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Waterborne Outbreak of SALMONELLOSIS

Investigation & Risk Factor Survey of Splash Pads

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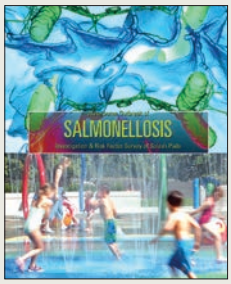

This month's cover article explores the investigation that resulted from an uncommon outbreak of salmonellosis linked to a splash pad. The authors also conducted a survey to gauge water quality and patron behaviors at splash pads. Most splash pads surveyed used a recirculating water system, but 21% tested below recommended free residual chlorine levels and 33% contained an indicator of environmental or fecal contamination. Among the patrons observed, common high-risk behaviors included sitting on the fountain or spray head and putting mouth to water. The article argues that water venue regulations and improved patron education are important to prevent future outbreaks.

See page 8.

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PRESIDENT'S MESSAGE

David E. Riggs,
MS, REHS/RS

Stepping Back

During the last year, I have written a lot about the future of environmental health and the environmental health profession. In this column, I want to reverse direction and talk about the accomplishments of NEHA's officers, regional vice-presidents (RVPs), staff, and membership. To set the stage for the discussion that follows, let me elaborate on my term as NEHA president over the last year.

When I became NEHA president, I did it to give back to a profession I have practiced in my entire adult life and an association in which I have the greatest pride. It was my idea to give back to my colleagues the lessons and experiences I have gained in practicing environmental health for almost four and a half decades. To my surprise and satisfaction, I quickly found that I learned much from my fellow officers and NEHA's membership and staff. It has been my pleasure to interact with our state affiliates, partner organizations, and individual members. In every case, I learned something new and significant about the art and science of the environmental health practice. In other words, although my original intent was to give back, I was the actual recipient.

Now that I have set the stage for looking back over the last year, let me share with you the state of NEHA today and the accomplishments we have made together.

A great preponderance of our association's accomplishments fall into the area of strengthening relationships between NEHA and its state affiliates and members. Strong affiliates and an active, involved membership are the life blood of our association. NEHA's board of directors, executive director, and staff have implemented many initiatives to foster these relationships.

> *If this year is the beginning of a new NEHA, we are all in for a great ride!*

The development and implementation of a new customer relationship management and data system are underway. When in full operation, this system will enable members to explore the status of their membership, credentials, continuing education, and professional development through a single-entry point. In addition, registering for our Annual Educational Conference (AEC) & Exhibition and other special events will be easier and faster.

During the last year, our RVPs have expanded their presence and roles in state affiliates. The national officers have attended state affiliate, partner, and stakeholder events and meetings.

The 2017 AEC in Grand Rapids, Michigan, will offer a special 1-day training for state affiliate presidents. It is the goal of this training to give these leaders the tools to promote their affiliates through improved management, outreach, and organization. To my knowledge, this type of training has not been offered before and is now an integral part of the AEC.

NEHA has undertaken a review of policy statements and position papers by RVPs, national officers, and staff. The results are that these documents are currently being categorized as needing revision or, at the other end of the scale, needing "sun setting." A new policy statement was developed this year that deals with climate change. You can review this statement on NEHA's Web site at www.neha.org/publications/position-papers.

Over the next few years, the necessity for NEHA and its membership to raise environmental health awareness is clear. Also, as environmental health professionals, we must speak out locally and nationally. To this end, NEHA has expanded the breadth and depth of its presence in Washington, DC. In February 2017, our national officers attended a day on Capitol Hill to visit Senate and House offices to discuss environmental health goals and positions. Our staff members based in Washington, DC, are a daily presence that provides support for environmental health and the environmental health profession.

During the last year, NEHA has begun to pivot toward the younger membership. As we see the graying of the baby boomer generation, our profession and association will see a shift in human capital that is unequaled in history. NEHA has started the process to make our association more useful to younger members, and to offer a greater return on investment. Generation X and millennials seek great experiences and a chance to identify with a greater cause. The 2017 AEC has been restructured to offer an even better experience for attendees.

NEHA has moved forward in becoming the premier environmental health organization in the nation. It has also started the change to become a paperless association. The structure and organization of the AEC has been streamlined and made more interactive to provide a better return on investment. We have begun the process of making our data, membership, and record keeping more reliable and easier to use for members and staff.

I owe a great debt to NEHA's staff, executive director, and board of directors for a successful year and the achievements we have accomplished. If this year is the beginning of a new NEHA, we are all in for a great ride!

David E. Riggs
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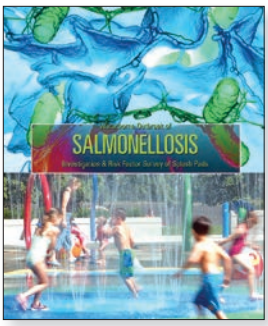
Did You Know?

This column marks the last President's Message written by NEHA President David Riggs. Riggs will step down as NEHA president in July at the 2017 Annual Educational Conference (AEC) & Exhibition in Grand Rapids, Michigan. The *Journal* would like to thank Riggs for contributing columns during his year as president and for providing our readers with insights into the association and profession. You can view all past NEHA president columns from 2014 to the present at www.neha.org/publications/journal-environmental-health/presidents-columns. The July/August issue will mark the first column written by Adam London, current NEHA president-elect, who will assume the position of president when Riggs steps down at the 2017 AEC.



Water Quality Survey of Splash Pads After a Waterborne Salmonellosis Outbreak —Tennessee, 2014

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Abstract **Waterborne outbreaks of salmonellosis are uncommon. The Tennessee Department of Health investigated a salmonellosis outbreak of 10 cases with the only common risk factor being exposure to a single splash pad. Risks included water splashed in the face at the splash pad and no free residual chlorine in the water system. We surveyed water quality and patron behaviors at splash pads statewide. Of the 29 splash pads participating in the water quality survey, 24 (83%) used a recirculating water system. Of the 24, 5 (21%) water samples were tested by polymerase chain reaction and found to be positive for *E. coli, Giardia*, norovirus, or *Salmonella*. Among 95 patrons observed, we identified common high-risk behaviors of sitting on the fountain or spray head and putting mouth to water. Water venue regulations and improved education of patrons are important to aid prevention efforts.**

Introduction

During 2009, more than 50 million people swam during an estimated 300 million visits to recreational waters in the U.S. (U.S. Census Bureau, 2011). Included among recreational waters are hot tubs, swimming pools, lakes, oceans, and rivers. Among potential risks for recreational swimming is waterborne illness resulting from ingestion of contaminated water. Diarrhea, the most common manifestation of waterborne illness, results when a person ingests water contaminated with enteric pathogens, including *Cryptosporidium*, *Giardia*, *Shigella*, norovirus, and *E. coli* O157:H7 (Hlavsa et al., 2011).

Despite being among the most common enteric pathogens, nontyphoidal *Salmonella* is rarely identified as the source of waterborne illness (World Health Organization, 2008). During June 2014, the Tennessee Department of Health (TDH) investigated a salmonellosis outbreak associated with a single splash pad. Splash pads, which are not regulated in Tennessee, are any fountain or water spray device intended for or accessible to recreational use (see photo on page 9). A limited number of outbreaks associated with splash pads have been reported, and a study of water quality was rarely included (Bancroft, Keifer, & Keene, 2012; Eisenstein, Bodager, & Ginzl, 2008; Kirian, Meregillano, Gennette, & Weintraub, 2008; Nett et al., 2010). We investigated the outbreak of salmonellosis and then conducted a statewide survey of splash pads to learn more about their water quality and observe patron behaviors that might increase the risk for infection.

Methods

Outbreak Investigation

During June 2014, routine disease surveillance and patient interviews conducted by TDH identified an outbreak of five *Salmonella* Newport infections among patrons of a single splash pad. Standard outbreak investigation methods were used, including case finding from local healthcare providers, patient interviewing, and laboratory isolation and subtyping by pulsed-field gel electrophoresis (PFGE). A case-control study was performed to identify exposures associated with *Salmonella* infection among patrons of the implicated splash pad.

Cases were defined as either confirmed (a person who developed diarrhea, defined as ≥3 loose stools during 24 hours, within 16 days of visiting the splash pad, and with laboratory confirmation of *Salmonella* Newport) or probable (a person who developed diarrhea within 16 days of visiting the splash pad without laboratory confirmation). The 16-day incubation period for *Salmonella* was used because the ingestion dose was likely low because of the dilution effect of the splash pad water (Heymann, 2004). We attempted to match three control subjects per case-patient, stratified by age group. Control subjects were age matched to case-patients and had visited the splash pad in the previous 30 days. Internet directories were used to identify households in the community near the splash pad and telephone calls were made to enroll control subjects. TDH staff visited the splash pad to enroll additional patrons as control subjects via in-person contact. After the outbreak was identified, a chlorine reading was taken and TDH staff reviewed

TABLE **1**

Splash Pad Characteristics Related to Hygiene and Water Quality (*N* = 29)

Characteristic	# (%)
Recirculated water	24 (83)
Hygienic practices and policies	
Signs posted	15 (52)
No food allowed	9 (31)
No drinks allowed	8 (28)
No animals allowed	7 (24)
Child supervision required	7 (24)
Exclusion of ill persons	6 (21)
Avoid swallowing water	5 (17)
Shower before entry	3 (10)
Recommend swim diaper	5 (17)
No changing diapers	1 (3)
Written policies	12 (41)
Body fluid contamination policy	9 (31)
Hygienic facilities available	
Restrooms	17 (59)
Hand wash sinks	15 (52)
Drinking water fountains	11 (38)
Fence around facility	10 (35)
Food available on or near premises	10 (34)
Showers	5 (17)
Diaper changing stations	7 (24)
Changing rooms	5 (17)
Foot wash stations	4 (14)
Water quality	
pH, mean (*SD*)[a]	3.7 (3.1)
Free chlorine, mean ppm (*SD*)[a]	7.5 (0.4)
Total coliforms present[a]	3 (13)
E. coli present[a]	1 (4)
Specific pathogen identified[a,b]	5 (21)

SD = standard deviation; ppm = parts per million.
[a]*N* = 24 splash pads with recirculating water.
[b]1 for *Giardia*; 2 for enteropathogenic *E. coli*; 1 for norovirus, and 1 for Shiga toxin-producing *E. coli*, enterotoxigenic *E. coli*, *Salmonella*, and *Plesiomonas shigelloides*.

the maintenance logs during the initial visit. During a subsequent visit, an environmental assessment and water samples were taken.

Example of water features at a splash pad. Photo courtesy of Judy Manners.

Splash Pad Survey

In response to the waterborne *Salmonella* outbreak, we conducted a survey during August 2014 of all identified splash pads in Tennessee to learn about their operating characteristics. A comprehensive list of splash pads was unavailable, so we identified sites by searching the Internet for terms commonly used to name or describe them (e.g., splash pads, interactive fountains, or aquatic playgrounds); reviewing splash pad manufacturer web pages for past, current, and future projects; and reviewing award announcements from the Tennessee Department of Environment and Conservation's parks and recreation grants. Splash pad operators were requested to participate in the survey during an unannounced site visit. Participating site operators were asked questions addressing water recirculation, signage, written policies for hygienic behaviors, and hygienic facilities available to patrons.

During splash pad visits, water samples were collected from spray or fountain heads. Free chlorine levels were tested on site by using a commercial pool test kit. For microbial testing at TDH's Division of Laboratory Services, water samples of 100 mL for coliform culture and 1 gallon for polymerase chain reaction (PCR) analysis were collected. Total coliform and *E. coli* cultures were performed using methods approved by the U.S. Environmental Protection Agency (Standard Methods: 9223 B) for drinking water testing. Multiplex PCR (BioFire FilmArray Gastrointestinal Panel) analysis was used to test for 22 enteric pathogens. The gastrointestinal panel is not validated for water samples; therefore, the state laboratory developed a modified protocol. Water was passed through a 0.45 µm filter, and the filter was placed into 50 mL of lactose broth and incubated overnight (18–24 hours) at 35 °C. Broth was then tested by drawing a 200 µL sample for the multiplex PCR test and, if a *Salmonella* species was present, cultured using standard techniques.

Patron Observations

Splash pad patrons who appeared to be 18 years or younger were observed to examine behaviors that would increase the likelihood of venue contamination or fecal–oral disease transmission. This patron age group was chosen for their increased likelihood to participate in nonhygienic behaviors. A convenience sample of children was selected and risk behaviors were documented for 15 minutes or until they left the splash pad area. Risk behaviors of sitting on a fountain or spray head, putting their mouth to water, putting their fingers in their mouth, putting a hand down their swim shorts, and exposing their buttocks to water were recorded as present or absent during each 1 minute increment of the 15-minute observation period (Nett et al., 2010).

Results

Outbreak Investigation

All 10 case-patients (5 confirmed and 5 probable) and 27 control subjects were included in a case-control study. All 5 confirmed case-patients had stool cultures that yielded *Salmonella enterica* serotype Newport with matching PFGE patterns. The mean age of both case-patients and control subjects was 7 years; 5 (50%) case-patients and 12 (44%) control subjects were female. No other common exposure among case-patients was identified after examining shared events, food histories, and other exposures while at the park. All 10 (100%) case-patients had water splashed in their face while playing in the splash pad, compared with 19 (90%) of 21 control subjects. No free residual chlorine, which inactivates potential contaminants, was identified in the recirculated water during the TDH staff member's visit, and the splash pad was closed voluntarily. Review of maintenance logs revealed chlorine level testing was not routinely logged or performed. After cleaning and hyperchlorination, the splash pad was reopened. No samples were taken before closure and subsequent water samples collected upon reopening did not detect *Salmonella*, total coliforms, or *E. coli* by culture.

Splash Pad Survey

In Tennessee, 59 splash pad locations were identified, and operators were contacted to participate in our survey. Of these 59 splash pads, 29 operators (49%) voluntarily provided water samples for testing. Most of the splash pads, 24 of 29 (83%), used a recirculating water system. Of these, 5 (21%) tested below the 1.0 parts per million (ppm) free residual chlorine recommended by the Model Aquatic Health Code (Centers for Disease Control and Prevention [CDC], 2014) and 2 (8%) tested below the detectable limit. Water quality testing of the 24 recirculating water systems identified 3 (13%) that tested positive for total coliforms, 1 (4%) yielded *E. coli* by culture, and 5 (21%) tested positive for specific organisms via multiplex PCR (1 for *Giardia*; 2 for enteropathogenic *E. coli*; 1 for norovirus; and 1 for shiga toxin-producing *E. coli*, enterotoxigenic *E. coli*, *Salmonella* species, and *Plesiomonas shigelloides*). In total, 8 (33%) of 24 splash pads that recirculated water contained an indicator of environmental or fecal contamination.

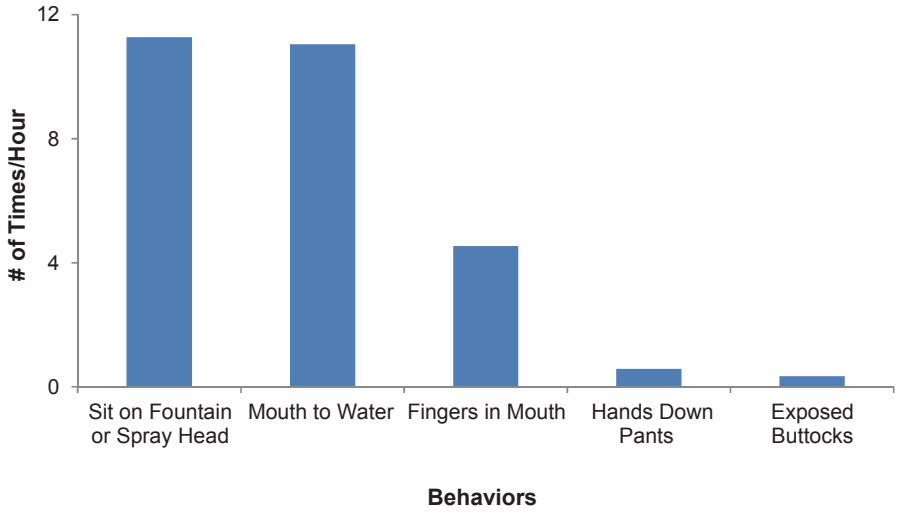
The 5 nonrecirculating splash pads tested negative for all organisms, and 2 had free residual chlorine levels <1.0 ppm. Examining hygienic practices and policies at the 29 splash pads, approximately half had posted hygiene signs (Table 1). Written hygiene policies were identified at less than half of splash pads, and less than one third reported having a written policy for body fluid contamination (e.g., blood, feces, or vomitus). Approximately half of splash pads had hygienic facilities, restrooms, or hand wash sinks, and approximately one third had a drinking water fountain available for patrons. Presence of environmental or fecal contamination indicators were not associated with inadequate water chlorination (p = .14) or the presence of posted hygiene signs (p = .99) or hygienic facilities (p = .71) at splash pads.

Patron Observations

From 95 patron observations at 17 splash pads, 20 (21%) were children wearing diapers or swim diapers, and 4 (20%) had a diaper changed in the splash pad area. Patrons spent an average of 11 minutes per hour sitting on a fountain spray head, 11 minutes per hour putting their mouth to water, and 4 minutes per hour putting their fingers in their mouth (Figure 1).

FIGURE **1**

Observed Rate of Behaviors for Splash Pad Patrons ≤18 Years



Discussion

Our investigation documented an unusual waterborne *Salmonella* Newport outbreak after patron exposures to insufficiently chlorinated water at a splash pad that used recirculating water. In all, 10 cases of *Salmonella* were epidemiologically linked to activities at a single splash pad with no free residual chlorine detected in the water. In a survey of splash pads, evidence of enteric pathogens—including *E. coli*, *Giardia*, *Salmonella*, and norovirus—was found in splash pads with recirculating water systems. The majority of children observed at splash pads during this investigation engaged in unsanitary behaviors, including sitting on a fountain or spray head and putting water or their fingers in their mouths. Recirculation of water at splash pads likely allows fecal–oral transmission of enteric pathogens by prolonging patron exposure to contaminated water.

The majority of splash pads in our survey used recirculated water and water quality concerns included no free residual chlorine and contamination with enteric pathogens. Free residual chlorine levels were difficult to maintain and potentially inadequate to disinfect the water if organic material from patrons or the surrounding environment was introduced. Each patron entering the splash pad potentially introduces some amount of organic material and the most common waterborne illnesses are infectious at low doses (Gerba, 2000). Water quality testing for specific pathogens identified contamination consistent with environmental or fecal sources at multiple venues. Specific pathogens found in the water included *Salmonella*, *E. coli*, *Giardia*, and norovirus. Although certain enteric pathogens might have resulted from environmental contamination by birds or animals, humans are the only known reservoir of norovirus.

Observations of splash pad patrons 18 years or younger identified that behaviors of sitting on a spray or fountain head and putting water or their fingers in their mouth were common. The majority of patrons were young (<5 years old) and therefore less likely to be aware of proper hygiene etiquette than older splash pad patrons. These prevalent but modifiable risk factors can be targeted to reduce the risk for waterborne illness. The Centers for Disease Control and Prevention (CDC) recommends patrons minimize waterborne illness risk for themselves and others by taking frequent restroom breaks, not ingesting the water, and refraining from water play while ill with diarrhea (Hlavsa et al., 2011). Signs posted at splash pads can help educate patrons and serve as reminders about these prevention steps. Our study

reported only half of splash pads had any hygiene signs posted, and the facilities to support the prevention steps were often not available at the sites. Only half of splash pads had restrooms with a toilet and hand sink, and approximately one third had a drinking water fountain.

A number of splash pads were originally designed to be decorative rather than recreational sites, helping to explain the limited attention to water quality by operators and lack of hygiene signs at facilities in our study. As prevention of contaminants is not considered a concern for decorative fountains, they often have fewer barriers (e.g., fencing) to prevent domestic animals from contacting the water. Regardless, even gated recreational splash pads are open to contamination by wild animals and birds. Determining which splash pads are accessible for recreational use and inspecting them to meet water quality regulations is a challenge for regulators.

Waterborne outbreaks of salmonellosis are uncommon (Outbreak Collaborative, 1971; Taylor, Sloan, Cooper, Morton, & Hunter, 2000). During 2009–2010, none of the 33 drinking water outbreaks or 81 recreational waterborne outbreaks reported to state health departments was as a result of *Salmonella* species (CDC, 2013; Hlavsa et al., 2014). During 2006, a waterborne outbreak of 69 cryptosporidiosis cases and 15 salmonellosis cases was associated with an interactive fountain in California (Kirian et al., 2008). Similar to our Tennessee outbreak, factors contributing to the California outbreak included the recirculation of water and inadequate disinfection. A limited number of drinking water outbreaks were identified with *Salmonella* as the causative agent during the past decade (Ailes et al., 2013; Hlavsa et al., 2011).

This study had certain limitations, including that the multiplex PCR, although validated for stool specimens, was not validated for use with water samples and the test sensitivity and specificity is not known. The multiplex PCR also does not differentiate live from inactivated organisms, an important distinction for developing disease. Nevertheless, five different enteric pathogens were identified in splash pad water samples, and their presence indicates the potential to cause disease if effective chlorine disinfection was not being performed. Our findings likely underestimated the contamination occurring during peak usage in summer months because the study was performed during August when schools had resumed and fewer patrons were present.

Conclusion

Poor water quality and risky patron behaviors that facilitate fecal–oral transmission of waterborne illness were present at a substantial proportion of splash pads surveyed in Tennessee. Vigilance among splash pads operators is needed to maintain proper water quality. Splash pad patrons should take precautions to help prevent illness, such as hand washing after using the toilet or before eating, changing diapers in an area separate from the splash pad, and avoiding ingestion of recreational water. Hygiene signs posted around these popular water venues can serve as a reminder to patrons. Furthermore, toilet, hand washing, and drinking water fountain facilities located nearby are essential. Public health jurisdictions can consider extending existing regulatory oversight for swimming pools to splash pads.

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Building the Future of Environmental Public Health Tracking: Proceedings and Recommendations of an Expert Panel Workshop

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Abstract **Since 2002, the national Environmental Health Tracking Program of the Centers for Disease Control and Prevention (CDC) has provided vital support to state environmental public health efforts while simultaneously building a nationwide network of state, local, and academic partners to improve our nation's capacity to understand and respond to environmental threats to public health. As part of program review and strategic planning, national thought leaders in environmental public health were convened to assess progress, identify gaps and challenges, and provide recommendations for enhancing the utility and impact of the Tracking Program. Several opportunities were identified. Chief among these was the need for continued and expanded CDC leadership to develop a coordinated Tracking Program agenda identifying specific scientific goals, data needs, and initiatives. Recommendations for future growth included expanded data availability and program coverage: i.e., making data available at the community scale and establishing tracking programs in all 50 states. Finally, a set of recommendations emphasizing communication to decision makers and the public was made that will be integral to the future utility and success of the Tracking Program.**

Introduction

A Vision for Environmental Public Health Tracking

From the earliest days of organized public health, understanding environmental hazards and exposures has been critical to protecting the health of communities. As the national infrastructure for environmental protection evolved since the creation of the U.S. Environmental Protection Agency (U.S. EPA) in 1970, there has been an emphasis on controlling pollution sources and monitoring environmental quality. While these efforts have helped improve environmental quality, the creation of environmental agencies contributed to a fragmentation of environmental public health efforts among environmental and health agencies (Burke, Shalauta, Tran, & Stern, 1997; Institute of Medicine, 1988). To address the uncoordinated patchwork of environmental public health in the U.S., the Pew Foundation established the Pew Environmental Health Commission at Johns Hopkins University in 1998. The commission found that as a result of decades of neglect, the nation's public health system was operating without basic information about chronic disease and related potential environmental factors (Environmental Health Tracking Project Team, 2000; Litt et al., 2004). To address this gap, the commission developed a blueprint for environmental public health tracking (EPHT) summarized in this overarching recommendation:

> Create a federally supported Nationwide Health Tracking Network that informs consumers, communities, public health practitioners, researchers, and policymakers on chronic diseases and related environmental hazards and population exposures. This will provide the capacity to better understand, respond to, and prevent chronic disease in this country.

In response to the commission recommendations, in 2002 the National Center for Environmental Health of the Centers for Disease Control and Prevention (CDC) established the Environmental Public Health Tracking Program. Since then, the Tracking Program has supported and worked with agency, community, and academic partners to develop the necessary systems, training, expertise, and capacity to address the vision of the commission. The Tracking Program has spawned many successful projects from the first years of work, including funding tracking programs in state and local agencies in 25 states, exposure prevention and community environmental health assessments, and new policies and research (Kearney, Namulanda, Qualters, & Talbott, 2015; Litt et al., 2007).

Renewing the Vision: Tracking Program Progress and Next Steps

Environmental public health science has advanced with new understandings of population exposures and recognition of a broader range of health impacts (Gibb et al., 2015).

The increased recognition of the public health importance of climate change, the emergence of the health impact assessment (HIA) as a core tool for public health decision making, and vast improvements in health information technology and availability—all present great opportunities for the future of tracking (Mueller et al., 2015; U.S. Global Change Research Program, 2014). Recognition of and attention to the link between environment and health has never been greater. Public health policy decisions ranging from transportation to community development are increasingly dependent upon strong public health information (National Association of Chronic Disease Directors [NACDD], 2015). Despite these successes, in the 12 years since its inception, the Tracking Program has been hampered by continued fragmentation in the field, scientific uncertainties, and limited resources.

Methods

Considering the successes and challenges that remain, this project provided recommendations for the future of tracking, building upon the progress made and continuing to work toward the vision of a nationwide network and related public health capacity to better understand, respond to, and prevent environmental hazards, exposures, and diseases. The discussion and recommendations below are the result of an expert panel workshop that included persons with expertise in community health, emergency preparedness, environmental health sciences, epidemiology, and public administration. Agencies and organizations represented on the panel included: the Association of Public Health Laboratories; U.S. EPA; U.S. Geological Survey; and state health and environment agencies from Massachusetts, Michigan, New Jersey, Oregon, and Washington. Also represented were academic institutions: Colorado School of Public Health, City University of New York School of Public Health, and Johns Hopkins School of Nursing. The panel convened at a workshop in Baltimore, Maryland, in March 2015. The recommendations were designed to inform strategic planning for the Tracking Program as it seeks to enhance the utility of efforts to develop and sustain program activities to build a nationwide network, as well as advance environmental public health capacity at all levels to better protect the nation's communities.

Results: Expert Panel Discussion

At the start of the workshop, participants engaged in an assessment, each providing their perspectives on the Tracking Program's accomplishments and challenges, as well as participants' suggestions for next steps. Following the assessment exercise, the discussion turned to practical ways to enhance the Tracking Program and implement the next steps.

Assessment Activity: Accomplishments

The Tracking Program has enhanced and sustained environmental public health capacity, which was particularly critical during the recent recession years when, without the Tracking Program, such capacity would have been minimal or even nonexistent. Additionally, the Tracking Program was lauded for enhancing technical expertise, creating access to data, facilitating the development of a multidisciplinary "people" network of grantees and federal partners across the nation, as well as partnerships and data sharing across agencies and community organizations within states. These infrastructure supports, data sharing activities, and partnerships were identified as fundamental to achieving the vision of the commission. Participants felt that these fundamental features must be sustained and, if possible, expanded as the program moves forward.

For example, the Tracking Program has helped U.S. EPA to be accountable for both policy actions and inactions by highlighting the links between environmental exposures and health—and, in turn, the resulting health protection afforded by improved environmental quality. The primary example for U.S. EPA has been related to air data, which is readily available. For example, the Wisconsin Tracking Program was able to use air data to develop the Regional Air Impact Modeling Initiative to link geographic estimates of toxic air pollutants and cancer risk. This initiative allowed for the investigation into factory emissions of trichloroethylene and adverse health effects (Centers for Disease Control and Prevention, 2006). Moreover, U.S. EPA is looking to expand the datasets that can be available to tracking programs to allow for linkage of nationally collected, geographically focused exposure data and local level public health outcomes. For example, there is potential to link with a number of U.S. EPA data and mapping resources including the Community Focused Exposure and Risk Screening Tool, EJSCREEN, and EnviroAtlas (U.S. Environmental Protection Agency, 2016a, 2016b, 2017).

Assessment Activity: Ongoing Challenges

Ongoing challenges identified at the workshop were centered on different aspects of data access, integration, and dissemination. Data access due to confidentiality and data use agreement issues has been an ongoing challenge and obtaining data at granular levels has been particularly difficult. Additionally, lack of standardized network architecture including data collection platforms, databases, and portals has created data integration challenges. These data limitations have hindered progress towards the aims outlined by the commission; finding solutions to such challenges should be a priority in moving the program forward.

Lack of awareness about EPHT by agency decision makers is a challenge to assuring its continued use and sustained support and growth. While the data might be useful, if policy makers and key stakeholders are unaware of the potential of the data, this resource will not be used to inform decision making. Building such awareness and "traction for tracking" may require an integrated training, communication, and outreach effort to establish tracking data and analytical tools as the preferred resource for the public health workforce to use in addressing complex environmental health issues. When assessment results are communicated to decision makers, the results should be identified as products of tracking.

Panelists also commented on strategies for building resources for tracking. Leveraging partnerships and cross-agency collaborations with regard to applied research can maximize resources. For example, using tracking data across agencies, such as the Food and Drug Administration and U.S. Department of Agriculture with regards to food safety practices and policies could streamline efforts and enhance outcomes. Furthermore, additional resources and opportunities for tracking might be available through partnerships related to community health improvement efforts undertaken by healthcare organizations.

Assessment Activity: Next Steps

Tracking data will be instrumental in addressing the changing world, including climate

change and understanding the health impacts of economic growth and globalization. A key to addressing such issues is sustaining and growing the tracking infrastructure and ensuring data availability to meet information needs of emerging public health challenges. Data enhancements must incorporate timely, accurate, community-level data (i.e., census tract level data, geocoded data, and potentially other data sources such as citizen science or crowdsourcing).

Additionally, collaborating with various stakeholders will help the Tracking Program identify data expansion opportunities both upstream and downstream. Moving beyond the traditionally studied exposure and outcome relationships to the incorporation of biomonitoring and other emerging sciences such as epigenetics to these relationships would further increase the value of the data linkages. There is a need to build broader partnerships with academic entities to facilitate development of hypotheses and research implementation related to the inclusion of emerging sciences into tracking.

The expectation of flat or potentially reduced funding for tracking is a major concern, as it likely prohibits the addition of new capabilities without trimming others. Evaluation mechanisms are needed to determine if or when to stop a particular activity to allow for a new initiative. These funding concerns go beyond whether a particular program can take on new activities; it affects the ultimate goal of the commission, which is to develop and maintain a nationwide network of tracking programs in all 50 states.

The panel discussed the potential of using tracking data to establish an understanding of baseline measurements for preparedness responses to events such as hurricanes or oil spills. For example, tracking data can allow for the analysis of spikes in adverse health effects related to disaster situations.

To date, tracking has emphasized traditional environmental health approaches focused on the ambient environment. The next steps include expanding to issues such as the built environment and understanding the social environment or socioeconomic context from which the hazard and health data arise to add further depth to exposure-adverse health effect relationships.

Tracking Enhancements and Implementation

The panelists then considered how to take advantage of the various opportunities identified in the context of the ongoing challenges. Four topics were addressed in the discussion of enhancements and implementation:

1. program vision and leadership;
2. new opportunities;
3. data, methods, or partners needed to move the program into the future; and
4. communication about tracking and its value.

Renewing the Scientific Vision

Tracking will benefit from a two-pronged strategy including both scientific and operational components. There should be a scientific foundation including an aim to build the environmental health evidence base. A priority activity will be to identify shared scientific goals within CDC and among partner agencies at the national level—and among grantees at the state and local levels—to develop environmental public health questions to address. The scientific goals must be clearly linked to practice to serve as the base for program operations.

Tracking will benefit from a high-level leadership group to provide input and help the program articulate the scientific vision, achieve a higher profile, and continue to grow. This leadership needs to determine the key players in setting the long-term agenda for the future. As it stands, state tracking programs have good partnerships with each other, federal agencies, academia, and nongovernmental organizations; however, to sustain and build on these existing partnerships, support from a core group of CDC and other federal agency leaders is needed. Partnerships with the private sector can also be enhanced.

The scientific agenda must be fleshed out and aligned with the practice-based mission and balanced with the capacity of the Tracking Program. Workshop participants suggested climate change and social determinants of health as priority scientific areas for tracking. The Tracking Program is primed to develop an approach to understanding the changing environment, but it will likely need additional exposure and outcome datasets. Additionally, the field of environmental public health is leaving the old paradigm of contaminant-by-contaminant prevention and entering a new paradigm with multifactorial exposures and determinants of health; this approach must be incorporated into the Tracking Program.

New Opportunities and Applications

Incorporating data from the Tracking Network into HIAs is one way to add value and build capacity into the Tracking Program. HIAs allow health departments to model the impact of a community's action and set priorities. For example, the Massachusetts Department of Transportation incorporated tracking data into its HIA for a highway project and was able to demonstrate that the project alternatives offered improved health over the status quo (NACDD, 2015). Moreover, because HIAs address the multifactorial nature of decision making, contributing to an HIA can showcase the breadth of data available through tracking programs and additionally could spur development of expanded tracking datasets, where needed. The increasing prevalence of HIAs as a policy-development approach at local, state, and national levels makes it a priority opportunity for tracking.

Strengthening tracking for community health was a core component of the commission's vision for the Tracking Program and thus will be important in moving forward. Using tracking to support community needs assessments is one way to accomplish this aim. There is potential to link with healthcare organizations in this area. Of course, there needs to be adequate capacity to follow up and to conduct the necessary interventions and education activities in response to the community needs and interests identified by these assessment efforts.

Working with the Association of Schools and Programs of Public Health to improve the link between academia and tracking allows for better support for research and training of students. Students can utilize data from the Tracking Network to develop manuscripts and research proposals, conditioning them to use this data in environmental public health research.

Moving Tracking Into the Future

Data scale, both in space and time, was identified as the biggest challenge in moving the Tracking Program into the future. The first priority is to identify holes and fill in the surveillance map; all states need to be included,

as this will better facilitate data completeness and linkages. Tracking need not create new surveillance systems, but rather should leverage existing systems when feasible. For example, the Tracking Program should work with U.S. EPA and the Agency for Toxic Substances and Disease Registry to incorporate available datasets, building on already ongoing activities. Enhancing the granularity of tracking data, e.g., to the census tract level, will be key for future improved utility of the data to allow for "drilling down" on exposure and health effect data. Strategies to overcome obstacles to obtaining this granular level of data are needed.

Additionally, data on chronic conditions and exposures at smaller time-scales allows for data users to examine specific time frames, which can prove useful for extreme events and disaster interventions. From an information technology perspective, tracking needs to incorporate both aspects of scale into the continued development of the portal. End users should be able to define the scale of time and space. Data sharing rules need to be established and enforced, and users must look at the right scale of data to answer their intended questions in order to best inform policy and program decisions.

Tracking can also benefit from nontraditional sources of data, such as healthcare utilization and crowdsourced disease information via mobile technology. Pharmaceutical scripts reported to national databases could be combined with tracking data for a better understanding of health needs on a local level. Public–private partnerships might be a feasible avenue in order to capitalize on these sources of data. As with any new source of information, however, tracking must invest in validating such data and then communicating the data's limitations. Applying socioeconomic factors then adds another layer to this data for the purpose of targeted interventions.

New Ways to Articulate and Communicate the Value of Tracking

HIAs were highlighted as an important instance of users outside of public health programs capitalizing on the potential of tracking programs. From a political perspective, the incorporation of tracking data into HIAs allow policy makers to examine interventions and outcomes with direct relevance for their constituents. Reframing tracking stories to analyze the return on investment for more strategic allocation of resources is another approach to exhibit its value to policy makers. For example, data from tracking have been used to demonstrate that community cancer rates were no higher than expected, thus avoiding a disease cluster investigation that would likely have been very costly and taken years to complete. Having multiple sectors of a community, both governmental and nongovernmental, use the tracking portal will inevitably create demand as well. It is essential that tracking programs communicate with a wide variety of stakeholders to assure that the program meets their needs, as well as communicating the value of tracking to them.

In terms of marketing the utility of tracking, the program needs to develop user statistics that are easily understood and shared to broad audiences, such as how the tracking data are/were used, i.e., individual or organization decision making, informing a public policy, or research, etc. Coupling this transparency with success stories will be integral to effective communication.

Concern about ecological fallacy with tracking data leads to caution in communicating the results of linkage projects. Focusing on examples where the exposure and outcome association is strong can help alleviate this concern. For areas where there is no known connection, the value of the Tracking Program lies in its ability to clarify the landscape, inform the debate, and suggest necessary research. Essentially, messaging must fall into three categories: known associations, no association, and unknown associations.

Tracking could benefit from a National Academy of Medicine report to establish it in the field as a valuable tool for scientific use. It is imperative that research conducted through the use of tracking data be published, as publication is one of the strongest ways to demonstrate and communicate tracking's value to the broader research community. Timing of publications and communication of the value of tracking through coordinated efforts between academia and government could prove powerful for translating the data into practice.

Recommendations

During the final session of the workshop, 12 recommendations were articulated under three categories: leadership, opportunities, and communication. Workshop participants ranked the recommendations. The recommendations are listed in priority order below.

Leadership

Engage program and agency leadership, build and maintain partnerships, create an agenda promoting science and practice

1. Develop and enhance strategic partnerships with
   a. Healthcare delivery systems
   b. Private sector, technology companies
   c. Federal agency partners in transportation, defense, emergency management, agriculture
   d. American Public Health Association
2. Foster multilevel leadership buy-in
   a. Leverage current CDC, U.S. EPA, and other agency leadership
   a. Institutionalize collaboration
3. Build and promote a shared agenda
   a. Strengthen the environmental public health evidence base
   b. Inform environmental public health practice actions and measure outcomes

Opportunities

Identify new data, linkages, and funding sources; develop disaster response capacity; provide training; and build toward a 50-state network

1. Explore new health topics and data linkages
   a. Promote and develop EPHT for use in HIAs, community health needs assessments, and other multidisciplinary assessment approaches
   b. Enhance data to address environmental justice, climate change, food, built environment, and community design
   c. Develop data linkage projects to include internal markers of exposure and health effects
2. Expand datasets to include other existing or emerging data, such as
   a. Healthcare-related data sources
   b. Other environmental data and models, such as those at U.S. EPA and other agencies
3. Develop tracking capacity to add value to disaster preparedness and response
4. Leverage resources, build internal efficiencies, and secure external support
5. Provide tracking training for health professionals and the general public
   a. Conduct massive online open courses

   b. Build EPHT into curriculum at public health schools/programs
   c. Establish research internships and fellowships
6. Expand to a 50-state network

Communication

Enhance data availability, branding, and coordinated communications

1. Disseminate timely data in user-friendly formats
2. Build brand identity and "traction for tracking," particularly among decision makers
3. Conduct effective communication and outreach
   a. Engage partners for coordinated communication activities
   b. Highlight outcomes and impacts
   c. Promote success stories to acknowledge and build on EPHT progress

Discussion and Conclusions: Building the Future of Tracking

This project gathered a diverse group of experts to assess and guide the work of the Tracking Program. The expert panelists noted that, since its inception in 2002, the Tracking Program has developed impressive networks of agency partnerships and environmental health professionals; created an infrastructure capable of sharing data and information for many important environmental public health topics; and built the corresponding analytical and response capacity for making informed public health actions through fellowships, trainings, and the 26-grantee programs housed in 25 states. As the Tracking Program considers the emerging issues and potential for growth, the workshop recommendations offer a way forward built on leadership and engagement of decision makers, collaborations, and new opportunities.

Several important limitations must be noted. The workshop did not include participants from the healthcare community or health economists. Outreach to these partners will be critical in establishing productive collaborations and will facilitate the development of new indicators for tracking, as well as the development of new assessment tools for the healthcare community. Project resources were such that only one in-person meeting could be held. Johns Hopkins investigators conducted outreach to environmental public health partners such as Association of State and Territorial Health Officials and the National Association of City and County Health Officials to extend the reach of the project. Finally, the extent to which the Tracking Program can implement the recommendations will depend on program resources.

The recommendations of the workshop direct the Tracking Program toward efforts that will maintain its influential role as part of the nation's environmental public health infrastructure, as well as build toward the original vision of the commission. The top priority next steps include developing a science-based, practice-linked agenda that leverages new sources of data down to the community and individual levels; enhancing the visibility of tracking as a decision-making resource not just within public health, but also for healthcare organizations; and coordinated communication efforts around the outcomes and successes of tracking work. While the Tracking Program is well positioned for these initiatives, the most effective way forward requires engagement across the spectrum of public and private environmental, health, and healthcare organizations to ensure success.

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Did You Know?

NEHA offers several different health tracking resources that can be found at www.neha.org/eh-topics/health-tracking-0. One of the resources available through NEHA's e-Learning program, Tracking 101, provides an overview of the major components of environmental public health tracking. Topics covered include the National Tracking Network and Program, surveillance and epidemiology, types of tracking data, GIS policies, and communication.

Consumer Perception of the Food and Drug Administration's Newest Recommended Food Facility Inspection Format: Words Matter

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Abstract **The Food and Drug Administration recommended restaurant inspection scores change to a format that incorporated three new categories of violations: priority, priority foundation, and core. It was uncertain whether interested consumers would value the more in-depth information or become more confused. The purpose of this study was to assess consumer perception of the recommended inspection system. Data were collected from an online survey. Results showed that consumers want convenient access to the information either online or on the wall of restaurants, and some consumers do want to read inspection reports and use them in making dining decisions. Choice of restaurant inspection format did appear to change consumer understanding and perceptions about some of the violations. Results also demonstrated the importance of the words used to categorize violations.**

Introduction

Consumer concerns have shifted from the availability of food to food quality, including attributes such as taste, nutritional content, and safety (Antle, 1999). According to a 2012 Food and Health Survey, nearly all adults in the U.S. say they have thought about the healthfulness of their diet, physical activity, and food safety—and more than 8 out of 10 (85%) admit to giving some thought to the safety of their foods and beverages over the past year (International Food Information Council Foundation, 2012). Restaurant inspection reports can be an important source of food safety information to consumers. Recently, the Food and Drug Administration (FDA) recommended a change from an inspection format that uses the words critical or noncritical to describe violations to a format that includes three categories of importance: priority, priority foundation, and core violations (U.S. Department of Health and Human Services [HHS], 2013). Consumers have an interest in restaurant sanitation (Jones & Grimm, 2008); therefore, it is important to see how this inspection format change affects consumer understanding of restaurant violations.

Literature Review

The food industry and government share the responsibility of providing safe food to consumers (HHS, 2013). In addition, according to the Freedom of Information Act, consumers have the right to access information from the federal government, including inspection reports (U.S. Department of Agriculture, 2016). The posting of inspection scores in restaurants or their availability on the Internet or in newspapers is an important step in communicating the results to consumers. In fact, Worsfold (2006) found that almost all respondents (90%) said the public had the right to know the result of a restaurant inspection. This finding is important because the reporting of restaurant inspections in the media not only provides information to consumers, but in turn impacts the inspection process itself through the restaurant's desire to keep their scores high and protect their reputation (Almanza, Ismail, & Mill, 2002). Effective and clear communication of the meaning of restaurant inspection results would therefore appear to be essential for everyone.

As interest in food safety grows, the restaurant inspection reports are becoming more important for consumers who are interested in using them to make dining choices. Knight and coauthors (2007) found that consumers who thought that a restaurant had received unsatisfactory inspection scores were less likely to choose that restaurant. Choi and coauthors (2011) stressed that health inspection scores are a reflection of restaurant cleanliness and presumably represent the "safety" of eating at the restaurant. Inspection scores may also affect restaurants' financial performance because of the potential impact on consumers' dining choices. Jin and Leslie (2003) found increased consumer confidence in making restaurant choices and increased revenue for businesses with high inspection scores.

Several studies have been conducted on restaurant inspections. Choi and coauthors (2013) found that inspection format had a significant effect on message strength, as well as consumer responses. They also showed that narrative messages elicited the strongest effect on perceived message strength and consumer responses. Dunlop and coauthors (2010) found similar benefits for the narrative format. Other studies have suggested that information presented in a numeric or letter grade format is simpler and easier to comprehend (Artz & Tybout, 1999; Bell, 1984; Dundes & Rajapaksa, 2001). It is possible that the newest recommended format with three categories of violations (priority,

TABLE **1**

Profiles of Respondents (*N* = 260)

Characteristic	*n*	%*
Gender		
Male	150	57.7 (49.2)
Female	108	41.5 (50.2)
Age		
18–29	94	36.2 (18.9)
30–39	94	36.2 (17.8)
40–49	37	14.2 (19.3)
50–59	23	8.8 (18.6)
60+	11	4.2 (25.3)
Household with children		
No children	181	69.6
Children under 6 years	25	9.6
Children 6 years and over	50	19.2
Others	3	1.2
Education		
Less than bachelor's degree	131	50.4 (70.7)
Bachelor's degree	104	40.0 (18.9)
Higher than bachelor's degree	25	9.6 (10.4)
Residential area		
New England	15	5.8 (4.7)
Mid-Atlantic	38	14.6 (13.3)
East North Central	35	13.5 (15.2)
West North Central	12	4.6 (6.6)
South Atlantic	69	26.5 (19.3)
East South Central	14	5.4 (6.0)
West South Central	26	10.0 (11.7)
Mountain	11	4.2 (7.2)
Pacific	35	13.5 (16.1)
Restaurant work experience		
Yes	113	43.5
No	146	56.2

*Number in parentheses represent U.S. Census 2012 data.
Note. Total numbers do not add up to 260 because respondents choose to not answer all questions.

priority foundation, and core) may offer more in-depth information than the most currently used method, which offers narrative information about two categories of violations (critical and noncritical). On the other hand, consumers might prefer a simpler format—as some previous studies have suggested.

Therefore, the purpose of this study was to assess consumer perception of the newest recommended inspection format. This study was not experimental, however, so the following research questions guided the analyses:

1. How would consumers like information to be made available and how much explanation of violations should be given (simple score, description)?
2. Will the newest format be more confusing or easier to understand?
3. What are consumer perceptions of risk associated with the different violations under the different inspection formats?

Methods

Using a review of the literature, this study developed a self-administered questionnaire for consumers. The questionnaire began with a cover letter that explained the current format and the newest format suggested by FDA (HHS, 2013). The questionnaire contained five sections. The first section captured consumers' interest and use of inspection information when making dining choices. The second section measured consumer perception of risk associated with different types of violations, including the maximum number of violations under which a restaurant would still be considered "passing." The third section asked consumer preference in inspection formats and their overall interest in simple versus detailed restaurant inspection information. The fourth section asked questions about three potential violations. The first violation was "Held beef stew without temperature control for more than 6 hours" (defined as a critical violation in the current format and a priority violation in the newest format). The second violation described "Restaurant accepted food that was not properly frozen upon delivery" (defined as a noncritical violation in the current format and a priority foundation violation in the newest format). The last violation was "Thawing frozen chicken under running water that is too warm (above 70 °F)" (defined as a noncritical violation in the current format and a core violation in the newest format).

Respondents were randomly divided into two groups and asked questions regarding either the current or newest format. For each group, violation statements were first presented without the coding term (critical and noncritical for the first group, and priority, priority foundation, and core for the second group), followed by violation statements that included the coding term. Finally, the last section inquired about sociodemographic information including age, gender, whether they lived in a household with children, their education, and previous experience with foodborne illness.

The questionnaire was sent to the Indiana State Health Department for feedback on the accuracy of the descriptions and questions about the inspection formats. After receiving institutional review board approval, the researchers distributed surveys to U.S. participants through an online company. A total of 318 responses were collected in April 2015. If responses were from same IP addresses or a majority of answers were missing, those responses were deleted and not included in the final analysis. In total, 260 usable responses were collected and analyzed using SPSS version 20.

Results

Demographic information was compared to 2012 U.S. Census data (Table 1). Among the 260 respondents, there were slightly more males (57.7%) than females (41.5%), which is fairly close to census data. The majority of respondents were 18 years to in their 30s (72.4%). Due to the respondents' age range, about two thirds had no children (69.6%). Respondents' education level was grouped into three categories: less than bachelor's degree (50.4%), bachelor's degree (40.0%), and higher than bachelor's degree (9.6%). Slightly less than half (43.5%) had experience working in restaurants. Residential area of respondents was also similar to census data (U.S. Census Bureau, 2012).

More than 70% of respondents said they never or almost never use a restaurant inspection report to choose a restaurant. Only 6.6% said they used a restaurant inspection report every time or almost every time. When inspection reports were used, 55.9% agreed that it affected their choices, while 26.2% disagreed. Slightly more than half of respondents, 51.5%, wanted the inspection reports online, and 35.4% wanted the inspection reports on the restaurant wall. Only one third of respondents knew that inspections are typically done every 6 months, and 27.3% thought it was most often done every month.

Perceptions about failing scores were also assessed. For the critical/noncritical format, most respondents (83.8%) said one or two critical violations (mean = 1.63, standard deviation (*SD*) = 1.17) and more than two thirds (70.3%) said between three to five noncritical violations (mean = 4.78, *SD* = 3.63) should be a failing score. For the newest format (priority/priority foundation/core), most respondents (81.9%) said a failing score should be one or two for priority violations (mean = 1.70, *SD* = 1.35), similar to perceptions about critical violations. For priority foundation violations, some respondents (14.6%) said one priority foundation violation should be a failing score, and others (10.8%) thought five priority foundation violations should be a failing score (mean = 2.91, *SD* = 1.83). Lastly, for core violations, the results were spread out (mean = 4.97, *SD* = 7.59).

Some respondents (9.2%) said even one core violation should be failing, which is a higher standard than for the noncritical violations and meant that some respondents thought core violations were very serious. Additionally, respondents were asked to assess failing scores for letter grade and numeric grade inspection formats, which are used in a few states. In the letter grade format, about 41.2% respondents said "C" should be a failing grade, and more than one third (37.7%) said "D" should be a failing grade. For the numeric score format, which uses a 100-point scale, more than half of the respondents (52.3%) said the failing score should be between 60 and 70 (mean = 63.87), unlike the federal recommendation for this older format, which was 60.

Consumer perceptions about the use of the four different formats were assessed on a 7-point Likert scale (Table 2). For "easiness to understand," the letter grade format received the highest mean score (mean = 6.38). The

TABLE **2**

Consumer Perception of the Four Inspection Formats

Perception	Letter Grade	Numeric Score	Critical/ Noncritical	Priority/Priority Foundation/Core
	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)
Easiness to understand[a]	6.38 (1.05)	6.08 (1.18)	4.68 (1.79)	3.36 (1.85)
Easiness for decision making[a]	6.43 (1.08)	6.13 (1.24)	4.58 (1.72)	3.43 (1.77)
Accuracy[b]	5.17 (1.56)	5.60 (1.49)	5.42 (1.39)	4.68 (1.82)
Time required to understand[c]	2.33 (1.95)	2.47 (1.89)	4.10 (1.79)	4.69 (1.69)

[a]1 = not very easy and 7 = very easy.
[b]1 = not very accurate and 7 = very accurate.
[c]1 = short amount of time and 7 = long amount of time.

FIGURE **1**

Preference Ranking of Inspection Systems

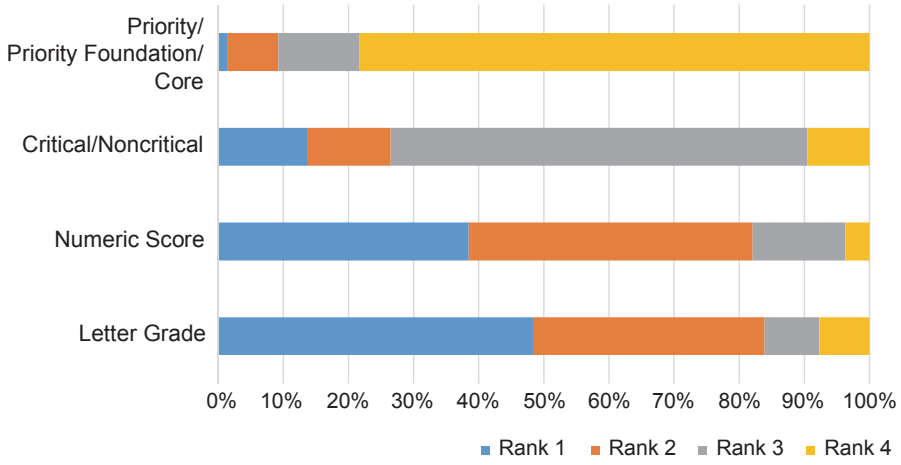

TABLE **3**

Paired Samples *t*-Test Comparing Violation Statements With and Without the Words Critical and Noncritical (*N* = 129)

Statement	Condition	Level of Seriousness[a] Mean (*SD*)	*t*[b]
Held beef stew without temperature control for more than 6 hours	Without critical	5.23 (1.59)	-5.766
	With critical	5.73 (1.42)	
Restaurant accepted food that was not properly frozen upon delivery	Without noncritical	5.71 (1.27)	9.492
	With noncritical	4.58 (1.53)	
Thawing frozen chicken under running water that is too warm (above 70 °F)	Without noncritical	4.48 (1.75)	5.400
	With noncritical	3.90 (1.78)	

[a]1 = not very serious and 7 = very serious.
[b]$p < .000$.

TABLE **4**

Paired Samples *t*-Test Comparing Violation Statements With and Without the Words Priority, Priority Foundation, and Core (*N* = 130)

Statement	Condition	Level of Seriousness[a] Mean (*SD*)	*t*
Held beef stew without temperature control for more than 6 hours	Without priority	5.24 (1.38)	-2.38[b]
	With priority	5.38 (1.31)	
Restaurant accepted food that was not properly frozen upon delivery	Without priority foundation	5.53 (1.37)	-0.599
	With priority foundation	5.57 (1.34)	
Thawing frozen chicken under running water that is too warm (above 70 °F)	Without core	4.78 (1.58)	-1.763
	With core	4.95 (1.65)	

[a]1 = not very serious and 7 = very serious.
[b]$p < .05$.

newest format (priority/priority foundation/core) received the lowest mean score (mean = 3.36). For "easiness to use in decision making," results were consistent with "easiness to understand," with the letter grade being the most easy to use (mean = 6.43) and the newest format being the least easy to use (mean = 3.43). For "accuracy," however, the numeric score format received the highest mean score (mean = 5.60) and the newest format again received the lowest (mean = 4.68). For the amount of time required to read and understand the inspection report, the letter grade format needed the least time (mean = 2.33), while the newest format needed the most time (mean = 4.69).

Respondents were then asked to rank their preferences (Figure 1). The letter grade format was most likely to be ranked one (47.3%) or two (36.2%). The numeric score format also received fairly high rankings (39.6% ranked it one and 42.3% ranked it two). Almost two thirds (63.8%), however, gave the critical/noncritical format a rank of three. In addition, the majority of respondents (77.7%) ranked priority/priority foundation/core as the least preferred format.

A series of paired-samples *t*-tests were conducted to compare descriptions of violations without the violation name (critical, noncritical, etc.), with descriptions that contained the violation name. Respondents thought that the statement "Held beef stew without temperature control more than 6 hours" that included the word "critical" was more serious (mean = 5.73) than when the word "critical" was absent (mean = 5.23), and the difference was statistically significant (t = -5.766, $p < .000$) (Table 3). The perception of seriousness was opposite when the word "noncritical" was used. When the statement "Restaurant accepted food that was not properly frozen upon delivery" did not include the word "noncritical," the perception of seriousness was higher (mean = 5.71) than when the word "noncritical" was present. This difference was also statistically significant (t = 9.492, $p < .000$). Similarly, perception of seriousness significantly decreased for "Thawing frozen chicken under running water that is too warm (above 70 °F)" (t = -5.073, $p < .000$) when the word "noncritical" was present (mean = 3.90) compared to when the word "noncritical" was absent (mean = 4.48).

Table 4 shows the paired-samples *t*-test series for presence versus absence of the words "priority," "priority foundation," and "core" in descriptions of the violations. When respondents read "priority" in the statement, they thought it was more serious (mean = 5.38, t = -2.38, p = .044) than the statement without the word "priority" (mean = 5.24). No such significant difference was found, however, in the use/nonuse of the words "priority foundation" or "core."

Further analyses using independent *t*-tests were conducted to compare between critical/noncritical and priority/priority foundation/core formats (Table 5). As expected, there was no difference in seriousness when violation codes were absent. For the identical violation with either the word "critical" or "priority" included, seriousness was perceived to be greater for "critical" (mean = 5.73, t = 2.040, p = .042) compared with "priority" (mean = 5.39). A second violation statement compared "noncritical" and "priority foundation." When the term "priority foundation" was included, the perception of seriousness was significantly heightened (mean = 5.55, t = -5.355, $p < .000$) compared with "noncritical" (mean = 4.48). The last violation statement compared the words "noncritical" and "core." The respondents' perception of seriousness was amplified with "core" (mean = 4.95, t = -4.943, $p < .000$) compared with "noncritical" (mean = 3.90).

TABLE **5**

Independent *t*-Test for Two Inspection Formats (Critical/Noncritical Versus Priority/Priority Foundation/Core)

Statement	Violations	*N*	Level of Seriousness[a] Mean (*SD*)	*t*
Held beef stew without temperature control for more than 6 hours	Critical	127	5.73 (1.42)	2.040[b]
	Priority	132	5.39 (1.31)	
Restaurant accepted food that was not properly frozen upon delivery	Noncritical	127	4.58 (1.55)	-5.355[c]
	Priority foundation	132	5.55 (1.34)	
Thawing frozen chicken under running water that is too warm (above 70 °F)	Noncritical	128	3.90 (1.78)	-4.943[c]
	Core	132	4.95 (1.64)	

[a]1 = not very serious and 7 = very serious.
[b]$p < .05$.
[c]$p < .000$.

Discussion

In spite of reported food safety interests, many consumers do not use restaurant inspection reports when choosing a restaurant. Those who use inspection results report that they do influence their restaurant choice. Most consumers want convenient access to results either online or on the wall of the restaurant. Only one third of consumers were aware that restaurants are typically inspected every 6 months.

Perceptions for failing scores were similar for critical and priority violations, and for noncritical and core violations. Failing scores for priority foundation violations were perceived to be between priority and core violations, as intended by FDA. The wide range of perceptions about core violations, however, showed that consumers would be confused with the newest format.

Consumers perceived the letter grade format to be the easiest to understand and use for dining choices. The newest format was thought to be the least easy format to understand and use. Even though consumers thought they would spend more time reading and trying to understand the newest format, they still did not consider it to be as accurate. Consumers perceived the numeric score format to be the most accurate, followed by the current format using critical/noncritical violations. Overall, most consumers preferred letter grades because they were easiest to understand and use, and required less time to read and understand. On the other hand, the newest format was the consumers' least preferred format because it was the least easy to understand and use, required the most time to read and understand, and was thought to be least accurate.

Consumers do appear to be influenced by the words used to describe violations. The perception of seriousness was amplified when the words "critical" or "priority" were present in the violation description. Conversely, when the term "noncritical" was present, the perception of seriousness was lower than expected. Consumers viewed the word "core" differently, with a heightened perception of seriousness. The use of "priority foundation" appeared to confuse consumers in that no difference was found when the term was present or absent. Results suggest that even though the narrative description of the violation is provided, the inclusion of the words for the violation category (critical, priority, etc.) influenced consumer perception beyond the narrative description.

Conclusion

Even though the restaurant inspection reports are primarily designed to regulate foodservices and serve as the communication medium between health inspectors and restaurants, some consumers do want to read inspection reports and have them inform their dining decisions. Results of this study demonstrate the importance of the words used to categorize violations for consumers. In fact, choice of restaurant inspection format appeared to change consumer understanding of the violations. If consumers are to better understand the importance of violations and restaurant safety, the choice of words used to describe violations should be carefully considered, or at least explained where inspection results are provided. Clearly, words are powerful and how they are viewed influences our perceptions.

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Inspector Perceptions of the Food and Drug Administration's Newest Recommended Food Facility Inspection Format: Training Matters

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Abstract **The Food and Drug Administration publishes the *Food Code* to guide restaurant inspections. The most recent version proposes a three-tier system categorizing violations as priority, priority foundation, and core. This study used a scenario-based questionnaire to examine inspector perceptions and preferences for inspection formats. Results suggest that inspectors would be able to maintain consistent evaluations when changing to the three-tier system, although the classifying terms under the three-tier system were confusing. Additionally, inspectors were not very positive about the new system; they were concerned that the new system would not be easy to understand and use, inspections would take a longer time, it would not accurately reflect the amount of risk associated with violations, and it would not be easy for consumers and managers to understand and use. The results suggest the need for additional training for inspectors before adoption, especially on the rationale and benefits of changing to a three-tier system.**

Introduction

The U.S. restaurant industry has enjoyed continuous growth in the last decade (Ghiselli, 2014) with 1 million restaurants and expected sales of $709.2 billion in 2015 (National Restaurant Association, 2015). As such, restaurants play an important role in providing nutritious and healthy food to the public (Almanza, Ghiselli, & Khan, 2014) with restaurant inspections essential to that process of providing healthy food (Reske, Jenkins, Fernandez, VanAmber, & Hedberg, 2007).

The Food and Drug Administration (FDA) publishes the *Food Code* to help guide restaurant inspection efforts. The *Food Code* is revised every 4 years with amendments every 2 years. FDA's newest release of the 2013 *Food Code* marks the 20th anniversary of the *Food Code* (U.S. Department of Health and Human Services [HHS], 2015) and reflects collaboration efforts among FDA, the U.S. Department of Agriculture's Food Safety and Inspection Service, and the Centers for Disease Control and Prevention, as well as the Conference for Food Protection (CFP). In fact, the 2013 edition directly incorporated the input of consumers and regulatory, industry, and academia stakeholders who participated in the 2012 meeting of the CFP (HHS, 2015).

The purposes of the *Food Code* are to "assist food control jurisdictions at all levels of government by providing them with a scientifically sound technical and legal basis for regulating the retail segment of the food industry," "reduce the risk of foodborne illnesses within food establishments," provide "uniform standards for retail food safety that reduce complexity and better ensure compliance," "eliminate redundant processes for establishing food safety criteria," and "establish a more standardized approach to inspections and audits of food establishments" (HHS, 2015).

The 2013 *Food Code* carried over many changes from the 2009 *Food Code*, including the revised designation system for code violations (HHS, 2009, 2015). This designation system changed "critical" and "noncritical" violations to violations categorized as a "priority" item, "priority foundation" item, or "core" item to better "link the provision to hazards associated with foodborne illness or injury" (HHS, 2015). In other words, the three-tier classification is expected to more closely associate the appropriate amount of risk with violations because its division of violations into three categories might be expected to offer better discrimination among risk levels. In support of this revision, it has been suggested that one advantage to the new designation system is that the "use of critical, priority, and priority foundation is a basis for the risk-based inspection strategy for food safety" (Indiana State Department of Health Food Protection Program, 2015).

While FDA provides the *Food Code* to guide restaurant inspections, states and other jurisdictions make decisions whether to implement the code in its entirety or in part (HHS, 2015). In other words, different inspection formats may be used in different parts of the county. Currently, many states still use the critical/noncritical inspection system (Food and Drug Administration, 2015).

Although narrative inspection systems such as the critical/noncritical inspection system provide detailed descriptions of violations that take into consideration repeated

TABLE **1**

Inspector Risk Perceptions of Violations With and Without Coding Terms (Paired *t*-Test) (*n* = 44)

Violation	Condition	Inspector Perceived Risk		
		Mean (*SD*)[a]	*df*	*t*
Violation 1: Held beef stew without temperature control for more than 6 hours	Without critical	6.80 (0.46)	43	-1.00
	With critical	6.82 (0.45)		
Violation 2: Restaurant accepted food that was not properly frozen upon delivery	Without noncritical	5.66 (1.45)	43	1.82
	With noncritical	5.34 (1.60)		
Violation 3: Thawing frozen chicken under running water that is too warm (above 70 °F)	Without noncritical	5.23 (1.54)	43	1.84
	With noncritical	5.05 (1.58)		
Violation 1: Held beef stew without temperature control for more than 6 hours	Without priority	6.86 (0.35)	36	2.137[b]
	With priority	6.59 (0.83)		
Violation 2: Restaurant accepted food that was not properly frozen upon delivery	Without priority foundation	6.11 (1.07)	36	1.782
	With priority foundation	5.95 (1.10)		
Violation 3: Thawing frozen chicken under running water that is too warm (above 70 °F)	Without core	5.14 (1.51)	36	3.079[c]
	With core	4.65 (1.78)		

[a]1 = not very serious and 7 = very serious.
[b]$p < .05$.
[c]$p < .005$.

violations and provide in-depth information, there is no defined passing or failing score. Passing or failing is based on the experience and professional judgment of the health inspector, so that the interpretation of severity or risk may be less clear to restaurant managers and consumers (Almanza et al., 2014). The newly proposed three-tier system faces the same problem. Additionally, "the new terms introduced into the 2009 FDA *Food Code* are not food safety-related terms that are relevant to educating the public, the regulated industry, and regulatory officials"—resulting in concerns over the feasibility of the new system as it might 1) require "a re-education process that does not emphasize food safety or foodborne illness prevention," as the new system demands changes to "naming convention" and "established culture of food safety" and 2) be "difficult for regulators to articulate and difficult for the regulated industry to understand" (Conference for Food Protection, 2012).

Moreover, research has shown that individual inspector, as well as inspection format, can influence inspection results (Almanza, Ismail, & Mills, 2002; Almanza, Nelson, & Lee, 2003; Lee, 2006; Lee, Nelson, & Almanza, 2010). To complicate the problem, individual inspector risk perception, which may directly impact inspection results, can be influenced by the narrative used to describe violations (Choi & Almanza, 2012). With these factors in mind, before making a decision about whether to adopt the new *Food Code*, some states may be concerned that changing the inspection system will cause confusion because of the changes in nomenclature and violation classifications. It is important, therefore, to examine whether changing to the three-tier violation system might change inspector risk perceptions and thus influence inspection results. This study proposes the following research questions:

1. What are inspector risk perceptions of violations under different systems?
2. How do inspectors think the proposed system will affect their interactions with restaurant managers and consumers?
3. What are inspector perceptions about the new inspection system (ease of understanding, ease of use, time needed to conduct inspection, accuracy, and preferences)?

Although inspection reports were designed as a communication tool between health inspectors and restaurant managers, consumers are now using inspection reports when making dining choices (Filion & Powell, 2009). As words used in narrative descriptions can also influence manager and consumer risk perceptions (Choi, Miao, Almanza, & Nelson, 2013; Lee, 2006), it is important to determine how a change to the three-tier inspection system might influence manager and consumer use of the inspection results. This health inspector study is one of three studies that examine restaurant manager and consumer opinions.

Methods

A scenario-based questionnaire was used in Indiana to assess 1) inspector risk perceptions about the three types of violations, 2) inspector format preferences, 3) inspector expectations about consumer and restaurant manager reactions, and 4) demographic information. The scenarios were assessed for violation descriptions with and without the word used to code for the violation type (critical, noncritical, priority, priority foundation, or core) in order to gauge the influence of the coding term on inspector risk perceptions. Additionally, open-ended questions were used to gain insights on reasons for inspector perceptions.

Currently, Indiana is using a critical/noncritical inspection system (Almanza et al., 2014). Indiana has been using the critical/noncritical inspection system since late 2000 (Indiana State Department of Health, 2004; Lee, Almanza, Nelson, & Ghiselli, 2009) and the state is now considering whether to adopt the new three-tier inspection system.

Inspector risk perceptions were assessed for three violations: "Held beef stew without temperature control for more than 6 hours" (classified as a critical violation under the critical/noncritical system and a priority violation in the three-tier format); "Restaurant accepted food that was not properly frozen upon delivery" (classified as a noncritical violation under the critical/noncritical system and a priority foundation violation in the three-tier format); and "Thawing frozen chicken under running water that is too warm (above 70 °F)" (classified as a noncriti-

cal violation under the critical/noncritical system and a core violation in the three-tier format). Inspectors were randomly divided into two groups to answer questions for each system: either the critical/noncritical system or the three-tier system, but not both. The violations were first presented without the classifying terms, then violation statements were presented with the classifying terms (critical and noncritical for the first group, and priority, priority foundation, and core for the second group); this allowed the assessment of how classifying terms impact inspector risk perceptions.

The questionnaire was assessed by the Indiana State Health Department for accuracy of the questions and violation descriptions. After institutional review board approval, an e-mail invitation was sent in May 2015 to all (189) health inspectors in the 92 counties in Indiana. After two waves of invitations, 141 responses were received. Not all respondents answered all questions. Data were analyzed with SPSS version 23 using a series of frequency tests, descriptive statistics, and *t*-tests.

Results

Inspector Risk Perception

Results from paired *t*-tests (with and without the classifying term) indicated that, as expected (because inspectors are trained professionals), inspectors perceive a comparable amount of risks for the same violations with or without classifying terms under the critical/noncritical system (Table 1). Even though it was not significant, it was also observed, however, that the addition of the word critical resulted in a more serious perception of the violation, and the word noncritical resulted in a less serious perception of the violation.

Surprisingly, the addition of the words priority, priority foundation, and core resulted in lower risk perceptions for all three violation categories, even though the results were only significant for the priority and core violations. This suggests that the classifying terms might be confusing to inspectors when switching to the three-tier system. On the other hand, even without training for the three-tier system, inspectors were able to correctly identify the relative seriousness of the three kinds of violations. For example, inspectors placed the priority foundation violations between priority and core violations in terms of associated risk—as seen in the mean score inspectors assigned for each violation category (6.59 for priority, 5.95 for priority foundation, and 4.65 for core).

When comparing the different systems, inspector risk perceptions were not significantly different for the same violation (Table 2). To ensure that no significant group difference existed, comparisons between different systems under the "without" condition (no classifying term) were made, and all the results were nonsignificant. This finding indicates that, as trained professionals, inspectors have a good understanding of the risks associated with different violations. As observed, however, there were still discrepancies in risk perception of a violation when the classifying system changed (e.g., 4.65 for core and 5.05 for noncritical), even though the results were not statistically significant. This finding suggests that training may be needed if the new system is adopted.

TABLE **2**

Inspector Risk Perceptions of Violations Under Current Versus New Inspection System (Independent *t*-Test) (*N* = 81)

Violation	Classifying Term	Inspector Perceived Risk			
		n	Mean (*SD*)[a]	*df*	*t*
Violation 1	Critical	44	6.82 (0.45)	79	1.54
	Priority	37	6.59 (0.83)		
Violation 2	Noncritical	44	5.34 (1.60)	79	-1.944
	Priority Foundation	37	5.95 (1.10)		
Violation 3	Noncritical	44	5.05 (1.58)	79	1.06
	Core	37	4.65 (1.78)		

[a]1 = low level of risk and 7 = high level of risk.

FIGURE **1**

Inspector Preferences in Terms of Inspection Format

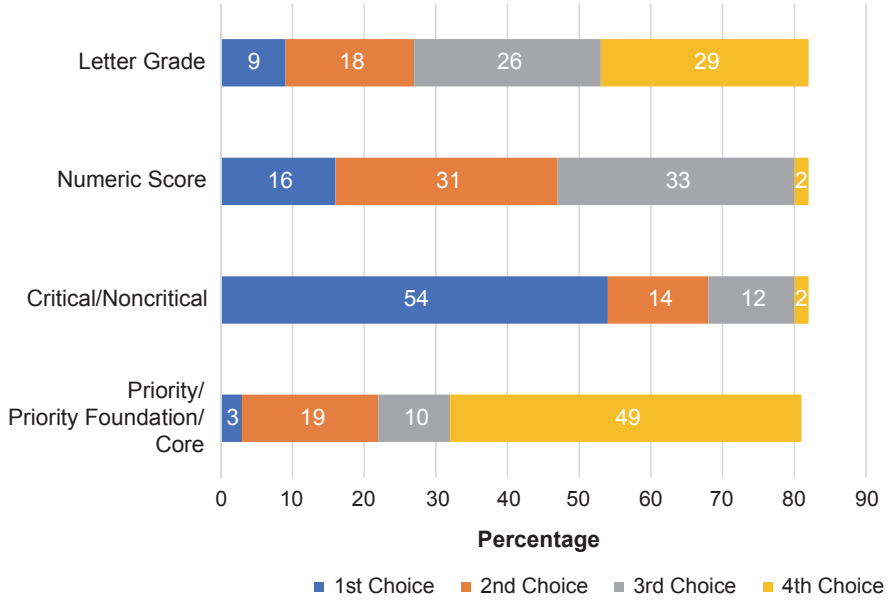


FIGURE **2**

Inspector Perceptions in Terms of Ease of Understanding

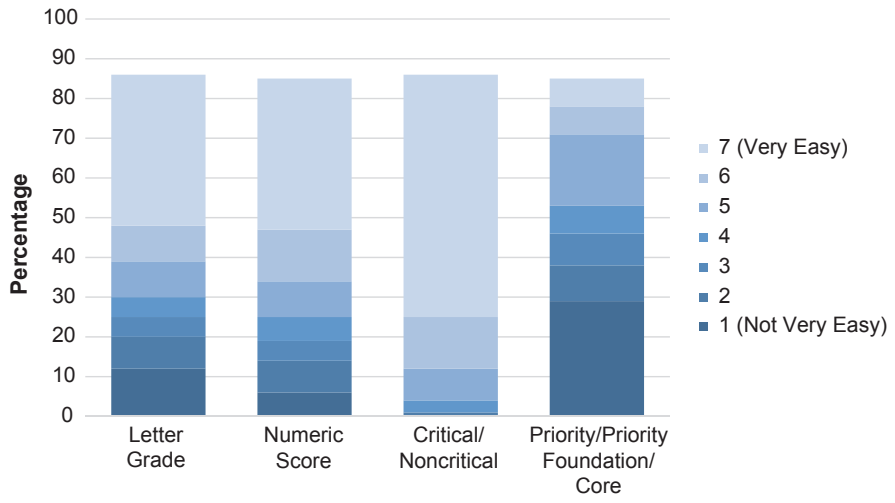
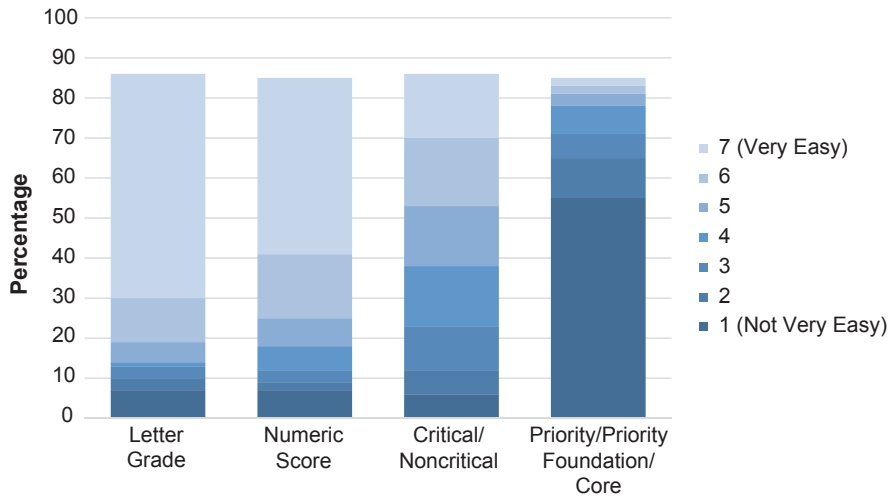


FIGURE **3**

Inspector Perceptions in Terms of Ease of Use



Inspector Preferences Regarding Inspection Format

Most inspectors (66%) preferred the critical/noncritical system as it is currently used in Indiana. Inspectors were also asked about letter grade and numeric systems and were found to hold mixed attitudes toward these two systems. The main concerns were that the letter grade and numeric systems (which offer less narrative in the score/result) would not be a "reliable source of information" or "representative of the situation," and that these systems would not "provide enough information for consumers to make decisions" even though these two systems generally enjoy the benefit of easy interpretation and comparison. Additionally, implementation issues were suggested, such as requests for reinspection when restaurants receive a grade that is below a B, and the need for more resources in local health departments that are already tight on resources. Finally, respondents suggested that numeric and letter grade systems might shift manager attention to the score instead of the actual violations.

On the other hand, it was interesting to discover how negative inspectors were towards the new system, as it is also a narrative system and therefore somewhat similar to the current critical/noncritical system. For the three-tier system, only three inspectors preferred it, compared with nine inspectors who preferred letter grades and 16 who preferred numeric scores (Figure 1). The reserved attitude toward the three-tier system was further reflected in inspector concerns: Inspectors felt that the new three-tier system would not be easy for them to understand (34%) and use (32%), inspections would take a longer time to conduct (27%), and the new system would not accurately reflect the amount of risk associated with different violations (26%) (Figures 2–5). Additionally, responses to open-ended questions also revealed that inspectors felt the three-tier system would be hard for managers and consumers to understand. They felt that managers would not be able to accurately assess the risk associated with violations, thus requiring the inspectors to spend extra time during and after the inspection for explanations. Furthermore, managers would need seminars or training materials and consumers would need information about the three-tier system on Web sites or other areas where inspections scores are made available to the public.

Anticipated Restaurant Manager and Consumer Reactions

Most inspectors (74%) believed that a change in the categorization of violations would not significantly change manager risk perceptions, but some had concerns that the removal of the word "critical" would reduce the perceived importance of these violations. In fact, inspectors were concerned that neither managers nor consumers would be able to accurately assess risk when priority or priority foundation categories were used.

Inspectors also thought consumers would not be able to accurately assess the risk associated with violations. More specifically, inspectors felt that replacing the term "criti-

cal" would lead consumers to underestimate the seriousness of such violations; replacing the term "noncritical" would lead consumers to overestimate the risks associated with such violations. Inspectors sensed that consumers would have difficulty interpreting inspection results particularly when the terms "priority" or "priority foundation" were used.

Discussion and Conclusion

Inspectors in general were not very positive about the new system. Training to prepare health inspectors to move to a new system should include rationale for the change. On the other hand, a change to the new system might not require as much training as anticipated because inspectors already knew the violations' risk based on the narrative descriptions, which did not significantly change when the coding of the violations changed, even though some discrepancies were observed (between critical/noncritical and priority/priority foundation/core systems). Most importantly, this finding suggests that inspectors will likely be able to maintain a consistent evaluation standard even when the format changes.

While the new inspection system intends to utilize new science-based terms to improve consistency in inspection results (HHS, 2015), it requires skilled assessments of risk that take into account different factors such as likelihood of foodborne illness, the characteristics of the hazards, and the number of three types of violations for failing/passing scores. These may lead to a need for longer inspections or more training, which could place a burden on health departments with limited resources. To reduce inspector resistance to this new inspection system, additional training and information about the benefits of using this system might be beneficial.

When considering inspection formats, manager and consumer needs should be considered. Inspectors were concerned that the new system would not be easy for managers to understand and that manager training would be needed. Inspectors viewed education as an important goal when conducting inspections. As one inspector stated, "without understanding, the power of enforcement is limited." Inspectors expressed the importance of balancing education and enforcement; as indicated by one inspector, "you can catch more flies with honey than vinegar." But inspectors also raised concerns over lack of manager and employee training in safe food handling, adding to the complexity of the problem and leading to confusion if the new system is implemented. Inspectors also expressed concern about consumer understanding of the new format and the need to provide information about the new system on Web sites and other locations where inspection results are made available to the public.

FIGURE **4**

Inspector Perceptions in Terms of Time Needed to Conduct Inspection

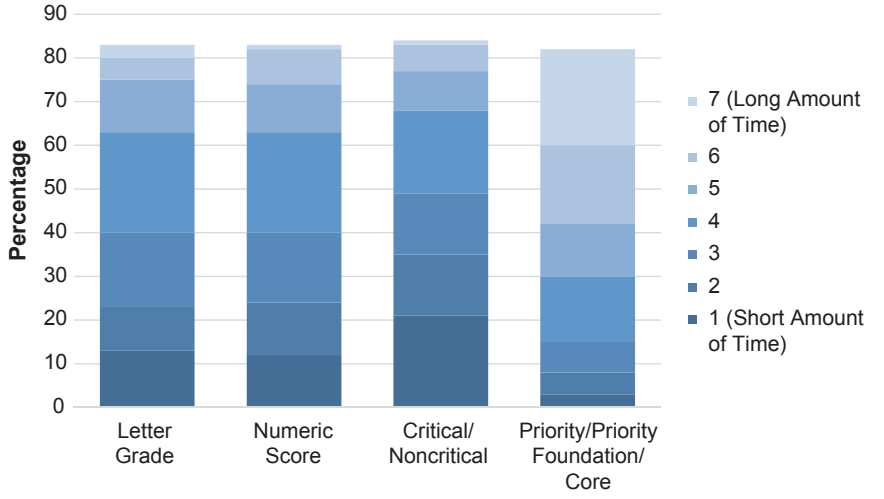
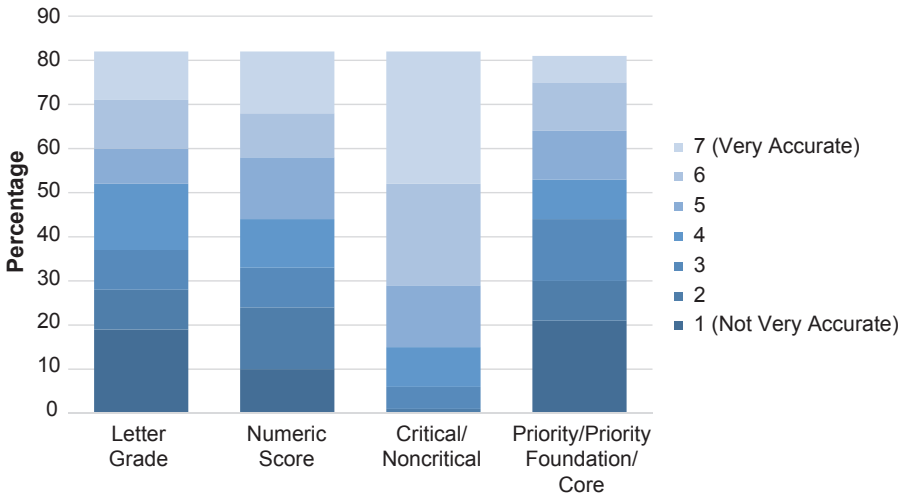


FIGURE **5**

Inspector Perceptions in Terms of Accuracy



This study may help state health departments and FDA in designing, implementing, and improving inspection systems, but it is not without limitation. In the future, we would recommend broadening the scope of this study to other states, as the current inspection systems may be different (numeric scores or letter grades, for example). In addition, a longitudinal study comparing pre- and

post-implementation of the three-tier system would also be useful.

Finally, it is important to extend this study to examine consumer and restaurant manager perceptions and conduct meaningful comparisons among the three groups. Ultimately, we can only realize the full benefits of the inspection system in providing safe and healthy food if everyone fully understands what the inspection results mean.

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BUILDING CAPACITY

Darryl Booth, MBA

Building Environmental Health Capacity in the Cloud

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 Accela 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 Accela 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 senior vice president and general manager of environmental health at Accela and has been monitoring regulatory and data tracking needs of agencies across the U.S. for almost 20 years. He serves as technical advisor to NEHA's informatics and technology section.

I vividly recall taking apart and repairing a file server in the late 1980s. It was physically huge and terribly bulky with sharp steel corners. Its total storage was nothing compared to contemporary hardware. We "techies" waited around all night for the thing to come back to life so that staff could work the next morning without interruption. These repairs were exhilarating projects before the Internet was generally available.

As I began my career directing software solutions for health departments, I remember meeting a customer who mounted their file server in the closet. Yes, there was a storage closet in their basement office (near the metal file cabinets) with unkempt network cables connecting that 4 ft^2 space through the ceiling tiles to the various IBM personal computers—you know, the ones with two big floppy drives in the front.

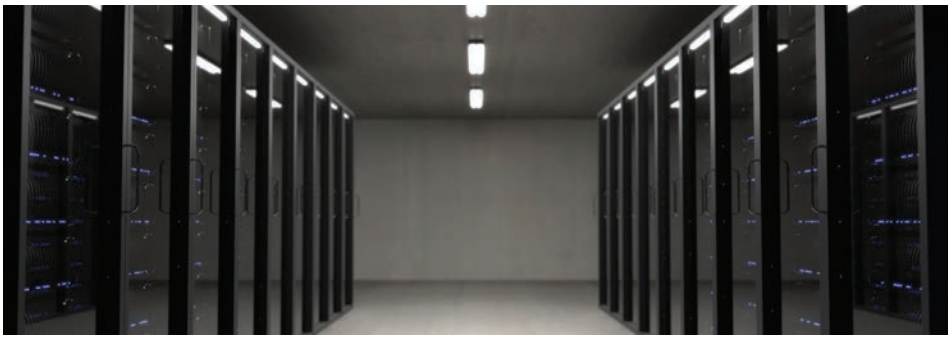
During that time (the mid-1990s), it was a boon to have one's own server. It meant that the health department was no longer beholden to the keepers of the mainframe systems that dominated the statewide system at the time. It meant independence. It meant that the health department could add users, create new programs, change fees, and design reports without going (one of my favorite expressions) hat-in-hand to the programmers to beg for the enhancements!

For many years thereafter, health departments routinely maintained department-level equipment and systems to preserve that welcomed autonomy. Modern networking, the Internet, and data exchange standards all served to ease the local mandate to keep critical systems running, secure, and resistant to failure.

The Cloud

It occurs to me that not every reader has the same idea of the cloud. Some might say, "It's the Internet." Others might guess, "It's all about storage—storing pictures, for example."

Cloud computing indeed uses the Internet and brings virtually unlimited storage and throughput for transactions, historical reference, attachments, etc. The cloud also features active redundancy. For example, an inspection report might be automatically duplicated and stored in five different data centers across the world. I also like that operating in the cloud means you've got the smartest people and the most expensive tools working for you because your enterprise might be sitting beside one of Amazon's critical services. And you can bet that a power outage is not going to keep an Amazon service handicapped for long. In other words, we become part of something that is too important to fail. We're no longer a single server or a single app.



The Future Is the Cloud

Government is at the tipping point in cloud conversion: 77% of local government agencies have up to 20% of their business operations in the cloud, according to the Center for Digital Government. For example, the city of McKinney, Texas, found improved efficiencies with Amazon Web Services, diverting resources that normally would have been spent on buying and maintaining information technology (IT) infrastructure to improve services.

Government still has a way to go to catch up with private industry, which embraced the cloud early having quickly realized its benefits, including the flexibility to meet dynamic operational needs. The whole world seems to be going to the cloud.

In fact, by 2020, Intuit estimates that more than 78% of U.S. small businesses will have adopted cloud computing with the top functions being office tools/productivity (56%) and operational uses (44%). Even large businesses with dedicated in-house IT resources, historically the cloud laggards, are quickly catching up with over half expecting to make the jump in the coming next few years, according to cloud migration and disaster recovery provider CloudEndure.

Objections to Cloud Strategies

If you haven't seen it already, prepare for two trends within your own organization. First, your organization's IT (or another centralized IT department) will move to consolidate and take over support of environmental health systems. This trend means moving servers to the "downtown" data center and creating a help desk to support all systems. Second, centralized IT will be keen to reduce the total number of servers (and expenses) by turning to cloud-based solutions.

Although you may not be the decision maker, if your department is considering the cloud, I suspect you'll hear some of the objections below.

- **Security:** "Our data is too sensitive to be in a server I can't protect." True, there are protected data in your care. Your provider and vendor must adhere to applicable Health Insurance Portability and Accountability Act (HIPAA) business associate agreements and should feature prominent certifications such as PCI, SOC 2, FISMA, and others that attest to the processes and safety measures needed for all sensitive transactions.
- **System access in a crisis:** During a local emergency, Internet access may be compromised. True, but in the cloud you can use Internet connections from the office, the library, home, Starbucks, or your smartphone. You actually have more backup systems compared to on premise systems.
- **Legacy apps:** When your legacy system interfaces nicely with that one piece of equipment (e.g., a thermal probe) and your processes are all built around that functionality, it's a challenge to navigate the path forward. Ask about an API (application program interface) that allows devices to connect and post data. In the end, weigh the value of that legacy feature against the larger list of benefits to your agency.
- **Territorial concerns:** "I don't want 'XYZ' to see my timesheets or set policy about my data." Similar to the security concern, these rules (if indeed valid) can be managed, configured, tested, and confirmed.
- **Direct accountability:** "Who can I turn to for urgent help?" No different from your current vendor or solution, formalize relationships and terms to ensure you have a service level agreement that mandates responsiveness.

Cloud Benefits

- **Disaster recovery**: Modern cloud offerings don't require traditional data backups because the cloud's redundancy means that your data are safe. Multiple data centers across the globe shelter us against most regional emergencies.
- **Automatic updates:** Typically, cloud software is updated incrementally without fanfare. So, instead of waiting 3 years to go from version 9 to version 10, you get small updates weekly or monthly.
- **Cutting the costs of hardware**: Not owning or maintaining hardware is a major time and cost saver. Check what your internal IT department charges your budget for each server.
- **Work from anywhere**: This benefit is great for inspections, obviously, but it also makes your office feel like more of a modern workplace.
- **Security**: The highest paid security experts center themselves around these big, ultra-secure data centers, so you can rest assured knowing the best are working on your behalf.
- **Predictable fees**: Pay as you go (moderate up-front costs) and only pay for what you use.
- **Naturally public facing**: When it's time to take forms online or push your data to the web, a cloud-based offering is already there!

Time to Consider the Cloud

You might be interested to know that my colleague and I are writing and editing this column using Google Docs. In real time, I see Kelly's contributions and she sees mine. We chat. We leave comments for one another. In the final stages of editing this column today, Kelly is on an international flight and I'm working at my desk in California.

Environmental health data management is ready for the same leaps forward.

Acknowledgement: Kelly Delaney, product marketing associate for Accela, contributed research for this column.

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DIRECT FROM ATSDR

Diane Jackson, PE

Revisiting Trichloroethylene Contaminated Hazardous Waste Sites After New Science Indicates the Need for a Lower Health Guideline

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 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 (NCEH) 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 column are those of the author(s) and do not necessarily represent the views of ATSDR, CDC, or HHS.

Diane Jackson is an environmental health scientist with the Office of the Associate Director for Science in ATSDR's Division of Community Health Investigations. She has more than 30 years of experience with ATSDR and the U.S. Environmental Protection Agency in environmental emergency response and environmental health.

As knowledge of chemical toxicity increases, the Agency for Toxic Substances and Disease Registry (ATSDR) modifies its evaluations to apply the best available science to protect public health. In January 2013, ATSDR finalized its Toxicological Profile addendum for trichloroethylene (TCE), which adopted the U.S. Environmental Protection Agency's (U.S. EPA) reference dose of 0.0005 mg/kg/day as its chronic oral minimal risk level (MRL) and the reference concentration of 2 µg/m^3 as its chronic inhalation MRL. As a result, ATSDR and U.S. EPA reduced the health guideline for TCE in inhaled air from 536 µg/m^3 to 2 µg/m^3, a 99.6% reduction. Health guidelines are drawn from the epidemiologic and toxicological literature with added uncertainty factors to ensure that they are protective of human health. An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects over a specified duration of exposure.

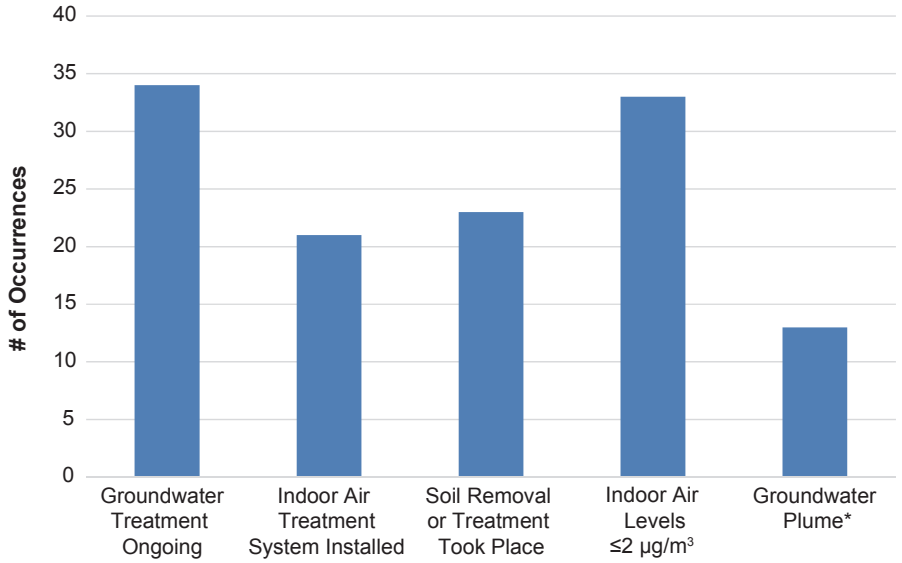
ATSDR and U.S. EPA evaluated thousands of TCE-contaminated hazardous waste sites in the U.S. before adopting this more protective value. The updated value is based primarily on animal studies identifying a correlation between TCE exposure and 1) immune system suppression and autoimmunity for the general population and 2) fetal heart malformation during the first trimester of pregnancy (U.S. Environmental Protection Agency [U.S. EPA], 2011).

Based on the updated value, ATSDR reviewed previously evaluated sites to determine if its conclusion should change and action was needed to stop, reduce, or prevent current exposure. Considering the short exposure window of concern for fetal heart malformation (i.e., several weeks during early pregnancy), ATSDR was especially interested in notifying pregnant women with current exposure to reduce the risk of this possible health outcome. Taking action at these sites could also help prevent the immune system and carcinogenic (i.e., liver, kidney, and non-Hodgkin's lymphoma) health effects from longer-term exposure.

TCE is a nonflammable, colorless liquid mainly used as a solvent to remove grease from metal parts. It is also an ingredient in adhesives, paint removers, and spot removers (Agency for Toxic Substances and Disease Registry [ATSDR], 2014, 2015). Since TCE was manufactured, used, and disposed of over many years, the chemical has been found in underground water sources and surface water.

FIGURE **1**

Criteria for Removing Sites From Further Review



*Groundwater plume not affecting nearby buildings or has low trichloroethylene levels.

It is a frequent site-related groundwater and indoor air contaminant, and among the most common contaminants released into the environment from hazardous waste sites (ATSDR, 2016). TCE in groundwater can also volatilize and contaminate indoor air through soil vapor intrusion (SVI). In SVI, volatile chemicals like TCE migrate from contaminated groundwater or soil into overlying buildings through utility lines, piping, cracks, or other openings in the floor or foundation slab (U.S. EPA, 2012). SVI was not well understood or investigated until a few years ago.

Triage Process

ATSDR used a two-step triage process to reevaluate sites.

1. Find the "worst first" by narrowing its database search to sites with a conclusion of "no public health hazard" or "indeterminate public health hazard" and 1) a maximum indoor air TCE level ≥2 µg/m^3 or 2) a maximum or average groundwater TCE concentration ≥5 µg/L. ATSDR found more than 60 indoor air and 1,000 groundwater sites that met the criteria from the 1,279 sites in its database.
2. Conduct an in-depth report review and request more information.

To determine the possibility of ongoing exposure, ATSDR first reviewed documents and online information for the indoor air sites and then for the groundwater sites. We excluded a majority of groundwater sites from further review when we determined that U.S. EPA was thoroughly addressing SVI in its 5-year review of National Priorities List sites. What remained were 102 sites that needed a more in-depth review.

Findings

In our review of the 102 sites considered at greatest risk for current TCE indoor air contamination levels above 2 µg/m^3, we found that at most of them, current exposure was not ongoing or was below health guidelines. Our review, however, also led to requests for new information on 36 sites. After reviewing the requested information, we determined that three sites needed immediate state or U.S. EPA action. We also made additional requests for data or action at 13 other sites. We are working with U.S. EPA and state agencies to ensure action to sample or reduce exposure at all 16 sites.

For the majority of the 102 sites, groundwater treatment or soil removal had reduced TCE contamination. Figure 1 shows the criteria for removing sites from further review. Note that more than one criterion may apply per site.

Figure 2 shows the states with the highest number of TCE sites out of the 102 reviewed: Florida, New York, Pennsylvania, and Washington.

During the review, ATSDR also found colocated contaminants, particularly perchloroethylene (PCE). In a report published by ATSDR that discussed SVI and colocated contaminants, 95% of sites with known past SVI had benzene, PCE, and/or TCE present together (Burk & Zarus, 2013).

Case Study

Meramec Cave System, Missouri

In October 2003, laboratory testing detected a maximum air TCE concentration of 1,666 µg/m^3 in Meramec Cavern (U.S. EPA 2016). Potential unconfirmed TCE sources included a nearby landfill and a waste site. More than 150,000 tourists visit the cave every year. The cave owner took immediate steps to reduce tourist and worker exposures to TCE by opening ventilation shafts in the upper areas of the cave. Subsequent testing showed that levels decreased below ATSDR's previous health guideline.

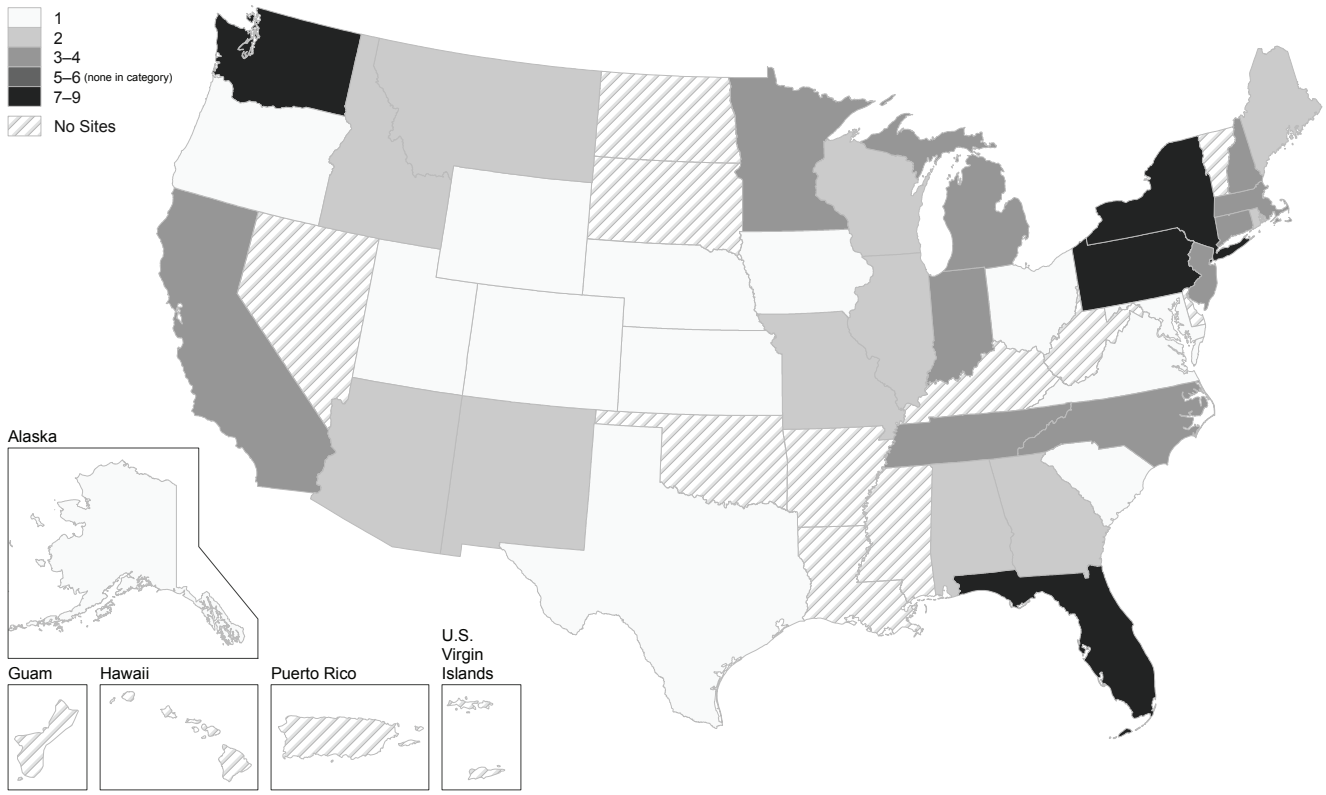
Based on the 2014 site review, ATSDR began coordinating the state and U.S. EPA to determine if TCE levels in the cave were above the new health guideline. The levels were high enough to pose an urgent public health threat. The state and U.S. EPA began working with the owner to reduce TCE levels in the cave air. Seasonal fluctuations in TCE levels were difficult to control and in March 2016, the owner proactively closed the cave for tours to install additional mitigation systems. Recent air samples verify that TCE concentrations are below levels of health concern.

Limitations

One limitation of reviewing older data in ATSDR's database is that we are unsure if the conclusion categories for the data apply to the indoor air exposure pathway. The older database only captured the highest hazard level and did not specify the pathway. Our screening process eliminated sites with a known hazard because U.S. EPA or a state environmental agency had likely taken action on those sites. Sites with a known hazard, however, could

FIGURE **2**

Number of Trichloroethylene Sites per U.S. State or Territory From the 102 Sites Reviewed, 1990–2015



have also had unknown (indeterminate) hazards that we did not evaluate. For example, we could have concluded that a drinking water pathway was a public health hazard and the indoor air pathway was an indeterminate hazard. Therefore, we could have missed some sites that should have been reviewed.

Although not part of our review, we know that short-term (e.g., diurnal changes; heating, ventilation, and air conditioning operation; weather events) and long-term (e.g., seasonal, source migration, degradation) factors can contribute to variability in TCE concentrations.

Next Steps

We urge public health officials to keep abreast of the current state of the science to inform their public health decisions and protect public health. We further recommend that groups evaluating SVI sites consider testing for benzene, PCE, and TCE.

Acknowledgements: Katherine M. Krasnodemski contributed to this report. Sally Zimmerman edited this report.

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Congratulations Scholarship Winners!

Accela recently awarded scholarships to nine environmental health professionals to attend the NEHA 2017 Annual Educational Conference.

Our scholarship recipients represent the best in the industry. Read their thoughts on the latest trending topics at **www.accela.com/nehascholarship**.

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DIRECT FROM CDC ENVIRONMENTAL HEALTH SERVICES BRANCH

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Justin Gerding, MPH, REHS
Centers for Disease Control and Prevention

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 these columns, EHSB and guest authors share insights and information about environmental health programs, trends, issues, and resources. The conclusions in this column are those of the author(s) and do not necessarily represent the views of CDC.

Vanessa Lamers is a project manager for the Public Health Foundation's Performance Management and Quality Improvement. LCDR Justin Gerding is an environmental health officer in CDC's National Center for Environmental Health.

Quality improvement efforts are important for increasing the efficiency and effectiveness of health department and environmental health programs and activities. In 2016, the Public Health Foundation (PHF) and the Centers for Disease Control and Prevention collaborated with five local health departments to identify interventions and implement quality improvement projects for their vector control services. The project used an innovative framework called a population health driver diagram, which is often used to capture and discuss specific activities necessary to address a community health objective (Bialek, Moran, & Kirshy, 2015).

The health departments used a driver diagram tailored to vector control (Figure 1), aligned with the 10 Essential Environmental Public Health Services (EEPHS) (Table 1), and intended to bring together stakeholders and partners to identify improvement areas and establish coordinated approaches. The 10 EEPHS identify necessary activities to improve environmental public health (Centers for Disease Control and Prevention, 2014). Use of the diagram led to the implementation of interventions and strategies to improve performance, enhance services, and increase collaboration among partner agencies to more effectively address vector control issues and concerns.

Each program prioritized intervention areas and worked with their community partners to address a wide range of vector control program services and activities, including

- enhancing public messaging and education,
- developing training for community and nonprofit organizations,
- increasing community outreach,
- promoting vector control policies,
- creating elementary school curricula, and
- altering or eliminating environments conducive to pest populations.

The health departments leveraged the driver diagram to guide quality improvement efforts, with resources such as PHF's *Public Health Quality Improvement Encyclopedia* and tools including the plan-do-check-act cycle (to test, assess, and improve programs and processes), aim statements (to create measurable, time-bound goals), and Gantt charts (for project planning and tracking) (Moran & Duffy, 2012). The following detailed descriptions highlight the results health departments achieved from using these improvement tools.

- **Frederick County Health Department, Maryland:** The health department noted a high number of campers and counselors requiring rabies postexposure prophylaxis in 2015. In response, the Community Health Services Division and Environmental Health Services Division developed a partnership with the camp, serving approximately 250 children each summer, to plan and design interventions. They developed an educational program on bat management, which included new materials mailed out annually and on-site training for camp staff and campers during the 2016 camp season. After providing the training, there was a 94% decrease (18 individuals in 2015 and 1 in 2016) in the number of individuals requiring rabies postexposure prophylaxis in the 2016 season. There are plans to offer this program to other camps in 2017. (Addressed EEPHS 3, 4, and 9.)

TABLE **1**

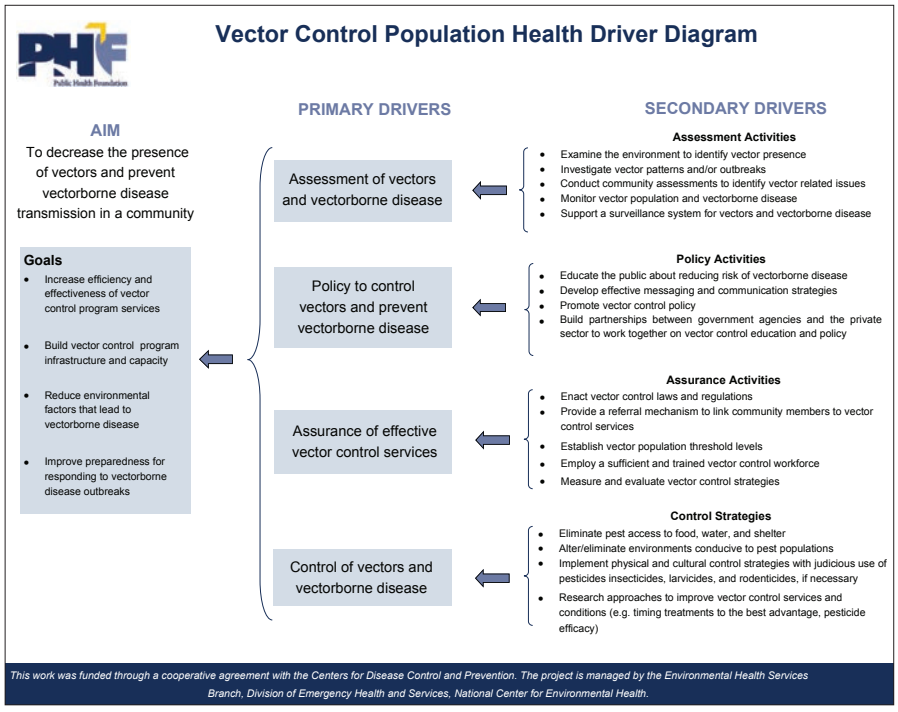
10 Essential Environmental Public Health Services

1. **Monitor** environmental and health status to identify and solve community environmental public health problems.
2. **Diagnose and investigate** environmental public health problems and health hazards in the community.
3. **Inform, educate, and empower** people about environmental public health issues.
4. **Mobilize** community partnerships and actions to identify and solve environmental health problems.
5. **Develop** policies and plans that support individual and community environmental public health efforts.
6. **Enforce** laws and regulations that protect environmental public health and ensure safety.
7. **Link** people to needed environmental public health services and assure the provision of environmental public health services when otherwise unavailable.
8. **Assure** a competent environmental public health workforce.
9. **Evaluate** effectiveness, accessibility, and quality of personal and population-based environmental public health services.
10. **Research** for new insights and innovative solutions to environmental public health problems.

Note. Available online at www.cdc.gov/nceh/ehs/10-essential-services/index.html.

FIGURE **1**

Vector Control Population Health Driver Diagram



- **Madison County Health Department, Alabama**: The health department developed and provided a mosquito control curriculum to three elementary school classes, documenting roughly a 22% increase (66.1% to 88.9%; 58.3% to 80.4%; 56% to 78%) in knowledge about mosquito control based on pre- and post-testing. After testing and improving the curriculum, Madison County later documented a 33% increase (58.8% to 91.7%) in knowledge. In addition, the department mobilized more than 80 community partners, completed dozens of informative presentations and interviews, and developed homeowner and practitioner checklists on how to eliminate places where mosquitoes lay eggs. (Addressed EEPHS 3 and 4.)
- **New Hanover County Health Department, North Carolina**: The health department developed a mosquito control curriculum and educational materials for a local elementary school that met and aligned with the state's core curriculum standards. They demonstrated a 15% increase (57.7% to 73.1%) in student knowledge about mosquito control based on the project pre- and post-test results and are now conducting outreach to other districts, schools, and educational programs. (Addressed EEPHS 3.)
- **St. Louis County Department of Public Health, Missouri**: The department built partnerships with the Missouri Department of Health and Senior Services' public health laboratory and neighboring local health authorities, and implemented a new surveillance system to monitor the presence of *Aedes albopictus* mosquitoes in the county. They

Quick Links

- Centers for Disease Control and Prevention's performance improvement resources: www.cdc.gov/nceh/ehs/activities/performance.html
- *Environmental Public Health Performance Standards, Version 2.0*: www.cdc.gov/nceh/ehs/envphps/docs/envphpsv2.pdf
- Public Health Foundation's population health driver diagrams: www.phf.org/driverdiagrams
- Vector Control for Environmental Health Professionals training: www.cdc.gov/nceh/ehs/elearn/vcehp.html
- Vector Control Population Health Driver Diagram and more resources: www.phf.org/vectorcontrol
- Zika-related quality improvement projects: www.phf.org/Zika

used a plan-do-check-act process to research methodology, test equipment and supplies, establish protocols, determine how to use data, pilot the surveillance program, and evaluate and adjust protocols. Their resulting GIS maps of *Ae. albopictus* mosquito counts around the county gave St. Louis and their partners the necessary information for Zika response and planning efforts in real time. (Addressed EEPHS 1 and 2.)

- **Tulsa Health Department, Oklahoma:** The health department mapped mosquito complaints against West Nile virus-infected mosquito populations and used this information to make decisions about the allocation of resources. They documented measurable improvements within 12 months, including increasing their mosquito surveillance coverage area by 89 square miles while decreasing overall work hours and mosquito trap usage. This trapping and surveillance efficiency saved $2,000 in trap batteries. Prioritizing and improving their processes also led to a 57% increase in efficiency of West Nile virus testing of collected mosquitoes. (Addressed EEPHS 1 and 4.)

Health departments and environmental health programs are encouraged to use the driver diagram as a resource for collaborating with stakeholders and developing coordinated vector control approaches among partners. While the driver diagram is effective for improving ongoing vector control activities and services, it can also be used for responding to new and emerging vectors and vectorborne diseases. Zika was becoming a top priority as the vector control programs initiated their quality improvement activities. In addition to the activities and accomplishments noted earlier, several of the health departments benefitted from using the driver diagram to establish well thought out and collaborative approaches for their Zika response. The Vector Control Population Health Driver Diagram (Figure 1) and additional information, examples, final products, and resources from these health departments are available on PHF's Web site (see the Quick Links sidebar). For more information on PHF's vector control work, check out their Web site (www.phf.org) or contact Vanessa Lamers at vlamers@phf.org.

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References

Bialek, R., Moran, J. & Kirshy, M. (2015). *Using a population health driver diagram to support health care and public health collaboration* (Discussion paper). Washington, DC: Institute of Medicine of the National Academies. Retrieved from https://nam.edu/perspectives-2015-using-a-population-health-driver-diagram-to-support-health-care-and-public-health-collaboration

Centers for Disease Control and Prevention. (2014). *Environmental public health performance standards: Version 2.0*. Atlanta, GA: Author. Retrieved from https://www.cdc.gov/nceh/ehs/envphps/docs/envphpsv2.pdf

Moran, J., & Duffy, G. (2012). *Public health quality improvement encyclopedia*. Washington, DC: Public Health Foundation.

Did You Know?

The Centers for Disease Control and Prevention's Environmental Health Services Branch has provided columns for the *Journal* since January 2006. This contribution adds up to over 100 columns that have provided our readers with insights and information about environmental health programs, trends, issues, and resources! You can find an archive of all these columns at www.cdc.gov/nceh/ehs/publications/jeh_ehsb_columns.htm.

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June 25–28, 2018: NEHA 2018 Annual Educational Conference & Exhibition, Anaheim, CA.

July 8–11, 2019: NEHA 2019 Annual Educational Conference & Exhibition, Nashville, TN.

July 13–16, 2020: NEHA 2020 Annual Educational Conference & Exhibition, New York, NY.

NEHA AFFILIATE AND REGIONAL LISTINGS

Alabama
October 17–19, 2017: Annual Education Conference, hosted by the Alabama Environmental Health Association, Mobile, AL. For more information, visit www.aeha-online.com.

Colorado
September 19–22, 2017: 63rd Annual Education Conference, hosted by the Colorado Environmental Health Association, Colorado Springs, CO. For more information, visit www.cehaweb.com.

Florida
August 24–27, 2017: Annual Education Meeting, hosted by the Florida Environmental Health Association, Palm Harbor, FL. For more information, visit www.feha.org.

Georgia
June 5–7, 2017: Annual Educational Conference, hosted by the Georgia Environmental Health Association, St. Simons Island, GA. For more information, visit www.geha-online.org.

Illinois
October 19–20, 2017: Annual Educational Conference, hosted by the Illinois Environmental Health Association, East Peoria, IL. For more information, visit http://iehaonline.org.

Jamaica
October 22–26, 2017: International Environmental Conference and IFEH Council Meeting, hosted by the Jamaica Association of Public Health Inspectors in association with the IFEH Americas Region Group member countries, Montego Bay, Jamaica. For more information, contact japhi.ifeh.conference@gmail.com.

Minnesota
September 19–21, 2017: FDA Central Region Retail Food Protection Seminar and NEHA Region 4 Biannual Educational Conference, Minneapolis, MN. For more information, visit www.mehaonline.org.

North Dakota
October 18–19, 2017: Fall Education Conference, hosted by the North Dakota Environmental Health Association. For more information, visit http://ndeha.org/wp/conferences.

Rhode Island
October 4–5, 2017: 55th Annual Yankee Conference on Environmental Health, Newport, RI. For more information, visit www.cteha.org.

Tennessee
October 4–6, 2017: 71st Annual Interstate Environmental Health Seminar, hosted by the Tennessee Environmental Health Association, Gatlinburg, TN. For more information, visit www.wvdhhr.org/wvas/IEHS/index.asp.

Texas
October 9–13, 2017: Annual Educational Conference, hosted by the Texas Environmental Health Association, Austin, TX. For more information, visit www.myteha.org.

Wisconsin
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You can share your event with the environmental health community by posting it directly on our community calendar at www.neha.org/news-events/community-calendar. Averaging 2,000 page views a month, you are sure to bring a lot of attention to your event. Make sure to check it often, and you might find a new event happening in your area!

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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!

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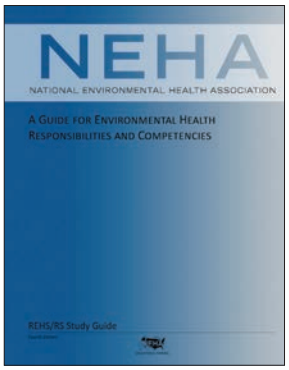
REHS/RS Study Guide (4th Edition)

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.

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Professional Food Manager (5th Edition)

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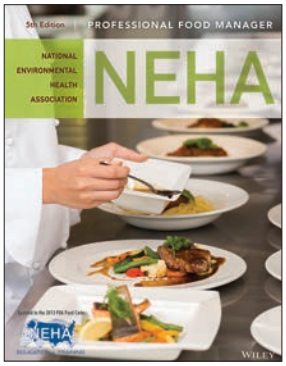

The new edition of NEHA's *Professional Food Manager* provides culinary and hospitality professionals and students with the knowledge they need to ensure successful execution of best food safety practices in the workplace. Updated to the 2015 Supplement to the 2013 Food and Drug Administration *Food Code*, this book provides vital information on the principles of food safety management and how to use those principles to create a food safety culture. Additionally, it contains streamlined, validated content by NEHA subject matter experts to support the education of food managers and provides the knowledge needed for culinary and hospitality professionals to pass accredited food manager certification exams.

166 pages / Paperback
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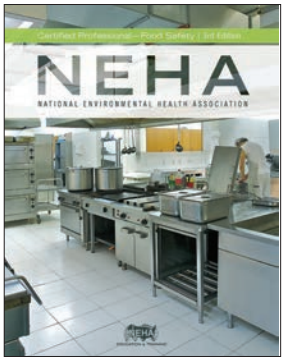
Certified Professional-Food Safety Manual (3rd Edition)

National Environmental Health Association (2014)



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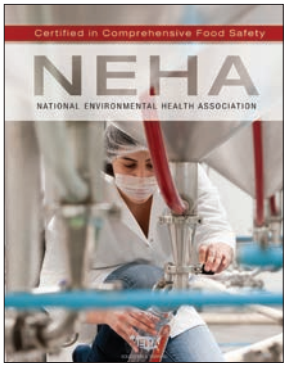
National Environmental Health Association (2014)



The Food Safety Modernization Act has recast the food safety landscape, including the role of the food safety professional. To position this field for the future, NEHA is proud to offer the Certified in Comprehensive Food Safety (CCFS) credential. The CCFS is a midlevel credential for food safety professionals that demonstrates expertise in how to ensure food is safe for consumers throughout the manufacturing and processing environment. It can be utilized by anyone wanting to continue a growth path in the food safety sector, whether in a regulatory/oversight role or in a food safety management or compliance position within the private sector. The *CCFS Manual* has been carefully developed to help prepare candidates for the CCFS exam and deals with the information required to perform effectively as a CCFS.

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University of Washington, Department of Environmental & Occupational Health Sciences
www.deohs.washington.edu

University of Wisconsin–Oshkosh, Lifelong Learning & Community Engagement
www.uwosh.edu/llce

University of Wisconsin–Stout, College of Science, Technology, Engineering, and Mathematics
www.uwstout.edu

SPECIAL **LISTING**

The board of directors includes NEHA's nationally elected officers and regional vice-presidents. Affiliate presidents (or appointed representatives) comprise the Affiliate Presidents Council. Technical advisors, the executive director, and all past presidents of the association are ex-officio council members. This list is current as of press time.

Larry Ramdin, REHS, CP-FS, HHS Region 9 Vice-President

David Dyjack, DrPH, CIH NEHA Executive Director

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Region 7—Tim Hatch, MPA, REHS, Environmental Programs, Planning, and Logistics Director, Center for Emergency Preparedness, Alabama Department of Public Health, Montgomery, AL.
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81st AEC 2017
National Environmental Health Association
Annual Educational Conference
Grand Rapids • Michigan • July 10-13, 2017

JULY 10–13, 2017 Annual Educational Conference & Exhibition

Local Solutions. National Influence.

***We are building a great conference** in "Beer City," also recently named the #1 travel destination by Lonely Planet! We are gathering local perspectives, as well as national experts, to bring you the latest and greatest in environmental health.*

Registration

Register online today at neha.org/aec/register to attend the NEHA 2017 AEC & Exhibition. After June 30, attendees can still register online, but must pay with credit card only. **See you in Grand Rapids!**

	Member	Nonmember
Registration: *Full Conference*	$695	$870
Registration: *Full Conference + 1-year NEHA Membership*	$790	
Single Day Registration	$310	$365

Hotel & Conference Venues

Lodging and conference venues are easily accessible via a connected sky walk. Discounted room rates are available at neha.org/aec/hotel-travel until our room block is sold out.

- **Lodging:**
  Amway Grand Plaza Hotel

- **Educational Sessions & Exhibition:**
  DeVos Place Convention Center

Photos of Grand Rapids courtesy of Experience Grand Rapids.

*Register and find details on sessions and events at **neha.org/aec**.*

Start planning your conference experience! Register today to access the 2017 AEC app and choose the sessions you want to attend.

Schedule at a Glance

Saturday, July 8

- Certified Professional - Food Safety Credential Review Course

Sunday, July 9

- Certified Professional - Food Safety Credential Review Course
- Preconference: Affiliate Leadership Workshop
- Preconference: Survival Skills for Environmental Health Leaders

Monday, July 10

- Certified Professional - Food Safety Credential Exam
- Certified in Comprehensive Food Safety Credential Exam
- Preconference: Private Well Outreach and Assessment for Environmental Health Professionals
- **4 PM Conference Opens: Keynote and Opening Session**
  - Keynote with Senator Debbie Stabenow (invited), U.S. Senator (MI), Ranking Member of the U.S. Senate Committee on Agriculture, Nutrition, and Forestry
  - Aiming for Equity, an environmental justice panel facilitated by Dr. Renée Branch Canady, Chief Executive Officer of the Michigan Public Health Institute
- Exhibition Grand Opening & Party

Tuesday, July 11

- Educational Sessions
- Exhibition, Poster Sessions, Career Center
- UL Event (off site)

Wednesday, July 12

- Breakfast & Town Hall Assembly
- Educational Sessions
- Awards Ceremony
- Brews, Blues & BBQ

Thursday, July 13

- Educational Sessions
- Closing Session on Sustainability, sponsored by NEHA's Business & Industry Affiliate
- Registered Environmental Health Specialist/Registered Sanitarian Credential Exam (PM)

**Schedule subject to change. Read more about the AEC session highlights we've got planned for you on page 58.*

Exhibition
Monday, July 10

Always one of the most popular AEC events, the Exhibition is your chance to network with one another and with a variety of experts in the environmental health field. From industry to federal agencies, you'll find no better collection of dedicated resources to help you in your career.

UL Event
Tuesday, July 11

This special evening at the Grand Rapids Public Museum has something for everyone. Stroll through the living history exhibit "Streets of Old Grand Rapids," take a ride on the antique carousel, enjoy a breath-taking planetarium show (free tickets available on a first come first serve basis), and socialize over appetizers and a cash bar in the elegant galleria and dance floor. **Purchase tickets in advance as this event typically sells out! Cost is $45 per person.**

Brews, Blues & BBQ
Wednesday, July 13

Join our conference networking social event dubbed Brews, Blues & BBQ! The event will be held on the Gillett Bridge, overlooking the river next to the Amway Grand Plaza hotel, and will feature local foods and brews (cash bar), as well as a live local band that will set a festive tone for the evening. **This event is included in all full conference registrations. Additional tickets are $65 per person.**




*Register and find details on sessions and events at **neha.org/aec**.*

NEHA NEWS

NEHA General Election 2017—Results

By Kristen Ruby-Cisneros (kruby@neha.org)

Elections are a critical part of the democratic process and are one way to provide members a voice in the running of their organization. NEHA voting members have an opportunity to vote for candidates of contested board of directors and regional vice-president positions, as well as cast votes regarding proposed Articles of Incorporation and Bylaw changes.

National officers of NEHA's board of directors serve a one-year term in each officer position (second vice-president, first vice-president, president-elect, president, and immediate past-president) for a total of five years. Regional vice-presidents serve three-year terms.

The following are results from the 2017 general election.

Second Vice-President

There were two qualified candidates for the second vice president position: Stan Hazan and Sandra Long. In addition to the candidate profiles that appeared in the March *JEH* and on NEHA's Web site, both candidates had profiles posted on the online ballot. Eligible voters were encouraged to vote during the month of March. The deadline to vote was March 31, 2017.

Voters elected Sandra Long as the second vice-president. Long will assume this position at the closing of NEHA's 2017 Annual Educational Conference (AEC) & Exhibition in July.

Regional Vice-Presidents (RVPs)

NEHA's membership is broken down into nine regions that represent U.S. geographic areas, as well as members in the U.S. military and abroad. The terms of three RVP positions expired in 2017: 1) Ned Therien, Region 1; 2) Sandra Long, Region 5; and 3) Tim Hatch, Region 7.

No eligible candidates for Regions 1 and 5 were confirmed prior to the election. Per board policy, these positions were filled by vote of the board. The list of candidates was based upon individuals who had indicated interest in response to e-mail outreach sent to members in those regions. There were two candidates for the Region 7 vacancy and those residing in Region 7 were able to vote for the candidates via the election ballot.

The new vice-presidents for the three regions are 1) Matthew Reighter, Region 1; 2) Tom Vyles, Region 5; and 3) Tim Mitchell, Region 7. These individuals will assume their positions at the close of the 2017 AEC and their terms will expire in 2020.

A listing of current NEHA national officers and RVPs, along with state breakdowns for each region, can be found on page 52. More information about NEHA's governance, including its Articles of Incorporation and Bylaws, the election processes, and associated deadlines, can be found at www.neha.org/about-neha/governance.

Thank you to all members who participated in this year's election and submitted their votes!

What's New in Washington, DC?

By Joanne Zurcher (jzurcher@neha.org)

Environmental Health Workforce Act of 2017

NEHA is thrilled to announce that in response to the efforts of our Washington, DC, staff educating members of Congress about the importance of the environmental health workforce, our new champion in the House of Representatives, Representative Brenda L. Lawrence (D-Michigan) has reintroduced the Environmental Health Workforce Act. The bill was reintroduced on April 5, 2017. This bill ensures that there is a consistent set of guidelines and standards for the training and education of environmental health professionals across the nation.

Only 28 states currently require a credential for environmental health workers.

The Environmental Health Workforce Act of 2017 will

1. direct the U.S. Department of Health and Human Services (HHS) secretary, in conjunction with relevant stakeholders, to develop model standards, guidelines, and technical assistance for credentialing environmental health workers;
2. direct HHS to develop a comprehensive environmental health workforce plan that identifies and addresses ways to strengthen the environmental health workforce; and
3. direct the comptroller general of the U.S. to examine and identify best practices in six states related to training and credentialing requirements for environmental health workers. This report will compare the best practices of three states that currently have credentialing requirements (Maryland, Ohio, and Washington) and three states that do not have such requirements (Indiana, Michigan, and Pennsylvania).

As our members know, credentialing serves as verification that a professional has achieved a baseline level of competency and is an impartial, third-party endorsement of an individual's professional knowledge and practical experience to perform relevant work responsibilities. Since 1937, NEHA has offered the Registered Environmental Health Specialist/Registered Sanitarian credential, which defines a set of competencies that are evidenced through testing and maintained through continuing education.

Given the diversity and complexity of recent environmental health issues that have been a high priority for public safety—lead-contaminated drinking water, food tainted with *E. coli*, and potential outbreaks of Zika virus—this legislation is a key component to ensuring we have a highly skilled workforce to find the best solutions and protect future generations.

Capitol Hill Briefing

On June 8, 2017, NEHA and Association of Food and Drug Officials (AFDO) are cohosting a congressional staff briefing in the U.S. Capitol that will focus on keeping America's food safe. Senator Tim Kaine (D-Virginia) is sponsoring the event and will provide opening remarks. NEHA Executive Director Dr. David Dyjack will moderate the panel and NEHA Past-President Bob Custard will give NEHA's

perspective. AFDO President Steven Mandernach will give AFDO's perspective. Also present at the event will be a foodborne illness victim, who will share their story to connect federal policy to real people.

NEHA's Second App Challenge! Innovating for Environmental Health: Water Quality

By Solly Poprish (spoprish@neha.org)

In March 2016, NEHA, with the support of Hedgerow Software (www.hedgerowsoftware.com) and Esri (www.esri.com), launched its first app challenge—Innovating for Environmental Health. Individuals competed to develop apps that would achieve one of the Healthy People 2020 environmental health objectives as identified by the U.S. Department of Health and Human Services. The mission of the competition was to create apps that could be used by environmental health professionals or the communities they protect, as well as inspire data-driven solutions to public health issues.

A total of 13 apps were submitted, which varied in environmental health topic and user audience. The first-place team developed Biky, an app that integrates alternative transportation, physical activity, and community building to tackle air contamination and promote a healthy lifestyle. Angela Jimenez attended the NEHA 2016 Annual Educational Conference (AEC) & Exhibiton on behalf of her team to present and receive the app challenge award. To learn more about last year's app challenge and submissions, please visit https://innovatingeh.devpost.com.

This year we launched our second Innovating for Environmental Health App Challenge with continued support from Hedgerow Software. This year's app challenge is different because it focuses on a specific environmental health topic—participants are competing to develop apps that use public data to solve water quality issues.

Water quality impacts us daily. We drink it, play in it, and grow our food with it, all of which have a direct impact on our health and well-being. Water quality issues that developers might focus on include increasing access to drinking water that meets Safe Drinking Water Act regulations, reducing waterborne disease outbreaks, reducing the global burden of disease due to poor water quality, and more.

Please visit www.neha.org to learn more about the app challenge and see how you can get involved.

If you are attending the NEHA 2017 AEC, please join us at the "Innovating for Environmental Health: Water Quality" session to hear about the innovative winners of the competition, and to learn the potential of integrating public data, technology, and environmental health.

NEHA Releases New Credentials in Food Safety Auditing

By TJay Gerber (tgerber@neha.org)

NEHA been working for several years on the development of a credential to meet the needs of an independent guarantee of a capable workforce for all levels of food safety auditing. NEHA gathered subject matter experts (SMEs) from around the globe to assist in the creation of the Certified in Food Safety Supplier Audits (CFSSA) and Registered Food Safety Auditor (RFSA) credentials. These credentials will build the international capacity of qualified, vetted professionals that will be needed to meet the requirements of the Food Safety Modernization Act (FSMA).

Development of the Credentials

NEHA's credentialing department is well versed in the creation and maintenance of credential programs. The department currently offers eight credentials, which includes the CFSSA and RFSA credentials. The credentialing department partnered with psychometricians from Professional Testing, Inc. to ensure that the credential exams, eligibility requirements, scoring, and continuing education requirements were valid, reliable, and legally defensible. The process took place over seven multiday meetings and involved the combined efforts of nearly 30 SMEs from government entities, regulatory agencies, academia, and other organizations. With guidance from the psychometricians, the SMEs discussed the various knowledge, skills, abilities, and job tasks that a future credential holder would require to be competent in the food safety auditing world.

Lead psychometrician Dr. Cynthia Woodley, who has developed certification programs for over 20 years, said, "The program that has been developed for NEHA is a really solid program. It not only is a knowledge-based program, but it is also measuring skills." The finished product is an impartial, third-party endorsement of an individual's professional knowledge and experience that verifies they have achieved a baseline level of competency in food safety auditing.

Throughout the creation process of the CFSSA credential, the SMEs discussed the importance of requiring experience in third-party audits. They stated, however, how difficult it might be for a food auditor to conduct a third-party audit without working for a certification body. By definition, a third-party certification audit is one conducted by a certification body. Thus, the RFSA credential was born.

The RFSA credential builds upon the knowledge of the CFSSA by requiring a certain number of audits in one food sector or category, as well as passing a witness audit checklist in one food sector or category. Trish Wester, one of the SMEs involved in the credential creation process, stated, "A witness audit will confirm that the candidate has the necessary technical knowledge to produce a product safely and knows how and where to gather information about what a site is doing."

Eligibility

The CFSSA and RFSA credentials require a high level of food safety knowledge. For this reason, SMEs discussed the various avenues a candidate would be able to apply for the credential. One such avenue is to hold a bachelor's degree or equivalent with 30 semester hours of core science education, 3 years of experience in food production or in conducting regulatory food inspections at a super-

visory or advanced capacity, evidence of hazard analysis and critical control point (HACCP) training, and evidence of the Professional Food Safety Auditor Training Course or equivalent. A candidate that can provide proof of the requirement is eligible to sit for the CFSSA exam. Once an individual passes the CFSSA exam, they are eligible to apply for the RFSA credential to become a third-party auditor.

Credential Exam and Continuing Education

An individual that is eligible to sit for the CFSSA credential exam will need to achieve a passing score covering a variety of food safety auditing topics that include conducting an audit, conducting post-audit activities, verifying prerequisite programs, planning food safety audits, and verifying food safety programs. The exam has 175 multiple-choice questions and individuals have 3 hours to complete the exam. Upon successfully passing the exam, the CFSSA credential holder will be prepared to complete first- and second-party audits. The CFSSA credential can also lead individuals into a career path to become a third-party auditor, where they will be one of the last lines of defense in the complex global food supply chain. After earning the CFSSA credential, individuals will need to submit 24 hours of continuing education units for the CFSSA. The RFSA credential requires 36 hours of continuing education, which covers the requirements of the CFSSA.

NEHA's credentialing department was well suited for the task at hand. With the assistance of SMEs from around the globe, we were able to create two credentials that are perhaps the most robust of all food auditing credentials currently available. Ultimately, the goal of these credentials is to create competent, qualified individuals to carry out the functions described in FSMA. Likewise, qualified individuals are needed to audit the effectiveness of internal food safety programs and supplier programs, as well as participate as an external third-party observer.

Find out more about the CFSSA and RFSA credentials at www.neha.org/credentials.

Focusing on Local Solutions, National Influence at the NEHA 2017 AEC

By Kristie Denbrock (kdenbrock@neha.org)

The NEHA 2017 Annual Educational Conference (AEC) & Exhibition will examine how local solutions can influence the health of the nation and the globe. The 2017 AEC, our 81st one, will take place July 10–13 at the DeVos Place Convention Center in Grand Rapids, Michigan. Environmental health professionals, industry leaders, government officials, and academics will share innovative tools of the trade, discuss multiagency coordination, and debate the hot topics.

The 11 educational tracks of the AEC represent 25 environmental health disciplines including water, food safety and defense, tracking and technology, healthy homes and communities, emerging issues, workforce and leadership, climate and heath, infectious and vectorborne diseases, and a wide variety of environmental public health issues.

U.S. Senator Debbie Stabenow (D-Michigan) will deliver the keynote address on Monday, July 10. Stabenow is the ranking member of the U.S. Senate Committee on Agriculture, Nutrition, and Forestry. Following the address is the opening session, "Aiming for Equity," an environmental justice panel facilitated by Dr. Renée Branch Canady, chief executive officer of the Michigan Public Health Institute.

Educational session highlights include "The Great Restaurant Grading Debate: Is Restaurant Grading an Effective Practice or Are We Misleading Ourselves and the Public?" NEHA Executive Director Dr. David Dyjack will moderate the debate as the audience listens to the pros and cons of grading from Terri Williams, director of environmental health for Los Angeles County, and Mick Miklos, senior manager at the National Restaurant Association.

Dr. Richard Raymond, former U. S. Department of Agriculture's Under Secretary for Food Safety, will lead a panel discussion on antibiotic resistance. Included on the panel will be Dr. Terry L. Dwelle, University of North Dakota School of Medicine and Health Sciences, and Dr. Bruce Stewart-Brown, senior vice president of Food Safety and Quality Live Operations, Perdue Farms.

The closing session will focus on sustainability and how the U.S. government and local entities view sustainability and human health connected through air and water pollution, indoor air quality, and the procurement of more sustainable products. Panel participants in the session will include Walker Smith, director, Office of Global Affairs and Policy, Office of International and Tribal Affairs, U.S. Environmental Protection Agency; Gabe Wing, director of Safety and Sustainability, Herman Miller; and Eric DeLong, deputy city manager for Grand Rapids.

Additional educational sessions include:

- Got Water? Community Preparation and Response to Water-Related Emergencies and Outbreaks
- IPM in Housing: Overcoming Obstacles
- Communication Is Key (UL Restaurant Code)
- Regulation in the Body Art Industry: Views of the Body Art Practitioner (demo)
- Norovirus in Schools and Hotels
- Green and Healthy Homes Initiatives
- Food Fraud

The AEC will also feature an exhibit hall, poster session, and a variety of networking and social events including the UL Event at the Grand Rapids Public Museum, Tuesday, July 11, 6:00–9:30 p.m., and the Brews, Blues, & BBQ on the beautiful Gillett Bridge featuring local foods, microbrews, and live music, Wednesday, July 12, 6:30–8:30 p.m.

For additional conference and registration information, please visit www.neha.org/aec. We hope to see you there!

NEHA NEWS

NEHA Staff Profile

As part of tradition, NEHA features new staff members in the *Journal* around the time of their one-year anniversary. These profiles give you an opportunity to get to know the NEHA staff better and to learn more about the great programs and activities going on in your association. This month we are pleased to introduce you to one NEHA staff member. Contact information for all NEHA staff can be found on page 53.

Santiago Ezcurra

I moved to Denver in March 2016 with my wife and started to look for a job right away. After months of interviews and trips all over town, I got struck by luck—I joined NEHA in May 2016 as a temporary employee to help with some online courses that were being updated. I was given the opportunity to work on other projects and apply some of my experience in video editing and animation. That's how it all started.

Now I'm NEHA's media production specialist, helping to create online courses; managing our e-Learning platform; and filming, editing, and animating videos.

It's really a sum of awesome coincidences that NEHA and I crossed paths. Although my degree is in advertising, I always had a passion for video creation that I developed as a hobby. I've worked in the educational industry in different countries as a language teacher. This experience helps me approach my online training work at NEHA from that perspective. Also, my career has been related to environmental health as I worked in that industry for several years in China. All the elements were there! And the truth is, I'm truly happy. Making a difference while I work on my passions is more than I could have believed prior to moving to the U.S.

As for my future, I'm an optimist. I always expect the best, but I take responsibility for the part that I need to play in order for things to happen. I think that we might have a couple of tough years ahead of us, but that will unite and empower the environmental industry, getting us ready for the challenges of the next decade. I am excited about improving my skills and learning more, which will enable me to develop new tools that will help environmental health professionals and create new content that can inspire more people to join NEHA.

DirecTalk
continued from page 62

thoughts come to mind when NEHA is mentioned in your personal communications? Trust? Value? Customer service? Commitment? Or, something else?

And this train of thought takes me back to membership. Attendee evaluations of our face-to-face training programs, webinars, and virtual conferences are exceptionally good. I receive ample compliments (and some complaints) from you about staff service. Our Annual Educational Conference & Exhibition is well liked and attendance is growing. So, when people are exposed to our products and services, they are generally favorable. How do we make this perception contagious? I'm increasingly convinced that we need to focus first on distribution, second on content, and third on brand. Let's learn to "touch" the profession, then give people what they need to know, and finally, leave them emotionally attached to us.

Winston Churchill said it best. He is quoted as describing post-World War II Russia as "a riddle, wrapped in a mystery, inside an enigma; but perhaps there is a key. That key is Russian national interest." Likewise, understanding your interests is central to our communication plan.

To that end, we have hired an association membership manager, Jonna Ashley, who has prior work experience with two other associations. Jonna will conduct focus group interviews with members and nonmembers this spring and summer to gain insight into their interests. I trust Jonna will open the door to one of those parallel universes I fail to understand, learning in the process how best to resonate with you.

Joshua Schrader left NEHA in 2016 to pursue other career interests. Sadly, he passed away in March 2017. He was gifted and intelligent, and I will always be thankful to him for providing me a glimpse into a parallel universe—the one of music. He also reinforced an important life lesson: to remain curious about what works and what doesn't work, and to not fear the unfamiliar. I miss him. I know if he was here he would offer insight into this complex and turbulent world of modern communications.

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Twitter: @DTDyjack

Did You Know?

The *Journal of Environmental Health* is turning 80 next month! *The Sanitarian* (original title of the *Journal* until 1962) was first published by the National Association of Sanitarians (changed to NEHA in 1970) in June 1938. With an average of two to four articles published in every issue, the *Journal* has contributed close to 2,000 peer-reviewed scientific articles during its publication.

So, let us ask you: How has the *Journal* impacted you, your work, the way you think, the policies and laws that govern your jurisdictions, and your understanding of the profession? Please share your thoughts and examples with us at jeh@neha.org!

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DirecTalk MUSINGS FROM THE 10TH FLOOR

David Dyjack, DrPH, CIH

Distribution > Content > Brand

Conversation with Joshua Schrader came naturally, both of us honoring our morning cravings. I clutched my espresso, he a smoldering cigarette. As early risers, we would cross paths outside the NEHA office before the business day began in earnest. Josh intrigued me because he was not of my world (i.e., my traditional public health world). At that time, he led NEHA's sales and training support, a business unit that sells our products and services. Josh often regaled me with stories of exploit and adventure from the previous weekend, which evidently were dedicated to his passion: music and deejaying in front of large crowds. What he described was a world that I knew nothing about, something akin to a parallel universe.

I'm struck by the number of universes I know nothing about, including how best to connect with our constituents. I am painfully aware when these connections go wrong, like when we accidently used the incorrect environmental media in a news alert. We used the term "air" when we should have used "water." Ouch. I was (appropriately) lit up by you folks. I did learn, however, that you were reading (and paying attention) to what we were sending out. I just wish this knowledge would have come to me in a less painful and embarrassing manner. Alternately, I am oblivious to when and how communication works—that parallel universe thing.

For the record, I receive analytics on our social media and its growth. We track open rates for our E-News and the number of unique visitors to our Web site. It's all very interesting, but I have little clue as to what these numbers mean. My biggest success has been an op-ed I recently published in *U.S. News & World Report*. Barack Obama's direct reports contacted me to convey thanks for the op-ed. What does that mean? Well, depends on who you talk to.

Joshua Schrader
August 13, 1975–March 8, 2017

This train of thought leads me to communication. I'm struck by the notion that distribution vehicles—such as e-mail, text, Twitter, LinkedIn, Facebook, and Instagram—are more important collectively than are content or brand. Where I struggle, even in conversations with experts, is on what distribution technique(s) do we use for a particular set of circumstances? Perhaps an e-news alert is appropriate for a legislative priority, but how does that ensure our association is seen as a value proposition to you and potential members? This question keeps me up at night.

While distribution vehicles are interesting, they need to be populated with content. Twitter provides fodder as an illustration. I'm continuously perplexed by the tweets that get "legs," or that are retweeted or liked. Generally speaking, pithy text is rarely retweeted, while a photo with an edgy comment seems to get traction. What am I to make of that? Furthermore, where do we post content that will have the greatest relevance to the professional practice?

Most of the inquiries I receive about subject matter expertise is couched by an adrenalin-driven crisis. "Help! What do you know about…?" Almost none of these inquiries is anticipated and relevant content on our Web site is absent. For example, a request came in today around best practices for regulating mobile food vendors. Last week it was U.S. Environmental Protection Agency support stories from the field from particular states. These inquiries are a little like "whack-a-mole."

Finally, there is the logo conversation, which I acknowledge is a sensitive and complicated issue. Many NEHA employees have emotionally expressed a desire and case to update and modernize our logo. Tinkering with a logo is not trivial. Logos should be original, timeless, adaptable, memorable, and relevant. Having said that, I see value in the effort.

Many employees and members have also suggested that we engage in a branding exercise. So, let me ask you, what emotions or

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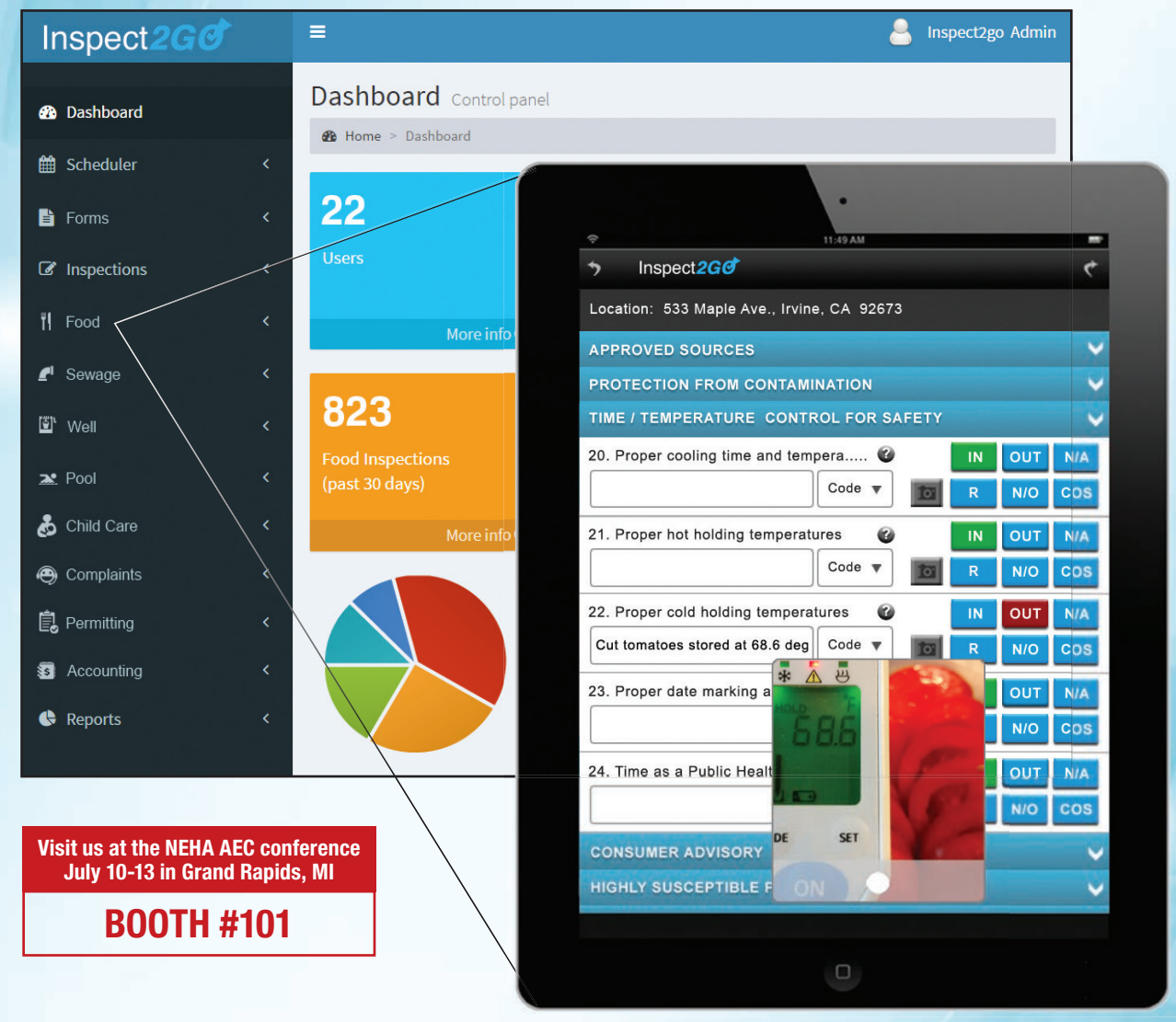

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INTERNATIONAL PERSPECTIVES

Assessment of Noise Level Distributions in Lagos Metropolis and the Potential for Adverse Health Effects

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Abstract **Elevated sound pressure levels can lead to sleep disturbance, annoyance, hearing impairment, speech interference, and severe stress on the auditory and nervous systems if sound levels are continuous and greater than international standard limits. The aim of this study was to evaluate the noise level distributions in Lagos, Nigeria. We selected 32 locations across the Lagos metropolis for this study. A digital sound meter capable of measuring 32 dB–130 dB was used. At each location, minimum and maximum noise levels were determined. Measurements were taken in morning (8–10 a.m.), afternoon (2–4 p.m.), and evening (6–8 p.m.) periods. The obtained values were presented as mean ± standard deviation in decibels (dB). The highest average sound pressure level was found to be 90.3 ± 15.3 dB, while the lowest value was 55.30 ± 4.6 dB. There was no statistical significant difference in the noise level distributions in the three monitoring sessions (p = .74). Noise level distributions in the city exceeded the acceptable standard limits set by the World Health Organization. Health effects related to incessant exposures to high noise levels are likely to be common and may result in negative impacts on the well-being of the inhabitants of the city.**

Introduction

One of the most undesirable side effects of an improperly planned city and poor building construction is environmental pollution and the degradation of quality of life. Noise pollution is an important significant environmental problem in many rapidly growing cities (Björk et al., 2006; Gangwar, Joshi, & Swami, 2006; Kisku et al., 2006). Frequent exposure to high levels of noise has the potential to cause severe stress on the auditory and nervous systems (Stansfeld, Haines, Berry, & Burr, 2009). Extended exposure to excessive sound has been proved to cause physical and psychological damage (World Health Organization [WHO], 2011). Noise adds to mental stress due to its annoyance and disturbance implications, and hence affects the general well-being of those exposed to it (Agarwal & Swami, 2011; Finegold, Harris, & von Gierke, 1994; Singh & Davar, 2004). The primary urban sources of noise are industrial, traffic, and community noise—of which traffic noise is the most important. In traffic noise, vehicles contribute about 70% of noise. Vehicle noise is created by the engine and the exhaust system of vehicles, aerodynamic friction, interaction between the vehicle and road system, and by the interaction among vehicles and indiscriminate use of vehicle horns (Björk et al., 2006; Chauhan, Pawar, Kumar, Kumar, & Kumar, 2010; Pathak, Tripathi, & Mishra, 2008; Rao & Rao, 1991).

In physics, sound is a mechanical energy of a vibrating object transmitted by pressure waves through a medium such as air or water that is capable of being detected by the human (or animal) hearing organs. According to the World Health Organization (WHO), environmental noise is an unwanted or harmful sound created by human activities (Berglund, Lindvall, & Schwela, 1999; WHO, 2011).

Unlike chemical pollution, noise energy does not accumulate in the body or in the environment, but it can have both short- and long-term adverse effects on people. Perceptions of sound and noise are highly subjective: one person's music is another's headache. The two terms are often used interchangeably, although few would call the sound that emanates from a highway anything but noise. Sound (and noise) is actually a process that consists of three components: the sound source, sound path, and sound receiver.

Meanwhile, sound pressure level is a measure of the air vibrations that make up sound. The human ear can detect a wide range of sound pressure levels, expressed in Pascals (Pa) from 20 µPa to 200 Pa, that are measured on a logarithmic scale with units of decibels (dB) to indicate the loudness of a sound. Sound pressure level changes continuously with time or distance, and within certain ranges.

Elevated levels of noise can be a serious threat to public health. Some of the adverse effects of noise pollution are psychological effects, speech interference, sleep disturbance, and poor work performance. Noise is a biological stressor. Among the health risks posed by noise pollution are high blood pressure, coronary heart disease, ulcer, colitis, and migraine headache. It has been demonstrated that there is a relationship between high noise level exposure and health problems (Babisch, 2011; Babisch, Gallacher, Elwood, & Ising, 1988; Concha-Barrientos,

TABLE **1**

Sound Pressure Level Distribution at Different Locations in the Lagos Metropolis

Location #	Name of Location	Average Sound Pressure Level (dB)		
		Morning	Afternoon	Evening
1	Agege (railway crossing)	88.1 ± 6.9	74.6 ± 7.5	74.6 ± 13.4
2	Alaba International Market	84.3 ± 9.6	75.3 ± 2.7	66.3 ± 8.3
3	Alimosho-Ikotun Bus Terminal	78.9 ± 6.5	78.3 ± 7.0	84.5 ± 6.1
4	Computer Village	80.9 ± 1.6	84.0 ± 3.3	55.5 ± 4.6
5	Ebute-Meta Train Terminus	81.9 ± 3.1	82.7 ± 7.5	92.3 ± 10.4
6	Egbeda	79.2 ± 7.4	79.1 ± 12.7	76.8 ± 11.3
7	Iddo Train Terminus	78.9 ± 6.5	78.3 ± 7.0	84.5 ± 6.1
8	Ikeja Bridge	75.8 ± 4.8	76.8 ± 3.7	77.2 ± 6.8
9	Ikeja City Mall	78.9 ± 11.9	76.1 ± 10.5	75.6 ± 8.8
10	Ikeja L.G.A. Secretariat	79.3 ± 7.9	80.7 ± 7.3	71.8 ± 3.7
11	Iyana Ipaja	78.9 ± 6.5	78.3 ± 7.0	84.5 ± 6.1
12	Ketu	81.3 ± 10.0	77.2 ± 6.8	76.1 ± 14.1
13	Lagos Central Mosque Seriki	84.8 ± 4.9	86.5 ± 7.4	83.8 ± 15.2
14	Lagos Island (Broad Street)	73.6 ± 7.6	84.8 ± 4.1	78.7 ± 14.9
15	Lagos Island (Tinubu Street)	79.3 ± 0.6	82.1 ± 10.6	81.4 ± 13.0
16	Lagos State University Gate	69.5 ± 8.1	72.5 ± 9.4	74.9 ± 7.7
17	Mile 12	85.4 ± 6.7	77.2 ± 10.1	68.7 ± 2.5
18	Mile 2	77.7 ± 9.5	76.5 ± 7.3	84.1 ± 6.7
19	Mushin Market	77.7 ± 7.9	83.4 ± 12.2	83.0 ± 11.4
20	Obalande Bus Terminal	81.2 ± 3.0	85.6 ± 10.0	85.8 ± 8.1
21	Ogba-Ojodu	73.8 ± 8.0	75.5 ± 8.6	77.4 ± 7.7
22	Ojo Market	77.7 ± 6.7	73.6 ± 5.2	71.9 ± 9.2
23	Ojota	82.3 ± 8.0	80.5 ± 5.2	88.9 ± 5.2
24	Ojuelegba Bridge	78.7 ± 3.5	87.8 ± 5.3	85.9 ± 12.3
25	Oshodi	78.0 ± 10.6	75.2 ± 9.2	79.1 ± 13.8
26	Oyingbo Market	80.8 ± 6.6	76.9 ± 7.5	88.7 ± 9.4
27	Pen Cinema	80.8 ± 6.6	76.5 ± 7.3	84.2 ± 6.6
28	Sabo-Ikorodu	81.7 ± 5.8	73.9 ± 2.9	90.3 ± 15.3
29	Trade Fair International Market	75.5 ± 6.1	86.3 ± 7.1	67.7 ± 6.2
30	Unilag Gate (Akoka)	74.7 ± 10.0	64.4 ± 1.3	70.1 ± 8.2
31	Victoria Island	76.2 ± 9.7	63.2 ± 4.1	66.2 ± 5.0
32	Yaba-Tejuosho Market	82.5 ± 8.3	76.5 ± 7.3	84.2 ± 6.6

Note. Results are presented as mean ± standard deviation.

Campbell-Lendrum, & Steenland, 2004). Exposure to loud noise increases an arousal response in the body. Adrenaline is released in the blood; heart rate, blood pressure, and respiration increase; gastrointestinal mobility is restricted; blood vessels contract; and muscles are stretched. Even though noise has no relationship with danger, the body automatically responds to noise as a warning signal (Babisch, 2002; den Boer & Schroten, 2007; van Kempen et al., 2012).

Even relatively low levels of noise can adversely affect human health and quality of life (Allaouchiche, Duflo, Debon, Bergeret, & Chassard, 2002; Berglund et al., 1999; Bharanthan et al., 2007). Noise is a psychosocial stressor that activates the sympathetic and endocrine systems. Acute effects occur at high sound levels in occupational settings, and also at lower environmental noise levels when certain activities such as concentration, relaxation, or sleep are disturbed.

The aim of this study is to measure noise level distributions in the metropolis of Lagos, Nigeria, and compare the obtained values with international standard limits, with the purpose of evaluating the possible adverse health effects of noise levels on the generality of the residents.

Materials and Methods

A digital sound meter (DSM 325) was used to measure sound levels in the selected study areas. DSM 325 is a handheld meter for a wide range of applications where accurate sound level measurements are required. The DSM 325 has a measurement range of 32–130 dB over three ranges (32–80 dB, 50–100 dB, and 80–130 dB) with a resolution of 0.1 dB and an accuracy of ± 1.5 dB.

Lagos has a population of approximately 17.5 million people and is the economic nerve center of Nigeria. We selected 32 locations for data collection (Table 1). Factors considered for the selected locations included commercial activities, vehicular traffic, closeness to the motor parks, and markets.

The DSM 325 was placed on a tripod stand at a height of 1.5 m above the ground level with its microphone pointing toward the noise source. Three measurements were taken at 10-min intervals at each location with their longitude and latitude noted. Maximum and minimum sound pressure levels were recorded. The procedures were repeated for three sessions during the weekdays: morning (8–10 a.m.), afternoon (2–4 p.m.), and evening (6–8 p.m.). The obtained values are presented in mean ± standard deviation in dB. SPSS version 20 was used for statistical analysis. A value of $p < .05$ was considered statistically significant.

Results

Sound level distributions for the morning, afternoon, and evening are presented in Table 1; the graphical representations of the distribution in the morning, afternoon, and evening sessions are reported in Figures 1–3. It was observed that the sources of noise distributions were from vehicular traffic, human activities, and commercial activities of the selected areas. No location was free of noise pollution based upon the values we obtained.

The maximum average sound pressure level recorded was 90.3 ± 15.3 dB at Sabo-Ikorodu, while the minimum average value

FIGURE 1

Maximum and Minimum Noise Level Distributions in the Morning Period

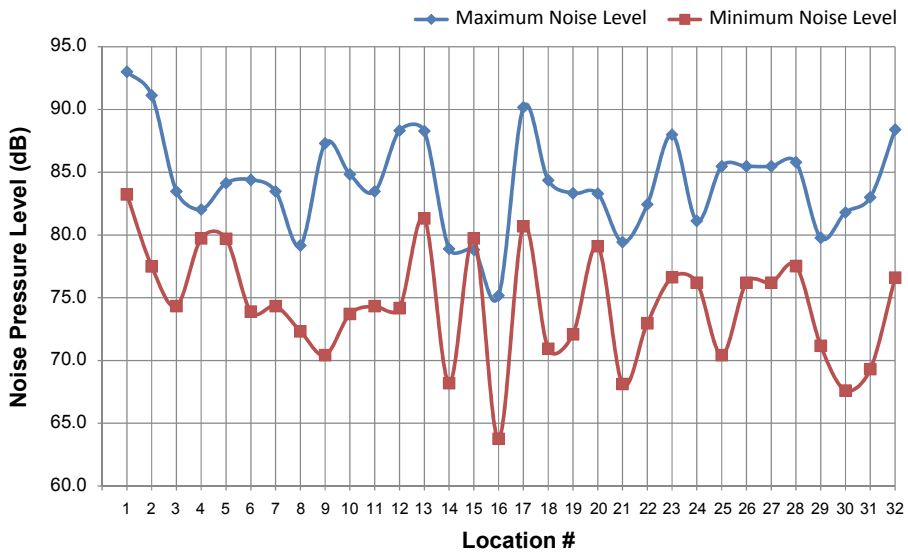
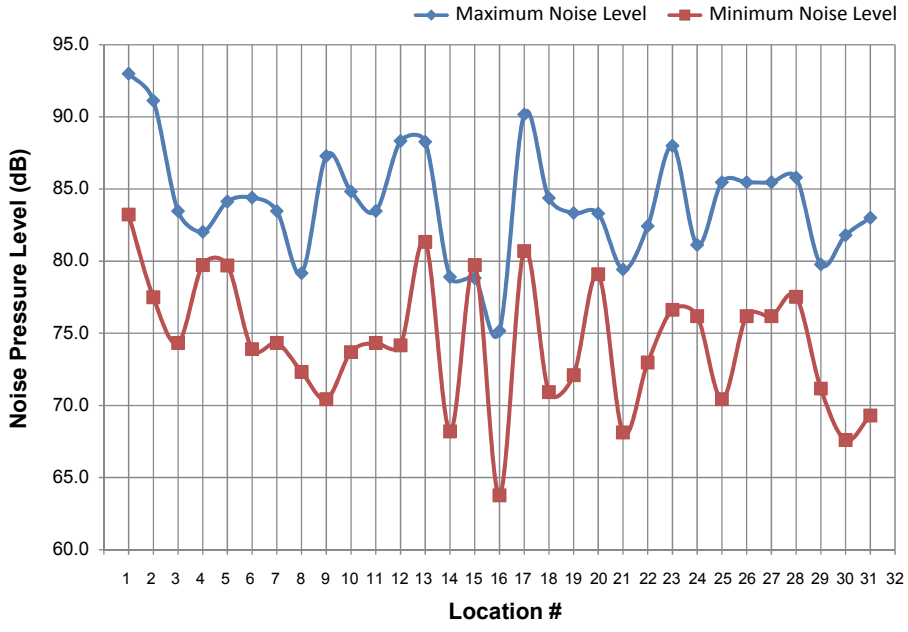


FIGURE 2

Maximum and Minimum Noise Level Distributions in the Afternoon Period



was 55.3 ± 4.6 dB at Computer Village in the evening session. Average sound pressure values for morning, afternoon, and evening were 79.3 ± 3.8, 78.1 ± 5.6, and 78.6 ± 8.3 vdB, respectively. There was no statistically significant difference in the sound level distribution values in the morning, afternoon, and evening sessions (p = .74).

The greatest maximum noise pressure level recorded in the 8–10 a.m. period was 91.1 ± 4.3 dB at Alaba International Market. The greatest minimum noise pressure level of 80.70 ± 5.75 dB was recorded at Mile 2 motor parks.

In the afternoon period of 2–4 p.m., Obalande Bus Terminal had the greatest maximum noise level of 92.63 ± 5.17 dB, with a minimum value recorded as 78.47 ± 3.72 dB. These levels are due to high commercial and vehicular activities in the area. The lowest maximum value was recorded at Unilag gate as 65.30 ± 4.85 dB, with a minimum value of 63.50 ± 5.14 dB. The commercial activity in this area is low because it is an academic environment compared with the other locations. The average maximum and minimum values for the afternoon session were 83.1 ± 6.5 dB and 73.1 ± 5.4 dB, respectively.

In the evening period of 6–8 p.m., the greatest maximum value was recorded at Sabo-Ikorodu area as 101.2 ± 5.6 dB, with a minimum value of 79.5 ± 2.2 dB. The traffic—both human and vehicular—was high in this area. The lowest maximum value of 58.8 ± 7.6 dB with a minimum value of 52.3 ± 3.1 dB was recorded at Computer Village (Ikeja). The average maximum and minimum values for the evening session were 84.9 ± 9.5 dB and 72.3 ± 7.9 dB, respectively.

Discussion

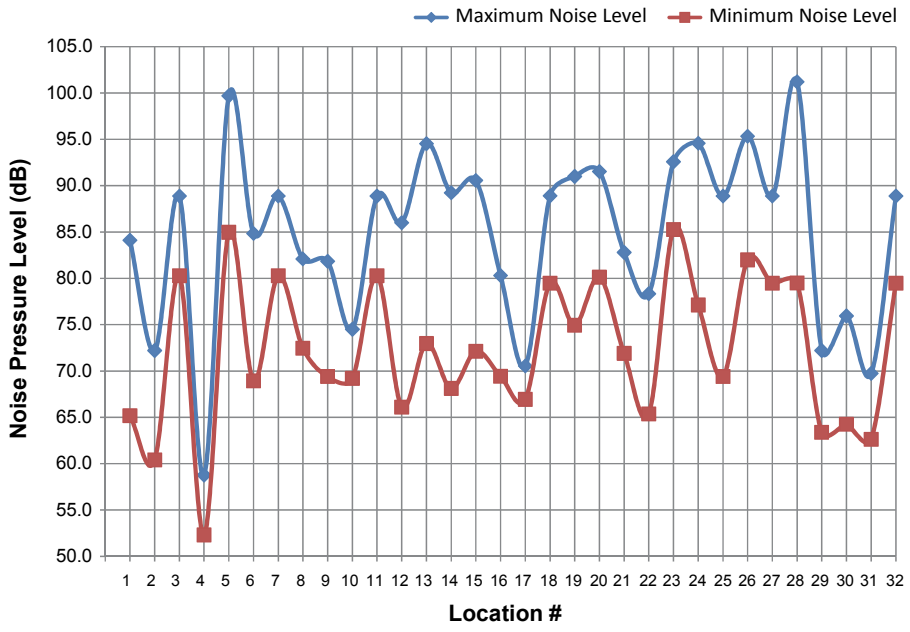
Lagos is a cosmopolitan city with a population of approximately 17.5 million inhabitants and with an annual growth rate of 3.2%. The Lagos metropolis covers 37% of the land area of Lagos State and is home to more than 85% of the state population. It also is the economic hub of Nigeria, with many private and public establishments.

The results obtained showed that the average sound pressure level in the Lagos metropolis was greater than WHO standard guidelines by 43.6%, 42.0%, and 42.7% in the morning, afternoon, and evening sessions, respectively. In comparison with other countries, noise levels measured in various locations in the city were greater than the standard limits. For example, the average noise levels measured in this study were greater than the stipulated limit in commercial areas in Australia (43.1%), India (21.0%), Japan (31.1%), and U.S. (31.1%) (Chauhan et al., 2010).

Human responses to noise exposures differs from person to person and can vary between

FIGURE **2**

Maximum and Minimum Noise Level Distributions in the Evening Period



an adaptation response for low noise levels, to repairable damage that disappears when the noise stops, or irreparable damage after severe exposure. Uninterrupted sleep is known to be a prerequisite for good physiological and mental functioning of healthy persons. Sleep disturbance, on the other hand, is considered to be an environmental noise effect. Environmental noise is not believed to be a direct cause of mental illness, but it is assumed that it accelerates and intensifies the development of latent mental disorders (WHO, 2009). Symptoms such as anxiety, emotional stress, nervous complaints, nausea, headaches, instability, argumentativeness, sexual impotency, changes in mood, increase in social conflicts, as well as general psychiatric disorders have been linked to incessant exposure to noise (Berglund et al., 1999; Chauhan et al., 2010; Pathak et al., 2008; Rao & Rao, 1991; Singh & Davar, 2004). According to Pathak and coauthors (2008), noise is one of the main reasons for headache, high blood pressure, and other stresses among exposed individuals. A study conducted by Finegold and coauthors (1994) indicated a high percentage of respondents displayed an annoyance reaction for the range of noise levels greater than 65 dB.

In this study, a sizable part of the community got annoyed when the noise was greater than a certain level; as the noise level increased, the level of annoyance increased. Road traffic noise studies suggest that cardiovascular risk increases when the outdoor noise levels during the day exceed 60–65 dB and 50–55 dB during the night (Babisch, 2011; Babisch et al., 1988).

The health implication of our monitoring these results indicated that the inhabitants of the Lagos metropolis were exposed to noise levels greater than 55 dB. Therefore, aural and nonaural health effects associated with noise pollution are possibly prevalent. According to previous reports, sleep disturbance, cardiovascular disease, elevated blood pressure level, prevalence of hypertension, myocardial infarction, and increased consumption of cardiovascular medications have been found to be common in areas where residents are continuously exposed to sound levels greater than 60 dB (Babisch, 2002, 2011; Babisch, Beule, Schust, Kersten, & Ising, 2005; Barregard, Bonde, & Ohrström, 2009; Clark & Stansfeld, 2007; Franssen, van Wiechen, Nagelkerke, & Lebret, 2004; Jarup et al., 2008).

Hearing impairment has been associated with excessive and continuous exposure to noise pollution. From the previous studies, men and women are equally at risk of noise-induced hearing impairment, with children and older people being more vulnerable (Berglund et al., 1999; Paunovic, 2013; Sliwinska-Kowalska & Davis, 2012; van Kempen et al., 2012; WHO, 2011). Health-based guidelines on community noise can serve as the basis for deriving noise standards within a framework of noise management.

Key issues of noise management include reduction options, models for forecasting and assessing source control action, setting noise emission standards for existing and planned sources, noise exposure assessment, and testing noise emission standards compliance (Berglund et al., 1999). When there is a possibility that public health will be endangered, even though scientific proof may be lacking, action should be taken to protect public health without awaiting the full scientific proof (Seidman & Standring, 2010). Concerted efforts should be made by the authorities to respond to legitimate complaints and expectations of the citizens to offer a quality sound environment to all metropolitan area inhabitants.

Noise management should have a foundation of constant monitoring of the environment for human exposures to elevated noise pressure levels. Special consideration to the consequences of noise when planning transport systems and land use will help to reduce noise pressure levels. Surveillance of noise-related health effects will help to inform policy to control noise pollution in fast-growing cities such as the Lagos metropolis (European Network on Noise and Health, 2013).

Conclusion

Noise pressure levels measured in the Lagos metropolis exceed the acceptable limits set by WHO. This high noise level can have serious implications for the general health and well-being of the inhabitants of the city. Measures should be taken to reduce the levels of noise pollution in the city. Such measures may include proper maintenance of vehicles and roadways, plantation of trees, and construction of noise barriers.

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