, including limited data related to establishment and employee characteristics as well as data collection occurring at a single point in time. Nonetheless, this research plays a significant role in detecting trends in food safety practices and behaviors and can serve as a baseline for future studies targeted toward food safety risk factors, in temporary establishments specifically.

This research demonstrates the need for developing relevant risk factors and data collection instruments tailored to temporary food establishments and food trucks; implementing specialized instruments would allow for tracking of risk factors that are more relevant to these types of establishments and subsequently increased ability to provide more customized methods of reducing risk factors. This work also indicates that further infrastructure and resources for routine inspection of temporary establishments is critical to prevent and curtail outbreaks, especially in view of the occurrence of outbreaks in the past *(2, 4)*. Facing challenges related to training temporary workers also needs to be addressed. Efforts to improve food handling behaviors and practices in temporary food establishments are needed to reduce the risk of foodborne disease when decisions are made related to resource dedication, intervention development, and policy evaluation. Tracking these efforts and, ultimately, the impact and effectiveness of these interventions will require additional studies.

REFERENCES

1. Conference for Food Protection. 2011. Temporary Food Establishments 2011. Available at: http://www.foodprotect.org/guides-documents/temporary-food-establishments-2011/. Accessed 20 April 2018.
2. Crump, J. A., C. R. Braden, M. E. Dey, R. M. Hoekstra, J. M. Rickelman-Apisa, D. A. Baldwin, S. J. De Fijter, S. F. Nowicki, E. M. Koch, T. L. Bannerman, and F. W. Smith. 2003. Outbreaks of *Escherichia coli* O157 infections at multiple county agricultural fairs: a hazard of mixing cattle, concession stands and children. *Epidemiol. Infect.* 131:1055–1062.
3. Faw, B., and J. Tuttle. 2014. Mobile food trucks: California EHS-Net study on risk factors and inspection challenges. *J. Environ. Health* 76:36–37.
4. Flynn, D. 2012. North Carolina state fair takes measures to prevent another *E. coli* outbreak. Food Safety News. Available at: https://www.foodsafetynews.com/2012/08/nc-state-fair-invests-measures-to-prevent-e-coli-o157h7-outbreaks. Accessed 21 September 2016.
5. Mass.gov. 2018. Retail food: food protection program resources related to retail food. Available at: https://www.mass.gov/lists/retail-food. Accessed 9 Feb 2018.
6. North Carolina Department of Health and Human Services. 2012. North Carolina food code manual. Available at: https://ehs.ncpublichealth.com/faf/docs/foodprot/NC-FoodCodeManual-2009-FINAL.pdf. Accessed 29 Sep 2018.
7. U.S. Food and Drug Administration. 2003. Developing a baseline on the occurrence of foodborne illness risk factors. Data Collection Instruction Manual.
8. U.S. Food and Drug Administration. 2010. FDA trend analysis report on the occurrence of foodborne illness risk factors in selected institutional foodservice, restaurant, and retail food store facility types (1998–2008). Available at: https://www.fda.gov/food/guidanceregulation/retailfoodprotection/foodborneillnessriskfactorreduction/default.htm. Accessed 22 July 2015.
9. U.S. Food and Drug Administration. 2013. FDA Food Code. U.S. Department of Health and Human Services. Available at: http://www.fda.gov/Food/GuidanceRegulation/RetailFoodProtection/FoodCode/ucm374275.htm. Accessed 27 September 2016.

In Memory

O. Peter Snyder, Jr.

IAFP extends sincere sympathy to the family of Dr. Oscar "Pete" Snyder. Dr. Snyder passed away March 1, 2019 at his home in Shoreview, Minnesota. He was a long-time educator and consultant in retail food quality assurance HACCP process validation, most recently serving as President of Snyder HACCP in Shoreview, Minnesota.

Dr. Snyder received his undergraduate degree in Hotel Restaurant Management from the University of Denver; his M.S. from the Massachusetts Institute of Technology; and his Ph.D. from the University of Massachusetts in Food Science and Technology. His career in the food service industry began in the late 1950s as a food R&D officer while serving in the U.S. Army. In 1974, Dr. Snyder became an Associate Professor of Food Science and Nutrition at the University of Minnesota. He founded the Hospitality Institute of Technology & Management (HITM), a food safety training, education and consulting firm in 1982, and implemented a statewide program in HACCP-based retail food operations.

An IAFP Member since 1975, Dr. Snyder served on numerous IAFP committees and Professional Development Groups (PDGs). He also served for many years on the *Food Protection Trends* Editorial Board. Dr. Snyder received the IAFP Honorary Life Membership Award in 2011.