

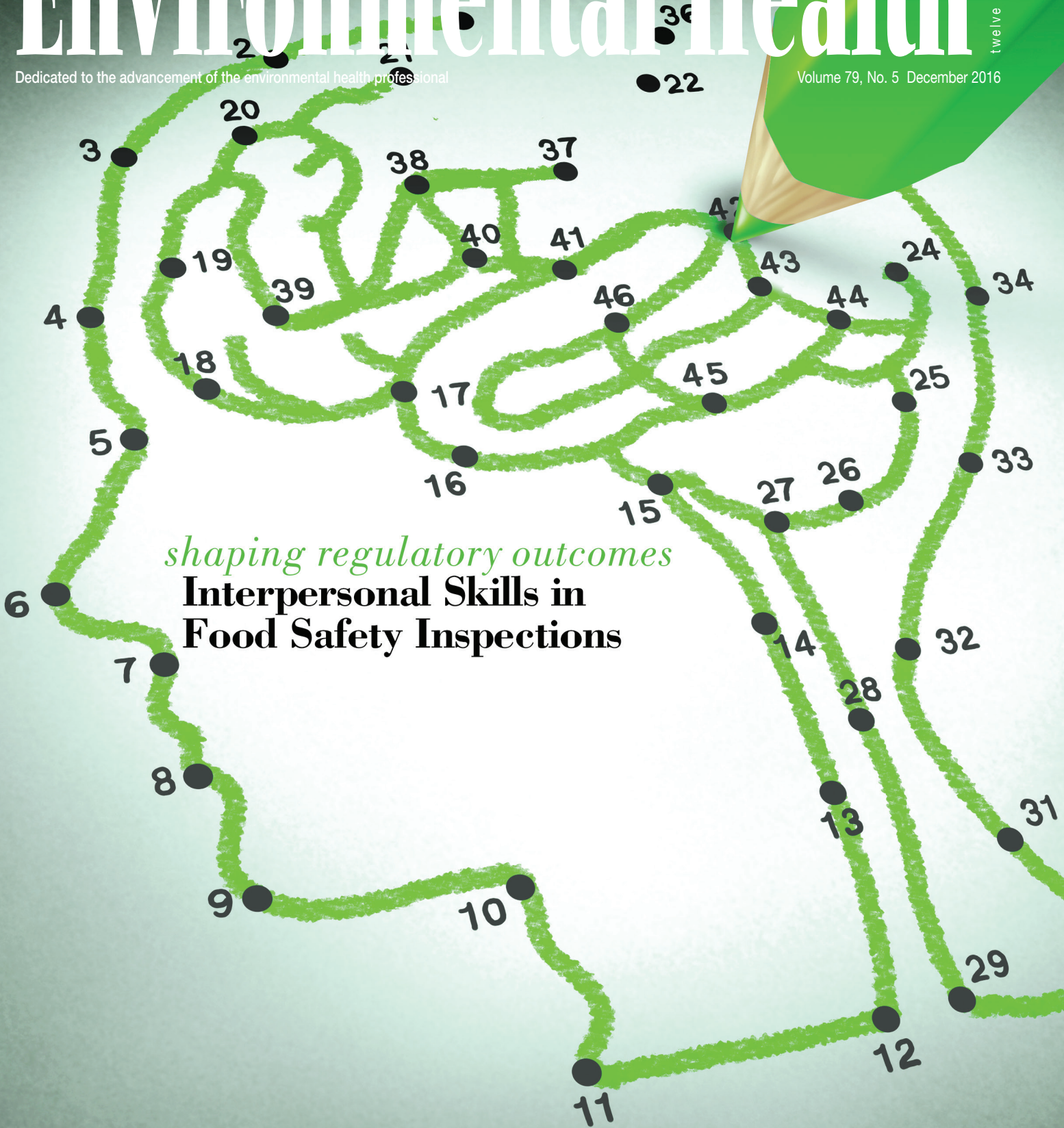
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Volume 79, No. 5 December 2016



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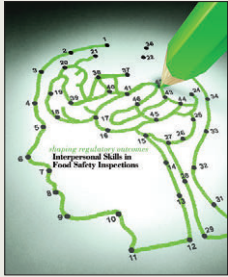
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# Environmental Health

Dedicated to the advancement of the environmental health professional

Volume 79, No. 5 December 2016

## ABOUT THE COVER



Growing evidence shows that interpersonal skills—such as communication, patience, empathy, respect, and consideration—are essential for conducting

regulatory inspections. Previous studies have shown that the effective use of interpersonal skills can increase compliance. This month's cover article, "Interpersonal Skills in the Practice of Food Safety Inspections: A Study of Compliance Assistance," conducted field observations of inspections, as well as interviews, to explore the relationship between inspectors and clients of inspected facilities. The study results support that interpersonal interactions shape regulatory outcomes.

See page 8.

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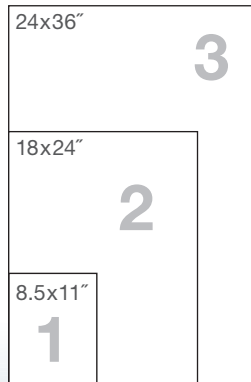


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- E-Journal Bonus Article: From Perchloroethylene Dry Cleaning to Professional Wet Cleaning: Making the Health and Business Case for Reducing Toxics

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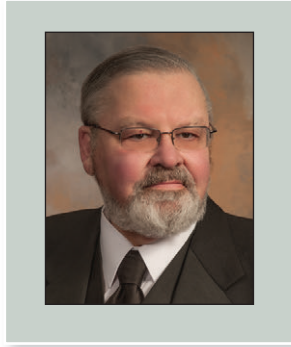
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## ► PRESIDENT'S MESSAGE



David E. Riggs,  
MS, REHS/RS

As I sit here at my computer, I think about the year that has just passed and the new year that we are about to begin. Over the last year I was invited to many state affiliate meetings to represent NEHA. At each of these affiliate meetings I gave a NEHA “state of the association” presentation, as well as presentations on various environmental health subjects, and many times, an interactive discussion about our profession and the practice of environmental health.

As we go into this new year, all of us should renew our journey to become more effective environmental health professionals. As we seek to continually elevate our profession, it is a good time to define the elements that an environmental health professional must possess.

Of course, the highest priority for the environmental health professional is technical competency. Knowledge of the science behind all our environmental decisions and actions is the keystone of our profession. Competency in our technical knowledge is certainly a basic building block for our profession. Technical knowledge, however, is just the beginning of building our professional capacity.

Every environmental health professional should also attempt to master the human sciences and liberal arts, including risk identification and communications, public speaking, technical writing, and interpersonal relations. The environmental health professional must not only know the science behind our actions, but must be able to communicate the reasons for our decisions to individuals, groups, stakeholders, and public officials.

## The Environmental Health Professional

*Being an environmental health professional is a difficult and complicated career that has its rewards and satisfactions.*

Credentials, certifications, technical competency, and scientific-based methods are the foundation we all need. The ability to identify and communicate effectively, however, is equally important to being a successful environmental health professional.

After practicing in our profession for four decades, I would like to share my thoughts on the elements that seem to be common denominators for most, if not all, of the successful environmental health professionals I have known.

Ethics is a set of values that guide our decisions, influence our actions, and give purpose to our lives. Professional and personal ethics in the environmental health practice are the cornerstones that help us make good decisions daily, which protect public health and promote the public's trust in our profession. Many of the decisions we are faced with are

prescribed by the laws and regulations that guide our programs. We face decisions daily, however, that are either too complicated or lie outside our legal guidelines. It is at these moments that we are guided by our ethics. Usually, it is these decisions that will have the greatest effect on our community.

Ethics not only guide our decisions, but they also help us navigate complex situations that have no easy or clear answers. The ethical professional knows that every decision or action might have significant consequences downstream from the present. In an ever-changing profession, along with technical expertise, ethical behavior is arguably the foundation of success personally and professionally.

Coalition building is another skill that the successful environmental health professional must develop and use. In a time where we all must deal with reduced budgets, limited time, and legal and fiscal restraints, the environmental health professional must develop and implement coalitions and partnerships to expand good environmental health practices to diverse communities. We must collaborate with stakeholders, allied professionals, governmental agencies, and nongovernmental organizations to leverage our influence locally and nationally. It is through this cooperative coalition building that the environmental health professional can introduce new stakeholders to environmental health principles and actions. Coalition building also allows us to educate more of the general public about our profession and environmental health as a basic component of good public health.

Flexibility as a professional is a skill that all successful environmental health professionals possess. Our rapidly changing field of practice, new technologies, changing laws, emerging environmental health threats, and fiscal limitations are just a few of the conditions that the environmental health professional must deal with continually.

Objectivity and compassion, although sounding completely opposite, are “two sides of the same coin.” Developing an objective view of environmental health problems, solutions, and outcomes must be balanced by the environmental health professional with compassion for stakeholders. We must consider what our decisions or actions might mean to individuals, families, and communities. Even though we must develop objectivity in the identification of problems and solutions,

we must have compassion for the people our decisions and actions can affect.

We have recently seen on the television news how the disconnect between objectivity and compassion can have serious and far-reaching effects on stakeholders and communities. As successful environmental health professionals, it is incumbent upon us, no matter what level we work at, to keep the strict balance between objectivity and compassion.

Dedication to our profession is an important component that we must inculcate in order to be successful in our profession. Dedication is a quality that develops as we practice our skills daily in local, state, and federal agencies; industry; and private practice. Dedication is the characteristic that builds the foundation for what it means to be an environmental health professional. With-

out dedication, the successful professional would not take on the difficult problems or implement, at times, the unpopular solution. Without dedication we would not work the long hours, attend public meetings, facilitate discussions, or find solutions.

Being an environmental health professional is a difficult and complicated career that has its rewards and satisfactions.

What does it mean to me to be an environmental health professional? To me it means that I can be proud of being a part of the environmental health profession because I know we all labor to make the world more healthy and safe. 🐼

*David E. Riggs*

[daviderriggs@comcast.com](mailto:daviderriggs@comcast.com)

## Did You Know?

Hotel reservations for NEHA's 2017 Annual Educational Conference (AEC) & Exhibition will open in late December! Make your plans to join NEHA in Grand Rapids, Michigan, July 10–13 for our 81st AEC. Visit [www.neha.org/aec](http://www.neha.org/aec) for more information.

# 2017

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## Walter S. Mangold Award

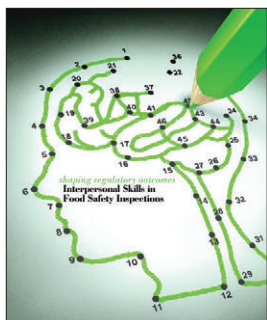
The Walter S. Mangold Award recognizes an individual for extraordinary achievement in environmental health. Since 1956, this award acknowledges the brightest and best in the profession. NEHA is currently accepting nominations for this award by an affiliate in good standing or by any five NEHA members, regardless of their affiliation.

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## Interpersonal Skills in the Practice of Food Safety Inspections: A Study of Compliance Assistance

Jenifer Buckley, PhD

**Abstract** Conducting food safety inspections requires interpersonal skills and technical expertise. This requirement is particularly important for agencies that adopt a compliance assistance approach by encouraging inspectors to assist industry in finding solutions to violations. This study describes a study of inspections that were conducted by inspectors from the Michigan Department of Agriculture and Rural Development Food and Dairy Division at small-scale processing facilities. Interactions between inspectors and small processors were explored through a qualitative, ethnographic approach using interviews and field observations. Inspectors emphasized the importance of interpersonal skills such as communication, patience, empathy, respect, and consideration in conducting inspections. This study examines how these skills were applied, how inspectors felt they improved compliance, the experiences through which inspectors attained these skills, and the training for which they expressed a need. These results provide new insights into the core competencies required in conducting inspections, and they provide the groundwork for further research.

### Introduction

There is growing evidence that interpersonal skills—such as communication, patience, empathy, respect, and consideration—are integral to conducting regulatory inspections. Studies indicate that inspectors exercise interpersonal skills while applying technical expertise in a range of public services (Lipsky, 2010), including enforcement of occupational safety laws (Scholz & Gray, 1997) and building codes (May & Wood, 2003). Enforcement is shaped by interpersonal interactions: inspectors take into account their prior experience of a facility and the intentions that they perceive in clients as they interpret and implement regulatory requirements.

The effective use of interpersonal skills increases compliance. Pautz (2009, 2010) found that environmental inspectors in Ohio and Virginia improved compliance by adopting a collaborative, interactive approach with personnel at landfills, dry cleaners, and other facilities. Other research on the dry cleaning industry also has pointed toward the importance of communication and assistance in regulatory interventions (Whittaker & Johanson, 2013).

Similarly, wholesale food manufacturers in Colorado voiced “a desire for a supportive approach” from regulators (Berzins, 2015; Buckley, 2015). Interpersonal skills may be particularly important in specific cultural

contexts. The guidance and education that inspectors provide reinforce what food service workers learn in native-language-based food safety training, increasing compliance (Potopsingh, 2015). Research on women-operated ethnic food establishments in Iowa finds that operators value the time that inspectors take to explain violations, instill knowledge, and build relationships (Nguyen, 2015). In a study of food safety training of Chinese restaurateurs, Liu and Kwon (2013) indicate that development of relationships of respect and trust is critical in restaurateurs’ receptivity to health inspectors.

Food safety regulatory agencies are increasingly recognizing the value of interpersonal skills in enforcement. Some state-level food safety agencies expressly encourage a compliance assistance approach, encouraging inspectors to assist industry in finding solutions to violations. At the federal level, skills such as communication and relationship building appear likely to become core competencies for food safety investigators. In implementing the Food Safety Modernization Act (FSMA), the Food and Drug Administration (FDA) has signalled a cultural shift, articulating an enforcement strategy of “educate before we regulate” and highlighting regulator training priorities that focus on behavior and technical knowledge (FDA, 2014; Taylor, 2015; Wagner, 2015).

This study describes a field investigation of food safety inspection practice aligned with the aforementioned transformation in FDA strategy and corresponding revisions to state- and local-level approaches. It presents a qualitative, ethnographic study of food safety inspections in Michigan that aimed to characterize interactions between inspec-



TABLE 1

**Inspectors' Participation and Demographic Information (N = 19)**

	#	%
<b>Section</b>		
Food	13	68
Dairy	6	32
<b>Participation</b>		
Field observations with interviews*	10	53
Interviews only	9	47
<b>Gender</b>		
Female	9	47
Male	10	53
<b>Years of experience**</b>		
Minimum	3	
Maximum	26	
Average	15	
Median	18	
*Twelve field observations involved 10 inspectors; one inspector was accompanied to the inspection of three facilities.		
**Values missing for three inspectors.		

tors and small food processors, focusing on their experiences dealing with each other, beneficial outcomes, challenges, and training desired. During interviews and field observations, inspectors emphasized interpersonal skills—such as communication, patience, empathy, respect, and consideration—as critical to improving compliance. The sections that follow describe the study's research method, present and discuss results, and consider implications for regulatory agencies and for further research.

## Method

This study examined Michigan Department of Agriculture and Rural Development (MDARD) Food and Dairy Division inspection of small food processing facilities that make cheese, bread, and jam. MDARD Food and Dairy Division inspectors evaluate compliance at food manufacturing plants, retail facilities, warehouses, dairy farms, dairy manufacturing plants, and transport vehicles. In 2012, 47 food inspectors were responsible for approximately 2,000 food manufacturers and 16,000 retail facilities, and 18 dairy inspectors were responsible for approximately 2,000 dairy farms and manufacturers.

Senior staff indicated that all inspectors were compliant with applicable retail and manufacturing program training standards and had received ongoing quality assurance checks to assure their consistency. Michigan uses the 2009 FDA *Food Code* for retail and adopts 21 C.F.R. § 100–199 for food manufacturing. Dairy facilities are regulated according to the 2007 Pasteurized Milk Ordinance and the Michigan Manufactured Milk Law.

## Participant Selection

Supervisors from MDARD Food and Dairy Division identified inspectors whose areas included small processing facilities. They provided inspectors' contact information, lists of facilities with facility contact information, and inspection due dates. Selection of processors and inspectors was determined in part by their availability during fieldwork. Processors and inspectors participated voluntarily.

This study was exploratory. In the absence of other research on food safety inspection practice, the study aimed to identify issues and develop hypotheses for further research, laying the groundwork for broader, more quantitative work such as surveys (Yin, 2014). The qualitative, ethnographic method—one-

on-one interviews with inspectors and direct observation of inspections—created an open-ended approach that allowed inspectors to depict their practices in their own terms.

Participants did not necessarily represent broader populations of inspectors or small processors; the study selected for inspectors who agreed to participate in order to maximize access to field situations that would improve understanding of inspection practice. This selection method likely biased the research toward inspectors who were more comfortable in their relationships with clients than were other inspectors, and who had fewer reservations about being under the scrutiny of a researcher. The implications and utility of this approach in developing further research are discussed in the conclusion section. Inspector participation is summarized in Table 1.

## Data Collection and Analysis

Data were collected in field observations of inspections and in semistructured interviews. Field observations were conducted at facilities for which an inspection was scheduled within the period of the study and both the processor and the assigned inspector were willing to participate in the study.

Two sets of observations were conducted. First, processing was observed for between 2–4 hours in order to improve understanding of the specifics of the operations. Second, food safety inspectors were accompanied to these facilities for the facilities' inspections. Inspections lasted between 1–3 hours. Informal one-on-one interviews with processors and inspectors were conducted before, during, and/or after observations. Observations focused on the approaches that inspectors took in working with small processors, discussion of violations, and the ways in which small processors felt that these inspections benefitted or constrained them.

Nine inspectors also participated in separate semistructured, one-on-one interviews between 30–90 minutes long. Discussion focused on the experiences of inspectors in dealing with small processors, what constituted a “good” inspection and a “good” inspector, and training that the participants desired either for themselves or for processors. Most interviews were audio recorded and transcribed. When interviews were not recorded, notes were taken manually. Interview transcripts and notes were coded

for emerging concepts (Corbin & Strauss, 2008) using NVivo, a qualitative data analysis program.

Inspectors' exercise of interpersonal skills was not an initial focus of the study. Evidence of an assistive inspection approach involving relationship building emerged soon after the research began. In early interviews, both processors and inspectors described the benefits of positive interpersonal interaction. Processors described ways in which inspectors had helped them, and inspectors described making efforts to learn about client businesses and taking an interest in the individuals with whom they interacted. These issues were explored in greater depth in subsequent interviews and they were a particular focus of field observations.

**Human Subjects Approval**

Required approvals for the study were obtained from Michigan State University's Human Research Protection Program. Field observations were approved by the institutional review board (IRB) under an expedited review procedure, and IRB staff determined data collection involving only interviews to be exempt from review.

**Results and Discussion**

Interpersonal skills emerged as critical in an assistive approach that improved compliance. The majority of inspectors described and demonstrated skills such as communication, patience, empathy, respect, and consideration. These skills are intertwined, and they overlap in the discussion here. This section examines how these skills were exercised and how inspectors felt the skills improved compliance. This section concludes by discussing the experiences through which inspectors developed these skills and describing training for which inspectors expressed a need.

**Communication**

All inspectors emphasized the communication skills that their roles required and the importance of information sharing to achieve compliance:

You always have the enforcement stick...Typically you can avoid that with good communication skills and teaching skills and getting them to willingly and voluntarily comply. And appealing to their sense of pride in ownership, their sense of pride in production and quality.

Inspectors explained to clients the rationale behind regulations and provided guidance on how to meet them. For example, they discussed studies supporting pasteurization, and the importance of pH testing in preventing botulism. One stated that he referred to his own training in order to reinforce the importance of hand sanitation, recounting to his clients how he and classmates had inoculated blood agar with washed hands and witnessed the growth of coliform bacteria. Inspectors indicated that they suggested cleaning compounds, guided clients through steps in labeling multi-ingredient products, described less expensive ways of meeting requirements, and provided guidance on reformulating recipes to retain desired product characteristics while meeting regulations.

At some facilities, inspectors became "the unpaid consultant," "their QA department, almost," as two inspectors put it. "We do everything from the shoulder to cry on, to marketing advice," a third stated. Assistance beyond strict matters of compliance included suggestions on business planning resources, facility layout and management, and possible sources of equipment and ingredients. One inspector brought a spare laboratory notebook to an inspection to give to a processor. The processor was developing a traceability system, and the inspector assisted by suggesting a layout for notebook entries.

**Patience and Empathy**

Patience was required to address such a range of issues. "If you work with me, I will bend over backwards," said one, "I will work with you until I'm blue in the face." Inspectors appreciated clients' consequent willingness to cooperate:

I think for the most part, I have really good cooperation. I try to explain why we mark it: "Here's your list." And I usually go through item by item, saying, you're using plastic containers, and they're all breaking up...I probably won't mark it if I don't have a good reason or didn't think it was an issue.

Inspectors described establishing a supportive, empathetic dynamic, "letting [clients] know that you're willing to walk through this process with them, shoulder to shoulder. I tell them there's no mountain we can't climb. Let's do it together." Inspectors balanced their position of authority by striking a more person-

to-person dynamic with clients. During field observations, nearly all inspectors complimented clients on improvements made since earlier inspections with respect to compliance, as well as business growth. Typical remarks included "Great article about you in the newspaper!" and "I was surprised and glad when I saw the [new] dining area!"

Inspectors also showed consideration for clients' production activities during inspections. A processor was making cheese during one observation, and the inspector checked with her before turning on the hot water to check the temperature, mindful that this might adversely affect the cheesemaking process. Another inspector had taken a cheesemaking short course in order to learn about the practices of new farmstead cheesemakers in his area, and the course gave him an appreciation for the careful attention required during this process:

When I go to cheese plants, I don't try to talk to the people actually doing the cheese too much, because I don't want them to lose track of where they're at—"I forgot to add this" or "I left it at that temperature too long, now the temperature's too low." I try not to do that.

Taking an empathetic approach helped inspectors "get things done." Although many of the inspectors appeared to genuinely care about client businesses, they also emphasized the strategic benefits of these relationships. They asked about family members or pets by name and, in one case, brought dog treats to an inspection. Showing an interest in clients' lives and families, getting to understand their businesses, and being "human" helped to lower clients' resistance to inspectors' presence, increased inspector credibility, and smoothed potential disagreements. As one described:

I've known some [inspectors] that really know the laws. If you go in and you offend the people, you're not going to get cooperation....You ask them a little bit about their family and how things are. You get that going, and it kind of lowers their defenses. And I'm amazed at some of the things that people tell you... [I say] "You can't do that!" And sometimes they just don't know.

**Respect and Consideration**

Exercise of these interpersonal skills established a give-and-take dynamic in which clients felt that they were treated fairly.

Inspectors emphasized the importance of not “nitpicking.” They wanted to avoid “overloading” clients. Instead, they gave clients the opportunity to correct minor violations during the inspection or stated violations verbally without recording them. In addition to encouraging compliance, inspectors stated that this approach increased motivation to comply, even at facilities with poor records:

They're willing to work even extra hard because they've got some recognition.... I get a lot of compliance by, “Hey, I don't have to write it down if you correct it right now. So let's fix it right now.” If you've got a light bulb out—hey, do you have a light bulb? “Yes.” Well, let's find one.

When determining whether to cite non-critical violations, inspectors took several factors into account, including their prior experience with clients, their trust in key personnel, and the costs that clients would incur in making corrections. “There are times when you have to cut them some slack,” one observed when explaining that he focused on incremental improvements. “If you didn't, I go into stores where they're barely hanging on.” During an observation, another inspector explained that her experience with the client affected which noncritical violations she recorded; she did not record violations that she was confident the client would address. During a visit to a facility whose physical plant was in need of renovation, a third inspector commented on the manager's cooperative attitude and good compliance history with respect to issues of critical risk. The inspector was sensitive to the considerable costs of improving the physical plant, commenting that she was “focusing on low-cost ways of improving quality.”

### **Experience and Training**

Inspectors had developed interpersonal skills over the course of their careers and through other life experience. This development informed their judgment in exercising communication, patience, empathy, respect, and consideration. Older inspectors commented on the importance of “real-world experience before you start going out and talking about how to run their business.” For example, parenting and teaching children gave them skills to diffuse tense situations, not take conflict personally, and balance “firm, but not too firm, consistent

discipline...focusing on the long-term picture instead of the short-term goal.” As one inspector explained:

A new inspector has a lot to develop.... If they're screaming at you, you've got to be able to stand there and let it go. In the beginning, when I was doing restaurants—restaurant people do that—I'd take that home a little bit. And now I don't...[I] say, “I'll be back tomorrow. You'll have a chance to look at the report, and we'll make some decisions then...” Actually, that's worked out a couple times for me. They've had a chance to think about it, kind of cool down.

Several inspectors indicated a desire for training in interpersonal skills, feeling that it would improve compliance rates and reduce client complaints to supervisors. Topics included conflict resolution, de-escalating tense situations, and routine communication skills. During a previous job, one had received Myers-Briggs Type Indicator training on recognizing one's personality type and working with people with different types, and spoke highly of the impact of the training on inspection abilities.

### **Conclusion**

Effective use of interpersonal skills—such as communication, patience, empathy, respect, and consideration—are among core inspector competencies that appear to improve compliance. These study results support findings in other sectors that suggest interpersonal interaction shapes regulatory outcomes. The results also improve our understanding of the practice of compliance assistance in food safety regulatory enforcement. This article concludes with observations on the intrinsically interpersonal nature of facility inspections, implications for inspector hiring and training, and suggestions for further research.

### **Inspections Are Intrinsically Interpersonal**

Facility inspections are intrinsically interpersonal. In the case of compliance assistance, which was the focus of our study, the importance of interpersonal skills is especially evident. Inspectors worked to explain requirements in a way that made sense to clients, in some cases going to great lengths to do so. While maintaining a position of authority, they nevertheless presented themselves

as “human” and achieved a dynamic of fairness and of give-and-take with clients. Yet even in agencies and situations in which inspectors adopt a stricter enforcement role and do not aim to provide assistance, effective use of interpersonal skills may nevertheless impact compliance. As discussed above, specific inspection contexts shaped inspectors' application of technical requirements, and inspectors took subjective factors into account when recording violations. Further investigation should examine the roles that interpersonal skills play in a broader range of inspection approaches, including those involving strict enforcement.

### **Implications for Inspector Hiring and Training**

This study has implications for inspector hiring and training. First, it suggests that investments in interpersonal skills training might ultimately improve inspection efficiencies by mitigating disagreements and reducing client complaints. Second, inspectors emphasized the importance of professional, life, and “real-world” experiences in developing their maturity and discernment. This finding suggests that a broad range of experiences shapes the abilities that are required to conduct inspections. Third, the study illustrates the challenges of separating inspectors' roles as regulatory enforcement officers from broader business development roles. This finding suggests that agencies need to prepare inspectors to be called upon for a wide range of expertise, and that agencies also need to strengthen networks with other resource providers.

### **Suggestions for Further Research**

As an exploratory study of food safety inspection practice, this research aimed to identify concepts and develop hypotheses for further study. While the results should not be generalized to all inspectors or inspection situations, they reveal new insights into inspection practice that warrant further, more systematic investigation.

First, compliance assistance should be better characterized among a broader representation of agencies. Agencies may employ different versions of such an approach, and a better understanding of this variety of approaches would inform federal implementation of FSMA, as well as state- and local-level actions. Second, research should correlate inspection

approaches with firm compliance. Third, conditions at different agency levels likely foster or discourage an assistive approach. These may include agency cultures and budgets, supervisory styles, and inspector personalities and other traits. Research on these matters may inform appropriations requests and training priorities. Fourth, expanding research to capture a broader and less-biased selection of inspectors would undoubtedly reveal new aspects of inspection practice. 🐞

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# A Community-Based Participatory Research Approach to Identifying Environmental Concerns

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**Abstract** A community-based participatory research process was used to develop an environmental initiative in Wichita, Kansas, called the Wichita Initiative to Renew the Environment (WIRE). The two-year project, led by University of Kansas School of Medicine–Wichita faculty and a community-based organization, was funded by the U.S. Environmental Protection Agency. The project aimed to identify, prioritize, and address Wichitans' environmental concerns by engaging the community to assist in developing the project design, establish a community-based environmental leadership council to guide the project, and identify and prioritize the community's environmental concerns based on impact and perceived urgency for action. The collaboration identified community priorities as: trash disposal, pollution in the Arkansas River and groundwater, and mobile source air pollution. Through WIRE, community members actively engaged and participated in identifying and prioritizing 19 environmental concerns most pertinent to the community, establishing an organization of 25 community members, and setting the stage for future projects to address those problems.

## Introduction

Community-based participatory research (CBPR) can serve as a process to identify, prioritize, and address health or environmental concerns (O'Fallon & Dearry, 2002), and bridge gaps between communities and academics (Wallerstein & Duran, 2010). In 2001, the National Institute of Environmental Health Sciences (NIEHS) endorsed six principles of CBPR: 1) defining community as a unit of identity, 2) ensuring projects are community-driven, 3) promoting active collaboration and participation at every stage of research, 4) fostering colearning, 5) disseminating results in useful terms, and 6) ensuring research and intervention strategies are culturally appropriate (O'Fallon & Dearry, 2002).

This article outlines a CBPR process that was conducted with a predominantly disenfranchised population in Wichita, Kansas, to identify and prioritize their environmental concerns. Although local environmental health officials had frequently identified multiple environmental and health issues that could impact the community, no assessment had ever been conducted with the community to identify their environmental concerns. We tried to remedy this knowledge gap with the Wichita Initiative to Renew the Environment (WIRE) project, with funding from a U.S. Environmental Protection Agency (U.S. EPA) cooperative agreement.

The project's objectives were to 1) engage community members to assist in developing the project design, 2) establish a community-

based environmental leadership council (ELC) to guide WIRE, and 3) identify the community's environmental concerns and prioritize them based on their impact on the community and community members' perceived urgency for action.

## Methods

In 2008, researchers in the Department of Preventive Medicine and Public Health at the University of Kansas School of Medicine–Wichita (KUSM–W) were awarded a two-year, Level I Community Action for a Renewed Environment (CARE) cooperative agreement from the U.S. EPA (O'Connor, 2008; Topper, 2007). This cooperative agreement inspired the CBPR initiative, WIRE, with a target audience of persons in inner-city Wichita, the largest city in Kansas.

At the outset of the project, Wichita was a sprawling city of approximately 136 square miles with a population of 356,995 (U.S. Census Bureau, 2006). The racial composition of the city was 76.6% White, 12.6% Black or African American, 1.9% American Indian and Alaskan Native, 4.9% Asian, 0.03% Native Hawaiian and other Pacific Islander, and 6.0% defined themselves as "other." Approximately 12% of the community was Hispanic. Wichita is in the center of Sedgwick County, which has 470,895 inhabitants. The four-county metropolitan statistical area that includes Wichita and Sedgwick County has approximately 592,126 inhabitants. The WIRE project served the inner-city corridor of Wichita, where the population is under 200,000.

The primary goals of CARE, and therefore of WIRE, were to 1) reduce exposures to toxic pollutants through collaborative action at the local level, 2) help communities

understand all potential sources of exposure to toxic pollutants, 3) work with communities to set priorities for risk reduction activities, and 4) create self-sustaining community-based partnerships that will continue to improve the local environment. Each of the six principles endorsed by NIEHS (O'Fallon & Dearry, 2002) will be described through the lens of the WIRE project.

To accomplish its goals, CARE's basic methodology was to form a design team of 10 community leaders representative of non-profit community groups, local government, industry, and academic institutions. The design team established broad, multistakeholder partnerships in a concerted effort to understand all sources of risk from toxic pollutants in inner-city Wichita. WIRE met with 1,500 individuals from the community and conducted 52 discussion groups to learn their environmental concerns.

At these discussion groups, WIRE study members encouraged participation in the ELC through a nomination process. As a result, WIRE included approximately 25 ELC community members from businesses, neighborhood associations, and community groups. The ELC assisted KUSM-W staff in organizing 92 pages of local concerns into 19 categories. Next, the ELC developed educational fact sheets (in English and Spanish) and videos based on the community's top 19 environmental concerns. The ELC presented the educational campaign to 769 community members from 43 community groups (primarily neighborhood associations) in the target area.

After the educational campaign, the ELC asked participants to prioritize the 19 environmental concerns, ranking them from zero (no) to five (greatest), in terms of the risks to the environment, to health, and to the economy; urgency for action; and their perception of community interest in addressing each of the concerns. More detailed information on WIRE and the ELC are presented in the Results section.

## Results and Discussion

### Defining Community as a Unit of Identity

The project area identified as the "community" for this project was chosen for its geographic and social characteristics (Israel,

Schulz, Parker, & Becker, 1998). The geographic community identified was the older, central core of Wichita, Kansas, which stretches along either side of a rail corridor that runs through the center of the city. This area was largely developed prior to 1930 and consists of industrial, commercial, residential, and recreational land uses, and is intersected by a network of freeways.

The central core contains predominately low-to-middle income people and is home to most of the minority population of Wichita. With a smaller voice and a lower socioeconomic standing, those who live in inner-city Wichita often disproportionately experience negative environmental conditions (Evans & Kantrowitz, 2002; Freudenberg, 2000; Sexton, Olden, & Johnson, 1993). They have fewer opportunities to feel their voices are heard (Bolland, Lian, & Formichella, 2005), especially regarding their ability to impact their environment, health, or quality of life (Israel et al., 1998).

Additionally, the project area lies within the Lower Arkansas River Basin, which drains into the Little and Big Arkansas Rivers, as well as the Arkansas River past the point of confluence of the Little and Big Arkansas Rivers in central Wichita. These two major rivers flow directly through the project area. The alluvial geology of the area, with sandy permeable soils and shallow groundwater—coupled with a large industrial and manufacturing base, and the associated materials handling and waste disposal practices—created a legacy of soil and groundwater contamination. Years of industrial activity from multiple source areas (e.g., former oil refineries, dry cleaning operations, manufacturing facilities, and grain elevators) resulted in volatile organic compounds (e.g., tetrachloroethene, trichloroethene, and petroleum-related compounds) contaminating the soil and groundwater.

These conditions resulted in the U.S. EPA and the Kansas Department of Health and Environment designating two major soil and groundwater contamination areas (the Gilbert and Mosley and the North Industrial Corridor). These two sites comprise approximately eight square miles of inner-city Wichita.

Within the central core of Wichita, where the identified contamination sites lie, there is a well-organized network of neighborhood associations, accounting for 63 of the city's 75

neighborhood associations (Figure 1). Developed in 1993 through community partnerships among government, business, schools, and churches, these neighborhood associations often serve as a civic and social center for Wichita communities. The WIRE project sought to build on this asset of networks already developed in the community (Israel et al., 1998; O'Fallon & Dearry, 2002).

### Ensuring Projects Are Community-Driven

In anticipation of project funding, KUSM-W researchers recruited a WIRE design team consisting of nine community leaders, who were selected based on their community involvement and leadership. Design team members represented local government, non-profit organizations, environmental experts, local businesses, state and municipal government officials, and public environmental health practitioners. The intent of the design team was to strategize with researchers at the beginning of the implementation of the cooperative agreement to maximize community engagement efforts and provide direction on project implementation.

In accordance with both the grant proposal and a recommendation from the design team, the next step of community engagement, to ensure the community identified the concerns, was to recruit community members with environmental interests to become members of the ELC. The purpose of the ELC was to assist in categorizing and prioritizing environmental concerns identified by the community and educating the public about these concerns. Once this initial goal was achieved, the ELC's next task was to develop environmental projects for the community to undertake to begin addressing the prioritized environmental concerns.

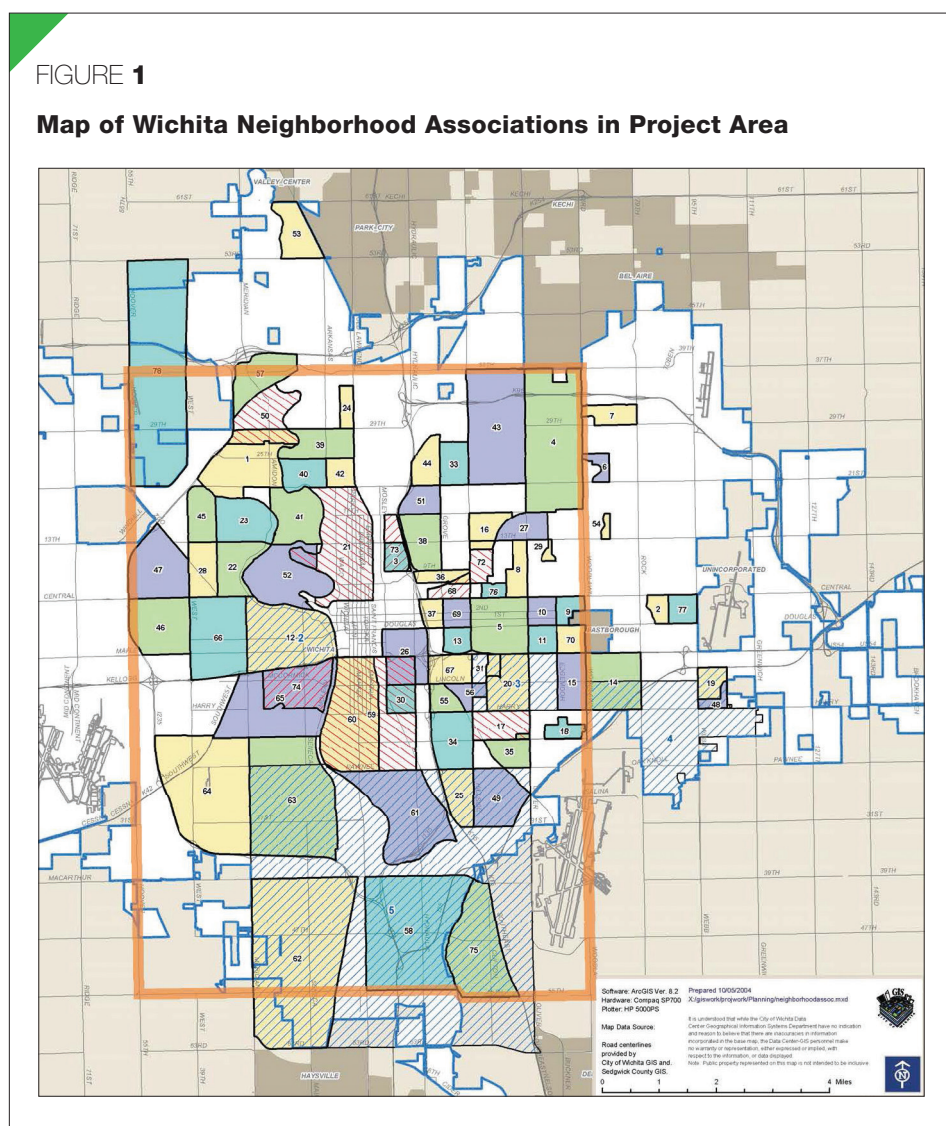
After conducting 52 discussion groups in the community (e.g., at neighborhood association, city council, and public meetings), more than 1,500 Wichitans in the project area had participated in identifying their top environmental concerns. At discussion groups, participants were lead through the "nominal group technique" to assess their top environmental concerns (Delbecq & Van de Ven, 1971). Though the scope of the WIRE study was much broader, this type of town hall approach had been successfully utilized in similar studies (Ponder-Brookins et al., 2014).

At the conclusion of each discussion group and through other efforts (e.g. e-mails, Web sites), participants were encouraged to nominate themselves or others to become a member of the ELC. Upon the conclusion of the discussion group phase of the project, a 25-member ELC was established representing businesses, neighborhood associations, community groups, government officials, and community members. The research team at KUSM-W encouraged ELC membership during presentations to neighborhood association meetings. Once formed, the ELC developed the infrastructure needed to become a functioning entity. The group adopted bylaws, elected officers, and established committees to address air and water quality, waste management, community outreach and education.

After completing the organizational process, the ELC's first task was to begin the process of categorizing and prioritizing the community's 92-page list of environmental concerns. These concerns were then stratified by the ELC into three environmental media: air, water, and solid waste. Within each environmental medium, subcommittees of the ELC consolidated the listed environmental concerns by combining similar responses, resulting in a total of 19 environmental issues (Table 1).

The top 19 issues were then presented to the public through an educational campaign. The ELC developed 19 educational fact sheets (in English and Spanish) and four videos (air, land use, water, and solid waste) based on the community's top environmental concerns. The educational materials also included ELC-produced videos with local statistics and details about risk to the local environment, health, and economy. The educational materials also outlined potential solutions for individuals, communities, and policies to address the environmental concerns. The ELC presented the educational campaign to nearly 800 community members from 45 community groups (primarily neighborhood associations) in the target area, including some groups that had not previously participated in the process.

After participating in the community education campaign, community members were asked to prioritize the 19 environmental concerns by rating each concern on five criteria: risks to the environment, to health, and to the economy; urgency for action; and their



perception of the community's interest in addressing each issue.

After receiving the priorities from the nearly 800 Wichitans from the target area, the ELC met to calculate averages for each issue. Thus, the residents of inner-city Wichita generated a list of environmental concerns that were prioritized in order of greatest importance to them (Israel, Checkoway, Schulz, & Zimmerman, 1994; Israel et al., 1998; O'Fallon & Dearry, 2002). Participatory issue prioritization is a critical component of CBRP, so, using this prioritized list, the ELC identified which environmental concerns would be best suited for a Level II CARE proposal for WIRE, and to engage the community to begin addressing their newly prioritized concerns (Salihu et al., 2015; Yoo

et al., 2004). The ELC identified three top concerns: 1) inefficient community waste management (collection, recycling, and disposal); 2) Arkansas River water quality; and 3) emissions from cars, trucks, and other mobile air pollution sources.

**Promoting Active Collaboration and Participation at Every Stage of Research**

To ensure that community representatives were actively collaborating early in the process (Israel et al., 1998; O'Fallon & Dearry, 2002), the university engaged design team members to guide the grant process. The design team members suggested that the first-year members of the ELC assume the design team's roles and responsibilities. The



TABLE 1

**Prioritized Community Environmental Concerns Consolidated Into 19 Environmental Issues**

Prioritized Issue	Mean
Trash disposal	3.48
Pollution in Arkansas River	3.44
Contamination in groundwater	3.44
Mobile source air pollution	3.42
Blight/sprawl	3.40
Household hazardous waste	3.33
Trash collection	3.30
Water scarcity	3.28
Secondhand smoke	3.27
Area source pollution	3.24
Green space	3.22
Flooding	3.22
Point source pollution	3.17
Electronic waste	3.09
Lead	3.00
Brownfields	3.00
Mold	2.78
Radon	2.73
Vapor intrusion	2.62

U.S. EPA funding was via a cooperative agreement, which established a strong relationship between U.S. EPA and the researchers. This relationship called for frequent interaction and visits between the U.S. EPA project manager and the researchers. There was an equal sense of ownership, however, over the project from the researchers, U.S. EPA, ELC, and to some extent, the community in general. As such, the ELC continued to guide much of the project's process and work product.

When designing this initiative with the design team and U.S. EPA, we wanted to offer community members the opportunity to engage with the process as extensively (e.g., serve on advisory council) or as casually (e.g., provide a list of top environmental concerns) as they wished. There were multiple partners and stakeholders throughout the project, including local schools and businesses, Wichita Chamber of Commerce, government, and community organizations.

Discussion groups were conducted and public presentations were given to elicit Wichitans' environmental concerns and priorities. Most of these presentations were conducted at meetings where community groups already convened (e.g., local events, neighborhood association meetings), enhancing access to community members. Additionally, the researchers and design team provided multiple presentations to inform and receive feedback from the city council to assure that the local government was aware of the group's activities and interaction with the community.

### Fostering Colearning

The WIRE project deliberately fostered a collaborative colearning environment in which peers learn from each other, a core CBPR principle that is designed to empower community members and provide an avenue to collaboratively address inequalities (Israel et al., 1998). This colearning environment was designed to foster sharing information, increasing capacity, and empowering community members. Whereas similar studies using CBPR principles in environmental research have not been able to maximize community colearning due to the nature of the projects (Ponder-Brookins et al., 2014), the WIRE project's broader scope allowed it to maximize colearning opportunities. The university researchers received direction from, and assessed perceptions of, the design team, ELC, and community members. The researchers solicited guidance from the design team and ELC on how to best identify the community's environmental concerns, how to most effectively engage the community in prioritizing those environmental concerns, and how to best approach environmental topics to keep the community engaged.

The ELC provided WIRE researchers with inventive ideas and strategies to identify and address community environmental issues. For instance, one ELC member organized planting events along the river and made agreements (e.g., mowing, planting) with the City of Wichita Parks and Recreation Department that could not be made at an organizational level. This "bottom-up" grassroots approach provided a refreshing perspective that allowed the ELC to successfully address community and neighborhood concerns without the bias or institutional hindrances that often accompany this type of process.

Individuals from the community shared their environmental concerns with university partners via discussion groups and at local and state environmental conferences, local district advisory boards, neighborhood associations, and community meetings. Next, the university researchers and ELC consolidated the 92-page list of environmental concerns into categories, and then gathered data and statistics to develop issue papers and educational videos for the top 19 environmental risks.

The university partner and ELC used the next phase of the initiative to conduct an educational campaign using objective environmental data for each of the 19 environmental risks. For example, one of the most frequent environmental concerns identified by the community was the muddy color and general appearance of the Arkansas River. Many residents thought the river was polluted from industrial and sewage treatment plant discharges. Although not aesthetically pleasing, the muddy color is common for a braided prairie stream with sandbars and a winding configuration. Accordingly, the Arkansas River educational campaign included environmental, health, and economic risk data in addition to nonrisks, such as the appearance of the Arkansas River.

After community members viewed the educational videos and/or read the 19 issue papers, they were asked to prioritize the 19 environmental concerns. This resulted in a prioritized list of environmental concerns raised by Wichitans that any individual or community group could use to begin addressing these concerns (Israel et al., 1994; Israel et al., 1998; O'Fallon & Deary, 2002).

Several ELC members who were professional engineers and architects made presentations to the ELC. The university and U.S. EPA hosted workshops for ELC members and others interested in brownfields, grant writing, and content-specific training and technical support. Moreover, the ELC learned from university faculty more about the scientific research process, especially how to engage the community to identify concerns.

The ELC was eager to move to action, and some ELC members struggled with somewhat academic conversations to define the 19 issues. For instance, many on the ELC had previously believed that Wichita's poorer air quality was due to industry pollution, but this conclusion is not what local data suggest.

Air quality in Wichita is impacted more from vehicular mobile source emissions. Additionally, the ELC was exposed to administrative realities such as quality assurance project plans, brownfields assessment programs, and administrative processes at a university (e.g., purchasing and budgeting requirements).

**Ensuring Research and Intervention Strategies Are Culturally Appropriate**

The strategies developed for WIRE were designed to be culturally appropriate (Israel et al., 1998; O’Fallon & Dearry, 2002). We intentionally engaged “unusual suspects” in identifying environmental concerns. Instead of asking community groups that are organized around environmental topics (e.g., the Sierra Club), we approached the inner-city core, neighborhood associations, worksites, government, nonprofits, and other community-based groups, offering to go to their meetings and provide dinner in exchange for an opportunity to speak with their members. For each of the 19 risks, community members were asked to prioritize the item’s impact on the economy (in addition to the impact on the environment and health). Viewing environmental issues from an economic perspective allowed many to be engaged in a process of which they would have otherwise opted out.

Additionally, there was a lot of information and data included in the 19 issue papers, and the ELC determined the average citizen would not read them all. As such, the ELC wrote and produced educational videos (written at a lower reading level than the issue papers) that could be used instead of, or in addition to, the issue papers. The ELC also offered an online assessment in addition to face-to-face meetings as opportunities to

participate. Finally, this entire endeavor was designed for the community to be engaged in identifying problems that were of interest and relevant to the community at all socioeconomic levels, enabling the project to reach across cultural boundaries in the community.

**Disseminating Results in Useful Terms**

In CBPR, results must be widely disseminated, using several mechanisms to communicate findings to varied audiences and interested stakeholders (Israel et al., 1998; O’Fallon & Dearry, 2002). In this project, the 19 issue papers (one set of deliverables of the project) were available online and at meetings in English and Spanish. The videos in particular, written with easily understandable terms, were widely disseminated through many of the same strategies used previously (e.g., neighborhood associations, district advisory boards, community groups, WIRE Web site).

We continued to remain in regular communication with the Wichita City Council, keeping them abreast of WIRE’s progress. Additionally, we utilized media, in the form of purchased media coverage (e.g., an air quality insert in *The Wichita Eagle*), as well as organic media coverage of our work to communicate our findings to the larger community. After issuing a press release of Wichita’s prioritized environmental concerns, local TV news stations KAKE and KWCH Eyewitness News published online stories detailing the work of WIRE. The local newspaper, *The Wichita Eagle*, published a front-page story highlighting the top 19 environmental concerns identified by the community (KAKE, 2010; KWCH 2010; *The Wichita Eagle*, 2010).

The chair of the ELC and university faculty members had several opportunities to

share lessons learned at national CARE and other U.S. EPA meetings. This article was written as a team effort by community and academic partners; we hope it serves as a model for other community-based teams to consider the process and benefits of utilizing a CBPR approach to identify—and eventually address—environmental concerns.

**Conclusions and Recommendations**

While principles of CBPR are well established in general, the specific use of CBPR principles in environmentally focused research projects is far from universal, but usage of true CBPR methods in environmental research has previously been successful. We applied CBPR principles to guide the WIRE project to the largest extent possible, though some grant requirements limited community involvement in the initial development of research questions. Through WIRE, community members actively engaged and participated in identifying environmental concerns most pertinent to their community, setting the stage for future projects to address those problems. This project demonstrated that community-based research projects on environmental issues guided by CBPR principles largely can be successful. 🐾

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# Use of the VectorTest for Advanced Warning of Human West Nile Virus Cases in Mississippi

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**Abstract** West Nile virus (WNV) continues to persist in Mississippi; 2012 was the worse year for human infections, with a total of 247 reported human cases and five deaths. Public health officials are keenly interested in ways to detect WNV in advance in their jurisdictions, so they can implement appropriate and timely mosquito control in affected areas. A total of 40,312 female *Culex quinquefasciatus* mosquitoes were collected by gravid traps in Mississippi in 2013 and 2014 and tested by VectorTest, a rapid immunochromatographic assay (“dip-stick” test) that is a highly specific and effective rapid threat assessment tool. This study evaluated if and to what extent VectorTest could provide advanced warning of impending human WNV cases in a specific area. These data were examined with regard to date of onset of human WNV cases to determine the predictive value of VectorTest for WNV activity. Both years, positive mosquito pools appeared before the vast majority (87.2%) of reported human cases. Overall, in 27 out of 37 human WNV cases (73.0%) occurring in our study sites, there was an average advanced warning of 26 days (range 11–53 days) as indicated by positive mosquito collections near the patient’s home. This operational health department study, although somewhat limited, reveals that mosquito sampling and testing can inform public health and mosquito control personnel of WNV activity in an area and of impending human cases.

## Introduction

West Nile virus (WNV) is a mosquito-borne, enveloped single-stranded, positive-sense RNA virus belonging to the *Flaviviridae* family of viruses (Tesh & Solomon, 2011). WNV was first discovered in the Western Hemisphere in 1999 in New York City, New York, where there were a total of 59 cases and seven deaths (Asnis, Conetta, Teixeira, Waldman, & Sampson, 2000; Mostashari et al., 2001). In

the U.S., WNV has become the leading cause of epidemic meningoencephalitis in humans; however, it is estimated that less than 1% of all WNV-infected patients develop the more serious neuroinvasive form of the disease.

There are no known specific treatments for WNV and the patient is generally treated with only supportive care. WNV was first documented in Mississippi in humans in July 2002 (Centers for Disease Control and

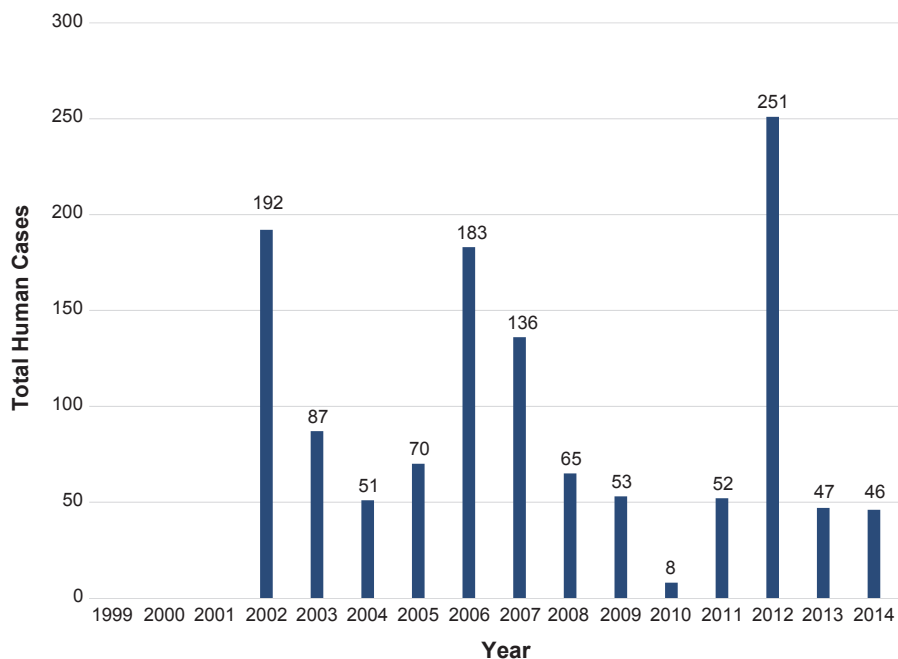
Prevention [CDC], 2002) and by the end of 2002, Mississippi had a total of 192 WNV cases with 162 of those resulting in serious encephalitis; there were 12 deaths (CDC, 2002). In the decade since its introduction into Mississippi, WNV has continued to persist statewide. The year 2012 was the 10th anniversary of the introduction of WNV in Mississippi and proved to be the worse year yet for human infections, with a total of 247 human cases and five deaths (Mississippi State Department of Health, 2014) (Figure 1).

Public health officials are keenly interested in ways to detect WNV in mosquitoes and sentinel animals, with the ultimate goal of implementing appropriate and timely mosquito control in affected areas (Goddard, 2013; Gu & Novak, 2004). Some studies have utilized landscape ecology and/or weather and demographic data to try to predict WNV activity (Gu, Unnasch, Katholi, Lampman, & Novak, 2008; Manore et al., 2014; Young, Tullis, & Cothren, 2013).

Mosquito numbers and WNV infection rates also may be used in WNV modeling and prediction efforts. There are several methods available for testing mosquitoes for WNV, including reverse transcription polymerase chain reaction (RT-PCR), Vero cell plaque assays, and viral antigen assays. The VectorTest is a rapid immunochromatographic assay (“dip-stick” test) intended for the qualitative determination of WNV antigens in infected mosquitoes (see photo at right). While PCR-based testing methods are the industry standard for virus identification, the availability of a simple, stable, sensitive, and rapid diagnostic test, such as the VectorTest, makes arboviral surveillance

FIGURE 1

**Historical Human West Nile Virus Cases by Year, Mississippi**



VectorTest (previously known as VecTest) kit (left) and test strips (right).

more cost-effective to state and local surveillance programs. Although the VectorTest might miss some positives as compared with PCR assays, VectorTest has been shown

to be highly specific and an effective rapid threat assessment tool for mosquito control personnel (Burkhalter et al., 2006; Turell et al., 2011).

Several studies have attempted to link mosquito surveillance data with human WNV infections (Ginsberg, Rochlin, & Campbell, 2010; Kilpatrick & Pape, 2013; Liu et al., 2009), and the best early season predictors of WNV activity have been found to be 1) early date of first positive pool, 2) low absolute numbers of mosquitoes in July, and 3) low numbers of mosquito species in July (Ginsberg et al., 2010). Studies have also shown that the number of WNV-positive mosquitoes in an area within the last 30 days is a significant predictor of human infection risk (Liu et al., 2009), and that standardized mosquito surveillance and testing provides strong predictive power to signal human WNV infection several weeks in advance (Kilpatrick & Pape, 2013; Kulasekera et al., 2001). In addition, minimum infection rates (MIR) and vector mosquito abundance can be combined into a “vector index” that is a good indicator of human WNV risk, a method advocated by CDC (Chung et al., 2013; Jones et al., 2011; Kwan et al., 2012).

The purpose of this study was to determine if, and to what extent, environmental health personnel can use mosquito testing to acquire advanced warning of impending human WNV cases in a specific area.

**Methods**

**Collection Sites**

Nine areas throughout Mississippi were selected for mosquito sampling. Three of the areas consisted of more than one town/city in one geographic location; all other areas were cities by themselves (Figure 2). The Golden Triangle collection area included the towns of West Point, Starkville, Columbus, and Louisville. The Jackson Metro area included the cities of Jackson, Pearl, Brandon, and Canton. The Biloxi/Gulfport area included the parts of Harrison County covered by these two cities. Five of the locations are known human WNV hot spots based on historical health department data and four of them historically exhibited little annual human WNV activity. All collections were made in urban areas known to potentially harbor *Culex quinquefasciatus* mosquitoes, and thus were considered favorable for WNV activity.

**Mosquito Collections**

Local county mosquito control staff, health department personnel, and health department interns were tasked with operating CDC Gravid Traps (see photo at bottom right) at the selected sites from approximately June 1–September 15 each year. These dates varied somewhat due to health department administrative and budget issues.

All personnel involved in trapping received appropriate training prior to project start. Gravid traps were used because they primarily attract female *Cx. quinquefasciatus* mosquitoes, which oviposit their eggs in highly organic water (e.g., containers with decaying leaves and septic ditches).

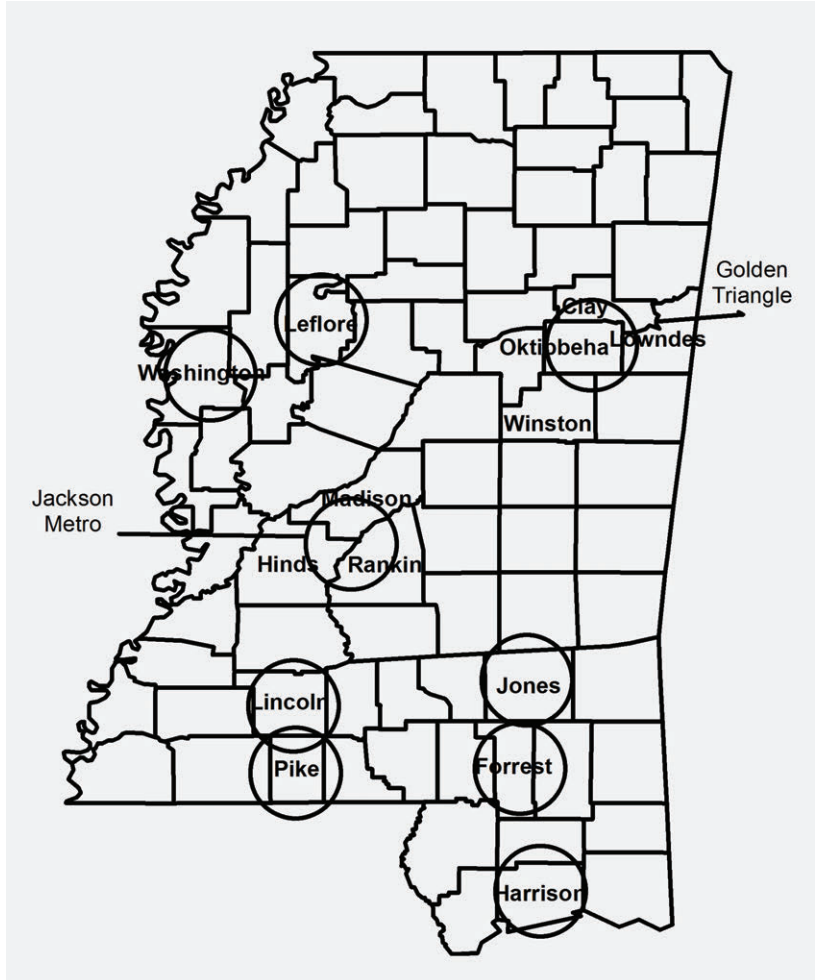
Traps were set weekly at each site in late afternoon and retrieved the following morning, unless inclement weather prevented retrieval. Each trap was powered by one 6 V, 10 amp rechargeable gelled-electrolyte battery. Traps were baited with a fish-oil emulsion mixture containing approximately three ounces of fish-oil emulsion to one gallon of water. Once the net was retrieved from the trap, mosquitoes were sorted into pools of no more than 50 female mosquitoes each. A collection is defined here as the total amount of mosquitoes collected in one trap night, which can be subdivided into smaller groups called “pools” for testing. In this study, due to financial constraints, no fewer than 10 mosquitoes were included in a pool for testing. Mosquito pools were then transported or shipped to the state public health laboratory for WNV testing.

**VectorTest Procedure and Quality Assurance Testing**

At the health department, mosquito identifications were confirmed and then pools were tested by VectorTest according to manufacturer instructions. Test strips were read within 30 minutes of the assay. Any strips with indistinct bands were classified as “maybe positive” samples (see photo on page 21). For outside quality assurance, all mosquito pools that tested positive and the “maybe” samples were sent to CDC, Division of Vector-Borne Diseases, Arboviral Diseases Branch in Fort Collins, Colorado, for follow-up testing and confirmation with RT-PCR using previously described methods (Burkhalter et al., 2006; Ryan et al., 2003).

FIGURE 2

**Nine Mosquito Collection Sites Throughout the State of Mississippi**



**Calculation of MIR**

We calculated MIR by dividing the total number of WNV-positive mosquito pools in each site by the total number of mosquitoes tested. MIR is expressed as the number of infected mosquitoes divided by total number tested multiplied by 1,000. The MIR is based on the assumption that infection rates are low and that only one mosquito is positive in a pool (CDC, 2013).

**WNV Human Case Data**

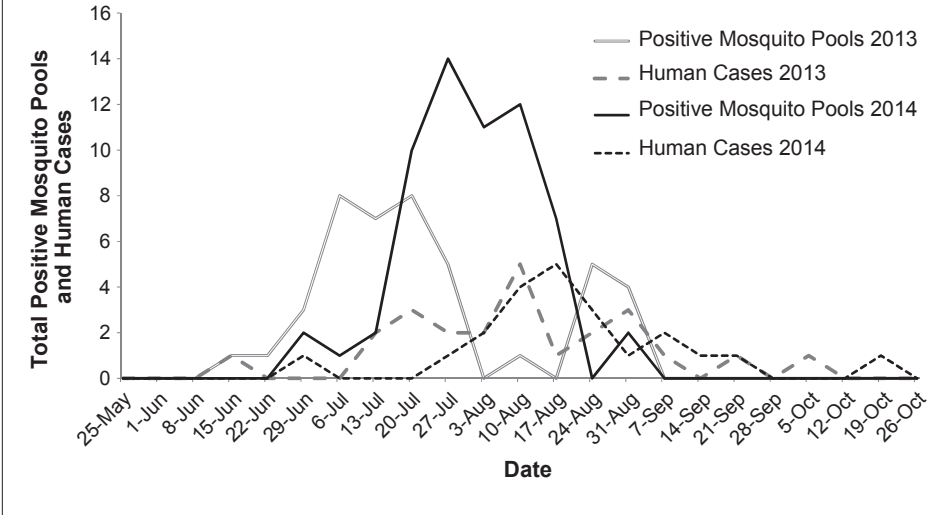
Human WNV cases were determined using the Mississippi State Department of Health (MSDH) EpiTracks system. These human WNV cases included clinical cases confirmed



A typical gravid trap set up.

FIGURE 3

**Overall Pattern of Dates of Mosquito Infection and Human West Nile Virus Symptom Onset for All Sites Combined, 2013–2014**



by the MSDH Public Health Laboratory and/or CDC, private reference laboratories, and blood banks. No personal information was collected in this analysis and cases were plotted on maps only to the nearest cross street. Date of onset was defined as the initial date the patient recalled symptoms (not date of doctor visit).

**Results and Discussion**

A total of 40,312 (16,259 in 2013 and 24,053 in 2014) *Cx. quinquefasciatus* mosquitoes were collected in the nine sites over the 2-year period with an average of 72.6 per trap (77.3 in 2013 and 66.91 in 2014) ranging from 5–900 in 2013 and 10–900 in 2014. During 2014, no collections were made from Greenwood due to contracting issues; therefore there were only eight sites that year. The overall MIR over the 2-year period ranged from 0–9.9 out of 1,000 with Hattiesburg having the highest MIR and Biloxi/Gulfport, Brookhaven, and the Golden Triangle areas having the lowest MIR. The low MIR of *Cx. quinquefasciatus* in Brookhaven during 2013 is likely due to lack of trap data, but interestingly, the Golden Triangle area had a zero MIR despite 22 collections. The low absolute numbers and MIR on the Mississippi Coast are likely due to the presence of a well-run, publicly-funded, integrated mosquito control program in that area.

There were 18 confirmed human WNV cases in the nine collection areas during 2013 and 21 cases in eight sites in 2014. Both years, and in all collection areas, positive mosquito pools appeared before the vast majority (87.2%) of reported human cases (Figure 3). Thirty-seven of these cases occurred within 4 miles of any gravid trap (and our analysis is based on those cases). The 4-mile distance between WNV cases and nearby gravid traps was chosen based upon average acreage covered in typical mosquito spray zones. Overall, in 27 out of 37 human WNV cases (73.0%) occurring in our study site, there was an average advanced warning of 26 days (range 11–53 days) as indicated by positive mosquito collections near the patient’s home, assuming that the patient contracted WNV at or near home.

As for quality assurance and outside confirmation of our results by CDC, 34 out of 36 of VectorTest positive samples (94.4%) were also WNV positive when retested using RT-PCR. This means two samples were false positives using VectorTest. The cause of this discrepancy is unknown. Of the seven “maybe” samples submitted from 2013, all but one was positive by RT-PCR (there appeared to be a faintly visible positive line with the VectorTest). As for 2014, a total of 63 out of 67 of VectorTest positive samples

(94.0%) were WNV positive when retested using RT-PCR. Four samples were considered questionable by RT-PCR, possibly suggesting that while there may have appeared to be a faint positive line on the VectorTest strip, there wasn’t enough titer to accurately confirm positive for WNV. Of the five “maybe” samples submitted from 2014, four were positive by RT-PCR and one fell into the questionable group after RT-PCR testing.

This operational health department study, although somewhat limited, reveals that mosquito sampling and testing can inform public health and mosquito control personnel of WNV activity in an area and therefore, of impending human cases.

In our study, the lead time before onset of human cases ranged from almost two weeks to two months, giving ample time for appropriate health department interventions such as educational campaigns and mosquito control. Further, our study demonstrates that a relatively inexpensive and less labor-intensive product, in this case VectorTest, is more than adequate for health departments or mosquito control agencies that might not have sophisticated and expensive molecular analysis capability. 🐞

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# Did You Know?

NEHA's EH<sub>2</sub>O Recreational Waters Virtual Conference will be held on January 18–19, 2017. This free conference is designed to enhance the knowledge of environmental health professionals to better prepare and respond to recreational events of public health concern. To learn more and register, go to [www.neha.org/eh-topics/water-quality-0/eh2o-recreational-waters-virtual-conference](http://www.neha.org/eh-topics/water-quality-0/eh2o-recreational-waters-virtual-conference).



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Michèle Samarya-Timm, MA,  
HO, MCHES, REHS, CPH, DLAAS  
Somerset County Department  
of Health

## Using New Technologies to Communicate Environmental Health



**Editor's Note:** In an effort to provide environmental health professionals with relevant information and tools to further the profession, their careers, and themselves, NEHA has teamed up with the American Academy of Sanitarians (AAS) to publish a column in the *Journal*. AAS is an organization that “elevates the standards, improves the practice, advances the professional proficiency, and promotes the highest levels of ethical conduct among professional sanitarians in every field of environmental health.” Membership with AAS is based upon meeting certain high standards and criteria, and AAS members represent a prestigious list of environmental health professionals from across the country.

Through the column, information from different AAS members who are subject-matter experts with knowledge and experience in a multitude of environmental health topics will be presented to the *Journal's* readership. This column strengthens the ties between both associations in the shared purposes of furthering and enhancing the environmental health profession.

Michèle Samarya-Timm is a health educator for Somerset County Department of Health in New Jersey. She focuses on enhancing multiagency collaborations in emergency preparedness and response, food safety and outbreak prevention, public health analysis, and health communications. She has been a member of AAS for 12 years.

Environmental health practitioners are often acutely aware of the compelling need to tell the story of what we do and why we do it. Historically, our profession has not been particularly effective in describing to others how environmental complexities affect personal and community health, and how this profession works with individuals, communities, and policy makers to reduce or eliminate environmental

health hazards. Perhaps it is time to revitalize our modes of outreach and consider how the environmental health profession can best make use of new technologies to become the professional narrators we need to be.

Communication is a core interpersonal and professional skill, and is an essential requisite for environmental health. This concept is not new. Almost a dozen years ago, Mor-

rone and co-authors (2005) explained that when it comes to environmental health, the purpose of communication is to increase the visibility of this science and improve the public's awareness and understanding of the role played by the environmental health profession in protecting the public's health. In other words, our collective dialogue and outreach are essential to “sell” what we do in environmental health. We should consider our every job encounter as a way to obtain buy in and to foster positive views of environmental health departments, professionals, and activities in our communities. We need to consider how to think more clearly about our professional competencies and illustrate our professional responsibilities to others in a way that is targeted, personal, and understandable.

While environmental health practitioners are well versed in the biological sciences, the nuances of social sciences, public relations, and image management tend to be lost in the hierarchy of our technical job competencies. Albert Einstein once reflected that most of the fundamental ideas of science are essentially simple and may, as a rule, be expressed in a language comprehensible to everyone (BrainyQuote, 2016). Unfortunately, in the course of our environmental health duties, we don't always present science-related topics to nonexperts in a clear and graspable way.

The public we are trying to reach isn't always just one person or a singular community. Looking at the depth and breadth of our communities, cultural and linguistic variations can factor into an audience's percep-

tion of a message. In addition, every person has their own set of schema or background knowledge that forms the lens in how they receive and interpret information. Environmental health challenges are often complex, but in contrast, our core community messages should be simply phrased. It is essential that our messages are capable of being repeatedly marketed and presented to others in a variety of ways and formats in order to reach people on a level that is both understandable and relatable.

Environmental health outreach is a dynamic process. How we connect and correspond with the public needs to adapt to the way people, communications, technologies, and pop culture change. Consider over the past century how the transfer of information radically morphed with the wide usage of radio and television, and in more recent decades, with expansion of the Internet, e-mail, cable TV, and the demise of print newspapers. The widespread use of smartphones and texting, as well as the social media explosion, has changed the way the world sends and receives information. In discussing this transmission view of communication, Rimal and Lapinski (2009) advise that we think carefully about the channels “through which intervention messages are disseminated, to whom the message is attributed, and how audience members respond and the features of messages that have the greatest impact” (p. 247).

As we look at our environmental health messages, consider the take away. Is the purpose of the communiqué awareness, action, or something else? How the outreach is framed, and the mode of distribution, has a tremendous impact on effectiveness. As a country, we are so inundated with information that grabbing an audience’s attention is difficult. In 2015, Microsoft released a research report that discussed people’s decreasing attention span, presumably due to information overload. According to the report, the average human attention span has dwindled from 12 seconds in 2000 to 8 seconds in 2013 (Microsoft, 2015). It also interestingly noted that the average attention span of a goldfish is 9 seconds.

An elevator speech has traditionally been considered the briefest form of extending to others a glimpse of what we do in environmental health. These days, would you be able to capably capture your message in the

140-character limit of Twitter? To be most effective, environmental health professionals need to enhance their competencies in new types of dialogue, as well as utilize effective, older approaches.

No matter the mode of communication—face to face, written word, ads, videos, press releases, and now Internet-based methodologies—it is essential to research and understand how people synthesize information. Disseminating information on an impending hurricane (risk communication) needs a different touch than promoting handwashing as a means to prevent the flu. Frequency of messaging also comes into play. Marketing professionals tout the “Rule of 7,” suggesting audiences need to hear or see a message 7 times before it makes a positive impact. Surely, environmental health can benefit from a clearly defined communications strategy, but where to start?

At least one baseline roadmap to upgrading environmental health outreach already exists. In 2011, the American Public Health Association collaborated with the Frameworks Institute to “uncover new ways to communicate about environmental health that resonate with the public and engage people in productive policy discussions (Krisberg, 2015).” The resulting resource, *Framing Environmental Health*, offers environmental health practitioners new strategies for talking about their work and its connection to healthy communities (Frameworks Institute, 2016).

On a local front, engaging in the explosion of social media platforms is essential, as the Internet is a powerful medium to distribute and amplify messages. Understand, however, that social media is so much more expansive than Facebook and Twitter. Limiting environmental health messages to these two sites restricts outreach performance. Look beyond to other existing and emerging electronic platforms to enhance the delivery of environmental health information. Consider applications such as LinkedIn, Google+, Pinterest, Tumblr, Wikipedia, YouTube, Yelp, Flickr, Snapchat, Instagram, Second Life, WordPress, and ZoomInfo. Engaging the public with such communication tools can serve as an effective podium to broadcast and amplify core environmental health messages.

Keep adapting the environmental health message. Remember people’s 8-second attention span. Try mixing up your outreach by

## Additional Resources

- **Promoting Environmental Health in Communities: Talking Points**  
[www.atsdr.cdc.gov/emes/public/docs/PEHC%20Talking%20Points%20for%20Specific%20Populations.pdf](http://www.atsdr.cdc.gov/emes/public/docs/PEHC%20Talking%20Points%20for%20Specific%20Populations.pdf)
- **Crisis and Emergency Risk Communication**  
<https://emergency.cdc.gov/cerc>

creating environmental health messages in different and engaging formats, such as infographics, memes, GIFs, visuals, movies, music, and apps. Explore uses of technology to reach communities and stakeholders, and to make environmental health communications targeted, impactful, and beneficial to your audience.

Most of our agencies are limited on staff, dollars, and time. Regardless, communication and outreach can be augmented with a little creativity. Try partnering with health educators, public information officers, or departments in your organization to identify and foster coordinated outreach. Provide internship opportunities for students studying fields such as marketing, communications, and public relations to create an outreach plan. Look to organizations, such as NEHA, for key messages and ideas on how to distribute them.

So, what is your call to action? Integrating outreach and communication strategies into your environmental health program provides a playbook for multimodal communication, helps with community relations, and assists in the popularization, outreach, and respect for environmental health. As those working in environmental health can benefit from best practices or examples of effective environmental health communication, please share your experiences with NEHA and the American Academy of Sanitarians at <https://twitter.com/nehorg> and <https://twitter.com/AASanitarians>. 🐬

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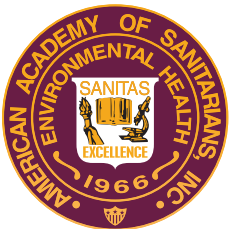
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# Did You Know?

Students enrolled in a National Environmental Health Science and Protection Accreditation Council-accredited academic program are eligible for the National Environmental Public Health Internship Program at approved local and state health departments or agencies. Students will be exposed to the exciting career opportunities, challenges, and benefits of working in environmental health agencies throughout the U.S. The application process will open December 15, 2016. Learn more at [www.neha.org/internships](http://www.neha.org/internships).

## DAVIS CALVIN WAGNER SANITARIAN AWARD



**The American Academy of Sanitarians (AAS) announces the annual Davis Calvin Wagner Award. The award will be presented by AAS during the National Environmental Health Association's (NEHA's) 2017 Annual Educational Conference & Exhibition. The award consists of an individual plaque and a perpetual plaque that is displayed in NEHA's office lobby.**

Nominations for this award are open to all AAS diplomates who:

1. Exhibit resourcefulness and dedication in promoting the improvement of the public's health through the application of environmental and public health practices.
2. Demonstrate professionalism, administrative and technical skill, and competence in applying such skills to raise the level of environmental health.
3. Continue to improve through involvement in continuing education type programs to keep abreast of new developments in environmental and public health.
4. Are of such excellence to merit AAS recognition.

**NOMINATIONS MUST BE RECEIVED BY APRIL 15, 2017.**

**Nomination packages should be sent electronically to [shep1578@gmail.com](mailto:shep1578@gmail.com). If desired, three hard copies of the nomination document may be submitted to**

American Academy of Sanitarians  
 c/o Craig A. Shepherd  
 1271 Statesville Road  
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For more information about the award nomination, eligibility, evaluation process, and previous recipients of the award, please visit [sanitarians.org/awards](http://sanitarians.org/awards).



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# Innovative Vector and Pest E-Learning for Environmental Health Professionals

**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 article are those of the author(s) and do not necessarily represent the views of CDC.

Martin A. Kalis, MA  
*Centers for Disease Control and Prevention*

John Oeffinger  
*Texas Health Institute*

Liljana Johnson Baddour, MPH  
*National Network of Public Health Institutes*

Christl Tate  
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Kathy Oeffinger  
*O2 Digital Media*

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Diana Kleiman  
*E-Learning Consultation*

Charles Shorter  
*Tulane School of Public Health and Tropical Medicine*

Environmental health professionals live in a constantly changing world. Staff turnover, shrinking budgets, program reorganization, and emerging threats such as the Zika virus are the new normal. Professional development opportunities are critical to maintaining and advancing this important workforce that protects public health. The need for high quality, interactive, and engaging education and training delivered in a consistent manner can be met through the use of e-learning, or online learning. E-learning has the unique ability to reach environmental health professionals in roughly 3,200 jurisdictions and can serve as a platform for cost-effectively increasing their knowledge and skills.

While the content for many in-person and e-learning courses is developed by either one or a small group of subject matter experts (SMEs), an innovate approach uses a collaborative framework that includes multiple organizations, partners, stakeholders, and SMEs to create informed content. The e-learning series, Vector Control for Environmental Health Professionals (VCEHP): The Importance of Integrated Pest Management, uses this innovative approach to provide new,

accessible learning opportunities in vector control and pest management for environmental health professionals. It is anticipated that the series will launch in early 2017.

## Background and Significance

Diseases are resurging in the U.S. and its territories that were once believed to be of no significant public health threat. Environmental health professionals are continually being asked to take on additional responsibilities with fewer resources, including learning new skills or improving existing ones.

The Centers for Disease Control and Prevention (CDC) is working to increase environmental health professional training and development opportunities through its National Center for Environmental Health (NCEH). Historically, NCEH partnered with the National Environmental Health Association (NEHA) to offer between two and four classroom-based integrated pest management (IPM) three-day sessions per year. These sessions have provided strong foundational knowledge in the science, principles, and concepts of IPM since 2006. Each regional session attracted an average of 50 attendees. Due to budget constraints and other chal-

lenges, these sessions have been curtailed and different methods of learning were explored. The VCEHP e-learning series will meet increasing demand in a more accessible manner with no cost to the user.

## Purpose

NCEH organized a multiorganization framework with the National Network of Public Health Institutes (NNPHI), Texas Health Institute, Tulane University School of Public Health and Tropical Medicine's Center for Applied Environmental Public Health, NEHA, and internationally respected SMEs in vector control and pest management to create the VCEHP e-learning series. The series innovatively equips environmental health and other professionals with the knowledge and skills to effectively reduce disease threats and other health concerns from vectors and public health pests. It uses the latest technology for enhanced learner-centric interaction, experience, and resource accessibility.

## Methods

A core team of 15 people from the five organizations met biweekly using a video/shared-

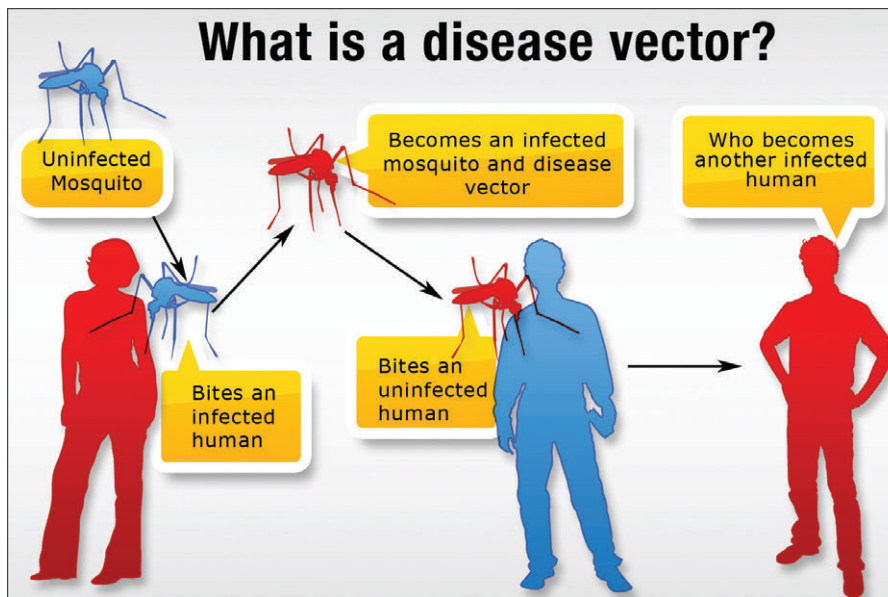
TABLE 1

**Vector Control for Environmental Health Professionals (VCEHP) E-Learning Courses**

Course #	Course Name	Average Time to Complete Course (Minutes)
VCEHP 101	Vectorborne Diseases of Public Health Importance	120
VCEHP 102	IPM Basics for Environmental Health Professionals	72
VCEHP 103	Performance Assessment and Improvement of Vector Control Services	81
VCEHP 104	Tick Biology and Control	73
VCEHP 105	Mosquito Biology and Control	133
VCEHP 106	Toxicology of Pesticides for Environmental Health Professionals	98
VCEHP 107	Rodent Management	137
VCEHP 108	Public Health Insect Pests in Food and Housing Environments	145
VCEHP 109	Pest Management Considerations for Schools	96
VCEHP 110	Risk Communication Basics for Environmental Health Professionals	77
VCEHP 111	Bed Bugs—Identification, Biology, and Control	70

FIGURE 1

**Example of a Course Screen Explaining Disease Vectors**



screen application to develop each VCEHP course. The team collaboratively identified and solved issues, assessed progress, and determined next steps. Aided by the knowledge and expertise of seven SMEs, the team

developed 11 courses (Table 1). A 21-step process facilitated content development, course production, and three phases of testing. A pilot test was conducted during fall 2015 by a sample of environmental health

**Did You Know?**

- Approximately 75% of all new or emerging diseases threatening human health today are zoonotic, with many of these being vectorborne in nature (Blancou, Chomel, Belotto, & Meslin, 2005).
- Since 2008, over 51,000 state and local public health jobs have been lost, representing more than 19% of the total state and local health department workforce (Association of State and Territorial Health Officials, 2014).

professionals. A total of 160 evaluations were completed. Each course had at least six pilot test evaluations completed.

The primary target audience for VCEHP is environmental health professionals working in local or state health departments, tribal organizations, schools, or private pest management companies. Courses within the VCEHP series include

1. Vectorborne Diseases of Public Health Importance,
2. IPM Basics for Environmental Health Professionals,
3. Performance Assessment and Improvement of Vector Control Services,
4. Tick Biology and Control,
5. Mosquito Biology and Control,
6. Toxicology of Pesticides for Environmental Health Professionals,
7. Rodent Management,
8. Public Health Insect Pests in Food and Housing Environments,
9. Pest Management Considerations for Schools,
10. Risk Communication Basics for Environmental Health Professionals, and
11. Bed Bugs—Identification, Biology, and Control.

VCEHP users will be able to access tools and resources to apply new knowledge in the field. Each course within VCEHP is designed to enable timely content updates to retain relevance and enhance applicability (Figures 1 and 2). Individuals completing the courses and the final evaluation instrument will have the option to receive continuing education credit through NEHA.

Over 92% of pilot testers agreed that they would recommend VCEHP to a colleague across all 11 courses. Over 85% of pilot testers reported they would be able to apply acquired knowledge in their work. Over 81% reported the information they gained will enhance their ability to do their job. One pilot tester commented, “[I am] better able to serve the citizens of my county and the cities within the county. I feel better prepared to respond to questions regarding the use of pesticides. I also found several good references should I have a question that I couldn’t answer.”

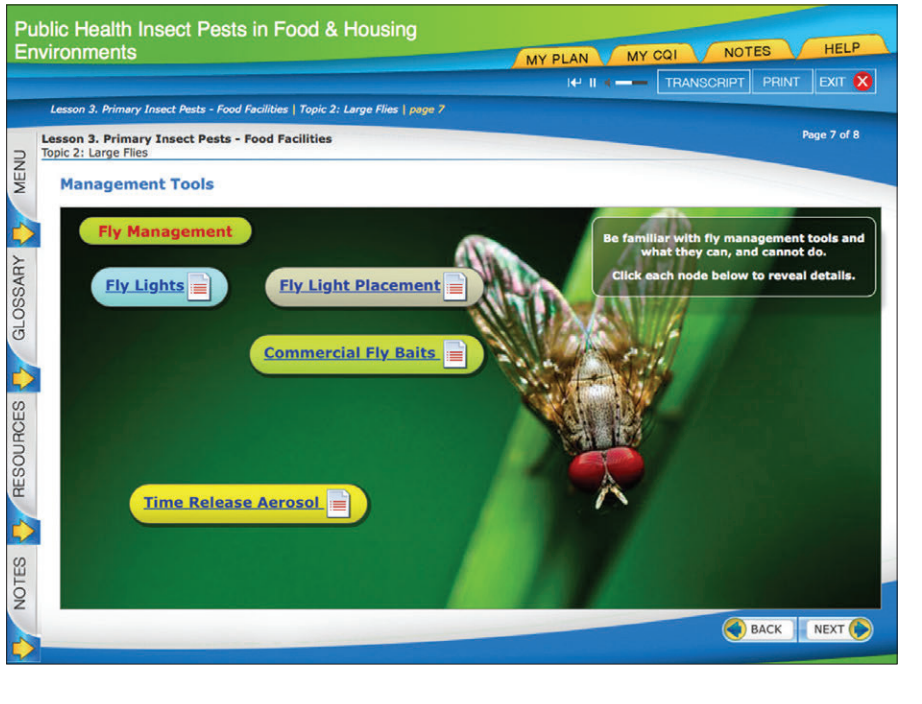
**Conclusion**

The VCEHP e-learning series will provide much needed training at no cost to environmental health professionals in early 2017. For more information, contact Martin Kalis with CDC’s Environmental Health Services Branch at [mkalis@cdc.gov](mailto:mkalis@cdc.gov). For more information about other tools and resources offered through NNPHI’s Public Health Learning Network, please visit [www.nnphi.org](http://www.nnphi.org).

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FIGURE 2

**Example of a Course Screen on Fly Management**



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**Win a \$1,000 Award  
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Students will be selected to present a 20-minute platform presentation and poster at the National Environmental Health Association's Annual Educational Conference & Exhibition in Grand Rapids, MI, July 10–13, 2017.

**Entries must be submitted by Tuesday, February 28, 2017,** to Leslie Mitchell

AEHAP Coordinator  
E-mail: [info@aehap.org](mailto:info@aehap.org)  
Phone: 206-522-5272

For additional information and research submission guidelines, please visit [www.aehap.org](http://www.aehap.org).

AEHAP gratefully acknowledges the volunteer efforts of AEHAP members who serve on the advisory committee for this competition.

# Opportunity for Students

**From EHAC-Accredited Environmental Health Degree Programs  
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The Association of Environmental Health Academic Programs (AEHAP), in partnership with NSF International, is offering a paid internship project to students from National Environmental Health Science and Protection Accreditation Council (EHAC)-accredited programs. The NSF International Scholarship Program is a great opportunity for an undergraduate student to gain valuable experience in the environmental health field. The NSF Scholar will be selected by AEHAP and will spend 8–10 weeks (March–May 2017) working on a research project identified by NSF International.

### Project Description

The applicant shall work with a professor from their degree program who will serve as a mentor/supervisor and agree to providing a host location from which to do the research. Research will focus on identifying how federal, state, and local jurisdictions regard or reference NSF standards and products in administrative codes or regulations. Candidate topics include drinking water, waste water, plumbing, food safety, or recreational water.

**Application deadline: January 15, 2017**

For more details and information on how to apply please go to [www.aehap.org/nsf-paid-summer-internship-opportunity-for-students](http://www.aehap.org/nsf-paid-summer-internship-opportunity-for-students)

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▶ **DIRECT FROM CDC** ENVIRONMENTAL PUBLIC HEALTH TRACKING NETWORK

CAPT Fuyuen Yip,  
MPH, PhD

## The Future of Environmental Public Health Tracking: 2020 and Beyond

**Editor's Note:** As part of our continuing effort to highlight innovative approaches and tools to improve the health and environment of communities, the *Journal* is pleased to publish a bimonthly column from the Centers for Disease Control and Prevention's (CDC's) Environmental Public Health Tracking Network (Tracking Network). The Tracking Network is a system of integrated health, exposure, and hazard information and data from a variety of national, state, and city sources. The Tracking Network brings together data concerning health and environmental problems with the goal of providing information to help improve where we live, work, and play.

Environmental causes of chronic diseases are hard to identify. Measuring amounts of hazardous substances in our environment in a standard way, tracing the spread of these over time and area, seeing how they show up in human tissues, and understanding how they may cause illness is critical. The Tracking Network is a tool that can help connect these efforts. Through these columns, readers will learn about the program and the resources, tools, and information available from CDC's Tracking Network.

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

CAPT Fuyuen Yip is the acting branch chief of the Environmental Public Health Tracking Program and is a commissioned officer with the U.S. Public Health Service.

In 2017, the National Environmental Public Health Tracking Program (Tracking Program) will mark its 15th anniversary. A lot has changed over the years—from the ways we do tracking to the people working in the program. I am relatively new to the Tracking Program, having started in March 2016. Even during my tenure, I have seen the program change and grow. It's ex-

citing to think about where the program will be in the next few months, and almost unimaginable to think about what it will be like in the next few years. The Tracking Program recently completed a strategic planning process to map out the goals, objectives, and strategies we want to accomplish by 2020. Before we get into that, let's look back at where we've been.

### A Brief History of Tracking

Data have been captured from federal, state, and local programs that track health, exposures, environmental hazards, and other risk factors. There has been huge progress in the amount and types of data collected, with great effort to validate and integrate these data to be used meaningfully by a diversity of users. The Tracking Program has grown and adapted to the changing public health landscape in response to this audience, including public health practitioners, researchers, consumers, and community members.

### Taking Environmental Public Health Tracking to 2020

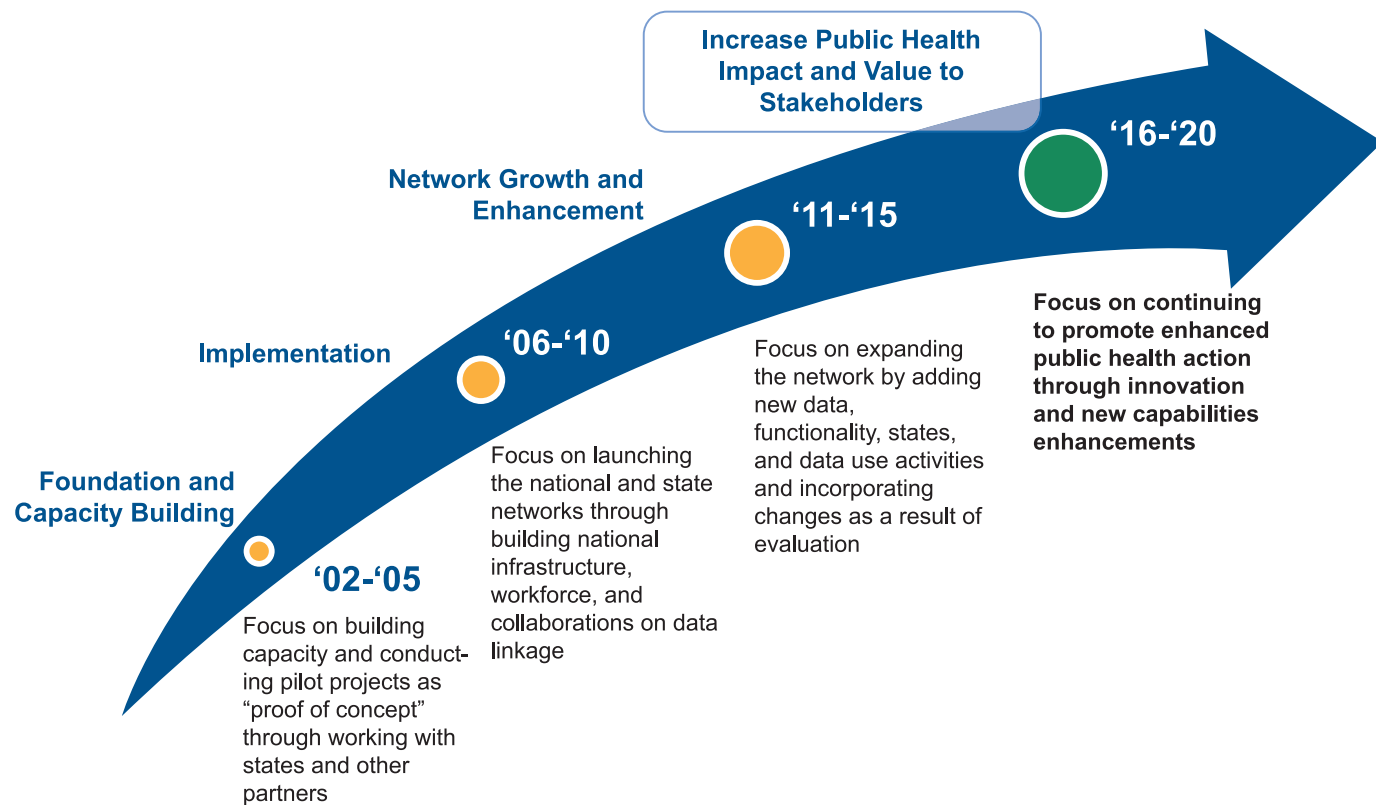
The Tracking Program is now well poised to advance the availability of the data, develop new analytic tools and methods, and improve dissemination of information. Accordingly, we are evolving technically and operationally to identify ways to better interact with our current stakeholders, as well as more nontraditional data users. For example, we are looking at how we can deliver data and information to this diverse audience to help enable public health action. We are figuring out how these data can be used to help advance the public health science agenda to support and inform not only national questions and policies, but also support the needs of independent investigators who bring innovative analyses and perspectives.

### Tracking Program Strategic Framework

Our new five-year strategic plan will help us transition into this next phase and help

FIGURE 1

**Evolution of the National Environmental Public Health Tracking Program and Focus for 2016–2020**



guide the program’s efforts throughout. Over the next five years, we will apply a strategic framework to help align, integrate, and prioritize Tracking Program activities, encourage innovation and promote greater operational efficiency, and increase collaboration within and across the tracking community. We developed three pillars—science and content, technology and informatics, and awareness and impact—to help define the Tracking Program’s plans to address these activities.

**Science and Content**

The focus of this pillar is to deliver relevant and actionable scientific content that addresses key environmental public health priorities and needs. Given the breadth and progress in environmental health science and public health practice, the program

must be thoughtful in both identifying key environmental health issues and anticipating emerging threats to ensure that the translation of science into health action is timely and relevant. Thus, the program will work with key stakeholders to establish a science to action agenda that provides clear direction and prioritizes key environmental health issues and surveillance questions that should be addressed. Development of this agenda and establishing supporting processes will help the program to maximize its limited resources on priority surveillance questions.

**Technology and Informatics**

We work to identify opportunities to modernize technologies and data analytics tools used by the Tracking Network and improve processes to efficiently generate and deliver

data and information to stakeholders. With the rapid changes in information technology, tools, and data analyses methodology, and as the size of the Tracking Network expands, opportunity abounds to analyze increasingly complex and granular datasets. Furthermore, the resulting insights and information gleaned from the data must be presented and delivered to a broad range of end users in ways that are meaningful, timely, and relevant. Identifying new software tools and enhancing functionality will help make the data more accessible to a wider audience and promote its usage.

**Awareness and Impact**

Key objectives of the Tracking Program on public health are to improve our understanding of the link between health and the environment, drive changes in public health

practice, guide community-level interventions, and support policy and decision making. As there are a diverse set of stakeholders, a broad range of topics covered, and various methods for delivering content, identifying innovative approaches to communicate information and data that are of value to individual stakeholders are important to increase awareness, expand usage, and enhance utility of the Network.

Foundational to these three pillars is the program capacity that supports the network of environmental health practitioners at federal, state, and local levels. The infrastructure also supports the creation of an effective workforce as the future success and impact of the Tracking Program depends on a strong foundation of talented and dedicated people. Over the next five years, in addition to attracting new talent, the Tracking Program will focus on opportunities to enhance the technical capabilities of the existing workforce and promote development and growth of the next generation of leaders in environmental public health.

Evaluating program impact and performance is a critical need so that ways can be found to better capture the value and impact of the Tracking Program's scientific pursuits, data products, and methods of delivery on effectively responding to stakeholder needs. This information will enable the Tracking Program to monitor the effectiveness of key activities, assess the degree of impact on public health outcomes, and adjust efforts as needed.

**Beyond 2020**

With the new strategic plan in place, we are working closely with the tracking community of funded state and local health departments to position the Tracking Program to be the leader in environmental public health surveillance for the U.S. As we expand our capacity and promote evidence-based practice, we aim to increase our contribution to the health of our nation.

What does the future hold for tracking? No one knows for certain. If past performance and implementation of strategic plans make

good indicators, however, I predict a bright and successful road ahead. 🐘

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**Reference**

Environmental Health Tracking Project Team. (2000). *America's environmental health gap: Why the country needs a nationwide health tracking network*. Retrieved from [http://www.jhsph.edu/research/centers-and-institutes/center-for-excellence-in-environmental-health-tracking/pew\\_technical\\_report.pdf](http://www.jhsph.edu/research/centers-and-institutes/center-for-excellence-in-environmental-health-tracking/pew_technical_report.pdf)

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# Thank You!

The *Journal* would like to thank the Centers for Disease Control and Prevention's Environmental Public Health Tracking Program and all the authors that have contributed to the tracking columns published in the *Journal* since 2014. The information shared through these columns has been invaluable. The column will be going on sabbatical in 2017, but we hope to bring it back in 2018.

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# UConn HEALTH

## Faculty Opening

The Division of Occupational and Environmental Medicine within the Department of Medicine at UConn Health invites applications for a tenure-track position.

### General Description:

Senior Faculty Position, Occupational Health/Environmental Health/Intervention Research.

UConn Health Department of Medicine invites applications for a tenure-track/tenured faculty position as Director of the Division of Occupational and Environmental Medicine (DOEM).

The DOEM has a rich history and tradition in cross-disciplinary, occupational health intervention research as well as established laboratories in acoustics and biodynamics. The DOEM is strengthened by collaborative academic and practitioner partnerships with a history of workplace directed outreach. The DOEM is a key component of the Center for the Promotion of Health in the New England Workplace (CPH-NEW), a NIOSH funded Total Work Health (TWH™) Center of Excellence.

The Director will provide administrative leadership to DOEM. The Director will also guide DOEM research and outreach activities.

Depending on the successful candidate's background, the Director responsibilities may include supervision of a human factors and bio dynamics laboratory. There are also opportunities for teaching in the graduate program. The mentoring of junior faculty is also expected. Finally, the Director should develop their own research program.

### Candidate Qualifications:

The successful candidate will have a multidisciplinary background in Occupational and/or Environmental Health. The successful candidate will have an established research career as demonstrated by outstanding research productivity. If the applicant is an academic clinician, s/he should have a comparable level of clinical accomplishment with outstanding research promise. The ideal candidate will have a demonstrated capacity for independent research and record of research funding with Principal Investigator experience as well as a history of successful mentoring of graduate and post-graduate students and/or medical residents and fellows. Candidates should have experience working in cross-disciplinary teams such as biomedical sciences, occupational medicine, ergonomics, industrial psychology and social sciences, biomedical engineering, and physical hazards. The candidate should be interested in the translation of laboratory and investigative work into improved health of the working population, and should be amenable to working with the private and public sectors and with labor and management groups.

This position is offered at the Associate or Full Professor Level. The academic departmental affiliation is with the Department of Medicine. The position is offered as tenure-track (investigator-track). Both Ph.D.s and M.D.s are encouraged to apply.

The position includes sponsored research development time and a laboratory start-up package that will be specific to the applicant.

A comprehensive review of applications will begin on October 23, 2016 and will continue until the position is filled. Please complete an application at <https://jobs.uchc.edu> (Search #2015-1162). Please direct questions to Joyce L. Smith, Director of Employment Services Human Resources, UConn Health, [josmith@uchc.edu](mailto:josmith@uchc.edu).

*UConn Health is an affirmative action employer, in addition to an EEO and M/F/V/PWD/PV employer*

## CAREER OPPORTUNITIES

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## EH CALENDAR

### UPCOMING NEHA CONFERENCE

July 10–13, 2017: NEHA 2017 Annual Educational Conference & Exhibition, Grand Rapids, MI. For more information, visit [www.neha.org/aec](http://www.neha.org/aec).

### NEHA AFFILIATE AND REGIONAL LISTINGS

#### California

April 10–13, 2017: 66th Annual Education Symposium, hosted by the California Environmental Health Association, Garden Grove, CA. For more information, visit [www.ceha.org](http://www.ceha.org).

#### Illinois

December 7–8, 2016: Annual Education Conference, hosted by the South Chapter of the Illinois Environmental Health Association, Belleville, IL. For more information, visit <http://iehaonline.org>.

#### Iowa

April 11–12, 2017: Iowa Governor's Conference on Public Health, Des Moines, IA. For more information, visit [www.ieha.net/IGCPH](http://www.ieha.net/IGCPH).

#### Kentucky

February 15–17, 2017: Annual Conference, hosted by the Kentucky Environmental Health Association, Lexington, KY. For more information, visit [www.kyeha.org](http://www.kyeha.org).

#### Minnesota

January 27, 2017: Winter Conference, hosted by the Minnesota Environmental Health Association, St. Paul, MN. For more information, visit [www.mehaonline.org](http://www.mehaonline.org).

#### Utah

April 26–28, 2017: Spring Conference, hosted by the Utah Environmental Health Association, Bryce Canyon, UT. For more information, visit [www.ueha.org/events.html](http://www.ueha.org/events.html) 🐾






## Did You Know?

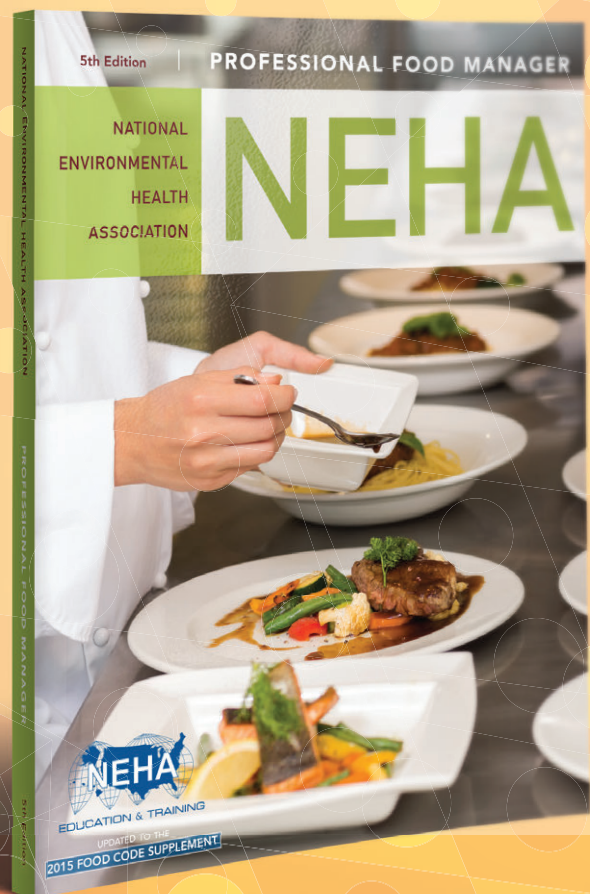
Posting your events on NEHA's online Community Calendar ([www.neha.org/news-events/community-calendar](http://www.neha.org/news-events/community-calendar)) is very easy, and it is a great way to share your event with environmental health professionals across the country. Also, visit our Community Calendar to see the events planned by NEHA and other organizations that pertain to environmental health.

# Updated and Redesigned to Meet the Needs of Today's Learner

## NEHA PROFESSIONAL FOOD MANAGER 5<sup>th</sup> Edition

### INSIDE THIS EDITION

-  Instructional design focused on improved learning and retention
-  Content aligns with American Culinary Federation Education Foundation competencies
-  Prepares candidates for CFP-approved food manager exams (e.g., Prometric, National Registry, ServSafe, etc.)
-  All-new instructor guide and companion classroom materials
-  Volume discounts for NEHA Food Safety Instructors

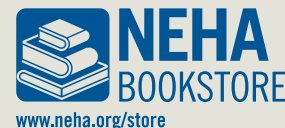


To order books or find out more about becoming a NEHA Food Safety Instructor, call **(303) 802-2166** or visit [neha.org](http://neha.org)



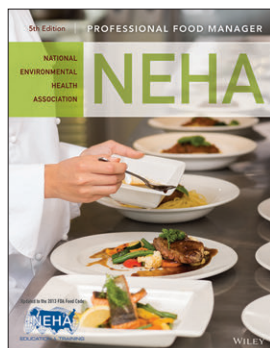
# RESOURCE CORNER

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



## Professional Food Manager, 5th Edition

National Environmental Health Association (2016)



**NEW!** NEHA's *Professional Food Manager, 5th Edition* 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

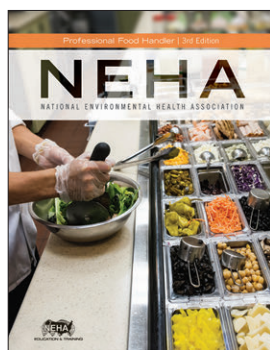
those principles to create a food safety culture. Additionally, it contains streamlined, validated content by NEHA subject matter experts to support the education of food managers and provides the knowledge needed for culinary and hospitality professionals to pass accredited food manager certification exams.

166 pages / Paperback

Member: \$22 / Nonmember: \$26

## Professional Food Handler, 3rd Edition

National Environmental Health Association, Inc. (2013)  
and MindLeaders, Inc. (Portions) (2013)



NEHA's *Professional Food Handler* textbook provides food handlers access to essential knowledge and understanding of fundamental food safety practices that they need to carry out their work safely. Concise, brightly illustrated, and written at the eighth-grade level, this student textbook is an effective tool in the workplace. Based on the 2013 Food and Drug Administration *Food Code*, this book presents all the

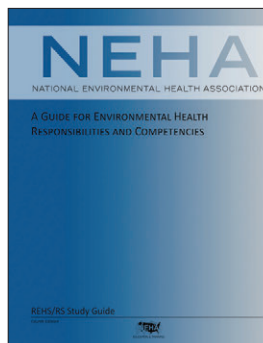
essential microbiological and technical food safety principles in ways that are easy to read, understand, and retain. In addition to containing fundamental food safety practices, the book also includes informative graphics that assist readers in retaining the information.

55 pages / Paperback

Member / Nonmember: \$7.50

## 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.

308 pages / Paperback

Member: \$149 / Nonmember: \$179

## Certified Professional-Food Safety Manual, 3rd Edition

National Environmental Health Association (2014)



The Certified Professional-Food Safety (CP-FS) credential is well respected throughout the environmental health and food safety field. This manual has been developed by experts from across the various food safety disciplines to help candidates prepare for NEHA's CP-FS exam. This book contains science-based, in depth information about causes and prevention of foodborne illness, HACCP plans and active managerial

control, cleaning and sanitizing, conducting facility plan reviews, pest control, risk-based inspections, sampling food for laboratory analysis, food defense, responding to food emergencies and foodborne illness outbreaks, and legal aspects of food safety.

358 pages / Spiral-bound paperback

Member: \$179 / Nonmember: \$209



## FEATURED ARTICLE QUIZ #3

### A Community-Based Participatory Research Approach to Identifying Environmental Concerns

Available to those holding an individual NEHA membership only, the *JEH Quiz*, offered six times per calendar year through the *Journal of Environmental Health*, is an easily accessible means to accumulate continuing-education (CE) credits toward maintaining your NEHA credentials.

1. Read the featured article carefully.
2. Select the correct answer to each *JEH Quiz* question.
3. a) Complete the online quiz at [www.neha.org/publications/journal-environmental-health](http://www.neha.org/publications/journal-environmental-health) (click on the December 2016 issue in the left menu),  
b) Fax the quiz to (303) 691-9490, or  
c) Mail the completed quiz to  
*JEH Quiz*, NEHA  
720 S. Colorado Blvd., Suite 1000-N  
Denver, CO 80246.  
Be sure to include your name and membership number!
4. One CE credit will be applied to your account with an effective date of December 1, 2016 (first day of issue).
5. Check your continuing education account online at [www.neha.org](http://www.neha.org).
6. You're on your way to earning CE hours!

#### Quiz Registration

Name

NEHA Member No.

E-mail

#### JEH Quiz #1 Answers July/August 2016

- |      |      |      |       |
|------|------|------|-------|
| 1. e | 4. b | 7. a | 10. e |
| 2. a | 5. d | 8. b | 11. a |
| 3. d | 6. c | 9. c | 12. d |

→ Quiz deadline: March 1, 2017

1. Community-based participatory research (CBPR) can serve as a process to \_\_ health or environmental concerns.
  - a. identify
  - b. prioritize
  - c. address
  - d. all the above
  - e. none of the above
2. In 2001, the National Institute of Environmental Health Sciences endorsed six principles of CBPR, which include all of the following except
  - a. ensuring projects are community-driven.
  - b. fundraising for the community.
  - c. promoting active collaboration and participation at every stage of research.
  - d. disseminating results in useful terms.
3. One of the project's objectives was to identify the community's environmental concerns and prioritize them based on their impact on the community and the community members' perceived urgency for action.
  - a. True.
  - b. False.
4. Which of the following was not a primary goal of the Wichita Initiative to Renew the Environment (WIRE)?
  - a. Reduce exposures to toxic pollutants through collaborative action.
  - b. Help communities understand all potential sources of exposure to toxic pollutants.
  - c. Provide monetary compensation for healthcare.
  - d. Create self-sustaining community-based partnerships.
5. The project area identified as "community" for this project was chosen for its geographic and social characteristics.
  - a. True.
  - b. False.
6. WIRE met with \_\_ individuals from the community and conducted \_\_ discussion groups to learn the environmental concerns of the community.
  - a. 1,500; 10
  - b. 1,500; 52
  - c. 2,000; 52
  - d. 2,000; 92
7. Upon conclusion of the discussion group phase of the project, an environmental leadership council (ELC) of \_\_ members was established.
  - a. 10
  - b. 25
  - c. 40
  - d. 50
8. The community's environmental health concerns were stratified by the ELC into three environmental media:
  - a. water, solid waste, and hazardous waste.
  - b. air, water, and hazardous waste.
  - c. air, groundwater, and drinking water.
  - d. air, water, and solid waste.
9. After participating in the community education campaign, community members were asked to prioritize the 19 environmental health concerns by rating each concern on five criteria, which include all of the following except
  - a. risk to the economy.
  - b. risk to health.
  - c. urgency for action.
  - d. risk to the environment.
  - e. cost to remediate the concern.
10. The highest prioritized environmental concern was \_\_.
  - a. groundwater contamination
  - b. trash collection
  - c. vapor intrusion
  - d. trash disposal
11. The lowest prioritized environmental concern was \_\_.
  - a. groundwater contamination
  - b. trash collection
  - c. vapor intrusion
  - d. trash disposal
12. Which of the following was not one of the 19 prioritized environmental concerns?
  - a. Pollution in the Arkansas River.
  - b. Vectorborne diseases.
  - c. Secondhand smoke.
  - d. Blight/sprawl.

# SUPPORT

## THE NEHA ENDOWMENT FOUNDATION

The NEHA Endowment Foundation was established to enable NEHA to do more for the environmental health profession than its annual budget might allow. Special projects and programs supported by the foundation will be carried out for the sole purpose of advancing the profession and its practitioners.

Individuals who have contributed to the foundation are listed below by club category. These listings are based on what people have actually donated to the foundation—not what they have pledged. Names will be published under the appropriate category for one year; additional contributions will move individuals to a different category in the following year(s). For each of the categories, there are a number of ways NEHA recognizes and thanks contributors to the foundation. If you are interested in contributing to the Endowment Foundation, please call NEHA at 303.756.9090. You can also donate online at [www.neha.org/donate](http://www.neha.org/donate).

*Thank you.*

### DELEGATE CLUB (\$25–\$99)

Name in the Journal for one year and endowment pin.

**Richard W. Mitzelfelt**  
Edgewood, NM

### HONORARY MEMBERS CLUB

(\$100–\$499)

Letter from the NEHA president, name in the Journal for one year, and endowment pin.

**Tim Hatch, MPA, REHS**  
Montgomery, AL

**Adam E. London, RS, MPA**  
Grand Rapids, MI

**Ned Therien, MPH**  
Olympia, WA

### 21st CENTURY CLUB (\$500–\$999)

Name submitted in drawing for a free one-year NEHA membership, name in the Journal for one year, and endowment pin.

**Bob Custard, REHS, CP-FS**  
Lovettsville, VA

**David T. Dyjack, DrPH, CIH**  
Denver, CO

**Bette J. Packer**  
Ham Lake, MN

**Peter M. Schmitt**  
Shakopee, MN

**LCDR James Speckhart, MS**  
Silver Spring, MD

### SUSTAINING MEMBERS CLUB

(\$1,000–\$2,499)

Name submitted in drawing for a free two-year NEHA membership, name in the Journal for one year, and endowment pin.

**James J. Balsamo, Jr., MS, MPH, MHA, RS, CP-FS**  
Metairie, LA

**Gavin F. Burdge**  
Lemoigne, PA

**George A. Morris, RS**  
Dousman, WI

### AFFILIATES CLUB

(\$2,500–\$4,999)

Name submitted in drawing for a free AEC registration, name in the Journal for one year, and endowment pin.

**Vince Radke, MPH, REHS, CP-FS, DAAS, CPH**  
Atlanta, GA

### EXECUTIVE CLUB AND ABOVE

(\$5,000–\$100,000)

Special invitation to the AEC President's Reception, name in the Journal for one year, and endowment pin.

## NEHA ENDOWMENT FOUNDATION PLEDGE CARD

I pledge to be a NEHA Endowment Foundation Contributor in the following category:

- |   |  |  |
|---|--|--|
| <input type="radio"/> Delegate Club (\$25)              | <input type="radio"/> Affiliates Club (\$2,500)            | <input type="radio"/> Visionary Society (\$50,000)   |
| <input type="radio"/> Honorary Members Club (\$100)     | <input type="radio"/> Executive Club (\$5,000)             | <input type="radio"/> Futurists Society (\$100,000)  |
| <input type="radio"/> 21st Century Club (\$500)         | <input type="radio"/> President's Club (\$10,000)          | <input type="radio"/> <b>You have my permission to disclose the fact and amount (by category) of my contribution and pledge.</b> |
| <input type="radio"/> Sustaining Members Club (\$1,000) | <input type="radio"/> Endowment Trustee Society (\$25,000) |  |

I plan to make annual contributions to attain the club level of \_\_\_\_\_ over the next \_\_\_\_\_ years.

Signature \_\_\_\_\_ Print Name \_\_\_\_\_

Organization \_\_\_\_\_ Phone \_\_\_\_\_

Street Address \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Enclosed is my check in the amount of \$\_\_\_\_\_ payable to **NEHA Endowment Foundation**.

Please bill my: MasterCard/Visa/American Express # \_\_\_\_\_ Exp. Date \_\_\_\_\_ CWV \_\_\_\_\_

Signature \_\_\_\_\_

**MAIL TO: NEHA, 720 S. Colorado Blvd., Suite 1000-N, Denver, CO 80246, or FAX to: 303.691.9490.**

1612JEHEND

# SPECIAL NEHA MEMBERS

## Sustaining Members

**Advanced Fresh Concepts Corp.**  
www.afcsushi.com

**Albuquerque Environmental Health Department**  
www.cabq.gov/environmentalhealth

**Allegheny County Health Department**  
www.achd.net

**American Chemistry Council**  
www.americanchemistry.com

**Anua**  
www.anuainternational.com

**Arlington County Public Health Division**  
www.arlingtonva.us

**Association of Environmental Health Academic Programs**  
www.aehap.org

**Black Hawk County Health Department**  
www.co.black-hawk.ia.us/258/Health-Department

**Cabell-Huntington Health Department**  
www.cabellhealth.org

**Chemstar Corporation**  
www.chemstarcorp.com

**City of Bloomington**  
www.bloomingtonmn.gov

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

**City of St. Louis Department of Health**  
www.stlouis-mo.gov/government/departments/health

**Coconino County Public Health**  
www.coconino.az.gov

**Colorado Department of Public Health & Environment, Division of Environmental Health and Sustainability, DPU**  
www.colorado.gov/pacific/cdphe/dehs

**Custom Data Processing, Inc.**  
www.cdpehs.com

**Denver Department of Environmental Health**  
www.denvergov.org/DEH

**Diversey, Inc.**  
www.diversey.com

**Douglas County Health Department**  
www.douglascountyhealth.com

**DuPage County Health Department**  
www.dupagehealth.org

**Eastern Idaho Public Health District**  
www.phd7.idaho.gov

**Ecobond Lead Defender**  
www.ecobondlb.com

**Ecolab**  
www.ecolab.com

**EcoSure**  
gail.wiley@ecolab.com

**Elite Food Safety Training**  
www.elitefoodsafety.com

**Florida Department of Health in Sarasota County**  
http://sarasota.floridahealth.gov

**Georgia Department of Public Health, Environmental Health Section**  
http://dph.georgia.gov/environmental-health

**Gila River Indian Community: Environmental Health Service**  
www.gilariver.org

**GLO GERM/Food Safety First**  
www.glogerm.com

**Hawkeye Area Community Action**  
www.hacap.org

**Health Department of Northwest Michigan**  
www.nwhealth.org

**HealthSpace USA Inc**  
www.healthspace.com

**Heuresis Corporation**  
www.heuresistech.com

**Hoot Systems, LLC**  
http://hootsystems.com

**Industrial Test Systems, Inc.**  
www.sensafe.com

**INGO, LLC**  
www.ingofirms.com

**Inspect2GO Health Inspection Software**  
www.inspect2go.com/ehs

**InspekPro, LLC**  
www.inspekpro.com

**ITW Pro Brands**  
http://itwprofessionalbrands.com

**Jackson County Environmental Health**  
www.jacksongov.org/EH

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

**Kanawha-Charleston Health Department**  
www.kchdvw.org

**Kenosha County Division of Health**  
www.co.kenosha.wi.us/index.aspx?NID=297

**LaMotte Company**  
www.lamotte.com

**Lenawee County Health Department**  
www.lenaweehealthdepartment.org

**Linn County Public Health**  
www.linncounty.org/health

**Macomb County Environmental Health Association**  
jarrod.murphy@macombgov.org

**Maricopa County Environmental Services**  
www.maricopa.gov/envsvc

**Metro Public Health Department**  
www.nashville.gov

**Micro Essential Lab**  
www.microessentiallab.com

**Mid-Iowa Community Health**  
www.micaonline.org

**Multnomah County Environmental Health**  
www.multco.us/health

**Nashua Department of Health**  
Nashua, NH

**National Center for Healthy Housing**  
www.nchh.org

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

**National Swimming Pool Foundation**  
www.nspf.org

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

**North Bay Parry Sound District Health Unit**  
www.myhealthunit.ca/en/index.asp

**Nova Scotia**  
Truro, NS, Canada

**NSF International**  
www.nsf.org

**Omaha Healthy Kids Alliance**  
www.omahahealthykids.org

**Ozark River Hygienic Hand-Wash Station**  
www.ozarkriver.com

**Polk County Public Works**  
www.polkcountyiowa.gov/publicworks

**Pride Community Services**  
www.prideinlogan.com

**Procter & Gamble Co.**  
www.pg.com

**Professional Laboratories, Inc.**  
www.prolabinc.com

**Prometric**  
www.prometric.com

**Protec Instrument Corporation**  
www.protecinstrument.com

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

**San Jamar**  
www.sanjamin.com

**Seattle & King County Public Health**  
www.kingcounty.gov/healthservices/health.aspx

**Seminole Tribe of Florida**  
www.seminoletribe.com

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

**Skogen's Festival Foods**  
www.festfoods.com

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

**Southwest District Health Department**  
www.swdh.org

**Southwest Utah Health Department**  
www.swuhealth.org

**Starbucks Coffee Company**  
www.starbucks.com

**StateFoodSafety.com**  
www.statefoodsafety.com

**Stater Brothers Market**  
www.staterbros.com

**Steritech Group, Inc.**  
www.steritech.com

**Sweeps Software, Inc.**  
www.sweepssoftware.com

**Taylor Technologies, Inc.**  
www.taylor technologies.com

**Texas Roadhouse**  
www.texasroadhouse.com

**Tri-County Health Department**  
www.tchd.org

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

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

**Williams Comfort Products**  
www.wfc-fc.com

**XTIVIA**  
www.xtivia.com

## Educational Institution Members

**Baylor University**  
www.baylor.edu

**East Carolina University**  
www.ecu.edu/cs-hhp/hlth

**East Tennessee State University, DEH**  
www.etsu.edu

**Eastern Kentucky University**  
http://ehs.eku.edu


**Illinois State University**  
www.ilstu.edu

**Michigan State University, Online Master of Science in Food Safety**  
www.online.foodsafety.msu.edu

**The University of Findlay**  
www.findlay.edu

**University of Illinois Springfield**  
www.uis.edu/publichealth

**University of Wisconsin-Oshkosh, Lifelong Learning & Community Engagement**  
www.uwosh.edu/lfce

**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.



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REHS, CP-FS  
Immediate  
Past-President

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davidriggs@comcast.net

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vradke@bellsouth.net

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POliverMSM@aol.com

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BobCustard@comcast.net

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ddyjack@neha.org

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nedinoly@juno.com  
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kallenrehs@yahoo.com  
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roykehs@laramiecounty.com  
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sharon.l.smith@state.mn.us  
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South Dakota, and Wisconsin. Term expires 2019.

**Region 5—Sandra Long, REHS, RS,** Inspection Services Supervisor, City of Plano Health Department, Plano, TX.  
sandra.l@plano.gov  
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lmadison@hline.org  
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tim.hatch@adph.state.al.us  
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**Region 8—LCDR James Speckhart, MS, USPHS,** Health and Safety Officer, FDA, CDRH-Health and Safety Office, Silver Spring, MD.  
jamesmspeckhart@gmail.com  
Delaware, Maryland, Pennsylvania, Virginia, Washington, DC, West Virginia, and members of the U.S. armed forces residing outside of the U.S. Term expires 2018.

**Region 9—Larry Ramdin, REHS, CP-FS, HHS,** Health Agent, Salem Board of Health, Salem, MA.  
lramdin@salem.com  
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chris.dankmeyer@maniilaq.org

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EncarnacionR@co.monterey.ca.us

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**Connecticut—Stacey Herbette,** Town of Wallingford, CT.  
stacey.herbette@gmail.com

**Florida—Michael Crea,** Sarasota, FL.  
crea@zedgepiercing.com

**Georgia—Tamika Pridgon,** tamika.pridgon@dpa.ga.gov

**Hawaii—John Nakashima,** Sanitarian IV, Food Safety Education Program, Hawaii Dept. of Health, Hilo, HI.  
john.nakashima@doh.hawaii.gov

**Idaho—Tyler Fortunati,** Idaho Dept. of Environmental Quality, Meridian, ID.  
tyler.fortunati@deq.idaho.gov

**Illinois—Katie Lynn,** Fulton County Health Dept., Canton, IL.  
klynn@fultonco.org

**Indiana—Mike Sutton,** Dept. of Environmental Management, Indianapolis, IN.  
msutton@idem.in.gov

**Iowa—Sandy Bubke, CEHT, HHS,** Manager, Monona County Environmental Health, Onawa, IA.  
mocoenvr@longlines.com

**Jamaica—Rowan Stephens,** St. Catherine, Jamaica.  
info@japhi.org.jm

**Kansas—Ed Kalas, RS,** Plus or Minus 2 Degrees, LLC, Silver Lake, KS.  
ed.kalas@yahoo.com

**Kentucky—Erica L. Brakefield, RS,** Technical Consultant, Kentucky Dept. for Public Health, Frankfort, KY.  
kentuckyeha@gmail.com

**Louisiana—Bill Schramm,** Louisiana Dept. of Environmental Quality, Baton Rouge, LA.  
bill.schramm@la.gov

**Maryland—James Lewis,** Westminster, MD.  
jlewis@mde.state.md.us

**Massachusetts—Leon Bethune,** Director, Boston Public Health Commission, West Roxbury, MA.  
bethleon@aol.com

**Michigan—Mary Farmer,** Jackson County Health Dept., Jackson, MI.  
mfarmer@meha.net

**Minnesota—Jeff Luedeman, REHS,** Minnesota Dept. of Agriculture, St. Paul, MN.  
jeff.luedeman@state.mn.us

**Mississippi—Susan Bates,** Mississippi Dept. of Health/Webster County Health

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## NEHA NEWS

**NEHA Staff Profile**

As part of tradition, NEHA features new staff members in the *Journal* around the time of their 1-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. Contact information for all NEHA staff can be found on page 45.

**Chelsea Maralason**

When I was hired at NEHA as the marketing and communications specialist last December, I was thrilled to have found an organization that has such a strong focus on environmental health and our community. As a lifelong environmentalist, I was drawn to NEHA's missions and values.

A major focus this year in my position was working closely with our Annual Educational Conference (AEC) & Exhibition. The 2016 AEC was such a great event and a wonderful introduction to our members. I helped develop the meeting app that many of you used at the conference, as well as the polling feature that helped audiences engage

with speakers during sessions. Another portion of my time is spent with our digital marketing efforts and social media.

I moved from Michigan to Denver last December, after graduating from Wayne State University in Detroit with a degree in journalism. While I loved journalism, it was marketing that I always found my way into. NEHA was a perfect way to start my marketing career. Outside of the office, I am taking up everything the beautiful state of Colorado has to offer. I love hiking with my two rescue dogs, Frida and Lucy, especially up in the mountains where my sister lives. I feel very lucky to have found both a career and a city that feel like home.

I was so happy meeting so many of you face to face at the 2016 AEC and look forward to the 2017 AEC in Grand Rapids, Michigan—a place close to my heart. If you need any recommendations for a brewery or restaurant, let me know! 🐾



## 2017 Joe Beck Educational Contribution Award

This award was established to recognize NEHA members, teams, or organizations for an outstanding educational contribution within the field of environmental health.

Named in honor of the late Professor Joe Beck, this award provides a pathway for the sharing of creative methods and tools to educate one another and the public about environmental health principles and practices. Don't miss this opportunity to submit a nomination to highlight the great work of your colleagues!

**Nomination deadline is March 15, 2017.**

To access the online application, visit  
[www.neha.org/joe-beck-educational-contribution-award](http://www.neha.org/joe-beck-educational-contribution-award).



# IN MEMORIAM

## Ron de Burger

NEHA was saddened to learn that Ron de Burger passed away on August 5, 2016. Over his 52-year career, de Burger was a highly respected leader in environmental public health in Canada, as well as the U.S and abroad. He began his career as a public health inspector in 1965. He went on to work at Ryerson University (1969–1982), the Province of British Columbia's Preventive Health Services (1982–1988), Dalhousie University (1988–1991), Ottawa's AIDS Education and Awareness Program (1991–1998), and Health Canada (1998–2001). De Burger finished his career as the director of Toronto Public Health's Healthy Environments department, retiring in 2014.

De Burger had a longstanding history of involvement with the Canadian Institute of Public Health Inspectors (CIPHI), serving as its national president from 1976–1980. In recognition of his contributions and dedication as a member and strong supporter of CIPHI, he was awarded life membership in 1983. In addition, he was president of the Canadian Public Health Association, an honorary member of the Ontario Public Health Association, a member of the advisory board to the National Collaborating Centre for Environmental Health (NCCEH), and served on the advisory council for the National Collaborating Centres for Public Health.

His involvement in environmental public health did not know borders. De Burger had been an active member of NEHA since 2001. He served as a technical advisor for NEHA in workforce development and general environmental health. He was a valuable and thoughtful peer reviewer for the *Journal of Environmental Health*. He also shared his knowledge and expertise as a speaker at several NEHA annual conferences.

Sylvanus Thompson, a friend and former Toronto Public Health colleague, shared, "Ron was an accomplished public health professional who was totally dedicated to NEHA, CIPHI, and similar professional organizations. Ron was not just my mentor, but also a friend. I benefitted significantly from his willingness to share his vast knowledge and experience. I have numerous cherished moments with Ron, but the proudest one will always be both of us accepting the Samuel J. Crumbine Consumer Protection Award on behalf of Toronto Public Health in 2011."

In a tribute to de Burger's legacy, NCCEH has named its Student Project Award in his honor. The Ron de Burger Student Award is an annual award offered to students involved in Canadian postsecondary institutions offering a public health inspection program or a degree in public health.

NEHA wishes to express its deepest sympathies to de Burger's family, colleagues, and friends. He was an outstanding figure in the field of environmental public health and will be greatly missed.

## Lawrence Pong

NEHA was saddened to learn that Lawrence Pong passed away on August 7, 2016. He was a consummate environmental health professional who was nationally recognized as a food safety subject matter expert. He worked for the City and County of San Francisco's Department of Environment Health for over 35 years as a principle environmental health inspector and manager of training, as well as the department's lead foodborne outbreak investigator. He taught food safety classes at San Francisco City College's Department of Biology until his passing.

Pong was an energetic person who loved to share his knowledge with others. He had an unequaled knowledge of retail food safety, especially ethnic food safety. His presentations at numerous conferences were always entertaining, relevant, and extremely educational, and in most cases, they were standing-room only. He spoke at several NEHA annual conferences and was a trainer for NEHA's Epi-Ready project in the mid-2000s. Among other contributions, Pong was an item writer and reviewer for the food manager certification examination created by the National Registry of Food Safety Professionals.

He also shared his passion and energy with several organizations, such as NEHA and the National Automatic Merchandising Association's (NAMA's) Automatic Merchandising Health Industry Council. Dr. David McSwane, executive director of the Conference for Food Protection, shared, "Lawrence was always thinking about new innovations regarding the vending of food and beverages—even before the industry had thought of it. Many of his ideas about training regulators on how to inspect vending machines were incorporated into NAMA training seminars."

"I will miss Larry as he was one of my best personal and professional acquaintances. His legacy will be that he has set a role model for present and future environmental health professionals to follow. Larry will be sorely missed by the entire environmental health profession," stated George Nakamura, longtime friend and fellow food safety expert.

NEHA wishes to express its deepest sympathies to Pong's family, colleagues, and friends. He was an outstanding figure in the field of food safety and environmental health. He will be greatly missed. 🌹

Editor's Note: The *Journal* will publish the In Memoriam section twice a year in the June and December issues. If you would like to share information on the passing of a noteworthy environmental health professional, please contact Kristen Ruby-Cisneros at [kruby@neha.org](mailto:kruby@neha.org).

**DirectTalk**

*continued from page 50*

would love to have each of you feel personally tethered to NEHA, realistically, our country is far too large for all of us to genuinely feel that way. This realization is why strong, well-managed state affiliates are vital to the profession. Too many states either don't have an affiliate or the current one is in disarray. We have to figure this situation out, and I will personally invest in the creation, construction, and strengthening processes in support of local affiliates. If you have ideas on how best to accomplish this initiative, I want to hear from you.

I feel that self-reinforcing professional cohesion is a legacy issue for my time as executive director. States, localities, and chapters should be mutually supportive and strategically cooperative. To jump-start the process, we plan to provide targeted training for affiliate presidents at our AEC. Next year I intend to visit with some of the largest private foundations in the U.S. in an attempt to secure resources to blow life into this critical initiative.

We are indeed only as strong as our weakest link. I ponder what has become of the once proud Greek intellectual and cultural revolution as a clarion call to action for our profession. Now is not the time for status quo.

The return trip to my hotel from the scuba diving site developed into a classic Greek drama. First, no one could locate the driver for the return ride home. In the process of waiting for the driver to materialize, we took on two additional passengers. They were to be dropped



*Remnants of the Hygeia Temple. Photo courtesy of David Dyjack.*

off first, some 30 kilometers from where most of us were staying. The drive home was a vintage knuckle biter for sure, courtesy of hairpin turns executed at high speeds on narrow Greek roads; however, we enjoyed the camaraderie and embraced the pure joy of the experience.

2017 will likely be a knuckle biter for us as well. There will be sharp bends in the road associated with the incoming presidential administration, and the implications of the new Congress remain uncertain. We have new systems, policies, and efforts for profes-

sional cohesion to forge. Any great endeavor inevitably incurs some measure of fear and anxiety along the route. I say the ride is worth it. Let's enjoy our camaraderie and drink deeply from the spirit of the Christmas season along the way.

Happy holidays and best wishes for the new year. 🐻

*Dave*

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## Exhibition

### Exhibitors

Be sure to reserve your booth! Space is limited, so don't miss being part of this year's conference. Exhibiting at the AEC allows you to meet face-to-face with 1,000 environmental health professionals from all over the nation.

Exhibit Booth Purchase  
[neha.org/aec/exhibition](http://neha.org/aec/exhibition)

## Reservations

Hotel reservations available in late December at [neha.org/aec/hotel](http://neha.org/aec/hotel).



Photos Courtesy of Experience Grand Rapids

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David Dyjack, DrPH, CIH

## Tied to the Mast

**A**thenian nature is social, communicative, and restless, while not necessarily troubled by punctuality. So, I was more than pleased when the Kalypso Divers' van arrived promptly at 8 a.m. to whisk me and a handful of Russians and Danes out for a day of scuba diving in the Libyan Sea. The route we travelled originated in the timeless old city of Rethymno as we embarked on a tortured, 60-minute drive over narrow and winding roads to the south of Crete.

The initial adrenalin rush of the scuba diving experience was punctuated by the presence of yellow-headed moray eels some 80–100 feet beneath the surface. Stones comprised the foundation of the sea bottom, providing safe haven for vulnerable marine life and a stabilizing presence against erosion. After achieving neutral buoyancy, I reflected on Greek mythology, particularly on the goddess Hygeia—the personification of health and cleanliness. The Greeks were among the first to recognize the value of the healing and disease prevention arts, as much of the modern public health profession is grounded by the efforts of environmental health professionals. We benefit by learning from what history can teach us as we embark on our journey into the future.

What did we learn in 2016? We started each NEHA staff meeting with a member who had 30 minutes to tell us about their experience with NEHA, no holds barred. I deliberately invited members who had expressed displeasure with us. We received an earful of criticism from these members about our Web site being light on content. The second most common

*None of us  
is as smart  
as all of us.*

observation was that we can do a better job at explaining the value of membership. Perhaps most surprising, our partners in Washington, DC, expressed a pent up demand for NEHA to exert leadership on the national stage.

As we transition from 2016 into 2017, let's consider influencing the new presidential administration, prioritizing and energizing our policy activities, and renewing our commitment to one another. NEHA will do its part by focusing on three key initiatives.

### **Initiative 1: Policy Development**

Yes, our Washington, DC, office has achieved considerable traction since we opened operations 1 year ago, and there is so much more to accomplish. This upcoming year we will support Congresswoman Brenda Lawrence's (D-Michigan) Environmental Health Workforce Act of 2016 (H.R. 5543), conduct our first "Hill Day" sometime this spring, and deliver leadership on issues important to you. We hosted a very successful Capitol Hill briefing last July, and will likely convene another this spring. You asked for a voice in the nation's capital, and now you have one.

We will also review, update, and sunset as appropriate the plethora of position and policy statements that can be currently found on our Web site. The board will work with staff to identify emerging issues that will benefit from a new set of eyes and attendant policies. These policies and position statements will be crafted to provide you guidance in your own work in the event you need it.

### **Initiative 2: Systems of Engagement**

None of us is as smart as all of us. NEHA recommits itself to stitching together a national system of engagement and to listen and learn from you. We have requested our regional vice-presidents to become intimately familiar with the needs of local affiliates and their members, and to ask, "How can NEHA assist?" We will complement that effort with our Centers for Disease Control and Prevention-funded environmental health workforce needs assessment. This work will begin in earnest through the conduct of focus groups at our 2017 Annual Educational Conference (AEC) & Exhibition. We understand our core mission is capacity building and desire to provide you with what you need to know and when you need to know it, in a format conducive for you.

### **Initiative 3: Professional Environment**

Social science research has established that a cohesive workforce is a more productive workforce. At the same time, there is a transformative power of proximity. As much as I

*continued on page 48*



# Share your success and shine a light on **innovation**

For the past two years, our Building Capacity column in the *Journal* has featured fresh ideas and the work of innovative thought leaders.

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# Atrazine in Kentucky Drinking Water: Intermethod Comparison of U.S. Environmental Protection Agency Analytical Methods 507 and 508.1

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**Abstract** This study examines the analytical methods used to test drinking water for atrazine along with the seasonal variation of atrazine in drinking water. Samples from 117 counties throughout Kentucky from January 2000 to December 2008 were analyzed. Methods 507 and 508.1 were compared using the Mann-Whitney U test. Median values of these methods were similar ( $p = .7421$ ). To examine seasonal variation, data from each year and from the entire period were analyzed using one-way ANOVA; pairwise multiple comparisons were made for years with significant differences. All the years except 2001, 2005, 2006, and 2007 had significantly different atrazine concentrations between seasons. The Seasonal Kendall Test for Trend was used to identify trends in atrazine over time. Yearly means ranged from 0.000043 mg/L ( $\pm 0.000011$  mg/L) to 0.000995 mg/L ( $\pm 0.000510$  mg/L). The highest levels were observed during spring in most years. A significant ( $p = .000092$ ) decreasing trend of  $-7.6 \times 10^{-6}$  mg/L/year was found. Decreasing trends were also present in all five regions of the state during this period. This study illustrates the need for changes in sampling methodology used today, so that effective exposure assessments can be conducted to study the public's exposure to atrazine in drinking water.

## Introduction

Worldwide pesticide use has increased dramatically, with pesticide production doubling every 10 years since 1945 (Dich, Zahm, Hanberg, & Adami, 1997). Atrazine, a restricted-use, triazine herbicide used to inhibit the growth of broadleaf and grassy weeds in the production of corn and other crops, is one of the most commonly used pesticides in the U.S., with approximately 75 million pounds used in 1997 and nearly 80 million pounds used in 2007 (Grube, Donaldson, Kiely, & Wu, 2011; Kiely, Donaldson, & Grube, 2004).

Concerns regarding atrazine include its mobility and potential to contaminate ground and surface freshwater sources, both of which are used as drinking water supplies. Today, it is one of the most frequently detected agricultural chemicals found in drinking water samples (Benotti et al., 2009). Adverse health effects in animals and humans make drinking water contamination a public health concern. A study conducted by Golla and co-authors (2012) found that community drinking water sources had significantly higher atrazine concentrations compared with noncommunity sources.

Atrazine has known endocrine-disrupting potential in animals. Endocrine disruption has been observed in aquatic organisms, such as frogs, causing demasculinization at concentrations below the maximum contaminant level (MCL), and as low as 0.1 parts per billion (ppb) (Hayes et al., 2002). Similar effects have been seen in rats (Cooper, Stoker, Tyrey, Goldman, & McElroy, 2000; Stoker, Laws, Guidici, & Cooper, 2000).

Nonendocrine-disrupting effects have also been observed. According to the *Atrazine Health and Safety Guide* published by the World Health Organization (1990), cardiac toxicity was observed in dogs after long-term oral administration of atrazine and studies on rats have shown that atrazine and its metabolites bind effectively to red blood cells and to the tissues of some of the major organs. Further, rats and mice have shown reduced food intake, decreased weight gain, and toxic effects, such as muscle and retinal degeneration, necrosis of the liver, and hematological effect following atrazine exposure. Additionally, an increase in mammary tumors was observed in rats. Some of the toxic effects of atrazine could be due to its direct impact on dendritic cell maturation and function (Pinchuk, Lee, & Filipov, 2007).

Although atrazine has demonstrated adverse health outcomes in animals, studies of the human health effects of atrazine are inconclusive and warrant further investigation. Atrazine has a potential to cause many acute health issues in humans, including muscle spasms, hypotension, antidiuresis, adrenal degeneration, and congestion of heart, lungs, and kidneys (U.S. Environmental Protection Agency [U.S. EPA], 2012). These health issues occur especially with exposures above

the MCL. Documented chronic health effects in humans due to the consumption of atrazine-contaminated water include weight loss, mammary tumors, muscle and retinal degeneration, and cardiovascular damage.

Atrazine can have carcinogenic potential when there are lifetime exposures above the MCL (U.S. EPA, 2012). Further, atrazine has been identified as an estrogen; it has been demonstrated that xenoestrogens can promote cancer by enhancing the production of genotoxic estrogens and mutations in cells. Exposure to excess estrogen is considered to be a risk factor for the development of breast cancer (Kettles, Browning, Prince, & Horstman, 1997). For these reasons, U.S. EPA has classified atrazine as a “possible human carcinogen” (group C) under the cancer assessment guidelines (U.S. EPA, 2002).

Atrazine has also been linked to negative reproductive health endpoints, including preterm birth, intrauterine growth retardation, and various birth defects (Agopian, Cai, Langlois, Canfield, & Lupo, 2013; Agopian, Langlois, Cai, Canfield, & Lupo, 2013; Agopian, Lupo, Canfield, & Langlois, 2013; Munger et al., 1997; Rinsky, Hopenhayn, Golla, Browning, & Bush, 2012).

Ingestion is a major route of human exposure to atrazine; therefore, contamination of drinking water supplies with atrazine poses an important risk to public health, especially in Midwestern states where atrazine is most commonly applied.

Due to atrazine's potential human health effects, U.S. EPA has established an MCL of 0.003 mg/L (3 ppb) (Agency for Toxic Substances and Disease Registry, 2003). Specifically, the Safe Drinking Water Act (SDWA) requires every public water system to test for atrazine quarterly and maintain an average annual level at or below the MCL (U.S. EPA, 2012).

U.S. EPA has approved six analytical methods for the detection and quantification of atrazine in drinking water under 40 C.F.R. 141.24–505, 507, 508.1, 525.2, 551.1 (40 C.F.R. § 141.24, 2003); U.S. EPA method 8270C, a common Resource Conservation and Recovery Act compliance analysis method, is also capable of detecting atrazine in water. All of these methods utilize gas chromatography, the preferred analytical method to detect atrazine in water, and many share process and analytic procedures (Munch, 1995a, 1995b, 1995c, 1995d; U.S. EPA, 1996). Even though

U.S. EPA has approved six analytical methods, there has been little published research concerning the similarity of results obtained using each method.

In addition, although regular monitoring is required, utilization of quarterly sampling and an annual average might not provide a complete picture of atrazine in drinking water. Levels of atrazine in drinking water sources are influenced by myriad factors, including seasonal variation. Atrazine concentrations were found in farmhouses not only in the planting season, but also in the nonplanting season (Golla, Curwin, Sanderson, & Nishioka, 2012). A similar trend was seen by Ochoa-Acuna and co-authors (2009) in Indiana water systems, with atrazine concentrations peaking in spring and early summer. Additionally, Villanueva and co-authors (2005) found elevated levels of atrazine in drinking water in Brittany in spring, with levels tapering off throughout the rest of the year.

The objective of this study was to characterize sources of variation in atrazine concentrations in Kentucky drinking water samples collected during 2000–2008. This objective was addressed through comparing results from approved U.S. EPA analytical methods and identifying seasonal variation in atrazine concentrations over time.

## Methods

Kentucky is among the heaviest users of atrazine in the U.S., applying 1.9 million pounds of atrazine in 2010 (U.S. Department of Agriculture, 2010). It is known that atrazine makes its way into bodies of water such as streams, rivers, and lakes primarily through runoff from the fields (U.S. EPA, 2013). When these bodies of water happen to be drinking water sources, there is a potential for atrazine exposure through ingestion. This situation presents an opportunity to study atrazine variability in drinking water over time. Data for this study were obtained from two sources, the Kentucky Department for Environmental Protection's Division of Water and the Kentucky Geological Survey.

The two data sources included a total of 11,218 samples from 117 of the 120 counties in Kentucky. Data were collected in 1991–2008. Samples were analyzed using multiple methods, including U.S. EPA analytical methods 505, 507, 508.1, 525.2, and 8270C. Only one data set contained data prior to year 2000. Con-

sequently, analyses were restricted to data collected during 2000–2008. Information available from both data sources included analyte name, water supply identification number, sample date, county, analytical method used, analytical method limit of detection, and atrazine concentration (in  $\mu\text{g/L}$  or  $\text{mg/L}$ ). All results in  $\mu\text{g/L}$  were converted to  $\text{mg/L}$ .

## Intermethod Comparison of U.S. EPA Analytical Methods 507 and 508.1

Of the aforementioned methods for analysis of atrazine in drinking water, four are commonly used in Kentucky: 507, 508.1, 525.2 and 8270C. Samples missing necessary information (i.e. sampling date, county, atrazine concentration ( $\text{mg/L}$ ), and analytical method) were excluded, as were any samples analyzed using a method other than those previously mentioned. In all, 33 data pairs were available to compare analytical methods 507 and 508.1, while the other methods did not yield more than one data pair during the study period. Consequently, only analytical methods 507 and 508.1 were compared. Differences in the results of the two methods were formally assessed using the Mann-Whitney U test.

## Assessing Seasonal Variation

For the assessment of seasonal variation in atrazine concentrations, we included data provided from both sources on samples analyzed using any of the approved analytical methods. Data points that did not include a sample date in 2000–2008, county, or result were excluded. Of the 11,218 total samples collected, 4,129 samples were retained for statistical analysis.

In accordance with U.S. EPA guidelines, atrazine methodology calls for quarterly samples to be taken each year (U.S. EPA, 2012). Here, we define the four sampling quarters as seasons. Samples were divided into seasons according to collection dates. If multiple samples were collected in a county within a single season, a mean value was calculated; mean seasonal concentrations were calculated for all five regions of Kentucky, as well as the entire state. Changes in mean atrazine concentrations over time were plotted and visually examined. Atrazine concentrations were log-transformed and analyzed using one-way ANOVA to determine differences in mean atrazine concentrations between seasons. Pairwise multiple comparisons analysis using

TABLE 1

**Analytical Method Usage by Total Number of Samples**

Method	Samples	
	<i>N</i> = 2,980	%
505	1	<0.01
507	527	17.7
508.1	77	2.6
525.2	497	16.7
8270C	1,611	54.1
Other	267	9.0

Tukey-Kramer adjustment was also used to determine differences between seasons. Inter-method comparison and seasonal variation analysis was performed using SAS version 9.2.

Finally, the Seasonal Kendall Test for Trend was used to determine if a linear trend of atrazine over time throughout the state exists. The Seasonal Kendall Test for Trend was applied to each of the five regions of Kentucky: Mississippian Plateaus (Pennyryle), Bluegrass, Jackson Purchase, Eastern Coal Field, and Western Coal Field. S-Plus version 6.2 was used for this analysis.

## Results

### Intermethod Comparison

Table 1 presents the overall use of each analytical method during 2000–2008 in terms of the total number of samples for which they were used. Method 8270C was the most commonly used method during the study period, with 54% of samples analyzed using this method. Together, methods 525.2 and 507 made up 34% of the analyzed samples, with the remainder using methods 505, 508.1, and others. There were 33 pairs of samples taken within the same county on the same day that were analyzed using U.S. EPA methods 507 and 508.1. These data points were used in the intermethod comparison analysis.

As shown in Table 2, method 507 had a mean concentration of 0.000330 mg/L ( $\pm$  0.000130 mg/L) and a median concentration of 0.000300 mg/L. Method 508.1 had a mean concentration of 0.000310 mg/L ( $\pm$  0.0000540 mg/L) and a median concentration of 0.000300 mg/L. The concentration of each data point is similar for 31 of the (Pennyryle) 33 drinking

TABLE 2

**Results of Intermethod Comparison Data**

Method	<i>N</i>	Mean (mg/L)	<i>SD</i> (mg/L)	Median (mg/L)	<i>p</i> -Value
507	33	0.000310	0.000126	0.0003	.7421
508.1	33	0.000330	0.000054	0.0003	

TABLE 3

**Number and Distribution of Samples by Year (2000–2008)**

Year	<i>N</i>	Mean (mg/L)	<i>SD</i> (mg/L)
2000	180	0.000146	0.000274
2001	217	0.000219	0.002040
2002	200	0.000186	0.000427
2003	195	0.000129	0.000359
2004	143	0.000239	0.000905
2005	260	0.0000995	0.000510
2006	289	0.000046	0.000140
2007	248	0.000043	0.000011
2008	257	0.000050	0.000143
2000–2008	1,989	0.000117	0.000772

*Note.* Yearly means ranged from 0.000043 mg/L ( $\pm$  0.000011 mg/L) to 0.000995 mg/L ( $\pm$  0.000510 mg/L).

water samples. The pairs differed at two points, both occurring on 6/7/2000, where method 508.1 had concentrations of 0.000586 mg/L (0.586 ppb) and 0.000436 mg/L (0.436 ppb) and method 507 had concentrations 0.000916 mg/L (0.916 ppb) and 0.000700 mg/L (0.7 ppb). Overall, there was no difference between the atrazine concentrations obtained by methods 507 and 508.1 ( $p$  = 0.7421).

### Seasonal Variation

The number and distribution of samples available for each year can be seen in Table 3. Results of the one-way ANOVA are presented in Figure 1. During the entire period (2000–2008), atrazine levels present in spring were higher than levels present in other seasons ( $p$  < .01). Levels in summer and fall were also higher than levels in winter ( $p$  < .05). Results from the ANOVA indicate significant differences ( $p$  < .05) during the 9-year period. Atrazine was highest in spring in all years except 2000 and 2003.

In 2000, spring and fall had similar concentrations of atrazine that were higher than those

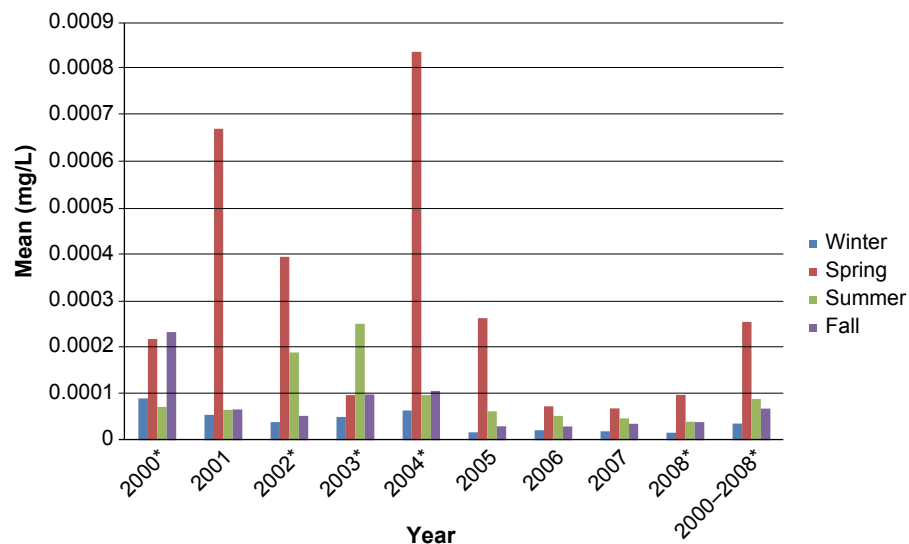
found in summer and winter. Fall was found to have significantly greater concentrations than both summer ( $p$  < .0001) and winter ( $p$  < .0001), and spring was found to be significantly greater than winter ( $p$  = .0168). In 2003, atrazine was higher in summer than all other seasons, although the difference was only significant between summer and winter ( $p$  = .0075).

In 2002, spring had significantly greater concentrations than both fall ( $p$  < .0001) and winter ( $p$  < .0001), and summer had significantly greater concentrations than both fall ( $p$  = .0422) and winter ( $p$  = .004). In 2004, spring had significantly greater concentrations than each of the other seasons ( $p$  = .0151,  $p$  = .0020, and  $p$  = .0005 for summer, fall, and winter, respectively). From 2006–2008, atrazine remained relatively low and was similar between seasons, although in 2008 concentrations were significantly different for spring and winter ( $p$  = .0311).

During the entire sampling period of 2000–2008, there was an overall constant decrease in the amount of atrazine in Kentucky drinking water. The Seasonal Kendall Test yielded a

FIGURE 1

### Mean Atrazine Levels (mg/L) by Season From 2000–2008 Obtained From One-Way ANOVA



\*Significant result ( $p < .05$ ).

TABLE 4

### Mean Atrazine Concentration in Kentucky Drinking Water by Region From 2000–2008 Using Seasonal Kendall Test for Trend

Region	Slope (mg/L/year)	p-Value
Jackson Purchase	$-7.16 \times 10^{-6}$	.0038
Western Coal Field	$-8.94 \times 10^{-6}$	.047
Bluegrass	$-5.31 \times 10^{-6}$	.00021
Eastern Coal Field	$-4.31 \times 10^{-6}$	.00055
Mississippian Plateaus (Pennyrile)	$-1.03 \times 10^{-5}$	.0015
Entire state	$-7.6 \times 10^{-6}$	.000092

significant estimated annual trend of  $-7.6 \times 10^{-6}$  mg/L/year ( $p = .000092$ ) for the entire state during the 2000–2008 period (Table 4). Additionally, there were no differences in this trend seen between seasons ( $p = 0.864$ ). Similar decreasing linear trends were seen throughout the five regions in the state during this period as well. The greatest decrease was seen in the Mississippian Plateaus (Pennyrile) region in Southern Kentucky ( $-1.03 \times 10^{-5}$  mg/L/year;  $p = .0015$ ).

## Discussion

Atrazine is among the most commonly used pesticides in the U.S., especially in corn-pro-

ducing states, which includes the Midwest, some southern states, and the Northeast. Kentucky ranks among the heavier users of atrazine. For this reason, the results of this study are likely generalizable to most states that use atrazine.

## Intermethod Comparison

U.S. EPA's approval of multiple methods for the analysis of atrazine in drinking water would indicate that similar results are to be expected from these methods. To date, however, there is little information regarding the similarity of results obtained using approved

methods. We observed concordance in results of atrazine concentrations in drinking water samples using U.S. EPA analytical methods 507 and 508.1. Although 507 and 508.1 are not the most widely used analytical methods in Kentucky (17.7% and 2.6% of samples, respectively), concordance in their results seems to suggest that the variability seen throughout the year is likely not due to variability in the analytical methods used.

## Seasonal Variation

Atrazine application typically occurs in spring, and therefore higher concentrations may be expected in spring than in other seasons. This trend was seen in most years, with 2000 and 2003 being the only years that did not see elevated levels in the spring. Interestingly, summer was also found to have significantly greater levels than both fall and winter in many years, suggesting that either atrazine use continued beyond spring into the summer months, or atrazine persisted in the environment and was subsequently released into drinking water throughout the summer.

Overall, the results of the seasonal variation of atrazine suggest that there is variability in the concentrations found in drinking water, with levels peaking in the spring and summer. Additionally, with few exceptions, Kentucky residents are not being exposed to levels of atrazine greater than the MCL mandated by U.S. EPA. While no statewide mean or median value exceeded the MCL of 0.003000 mg/L, only five counties exceeded the MCL at some point during the study period. The maintenance of low concentrations could be due to many factors, ranging from adequacy of control technology to pesticide usage.

Though the levels of atrazine are being maintained at levels deemed to be safe by U.S. EPA, the fluctuations throughout the year could lead to human exposures greater than the MCL. Though atrazine sales and use have increased steadily since its development, data indicate sales and use have been relatively stable over recent years, with between 70–80 million pounds used per year (Aspelin, Grube, Kiely, 1999; Grube et al., 2011; Kiely et al., 2004).

This information makes the finding of a decreasing linear trend throughout the state both surprising and encouraging. This decreasing trend could be due to many factors. Again, changes in control technologies



could result in better elimination of atrazine in drinking water, resulting in lower concentrations from year to year. Additionally, any changes in pesticide usage could account for some of this decrease. Interestingly, the U.S. Geological Survey found the opposite trend in southern streams: they observed a significant upward trend in atrazine concentration in urban streams in the South during 1996–2004 (Ryberg, Vecchia, Martin, & Gilliom, 2010).

The use of quarterly samples throughout the year might lead to an unrepresentative concentration of atrazine in drinking water for an entire year, as it might not adequately capture variability present throughout the year (Golla, 2003). As atrazine exposure has been linked to numerous adverse health outcomes, an underrepresentation of exposure could have important public health implications.

Increasing the number of necessary samples in peak usage seasons could lead to a better representation of public exposure to atrazine in drinking water and lead to methods to better control and maintain lower, stationary levels. Atrazine is known to be effectively removed from drinking water by the use of granular activated carbon (U.S. EPA, 2013). The best way to control atrazine levels in drinking water, however, is by following the recommended best management practices while applying this pesticide in the fields. This best practice in turn reduces the amount of atrazine that enters water through storm runoff (Devlin, Regehr, & Barnes, 2000).

This study relied on previously collected data, which did not allow the researcher to design and implement the sampling methodology. This limitation resulted in the ability to compare only two U.S. EPA analytical methods. The secondary data also did not supply information for every county in the state of Kentucky, nor were there samples for each season of each year for all counties within the state. Additionally, the methods used in SDWA analysis are advanced laboratory analytical methods and are conducted by many analysts, potentially leading to error in the analysis of the collected drinking water samples. Future research should address these shortcomings in order to gain a more complete picture of atrazine's persistence in drinking water.

### Conclusion

This study illustrates the need for changes in the sampling methodology used today, as the current sampling methodology poses the potential for an underestimation of atrazine in drinking water due to seasonal variability. Increased sampling could lead to a better estimation of public exposure. This study serves as a starting point for future research into the analysis of the current U.S. EPA methodology for testing drinking water for atrazine and its persistence in the environment. Continued examination of within- and between-season variations in atrazine in drinking water, using more advanced statistical techniques such as time series analysis, is necessary.

Additionally, further examination of the other analytical methods used to test for atrazine in drinking water is needed. Future research into new, more effective control technologies that could maintain stationary levels of atrazine in drinking water is also necessary in order to keep public exposure to a minimum. Continued examination of atrazine will provide a better understanding of atrazine's persistence in the environment and help to inform regulations, analytical methods, and policies for the control of human exposure to atrazine. 🐞

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