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Volume 77, No. 10 June 2015

DOES IT WORK?

Follow-up Inspections as a Tool in Reducing Critical Violations

full service restaurants are 1.4 to 2x more likely to have violations after a follow-up inspection compared to fast food restaurants

Twofold increase in the odds of being given one of the following violations during a follow-up inspection

- poor personal hygiene
- improper holding temperatures
- poor equipment cleanliness
- cross contamination
- improper sanitizing concentration

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ABOUT THE COVER

Many regulatory agencies are trying to find ways to improve food safety, decrease regulatory infractions, and decrease the risk of foodborne outbreaks. The results of the study described in our cover article this month, "The Effect of Follow-up Inspections on Critical Violations Identified During Restaurant Inspections," indicate that restaurants being subjected to the most severe consequences resulting from poor food safety practices (i.e., closure, fines) does not appear to be a deterrent for poor food safety practices in the future. The staff at these restaurants may need more intensive intervention, training, or permanent closure to ensure that food safety standards are met.

See page 8.

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PRESIDENT'S MESSAGE

Carolyn Hester Harvey, PhD, CIH, RS, DAAS, CHMM

Closing Thoughts and the Road Forward

My year as president of NEHA is coming to a close. I am very grateful to each of you for your support and encouragement during the past year. As we started on a new road of discovery in July 2014, the board of directors had a monumental task to replace a person who had led NEHA for over 31 years. We also had the enormous responsibility of maintaining NEHA operations and keeping the lights on. As I wrote in my first column, the most important item on the agenda during my presidency would be hiring a new executive director for NEHA. Many of you e-mailed or called me to express your support for NEHA and the board of directors as we began a search for a new executive director who could lead NEHA into the 21st century. The executive search team was formed at the April 2014 board of directors meeting and immediately began work to identify a search firm to guide us through the process.

In late September, the board of directors met to discuss the ongoing operations of NEHA. After review and discussions regarding current operations, the board of directors voted to hire an interim executive director. The board wisely chose a past president to lead NEHA until we found a permanent executive director. Brian Collins, 2012–2013 NEHA president, had recently retired after serving for over 25 years as an environmental health director. His familiarity with NEHA as a large and complex organization was very helpful in which he was able to draw upon his experiences as a board member and having gone through the leadership from second vice president to past president. His thorough knowledge of NEHA, management skills, and the profession gave him an insight into what was needed during this transition period. Brian was and continues to be the absolute best choice for leading NEHA in the interim while we worked to identify and bring on board our new executive director. My appreciation to Brian for stepping up to the plate and taking on this role for NEHA is boundless.

> *Please know of my deep appreciation for providing me with the opportunity to serve you and NEHA.*

By late fall our search firm had received over 40 applications for the NEHA executive director position. The executive search team spent the next eight weeks working on reducing the number of applicants to a smaller group whom they interviewed via Skype. Four candidates were selected for in-person interviews with the board of directors and the executive search team. Our normal December board of directors' meeting was moved to the second week of January. At this board meeting, the executive search team and the entire board of directors interviewed the four candidates whom we had brought to Denver. After much discussion, questions, and comments, the board of directors in conjunction with the executive search team voted on a new executive director. Our unanimous choice was Dr. David Dyjack. Dr. Dyjack, as you may have read in last month's column, was the most qualified candidate and his expertise and knowledge about all of the boards' areas of concern was admirable, and even more so was his vision for NEHA and our profession moving forward.

Our new executive director started officially on May 4. Brian Collins will continue to manage NEHA and work with Dr. Dyjack to ensure a seamless transition. This year has brought the board together in a new way including having our October board of directors meeting in person. The board of directors has excelled this year, enabling NEHA to continue to move forward and to adjust to the changes that are inherent in management and our dynamic profession.

As I look back on my year as president, I have found NEHA to be an organization of and for people who care greatly about environmental health and ordinary citizens. It has been a privilege to work with our wonderful board of directors as they worked tirelessly to sustain and improve our organization. As board members, we are volunteers, and most if not all of us have full-time jobs. This year has been a challenge for NEHA, its members, its staff, and its board. The staff, management, and board have given more of their time, thought, and energy than at any other period in NEHA's recent history. Our year has been one most of us are looking forward to closing out and moving on with a new executive director and a future in which we can all be participating members of the new and improved NEHA.

I want to assure you we have chosen a new executive director who will lead NEHA to greater heights with your support and involvement. I believe you will find him to be an excellent choice to continue the current work and enhance the opportunities of NEHA for which many of you have contributed a good part of your working lives as active members.

As I close my last column, please know of my deep appreciation and affection for you as members, and for providing me with the opportunity you gave me to serve you and NEHA as your president. Your support and kind thoughts throughout the past year were greatly appreciated. I look forward to visiting with many of you in Orlando, Florida, at the 2015 Annual Educational Conference & Exhibition on July 13–15 to usher in a new era for NEHA.

Dr. Carolyn Harvey
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The Effect of Follow-up Inspections on Critical Violations Identified During Restaurant Inspections

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Abstract **Follow-up inspections are recommended by the Food and Drug Administration as a tool to verify corrections to violations cited during restaurant inspections. The effectiveness of follow-up inspections as a tool in reducing critical violations is unknown, however. The purpose of the authors' study was to assess whether a serious violation that leads to a follow-up inspection reduces the probability of specific critical violations occurring during the next routine inspection. Outcome measures included poor personal hygiene, improper holding temperatures, substandard equipment cleanliness, potential cross contamination, and improper sanitizer concentration. The risk of having a violation increased for all targeted critical violations during inspections conducted after a follow-up inspection compared to restaurant inspections without a prior follow-up, when adjusting for restaurant type, inspector experience, and season.**

Introduction

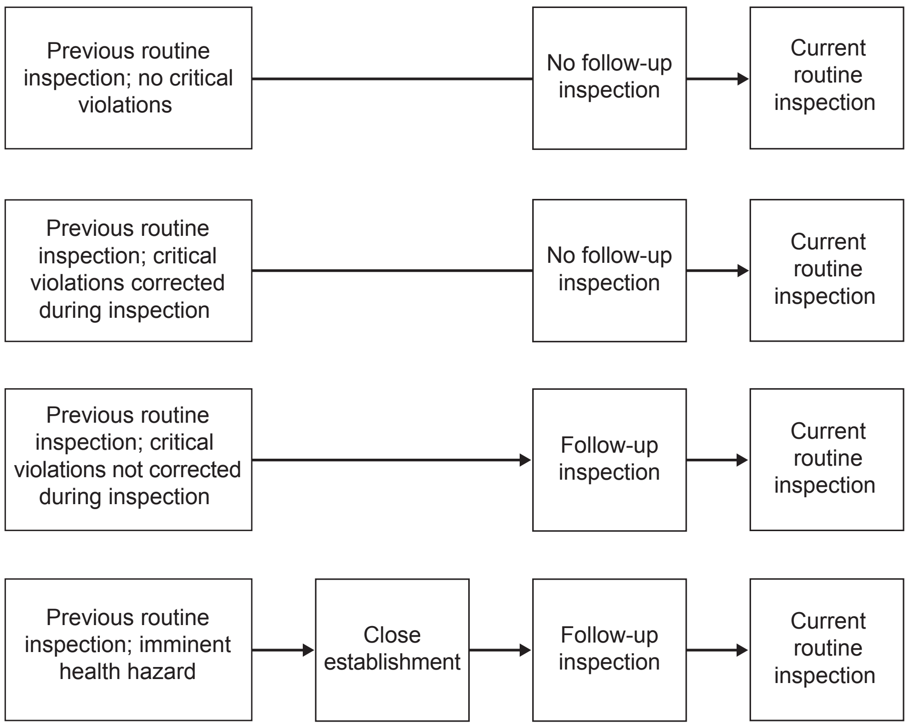
Periodic inspection of restaurants is a key strategy to ensure safe food handling procedures are carried out by commercial food establishments. As specified in the Voluntary National Retail Food Regulatory Program Standards, if inspectors find conditions that pose an imminent health hazard (lack of water, sewage backed up, inability to hold food at proper temperatures, lack of handwashing facilities, etc.) they must immediately close the restaurant and not allow the establishment to resume business until they have been subject to a follow-up inspection to document that all deficiencies have been corrected (Food and Drug Administration [FDA], 2011). The establishment may also be closed if other critical violations exist that cannot be resolved during the inspection. These standards have been adopted by at least 46 of the 56 states and territories (FDA, 2009).

In addition to the closure-for-imminent-health-hazard requirement, the Salt Lake County Health Department (SLCoHD) Food Program Guidelines, in accordance with FDA recommendations, include a requirement that inspectors conduct a follow-up inspection and assess a $100 fee if a restaurant is cited for multiple nonimminent critical violations (Salt Lake County Health Department Bureau of Food Protection, 2011). These violations include but are not limited to inadequate knowledge as demonstrated by excessive violations and the inability to properly wash and sanitize equipment and utensils. The process of determining whether a restaurant should be reinspected is illustrated in Figure 1.

The purpose of our study was to assess the effectiveness of follow-up inspections in reducing critical violations by examining whether enforcement actions (closures, fines, etc.) related to a serious violation that led to a follow-up inspection reduced the probability of specific critical violations occurring during the next routine inspection. The Food and Drug Administration (FDA) believes that follow-up inspections are a necessary component for reducing the occurrence of foodborne illness risk factors. Standard 6 of the Voluntary National Retail Food Regulatory Program Standards, which is intended to focus regulatory agencies' activities on controlling foodborne illness risk factors, states enforcement activities should "result in follow-up actions for out-of-control risk factors and timely correction of code violations." No published studies exist, however, that have examined the effect of follow-up inspections on subsequent inspection results. A search of PubMed and EBSCOhost Web Databases returned no published studies that have

FIGURE 1

Inspection Flow Chart



examined the effect of closures on subsequent inspection results.

Conducting follow-up inspections consumes valuable resources. SLCoHD inspectors conducted 263 follow-up inspections during the study period (Table 1). It is imperative that effective and efficient activities be conducted due to the economic conditions facing local health departments. Therefore an effectiveness evaluation of follow-up inspections is necessary. Follow-up inspections should be conducted to ensure imminent hazards have been corrected, but whether follow-up inspections are effective in creating long-term improvement is unknown. Alternative methods of correction may be preferred to ensure fiscal responsibility and risk reduction if follow-up inspections are not effective.

Methods

Study Design

Our study was a retrospective analysis of restaurant inspection results conducted by SLCoHD between January 1, 2008, and April 1, 2011. The study was limited to fast food and full service restaurants, which comprise almost 75% of the restaurants in Salt Lake County. Other restaurant types include smaller, low-risk establishments (convenience stores, pizza shops, snow cone shacks, etc.), which do not have the processes, menus, and procedures generally found in fast food and full service restaurants. A total of 5,255 routine and follow-up inspections were conducted at 1,322 restaurants during the study period.

Most aspects of safe food provisioning are behavioral, from the use of gloves to checking and maintaining proper temperatures to ensuring proper sanitizer concentration. Behavioral theories can be used to help explain workers' food handling behaviors. The Theory of Planned Behavior, first presented by Ajzen (1991), has been applied in a variety of settings. In this theory behavior is primarily a result of intention. Intention is determined by attitudes about the behavior, perceived behavioral control, and social norms about these behaviors. We postulated that the follow-up inspection, with its formality and potentially costly consequences, creates an environment that impacts workers' attitudes about the specific behaviors involved in proper food handling. In particular the education and persuasion provided by an effective food inspector can increase the workers' perception of their ability to follow required food handling practices. These impacts on attitudes and perceived behavioral control at the individual level create a new social norm where more workers carry out, and expect others to carry out, appropriate food handling behaviors.

Outcome Measures

In our study the outcome measures were citations for five specific critical violations during an inspection. The five critical violations used were poor personal hygiene, improper holding temperatures, poor food contact equipment cleanliness, protection from cross contamination, and improper sanitizer concentration. These specific critical violations were chosen because they are the five most frequently cited critical violations in Salt Lake County. The use of critical violations in lieu of foodborne illness cases as a national performance measure to assess compliance with the food code has been recommended by FDA (FDA, 2000).

Statistical Analysis

Comparisons of the proportion of inspections during which each of the five outcome critical violations occurred were compared based on whether the restaurant had been subject to a follow-up inspection immediately prior to the inspection or not (Figure 1). Comparisons were also made distinguishing those restaurants where a critical violation had occurred during the routine inspection that led to the follow-up inspection and whether this critical violation was of the same type as the outcome critical violation.

Multivariate logistic regression models were used to assess the relationship between the occurrences of a follow-up inspection on the odds of a specific critical violation during the subsequent routine inspection, controlling for other factors thought to be associated with the outcome measures. Odds ratios (*ORs*) were used to describe the effect of the follow-up inspection in reducing the occurrence of critical violations.

The covariates included restaurant type, season, and inspector experience. Restaurant type delineated fast service and full service restaurants. Season was described as winter (December, January, February), spring (March, April, May), summer (June, July, August), and fall (September, October, November). An "experienced inspector" was defined as an inspector with more than a year of experience. As such a given inspector may have been categorized as "inexperienced" for inspections conducted early in the study and "experienced" for inspections late in the study. Inspector experience may affect the number of violations identified during a routine inspection. New inspectors may be more critical during inspections whereas repeat inspectors tend to identify fewer violations over time (Jin & Lee, 2012). Experienced inspectors may be more willing not to cite a violation if it is corrected during the inspection, especially if the inspector has developed a relationship with restaurant personnel.

Two model specifications were used in the analysis. In the first model specification (model specification 1), the effect of having a follow-up inspection for any reason was used as the primary risk factor. The second model specification used a three-level variable as the primary risk factor. In this scheme each inspection was classified as 1) no preceding follow-up inspection (referent group); 2) preceding follow-up inspection where a critical violation did not occur of the same type as the dependent variable during the routine inspection that led to the follow-up inspection; and 3) preceding follow-up inspection where a critical violation occurred of the same type as the dependent variable during the routine inspection that lead to the follow-up inspection.

A generalized estimating equation estimator with a first order autoregressive (AR1) correlation structure was utilized to account for any correlation between the inspections conducted at individual restaurants. A comparison of correlation structures determined the AR1 structure performed as well as other correlation structures. Data were analyzed using Stata version 9.

Results

Of the 5,255 routine inspections used in this analysis, 5.0% (n = 263) were preceded by a follow-up inspection (Table 1). The number of fast food restaurants was approximately twice the number of full service establishments. The percentage of inspections conducted in summer was lower than other seasons and the majority of inspections were conducted by experienced inspectors.

The percentages of inspections with and without matching violations cited during the inspection that led to the follow-up and the

TABLE **1**

Inspection Distribution by Independent Variable, Number, and Percentage

Variable	Previous Follow-up Inspection		Total
	Yes # (%)	No # (%)	#
Critical violation			
Holding temperature	135 (8.6)	1141 (91.4)	576
Personal hygiene	111 (8.6)	1178 (91.4)	1289
Equipment cleanliness	121 (8.0)	1391 (92.0)	1512
Cross contamination	59 (9.2)	586 (90.8)	645
Sanitizer concentration	37 (9.5)	354 (90.5)	391
Restaurant type			
Fast food restaurant	164 (4.7)	3313 (95.3)	3477
Full service restaurant	99 (5.6)	1679 (94.4)	1778
Season			
Winter	83 (5.0)	1572 (95.0)	1655
Spring	71 (4.9)	1384 (95.1)	1455
Summer	46 (4.8)	921 (95.2)	967
Fall	63 (5.4)	1115 (94.6)	1178
Inspector experience			
Inexperienced	32 (5.4)	561 (94.6)	593
Experienced	231 (5.0)	4431 (95.0)	4662

TABLE **2**

Percentage of Inspections With and Without Matching Violations in Inspections Conducted Before and After a Follow-up Inspection

Group	#	%
No previous follow-up inspection	4992	95.0
Holding temperature violation in inspections before and after follow-up?		
Yes	179	3.4
No	84	1.6
Personal hygiene violation in inspections before and after follow-up?		
Yes	109	2.1
No	154	2.9
Equipment cleanliness violation in inspections before and after follow-up?		
Yes	152	2.9
No	111	2.1
Cross-contamination violation in inspections before and after follow-up?		
Yes	63	1.2
No	200	3.8
Sanitizer concentration violation in inspections before and after follow-up?		
Yes	45	0.9
No	218	4.1

TABLE **3**

The Effect of Follow-up Inspection Results on Specific Critical Violations by Before and After Follow-up, Restaurant Type, Season, and Inspector Experience

Variable	Holding Temperature a*OR*[a] (*p*-Value)	Personal Hygiene a*OR* (*p*-Value)	Equipment Cleanliness a*OR* (*p*-Value)	Cross Contamination a*OR* (*p*-Value)	Sanitizer Concentration a*OR* (*p*-Value)
Model specification 1					
Previous follow-up inspection (no = referent)	1.83 (<.001)	1.96 (.00)	1.67 (<.001)	1.68 (<.001)	1.92 (<.001)
Fast food vs. full service (fast food = referent)	1.96 (<.001)	1.59 (<.001)	1.45 (<.001)	1.39 (<.001)	1.56 (<.001)
Experienced inspector (no = referent)	0.93 (.49)	1.00 (.99)	0.95 (.60)	1.08 (.57)	1.12 (.53)
Season (winter = referent)					
Spring	0.93 (.33)	1.00 (.97)	0.91 (.24)	0.97 (.79)	0.97 (.81)
Summer	0.93 (.41)	0.99 (.90)	1.09 (.31)	0.94 (.61)	1.07 (.65)
Fall	0.87 (.10)	0.91 (.31)	0.88 (.12)	0.95 (.63)	0.71 (.03)
Model specification 2					
Without matching violations before and after follow-up (no follow-up = referent)	1.67 (.02)	1.88 (<.001)	1.45 (.06)	1.39 (<.001)	1.56 (<.001)
With matching violations before and after follow-up (no follow-up = referent)	1.91 (<.001)	2.07 (<.001)	1.85 (<.001)	1.90 (.04)	3.42 (<.001)
Fast food vs. full service (fast food = referent)	1.95 (<.001)	1.59 (<.001)	1.45 (<.001)	1.40 (<.001)	1.56 (<.001)
Experienced inspector (no = referent)	0.93 (.45)	1.01 (.94)	0.95 (.60)	1.80 (.59)	1.12 (.55)
Season (winter = referent)					
Spring	0.93 (.33)	1.00 (.96)	0.91 (.23)	0.97 (.75)	0.97 (.84)
Summer	0.93 (.38)	0.98 (.87)	1.09 (.32)	0.94 (.57)	1.07 (.64)
Fall	0.87 (.10)	0.92 (.31)	0.88 (.11)	0.94 (.60)	0.72 (.03)

[a]a*OR* = adjusted odds ratio.

inspection subsequent to the follow-up are listed in Table 2. The "yes" category included the number of inspections with matching violations cited during inspections conducted immediately before and after the follow-up inspection. The "yes" category does not imply that all of the violations counted were cited in the inspection conducted before the follow-up inspection. The inspection was counted in the "no" category if the violation was not cited during routine inspections conducted before and after the follow-up inspection. Holding temperature and equipment cleanliness violations had a larger percentage of inspections in which those violations were cited during inspections conducted before and after the follow-up compared to those without matching violations.

In the multivariable models, the risk of having a violation increased for all targeted critical violations during inspections conducted after a follow-up inspection compared to restaurant inspections without a prior follow-up, when adjusting for restaurant type, inspector experience, and season (Table 3). The adjusted *OR*s were significant for all target violations (a*OR* range = 1.67–1.96) with the largest *OR*s associated with personal hygiene violations (a*OR* = 1.96, $p < .001$).

Compared to fast food restaurants, full service restaurants were 1.4 times to 2 times more likely to have violations in all of the targeted areas after a follow-up inspection. Inspector experience and season were not significantly different in any of the violations with the exception of sanitizer concentration violations cited in fall compared to winter (a*OR* = 0.71, $p = .03$).

In the violation-specific models (model specification 2), increased odds existed of each violation if the same violations were cited in the inspection that resulted in a follow-up inspection (a*OR* range = 1.85–3.42). Increased odds also occurred of each targeted violation if the same violations were not cited during inspections conducted before and after the follow-up inspection (a*OR* range = 1.45–1.88), although the odds were lower than if the same violations were cited. The remaining results were essentially the same as the first set of models: full service establishments were more likely to be cited for the targeted violations, while the other factors were not significantly associated with the occurrence of the violation. As in the first set of models, however, sanitizer concentration violations were significantly lower in inspections conducted in the fall compared to winter (*aOR* = 0.72, *p* = .03).

Discussion

Having been subject to the most severe consequences resulting from poor food safety practices (i.e., closure, fines) does not appear to be a deterrent for poor food safety practices in the future. In fact, for each critical violation studied, the frequency of critical violations cited by inspectors was significantly higher among those restaurants that had received a follow-up inspection after their previous routine inspection. Jin and Lee (2012) found similar results and concluded follow-up inspections may encourage temporary improvement but are not effective in promoting long-term compliance. These findings are also consistent with recent studies indicating that allocation of additional enforcement resources toward repeat offenders may be less efficient than random inspections (Gray & Shimshack, 2011).

In the multivariable analysis, the *OR*s for all of the five violations examined in our study indicate nearly a twofold increase in the odds of being given a critical violation, controlling for restaurant type, season, and inspector experience. When considering only those situations where a critical violation occurred of the same type as the outcome measure being considered during the routine inspection that led to the follow-up inspection, the results were the same.

Full service restaurants were significantly more likely to be cited for each of the targeted violations in all model specifications. This effect may be due a number of factors including less complex menus and processes or corporate requirements and training found in some fast food establishments. Additional stratification of restaurant food type (pizza, ethnic foods, etc.) and primary language spoken by restaurant owner and mangers was not conducted due to a lack of appropriate data; however, that type of information may be valuable in assessing valid relationships. Season and inspector experience did not appear to affect the results.

To our knowledge ours was the first study examining the effect of severe regulatory action on subsequent adherence to food safety regulations. One study conducted in Oklahoma in 2006 examined recurrent critical violations based on restaurant type, local and national chain affiliation, and inspector variability (Phillips, Elledge, Basara, Lynch, & Boatright, 2006). The authors concluded that recurrent violations were indicative of differences among conditions in the establishments and not inspection practices. That study did not examine the effect of follow-up inspections on critical violations, however.

Many regulatory agencies are trying to find ways to improve food safety, decrease regulatory infractions, and decrease the risk of foodborne outbreaks. The results of our study indicate that severe regulatory actions do not act as a deterrent to future poor practices or have other positive impacts on food safety. Rather, the results seem to indicate that a subset of establishments do not practice needed food safety skills and are not compelled to change their inadequate practices in spite of regulatory action. The management and workers of such restaurants may need more intensive intervention, training, or permanent closure, to ensure that food safety standards are met and that the public is protected from deficient food handling practices.

Conclusion

Additional studies may address this issue. SLCoHD recently adopted a graduated penalty schedule in which the closure period for critical violations increases with the number of times a restaurant is closed. Revocation of the restaurant permit occurs after the third closure. Future studies will be required to assess the effectiveness of the new penalty schedule. An assessment of restaurant owners and managers' attitudes and active managerial controls may also provide direction for future training and other interventions. External validity is a limitation with the current study due to the data that were available. Additional studies using randomized assignment of restaurants may be useful in determining whether the study is applicable to other jurisdictions.

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Change in Childhood Lead Exposure Prevalence With New Reference Level

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Abstract **In 2012, the Centers for Disease Control and Prevention changed the "actionable" reference blood lead level from 10 µg/dL to 5 µg/dL, representing the highest 2.5 percentile of lead levels nationwide. In a high-risk urban community, the prevalence of children classified as lead exposed increased ninefold, from 1% to 9.1% ($p < .0001$) with the new reference level. This dramatic increase in the prevalence of children newly classified as lead exposed will require additional health care and public health resources for tracking, surveillance, and home lead abatement.**

Introduction

Lead poisoning causes a variety of health problems, ranging from subtle behavior changes to fatal encephalopathy (American Academy of Pediatrics Committee on Environmental Health [AAPCEH], 2005). Lead exposure in children in the U.S. results from a variety of environmental sources, including lead paint, lead pipes, and leaded gasoline (AAPCEH, 2005). Although banned in 1978, lead paint in older homes remains the most significant source of exposure. In addition, the lead content of soil remains high in some areas due to contamination with pre-1970s leaded gasoline. Young children are at high risk of lead exposure because of their hand-to-mouth behavior, which leads to ingestion of lead paint chips, dust, and soil (AAPCEH, 2005).

Children who are living in poverty or foster homes, enrolled in Medicaid, or living in pre-1978 housing are at highest risk for lead exposure (AAPCEH, 2005; Chung, Webb, Clampet-Lundquist, & Campbell, 2001; Raymond, Wheeler, Brown, & Centers for Disease Control and Prevention, 2011). At-risk children are routinely screened for elevated blood lead levels (BLLs) at one and two years of age. Children who screen positive are periodically retested, provided health education, treated if necessary, and possibly referred to early intervention services. In addition, their housing may need lead abatement.

While the effects of lead exposure have been known for many years, more recent data have documented that no safe level of lead in the blood exists. A study correlating IQ and BLL demonstrated the sharpest decrease in IQ is associated with BLLs of less than 10 µg/dL (Canfield et al., 2003).

In 1991, the Centers for Disease Control and Prevention (CDC) defined the BLL that "should prompt public health action" as 10 µg/dL (CDC, 1991). In 2012, CDC changed the "actionable" reference lead level from 10 µg/dL to 5 µg/dL (CDC, 2012). The new reference value is based on the 97.5th percentile of the National Health and Nutrition Examination Survey's BLL distribution in children (Wheeler, 2013). With this new reference value, CDC estimates 450,000 children in the U.S. are lead exposed (CDC, 2012). Newly classified lead-exposed children, however, will aggregate disproportionately in high-risk communities. CDC recommends "using this reference value to identify high-risk childhood populations and geographic areas most in need of primary prevention (CDC, 2012)."

The majority of the children receiving care at our academic urban pediatric practice are enrolled in Medicaid and live in a community where most of the housing stock was built before 1978 (Campbell et al., 2011). Our study was designed to evaluate the change in prevalence of children classified as lead exposed using the old and new "actionable" lead reference values in our practice. This information is important to assess the resources required to monitor, educate, treat, and refer the additional children newly classified as lead exposed.

Methods

We conducted a retrospective cross-sectional study of all BLLs drawn between November 29, 2010, and October 1, 2012, in children ≤5 years of age at an urban, academic, hospital-based pediatric practice. The practice provides care to a high-risk community in Philadelphia where 90% of housing was built pre-1978 (Campbell et al., 2011). Most children followed at the practice are minority (78% African American, 12% Latino) and low income (85% Medicaid, 10% uninsured). In this practice, children are routinely screened for lead exposure around 12 months and again on or after 24 months of age. If not screened previously, children are screened before their fifth birthday.

All levels were drawn via venipuncture and processed by Quest Laboratories. Only

TABLE **1**

Prevalence of Children Under Five Years of Age Classified as Lead Exposed Using the 10 µg/dL and 5 µg/dL Reference Levels

Blood Lead Level	All Children *N* = 1948	<12 Months *n* = 632	12–23 Months *n* = 403	24–35 Months *n* = 709	36–47 Months *n* = 139	48–59 Months *n* = 65
≥10 µg/dL	0.98% (*n* = 19)	0.16% (*n* = 1)	0.74% (*n* = 3)	2.12% (*n* = 15)	0.0% (*n* = 0)	0% (*n* = 0)
5–9 µg/dL	8.16% (*n* = 159)	2.06% (*n* = 13)	9.93% (*n* = 40)	11.57% (*n* = 82)	12.23% (*n* = 17)	10.77% (*n* = 7)
≥5 µg/dL	9.14% (*n* = 178)	2.22% (*n* = 14)	10.67% (*n* = 43)	13.68% (*n* = 97)	12.23% (*n* = 17)	10.77% (*n* = 7)

one lead test per child was included in the analysis. If a child was tested more than once, we used the lead test result closest to age 24 months, regardless of level. We selected the lead level closest to 24 months because 24 months is the standard age for lead screening. This screening age was chosen over the initial screen at 9–12 months if more than one level was present because at age two the screening level is more reflective of actual lead burden, as some children at 9–12 months may not be mobile and are therefore less likely to be exposed to lead paint chips.

We calculated the overall and age-specific prevalence of lead exposure using the reference cutoffs of 10 µg/dL and 5 µg/dL. Children were stratified by age as <12 months, 12–23 months, 24–35 months, 36–47 months, and 48–59 months. Lead test results were categorized into three groups: (≥10 µg/dL, 5–9.9 µg/dL, and <5 µg/dL). We used the sign test to compare percentages of lead-exposed children with cutoffs of 10 µg/dL and 5 µg/dL in each age group. All *p*-values were two-tailed. Analyses were performed using Stata version 12. The study was approved by the Einstein Healthcare Network institutional review board.

Results

The study population included 1,948 children; their mean age was 21.2 months (range: 7.2–64.4) and 976 (50.1%) were girls. Of these children, 178 had more than one lead test. The number of children in the three lead level groups (≥10 µg/dL, 5–9.9 µg/dL, and <5 µg/dL) was similar during the study period (Spearman rank correlation = -0.03, $p = .2$). When the reference level was changed to 5 µg/dL, dramatic increases occurred in prevalence in each age group (all $p < .016$) (Table 1).

Nineteen children (1%, 95% confidence interval [*CI*], 0.6%–1.5%) had lead levels of ≥10 µg/dL and 178 (9.1%, 95% *CI*, 7.9%–10.5%) had levels of ≥5 µg/dL (Table 1). Over nine times as many children had abnormal lead levels when the reference level was lowered to 5 µg/dL ($p < .0001$). The increases in prevalence were similar in boys and girls ($p = .7$).

Discussion

The results of our study highlight the clinical and public health implications of redefining "actionable" lead levels from 10 µg/dL to 5 µg/dL. In our practice serving a high-risk community in Philadelphia, 9.3% of young children were classified as lead exposed with the new reference value. This far exceeds the 2.5% nationwide prevalence of exposure (Wheeler, 2013). The ninefold increase in prevalence with the 5 µg/dL reference value was even greater than the fivefold increase reported by the Pennsylvania Department of Health (PA DOH) in Philadelphia (PA DOH, 2011). Of note, PA DOH selected the maximum lead level for each child and included unconfirmed (capillary) lead levels. In our study we selected the value closest to age 24 months, regardless of level, and all samples were confirmed (venous).

Nationwide, one-fourth of housing units are considered "unhealthy (Raymond et al., 2011)." One criterion for being considered an "unhealthy home" is peeling paint in housing built before 1978. In Philadelphia, the site of our study, over 90% of housing stock is pre-1978. CDC describes children who are African-American, living in poverty, enrolled in Medicaid, and living in older housing as having the highest risk for lead exposure (Wheeler, 2013). In inner city communities where a majority of children have all of these risk factors, little is known about the prevalence of lead exposure and its deleterious effects. Given the large number of communities in the U.S. where most children meet all of these risk factors and reside in unhealthy housing, it is likely that many other communities such as ours may experience a comparable high prevalence of lead exposure.

This dramatic increase of children newly classified as lead exposed represents promises and challenges. The promises are that more children at risk will be identified as eligible for secondary prevention services and achieve better outcomes. More families will be educated about lead exposure, more children will be referred to early intervention services, and more homes will be marked for lead abatement. The hope is that through these interventions, children will minimize future lead exposure and achieve better health and social outcomes than if they had not been identified as lead exposed.

A number of challenges are highlighted by this new increase in prevalence of lead exposure. We know that primary prevention of lead poisoning by means of parental education is of limited effectiveness. It is well documented, however, that abatement of unhealthy homes in high-risk neighborhoods can prevent lead exposure (Campbell et al., 2011). The challenge is defining the party responsible for performing lead abatement. In inner city communities where most units are tenant occupied, enforcement of lead abatement laws can prove difficult to enforce and ultimately public funding is often used for this purpose.

Additional challenges include limited public health and health care resources to achieve the goals of limiting lead exposure and improving health outcomes. From a public health perspective, the 2012 CDC release of the change in actionable lead levels coincided with drastic cuts to CDC's Healthy Homes and Lead Poisoning Prevention Program. State and local agencies that work to prevent and monitor lead poisoning have lost their funding and may be eliminated. It is estimated that in communities with high risk for lead exposure, every dollar invested in lead hazard control results in a long-term return of $17–$221 in savings on health care and special education in addition to increased income and tax revenue (Gould, 2009). Thus, the long-term implications of any budgetary cuts are likely to be costly, both socially and economically.

Conclusion

The new guidelines will have a significant impact for health care providers in high-risk areas due to the increased manpower required for retesting, tracking, education, and referral. Adequate resources are critical to support the new recommendations in high-risk populations and geographic areas in greatest need. It remains to be seen whether these new recommendations will ultimately lead to a decrease in the average BLLs of children nationwide. More studies are warranted to evaluate the effects of these policy changes on various types of communities across the U.S. and to assess the effectiveness in reducing childhood lead exposure.

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Food Safety Knowledge and Practices of Young Adults

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Abstract **The objective of the study described in this article was to ascertain the food safety knowledge and practices of undergraduate students attending a major American university. The study participants were undergraduate college students (mean age 18.9 +/-1.14 *SD*) enrolled in a required health course. The students were invited to take a validated food safety knowledge questionnaire as part of a health risk behavior online survey. The 786 respondents indicated their food is most often prepared at on-campus dining facilities and the majority of the students (72%) felt they were "unlikely or "very unlikely" at risk of foodborne disease. The mean food safety knowledge score of the participants was 10.23 (43%) +/-4.13 *SD* (25%–60%), indicating the study population overall has poor knowledge of safe food practices. As a result, food safety educational initiatives and awareness campaigns should be developed to better inform young adults about safe food handling practices and habits.**

Introduction

Despite significant accomplishments in food safety over the past two decades, foodborne illnesses continue to be a major concern in the U.S. In 2011, updated analyses suggested the U.S. averages 48 million foodborne illnesses each year, including 128,000 hospitalizations and 3,000 deaths (Scallan et al., 2011; Scallan, Griffin, Angulo, Tauxe, & Hoekstra, 2011). Furthermore, the sum of direct health-related costs associated with foodborne illnesses was estimated at $51 billion per year; this figure jumps to $77.7 billion when factoring in a functional disability measure of monetized quality-adjusted life years (Scharff, 2012). Implicit among these statistics are several demographic groups that may be considered more or less at risk of foodborne illnesses. One such group is college students, who may put themselves at increased risk by consuming unsafe foods or not following accepted food safety practices.

The principal aim of our study was to assess the food safety knowledge and practices of undergraduate students enrolled in a required health course at a major university. A web-based questionnaire was used to characterize these attributes of the students. The questionnaire was derived using a subset of questions from an updated, validated, and reliable instrument developed by Byrd-Bredbenner and co-authors (2007a). Data obtained from the research could be helpful to health educators and environmental/public health professionals in preventing or mitigating unsafe food consumption habits of young adults.

A limited number of studies have been published on food safety knowledge and behavior of college students and young adults. Among them was a food safety knowledge test administered to 460 students at a major American university (McArthur, Holbert, & Forsythe, 2007). Another study involved a self-reported survey (online) about the risky food consumption behaviors and food safety knowledge of 4,343 young adults, who were recruited from universities and colleges across the U.S. (Byrd-Bredbenner et al., 2007a, 2007b, 2008). The results of these two studies were quite different. In the former case, the students' mean score on the test was 39%, whereas in the latter case the percentage of food safety knowledge questions that were answered correctly by the participants was 60%.

Using the survey instruments developed by Byrd-Bredbenner and her colleagues, the self-reported food-handling practices and beliefs of young adults were compared with their actual food-handling behaviors (Abbot, Byrd-Bredbenner, Shaffner, Bruhn, & Blalock, 2009). Of the 1,228 individuals who completed the online screener survey at a large American university, only 153 young adults actually participated in the two-part study. While the students correctly answered two-thirds of the food safety knowledge items in the survey, their observed compliance scores ranged from a low of 29% to a high of 67% for food safety practice categories.

Based on moderate evidence from survey assessments and direct observational food

TABLE **1**

Demographic Characteristics of Survey Respondents (*N* = 786)

Demographic	Study Population, *n* (%)
Age (Years)	
18	379 (48)
19	242 (31)
20	75 (10)
21	46 (6)
22 or older	44 (6)
Gender	
Male	273 (35)
Female	513 (65)
Class Standing	
Freshman	586 (75)
Sophomore	109 (14)
Junior	74 (9)
Senior	16 (2)
Full-Time Student	
Yes	781 (99)
No	5 (1)
Intended Major	
Yes	752 (96)
No	32 (4)
Major	
Don't know	9 (1)
College of Allied Health	22 (3)
College of Arts & Sciences	154 (21)
College of Business	120 (16)
College of Education	39 (5)
College of Fine Arts & Communication	60 (8)
College of Health & Human Performance	80 (11)

Demographic	Study Population, *n* (%)
Major (continued)	
College of Human Ecology	68 (9)
College of Nursing	151 (20)
College of Technology & Computer Science	47 (6)
Ethnicity	
White—not Hispanic	538 (69)
African-American—not Hispanic	148 (19)
Hispanic or Latino	29 (4)
Asian or Pacific Islander	30 (4)
American Indian or Alaskan Native	9 (1)
Other	28 (4)
Marital Status	
Never married	761 (97)
Married	6 (1)
Other	14 (2)
Residing With Whom (Select All That Apply)	
Alone	49 (6)
Spouse or domestic partner	17 (2)
Roommate(s) or friend(s)	665 (85)
Parent(s) or guardian(s)	140 (18)
Other relatives	17 (2)
Children	6 (1)
Residence	
College dormitory or residence hall	606 (78)
Fraternity or sorority house	2 (0)
Off-campus house or apartment	148 (19)
Parent/guardian's home	25 (3)

safety practice studies, the U.S. Department of Agriculture's (USDA's) Center for Nutrition Policy and Promotion concluded that college students represent a demographic group at a high risk for foodborne illness because of common unsafe food handling and consumption behaviors (USDA, 2010). From 2006 to 2010, the International Food Information Council (IFIC) Foundation conducted a web-based survey of approximately 1,000 participants across the U.S. Among their conclusions and recommendations, the IFIC recommended that food safety educators target programs that include "foods stored and prepared in dorm rooms or other minimally equipped spaces (Cody, Gravani, Smith-Edge, Dooher, & White, 2012)."

Similar studies about food safety knowledge and practices involved international college students. One study in Greece found the scores were surprisingly low, with only 38% of food handling practice questions being answered correctly and just 37% of food safety knowledge questions being answered correctly (Lazou, Georgiadis, Pentieva, McKevitt, & Iossifidou, 2012). In another study conducted in Turkey, it was found that female college students generally had safer food handling practices, but their food safety knowledge and handling practices were still insufficient for preventing foodborne illness (Sanlier & Konaklioglu, 2012).

Our study differs from the other studies in several ways. First, our study population consisted predominantly of freshmen college students who currently live on campus, probably away from home for the first time. Second, our survey collected several demographic variables that could help identify subpopulations at greater risk of foodborne illnesses; studies have shown that demographic variables strongly influence food safety attitudes (Kennedy, Worosz, Todd, & Lapinski, 2008). Third, our study also included the students' feelings about their risks of foodborne disease, which are important in the risk perception construct (Gordon, 2003).

Methods

Our study population was undergraduate students enrolled in a required university course on personal health. Each semester, all students in this course are given the opportunity to participate in a Health Risk Behavior Assessment Survey. Past analyses have included sexual practices, drug and alcohol consumption, and gambling habits. To our knowledge, no previous studies had been conducted to assess food safety knowledge and behaviors.

The spring 2013 semester survey was available in an embedded online web address link sent via an e-mail from January 14 through February 4, 2013. Participation was voluntary and anonymous, but students who elected to complete the survey were given five points extra credit on their first exam. Students wishing not to complete the survey were given other opportunities for earning extra credit at another point later in the semester. The study was granted an exemption status for human use by the university's institutional review board.

In addition to general demographic questions (Table 1), the food safety section of the spring 2013 Health Risk Behavior Assessment Survey was limited to 24 questions. We derived most of the questions for the food safety section of this survey from a subset of a questionnaire originally developed as a survey instrument by Byrd-Bredbenner and coauthors (2007a); the authors indicated they used questions from previously reported studies to develop the survey instrument, as well as developing questions from current educational campaigns by USDA and U.S. Department of Health and Human Services. The reader is referred elsewhere for details about the validation process of the original survey instrument (Bryd-Bredbenner et al., 2007a).

The first part of our food safety questionnaire consisted of three opinion questions that asked the participant to (1) rank in order where their food is most often prepared, (2) rate their perceived risk for foodborne disease, and (3) choose which food safety topic is most important to educate young adults. The next 21 questions (derived from Byrd-Bredbenner et al., 2007a) were used to evaluate the food safety knowledge and practices of the students. The 21 questions were chosen from the original survey instrument based on our collective expertise and consultation. Each question contained one correct answer with the exception of one question that had four correct answers. Each correct response was awarded one point for a total of 24 possible points. These questions were arranged within five broad categories that included: 1) cross contamination/disinfection procedures, 2) safe time/temperatures for cooking/storing food, 3) foods that increase risk of foodborne disease, 4) groups at greatest risk for foodborne disease, and 5) common food sources of foodborne disease pathogens (Table 2).

Questions in the survey consisted of multiple choice and dichotomous series items. The data were analyzed using Qualtrics and SPSS version 19.0. Descriptive statistics were used to describe demographic characteristics and display food safety knowledge mean scores and standard deviations. Demographic characteristics were represented as the independent variables and the total points of the food safety knowledge score was listed as the dependent variable. The mean scores among various demographic variables were analyzed using independent sample *t*-tests and analysis of variance.

TABLE **2**

Correct Responses to Food Safety Knowledge Questions

Survey Question	Correct Response, # (%)
1. The best way to keep from getting food poisoning from fresh fruits and vegetables is to wash them with:	289 (37)
2. After you have used a cutting board to slice raw meat, chicken, or fish and need to cut other foods, which of these is the best way to prevent food poisoning?	517 (67)
3. Which procedure for cleaning kitchen counters is most likely to prevent food poisoning?	205 (27)
4. Which is the most hygienic way to wash your hands?	427 (55)
5. To prevent food poisoning, which of these individuals should not prepare food for other people? (Check all that apply)	468 (61); 583 (76); 535 (69); 620 (80)*
6. What is the recommended freezer temperature for preventing food poisoning?	97 (13)
7. Which of the following is considered the most important way to prevent food poisoning?	548 (71)
8. For ground beef to be safe to eat, it needs to be cooked until its internal temperature reaches:	377 (49)
9. What is the maximum temperature refrigerators should be to preserve the safety of foods?	357 (46)
10. Which method is the most accurate way of determining whether hamburgers are cooked enough to prevent food poisoning?	403 (53)
11. What is the least safe method for thawing a frozen roast?	447 (58)
12. What is the safest method for cooling a large pot of hot soup?	95 (12)
13. Chilling or freezing eliminates harmful germs in food.	456 (60)
14. Which food is least likely to cause food poisoning?	294 (38)
15. Which foods do pregnant women, infants, and children not need to avoid?	259 (34)
16. *Salmonella* bacteria can cause food poisoning. How can a food be made safe if it has *Salmonella* in it?	333 (44)
17. Staph (*Staphylococcus*) bacteria that cause food poisoning are most likely associated with which food?	146 (19)
18. Botulism is a disease that is most likely associated with which food?	175 (23)
19. *Listeria* bacteria are most likely associated with which food?	115 (15)
20. Harmful *E. coli* bacteria are most likely associated with which food?	285 (38)
21. You may contaminate the next food you touch with *Salmonella* bacteria if you don't wash your hands after touching:	360 (47)

*Correct responses for multiple possible correct answers.

Results

Of the 968 undergraduate students offered to participate in the study, 786 completed the survey for a response rate of 82%. Respondents included 513 (65%) female and 273 (35%) male participants. Based on the percentage

TABLE **3**

Demographic and Overall Score Comparisons

Demographic	Mean +/– *SD* (Range 0–24)	Mean Score (%)
Age (Years)		
18	10.56 +/– 3.44	44 (29–58)
19	10.70 +/– 3.53	45 (29–58)
20	10.81 +/– 3.84	45 (29–61)
21	10.28 +/– 3.76	43 (27–58)
22 or older	11.20 +/– 3.81	47 (31–63)
Gender		
Male	10.22 +/– 3.62	43 (28–58)
Female	10.89 +/– 3.49	45 (31–60)
Class Standing		
Freshman	10.62 +/– 3.47	44 (29–58)
Sophomore	10.69 +/– 3.88	45 (28–61)
Junior	10.70 +/– 3.74	45 (29–60)
Senior	12.06 +/– 3.11	50 (38–63)
Major		
Don't know	8.44 +/– 3.88	35 (19–51)
College of Allied Health	9.55 +/– 4.27	40 (22–58)
College of Arts & Sciences	11.44 +/– 3.05	48 (35–60)
College of Business	10.12 +/– 3.41	42 (28–56)
College of Education	9.79 +/– 3.64	42 (26–56)
College of Fine Arts & Communication	10.55 +/– 3.76	44 (28–60)
College of Health & Human Performance	10.88 +/– 3.59	45 (31–61)
College of Human Ecology	11.37 +/– 3.81	47 (32–63)
College of Nursing	10.99 +/– 3.08	46 (33–59)
College of Technology & Computer Science	10.68 +/– 2.67	45 (33–56)
Ethnicity		
White—not Hispanic	10.88 +/– 3.57	45 (30–60)
African-American—not Hispanic	10.61 +/– 3.13	44 (31–57)
Hispanic or Latino	9.48 +/– 3.38	40 (25–34)
Asian or Pacific Islander	9.37 +/– 3.33	39 (25–53)
American Indian or Alaskan Native	10.44 +/– 2.70	44 (33–55)
Other	11.21 +/– 3.46	47 (34–59)

breakdown of male vs. female of the freshmen class, the survey was offered to a population of approximately 60% females and 40% males. The mean age was 18.9 years +/-1.14. The vast majority of students were freshman (75%) and sophomores (14%) in a full-time status. A wide representation was present from the university's nine colleges. The student ethnicities were predominantly white—not Hispanic (69%) and African-American—not Hispanic (19%) and most had never been married (97%). As expected, college dormitory or residence hall was the listed predominant residence (78%) (Table 1).

In order to understand where the respondents ate, they were asked to rank where their food is usually prepared, using rank scores from 1 (most often) to 5 (least often). Students ranked "on-campus cafeteria or snack bar/fast food place" as the place where their food is most often prepared. In decreasing order, students stated their food was also prepared at off-campus restaurants, dormitory kitchen or room microwave, deli shops or deli sections of grocery stores, and lastly, fraternity/sorority house or off-campus home. It should be noted, however, that this particular university requires all freshman to live in campus dormitories their first year. On average less than 25% elect to stay in dormitories past their first year with most moving into local apartments. Accordingly, within six months of the survey, most of the study population will have moved into local apartments and be solely responsible for their meal preparation.

To obtain baseline knowledge of how these young adults feel about their risk for foodborne disease, they were asked to rate their level of risk. The vast majority of students (72%) feel that they are "very unlikely" (27%) or "unlikely" (45%) to be at risk of foodborne disease. Only a small proportion of the respondents (9%) felt that they were "likely" or "very likely" at risk for foodborne illness.

To gain insight into the food safety topics that students' considered most important for education, they were asked to select two topics from five possible categories. Overall, most students felt that the two most important food safety topics to educate young adults about were "cross contamination and disinfection procedures" and "safe times/temperatures for cooking/storing food." The two food safety topics that the students felt least important to be educated about were "foods that increase risk of foodborne disease" and "groups at greatest risk for foodborne disease."

The food safety knowledge portion of the survey contained 21 questions with 24 possible correct responses (Table 2). The scores ranged from 0–19 total points (0%–79%). A data screening was conducted to determine the distribution and skewness of the total scores of the respondents, which followed a close-to-normal distribution. The mean food safety knowledge scores of the participants was 10.23 (43%) +/-4.13 (25%–60%) (Table 3).

Due to wide variations of individual demographic characteristic sample sizes, independent sample *t*-tests were necessary to compare groups of similar size. Mean food safety knowledge scores were compared by age, gender, class standing, major, ethnicity, and the students' feeling of risk of foodborne disease (Table 4). The mean score of 45% for female participants was slightly higher than male students score of 43% ($p < .05$) (Table

3). Overall, the mean food safety knowledge scores were very similar ($p > .05$) between the groups of 18 and 19 years and older, freshman and upperclassman, health and not health majors, white—not Hispanic and nonwhite, unlikely at risk, and undecided/likely at risk of foodborne disease (Table 4).

Out of 24 possible points, only 11 of the correct responses were selected more than 50% of the time (Table 2). The students were most knowledgeable in identifying which individuals should not prepare food for other people, with the four correct responses of "a person with diarrhea, fever, sore throat, or vomiting" being selected 61%–80% of the time.

The section of questions receiving the lowest scores was that concerning "common food sources of foodborne disease pathogens." Students were largely unaware of food products associated with *Staphylococcus*, botulism (i.e., *C. botulinum*), *Listeria*, *E. coli*, or *Salmonella*. Only 44% of the respondents identified "cook it thoroughly" as the correct response for how to make a food safe from *Salmonella* contamination. Similarly, only 47% of the respondents correctly identified "raw chicken" as the food most often associated with *Salmonella*. Yet, the respondents were still more familiar with *Salmonella* than other foodborne disease pathogens.

The question regarding *Staphylococcus* bacteria was correctly answered by only 19% of the respondents as "food that is prepared by cooks with their bare hands and left at room temperature." Botulism and canned food were associated by 23% of the respondents; *Listeria* and deli meats were associated by 15%; and most surprisingly only 38% of the respondents were able to properly identify *E. coli* to be associated with "raw or undercooked beef," despite past widespread media coverage of high-profile beef and *E. coli* outbreaks (Table 2).

TABLE **4**

Demographic Groups and Overall Score Comparisons

Demographic	Mean +/- *SD*	Significance (Two-Tailed)	95% Confidence Interval
Age			
18	10.56 +/– 3.44	.507	(–.665, .329)
19	10.73 +/– 3.64		
Gender			
Male	10.22 +/– 3.62	.012	(–1.189, -.150)
Female	10.89 +/– 3.49		
Class Standing			
Freshman	10.62 +/– 3.47	.553	(–.742, .398)
Upperclassmen	10.79 +/– 3.77		
Major			
Health	10.83 +/– 3.38	.756	(–.434, .598)
Non-health	10.75 +/– 3.42		
Ethnicity			
White—not Hispanic	10.88 +/– 3.57	.066	(–.033, 1.013)
Other	10.39 +/– 3.18		
Perception of Foodborne Disease Risk			
Unlikely at risk	10.85 +/– 3.24	.772	(–.443, .596)
Undecided/likely at risk	10.78 +/– 3.44		

Note. Independent samples *t*-tests were used to compare group means; equal variances assumed; two-sided.

Discussion

Although several authors suggest that college students are among the most at-risk populations for foodborne illness (Booth, Hernandez, Baker, Grajales, & Pribis, 2013), only 9% of the students in our study population feel that they are at increased risk. Such feelings are known to influence risk perception, a subjective judgment also influenced by hazard awareness and severity, along with the individual's ability to exercise control (Gordon, 2003). From a foodborne disease perspective, an important factor influencing risk perception is the association (or lack thereof) between an illness and a particular food or poor food handling practice. In the context of behaviorism theory, awareness of an unsafe food practice and its association with foodborne illness can provide the necessary reinforcement for behavioral change. Without such reinforcement, students may not be motivated to change their food safety behaviors (Yarrow, Remig, & Higgins 2009).

The food safety knowledge scores of our study population were very poor, with less than half of the food safety knowledge questions being answered correctly. The findings of our study align with previous research indicating students and young adults have a limited knowledge of food safety, including safe food handling practices. Interestingly, our study population scored best on the knowledge question about who should not prepare food (i.e., those with symptoms of illness). While this finding is reassuring, most of the study participants probably do not realize that many food workers continue to work despite having such symptoms (Sumner et al., 2011). Our finding offers the opportunity to focus educational efforts on the importance of routine adherence to safe food handling practices, because the disease status of food workers (and students) is often unknown, and infected persons are often asymptomatic.

Of all the questions in our survey, the students were least knowledgeable about common food sources of foodborne pathogens. This is consistent with the findings of other studies (Abbot et al., 2009). We were not surprised by these findings for several reasons. Most of the public, including college students, seem to lack knowledge of basic microbiology in general, and food microbiology in particular. Awareness of common foodborne pathogens (e.g., *E. coli*, *Salmonella*, *Campylobacter*, *Listeria*) often comes from newscasts of highly publicized foodborne disease outbreaks (Lin, Jensen, & Yen, 2005), but these news stories rarely provide detailed information about the most "common" sources of the foodborne pathogens. Furthermore, to add to the confusion, many media outlets refer to all foodborne diseases as food poisonings, or they mistakenly refer to a bacterial pathogen as a virus or toxin. While college students with health majors may have more knowledge about microbiology and infections (Lazou et al., 2012; Yarrow et al., 2009), the vast majority of our study population included freshmen who have taken few courses in biology.

Our study revealed that students feel the two most important food safety topics for educating young adults were (1) cross contamination and disinfection procedures and (2) safe times/temperatures for cooking/storing food. Indeed, about half of the students in our study did poorly on questions related to these topics. Therefore, for our study population, these topics should be given high priority in developing food safety education and training programs.

The principal limitation of our study is the food safety knowledge questionnaire was limited to 21 of the 39 total questions from the survey instrument developed by Byrd-Bredbenner and co-authors (2007a). This limited our ability to fully evaluate each of the "scales" from the original survey instrument. In addition, since our study population comprised mostly 18–19 year old students at one university, these results are not generalizable to all students of different ages across the U.S. Finally, the scores of food safety knowledge (correct or incorrect) and self-reported practices do not necessarily translate into the students' actual food handling practices. In fact, significant differences have been reported between self-reported knowledge and practices with actual observations of the study participants; the observed practices are usually worse than indicated by the self-reported surveys (Abbot et al., 2009; Redmond & Griffith, 2005).

Overall, we believe the strengths of our study outweigh its limitations. Our sample size was quite large, and the participation rate was very high. The questionnaire was derived mostly from a validated survey instrument, and the questions covered key topics for developing focused food safety educational programs, at least for the targeted college population. Furthermore, the questions about demographics, perceptions of risk, ranking of student food preparation sites, and student-prioritized food safety training topics are valuable to developing educational strategies and metrics for intervention effectiveness.

Conclusion

Most college freshman experience living away from home for the first time, and this typically involves making choices about how and where to obtain (and prepare) their food. Additionally, many young adults currently or may soon be employed in the food service industry, as well as responsible for preparing meals for their own family, including vulnerable populations such as the very young and elderly. Developing educational interventions are particularly important for young adults, because they are developing habits that could translate into safe practices and food safety awareness as they become older (Stein, Dirks, & Quinlan, 2010). Our study adds to the growing body of knowledge about the importance of food safety education in the curriculum of college students, perhaps as an addition to the syllabi of college health courses.

Disclaimer: The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, or the U.S. government.

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INTERNATIONAL PERSPECTIVES

An Evaluation of Southeastern Ontario Recreational Water Quality

Although most of the information presented in the Journal refers to situations within the United States, environmental health and protection know no boundaries. The Journal periodically runs International Perspectives to ensure that issues relevant to our international membership, representing over 25 countries worldwide, are addressed. Our goal is to raise diverse issues of interest to all our readers, irrespective of origin.

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Abstract **Fecal contamination in recreational waters causes adverse health outcomes in humans; yet, surprisingly, a paucity of literature addresses recreational water quality in North America. The authors addressed this gap by evaluating *E. coli* contamination of southeastern Ontario, Canada, recreational beach waters between the years 2008–2011. They tested water samples for microbial contamination by the membrane filtration method. They used Friedman's and repeated measures analyses of variance and descriptive statistics to assess annual and monthly *E. coli* levels as well as noncompliance to the Ontario bathing beach standard. Seven waters showed high noncompliance to the Ontario standard, which could negatively affect the health of local recreational beach users. The authors' study provides much needed baseline information on beach water quality. They call for greater recreational water sampling and reporting standardization across North American jurisdictions.**

Introduction

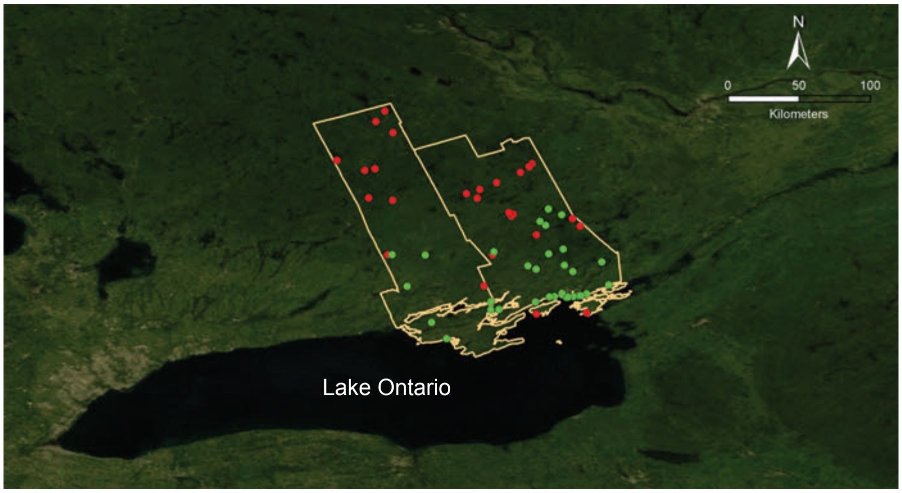
Enteric pathogens in recreational waters pose a serious public health risk to recreational swimmers, as they can cause gastrointestinal (GI) illness and adverse health outcomes (Health Canada, 2006). The health burden and economic impacts of GI illness are staggering. Global estimates indicate that bathing in polluted waters causes 250 million cases of GI illness and upper respiratory disease and results in 400,000 disability-adjusted life years annually (Group of Experts on the Scientific Aspects of Marine Environmental Protection & Advisory Committee on Protection of the Sea, 2001). Waterborne diseases are responsible for over 40,000 hospitalizations and cost approximately $970 million in the U.S. annually (Collier et al., 2012).

Health authorities monitor recreational waters for fecal indicator bacteria, the elevated presence of which indicates fecal contamination and therefore the potential presence of enteric pathogens (U.S. Environmental Protection Agency [U.S. EPA], 2011). *E. coli* is the current indicator of fecal pathogens for fresh waters in Canada. The most recent Canadian guidelines were developed in early 2012, prior to publication of the U.S. Environmental Protection Agency's (U.S. EPA's) 2012 guidelines. The Canadian guidelines were based on U.S. EPA epidemiological studies, and recommend a swimming advisory or closure when the geometric mean concentration (based on a minimum of five samples) exceeds 200 *E. coli* CFU/100 mL, or when a single-sample maximum concentration exceeds 400 *E. coli* CFU/100 mL (Health Canada, 2012). These guidelines correspond to an acceptable illness rate of approximately 10–20 illnesses per 1,000 swimmers, according to U.S. EPA's regression analysis of epidemiological data from the 1980s (Dufour, 1984).

The criteria for the standards implemented by provincial/territorial jurisdiction can vary from Canadian federal guidelines. The province of Ontario's guidelines, most recently updated in 2008, are more con-

FIGURE **1a**

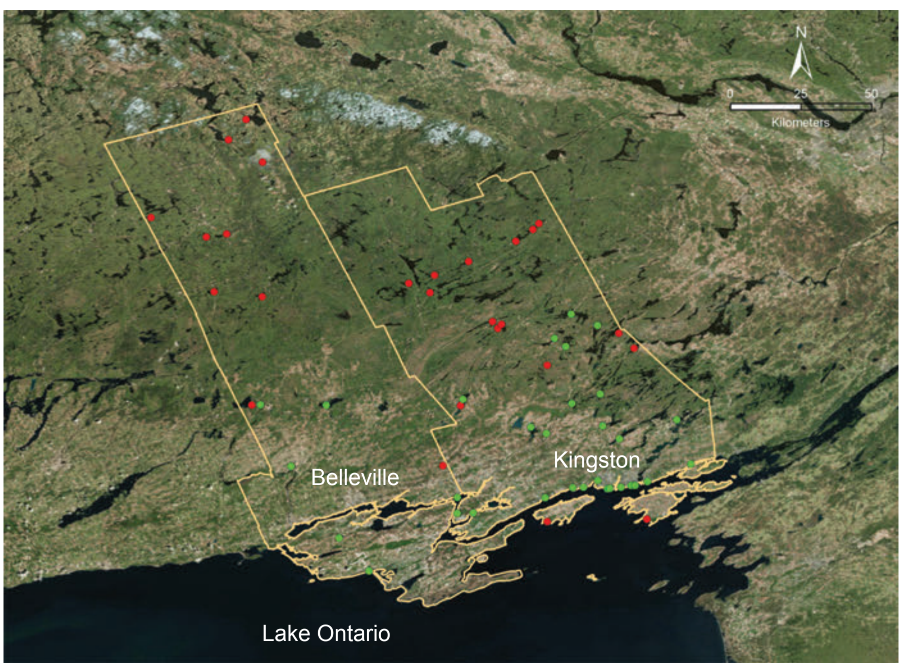
Spatial Distribution of Study Beaches



Public health unit areas Hastings and Prince Edward counties (left) and Kingston, Frontenac, and Lennox and Addington (right) and the surrounding geographic area. Green dots represent beaches included in the study, red dots represent excluded beaches. Image credit: Julia Krolik. Source: Esri, DigitalGlobe, GeoEye, 1-cubed, U.S. Department of Agriculture, U.S. Geological Society, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS user community.

FIGURE **1b**

Close Up of the Public Health Unit Areas



Hastings and Prince Edward counties (left) and Kingston, Frontenac, and Lennox and Addington (right). Green dots represent beaches included in the study, red dots represent excluded beaches. Image credit: Julia Krolik. Source: Esri, DigitalGlobe, GeoEye, 1-cubed, U.S. Department of Agriculture, U.S. Geological Society, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS user community.

servative than the Canadian guidelines: a swimming advisory or closure occurs if the geometric mean on a specified sampling date exceeds 100 *E. coli* CFU/100 mL (Ontario Ministry of Health and Long-Term Care, 2008). This corresponds to an acceptable illness rate of 7.05 GI illnesses/1,000 swimmers according to U.S. EPA's regression analysis of epidemiological data (Dufour, 1984). Additionally, other environmental factors contribute to a beach posting decision (e.g., heavy rainfall).

Our study assessed the quality of Lake Ontario and inland recreational waters in southeastern Ontario by examining possible differences in *E. coli* contamination by year, month, and location (Lake Ontario vs. inland waters); examining noncompliance by year; and identifying the most contaminated waters in this particular study region of southeastern Ontario. Such assessments are necessary to appropriately inform research, interventions, and guidelines for safe recreational waters in the future.

Methods

Study Areas and Recreational Water Sampling Protocol

Our study was limited to public recreational beach waters in the 1) Kingston, Frontenac, and Lennox and Addington (KFL&A) Public Health Unit (PHU) area, which serves the Frontenac Islands, Kingston, Loyalist, Greater Napanee, South Frontenac, Stone Mills, Central Frontenac, North Frontenac, and Addington Highlands, Ontario; and 2) the Hastings and Prince Edward counties (H&PEC) PHU area, which serves the county of Prince Edward, Hastings County, Quinte West, and Belleville, Ontario. Additional surrounding PHU regions were not included either due to a lack of data, poor quality data, or poor records management. Each PHU conducts routine public recreational water surveillance in its respective jurisdiction during each year's summer season (approximately late May to end of August or mid-September), in accordance with sampling guidelines established by the Ontario Ministry of Health and Long-Term Care (Ontario Ministry of Health and Long-Term Care, 1998, 2008).

Recreational water samples were collected in 200-mL sterile bottles, containing 0.8 millimolarity (mM) sodium thiosulphate, by lowering the bottle approximately 0.15–0.30 m under the surface of the water, to a point where the water depth was approximately 1.0–1.5 m. In shallower waters, samples were obtained within the swimming area, but as far away from shore as possible. In general, five water samples were collected per sampling day for beaches up to 1,000 m in length, or one sample for every 200 m for beaches over 1,000 m. Following collection, samples were stored at a temperature of approximately 4°C during transport.

E. coli Enumeration Methods

All recreational water samples were submitted to the Public Health Ontario Laboratory, Kingston, where they were processed by the membrane filtration procedure (U.S. EPA, 2005) within one calendar day of delivery. The following protocol for *E. coli* enumeration is a modified version of several protocols (American Public Health Association, American Water Works Association, & Water Environment Federation, 2012; Ciebin, 1985, 1991). First, 10 mL of each water sample was filtered through a cellulose esters membrane filter (pore size 0.45 µm). Second, the filters were placed on a fecal coliform chromogenic substrate 5-bromo-4-chloro-3-indolylbeta-D-glucuronide agar medium (FC-BCIG) and incubated for 18–22 hours at 43.5°C. Subsequently, the chromogenic substrate (BCIG) was cleaved by the enzyme β-glucuronidase of *E. coli*, producing blue or blue-green colored colonies on the medium, which were counted as positive for *E. coli*. Colony counts from these 10-mL samples were then multiplied by 10 (the dilution factor) and reported as *E. coli* CFU/100 mL of water sample. All samples per recreational water on a given sampling day were combined to calculate the geometric mean abundance estimate for each recreational water (referred to herein as daily geometric mean). For 10-mL samples that contained no visible *E. coli* CFU, results were reported as <10 CFU/100 mL, but were converted to values of 10 CFU/100 mL for geometric means calculations. Likewise, 10-mL samples exceeding counts of 100 *E. coli* CFU were reported as >1,000 CFU/100 mL and converted to values of 1,000 CFU/100 mL for geometric means calculations, as is the current standard practice by Ontario PHUs.

TABLE **1**

Geometric Means

Annual Geometric Means: All Locations	**$\chi 2$**	***df***	***p*-Value**
Composite of KFL&A[a] and H&PEC[a]	5.285	2	.071
KFL&A	8.548	3	.036
H&PEC	0.857	2	.651
Annual Geometric Means: Lake Ontario versus Inland Waters	***F***	***df***	***p*-Value**
Composite of KFL&A and H&PEC			
Location	4.818	1, 29	.036
Year	4.289	2, 58	.018
Location x year	1.217	2, 58	.304
KFL&A			
Location	8.393	1, 22	.008
Year	4.787	3, 66	.040
Location x year	4.188	3, 66	.009
Monthly Geometric Means: All Locations	**$\chi 2$**	***df***	***p*-Value**
All years			
Composite of KFL&A and H&PEC	0.407	2	.816
KFL&A	0.083	2	.959
H&PEC	4.571	2	.102
Per year			
Composite of KFL&A and H&PEC			
Year 2009	0.286	2	.867
Year 2010	0.122	2	.941
Year 2011	2.538	2	.281
KFL&A			
Year 2008	0.36	2	.835
Year 2009	0.095	2	.953
Year 2010	1.816	2	.403
Year 2011	1.736	2	.420
H&PEC			
Year 2009	2.571	2	.276
Year 2010	3.429	2	.180
Year 2011	0.857	2	.651

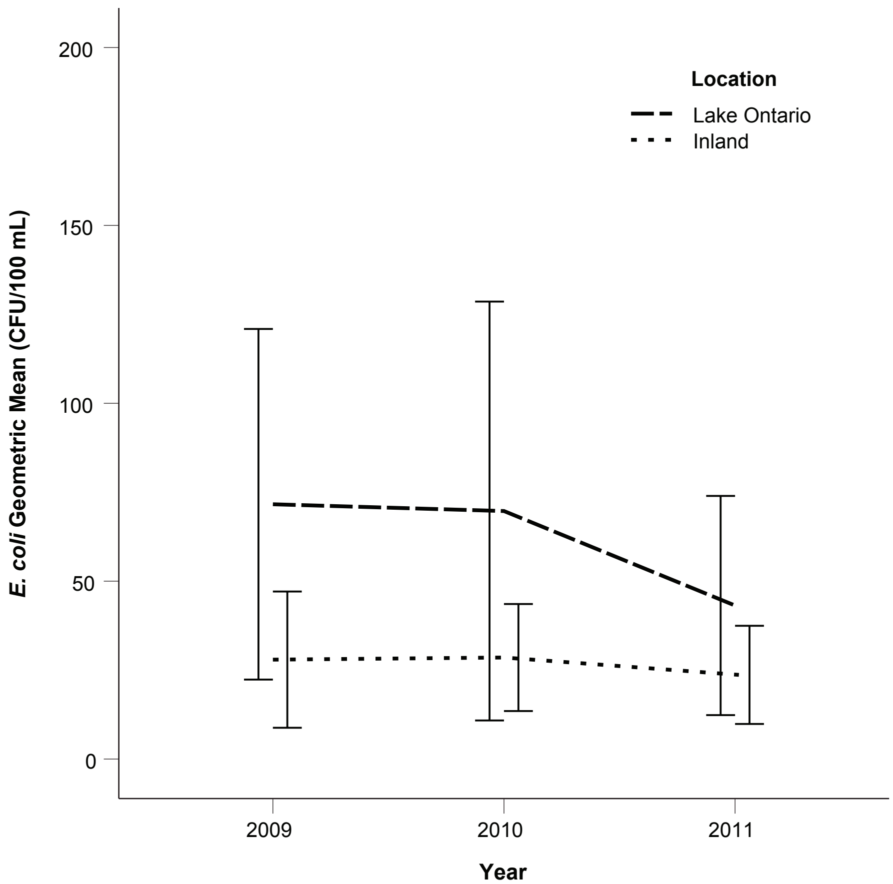
[a]KFL&A = Kingston, Frontenac, and Lennox and Addington beaches; H&PEC = Hastings and Prince Edward counties beaches.

Recreational Water Selection Criteria

Seasonal recreational water monitoring data were available for KFL&A for the years 2008–2011 and for H&PEC for the years 2009–2011. Since the frequency of sampling differed among waters/beaches, we included only waters that were monitored at least six visits or more per beach season (approximately biweekly measures or more frequently; Figure 1a and 1b), which was consistent with an assessment of Lake Huron recreational water quality (Ontario Ministry of the Environment, 2005). Consequently, inland waters for which data were available were often excluded because sampling was confined to infrequent visits each season (KFL&A: inclusion of 12 of the 15 Lake Ontario waters [80.0 %] and 12 of the 29 inland waters

FIGURE **2a**

Annual Mean *E. coli* Geometric Means for Lake Ontario vs. Inland Beaches for a Composite of All Kingston, Frontenac, and Lennox and Addington and Hastings and Prince Edward Counties Beaches



Error bars: +/- 2 *SE*.

[41.4%]. H&PEC: inclusion of three of the three [100.0%] Lake Ontario waters and 4 of the 14 [28.6%] inland waters).

Statistical Analyses

Analyses were conducted on a composite of all KFL&A and H&PEC waters (years 2009–2011), and for each jurisdiction exclusively (KFL&A: years 2008–2011, H&PEC: years 2009–2011), unless where specified differently. Statistical analyses were performed using SPSS version 20. Two-sided *p*-values of <.05 were considered to be statistically significant.

Annual geometric means were computed by taking the arithmetic mean of daily geometric means per recreational water per year. Tests for differences in annual geometric means were conducted for 1) all locations and 2) for Lake Ontario vs. inland waters. H&PEC waters were not analyzed separately in 2) due to the jurisdiction's small available sample size. The first group of tests was conducted using Friedman's analyses of variance (ANOVAs), and where differences were seen across years, Wilcoxon signed-rank tests were applied to consecutive years while applying a Bonferroni correction on the number of tests. The second group of tests was conducted using repeated measures ANOVAs on $\log_{10}$ transformed data, and where differences were seen, repeated contrasts were applied to consecutive years.

Monthly geometric means were computed by taking the arithmetic mean of all daily geometric means for each recreational water per month, separately for each year. May and September were excluded because sampling only occurred for a portion of each of the two months, and so these data were unreliable. Friedman's ANOVAs were used for tests on differences in monthly geometric means for all years combined and for each season separately.

Noncompliance refers to any recreational water in which a daily *E. coli* geometric mean exceeds the Ontario standard of 100 CFU/100 mL. Basic descriptive statistics were performed to determine the percentage of waters that 1) exhibited noncompliance on at least one occasion each year, and 2) were highly noncompliant (greater than or equal to 25% of a water's daily geometric means exceeded the Ontario standard in a season; a cutoff chosen based on our experience with the available data).

Results

Annual Geometric Means

All Locations

No statistically significant differences occurred in median *E. coli* geometric means for a composite of KFL&A and H&PEC recreational waters or H&PEC exclusively (Table 1). KFL&A exclusively showed a significant difference, however, with greater *E. coli* contamination in 2010 than in 2011 (Wilcoxon signed rank test: 2010 vs. 2011: $Z = -3.4$, $p = .001$; 2008 vs. 2009: $Z = -0.286$, $p = .775$; 2009 vs. 2010: $Z = -0.852$, $p = .394$).

Lake Ontario vs. Inland Waters

For a composite of KFL&A and H&PEC waters and for KFL&A exclusively, repeated measures ANOVAs showed that mean annual *E. coli* geometric means were significantly affected by water location, with Lake Ontario waters being more contaminated than inland waters (Figure 2a and 2b, Table 1). Mean *E. coli* geometric means varied significantly across years (Figure 3), and for KFL&A exclusively, *E. coli* geometric means depended on water location. Repeated contrasts found differences between years; for a composite of KFL&A and H&PEC waters, differences occurred between 2009 and 2010, and between 2010 and 2011 (2009 vs. 2010: $F_{1, 29} = 4.529$, $p = .042$; 2010 vs. 2011: $F_{1, 29} = 6.751$, $p = .015$), and for KFL&A exclusively, *E. coli* contamination was higher in the year 2010 versus the year 2011 (2010 vs. 2011: $F_{1, 22} = 13.816$, $p = .001$; 2008 vs. 2009: $F_{1, 22} = 0.717$, $p = .406$; 2009 vs. 2010: $F_{1, 22} = .989$, $p = .331$).

Monthly Geometric Means

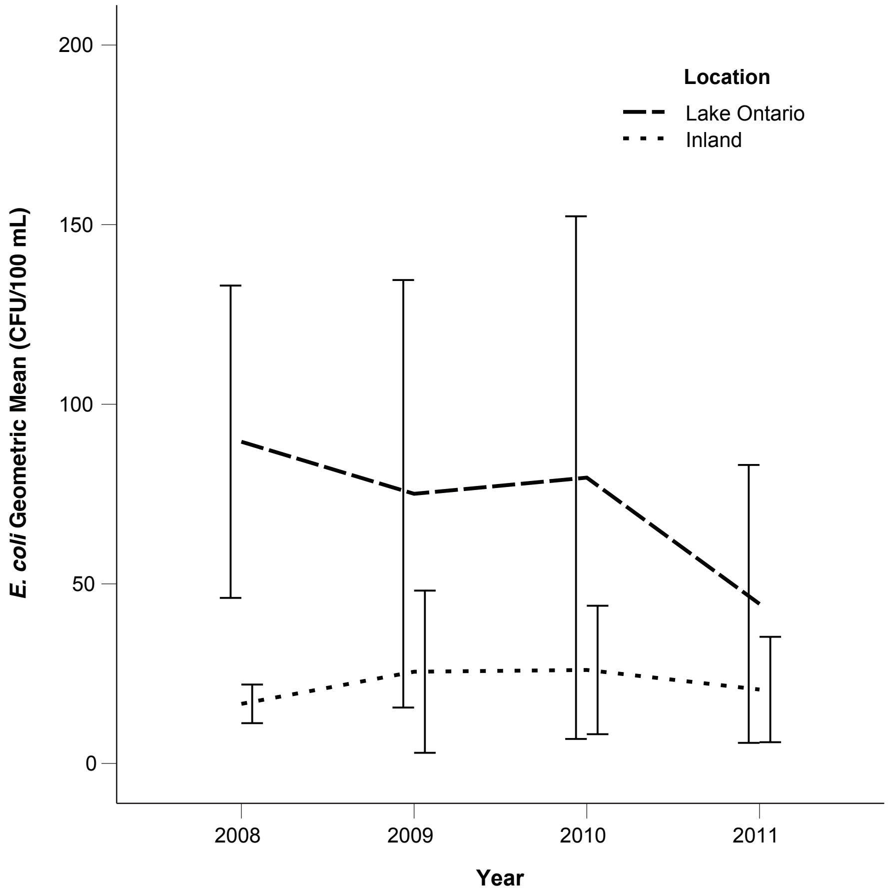
No significant monthly differences occurred in median *E. coli* geometric means for a composite of KFL&A and H&PEC waters or for each jurisdiction analyzed exclusively, both across study years and per year (Table 1).

Noncompliance

Table 2 shows noncompliance in at least one daily geometric mean for the composite of KFL&A and H&PEC waters and each jurisdiction separately both across all study years, and per year. High noncompliance was seen in KFL&A waters.

FIGURE **2b**

Annual Mean *E. coli* Geometric Means for Lake Ontario vs. Inland Beaches for Kingston, Frontenac, and Lennox and Addington



Error bars: +/- 2 *SE*.

Discussion

Recreational water quality studies are fundamentally lacking in the literature, thereby hindering our understanding of water issues across North America. In an attempt to fill this gap, our study assessed water quality in southeastern Ontario recreational waters within the KFL&A and H&PEC PHUs between the years 2008–2011. The average recreational water showed annual and monthly *E. coli* contamination far below the Ontario standard, which suggests that the majority of recreational waters contributed between little to no GI illness risk to recreational bathers. The year 2010 was significantly more contaminated than the year 2011 for KFL&A. While meteorological data were unavailable for our study, the year 2011 is notable with little precipitation being documented in the region, and less precipitation may result in fewer sewage overflows (Lipp et al., 2001; U.S. EPA, 2011; Wong et al., 2009; Wyer et al., 1995). Overall, Lake Ontario waters showed significantly higher annual median geometric means than inland waters. Greater contamination of the Lake Ontario waters may be related to higher pollution levels, higher human population densities, and ongoing dynamic changes in land use surrounding Lake Ontario (Environment Canada & U.S. EPA, 2009).

No detectable differences occurred in contamination across months. To our knowledge, only one other study assessed monthly contamination differences, finding that August generally had the greatest level of contamination (Ontario Ministry of the Environment, 2005). Further studies are needed to determine monthly contamination patterns. During the study years 2009–2011, over 50% of all KFL&A and H&PEC waters showed noncompliance on at least one sampling day. Only within the KFL&A jurisdiction were high levels of noncompliance seen (29% of beaches).

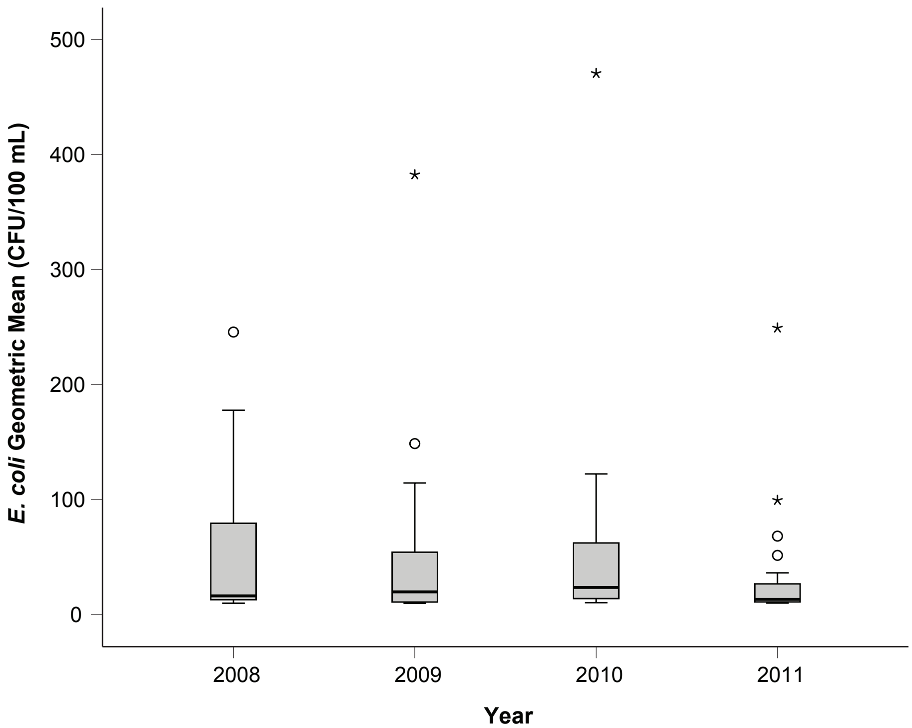
Comparison to the Surrounding Geographic Area

Recreational water monitoring studies are rarely published, making relative comparisons between southeastern Ontario recreational waters and the surrounding geographic area difficult. The best insight was found in the 2009 State of the Great Lakes report, which focused solely on Great Lakes recreational waters in Canada and the U.S. Waters were considered to be of good quality if they were open more than 95% of the beach season; the percentage of good quality waters were Lake Ontario: 26% (Canada) and 75% (U.S.); Lake Superior: 79% (Canada) and 97% (U.S.); Lake Michigan: 83% (U.S.); Lake Huron: 67% (Canada) and 99% (U.S.); and Lake Erie: 32% (Canada) and 47% (U.S.) (Environment Canada & U.S. EPA, 2009).

In order to compare these results to the current study, a rough estimate on the percentage of Lake Ontario waters open over 95% of the season was determined. Beaches in the current study were open for as many as 112 days per season. Therefore, a beach is considered "open" more than 95% of a season if it is closed for less than 5.6 days

FIGURE 3

Annual Median *E. coli* Geometric Means for Kingston, Frontenac, and Lennox and Addington Beaches



Medians are plotted, and the boxes represent the interquartile range; vertical bars represent the range of values within 1.5 times the interquartile range of the median. Open circles represent outliers between 1.5 and 3 box lengths from the upper or lower edge of the box. Asterisks represent extreme values that are more than 3 box lengths from the upper or lower edge of the box.

(112 days in the beach season/0.05 [percentage] of the season = 5.6 days). For each recreational water, the mean number of days between exceeding the Ontario standard and the next water sample testing date was calculated, and then an overall mean estimate for beach closure was calculated as 6.9 days. Since 6.9 days is greater than 5.6 days, we estimated that any water that exceeded the Ontario standard on one occasion was not of good quality according to the 2009 State of the Great Lakes Report. Of the 15 Lake Ontario waters, this estimate suggested that 33%, 33%, and 60% were of good quality (open greater than 95% of the season) for the years 2009, 2010, and 2011, respectively.

Depending on the year of analysis, a similar or greater percentage of the Lake Ontario waters in the current study were of good quality compared to the Canadian Lake Ontario and Lake Erie waters of the State of the Great Lakes report, although a smaller percentage of the Lake Ontario waters in our study were of good quality compared to the report's Canadian Lake Huron and Lake Superior waters. The U.S. recreational waters of the State of the Great Lakes report appear to have a much higher percentage of good quality waters than the current study for all Great Lakes (except Lake Erie during 2011).

Several problems exist with the above comparison. First, the 2009 State of the Great Lakes report was conducted using 2006–2007 data, and so the comparison is indirect. Second, the U.S. beach bathing standard during that time frame (which has since changed) was less conservative than the Ontario standard; in the U.S. the beach bathing standard was a single-sample exceeding 235 *E. coli* CFU/100 mL (300 CFU/100 mL in Michigan); a difference that has a substantial effect on recreational water closure rates. Third, recreational waters are monitored at different sampling frequencies across jurisdictions and even within the same jurisdiction, which affects the number of days a beach is temporarily closed upon being posted. Lastly, several other differences exist across jurisdictions in both countries in terms of monitoring, analysis, and management protocols that make direct comparisons challenging (Nevers & Whitman, 2011).

Recommendations

Adequate comparisons between jurisdictions can only occur if two necessary conditions are met. First, standardization in recreational water sampling protocols between jurisdictions should be implemented to ensure that reliable and accurate estimates of water quality are established. Second, recreational water monitoring data are more easily accessed and comparisons are conducted according to a single beach posting criteria. Recent changes to U.S. EPA guidelines appear to more closely reflect the criteria standard of Ontario. The U.S. EPA 2012 guidelines were updated to reflect more recent epidemiological studies in which the definition of GI illness was more accurately defined to include illnesses that did not require the symptom of a fever (U.S. EPA, 2012). This new definition of illness coincides with more reported illnesses at the same level of water quality. Reflecting this change, the new suggested *E. coli* criteria is that a swimming advisory or closure be issued when the geometric mean concentration (based on several samples spaced over a 30-day period) exceeds 126 *E. coli* CFU/100 mL and a ≤10% excursion frequency of the statistical threshold value occurs (STV, the 90th percentile of the water quality distribution) of 401 *E. coli* CFU/100 mL in the same 30-day interval. This corresponds to an acceptable illness rate of 36 per 1,000 swimmers with the new definition.

The U.S. EPA 2012 guidelines also encourage a more conservative standard of 100 *E. coli* CFU/100 mL with an STV of 320 *E. coli* CFU/100 mL, corresponding to an acceptable illness rate of 32 per 1,000 swimmers with the new illness definition. This encouraged geometric mean criteria standard reflects that of the conservative Ontario criteria standard, which would certainly aid in more direct comparisons between beach waters in Ontario and the U.S. Alternatively, the U.S. EPA 2012 guidelines recommend standards for enterococci as a fecal bacterium by means of culture methods or by use of a validated molecular testing method using quantitative polymerase chain reaction. Enterococci criteria reflect the same acceptable illness rates as the *E. coli* standards above, which would allow statistical tests to make direct comparisons between U.S. beaches regardless of which fecal indicator bacteria and quantification methods are used.

We recommend that the Canadian guidelines be updated to reflect the U.S. EPA's recent studies and new GI illness definition and that a new suggested Canadian criteria standard reflect those of Ontario and the U.S. EPA.

Remediation measures are necessary to improve the quality of the seven KFL&A public recreational waters that displayed high noncompliance. Several effective remediation efforts can be implemented if PHUs collaborate with municipalities and government agencies, such as deterring bird populations from settling at beaches to preventing avian fecal droppings contributing as nonpoint sources of contamination (Jones & Obiri-Danso, 1999; Oshiro & Fujioka, 1995); deep mechanical sand grooming without leveling to increase aeration, permitting sand to dry quickly and for ultraviolet light penetration to kill harmful bacteria (Kinzelman, Pond, Longmaid, & Bagley, 2004); and reconstruction of wetlands to intercept surface-water runoff, preventing pollutants from reaching open water (Gersberg, Lyon, Brenner, & Elkins, 1987; Karim, Glenn, & Gerba, 2008; Srinivasan, Weaver, Lesikar, & Persyn, 2000).

TABLE **2**

Noncompliance

Overall Noncompliance	% Noncompliance
KFL&A[a] and H&PEC[a] (*N* = 31)	
Across all study years (2009–2011)	54.8
Per year	
Year 2009	41.9
Year 2010	48.4
Year 2011	29.0
KFL&A (*n* = 24)	
Across all study years (2008–2011)	58.3
Per year	
Year 2008	41.7
Year 2009	37.5
Year 2010	45.8
Year 2011	25.0
H&PEC (*n* = 7)	
Across all study years (2009–2011)	71.4
Per year	
Year 2009	57.1
Year 2010	57.1
Year 2011	42.9
High noncompliance	
KFL&A (*n* = 24)	
Across all study years (2008–2011)	29.2
Per year	
Year 2008	16.7
Year 2009	8.3
Year 2010	16.7
Year 2011	4.2

[a]KFL&A = Kingston, Frontenac, and Lennox and Addington beaches; H&PEC = Hastings and Prince Edward counties beaches.

Limitations

Our study has two notable limitations. First, this study had an inadequate sampling frequency of inland recreational waters; this underrepresentation may lead to incorrect conclusions about the state of inland waters. Second, overestimation of geometric means occurred where *E. coli* levels were less than 10 CFU/100 mL and underestimation for *E. coli* levels greater than 1,000 CFU/100 mL, as they were equated to 10 CFU/100 mL and 1,000 CFU/100 mL, respectively, for ease of geometric mean calculations. Since these methods were applied to all waters, relative comparisons were not affected, regardless of the true counts differing slightly from those reported here.

Conclusion

Routine public recreational water surveillance data in southeastern Ontario's KFL&A and H&PEC PHU areas revealed significant *E. coli* contamination, which may negatively affect the health of recreational beach users. We hope that similar studies will become more prevalent and aid in our universal understanding of recreational water quality across North America while at the same time encouraging improved compliance and attention to this important vector for infectious diseases.

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BUILDING CAPACITY

Darryl Booth, MBA

Internet of Things Builds Capacity for Automatic Temperature Logging

Editor's Note: A need exists within environmental health agencies to increase their capacity to perform in an environment of diminishing resources. With limited resources and increasing demands, we need to seek new approaches to the business of environmental health.

Acutely aware of these challenges, NEHA has initiated a partnership with Decade Software Company called *Building Capacity*. *Building Capacity* is a joint effort to educate, reinforce, and build upon successes within the profession, using technology to improve efficiency and extend the impact of environmental health agencies.

The *Journal* is pleased to publish this bimonthly column from Decade Software Company that will provide readers with insight into the *Building Capacity* initiative, as well as be a conduit for fostering the capacity building of environmental health agencies across the country.

The conclusions of this column are those of the author(s) and do not necessarily represent the views of NEHA.

Darryl Booth is president of Decade Software Company and has been monitoring regulatory and data tracking needs of agencies across the U.S. for 18 years. He serves as technical advisor to NEHA's technology section, which includes computers, software, GIS, and management applications.

In my previous column, I spoke of how analytics can guide and make more accurate the work of health departments. The data present increasingly greater value as we move closer to their source. What if the data were immediate … instantly available?

The Internet of Things is an emerging phrase among tech circles that characterizes a class of discrete devices, usually single purposed, each with a connection to the Internet. Your new baby monitor, for example, may feature the capacity to check on your sleeping child using your iPhone down the hall or even across town.

The Internet of Things offers public health informatics on a smaller scale; that is, using devices in areas critical to public health to electronically capture and report, in real-time, such variables as the chemical thresholds in a public pool or the temperature in a restaurant or warehouse refrigerator. Devices record on a regular basis (e.g., once an hour or once a minute) and store the data to internal memory or to a cloud-based service, where they are visible to anybody with proper access (Figure 1). Many devices feature an alarm system that will send threshold alerts via any combination of SMS, e-mail, audible alarm, visual indicator, or even a phone call.

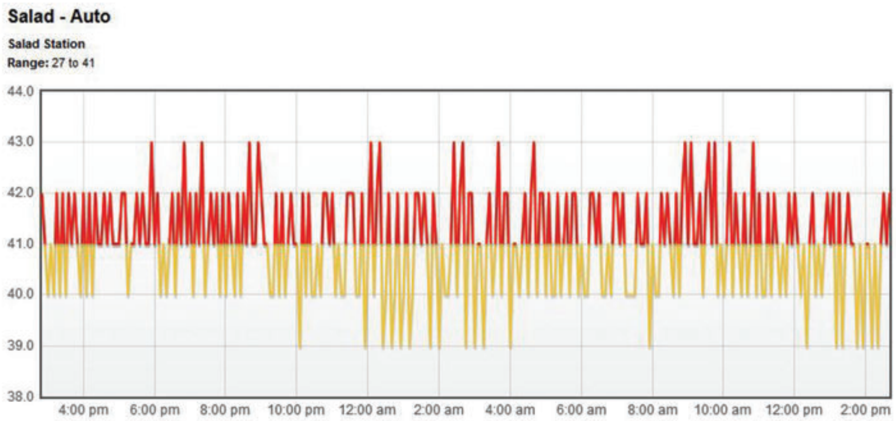
This is an emerging and somewhat ambitious concept. My circle of health professionals, briefed on the matter, tended to have to mull it over to consider the potential. I foresee that this technology will become increasingly commonplace, however, and that health departments should be ready to embrace these new datasets.

The market for this technology is growing quickly. The Food Safety Modernization Act (FSMA) called for, among other items, improved and speedier surveillance of food safety issues, placing more responsibility for safe food directly on entities involved in the food production process. "FSMA really opened the door for technology to be introduced into public health surveillance systems," says Timothy Akers, assistant vice president for research innovation and advocacy and professor of public health at Morgan State University. "I see this technology inevitably becoming a requirement in food safety; it's a great way for local health departments and other federal agencies to monitor and protect public health."

Indeed, the fourth hazard analysis and critical control points (HACCP) principle recommends that "monitoring should be continuous," and a regulator's manual for

FIGURE **1**

Data Automatically Tracked in Salad Bar Monitor



Anomalous Data

Salad Station	2015-03-24 14:50:01 -0400	42
Salad Station	2015-03-24 15:15:01 -0400	42
Salad Station	2015-03-24 15:25:01 -0400	42

Color code: yellow = normal range, red = above normal range. Image used with permission from Touchblock®.

applying HACCP principles to risk-based retail and food service recommends suggesting to operators the purchase of a "data logger to record cooling overnight."

Akers and Cynthia Tucker, PhD, MBA, RDN, LDN, research faculty in the nutritional sciences program at Morgan State, conducted a pilot test of a food safety informatics tool in a university student food service center (Tucker, Larkin, & Akers, 2011). Arguably the first of its kind, the study results show the benefit of automated temperature monitoring for cold and dry storage areas as a matter of proactive public health technology; over a period of just 24 hours, the sensors identified several breaches of temperature standards that upon investigation could not be attributed to deliveries or other variables.

Tucker told me that this concept is directly in line with the goal of FSMA. "These systems enable restaurants to be proactive instead of reactive, which is one of the stated goals of FSMA. Capturing this information in an automated, electronic manner is more credible than paper and pencil and helps them protect the consumer. Nothing can be erased or entered at the last minute when you see an inspector walk through the door. In fact, it will make the health inspection run even smoother, as it speaks to how they run their organization."

Agrees Akers, "When someone puts a pen to paper to write down their times for their food issues, the validity of that data immediately becomes suspect from a surveillance point of view. If there is an objective, surveillance-type system set up to collect real-time, accurate, and unbiased data, we put the nation's safety in the forefront, and we also eliminate any biases."

Five Guys Burgers and Fries, a popular burger chain, has been using informatic technology since 2009 to capture temperatures in coolers and prep rooms every minute and for HACCP compliance. The brand that they use, Touchblock® (product name in process of being changed to ComplianceMate), also provides the restaurants with a Bluetooth probe: as the employee temps all the items required in the checklist, the device uploads that information electronically to the cloud.

"I know from experience throughout my career in the restaurant industry that paper logs are only as good as the people who actually fill them out," says Jim Gibson, vice president of food safety and quality assurance at Five Guys. "When I heard about the technology, I thought, 'this is a great tool.' It speeds up the time it takes to temp products, and provides automated, documented, and validated data that is visible to those who need it—the store, managers, corporate, and local regulators."

Restaurants are, of course, legally compelled to provide food safety logs during a health inspection. Having this data doesn't have a huge impact on the inspection, says Jeanelle Rogers, a health inspector with Fairfax County's Division of Environmental Health, but it is good to see. "This concept matches the requirements of active managerial control. It helps the certified food manager be proactive. It's not the sole evidence that we use when capturing temperatures during inspections, but it does make us feel much better about the facility. They can catch a problem even when we aren't there and do something about it. It helps them demonstrate knowledge and control."

Electronically captured data can also aid reported foodborne illness investigations. "In the past four or five years, we've had to utilize the data about 25 times with health departments to confirm and prove that we weren't the cause of a claim of foodborne illness," notes Gibson.

We'd most likely all agree that a health department can't advocate for one compliance device over another, so long as compliance is reached. But within your capacity as the regulator, you likely can make recommendations, ranging from behaviors to training to methods, that will help restaurants keep their patrons safe. Other more subtle options exist, such as economic or branding incentives for restaurants that have this software. I'm thinking here about awards of excellence that I've seen awarded to facilities (along with a permit discount) that consistently go above and beyond to ensure food safety compliance. It wouldn't be inappropriate, I think, to call out the financial benefits. For example, Gibson told me that Five Guys has caught 300 cases of failed coolers in the last five years. "We've been able to get people to the store to save tens of thousands of dollars of product. The dollar amount is incredible in regards to savings."

I would like to see federal regulatory agencies pursue this subject further; I wouldn't be surprised to find this topic rising in the spotlight in the coming years. Speaking philosophically, what if health departments could interact directly with the data in the cloud? What if the data were pooled into a national repository for analysis?

From Tucker and co-authors' study:

> . . . [P]ublic health is confronted with a myriad of challenges, a complex taxonomy of risks that can go unexamined without standardized data collection systems. The most significant challenge to establish a public health imperative has been educating policy makers and federal, state, and local regulators about the hazards of contaminated foods that are consumed by people in both public and private foodservice facilities. In contrast, if mandated, industry adapts quickly when evidence-based policy helps to guide industry down a path of efficiency (Tucker et al., 2011).

"From a national security point of view," says Akers, "if counties were collecting this type of informatic data, it would be to our advantage to run, for example, some type of analysis to find patterns in food safety data and guide food safety efforts through predictions."

These systems are relatively cheap, easy to install and maintain, and absolutely beneficial for any industry player handling food, says Gibson. "With anything in food safety, it's kind of like insurance—you're purchasing something that hopefully you'll never have to really use, if that makes sense. Some look at it as throwing money into a hole. But really its not a matter of '"if' it's going to happen but 'when.'"

The charter of this column is to expose right-minded technology projects that promise increased capacity. These opportunities may arise from your colleagues, your municipality, or from the private technical sector. By remaining open to these opportunities as they emerge, you reserve the power to be a contributor to the concept, and build up and develop it for your constituency.

Learn more: www.decadesoftware.com/Column.

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DIRECT FROM ATSDR

Are Schools Safe From Indoor Radon?

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Julia Bryant, MA
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Editor's Note: As part of our continuing effort to highlight innovative approaches to improving the health and environment of communities, the *Journal* is pleased to publish a bimonthly column from the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR, based in Atlanta, Georgia, is a federal public health agency of the U.S. Department of Health and Human Services (HHS) and shares a common office of the Director with the National Center for Environmental Health at the Centers for Disease Control and Prevention (CDC). ATSDR serves the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances.

The purpose of this column is to inform readers of ATSDR's activities and initiatives to better understand the relationship between exposure to hazardous substances in the environment and their impact on human health and how to protect public health. We believe that the column will provide a valuable resource to our readership by helping to make known the considerable resources and expertise that ATSDR has available to assist communities, states, and others to assure good environmental health practice for all is served.

The conclusions of this article are those of the author(s) and do not necessarily represent the views of ATSDR, CDC, or HHS.

Stephanie Foster is the lead spatial epidemiologist and research coordinator for the Geospatial Research, Analysis, and Services Program (GRASP) at ATSDR, where she currently leads multiple projects exploring the spatial relationships between environmental hazards and health outcomes. Andrew Dent is program director of GRASP and is responsible for directing the geospatial analytic, research, technology, emergency preparedness/response, and outreach activities undertaken by GRASP. Julia Bryant has been a member of GRASP since January 2010, first as an Oak Ridge Institute for Science and Education (ORISE) fellow and currently as a contractor employed by Booz Allen Hamilton. Brian Tencza is a team lead in the Environmental Medicine Branch in the Division of Toxicology and Human Health Sciences at ATSDR. Erica Adams is currently an ORISE fellow at GRASP. Nina Dutton is an ORISE research participation program fellow at ATSDR.

The U.S. Environmental Protection Agency (U.S. EPA) estimates approximately 21,000 lung cancer deaths are attributable to radon exposure (U.S. EPA, 2003). This number is approximately seven times greater than the number of lung cancer deaths due to secondhand smoke exposure and about twice as many deaths caused by drunk drivers (Centers for Disease Control and Prevention, 2015; Foundation for Advancing Alcohol Responsibility, 2013; National Cancer Institute, 2012). Despite these startling statistics, very few programs are in place to monitor or evaluate indoor radon levels in homes and public buildings in the U.S. Since radon gas is colorless, odorless, and tasteless, testing is the only way to determine its presence (Agency for Toxic Substances and Disease Registry [ATSDR], 2012; U.S. EPA, 2003; U.S. Geological Survey, 1993). When testing reveals levels greater than 4 picocuries per liter (pCi/L), mitigation is recommended by U.S. EPA and several effective strategies for reducing indoor radon levels exist (American Association of Radon Scientists and Technologists, 2014; U.S. EPA, 2010). Given the absence of a national program for radon surveillance and the ubiquitous nature of radon gas, we have undertaken a series of activities to understand the extent to which indoor radon may be a risk for Americans, specifically for children attending public schools, in hopes of increasing awareness about the importance of radon testing.

In 2013, we began a study of the scope and extent of regular and standard radon testing programs in schools across the nation. We learned that many states have active radon testing and mitigation programs. For example, in the last eight years New Jersey has tested

1,705 (51%) public schools (New Jersey Department of Environmental Protection, 2014). We also learned, however, that laws and regulations for reducing radon in schools were scarce (Bernstein, 2013). Additionally, we were surprised to uncover the variations in requirements among different laws. Since our original inquiries, some states have lost funding to support their legislation. Other states have added language in support of testing or radon-resistant new construction practices (Environmental Law Institute, 2014). Policies for radon testing in schools and radon-resistant new construction continue to be uncommon and moving targets.

As part of this effort we reached out to all state programs we believed to be engaged in radon testing in schools. As a result of our inquiries we were able to partner with many of these states. These partnerships provided us radon results from testing conducted in schools. Florida's comprehensive radon testing program provided both residential and school testing results. Therefore, we analyzed 13 years (1990–2012) of indoor radon test results from both residential homes and schools. In Florida no counties are designated U.S. EPA Radon Zone 1 ("predicted average indoor radon screening level greater than 4 pCi/L") and only nine counties are designated U.S. EPA Radon Zone 2 ("predicted average indoor radon screening level between 2 and 4 pCi/L") (U.S. EPA, 2012). Regardless, 10,780 (18.4%) residential radon tests and 335 (8.9%) schools had results greater than 4 pCi/L, U.S. EPA's action level. Additionally, we explored the spatial relationship between schools and residences with test results greater than 4 pCi/L. Using circular buffers of a quarter mile, half mile, one mile, and three miles we examined the number of schools with >4 pCi/L test results within each buffer distance category of a residence with >4 pCi/L results. For each of these distances a statistically significant and strong association exists between residential test results and school radon test results. For schools located within a quarter mile of residences with test results above U.S. EPA's action level an odds ratio (*OR*) of 2.8 (95% confidence interval [*CI*] 2.0, 4.0) exists; that is, if a school is located within a quarter mile of a residential radon test result above the U.S. EPA's action level, that school has almost a threefold increased odds of having an indoor radon level greater than 4 pCi/L. At a half mile, the *OR* = 2.3 (95% *CI* 1.8, 3.0); at one mile, the *OR* = 2.1 (95% *CI* 1.7, 2.5); and at three miles, the *OR* = 1.4 (95% *CI* 1.2, 1.6). We continue to acquire residential and school data to confirm the validity of this spatial relationship in other states.

To further our awareness efforts we are partnering with an elementary school in metropolitan Atlanta to pilot outreach activities. In Georgia, the four metropolitan counties of Cobb, DeKalb, Fulton, and Gwinnett are the only counties in the state designated U.S. EPA Radon Zone 1. For this project we are preparing an overview of radon, for third and fifth grade students, that includes information about radon and its effects, how radon enters buildings, testing for radon, and mitigation strategies to reduce indoor radon levels, if necessary. Additionally, we plan to provide test kits for all students participating in the lesson and kits to test for indoor radon in participating classrooms. The outreach will culminate with a follow-up lesson exploring the test result data through basic statistics, GIS visualization, and spatial analysis. Our hope is these outreach activities will result in a new generation cognizant of issues associated with radon exposure. Furthermore, we hope the children will share this information with their guardians to motivate voluntary residential radon testing.

We are also developing two products to supplement our research efforts: an activity/coloring book and a series of state-specific radon fact sheets. The activity/coloring book will share information about radon appropriate for young audiences. For a more comprehensive understanding of potential radon exposure, we are developing a series of state-specific radon fact sheets that will present demographic information describing the population potentially at risk for indoor radon exposure by county. Additionally, the state fact sheet will include an overview of schools, student and teacher populations, and number of occupied households located in U.S. EPA Radon Zone 1, as well as a map of each state reflecting the U.S. EPA Radon Zones. We anticipate both products being available online later this year.

Eliminating exposure to indoor radon can significantly reduce future lung cancer morbidity. By applying spatial analysis techniques, we anticipate gaining a greater understanding of the relationship between residential test results and indoor radon level in schools. We hope that our research, outreach, and educational products will increase awareness of the importance of radon testing and radon-resistant new construction practices. Additionally, we anticipate these efforts will result in a new generation aware of the impact of radon exposure, empowered to protect their future health.

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Even if you can't attend every session that interests you at the NEHA 2015 AEC, it doesn't mean that you have to miss out. NEHA will be recording about 25 sessions in several topic areas, allowing you to stay educated and earn continuing education credits from your home or office. These will be available for free to all 2015 AEC attendees and NEHA members about two weeks after the conference.

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DIRECT FROM CDC ENVIRONMENTAL HEALTH SERVICES BRANCH

Dawn H. Gouge, PhD

Marc L. Lame, MSc, PhD

Environmental Health Professionals Work the Bugs Out—School Integrated Pest Management

Editor's Note: **NEHA strives to provide up-to-date and relevant information on environmental health and to build partnerships in the profession. In pursuit of these goals, we feature a column from the Environmental Health Services Branch (EHSB) of the Centers for Disease Control and Prevention (CDC) in every issue of the *Journal*.**

In this column, EHSB and guest authors from across CDC will highlight a variety of concerns, opportunities, challenges, and successes that we all share in environmental public health. EHSB's objective is to strengthen the role of state, local, tribal, and national environmental health programs and professionals to anticipate, identify, and respond to adverse environmental exposures and the consequences of these exposures for human health.

The conclusions in this article are those of the author(s) and do not necessarily represent the views of CDC.

Dawn H. Gouge is an urban entomologist at the University of Arizona Department of Entomology. Her extension, teaching, and research focus is on the implementation of integrated pest management strategies to manage public health pests in sensitive environments (schools, child care, and assisted living environments, etc.). Marc L. Lame is a clinical professor for Indiana University's School of Public and Environmental Affairs. He teaches environmental management courses and serves as an integrated pest management advisor for federal, state, and advocacy organizations.

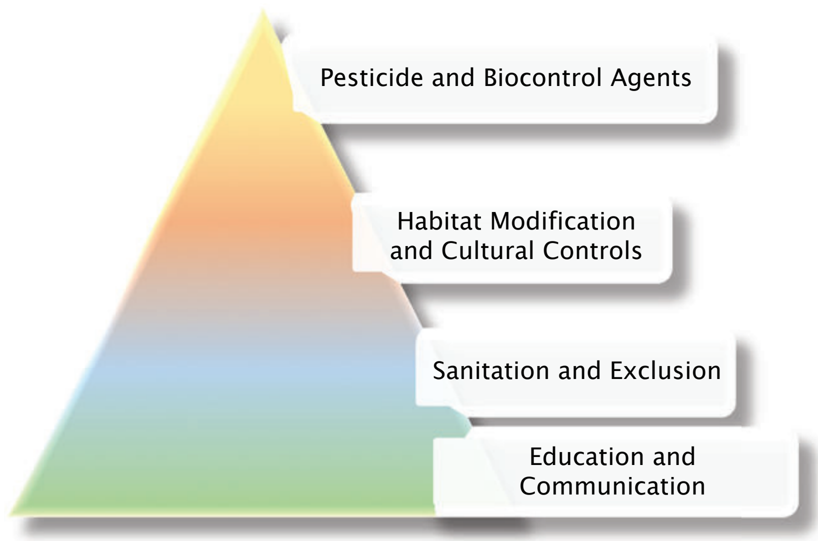
Parents send their kids off to school believing that their children will be in a safe learning environment. This academic year, 50 million students are attending public K–12 schools, with an additional five million attending private schools. Including staff, more than 60 million people are in the U.S. school community, which is an equivalent population to that of the UK or Italy. This body of humanity spends a significant por tion of their day in our 98,300 public schools (13,600 school districts), and 30,900 private schools. So it's not surprising that the quality of the school environment influences the health and well-being of those inhabiting the facilities. Yet children continue to face risks from pests and unnecessary pesticide exposure in schools.

In 2012 the American Academy of Pediatrics (AAP) issued a policy statement addressing pesticide exposure in children (Roberts & Karr, 2012). While it is well established that children are more vulnerable to the effects of toxicants (National Research Council, 1993) and both children and school employees experience illness due to pesticide exposure in schools (Alarcon et al., 2005), the AAP statement highlights current risks to children, offers solutions, and demands action to be taken. The authors cite epidemiologic evidence associating early life exposure to pesticides with pediatric cancers, decreased cognitive function, and behavioral problems. AAP recommends actions to reduce the risks from pesticides by advocating policies that promote integrated pest management (IPM), comprehensive pesticide labeling, and marketing practices that incorporate child health considerations.

Well-managed school districts are practicing IPM to reduce risks related to pests and pest management practices and the benefits of school IPM are clear. Gouge and co-authors (2006) documented that schools implementing high-level IPM averaged a 71% reduction in the number of pesticide applications and a 78% reduction in pest complaints. School districts practicing IPM have lower chances of pest-related exposure; IPM reduced the incidence of roving bed bugs by greater than 75% in an inner-city high school district in Arizona. High-performing school districts demonstrate a high level of emergency preparedness when it comes to vectorborne disease and pathogen-related illnesses. In 2003 Arizona school staff involved in IPM programs were well prepared for West Nile virus (WNV) as it moved west across the coun-

FIGURE **1**

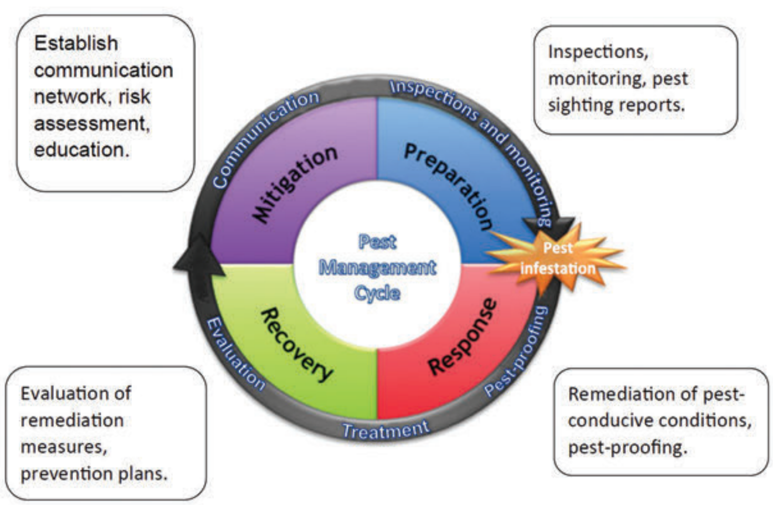
Integrated Pest Management Pyramid



The foundation of integrated pest management is education and communication, while sanitation, maintenance, and pest exclusion measures, manages, or prevents the bulk of pest issues. The safest, most effective pesticides or biocontrol agents are used when necessary.

FIGURE **2**

Pest Management Cycle: Integrated Pest Management Is a Dynamic Investigative Process



try. IPM districts were actively monitoring grounds for mosquito breeding sites and were some of the first to submit mosquito samples positive for WNV in the state. Their response was well planned and included education efforts for local communities. Reducing risks associated with pests and pest management practices also reduces litigation risks.

Many school IPM efforts are led by the district custodial, maintenance, and food-service managers because sanitation and site maintenance are so critical to preventing pests. Still, the vast majority of school districts contract with pest management companies for pest management services. But according to survey work conducted in North Carolina by Nalyanya and co-authors (2005), pest management companies may report IPM practices in schools but apply pesticides on a predetermined schedule, which is contrary to the principles of IPM. The authors concluded that the pest management professionals surveyed did not practice rigorous IPM.

As with the broader field of environmental health, IPM is science based. It is also a decision-making strategy that aims at establishing the safest, most effective pest management practices (Figure 1), which consider the ecology of pests in the target environment. In other words, it's plain common sense. Outmoded exterminator pest control relies on the repeated application of pesticides, whether needed or not. When infestations occur the emphasis is on additional pesticide applications, while IPM efforts center on monitoring and identification of pests, and correction of pest-conducive conditions (Figure 2). When pests show up, action is taken to fix the fundamental reasons why the pests are present.

State school pest management regulation is often pesticide centric and mostly devoid of sanitary rule. Thirty-five states have approved specific restrictions on pesticide use in schools and 38 states in child-care facilities (Hurley et al., 2014). While the pest management industry continues to make advances and improve standards, it's unlikely that school districts can rely entirely on traditional pest management contractors to establish verifiable IPM, particularly when most preventive actions are accomplished through sanitation, maintenance, and daily monitoring by school staff.

Environmental health practitioners (EHPs) represent some of the very few regulators mandated to visit schools and thereby influence schools to implement better IPM practices as part of their normal education and enforcement activities. Everyday connections to pest management can be made about conditions conducive for pathogens caused by improper cleaning or maintenance. We often state that "pest management is people management," and by linking IPM to the best management practices critical to environmental health, EHPs can expand the thinking of school staff such that they understand how to support and DEMAND better pest management.

What You Can Do

1. Get connected to regional, state, and tribal programs: www.epa.gov/opp00001/ipm/ipmcontacts.htm#region9
2. Get informed: www.neha.org/index.shtml
3. Get the message out there. Encourage IPM implementation through education both on the job and at home. Ask your child's school district how they manage pests. Integrate IPM into the 10 Essential Public Health Services that describe public health activities that all communities undertake: www.cdc.gov/nphpsp/essentialservices.html

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Did You Know?

NEHA and the Centers for Disease Control and Prevention offer several free online trainings on integrated pest management (IPM) such as the control of Rocky Mountain spotted fever and other tick-borne diseases through IPM and the importance of IPM in the biology and control of vectors and public health pests. Visit www.nehacert.org and click on the "Free CDC, EPA, & FDA Training Courses" box.

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How did we do?
You may have seen this question at the end of NEHA's staff e-mails along with a link to a quick customer satisfaction survey. We want to know how our members feel about their interaction with the NEHA staff and their ability to address questions or issues in a timely and complete manner. So, the next time you've been in contact with a NEHA staff member, please take a few minutes to complete the survey at www.surveymonkey.com/s/neha-cust-sat-survey and tell us, "How did we do?"

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EH CALENDAR

UPCOMING NEHA CONFERENCE

July 13–15, 2015: NEHA's 79th Annual Educational Conference & Exhibition, Renaissance Orlando at SeaWorld, Orlando, FL. For more information, visit www.neha2015aec.org.

NEHA AFFILIATE AND REGIONAL LISTINGS

Alaska
October 6–9, 2015: Annual Educational Conference, hosted by the Alaska Environmental Health Association, Anchorage, AK. For more information, visit https://sites.google.com/site/aehatest/.

Colorado
September 22–25, 2015: Annual Education Conference & Exhibition, hosted by the Colorado Environmental Health Association, Fort Collins, CO. For more information, visit www.cehaweb.com/aec.html.

Georgia
June 10–12, 2015: Annual Education Conference, hosted by the Georgia Environmental Health Association, Helen, GA. For more information, visit www.geha-online.org.

Iowa
October 7–8, 2015: NEHA Region 4 Environmental Health Conference, hosted by the Iowa Environmental Health Association, Waterloo, IA. For more information, visit www.ieha.net.

Kentucky
July 29–31, 2015: 69th Annual Interstate Environmental Health Seminar, hosted by the Kentucky Association of Milk, Food, and Environmental Sanitarians, Corbin, KY. For more information, visit www.wvdhhr.org/wvas/IEHS/index.asp.

North Dakota
October 20–22, 2015: Fall Education Conference, hosted by the North Dakota Environmental Health Association, Jamestown, ND. For more information, visit http://ndeha.org/wp/conferences.

Texas
October 12–16, 2015: 60th Annual Education Conference, hosted by the Texas Environmental Health Association. For more information, visit www.myteha.org.

Wyoming
October 6–8, 2015: Annual Education Conference, hosted by the Wyoming Environmental Health Association, Saratoga, WY. For more information, visit www.wehaonline.net/events.asp.

TOPICAL LISTINGS

Aquatic Venues/Recreational Health

October 6–7, 2015: Conference for the Model Aquatic Health Code (CMAHC) Biennial Conference, "Bringing the Voice of Aquatics to Updating the MAHC," Scottsdale, AZ. For more information, visit http://cmahc.org/biennial_conference.php.

October 7–9, 2015: 12th Annual World Aquatic Health Conference, "Shaping the Future Through Aquatics," hosted by the National Swimming Pool Foundation, Scottsdale, AZ. For more information, visit www.thewahc.org.

Food Safety
June 2–3, 2015: Rocky Mountain Food Safety Conference, Johnson & Wales University, Denver, CO. For more information, visit www.rmfoodsafety.org.

Health Message on a Tee Shirt

Dear Editor:

Recently, my wife and I had lunch at the Hanalei Gourmet in Hanalei, Kauai. We noticed that the waitresses were wearing tee shirts with a message on the back. With further inquiry, we found that the message was a warning required to be posted by the health department: a warning not to eat raw foods, meats, poultry, seafood, shellfish, and eggs. We also found out that they were not able to print and post the warning prominently and print it on the menu in the time given by the health department, but were able to arrange to have it printed on the tee shirts. I thought this was a rather unique way to comply. I told our waitress that I was a retired sanitarian and used to inspect restaurants; she slipped away for a minute and returned with a smile and a complimentary tee shirt. On the front of the shirt is an emblem that says, "Please Wash Your Hands." A sanitarian story to share with your public/environmental health readers.

Richard Roberts, MPH, DAAS
Grover Beach, CA

Did You Know?

NEHA's 2016 Annual Educational Conference (AEC) & Exhibition will be held in San Antonio, Texas, June 13–15. Check out www.neha.org in late summer for more details about the 2016 AEC—our 80th one!

RESOURCE CORNER

Resource Corner highlights different resources that NEHA has available to meet your education and training needs. These timely resources provide you with information and knowledge to advance your professional development. Visit NEHA's online Bookstore for additional information about these, and many other, pertinent resources!

NEHA BOOKSTORE
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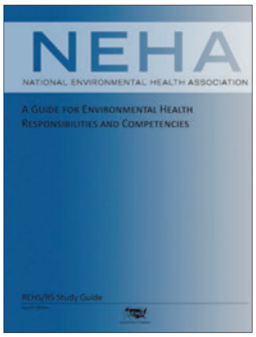
REHS/RS Study Guide (Fourth Edition)

National Environmental Health Association (2014)

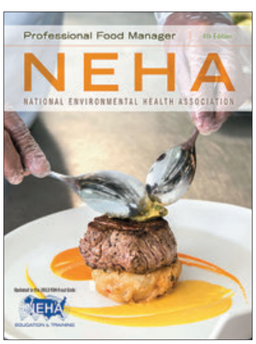


The Registered Environmental Health Specialist/Registered Sanitarian (REHS/RS) credential is NEHA's premier credential. This study guide provides a tool for individuals to prepare for the REHS/RS exam and has been revised and updated to reflect changes and advancements in technologies and theories in the environmental health and protection field. The study guide covers the following topic areas: general environmental health; statutes and regulations; food protection; potable water; wastewater; solid and hazardous waste; zoonoses, vectors, pests, and poisonous plants; radiation protection; occupational safety and health; air quality; environmental noise; housing sanitation; institutions and licensed establishments; swimming pools and recreational facilities; and disaster sanitation.

308 pages / Paperback / Catalog #EZ3010
Member: $149 / Nonmember: $179

Professional Food Manager (Fourth Edition)

National Environmental Health Association, Inc. (2015)
Skillsoft, Inc. (Portions) (2015)



New! Building on the success of previous editions, the new edition is written in an easy-to-read style that prepares current and soon-to-be managers for the many food safety challenges encountered in the workplace. Updated to FDA's *2013 Food Code*, the book provides vital information on topics such as the key principles of food safety management and how to use these principles to create a food safety culture. Current and prospective managers needing food safety manager certification as well as those who are already certified and seeking a refresher on best practices in food safety will find this book an invaluable resource.

141 pages / Paperback/ Catalog #EZ6003
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Certified Professional-Food Safety Manual (Third Edition)

National Environmental Health Association (2014)

The Certified Professional-Food Safety (CP-FS) credential is well respected throughout the environmental health and food safety field. This manual has been developed by experts from across the various food safety disciplines to help candidates prepare for NEHA's CP-FS exam. This book contains science-based, in depth information about causes and prevention of foodborne illness, HACCP plans and active managerial control, cleaning and sanitizing, conducting facility plan reviews, pest control, risk-based inspections, sampling food for laboratory analysis, food defense, responding to food emergencies and foodborne illness outbreaks, and legal aspects of food safety.

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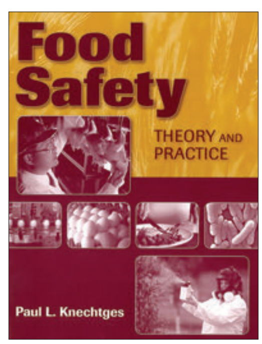
Food Safety: Theory and Practice

Paul L. Knechtges (2012)



Authored by a NEHA member and co-author of the article on page 18!
Written from a "farm-to-fork" perspective, this book provides a comprehensive overview of food safety and discusses the biological, chemical, and physical agents of foodborne diseases. Topics covered include risk and hazard analysis of goods; the prevention of foodborne illnesses and diseases; safety management of the food supply; food safety laws, regulations, enforcement, and responsibilities; and the pivotal role of food sanitation/safety inspectors. Early chapters introduce readers to the history and fundamental principles of food safety. Later chapters provide an overview of the risk and hazard analysis of different foods and the important advances in technology that have become indispensable in controlling hazards in the modern food industry.

460 pages / Paperback / Catalog #1120
Member: $78 / Nonmember: $83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Thank you.

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Allegheny County Health Department
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City of Fall River Health & Human Services
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City of Houston Environmental Health
www.houstontx.gov/health/environmental-health

City of Milwaukee Health Department, Consumer Environmental Health
http://city.milwaukee.gov/Health

City of San Diego Environmental Services Department
www.sandiego.gov/environmental-services

City of St. Louis Department of Health
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Coconino County Public Health
www.coconino.az.gov

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Erie County Department of Health
www2.erie.gov/health

Florida Department of Health
www.doh.state.fl.us

GLO GERM/Food Safety First
www.glogerm.com

HealthSpace USA Inc.
www.healthspace.com

Industrial Test Systems, Inc.
www.sensafe.com

Inspect2Go
www.inspect2go.com

International Association of Plumbing and Mechanical Officials
www.iapmo.org

ITW PRO Brands
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Jackson County Environmental Health
www.jacksongov.org/EH

Jefferson County Health Department (Missouri)
www.jeffcohealth.org

Jefferson County Public Health (Colorado)
http://jeffco.us/health

Kansas Department of Health & Environmental
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Kenosha County Division of Health
www.co.kenosha.wi.us

LaMotte Company
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health@linncounty.org

Maricopa County Environmental Services
jkolman@mail.maricopa.gov

McDonough County Health Department
www.mchdept.com

Mesothelioma Lawyer Center
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Mid-Iowa Community Action
www.micaonline.org

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www.mitchellhumphrey.com

Mycometer
www.mycometer.com

National Environmental Health Science and Protection Accreditation Council
www.ehacoffice.org

National Registry of Food Safety Professionals
www.nrfsp.com

National Restaurant Association
www.restaurant.org

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www.nspf.org

Neogen Corporation
www.neogen.com

New Mexico Environment Department
www.nmenv.state.nm.us

New York City Department of Health & Mental Hygiene
www.nyc.gov/health

North Bay Parry Sound District Health Unit
www.healthunit.biz

Nova Scotia Department of Agriculture
www.gov.ns.ca

NSF International
www.nsf.org

Omaha Healthy Kids Alliance
www.omahahealthykids.org

Oneida Indian Tribe of Wisconsin
www.oneidanation.org

Orkin
www.orkincommercial.com

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Polk County Public Works
www.polkcountyiowa.gov/publicworks

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www.quantemfood.com

Racine City Department of Health
www.cityofracine.org/Health.aspx

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www.remcoproducts.com

Sacramento County Environmental Management Department
www.emd.saccounty.net

San Jamar
www.sanjamar.com

Sarasota County Office of Environmental Health
http://sarasota.floridahealth.gov

Shat-R-Shield Inc.
www.shat-r-shield.com

Skillsoft
www.skillsoft.com

Sonoma County Permit and Resource Management Department, Wells and Septic Section
www.sonoma-county.org/prmd

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www.staterbros.com

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www.taylortechnologies.com

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www.steritech.com

Tri-County Health Department
www.tchd.org

Underwriters Laboratories, Inc.
www.ul.com

Waco-McLennan County Public Health District
www.waco-texas.com/cms-healthdepartment

Washington County Environmental Health (Oregon)
www.co.washington.or.us/HHS/EnvironmentalHealth

Waukesha County Public Health Division
sward@waukeshacounty.gov

Winn-Dixie Stores, Inc.
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WVDHHR Office of Environmental Health Services
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www.online.foodsafety.msu.edu

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University of Illinois Springfield
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To update information, contact Terry Osner at tosner@neha.org.

FREE BENEFITS

Recorded Sessions at the AEC

Did you know that when you attend the AEC you get access to all recorded sessions and their continuing education (CE) hours for six months following the conference? This year there will be about 36 CEs available via recorded sessions, so if there are sessions you're not able to attend in person, you can view them later as a free perk.

Unable to Attend?

If you're unable to join all the free benefits of in-person education, training opportunities, networking, and our fabulous Exhibition, the next best thing is our recorded sessions.

For only $99/members or $215/nonmembers, you will get access to the recorded sessions for your CE hours. That is a bargain equating to less than $3 per CE hour!

Register for the AEC: neha2015aec.org/register

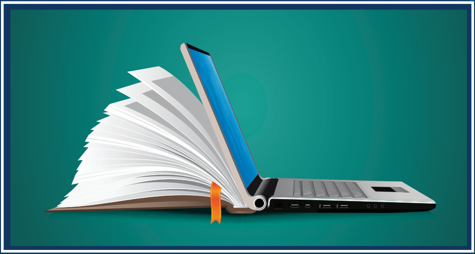
Purchase 2015 Recorded Sessions: neha2015aec.org/recorded-sessions

CE HOURS

Attendees of the AEC can earn up to 24 hours of CE for their NEHA credential.

NEHA has been recognized as a provider of relevant CE and recertification credits for these organizations:

- Florida Department of Health Registered Sanitarian
- Florida Department of Health Certified Environmental Health Professional
- California Registered Environmental Health Specialist



NEW AT THE 2015 AEC EXHIBITION!

Monday, July 13

4:15–5 pm Award Presentations—Part II in the Exhibition
5–7 pm Exhibition Grand Opening & Party and Award Winners Circle

AEC attendees always enjoy the opportunity to chat with exhibitors to discover the latest and greatest tools that help make their jobs easier and more efficient. We are excited to bring you close to 100 exhibitors who want to connect with environmental health professionals in all disciplines.

This year we will be holding part of the award ceremony in the Exhibition with a separate area dedicated on Monday afternoon to the ceremony and the Award Winners Circle before the Exhibition Grand Opening & Party. This area will have an elevated platform for the award presentations and tables designated for attendees to mingle with the award recipients in the Award Winners Circle.

Since the focus of this afternoon award ceremony is on the awards, exhibitors will not be at their booths and the booth area will be restricted until after the conclusion of the award presentations. Booths in the Exhibition will not be staffed until the Grand Opening & Party begins from 5–7 pm.

We appreciate everyone's cooperation to give full attention to the events as they are scheduled to occur in the Exhibition.

Tuesday, July 14

To encourage more networking and opportunities to interact with our vendors, we will be having a concession lunch in the Exhibition this year. Boxed lunches will be available for purchase at several stations throughout the Exhibition. Each full conference attendee will receive a voucher for $15 toward their lunch on Tuesday in the Exhibition only.

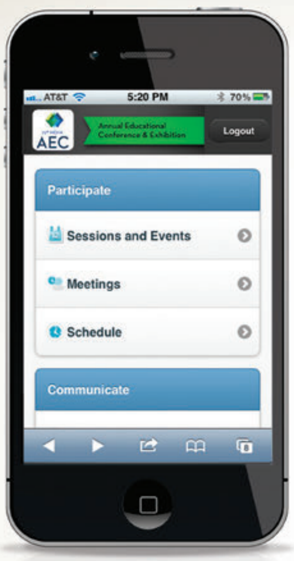
Earn gaming points if you attend the Keynote Presentation! Connect4 NEHA is our brand-new mobile app networking game! See details on the next page.

KEYNOTE SPEAKER

NEHA's new executive director, David T. Dyjack, DrPH, CIH, will deliver the keynote address at the 2015 AEC on Monday, July 13, at 3:30 pm. The keynote will be in keeping with the conference theme for 2015 AEC, Imagine the New NEHA: Tools for Success Today and Making a Difference for Tomorrow. Dyjack will discuss the role of leadership to disrupt a status quo that often fails to make lasting, positive changes, as it is too often dictated by the whims of an American society that sees environmental and public health issues primarily in the short term.

Check out the video introduction from Dr. Dyjack for those receiving this as an E-*Journal* or visit youtube.com/watch?v=_nOkiA4N-ql&feature=youtu.be.

YOUR AEC MEETING COMPANION



Download the AEC App from Google Play or iTunes

Enhance your learning experience whether you attend the AEC or participate online from your home or office.

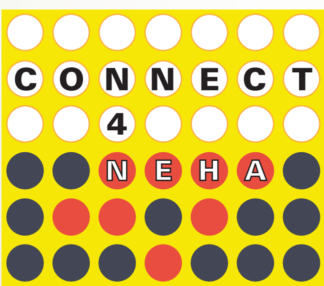
- **Stay connected and informed:** View interactive maps, session descriptions, speakers, exhibitors, and attendee profiles.
- **Create your customized conference schedule:** Add sessions and events you want to attend to your schedule. Then, export the schedule to your Outlook or other electronic calendar.
- **Network and converse:** "Meet" other attendees, speakers, and exhibitors via the chat forums. Request meeting connections, swap digital business cards, or connect digitally with others in your area of specialty or geographic region.
- **Learn:** Use the chat feature to ask questions, post comments, and communicate with speakers, exhibitors, and other attendees.

Your Continuing Education Resource

After the conference, you can still access the educational sessions, view presentation slides, and obtain supplemental materials through the continuing education resource.

CONNECT4 NEHA

Learn About Our New Game Using the AEC Meeting Companion App!



Connect4 NEHA is a new way for AEC attendees to connect with one another, earn points using our meeting companion app, win prizes, and most of all, have fun!

Available to all attendees, Connect4 NEHA is easy to play and will enhance your AEC experience.

How do I play?

When you download the AEC meeting companion app to your smartphone or tablet (search NEHA AEC 2015 from Google Play or iTunes), you're already playing! Connect4 NEHA is like a digital scavenger hunt. You'll be given a list of certain achievements that award you points. Need some examples on ways to earn points?

- Set up your profile
- Add sessions you plan to attend to your schedule
- Attend the UL Event or the Keynote Presentation
- Visit an exhibitor booth
- Mingle with an award winner

You get the picture—it's easy to earn points! When you use the meeting companion app, you will be able to see who the top point earners are and try to beat them. Participants will be eligible to win prizes depending on the points they earn in several point levels!

How do I get started?

When you register for the AEC, watch your inbox for your invitation from **aec@neha.org.** Download the meeting companion app to your smartphone or tablet, and of course, set up your personal profile. Look for more details on neha2015aec.org and learn how to become mayor, commissioner, governor, president, supreme world leader, or the ultimate player—master of the universe!

Environmental health professionals know that the problems facing our communities and our environment are too big to deal with alone. Connect4 NEHA is the same in that the more you connect with others and expand your educational and social opportunities, the more successful we become and together build healthier communities and a better world!

neha2015aec.org @nehaorg

PRE-CONFERENCE COURSES AND EXAMS

Schedule is subject to change.

Advance your expertise and career potential by obtaining a NEHA credential or certification at the AEC. You may choose to take just a credential/certification course, just an exam, or both a course and an exam. *Note: Only qualified applicants will be able to sit for an exam.*

Visit neha.org/credential for details on each exam or pearsonvue.com/neha for alternate test options. Registration is available on site for credential review courses on a space available basis.

Certified Professional – Food Safety (CP-FS)

Saturday & Sunday, July 11 and 12, 8 am – 5 pm

This two-day refresher course is designed to enhance your preparation for the NEHA CP-FS credential exam. Participants are expected to have prior food safety knowledge and training equal to the eligibility requirements to sit for the CP-FS exam. The course will cover exam content areas as described in the job task analysis. The instructor will be available during and after the course for questions.

Cost: *$325 for members and $425 for nonmembers. Includes the CP-FS Study Package (*CP-FS manual, *NEHA's* Professional Food Manager *book, and the* 2009 and 2013 FDA Food Codes *on CD), a $235 value.*

Exam: Monday, July 13, 8 – 10:30 am
Separate application and exam fee required.
Contact credentialing@neha.org for information.

Certified in Comprehensive Food Safety (CCFS)

Friday & Saturday, July 10 and 11, 8 am – 5 pm
Sunday, July 12, 8 am – 12 pm

NEHA is pleased to offer the course for the CCFS credential at the 2015 AEC. The CCFS is a strong core credential for food safety professionals with a primary concern of overseeing the producing, processing, and manufacturing environments of the U.S. food supply. It has been designed to meet the increasing need for highly qualified food safety professionals from both industry and the regulatory community that provide oversight in preventing food safety breaches at U.S. production and manufacturing facilities and abroad. The credential course will cover exam content areas as described in the job task analysis. The course will utilize different learning modalities from critical thinking exercises to small group breakouts and videos.

Cost: *$375 for members and $475 for nonmembers. Includes NEHA's* CCFS Preparation Guide.

Exam: Monday, July 13, 8 – 10:30 am
Separate application and exam fee required.
Contact credentialing@neha.org for information.

Registered Environmental Health Specialist/ Registered Sanitarian (REHS/RS)

Friday & Saturday, July 10 and 11, 8 am – 5 pm
Sunday, July 12, 8 am – 12 pm

This two and a half day refresher course is designed to enhance your preparation for the NEHA REHS/RS credential exam. Participants are expected to have a solid foundation of environmental health knowledge and training equal to the eligibility requirements to sit for the REHS/RS credential exam. This course alone is not enough to pass the REHS/RS credential exam. The class will cover exam content areas as described in the job task analysis. The instructor will be available during and after the course for questions.

Cost: *$499 for members and $599 for nonmembers. Includes the* REHS/RS Study Guide*, a $179 value.*

Exam: Sunday, July 12, 1 – 6 pm
Separate application and exam fee required.
Contact credentialing@neha.org for information.

HACCP—Managing Hazards at the Retail Level

Sunday, July 12, 8 am – 5 pm

The course is designed to teach the requirements needed for HACCP team/staff and to provide managers, regulators, and frontline food safety personnel in retail food facilities with an understanding of how behavior and active participation in creating, implementing, and maintaining a HACCP plan can greatly impact the likelihood for success. Special emphasis is placed on the process HACCP approach.

Managing Hazards at the Retail Level is offered and certified by NEHA; the course is further accredited by the International HACCP Alliance.

Cost (course and exam): *$249 for members and $299 for nonmembers.*

Exam: Monday, July 13, 8 – 10 am

NETWORKING

ANNUAL UL EVENT

Hard Rock Café at Universal's City Walk | Sunday, July 12

Shuttles from the Renaissance Orlando at SeaWorld to Universal's City Walk start at 5:30 pm and the return shuttles to the hotel will end at 9 pm.

No trip to Orlando would be complete without experiencing Universal's City Walk nightlife! Join us in the heart of City Walk as we get the VIP treatment at the Hard Rock Café, red carpet entrance included!

Always a great way to kick off the AEC, the UL Event is designed with networking in mind, not to mention appetizers and cocktails in the John Lennon Room. This venue is an exact replica of John Lennon and Yoko Ono's Manhattan apartment, an exclusive part of the Hard Rock Café accessible only for special events such as this.

Due to the intimate venue size, tickets are limited to the first 200 people and we cannot guarantee on-site tickets will be available. We will provide shuttle buses to and from the hotel to Universal's City Walk, which is included in the UL Event ticket price.

The UL Event is not included in the AEC registration so separate tickets are required.
Purchase Your UL Event Ticket Today! $30 Per Person. Visit neha2015aec.org/ul-event.

Clean the World®

Learn more about Clean the World at cleantheworld.org.

CLEANING THE WORLD *is a great way* TO NETWORK

Sunday, July 12 from 12:30 – 4 pm

The annual Volunteer Community Event at the AEC was started as a way for us to give back to the host city we were visiting and attempt to mitigate our carbon footprint. It soon evolved into one of the top ways for AEC attendees to network! Secure your spot this year at Clean the World, where volunteers will assist with collecting, sorting, and processing discarded soap, shampoo, conditioner, and lotion product donations from participating hospitality partners.

Clean the World employs an environmentally and hygienically safe recycling process at three facilities in Orlando, Las Vegas, and Hong Kong. As the world's first and only high-volume soap recycler, they ensure that all bars of recycled soap are completely safe and will not harm the end user due to disease or pathogens. After sterilization the bars are repressed and repackaged into new bars and donated around the world to prevent millions of hygiene-related deaths each year.

See photos from NEHA's 2014 AEC Community Event at Clean the World's Las Vegas facility at tinyurl.com/nhebdww.

The event is free to participate but advance registration is required!
Registration information, volunteer packet, and waiver can be found at neha2015aec.org/community-volunteer-event.

BE INSPIRED!

In a world where environmental health professionals are often unsung heroes, the AEC is the ideal time and place to recognize and congratulate your peers for their contributions. With almost two dozen awards given, hear the inspirational stories and learn about the people in the honored spotlight.

The diversity you will find in the 2015 award winners covers a broad spectrum of excellence in the field. From sustainability and education to food safety and leadership—the award winners represent the best in the field and the past, present, and future movers and shakers for our profession.

Learn more about last year's environmental health award winners and scholarship awards at neha.org/about/Awards/2014-Awards.html.

NEW FOR 2015!

New networking opportunity: the **Award Winners Circle!**
This will be a place where attendees can connect, chat with, and be inspired by the award winners recognized at the AEC.

The first annual **Secretary's Awards for Healthy Homes**—from the U.S. Department of Housing and Urban Development in partnership with NEHA—for excellence in healthy housing innovation and achievement in

- Public Housing/Multifamily Supported Housing
- Public Policy
- Cross Program Coordination among Health, Environment, and Housing

SCHEDULE OVERVIEW

Friday, July 10

Review Courses: REHS/RS, CCFS

Saturday, July 11

Review Courses:
REHS/RS, CP-FS, CCFS

Sunday, July 12

Review Courses: REHS/RS, CP-FS, CCFS, HACCP
Exam: REHS/RS (afternoon)
Events:

- Community Event
- First Time Attendee Workshop
- Annual UL Event

Monday, July 13

Exams: CP-FS, CCFS, HACCP
Events:

- Education Sessions
- Networking Luncheon
- Keynote Presentation
- Award Presentations
- Award Winners Circle
- Exhibition Grand Opening & Party

Tuesday, July 14

Events:

- Education Sessions
- Exhibition
- Lunch in Exhibition
- Student Research Presentations
- Poster Session

Wednesday, July 15

Events:

- Breakfast & Town Hall Assembly
- Education Sessions
- Field Trips
- Presidents Banquet

For an updated and complete agenda, visit neha2015aec.org/sessions-and-events.

A Wise Investment for You and Your Organization

- Gain the skills, knowledge, and expertise needed to build capacity for environmental health activities.
- Help solve your environmental health organization's daily and strategic challenges and make recommendations to help improve your bottom-line results.
- Learn from speakers that are environmental health subject matter experts, industry leaders, and peers that share common challenges.
- Earn continuing education credit to maintain your professional credential(s).
- Receive a return on investment (ROI) with both immediate and long-term benefits.

See For Yourself
Visit
neha2015aec.org/about
for ROI and other information about the AEC.

NEW TO THE NEHA AEC?

Check out our video from last year's conference using the E-*Journal* to get a peek of what it's all about!

Or, you can view the video at neha2015aec.org/about.

MAP YOUR VISIT FOR EDUCATIONAL AMUSEMENT *at the* NEHA AEC

ENVIRONMENTAL HEALTH
EDUCATION & TRAINING

OUR MOST POPULAR PARKS

Food Safety Focus Series sponsored by Skillsoft & Prometric

Monday, July 13

The series objective is to provide information, updates, and a forum for discussion regarding the creation, implementation, and functioning of an integrated food safety system. This year's five-part series will kick off with members of NEHA's board of directors and representatives from the FDA Office of Partnerships updating attendees on the Partnership for Food Protection and the initiatives of its workgroups as related to the **local** health agency. Subsequent presentations will focus on initiatives specific to foodborne illness outbreak investigations and food-related emergency responses.

5 sessions

The Florida Onsite Sewage Nitrogen Reduction Strategies Study Series

Tuesday, July 14

This half-day series will cover state-mandated research on nitrogen loading from onsite wastewater treatment systems. Presenters will address different types of systems and possible cost-effective, passive strategies for nitrogen reduction that complement the use of conventional onsite wastewater treatment systems. The results and models created by this project have implications for nitrogen reduction efforts far and wide.

5 sessions

Leadership & Management Communications & Outreach Series

Wednesday, July 15

This three-hour series begins by looking at the why and how behind your agency's communications strategy and walks you through planning a strategic approach. Then, using the example of hand washing, attendees will apply an evidence-based model to optimize messages that target populations and produce desired outcomes in behavior. Finally, see how one agency is leveraging video technology in social media to create environmental health education that sticks.

3 sessions

DISNEY MAGIC ATTRACTIONS

Monday, July 13
Protecting, Conserving, Reclaiming, and Reusing the Water that Gives Us Life

Tuesday, July 14
Thinking Inside the Box: Using Cartoons to Imagineer Food Defense

Wednesday, July 15
Conserving the Magic: Creating a Culture of Environmentality™

Sustainable Solid Waste Management Tour: The Magical World of Biodigestion *(Separate registration is required for this field trip.)*

LAND, SEA, AND SPACE ATTRACTIONS

Monday, July 13
Navigating the Seas of Technology: Computer-Based Training for an International Cruise Line

Wednesday, July 15
Fire, Security, and Emergency Management Challenges for NASA's Space Program

Wednesday, July 15
Florida Onsite Wastewater Association Training Center
(Separate registration is required for this field trip.)

Wednesday, July 15
Tour of Aquatica, SeaWorld's Waterpark
(Separate registration is required for this field trip.)

UNIVERSAL APPEAL

Our comprehensive menu of environmental health and safety training and education programs includes over 150 educational presentations in over 20 different tracks, and well over 24 hours of continuing education credit. See neha2015aec.org/sessions-and-events for a complete listing.

- Super Bowl 2015: From Planning to Execution
- Health, Safety, and Security During an Outbreak of Ebola Virus Disease
- Legalized Trouble: What Legalized Marijuana Means for Environmental Health
- Everyone Deserves a Decent Throne Series
- "Doggie Dips" at Swimming Pools: Is This for Real?
- Drop In Learning Labs: attendee-driven educational interactions that consist of hands-on demonstrations and small group consultations

AWARD WINNING ATTRACTIONS

AWARD WINNER PRESENTATIONS

AEHAP/NCEH Student Research Competition Winners

NEHA/UL Sabbatical Exchange Award Winner: To Glove or Not to Glove?

2015 Excellence in Sustainability Award Winner

APSP 2013 Dr. R. Neil Lowry Grant Award Winner: Developing a Drowning Prevention Awareness Program that Works for You

APSP 2014 Dr. R. Neil Lowry Grant Award Winner: Geared Towards Compliance: A Public Pool and Spa Operator Regulatory Training Program

GO AHEAD
GIVE IN

VISIT THE ORLANDO ATTRACTIONS YOU'VE *always* WANTED TO SEE!

NEHA AEC DESIGNATED HOTEL

Renaissance Orlando at SeaWorld
Room rate: $129 per night + taxes.
AEC attendees will not have to pay the hotel's resort or Internet fees.

For more information, visit neha2015aec.org/hotel.

With dozens of theme parks and attractions, world-class golf courses, and miles of ocean and gulf beaches a short drive away, you will want to plan an extended stay in Orlando before or after (or both!) the conference. Cool off at a water park, visit an orange grove, take an airboat ride, or drive a NASCAR race car!

So Much to Explore!

- SeaWorld Orlando
- Disney's Magic Kingdom, Animal Kingdom, Hollywood Studios, Epcot
- Kennedy Space Center and Visitor Complex
- Discovery Cove
- Legoland
- Universal Studios Florida including the Wizarding World of Harry Potter
- Richard Petty Driving Experience
- Busch Gardens Tampa
- Gatorland and Wild Florida Gator Park


When you're ready to apply principles of environmental health.
American Public University understands your passion for solving complex issues in the environment. Our programs offer dynamic, collaborative approaches to environmental studies that are affordable and 100% online. Choose from 190+ career-relevant online degree and certificate programs including:
• Master of Public Health
• Master of Public Administration
• M.S., Environmental Policy and Management
5% tuition grant provided to National Environmental Health Association members
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