

Sanitation in Classroom and Food Preparation Areas in Child-Care Facilities in North Carolina and South Carolina

Kelly C. Wohlgenant
Sheryl C. Cates
RTI International

Angela Fraser
Clemson University

Benjamin Chapman
Lee-Ann Jaykus
North Carolina State University

Xi Chen
Clemson University

Abstract Approximately 60% of U.S. children aged five and younger spend time in child-care settings. Such environments increase the risk of diarrheal disease, including diseases caused by enteric pathogens. To describe adherence to sanitation standards in classrooms and food preparation areas in child-care facilities, the authors conducted site visits in 40 North Carolina and South Carolina child-care facilities. Audits in up to two classrooms (rooms providing care for infants and toddlers) and the kitchen were performed using a form similar to a regulatory inspection form. Audit data were used to calculate indices to describe adherence to sanitation standards and were based on state environmental health regulations for child-care centers, the Food and Drug Administration's *Food Code 2009*, and guidance from food safety experts. Most facilities participating in the authors' study adhered to sanitation standards within the classroom; however, deficiencies with regard to sanitation in food preparation areas and refrigerator operating temperatures were noted. These results provide insight into possible risk factors for enteric disease transmission in child-care facilities.

Introduction

Children five years of age and younger are at greater risk for foodborne illness because of their developing immune systems, among other factors (Koehler et al., 2006). One Texas study found that children aged zero to two years are 17 times more likely to develop foodborne illness than children who are three to five years (Sullivan, Woodward, Pickering, & DuPont, 1984). In addition to age, child-care attendance is a risk factor for contracting diarrheal disease. The association between child-care attendance and increased risk for diarrheal disease is well documented and, depending on the study, children cared for outside the home are 2.3 to 3.5 times more likely to experience diarrheal disease than those cared for in the home (Lu et al., 2004).

In the U.S., 60% of children under six years of age spend time in nonparental child care (National Center for Education Statistics, 2005). Among children who spend time in nonparental care, 36% are cared for in center-based facilities an average of 29 hours per week and 9% spend time in home-based facilities an average of 36 hours per week (Daniel J. Evans School of Public Affairs, 2006/2007). These types of environments can be reservoirs for pathogens associated with foodborne routes. Many child-care employees are inadequately trained in proper food safety and hygiene practices, and often only the director receives formal food safety training (Enke, Briley, Curtis, Greninger, & Staskel, 2007). Lack of appropriate personal hygiene practices is a well-documented mode of transmis-

sion for foodborne illness caused by *E. coli* O157:H7, rotaviruses, *Shigella*, and other pathogens (Heymann, 2004). Sullivan and co-authors (1984) reported that diapering and handling food by the same caregiver resulted in high rates of diarrhea among children in 736 licensed child-care facilities in Texas.

Our study was designed to examine the hygiene and sanitation practices of child-care workers to learn more about potential causes of pathogen dissemination in the child-care environment. Because the known transmission routes for diarrheal illnesses are through person-to-person contact, fomites, and ingestion of contaminated food, the project team used a combination of data collection approaches (Brady, 2005). Methods included surveys of child-care facility directors, direct observations of providers within the classrooms, microbial hand and surface sampling, and environmental kitchen and classroom audits. This article presents the results of the surveys of child-care facility directors and the kitchen and classroom audits.

Methods

The institutional review boards at Clemson University, North Carolina State University, and RTI International approved the study protocol and informed consent was obtained from all participants.

Recruitment

We used convenience sampling to recruit 40 licensed center and home-based child-care facilities in North and South Carolina. Inclusion criteria included the following: 1) facility must operate year round; 2) facility must not be a drop-in only facility; 3) facility must not provide services exclusively for a special population of children (e.g., services for only mentally

TABLE 1

Calculation of Sanitation Indices

| Kitchen Sanitation Index (Index Score 0–10)^a |
|---|
| Food stored at least six inches off the floor |
| Food in closed containers or packages |
| Stove and refrigerator clean and in good repair |
| Proper dish washing set up ^b |
| Hand wash sink has soap |
| Hand wash sink has approved drying device |
| Workers wearing clean clothes during food preparation |
| Workers wearing hair restraints during food preparation |
| Workers wearing gloves during food preparation |
| Workers not wearing jewelry during food preparation |
| Classroom Sanitation Index (Index Score 0–8)^{c,d,e} |
| Soft surface toys clean and in good condition |
| Trash cans clean |
| Non-diaper trash cans lined |
| Eating surfaces clean and in good repair |
| Floor areas where children play clean |
| Hand wash sink has warm water |
| Hand wash sink has soap |
| Hand wash sink has approved drying device |

^aThe following items were omitted from the index because all observations were in compliance once missing and not applicable values were imputed: clean dishes and utensils stored at least six inches off the floor, work table clean and in good repair, and hand wash sink has warm water.

^bBased on proper sink setup/sanitizer test kit available for facilities that washed dishes by hand or dish washing machine working.

^cThe following items were omitted from the index because all observations were in compliance once missing and not applicable values were imputed: child-care providers well groomed; child-care providers in good health; children's belongings in clean, dry place; hard-surface toys clean and in good repair; and changing pads or other changing surfaces clean and in good repair.

^dApproximately 55% of home-based child-care facilities did not have a diaper trash can (e.g., soiled diapers were disposed of in a trash can outside the home); thus, the audit items related to the diaper trash can were excluded from the index.

^eSixty-seven percent or fewer classrooms had bedding, cribs, play mats, or high chairs; thus, these audit items were excluded from the index.

TABLE 2

Characteristics of Child-Care Facilities

| Characteristic | Centers (n = 27) | Homes (n = 8) | All Facilities (N = 35)^a |
|--|-----------------------------|--------------------------|--|
| Meal preparation | | | |
| Types of meals and snacks served to infants and toddlers ^b | | | |
| Meals/snacks sent in by child's parents | 74.1% | 25.0% | 62.9% |
| Meals/snacks cooked and prepared by facility | 48.1% | 87.5% | 57.1% |
| Meals/snacks purchased by facility from outside food service operation | 33.3% | 0.0% | 25.7% |
| Meals/snacks in ready-to-eat, single-serving containers purchased and prepared by facility | 14.8% | 25.0% | 17.1% |
| Other | 14.8% | 0.0% | 11.4% |
| Average number of meals served | 1.6 | 2.1 | 1.8 |
| Average number of snacks served | 1.7 | 1.4 | 1.6 |
| Food preparer has food safety certification | 42.9% | 12.5% | 34.5% |
| Employees | | | |
| Years experience as facility director | | | |
| Under 1 year | 3.7% | 0.0% | 2.9% |
| 1–5 years | 22.2% | 37.5% | 25.7% |
| 6–10 years | 29.6% | 25.0% | 28.6% |
| 11–15 years | 18.5% | 12.5% | 17.1% |
| 16 or more years | 25.9% | 12.5% | 22.9% |
| No answer | 0.0% | 12.5% | 2.9% |
| Mean number of employees | | | |
| Management | 1.6 | N/A | 1.6 |
| Child care providers | 14.1 | N/A | 13.7 |
| Food preparation employees who do not also provide child care | 0.7 | N/A | 0.8 |
| Other | 0.5 | N/A | 0.5 |
| Total | 17.0 | N/A | 16.6 |
| Average number of years of experience for all types of employees (%) | | | |
| 1–5 years | 0.0% | N/A | 0.0% |
| 6–10 years | 37.0% | N/A | 35.7% |
| 11–15 years | 44.4% | N/A | 46.4% |
| 16 or more years | 11.1% | N/A | 10.7% |
| No answer | 7.4% | N/A | 7.1% |

continued on page 22

impaired or physically challenged children); 4) facility must provide care to children less than five years old; and 5) facility must serve lunch and snack to toddlers daily.

Study incentives were tailored to the needs of each state. North Carolina directors and their staff were offered free admission to a food safety training course, and South Carolina directors received several children's books. After on-site data collection, directors were contacted by

phone for a follow-up interview and offered a \$50 gift card for their participation.

Data Collection

Site visits were conducted from January 2010 to February 2011. Of the 40 licensed facilities visited, we excluded five from the analysis dataset because they only had preschool aged children (aged three to five) present the day of the site visit. Excluding these sites

allowed for consistency so that all data was from classrooms (infant, toddler, or combined infant/toddler) in which children were still in diapers, a factor that may increase the likelihood of pathogen transmission in child-care facilities (Arvelo et al., 2009).

The final sample size included 35 facilities—27 centers (77%) and 8 homes (23%). Fourteen of the facilities (40%) were located in North Carolina and 21 (60%) were located in South Carolina. Data were collected in two classrooms at 16 facilities; thus, the sample size for classroom-level data was 51 rooms. Data were also collected from the kitchens of 29 facilities. At the time of the site visit, the facility director completed a self-administered questionnaire to collect information on the characteristics of the facility and training. We conducted a follow-up survey from June to August 2011 with 27 of the child-care facility directors to collect additional information on the facilities' sanitation practices.

Audit Forms

The audit forms were designed to assess sanitary conditions of the facilities and were primarily based on North and South Carolina's environmental health regulations for child-care centers (North Carolina Department of Environment and Natural Resources, Office of Environmental Health Services, 2007; South Carolina Department of Social Services, 2006). For conflicting regulations, the audit item was based on guidance from food safety experts and the Food and Drug Administration (FDA) *Food Code 2009* (FDA, 2013). Separate audit forms for kitchens and classrooms were developed. Each form consisted of a checklist in which data collectors were instructed to check "Yes" for compliance, "No" for deviation, or "NA" for "Not applicable," with additional space provided for notes.

The kitchen audit form collected the following information: proper storage of dry food and dishes/utensils, cleanliness and condition of equipment, compliance with hand sink requirements (e.g., soap availability), worker hygiene (if handling food during audit), compliance with dishwashing requirements, whether food thermometer was present, and whether an employee had received food safety certification. The data collector recorded whether a thermometer was present in the refrigerator and measured the ambient refrigerator temperature using a metal-stem thermometer.

TABLE 2 continued from page 21

Characteristics of Child-Care Facilities

| Characteristic | Centers (n = 27) | Homes (n = 8) | All Facilities (N = 35) |
|---|------------------|---------------|-------------------------|
| Facility Characteristics | | | |
| Type | | | |
| For profit (n = 21) | 48.2% | 100.0% | 60.0% |
| Nonprofit (n = 11) | 40.7% | | 31.4% |
| No answer (n = 3) | 11.1% | | 8.6% |
| For profit—Independently owned and operated | 92.3% | 100.0% | 95.2% |
| For profit—chain | 7.7% | | 4.8% |
| Nonprofit—Head Start ^b | 18.2% | | 18.2% |
| Nonprofit—church sponsored ^b | 54.6% | | 54.6% |
| Nonprofit—business/corporate sponsored ^b | 9.1% | | 9.1% |
| Nonprofit—public school sponsored ^b | 9.1% | | 9.1% |
| Nonprofit—other ^b | 9.1% | | 9.1% |
| Participants in Child and Adult Care Food Program | 37.0% | 75.0% | 45.7% |
| Accredited by National Association for the Education of Young Children ^b | 11.1% | 25.0% | 14.3% |
| Mean number of children | | | |
| Infants (<12 months) | 7.4 | 0.8 | 5.9 |
| Toddlers (~12–23 months) | 12.1 | 1.6 | 9.6 |
| All children | 82.9 | 6.5 | 64.9 |
| ^a Note: For some characteristics, not all 35 facility directors responded to survey question. N/A = not applicable. ^b Respondents could select multiple answers. | | | |

The classroom audit collected the following information: cleanliness and health of providers, health of children, cleanliness and condition of equipment and toys, compliance with trash can requirements for diaper and other trash cans, compliance with hand sink requirements, and cleanliness and condition of surfaces (diapering, eating, and floor areas). If the classroom had a refrigerator, the data collector recorded whether a thermometer was present and measured the ambient refrigerator temperature using a metal-stem thermometer. For audit items referring to a provider's or object's "cleanliness," the item was considered in compliance if it was free of visible dirt, soil, or debris.

Before full-scale data collection, the questionnaire and audit forms were pretested at five local child-care facilities (three centers and two homes) and minor changes were made.

Data Analysis

We computed proportions for categorical variables and means for continuous variables. We computed separate indices to provide an aggregate

measure of the sanitation of the kitchen versus the classrooms (see Table 1). For each item included in the index, a value of 0 was assigned for noncompliant items, and a value of 1 was assigned for compliant items. For cases with missing or not applicable values, data were imputed based on the distribution for centers or homes (depending on facility type). An index score was calculated by summing across all items, and then a mean index was computed for all observations. If the value for any one item was equal to 1 or compliant for all observations, then the item was omitted from the index calculation because it would have no effect across groups. Also omitted from the index calculation were audit items for which 25% or more of the facilities did not have the item evaluated. Food preparation variables, including ambient temperatures collected from the kitchen and classroom refrigerators (if present), presence of a food thermometer in kitchen, and food safety certification were not included in the sanitation indices. Analyses were conducted using SAS v. 9.2.

TABLE 3

Provision of Food Safety, Hygiene, and Sanitation Training and Written Policies and Procedures to Child-Care Facilities

| Characteristic | Facility Type (%) | | |
|--|---------------------|------------------|---|
| | Centers (n = 27) | Homes (n = 8) | All Facilities (N = 35) ^a |
| Types of training provided to new employees ^b | | | |
| Safe food handling | 70.4 | 87.5 | 74.3 |
| Hygiene practices | 81.5 | 50.0 | 74.3 |
| Sanitation practices | 92.6 | 62.5 | 85.7 |
| Types of ongoing training provided ^b | | | |
| Safe food handling | 51.9 | 87.5 | 60.0 |
| Hygiene practices | 77.8 | 50.0 | 71.4 |
| Sanitation practices | 85.2 | 50.0 | 77.1 |
| Frequency of ongoing training provided | | | |
| At least monthly | 14.8 | 0.0 | 11.4 |
| At least quarterly | 18.5 | 12.5 | 17.1 |
| At least annually | 51.9 | 50.0 | 51.4 |
| Less than annually | 0.0 | 25.0 | 5.7 |
| Never | 11.1 | 12.5 | 11.4 |
| No answer | 3.7 | 0.0 | 2.9 |
| Facility has written policy or procedure ^b | | | |
| Hand washing | 81.5 | 87.5 | 82.9 |
| Food preparation | 48.1 | 37.5 | 45.7 |
| Diaper changing | 88.9 | 87.5 | 88.6 |
| Surface washing (method for disinfecting countertops, table tops, or other surfaces) | 77.8 | 75.0 | 77.1 |
| Removing, replacing, or covering shoes when entering rooms that infants use for play | 18.5 | 0.0 | 14.3 |
| Sick employees | 74.1 | 62.5 | 71.4 |
| Sick children | 96.3 | 100.0 | 97.1 |

^aFor some characteristics, not all 35 facility directors responded to survey question.
^bRespondents could select multiple answers.

Results

Results are shown for all facilities and by type of facility (center vs. home). Statistical testing of differences was not conducted for the two types of facilities because of the small sample size.

Facility Characteristics and Training

Table 2 provides the characteristics of the child-care facilities and Table 3 describes the facilities' food safety, hygiene, and sanitation training, and written policies and procedures. Although center-based facilities most often served food sent in by parents (74.1%), home-based facilities most often prepared meals for children (87.5%). Among both cen-

ter and home-based facilities, an average of 1.8 meals and 1.6 snacks were served daily. New employee training in safe food handling, hygiene, or sanitation was provided by 91.4% or more of facilities. Most (88.6%) facilities also provided ongoing training, with 58.1% of these facilities providing such training annually. Most facilities had written sanitation and hygiene policies and procedures, but only 45.7% had written policies and procedures for food preparation.

Kitchen and Classroom Audits

Table 4 provides the results of the kitchen audits for facilities with separate food preparation areas (N = 29). Compliance was 90%

or better for many items such as clean dishes and utensils stored at least six inches off the floor and work table clean and in good repair. Fewer than 17 facilities, however, were in compliance with the following items: food handlers wearing effective hair restraints, food handlers wearing gloves, sanitizer test kit available for facilities that wash dishes by hand, and a food thermometer available.

Table 5 provides the results of the classroom audits (N = 51). Compliance was 90% or better for many items such as children's belongings in clean dry place, hard-surface toys clean and in good repair, and changing pads or other changing surfaces clean and in good repair. Only 66.0% of 47 classrooms with diaper trash cans had trash cans with hands-free covers.

Follow-Up Survey

Table 6 provides the results of the follow-up survey on additional sanitation practices. Seventy percent of the facilities washed dishes, and of these, most sanitized dishes using a Steramine solution (36.8%) or chlorine solution (31.6%).

Sanitation Indices

The mean kitchen sanitation index (0 to 10) was 7.3 (standard deviation [SD] = 1.5) for all facilities, 7.9 (SD = 1.3) for centers, and 6.0 (SD = 1.1) for homes. The mean classroom sanitation index (0 to 8) was 7.7 (SD = 0.7) for all facilities, 7.8 (SD = 0.5) for centers, and 7.4 (SD = 1.4) for homes.

Food Preparation

For facilities with separate kitchens (N = 29), 47.6% of centers and 62.5% of homes had refrigerators with ambient temperatures >39°F. For classrooms with refrigerators used to store food and beverages for children (N = 29), 40.0% of centers and 75.0% of homes had refrigerators with ambient temperatures >39°F.

For facilities with separate kitchens, 41.4% did not have food thermometers available (33.3% of centers and 62.5% of homes), and only 34.5% of the facilities' workers had food safety certifications (42.9% of centers and 12.5% of homes).

Discussion

Among both center and home-based facilities with kitchens, excellent dry food storage practices, equipment sanitation practices, and adequate dish washing equipment

was observed. In the classrooms, providers appeared to be well groomed and in good health so as to minimize risk for spreading pathogens to children. Toys and equipment such as play mats, cribs, bedding, and high chairs appeared to be clean and in good repair, and hand washing stations were adequately stocked with soap, warm water, and an approved drying device as required by state regulations. Only 46 of 51 facilities had diaper trash cans in the classrooms; however, the majority of trash cans were in compliance, meaning they were clean, covered, and plastic lined.

Although we observed a number of audit items that suggest that child-care facilities follow safe sanitation practices, we also observed items that were not in compliance with state environmental health regulations or were not recommended best practices according to the FDA *Food Code 2009* (FDA, 2013). Facilities with separate kitchens could use improvement in several areas. First, only 23.5% of the workers in centers wore effective hair restraints. Although child-care facilities are not subject to the *Food Code* requirement to wear a hat or other type of hair covering such as a hair net, we used the *Food Code* because the North and South Carolina regulations for effective hair restraints differ.

Only 33.3% of workers at both center and home-based facilities were observed to wear single-use gloves while preparing food. This was not unexpected because workers in South Carolina are not required to wear gloves and workers in North Carolina are only required to wear gloves if nails are painted or artificial. Although gloves can be a physical barrier for pathogen transfer, some studies suggest that gloves may give food workers a false sense of security and even lessen hand washing frequency (Green et al., 2007; Todd, Michaels, Greig, Smith, & Bartleson, 2010). Thus, this finding may not be of particular concern.

Only 48% of facilities that washed dishes by hand had a sanitizer test kit. In lieu of the test kit requirement, the North and South Carolina inspection agencies allow immersion of dishes for at least one minute in clean hot water at a temperature of at least 170°F. The follow-up survey found that 7 of the 12 facilities that did not have test kits were not in compliance since they did not use the immersion method. Because only a subset of facilities participated in the follow-

TABLE 4
Results for the Kitchen Audit

| Item | % of Kitchens | | |
|--|---------------------|------------------|----------------------------|
| | Centers (n = 21) | Homes (n = 8) | All Facilities (N = 29) |
| Storage | | | |
| Dry food at least 6 inches off floor (n = 28) | 90.0 | 100.0 | 92.9 |
| Dry food in closed containers/packages | 90.5 | 100.0 | 93.1 |
| Clean dishes and utensils at least 6 inches off floor | 100.0 | 100.0 | 100.0 |
| Equipment clean and in good repair^a | | | |
| Stove (n = 27) | 100.0 | 75.0 | 92.6 |
| Refrigerator (n = 28) | 95.0 | 87.5 | 92.9 |
| Work table (n = 29) | 100.0 | 100.0 | 100.0 |
| Hand sinks | | | |
| Warm water available | 95.2 | 100.0 | 96.6 |
| Soap available | 85.7 | 87.5 | 86.2 |
| Approved drying device | 90.5 | 62.5 | 82.8 |
| Workers^b | | | |
| Wearing clean clothes | 100.0 | 87.5 | 95.8 |
| Wearing effective hair restraints ^c | 23.5 | 100.0 | 16.7 |
| Wearing gloves | 47.1 | 0.0 | 33.3 |
| Not wearing jewelry | 82.4 | 71.4 | 79.2 |
| Dishwashing | | | |
| Proper sink setup for facilities that wash dishes by hand (n = 23) | 93.3 | 100.0 | 95.7 |
| Dishwashing machine working (n = 9) | 100.0 | 100.0 | 100.0 |
| Refrigerator | | | |
| Thermometers in refrigerator | 90.5 | 87.5 | 89.7 |
| Ambient temperature of refrigerators was 39°F or below as measured by data collector | 42.9 | 37.5 | 41.4 |
| Measuring device | | | |
| Sanitizer test kit (n = 23) ^d | 66.7 | 12.5 | 48.0 |
| Food thermometer | 66.7 | 37.5 | 58.6 |

^aFor kitchens with the equipment present: the number of kitchens audited with the item present is provided in the table.
^bFor kitchens with workers handling food during the audit (N = 24; n = 7 homes; n = 17 centers).
^cEvaluated based on *Food Code 2009* recommendations.
^dFor facilities that washed dishes by hand.

up survey, future research should investigate this finding.

Overall, center-based kitchens were in greater compliance with our audit form than were home-based kitchens as indicated by the sanitation index scores (7.9 centers vs. 6.0 homes). This finding is of particular concern given that a greater percentage of home-based facilities (87.5%) prepare meals and snacks for children than do center-based facilities (48.1%). These results and the fact that a smaller percentage of home-based child-care facility employees have received hygiene and

sanitation training compared with employees of center-based facilities underscore the need for increased sanitation and hygiene training for employees of home-based facilities. Our study results suggest that education for home-based facilities should stress the importance of using disposable paper towels as opposed to wash cloths or dish towels to dry hands after hand washing.

Our study findings suggest that both center- and home-based facilities can improve their food preparation practices. Many facilities (41.4%) did not have a metal-stem food

TABLE 5

Results for the Classroom Audit

| Item | % of Rooms | | |
|--|---------------------|------------------|-------------------------------|
| | Centers (n = 43) | Homes (n = 8) | All Facilities (N = 51) |
| Providers | | | |
| Child care providers well groomed | 100.0 | 100.0 | 100.0 |
| Child care providers in good health | 100.0 | 100.0 | 100.0 |
| Children | | | |
| Children in good health | 86.0 | 100.0 | 88.2 |
| Children's personal belongings in clean, dry place | 100.0 | 100.0 | 100.0 |
| Equipment/toys clean and in good condition ^a | | | |
| Bedding (n = 30) | 88.5 | 50.0 | 83.8 |
| Cribs (n = 34) | 100.0 | 80.0 | 97.1 |
| Play mats (n = 31) | 92.0 | 83.3 | 90.3 |
| Soft toys (n = 50) | 97.7 | 100.0 | 98.0 |
| Hard toys (n = 51) | 100.0 | 100.0 | 100.0 |
| High chairs (n = 24) | 95.7 | 100.0 | 91.7 |
| Trash cans ^b | | | |
| Trash cans clean (n = 50) | 97.7 | 87.5 | 96.0 |
| Diaper trash can plastic lined (n = 46) | 95.2 | 50.0 | 91.3 |
| All other trash cans plastic lined (n = 46) | 94.9 | 100.0 | 95.7 |
| Cover on diaper trash can (n = 47) | 93.0 | 75.0 | 91.5 |
| Hands-free cover on diaper trash can (n = 47) | 67.4 | 50.0 | 66.0 |
| Hand sinks | | | |
| Warm water available | 95.3 | 100.0 | 96.1 |
| Soap available | 97.7 | 87.5 | 96.1 |
| Approved drying device available | 93.0 | 87.5 | 92.2 |
| Surfaces ^c | | | |
| Changing pads/surfaces clean and in good repair (n = 49) | 100.0 | 100.0 | 100.0 |
| Eating surfaces clean and in good repair (n = 45) | 100.0 | 87.5 | 97.8 |
| Floor areas where children play clean (n = 51) | 95.3 | 87.5 | 94.1 |
| Refrigerator (n = 29) ^d | | | |
| Thermometers in refrigerator | 76.0 | 75.0 | 75.9 |
| Ambient temperature of refrigerators was 39°F or below as measured by data collector | 28.0 | 0.0 | 24.1 |

^aFor rooms with the item present. The number of rooms audited with the items is provided in the table.

^bFor rooms with trash cans. The number of rooms audited with trash cans is provided in the table.

^cFor rooms with the surface. The number of rooms audited with the surface is provided in the table.

^dFor rooms with refrigerators.

thermometer as required by state regulations to ensure that the internal temperature of cooked foods is correct. It is difficult to know the implication of this finding without knowing the exact types of foods served to children. Future research should examine the types of foods served in child-care settings;

in particular, home-based facilities that are often not subject to regulations or routine inspection and, as suggested by our study, may often prepare more meals for children than center-based facilities.

Finally, although most facilities had appliance thermometers in kitchen refrigerators,

only 41.4% had refrigerators with ambient temperatures of 39°F or below as measured by a data collector. These results suggest that potentially hazardous foods were not likely remaining at 41°F as recommended by the *Food Code*, posing a potential health risk to children. This was even more of a concern for classroom refrigerators used to store food and infant formula (75.9% of rooms had refrigerators at unsafe temperatures). Almansour and co-authors (2011) measured the temperature of sack lunches sent in by parents at child-care centers, some of which were stored in classroom refrigerators, and found that they were kept at unsafe temperatures.

Our study findings closely mimic what has been found when investigating consumer understanding of recommended refrigeration practices in which researchers found that many consumers are not aware of the recommended temperature for domestic refrigerators (Kosa, Cates, Karns, Godwin, & Chambers, 2007). A study of institutional food service settings in elementary schools found a slightly higher rate of compliance (71%) in elementary schools for keeping potentially hazardous foods at recommended holding temperatures (FDA, 2010).

Although only required by South Carolina's regulations, 34% of diaper trash cans did not have hands-free covers as recommended by the American Academy of Pediatrics guidelines (American Academy of Pediatrics, 2011). This recommendation is supported by a study conducted by Kotch and co-authors (2007) that showed that child-care centers that had specialized diaper-changing and other equipment including hands-free diaper trash receptacles had a significant reduction in the frequency of diarrheal illness among children. Therefore, child-care facilities can potentially improve sanitation by simply incorporating trash cans with hands-free covers.

It is important to consider the limitations of our study. First, the site visits were only conducted in 35 facilities in North and South Carolina that were recruited via convenience sampling. Thus, study findings are not generalizable to a larger population of child-care facilities. Additionally, site visits were not unannounced. Therefore, participants may not have behaved as they would normally—a bias known as the Hawthorne effect. Data were only collected during one point in time, so it is possible that observed practices are

not representative of the facilities' typical practices. Finally, although facilities showed compliance with some practices, and a relative lack of compliance with other practices, the public health significance of these findings is unknown because data on facility diarrheal rates was not collected.

Despite these limitations, our study has informed the development of educational materials for the training of child care workers (www.fightbac.org/campaigns/fight-bac-goes-to-childcare).

Conclusion

Overall, child-care facilities audited in our study adhered to recommended sanitation practices in the classrooms, but improvements are needed with regard to sanitation practices in facility kitchens. This is especially true for home-based facilities where more meals are prepared for children than in center-based facilities, and, unlike center-based facilities, home-based facilities are not subject to regular environmental health inspections in many states. With regard to kitchen and classroom refrigerators, improvements are needed to ensure the temperature remains at 39°F or below. It is recommended that staff periodically check that refrigerator

TABLE 6
Results of the Follow-Up Survey

| Item | % of Rooms | | |
|--|---------------------|------------------|-------------------------------|
| | Centers (n = 24) | Homes (n = 3) | All Facilities (N = 27) |
| Wash dishes | 66.7 | 100.0 | 70.4 |
| If wash dishes, methods used for sanitizing dishes ^a | | | |
| Submerge dishes in a Steramine solution | 43.8 | 0 | 36.8 |
| Submerge dishes in hot water at least 170°F | 12.5 | 0 | 10.5 |
| Submerge dishes in a chlorine solution | 37.5 | 0 | 31.6 |
| Use a dishwashing machine (e.g., dishwasher) with a sanitizing cycle | 6.3 | 33.3 | 10.5 |
| Other method used to sanitize or clean dishes | 18.8 | 100.0 | 31.6 |

^aRespondents could select multiple answers.

thermometers are calibrated properly and check the ambient temperatures of the refrigerators daily. Our study provided insight into the potential transmission modes for enteric pathogens in child-care facilities in North and South Carolina and identified how facilities can improve sanitation practices. Increased

education for staff that is focused on the gaps identified can potentially prevent young children from contracting foodborne illness. 🐜

Corresponding Author: Sheryl C. Cates, RTI International, 3040 Cornwallis Road, Research Triangle Park, NC 27709. E-mail: scc@rti.org.

References

Almansour, F.D., Sweitzer, S.J., Magness, A.A., Calloway, E.E., McAllaster, M.R., Roberts-Gray, C.R., Hoelscher, D.M., & Briley, M.E. (2011). Temperature of foods sent by parents of preschool-aged children. *Pediatrics*, 128(3), 519–523.

American Academy of Pediatrics. (2011). *Health promotion and protection. National health and safety performance standards: Guidelines for out-of-home child-care (3rd ed.)*. Retrieved from http://nrckids.org/CFOC3/PDFVersion/PDF_Color/CFOC3_ch3.pdf

Arvelo, W., Hinkle, C.J., Nguyen, T.A., Weiser, T., Steinmuller, N., Khan, F., Gladbach, S., Parsons, M., Jennings, D., Zhu, B.P., Mintz, E., & Bowen, A. (2009). Transmission risk factors and treatment of pediatric shigellosis during a large daycare center-associated outbreak of multidrug resistant *Shigella sonnei*: Implications for the management of shigellosis outbreaks among children. *The Pediatric Infectious Disease Journal*, 28(11), 976–980.

Brady, M.T. (2005). Infectious disease in pediatric out-of-home child-care. *American Journal of Infection Control*, 33(5), 276–285.

Daniel J. Evans School of Public Affairs, University of Washington. (2006/2007). *Fact sheet: Percent of all non-parental child-care hours by type of child-care*. Seattle: Author.

Enke, A.A., Briley, M.E., Curtis, S.R., Greninger, S.A., & Staskel, D.M. (2007). Quality management procedures influence the food safety practices of child-care centers. *Early Childhood Education Journal*, 35(1), 75–81.

Green, L.R., Radke, V., Manson, R., Bushnell, L., Reimann, D.W., Mack, J.C., Motsinger, M.D., Stigger, T., & Selman, C.A. (2007). Factors related to food worker hand hygiene practices. *Journal of Food Protection*, 70(3), 661–666.

Heymann, D.L. (2004). *Control of communicable diseases manual* (pp. 139, 161, 230, 225–226, 248, 250, 488–489, 514). Washington, DC: American Public Health Association.

Koehler, K.M., Lasky, T., Fein, S.B., Delong, S.M., Hawkins, M.A., Rabatsky-Ehr, T., Ray, S.M., Shiferaw, B., Swanson, E., & Vugia, D.J. (2006). Population-based incidence of infection with selected bacterial enteric pathogens in children younger than five years of age, 1996–1998. *The Pediatric Infectious Disease Journal*, 25(2), 129–134.

Kosa, K.M., Cates, S.C., Karns, K., Godwin, S.L., & Chambers, D. (2007). Consumer home refrigeration practices: Results of a web-based survey. *Journal of Food Protection*, 70(7), 1640–1649.

References

- Kotch, J.B., Isbell, P., Weber, D.J., Nguyen, V., Savage, E., Gunn, E., Skinner, M., Fowlkes, S., Virk, J., & Allen, J. (2007). Hand-washing and diapering equipment reduces disease among children in out-of-home child-care centers. *Pediatrics*, 120(1), e29–36.
- Lu, N., Samuels, M.E., Shi, L., Baker, S. L., Glover, S.H., & Sanders, J.M. (2004). Child day care risks of common infectious diseases revisited. *Child: Care, Health & Development*, 30(4), 361–368.
- National Center for Education Statistics, U.S. Department of Education. (2005, November). *Child-care and early education arrangements of infants, toddlers, and preschoolers: 2001*. Retrieved from <http://nces.ed.gov/pubs2006/2006039.pdf>
- North Carolina Department of Environment and Natural Resources, Office of Environmental Health Services. (2007). *North Carolina child care regulations* (15A NCAC 18A .2800, pp. 1–24). Retrieved from <http://nrckids.org/index.cfm/resources/state-licensing-and-regulation-informationnorth-carolina-regulations/>
- South Carolina Department of Social Services. (2006). *Child-care licensing and regulatory services operating manual*. Retrieved from <http://www.state.sc.us/dss/cdclrs/manual/index.html>
- Sullivan, P., Woodward, W.E., Pickering, L.K., & DuPont, H.L. (1984). Longitudinal study of occurrence of diarrheal disease in day care centers. *American Journal of Public Health*, 74(9), 987–991.
- Todd, E.C., Michaels, B.S., Greig, J.D., Smith, D., & Bartleson, C.A. (2010). Outbreaks where food workers have been implicated in the spread of foodborne disease. Part 8. Gloves as barriers to prevent contamination of food by workers. *Journal of Food Protection*, 73(9), 1762–1773.
- 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)—Institutional food service*. Retrieved from <http://www.fda.gov/Food/GuidanceRegulation/RetailFoodProtection/FoodbornellnessRiskFactorReduction/ucm223293.htm>
- U.S. Food and Drug Administration. (2013). *FDA Food code 2009*. Retrieved from <http://www.fda.gov/Food/GuidanceRegulation/RetailFoodProtection/FoodCode/UCM2019396.htm>

Save Over \$50 When You Purchase

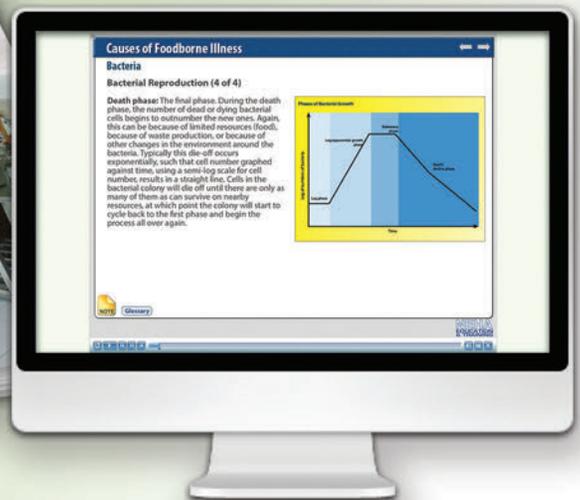
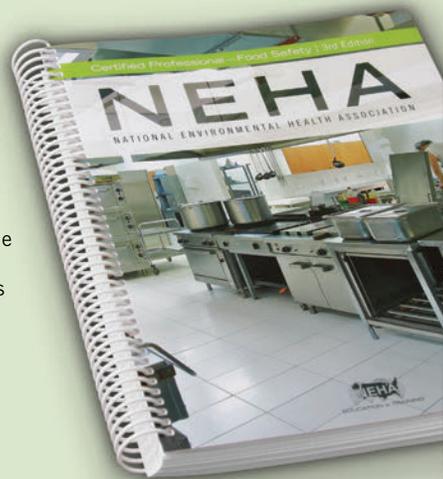
CP-FS Study Manual Together With The CP-FS Online Prep Course

All-New CP-FS Study Manual

- Causes and prevention of foodborne illness
- HACCP plans and active managerial control
- Cleaning and sanitizing
- Pest control
- Risk-based inspections
- Food defense
- Food emergencies and foodborne illness outbreaks
- Conducting facility plan reviews

CP-FS Online Exam Prep Course

- 40 self-paced lessons covering core CP-FS concepts
- Concise topic summaries
- Focused video tutorials by food safety experts
- Fully illustrated
- Short quiz after every lesson
- Final practice exams to build confidence



For more information or to purchase the CP-FS Study Bundle, go to: nehahaccp.org