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The Importance of Environmental Health Expertise in Understanding Water Systems

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ABOUT THE COVER

In a review of Legionnaires' disease outbreaks reported to the Centers for Disease Control and Prevention (CDC) during 2000–2014, 85% of outbreaks were caused by problems that effective water management could have prevented. In this month's cover article, "Legionnaires' Disease at a Hotel in Missouri, 2015: The Importance of Environmental Health Expertise in Understanding Water Systems," CDC assisted state and local health departments to identify possible sources and transmission factors and to recommend improvements to water management during a Legionnaires' disease outbreak at a hotel. The article highlights the importance of environmental health professionals in helping to prevent Legionnaires' disease.

See page 8.

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PRESIDENT'S MESSAGE

Vince Radke, MPH, RS,
CP-FS, DLAAS, CPH

Show Me the Data

In the 1996 movie *Jerry Maguire*, sports agent Jerry Maguire (Tom Cruise) is asked by client Rod Tidwell (Cuba Gooding, Jr.) how negotiations with Rod's football team are going. During a phone call between the two, Rod emphatically instructs Jerry to "show me the money!" Like Rod, local and state leaders, the private sector, and people in our communities are asking, "Show me the data, the environmental health data!"

In environmental health, a few of us collect useful data that are used to improve the health of people in our communities. In many cases, environmental health data are not available to make decisions that can help reduce or prevent injuries, illnesses, and deaths. While at the Centers for Disease Control and Prevention (CDC), a colleague of mine from the National Center for Environmental Health (NCEH), along with other people from CDC, attended a breakfast with the director of CDC. During the breakfast my colleague described the work he was doing at NCEH. The director appreciated the work my colleague was doing but said (and I'm paraphrasing here), "You know the problem with environmental health, you have no data."

After hearing this story from my colleague, I was not happy but I did realize that the director was correct. When looking at the data my colleagues in epidemiology and laboratories were collecting to help solve human health issues, environmental health was a distant third. We are, however, making progress in data collection in some areas of environmental health, specifically food safety and recreational water use.

> *As environmental health professionals, we need to ask ourselves, "What do we not know that we need to know?"*

Historically, many in the food service industry were reluctant to spend money to develop and staff their restaurants with certified food protection managers (CFPMs). A few in the industry saw the wisdom of having CFPMs and went ahead and placed them in their restaurants. Most told the health departments, however, that there was a lack of data that showed having a CFPM improved food safety. As data (e.g., violations, illnesses, outbreaks) were collected and analyzed over time, the benefit of having a CFPM was shown. The food service industry took notice of this benefit and regulations were passed requiring a CFPM to be present in restaurants. A similar turn of events took place in the development of the Model Aquatic Health Code (MAHC). In its development, data on drownings, injuries, emergency department visits, and waterborne illness outbreaks were used. These data were used to help support the adoption of MAHC at state and local levels.

There are other areas in environmental health where we need data—vectorborne diseases, other waterborne diseases, hazardous and toxic substances, noise, and others. As environmental health professionals, we need to ask ourselves, "What do we not know that we need to know?" In addition, we need to take a step outside our environmental health comfort zone. We need economic data to go along with our environmental health data. To gather this information, we will need the help of others. We will need a health economist or public health economist, or better yet, an environmental health economist. Our primary data collection will always be around health but having economic data will support and lend weight to our environmental health data.

There needs to be a plan on what, how, and why we collect environmental health data. This situation reminds me of my time collecting routine environmental swab samples in kitchens as a young sanitarian at the Fairfax County Health Department. I would collect the samples, take them to the laboratory for analysis, and wait for the results. When the results came back positive or negative, I would record them in a book. If positive, I would call the restaurant to inform them of the results. There was no other follow up on my part.

To paraphrase Dr. William Foege, a former CDC director, "Collection and analysis of data shouldn't be allowed to consume resources if action does not follow." The purpose of collecting environmental health data must be known ahead of time. Collecting data for the purpose of monitoring health is critical in environmental health. In order to get the most benefit, our data must be collected in a routine, uniform, and standardized manner. Finally, once these environmental data are collected and analyzed, they must be disseminated and communicated to key stakeholders to ensure the health of people in our communities.

Vince

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Vince Radke, MPH, RS, CP-FS, DLAAS, CPH

SPECIAL REPORT

Legionnaires' Disease at a Hotel in Missouri, 2015: The Importance of Environmental Health Expertise in Understanding Water Systems

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Abstract **During a Legionnaires' disease outbreak at a Missouri hotel in 2015, the Centers for Disease Control and Prevention assisted state and local health departments to identify possible sources and transmission factors and to recommend improvements to water management. We performed an environmental assessment to understand the hotel's water systems and identify areas of risk for *Legionella* amplification and transmission. We obtained samples from the pool, spa, and potable water systems for *Legionella* culture. In the potable water system, we noted temperatures ideal for *Legionella* amplification and areas of water stagnation. Additionally, we found inadequate documentation of pool and spa disinfection and maintenance. Of 40 water samples, *Legionella pneumophila* serogroup 1 that matched the sequence type of one available clinical isolate was recovered from five sink and shower fixtures. A comprehensive environmental assessment proved crucial to identifying maintenance issues in the hotel's water systems and underscored the need for a water management program to reduce Legionnaires' disease risk.**

Introduction

Legionnaires' disease (LD) is a severe pneumonia caused by the bacterium *Legionella*. Approximately 9% of cases are fatal (Dooling et al., 2015). The rate of reported LD cases in the U.S. rose nearly 300% from 2000–2014, likely due to a number of factors (e.g., an increase in susceptible populations, aging infrastructure leading to increased opportunities for *Legionella* growth, increased awareness with improved testing and reporting) (Garrison et al., 2016). *Legionella* is found in freshwater sources. It amplifies in manmade water systems (e.g., spas, potable water systems, cooling towers) and disseminates via aerosolized droplets (Fields, 1996).

In a review of LD outbreaks reported to the Centers for Disease Control and Prevention (CDC) during 2000–2014, 85% of outbreaks were caused by problems that effective water management could have prevented. Hotels and resorts accounted for 44% of outbreaks in this analysis (Garrison et al., 2016). Inadequate water system maintenance creates conditions favorable for *Legionella* amplification, including tepid water temperatures (77–108 °F), low residual disinfectant levels, water stagnation, and the presence of free-living protozoa, biofilm, scale, and sediment (Centers for Disease Control and Prevention [CDC], 2017). Changes in water pressure and water quality due to external factors, such as construction or water main breaks, have also been associated with amplification of *Legionella* in building water systems (Mermel, Josephson, Giorgio, Dempsey, & Parenteau, 1995). An industry standard published in 2015 described measures to reduce the risk of *Legionella* amplification and transmission in building water systems through use of water management programs (ASHRAE, 2015).

In-depth knowledge of facility water systems is critical for LD prevention and outbreak response. Key components of facility water systems include source water (i.e., from a municipal water treatment plant, private well, or other source), cold water distribution, heating, hot water distribution, wastewater elimination, and disinfectant treatment (CDC, 2017). An environmental assessment, which includes measurement of water quality parameters (i.e., disinfectant levels, pH, temperature) and water sampling for *Legionella*, can help identify factors that can lead to *Legionella* amplification and transmission.

Trained environmental health specialists with knowledge of industry standards are needed to evaluate facility water system maintenance procedures, develop and implement *Legionella* environmental sampling plans, measure water quality parameters, advise on *Legionella* remediation options (i.e., hyperchlorination or superheating and flushing), and provide technical direction for the development of a water management program. Environmental health specialists can also use fundamental industrial hygiene principles such as engineering controls, work practice modifications, and administrative operations to understand and guide water management interventions.

We describe an LD outbreak associated with a Missouri hotel, the initial public health investigation, and the subsequent comprehensive environmental assessment, underscoring the need for environmental health specialists trained in current industry standards to recommend control efforts and support development of a water management program to reduce the risk of future LD cases.

Methods

Initial Outbreak Investigation

In April and June 2015, two LD cases confirmed by *Legionella* urinary antigen testing were reported among persons who had stayed in the same Missouri hotel. Local public health officials conducted an environmental assessment of all water systems; however, because spas are a common source of hotel-related outbreaks (Dooling et al., 2015), control efforts initially were focused solely on disinfection of the pool and spa. At the time, water samples were not collected from other building water systems for *Legionella* testing.

In October 2015, a third guest at the same hotel died of LD, prompting further investigation by state public health officials. After review of the initial environmental assessment, a total of five environmental samples were collected from the pool, spa, spa filter, water heater, and a tank associated with the heating, ventilation, and air-conditioning (HVAC) system. *Legionella* testing of these samples at an Environmental *Legionella* Isolation Techniques Evaluation (ELITE) member laboratory (www.cdc.gov/legionella/elite.html) was negative. The state health department requested CDC's assistance for the environmental investigation.

Epi-Aid Environmental Assessment

In November 2015, CDC epidemiology and laboratory staff joined state and local epidemiology and environmental health staff to interview the building owner, maintenance employees, and pool/spa contractors. They performed a detailed environmental assessment of the hotel, including a review of

- facility blueprints and survey of the facility (i.e., occupancy rates, number of buildings and floors);
- sources of water (i.e., potable water, spa, cooling towers, decorative fountains); premise plumbing system components (i.e., where and how water flows through buildings [water heaters, storage tanks, and point-of-use sites such as showers and sink fixtures]);
- changes in municipal disinfectant use;
- water system maintenance records;
- water management program;
- water quality parameters; and
- factors external to the building such as construction and water main breaks.

The team identified potential sites of *Legionella* amplification and transmission using a standardized environmental assessment form (CDC, 2015) and hand-drawn water system diagrams provided by hotel staff.

Epi-Aid Water Quality Measurement and Environmental Sampling

During the assessment, the team examined water quality parameters (e.g., pH, temperature, disinfectant levels) at sites near the water entry into the building (proximal) and along the water distribution system at point-of-use (medial and distal) to identify areas of risk for *Legionella* growth. We noted all aerosol-generating devices (e.g., showers, faucets, spa) that represented potential points of exposure and measured the above-mentioned water parameters. Because of the recent change in municipal disinfection (from chlorine to monochloramine), total chlorine levels were measured at selected sites (CDC, 2018a; Fields, 1996; U.S. Environmental Protection Agency, Office of Water, 2016).

Using knowledge of the facility's water distribution and water quality parameters, along with epidemiologic data, the team developed a water sampling plan for *Legionella* that included sites throughout the hot water distribution systems and associated heaters, storage tanks, and hot water returns (CDC, 2018a; Kozak, Lucas, & Winchell, 2013). Improperly maintained spa filters can serve as a source of *Legionella* growth; therefore, we also obtained biofilm swabs of filter housings identified in the spa and pools (CDC, 2018b; Garrison et al., 2016).

Water samples and biofilm swabs were processed at CDC's *Legionella* Laboratory. *Legionella* isolates were characterized by serogroup and sequence typing (Lück, Fry, Helbig, Jarraud, & Harrison, 2013).

Results

Epi-Aid Environmental Assessment

The hotel's two buildings were constructed in 1989 and in February–August 2015, respectively, and are connected independently to the municipal water supply. No interruptions to the potable water system were reported during the more recent construction. The assessment focused on the older building, where all guest rooms possibly associated with LD cases were located. This building had 3 floors with 79 guest rooms arranged around a central atrium overlooking an unenclosed pool and spa. A 4.5-ft wall separated the pool and spa from the elevator, front desk, and surrounding rooms.

The municipal water facility used a chlorine disinfection system until August 2015 but changed to monochloramine disinfection in September 2015 to meet federal drinking water standards. Heated water from the water heater was stored in a hot water storage tank and traveled through riser pipes and a recirculating loop to deliver and collect water from the guest room sinks and showers/bathtubs on each floor. Thermostatic mixing valves were located on sinks and showers of the guest rooms. The potable water system relied on municipal disinfection. By design, the HVAC system did not aerosolize water (i.e., it was not a cooling tower or evaporative condenser) and thus likely did not pose a risk for *Legionella* transmission.

TABLE **1**

Measured Water Parameters for Hotel A, Missouri, November 2015

Sample Site	Collected Specimen Types	Location Within Potable Water Distribution	Measured pH	Measured Temperature (°F)	Measured Total Chlorine (mg/L)	Measured Bromine (ppm)	*Legionella* (Serogroup, Sequence-Type [ST])
Spa[a]	Bulk water	–	7.8–8.2	100.7	–	4	
	Swab (water line)	–			–		
Spa filter, left[a]	Bulk sand	–	7.5–8.0	93.1	–		
Spa filter, right[a]	Bulk sand	–	7.5	97.9	–	4	
Spa jets	Swab	–			–		
Pool[a]	Bulk water	–	7.8–8.2	89.2	–	2	
	Swab (water line)	–			–		
Pool filter	Bulk sand	–	7.5–8.0		–		
Pool jets	Swab	–			–		
Basement toilet, near water main (cold water)[b]	None	Proximal	7.0–8.0	60.4	2.0		
Water heater[b]	Bulk water	Proximal	7.0	136.5	1.3		
Hot water storage tank[b]	Bulk water	Proximal	8.0–9.0	100.7	1.5		
Room 111 shower[b]	Swab	Medial					
	Bulk water	Medial	7.0	124.2	1.2		
Room 125 shower[b]	Swab	Distal					
	Bulk water	Distal	7.0–8.0	113.9	1.5		
Room 125 Jacuzzi tub faucet and jets[b]	Swab	Distal					
	Bulk water	Distal	Not measured	Not measured	Not measured		
Room 201 bathroom sink[b]	Swab	Distal					
Room 201 shower[b]	Swab	Distal					
	Bulk water	Distal	7.0	122.9	1.0		

continued ▸

Epi-Aid Water Quality Measurement and Environmental Sampling

The hotel did not have a water management program. Review of the spa's maintenance records revealed inadequate documentation of disinfection, drainage, and scrubbing. Bromine and calcium hypochlorite disinfectants were hand-fed by a private contractor for periodic disinfection of the spa and pool. Bromine levels were measured and found to be within acceptable ranges per standards for the spa but were low for the pool (Table 1) (CDC, 2018b). The spa had been drained and scrubbed and the sand filter changed after the third LD case was reported but before environmental sampling by state public health officials.

We identified unused guest rooms and an out-of-service water softener tank as sites of possible water stagnation within the potable water system. We found that some measured water temperatures at proximal and distal sites of water use were within the ideal range for *Legionella* amplification (77–108 °F) (Table 1). We noted heavy scale and sedimentation on most sink faucet aerators. Disinfectant was detectable throughout the system (Table 1).

We collected a total of 40 bulk and swab samples from the pools and spas, including the sand filters, jets, and water line; proximal, medial, and distal points in the potable water system; and the hot water storage tank (Figure 1). *Legionella pneumophila* serogroup 1 was recovered from five guest room sink

TABLE **1** continued

Measured Water Parameters for Hotel A, Missouri, November 2015

Sample Site	Collected Specimen Types	Location Within Potable Water Distribution	Measured pH	Measured Temperature (°F)	Measured Total Chlorine (mg/L)	Measured Bromine (ppm)	*Legionella* (Serogroup, Sequence-Type [ST])
Room 215 bathroom sink[b]	Swab	Distal					
	Bulk water	Distal	7.5	121.8	1.2		
Room 215 shower[b]	Swab	Distal					
	Bulk water	Distal	8.0	120.8	1.2		(1, ST763)
Room 219 bathroom sink[b]	Swab	Medial					(1, ST763)
	Bulk water	Medial	7.5	121.8	1.4		(1, ST763)
Room 219 shower[b]	Swab	Medial					
	Bulk water	Medial	7.0–8.0	108.8	0.4		
Room 310 bathroom sink[b]	Swab	Medial					
	Bulk water	Medial	7.5–8.0	107.6	1.4		(1, ST763)
Room 310 shower[b]	Swab	Distal					
	Bulk water	Distal	7.0–7.5	113.5	1.4		
Room 320 bathroom sink[b]	Swab	Medial					
	Bulk water	Medial	7.0–8.0	112.6	1.1–1.2		
Room 320 shower[b]	Swab	Medial					
	Bulk water	Medial	7.5–8.0	109.1	1.4		
Room 328 bathroom sink[b]	Swab	Medial					(1, ST763)
	Bulk water	Medial	8.0	115.2	1.2		
Room 328 shower[b]	Swab	Medial					
	Bulk water	Medial	8.0	112.8	1.2		

[a]Pool and spa water quality parameters for temperature: ≤104 °F; pH: 7.2–7.8; bromine: 3.0–8.0 ppm for the pool and 4.0–8.0 ppm for the spa (Centers for Disease Control and Prevention [CDC], 2016).
[b]Potable water quality parameters for temperature: water heater/storage tank = 140 °F, shower/sink hot water = 120–124 °F, shower/sink or other cold water = <68 °F; total chlorine: detectable, but ≤4.0 mg/L (U.S. Environmental Protection Agency, Office of Water, 2016); pH: 6.5–8.5 (CDC, 2017).

and shower fixtures. All environmental isolates matched the sequence type (ST763) of the only available clinical isolate, which had been obtained from the third infected guest.

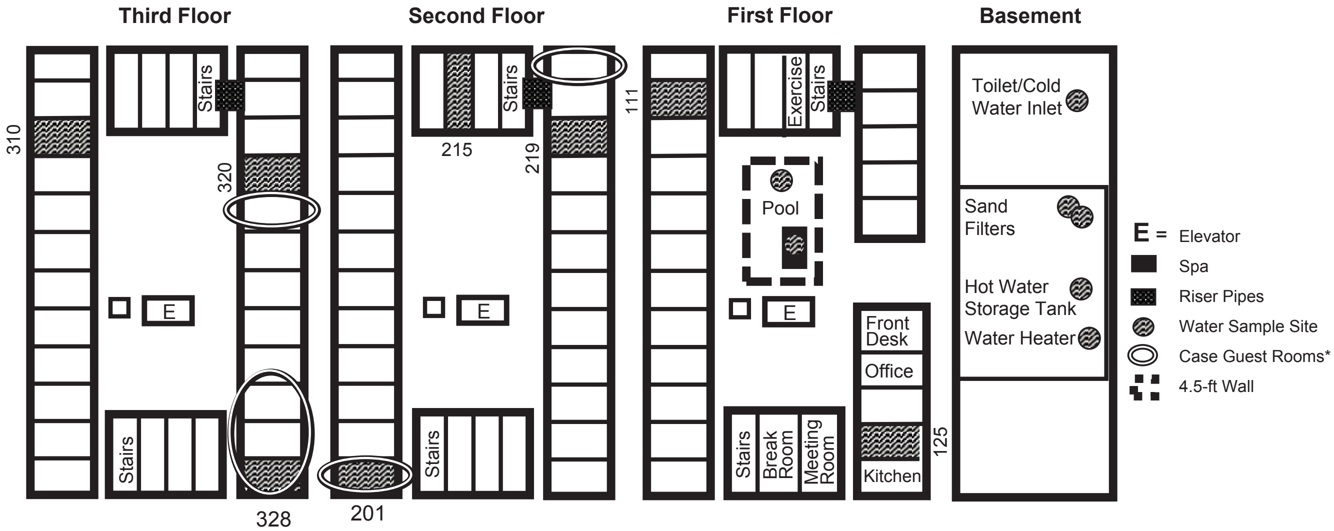
Discussion

LD outbreaks have been linked to inadequate water management (Garrison et al., 2016). Data from the environmental investigation suggest that the three infected guests likely were exposed to *Legionella* from the hotel's potable water system, although the incomplete documentation made it impossible to rule out an earlier deficiency associated with the spa. Temperatures optimal for *Legionella* amplification and areas of water stagnation in the potable water system might have increased the risk for *Legionella* growth. Lack of adequate maintenance documentation for the pool and spa and use of a hand-fed disinfection delivery system were inconsistent with CDC guidance for managing public aquatic facilities (CDC, 2018b). A water management program might have prevented these gaps in water system maintenance.

The absence of *Legionella* detection during the initial investigation might be a result of the small number of samples collected from the potable water system for testing and of disinfection of the spa before sampling. Subsequent sampling of 40 sites for *Legionella*, guided by a thorough environmental assessment of the potable water system, yielded *Legionella*.

FIGURE **1**

Building Schematic With Representative and Case Room Sampling Sites for Hotel A, Missouri, 2015



*Room locations for two cases were unknown; based on interviews, possible rooms of cases are circled.

To reduce the risk of *Legionella* amplification and transmission, the team recommended immediate hyperchlorination and/or superheating and flushing of the potable water system directed by a contractor specializing in *Legionella* remediation. Hotel staff were advised to eliminate low-flow areas by routinely flushing water fixtures in vacant rooms, to increase hot water temperatures outside the *Legionella* amplification range in the presence of thermostatic mixing valves (to prevent scalding), and to remove sedimentation from aerators (ASHRAE, 2015). We also recommended appropriate pool and spa maintenance with documentation to meet state and local environmental codes and installation of an automated disinfection delivery system (CDC, 2018b).

To reduce the risk of future cases, hotel staff were advised to develop and implement a water management program based on industry standards (ASHRAE, 2015) that would address maintenance gaps through the identification of control points, routine monitoring of control measures, and when necessary, corrective actions (CDC, 2017).

When LD clusters are identified, a comprehensive environmental assessment and water sampling should be considered for all potential sites of *Legionella* transmission as informed by case epidemiology. In this case, initially local public health officials considered spas to be the most likely source, and thus focused their investigation on spas. A more comprehensive environmental assessment with sampling from additional sites, however, ultimately revealed *Legionella* growth in the potable water system. A multidisciplinary team of environmental health specialists, epidemiologists, public health officials, and facility management staff is best equipped to identify all potential sources, develop a water sampling plan, measure parameters, and collect samples using appropriate techniques and then apply environmental interventions.

In circumstances where an environmental health specialist is unavailable, other public health staff (trained by or in consultation with an environmental health specialist) can perform environmental assessments and sampling based on industry standards. Furthermore, continual water quality monitoring and water sampling for *Legionella* can 1) help identify a source and/or factors promoting transmission during an outbreak, 2) confirm that reduction of the outbreak strain has occurred following remediation activities, and 3) establish a baseline to evaluate the effectiveness of an ongoing water management program.

Conclusion

Environmental health specialists play a key role in helping prevent LD. They will be called upon to assist health departments in building LD investigation capacity for timely identification of potential transmission sources and providing evidence-based prevention guidance tailored to specific buildings. Their expertise will be instrumental in supporting building owners and managers to develop and implement water management programs.

Therefore, it is important that environmental health specialists be trained to understand and appropriately apply the industry standards (Kunz & Cooley, 2016). In 2016, CDC and its partners developed a toolkit (CDC, 2017) to facilitate implementation of industry standards (ASHRAE, 2015). The toolkit describes step-by-step how to develop a water management program, beginning with the identification of water systems at risk for *Legionella* amplification and transmission, to providing real-life examples of how potential risk could be reduced. The adoption of these standards through widespread use of water management programs could reduce the burden of LD in the U.S.

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References

ASHRAE. (2015). *Standard 188-2015—Legionellosis: Risk management for building water systems (ANSI approved)*. Retrieved from https://www.techstreet.com/ashrae/products/1897561

Centers for Disease Control and Prevention. (2015). Legionella *environmental assessment form* (CS254961-A). Retrieved from https://www.cdc.gov/legionella/downloads/legionella-environmental-assessment.pdf

Centers for Disease Control and Prevention. (2017). *Developing a water management program to reduce* Legionella *growth & spread in buildings: A practical guide to implementing industry standards* (CS278126-A). Retrieved from http://www.cdc.gov/legionella/downloads/toolkit.pdf

Centers for Disease Control and Prevention. (2018a). Legionella*: Sampling/environmental assessment videos*. Retrieved from https://www.cdc.gov/legionella/videos.html

Centers for Disease Control and Prevention. (2018b). *Model Aquatic Health Code (MAHC): An all-inclusive model public swimming pool and spa code*. Retrieved from http://www.cdc.gov/mahc/index.html

Dooling, K.L., Toews, K.-A., Hicks, L.A., Garrison, L.E., Bachaus, B., Zansky, S., . . . Langley, G.E. (2015). Active bacterial core surveillance for legionellosis—United States, 2011–2013. *Morbidity and Mortality Weekly Report*, *64*(42), 1190–1193.

Fields, B.S. (1996). The molecular ecology of legionellae. *Trends in Microbiology*, *4*(7), 286–290.

Garrison, L.E., Kunz, J.M., Cooley, L.A., Moore, M.R., Lucas, C., Schrag, S., . . . Whitney, C.G. (2016). Vital signs: Deficiencies in environmental control identified in outbreaks of Legionnaires' Disease—North America, 2000–2014. *Morbidity and Mortality Weekly Report*, *65*(22), 576–584.

Kozak, N.A., Lucas, C.E, & Winchell, J.M. (2013). Identification of *Legionella* in the environment. In C. Buchrieser & H. Hilbi (Eds.), Legionella: *Methods and protocols* (part of the *Methods in Molecular Biology* books series, pp. 3–25). Totowa, NJ: Humana Press. Retrieved from https://www.springer.com/us/book/9781627031608

Kunz, J.M., & Cooley, L.A. (2016). Preventing Legionnaires' disease: Environmental health expertise is key. *Journal of Environmental Health*, *79*(1), 24–26. Retrieved from https://www.cdc.gov/nceh/ehs/docs/jeh/2016/july-aug-legion.pdf

Lück, C., Fry, N.K., Helbig, J.H., Jarraud, S., & Harrison, T.G. (2013). Typing methods for *Legionella*. In C. Buchrieser & H. Hilbi (Eds.), Legionella*: Methods and protocols* (part of the *Methods in Molecular Biology* books series, pp. 119–148). Totowa, NJ: Humana Press. Retrieved from https://www.springer.com/us/book/9781627031608

Mermel, L.A., Josephson, S.L., Giorgio, C.H., Dempsey, J., & Parenteau, S. (1995). Association of Legionnaires' disease with construction: Contamination of potable water? *Infection Control & Hospital Epidemiology*, *16*(2), 76–81.

U.S. Environmental Protection Agency, Office of Water. (2016). *Technologies for* Legionella *control in premise plumbing systems: Scientific literature review* (EPA Report No. 810-R-16-001). Retrieved from https://www.epa.gov/sites/production/files/2016-09/documents/legionella_document_master_september_2016_final.pdf

Exposure to Computer Work and Prevalence of Musculoskeletal Symptoms Among University Employees: A Cross-Sectional Study

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Abstract **University faculty and staff, like other kinds of computer users, are exposed daily to long hours of computer work and thereby can be at risk of musculoskeletal symptoms (MSS). The objectives of this study were to 1) assess computer use-related exposures, 2) estimate the prevalence of MSS, and 3) analyze the relationship between ergonomic exposures and MSS among university faculty and staff. Questionnaire administration and ergonomic assessment were conducted among 51 faculty and staff via office visits. The majority of participants (approximately 70%) were exposed for prolonged time periods (i.e., >4 hr/day) with reduced rest breaks during their computer work. More than 75% of the participants had their keypads at a slope >10 degrees. Among all the MSS studied, lower back pain (60%), neck pain (58%), and shoulder pain (49%) were the top three prevalent MSS. Participants who worked >4 hr/day were significantly associated with neck pain ($p = .036$) and low back pain ($p = .043$). Also, the risk of low back pain decreased (odds ratio = 0.7) with an increase in rest breaks. Computer work for prolonged hours with fewer breaks might enhance the risk of MSS. Further research is needed to validate our findings.**

Introduction

Since the invention of the computer, there has been an ever-increasing use of computers for daily work, including recreational and occupational work. About 90% of households (File & Ryan, 2014) and 95% of education buildings (U.S. Energy Information Administration, 2016) in the U.S. own or use computers. The association between computer use and musculoskeletal symptoms (MSS) has been widely studied (Punnett & Bergqvist, 1997; Tittiranonda, Burastero, & Rempel, 1999). Factors such as awkward body postures, poor design of computer-related equipment, prolonged work hours with fewer breaks, high body mass index (BMI), and others have been found to be associated with MSS (Bhanderi, Choudary, Parmar, & Doshi, 2008; Brandt et al., 2004; Ortiz-Hernández, Tamez-González, Martínez-Alcántara, & Méndez-Ramírez, 2003).

Computer users of diverse backgrounds including video display terminal unit workers (Helland et al., 2008), software professionals (Shrivastava & Bobhate, 2012), call center workers (Crawford, Laiou, Spurgeon, & McMillan, 2008), college students (Hupert et al., 2004; Katz et al., 2002), adolescents (Shan et al., 2013), and others (Adedoyin, Idowu, Adagunodo, Owoyomi, & Idowu, 2005; Bernard, Sauter, Fine, Petersen, & Hales, 1994) were shown to be associated with computer use-related MSS. Faculty and staff working in a university setting are also exposed to long hours of computer work on a daily basis. Therefore, we hypothesized that university faculty and staff are at risk of computer use-related MSS. To our knowledge, however, there is no research study on computer work-related MSS among them.

The objectives of this cross-sectional study were to assess various aspects of computer work exposures, determine the prevalence of MSS, and analyze the relationship between specific ergonomic exposures and MSS among university faculty and staff. We used a combination of objective and subjective methodologies to achieve our objectives.

Methods

Study Participants and Inclusion Criteria

Upon approval from the Human Subjects Review Board at Western Kentucky University, we used simple random sampling to select a total of 51 full-time faculty and staff from different academic departments of the university who use computers for at least 3 hr/day on at least 4 days a week at their workplace. The characteristics of the study participants are reported in Table 1.

Questionnaire

We developed a questionnaire based on the modified Nordic Musculoskeletal Questionnaire (Wilson & Corlett, 1995). The questionnaire has items on background characteristics, computer work-related exposures, and MSS. A graduate student trained in physiotherapy

TABLE **1**

Study Participant Characteristics (*N* = 51)

Characteristic	Category	#	%
Sex	Male	12	24
	Female	39	76
Age	26–40	15	29
	41–63	35	69
	Not given	1	2
Race	White	37	73
	African	4	8
	African American	1	2
	Asian	4	8
	Other	2	4
	Not given	3	6
Job category	Faculty	36	71
	Staff	15	29
Handedness	Right	49	96
	Left	2	4

TABLE **2**

Study Participant Body Mass Index (BMI) (*N* = 51)

BMI	Category	Male # (%)	Female # (%)	Total # (%)
18.5–24.9	Normal	1 (2.0)	21 (41.2)	22 (43.1)
25.0–29.9	Overweight	6 (11.8)	8 (15.7)	14 (27.5)
≥30	Obese	5 (9.8)	9 (17.6)	14 (27.5)
Not given		0 (0)	1 (2.0)	1 (2.0)

administered the questionnaire and performed ergonomic assessments at the participant's workstation. All questions were asked in the form of an interview and ergonomic measurements were collected using a measuring tape and a protractor-goniometer. The methodology for all ergonomic measurements was adopted from Wilson and coauthor (1995).

Data Analysis

We used SPSS version 7.0 for all statistical analysis. We calculated BMI using the formula:

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height (m}^2\text{)}}$$

Frequency distributions were performed on all computer work-related variables (i.e., exposures) and MSS (i.e., outcome variables). We performed chi-square tests and logistic regression for association analysis.

Results and Discussion

Background Characteristics

Tables 1 and 2 summarize the characteristics of the study participants (N = 51). All the participants were either faculty or staff of the university. To our knowledge, this study is the first that assessed computer use and associated MSS among university faculty and staff. Out of a total of 51 participants, 12 were male and 39 were female (male:female ratio = 1:3). Almost all of the participants (50 out of 51) were between the ages of 26–63 years (Table 1). Among the participants, 15 (29%) were <40 years and 35 (69%) were >40 years. Only one participant declined to provide an age (Table 1). In terms of race, 37 participants (73%) were White and the rest were from diverse racial backgrounds. Regarding the job category, 36 out of 51 (71%) were faculty and 15 (29%) were staff. Right-handed participants outnumbered left-handed (49 versus 2) (Table 1).

The distribution of BMI and associated status categories are summarized in Table 2. Briefly, a total of 22 participants were in the normal range of BMI. A total of 28 participants (55%) were either overweight or obese, and among them, 17 (33%) were females and 11 (22%) were males (Table 2). The study sample predominantly consisted of employees who are female, White, overweight (BMI >25), >40 years old, and work as faculty.

Exposure Characteristics

We assessed individual-related and equipment-related exposures, distributions of which are presented in Tables 3 and 4, respectively. Almost all the participants (50 out of 51) spent at least 2 hr working on a computer as part of their job. More specifically, 35 participants (69%) spent between 4–8 hr on job-related computer work in a day and 38 participants (75%) spent more than 20 hr on computer work in a week (Table 3). A typical workday is 8 hr long. The current finding suggests that the majority of the participants spend more than half of their time in a day working on a computer.

It is not an exaggeration to say that nowadays, pen and pencil are almost completely replaced by computing devices. The majority of participants (38 out of 51; 75%) resorted to "typing" and "mousing" equally during their computer work (Table 3). Typing and mousing are two activities that require the computer user to reach out to the keypad or mouse and work in non-neutral upper extremity postures. So, prolonged exposure to typing and mousing might subject computer users to acquire abnormal body postures. We found that 34 participants (67%) had seldom (<50% of time) maintained good posture with respect to their back (Table 3). This finding suggests that the majority of faculty and staff were working in non-neutral body postures during their computer work. Abnormal body postures for prolonged time periods is a risk factor for musculoskeletal disorders (Cagnie, Danneels, Van Tiggelen, De Loose, & Cambier, 2007).

Only five participants (10%) resorted to abnormal bending or twisting type of body movements as part of their work at a computer in a typical workday. We found that 35 participants (69%) took breaks less frequently (<50% of time) during their computer work (Table 3). Reduced frequency of breaks during computer work was shown to be a risk factor for the development of MSS. Frequent rest breaks reduced the incidence of MSS among computer users (De Vera Barredo & Mahon, 2007). Taken together, we found a majority of the participants were exposed to typing and mousing activities in abnormal body postures for prolonged time periods with reduced rest breaks during their workday that involved computers.

Poor design and arrangement of their computer and related equipment can contribute to MSS among computer users (Punnett & Bergqvist, 1997). Therefore, we assessed equipment-related factors (Table 4). Regarding the type of keypad used, 37 participants (73%) used a soft keypad and 47 (92%) used a horizontal keypad during their computer work (Table 4). The majority of participant workstations were equipped with soft keypads, which minimize the stress on fingers during keystrokes. The majority of keypads, however, were of the horizontal type, which force the user to acquire non-neutral wrist and hand positions. Normal positioning of a hand is semipronated, yet the horizontal keypad requires the user to assume a supine position during typing and, to a larger extent, during mousing.

We found that 38 participants (75%) had their keypads with a slope between 10–15 degrees (angle of keypad with respect to horizontal desk) and one participant had a keypad with a slope >15 degrees (Table 4). Slope of the keypad influences the pressure around the carpal tunnel of the wrist joint. According to Hedge and coauthors (1999), the majority of participants subjected their wrists to abnormal extension while working on keypads with a slope around 15 degrees. Only one participant (2%) used an elbow support and 12 participants (24%) used a wrist support during their work with computers (Table 4). Use of supports for elbows and wrists reduces the pressure around the pertinent joint. But only a few participants reported using any kind of upper extremity support.

TABLE 3

Study Participant Exposure Characteristics (*N* = 51)

Variable	Category	#	%
Computer work (hr/day)	0–2.0	1	2.0
	2.1–4.0	15	29.4
	4.1–6.0	19	37.3
	6.1–8.0	16	31.4
Computer work (hr/week)	11–20	13	25.5
	21–30	14	27.5
	31–40	16	31.4
	>40	8	15.7
Type of computer work	Typing	11	21.6
	Mousing	2	3.9
	Both equally	38	74.5
Maintenance of good posture with respect to back	Less frequent	34	66.7
	More frequent	17	33.3
Bending	Less frequent	46	90.2
	More frequent	5	9.8
Twisting	Less frequent	46	90.2
	More frequent	5	9.8
Frequency of breaks	Less frequent	35	68.6
	More frequent	16	31.4

Almost all of the participants (*n* = 50) had well-cushioned seats and backrests. More than half of the participants (*n* = 28; 55%) had their elbows either 1 in. above (value <-1) or below (value >+1) the keypad position during computer work (Table 4). This nonalignment of elbows subjects the user to abnormal upper extremity postures. Taken together, the majority of the participants were at increased risk of subjecting their upper extremity (e.g., wrists, elbows, and shoulders) to abnormal work postures.

Prevalence of Musculoskeletal Symptoms

Nearly all of the participants (49 out of 51; 94%) reported one MSS during the past 12 months. In this study, we focused on upper body (i.e., neck, shoulder, elbow, wrist, and back) and hip symptoms only. Prevalence of MSS in various body regions is presented in Table 5. Among all MSS studied, lower back pain (60%), neck pain (58%), shoulder pain (49%), and wrist pain (45%) were found to be the top four prevalent symptoms (Table 5). Upper back pain, hip/buttock pain, and elbow pain were found to have a prevalence of 29%, 19%, and 4%, respectively (Table 5).

About 52% of the participants (27 out of 49) who reported one or other MSS perceived computer-work associated exposures such as prolonged computer work and bad posture as important contributors to their MSS. The rest of them (48%) perceived other medical conditions as reason for their MSS. Our results support those of a study in Nigeria where low back pain and neck pain were found to be the most common MSS among computer users on university campuses in Nigeria (Adedoyin et al., 2005). Also, low back pain and neck pain were the most common MSS among individuals exposed to a multitude of computer-related activities (Cagnie et al., 2007; Hakala, Rimpelä, Saarni, & Salminen, 2006). Neck, low back, wrist, and shoulder pain were also found to be the top four common MSS among university-level computer

TABLE **4**

Study Participant Equipment-Related Exposure Characteristics (*N* = 51)

Variable	Category	#	%
Keypad type I	Soft	37	72.5
	Hard	14	27.5
Keypad type II	Horizontal	47	92.2
	Others (vertical, etc.)	4	7.8
Keypad slope (degrees)	<10	12	23.5
	10–15	38	74.5
	>15	1	2.0
Use of elbow support	Yes	1	2.0
	No	50	98.0
Use of wrist support	Yes	12	23.5
	No	39	76.5
Seating	Cushioned	50	98.0
	Noncushioned	1	2.0
Backrest	Cushioned	50	98.0
	Noncushioned	1	2.0
Height of keypad minus height of elbow from ground level	<-1.00	8	15.7
	-1.00–+1.00	23	45.1
	>+1.00	20	39.2

users (Oha, Animägi, Pääsuke, Coggon, & Merisalu, 2014). It is noteworthy that our findings are consistent with those of others in regard to prevalence of MSS.

Association of Ergonomics Exposures With Musculoskeletal Symptoms

Based on the number of hours spent on computer work per day, all participants were classified into two groups: a low-exposure group (computer work <4hr/day) or a high-exposure group (computer work >4hr/day). Categorical analysis showed that the high exposure group was significantly associated with neck pain (p = .036) and low back pain prevalence (p = .043) (Table 6). The risk of experiencing MSS, including neck pain (odds ratio [*OR*] = 1.4), upper back pain (*OR* = 1.28), and wrist pain (*OR* = 1.1) increased with an increase in the number of hours of computer work per day (Table 7). The risk of experiencing shoulder pain (*OR* = 1.05) and upper back pain (*OR* = 1.04) slightly increased with an increase in the number of hours of computer work per week (Table 7).

Recent literature supports our finding that prolonged exposure to computer work is significantly associated with a higher rate of MSS (Gerr et al., 2002; Palmer, Cooper, Walker-Bone, Syddall, & Coggon, 2001; Skemiene, Ustinaviciene, Luksiene, Radisauskas, & Kaliniene, 2012). The risk of upper back pain decreased (*OR* = 0.2) with an increase in the frequency of assuming good posture (with respect to one's back) at work. Additionally, the risk of low back pain decreased (*OR* = 0.7) with an increase in frequency of breaks (Table 7). Maintaining good posture and taking breaks frequently appear to be protective factors for upper back and lower back pain, respectively.

Frequent breaks with or without stretching exercises were shown to improve musculoskeletal comfort and worker productivity (De Vera Barredo & Mahon, 2007; Henning, Jacques, Kissel, Sullivan, & Alteras-Webb, 1997). Taking frequent breaks during work increased with an increase in neck pain prevalence (*OR* = 1.4) and an increase in shoulder pain prevalence (*OR* = 1.73) (Table 7). It is intuitive to reason that an increase in neck or shoulder pain led to an increased frequency of breaks; however, the cross-sectional nature of this study prevents us from making such causal relationships. Use of wrist support increased with an increase in wrist pain prevalence (*OR* = 3.3) (Table 7). The literature pertaining to the role of wrist of support has been controversial. Use of wrist support was shown to both aggravate (Horie, Hargens, & Rempel, 1993) and alleviate (Seppälä, Luopajärvi, Nygård, & Mattila, 1997) wrist pain among computer users in two different studies.

Conclusion

Taken together, our study reveals that university faculty and staff are also susceptible to MSS related to computer use, like other kinds of computer users. We found few significant associations between certain computer use-related ergonomic factors and MSS among university faculty and staff. Prolonged exposure to computer work was significantly associated with neck pain, upper back pain, wrist pain, and low back pain. In addition, the majority of the participants were exposed to poorly designed computer equipment, subjecting them to the risk of MSS.

Despite few significant findings, there are a couple of limitations in our study for readers to be mindful of while drawing inferences. While we assessed exposure to computer usage in the workplace only, it is highly possible that employees were exposed to computers or computing devices (e.g., smartphones, laptops, tablets, etc.) outside of their workplaces at home, either for work or recreational purposes. It is also possible that participants might have been exposed to noncomputing activities outside of their jobs that could possibly influence (exacerbate or alleviate) MSS. All MSS examined in this study were self-reported. Physician-diagnosed MSS would have provided better insights into the problem prevalence. Lastly, sample size was not very large (*N* = 51). We believe that a larger sample size could minimize the variance and improve statistical power. We are planning to conduct similar studies with a bigger sample size.

Maintaining good body posture and taking frequent short breaks can help reduce the occurrence of MSS and promote a healthier academic work environment. In light of our study, we recommend occupational health professionals of universities proactively identify the most common MSS conditions

TABLE **5**

Prevalence of Musculoskeletal Symptoms Among Study Participants (*N* = 51)

Region of Pain/ Stiffness	#	%
Neck	30	58.8
Left shoulder	25	49.0
Right shoulder	24	47.1
Left elbow	2	3.9
Right elbow	2	3.9
Left wrist	23	45.1
Right wrist	23	45.1
Upper back	15	29.4
Lower back	31	60.8
Hips/buttock	10	19.6

associated with computer use by conducting annual ergonomic assessments, analyzing worker compensation claims data, and educating employees on risk and protective factors of computer use-related MSS.

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TABLE **6**

Results of Chi-Square Analysis

Computer Work (hr/day)	Neck Pain # (%)	Low Back Pain # (%)
2–4 (low exposure)	6 (11.8)	13 (25.5)
5–9 (high exposure)	24 (47.1)	18 (35.3)
Total (having MSS)	30 (58.8)	31 (60.8)
p-value	.036	.043

MSS = musculoskeletal symptoms.

TABLE **7**

Results of Logistic Regression Analysis

Dependent Variable	Independent Variable	Odds Ratio
Neck pain	Computer work (hr/day)	1.42
Upper back pain	Computer work (hr/day)	1.28
Wrist pain	Computer work (hr/day)	1.10
Low back pain	Computer work (hr/day)	0.80
Low back pain	Frequency of breaks	0.70
Shoulder pain	Computer work (hr/day)	1.05
Frequency of breaks	Neck pain	1.40
Frequency of breaks	Shoulder pain	1.73
Use of wrist support	Wrist pain	3.30

References

Adedoyin, R.A., Idowu, B.O., Adagunodo, R.E., Owoyomi, A.A., & Idowu, P.A. (2005). Musculoskeletal pain associated with the use of computer systems in Nigeria. *Technology and Health Care*, *13*(2), 125–130.

Bernard, B., Sauter, S., Fine, L., Petersen, M., & Hales, T. (1994). Job task and psychosocial risk factors for work-related musculoskeletal disorders among newspaper employees. *Scandinavian Journal of Work, Environment & Health*, *20*(6), 417–426.

Bhanderi, D., Choudhary, S.K., Parmar, L., & Doshi, V. (2008). A study of occurrence of musculoskeletal discomfort in computer operators. *Indian Journal of Community Medicine*, *33*(1), 65–66.

Brandt, L.P., Andersen, J.H., Lassen, C.F., Kryger, A., Overgaard, E., Vilstrup, I., & Mikkelsen, S. (2004). Neck and shoulder symptoms and disorders among Danish computer workers. *Scandinavian Journal of Work, Environment & Health*, *30*(5), 399–409.

Cagnie, B., Danneels, L., Van Tiggelen, D., De Loose, V., & Cambier, D. (2007). Individual and work related risk factors for neck pain among office workers: A cross sectional study. *European Spine Journal*, *16*(5), 679–686.

Crawford, J.O., Laiou, E., Spurgeon, A., & McMillan, G. (2008). Musculoskeletal disorders within the telecommunications sector: A systematic review. *International Journal of Industrial Ergonomics*, *38*(1), 56–72.

De Vera Barredo, R., & Mahon, K. (2007). The effects of exercise and rest breaks on musculoskeletal discomfort during computer tasks: An evidence-based perspective. *Journal of Physical Therapy Science*, *19*(2), 151–163.

File, T., & Ryan, C. (2014). *Computer and Internet use in the United States: 2013* (American Community Survey Reports, ACS-28). Washington, DC: U.S. Census Bureau. Retrieved from https://www.census.gov/history/pdf/2013comp-internet.pdf

Gerr, F., Marcus, M., Ensor, C., Kleinbaum, D., Cohen, S., Edwards, A., . . . Monteilh, C. (2002). A prospective study of computer user: I. Study design and incidence of musculoskeletal symptoms

References

and disorders. *American Journal of Industrial Medicine*, *41*(4), 221–235.

Hakala, P.T., Rimpelä, A.H., Saarni, L.A., & Salminen, J.J. (2006). Frequent computer-related activities increase the risk of neck-shoulder and low back pain in adolescents. *European Journal of Public Health*, *16*(5), 536–541.

Hedge, A., Morimoto, S., & McCrobie, D. (1999). Effects of keyboard tray geometry on upper body posture and comfort. *Ergonomics*, *42*(10), 1333–1349.

Helland, M., Horgen, G., Kvikstad, T.M., Garthus, T., Bruenech, J.R., & Aarås, A. (2008). Musculoskeletal, visual and psychosocial stress in VDU operators after moving to an ergonomically designed office landscape. *Applied Ergonomics*, *39*(3), 284–295.

Henning, R.A., Jacques, P., Kissel, G.V., Sullivan, A.B., & Alteras-Webb, S.M. (1997). Frequent short rest breaks from computer work: Effects on productivity and well-being at two field sites. *Ergonomics*, *40*(1), 78–91.

Horie, S., Hargens, A., & Rempel, D. (1993). *The effect of keyboard wrist rest in preventing carpal tunnel syndrome*. Presentation at the Proceedings of the American Public Health Association Annual Meeting, San Francisco, California.

Hupert, N., Amick, B.C., Fossel, A.H., Coley, C.M., Robertson, M.M., & Katz, J.N. (2004). Upper extremity musculoskeletal symptoms and functional impairment associated with computer use among college students. *Work*, *23*(2), 85–9.

Katz, J.N., Amick, B.C., III, Huppert, N., Cortes, M.C., Fossel, A.H., Robertson, M., & Coley, C.M. (2002). Assessment of upper extremity role functioning in students. *American Journal of Industrial Medicine*, *41*(1), 19–26.

Oha, K., Animägi, L., Pääsuke, M., Coggon, D., & Merisalu, E. (2014). Individual and work-related risk factors for musculoskeletal pain: A cross-sectional study among Estonian computer users. *BMC Musculoskeletal Disorders*, *15*(181), 1–5.

Ortiz-Hernández, L., Tamez-González, S., Martínez-Alcántara, S., & Méndez-Ramírez, I. (2003). Computer use increases the risk of musculoskeletal disorders among newspaper office workers. *Archives of Medical Research*, *34*(4), 331–342.

Palmer, K.T., Cooper, C., Walker-Bone, K., Syddall, H., & Coggon, D. (2001). Use of keyboards and symptoms in the neck and arm: Evidence from a national survey. *Occupational Medicine (London)*, *51*(6), 392–3.

Punnett, L., & Bergqvist, U. (1997). Visual display unit work and upper extremity musculoskeletal disorders: A review of epidemiological findings. *Arbete Och Hälsa*, *16*, 1–161.

Seppälä, P., Luopajärvi, T., Nygård, C.H., & Mattila, M. (1997). *Proceedings of the 13th Triennial Congress of the International Ergonomics Association*. Helsinki, Finland: Finnish Institute of Occupational Health.

Shan, Z., Deng, G., Li, J., Li, Y., Zhang, Y., & Zhao, Q. (2013). Correlational analysis of neck/shoulder pain and low back pain with the use of digital products, physical activity and psychological status among adolescents in Shanghai. *PLOS ONE*, *8*(10), e78109.

Shrivastava, S.R., & Bobhate, P.S. (2012). Computer related health problems among software professionals in Mumbai: A cross-sectional study. *International Journal of Health & Allied Sciences*, *1*(2), 74–78.

Skemiene, L., Ustinaviciene, R., Luksiene, D., Radisauskas, R., & Kaliniene, G. (2012). Computer use and musculoskeletal complaints in the Lithuanian adolescent population. *Central European Journal of Medicine*, *7*(2), 203–208.

Tittiranonda, P., Burastero, S., & Rempel, D. (1999). Risk factors for musculoskeletal disorders among computer users. *Occupational Medicine*, *14*(1), 17–38.

U.S. Energy Information Administration. (2016). *Computer and technology use in education buildings continues to increase*. Washington, DC: Author. Retrieved from https://www.eia.gov/todayinenergy/detail.php?id=24812

Wilson, J.R., & Corlett, E.N. (1995). *Evaluation of human work: A practical ergonomics methodology* (2nd ed.). Bristol, PA: Taylor & Francis, Inc.

Did You Know?

The Centers for Disease Control and Prevention has developed a website of resources to assist state and local health department personnel in investigating individual cases and outbreaks of Legionnaires' disease. Included on the website are surveillance and reporting resources, epidemiology investigation resources, healthcare investigation resources, environmental investigation resources, and communication resources. Learn more at www.cdc.gov/legionella/health-depts/index.html.

Worksite Built Environment and Objectively Measured Physical Activity While at Work: An Analysis Using Perceived and Objective Walkability and Greenness

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Abstract **The role of worksite environments in promoting physical activity (PA) remains largely unexplored. With workers in the U.S. spending half of their waking day in their work environment, the workplace could be an important venue for the promotion of health and PA. We examined associations between PA gained while at work and the built environment around the workplace. We measured PA using accelerometer devices in a sample of 119 participants of the Supports at Home and Work for Maintaining Energy Balance study, with a wear time of 1 week. Measures of built environment included perceived walkability, two different measures of objective walkability, and greenness.**

Working in an environment perceived as walkable was associated with more minutes of PA while at work in all models. When measured objectively, walkability was found significant in the adjusted models controlling for both home walkability and amount of PA gained in nonwork related activities. Greenness of the work environment was found nonsignificant. Findings suggest investing in walkable environments around the workplace or having worksites located in walkable areas can contribute to increased minutes of PA for employed people in the U.S.

Introduction

Walkability around the worksite is an unexplored aspect of the relationship between the worksite built environment and physical activity (PA). Employed people in the U.S. spend almost half of their nonsleep, daily time in worksite environments (Hipp et al., 2015), making workplace environments important venues for facilitating and promoting PA and healthy behaviors (Hoehner, Budd, Marx, Dodson, & Brownson, 2013). People can be active while actually doing their job, moving between office buildings, or doing errands or recreational activities around the workplace (Forsyth & Oakes, 2014).

While the workplace generally is recognized as a physical activity- and health promotion-venue (Quintiliani, Sattelmair, & Sorensen, 2007), most research has focused on wellness and health promotion programs inside the workplace (Baicker, Cutler, & Song, 2010; Goetzel & Ozminkowski, 2008; Hipp et al., 2017; Mujtaba & Cavico, 2013). Less attention has been paid to the role of the worksite built environment at naturally promoting PA by facilitating and encouraging errands, walking, and leisure exercise (Gehrke & Welch, 2017, Marquet et al., 2018).

Based on the literature, both walkability and greenness are environmental attributes with the potential to increase PA (James et al., 2017). Walkability is defined as the degree to which the built environment supports an individual in engaging in active transportation (Howell, Farber, Widener, & Booth, 2017; Marquet & Miralles-Guasch, 2015), while greenness represents the amount of green space and natural elements that are present in the environment (James, Banay, Hart, & Laden, 2015).

Recent advances in the study of environmental determinants of PA have demonstrated the need of going beyond self-assessed PA reports and instead using accelerometry to assess objectively the amount of PA gained by individuals (James et al., 2016). Similarly, environmental studies using only objective or only subjective measures of environmental attributes can be affected by bias and flaws (Sugiyama et al., 2014).

The present study examines the relationship between worksite environment and PA gained while at work. The study uses perceived and objective walkability measures and objective greenness, as well as PA recorded with accelerometers.

Methods

Participants came from a subsample (n = 119) of the Supports at Home and Work for Maintaining Energy Balance study, a cross-sectional telephone survey conducted in 2014 and aimed at examining the associations between residential and worksite environments on energy balance outcomes (Hoehner et al., 2013; Yang, Hipp, Marx, & Brownson, 2014). We obtained internal review board approval from the two participating institutions, Washington University in St. Louis (WUSTL) and the University of Missouri (MU). Researchers from WUSTL were responsible for gathering objective physical activity data, while MU researchers were responsible for collecting subjective data.

Consistent with the cross-sectional telephone survey, participants were recruited in four metropolitan areas of Missouri. Inclusion criteria were age (between 21–65), employment (≥20 hr/week at one primary location), and having no condition that prevented walking or bicycling. Participants were instructed and trained to wear a hip-mounted accelerometer device (ActiGraph GT3X+) for 7 days during waking hours. On average they wore it 14.8 hr/day (*SD* = 2.8 hr/day). ActiGraph devices have been extensively used in health research due to their small size and accuracy (Parry, Straker, Gilson, & Smith, 2013; Voss et al., 2016). Each participant was required to have at least 5 valid days (a valid day was defined as containing at least 10 valid hours).

The accelerometers were configured to measure activity counts for each 10 s-epoch. We then converted the activity counts measured by the accelerometer into moderate and vigorous activity minutes for each valid hour and day using the previously validated Troiano's algorithm (Troiano et al., 2008). Examples of moderate activities are walking or standing, while other activities that are more intense such as climbing stairs or running are classified as vigorous. Total minutes of PA while at work together with the share of active minutes while at work (total active minutes/total time at work) were used as dependent variables. A subset of questions from the Physical Activity Neighborhood Environment Survey (PANES) was used to measure the subjective perception of neighborhood walkability, both around the workplace and around home (Sallis et al., 2010). PANES items have been proved to be reliable and have been extensively used in research (Adlakha, Hipp, & Brownson, 2016; Hoehner et al., 2013; Yang et al., 2015).

A first objectively measured walkability score was obtained through the Walk Score algorithm. The algorithm is based on street design and street network distance to nine types of popular amenities and has also been used extensively in walkability studies (Forsyth, 2015; Hirsch, Winters, Ashe, Clarke, & McKay, 2016; Langlois, Wasfi, Ross, & El-Geneidy, 2016). A second measure of objective walkability was introduced using the Smart Location Database developed by the U.S. Environmental Protection Agency (Ramsey & Bell, 2014), which includes nationwide census block group-level data. We used *Z*-scores of gross population density, street intersection density, and land use diversity to estimate a walkability index at the census block group and then used a 0.5-mile buffer around home and worksite to estimate an average walkability score.

Finally, the normalized difference vegetation index (NDVI) was used as a measure of greenness. NDVI is commonly used in epidemiological studies as a measure of vegetation (Balseviciene et al., 2014; McMorris, Villeneuve, Su, & Jerrett, 2015). Multiple regression models were implemented after the bivariate analysis to test the association between PA gained while at work and measures of perceived walkability, objective walkability, and greenness.

Results

Most of the sample was female (75%), with an income higher than the poverty level (76.7%) and non-obese (61.6%) (Table 1). Non-obese individuals had a body mass index (BMI) below 30. Two thirds of the sample had a college education level or higher (66.6%). On average, participants engaged in 899.8 min of PA (light, moderate, or vigorous) while at work (*SD* = 612.1) and an additional 1,444 min while outside work (*SD* = 513.2). PA while at work represented an average 36.9% of the total PA registered.

An analysis of variance revealed significant variation among education levels ($F = 6.762$, $p < .001$); with a post hoc Tukey test showing that individuals with a high school education or less were associated with higher levels of PA while at work ($p < .001$). Analysis of variance did not draw any significant differences between PA registered while at work and perceived walkability or objective walkability measured at work or at home. Greenness around work and around home was not found significant, either.

There is, however, a positive relationship between active minutes at work (total active minutes/total time at work) and subjective walkability (Table 2, Model 1). Active minutes at work increased by 3.978 for each unit of perceived walkability (95% confidence interval [*CI*] [0.463, 7.492]). When the model was adjusted by sex, BMI, income, work type, and the amount of PA the participant was engaging in outside work, the same relationship was found between active minutes and perceived walkability around the worksite ($\beta = 4.26$; 95% *CI* [1.485, 7.875]). In Model 3, home walkability was introduced in the model, revealing an increase of 4.963 active minutes for each subjective walkability score increase around the worksite (95% *CI* [1.743, 8.130]), and a 4.24 active minute increase for every Walk Score objective walkability score increase (95% *CI* [0.637, 7.833]). Finally, Model 4 includes both home walkability and outside work PA, and found a significant increase of 5.05 active minutes per each subjective walkability unit increase (95% *CI* [1.84, 8.273]), and a 4.23 active minute increase for each Walk Score objective walkability score increase (95% *CI* [0.615, 7.854]).

Discussion

Our findings suggest walkability around the workplace has a positive effect on PA gained while at work. Results are also highly differentiated among population groups and depend on the PA that is being gained outside work and, ultimately, depend on the walkability measure explored. To the best of our knowledge, this study is the first attempt to use both perceived and objective measures of the built environment together with accelerometer-based measures of PA.

Recent research has looked at the role of walkable environments around work on transport-derived PA (Adams, Bull, & Foster, 2016). Significant research has also focused on the supports of the work environment for nutrition and healthy eating (Hipp et al., 2016) and how internal worksite programs and facilities can increase PA while at work (Gazmararian, Elon, Newsome, Schild, & Jacobson, 2013; Mujtaba & Cavico, 2013; Sliter & Yuan, 2015; Tabak,

TABLE **1**

Associations Between Environment Settings and Physical Activity

	Average Minutes of Work Physical Activity				Average Minutes of Outside Work Physical Activity				Share of Work Physical Activity Over Total Physical Activity (%)			
	n	Mean	*SD*	*p*-Value	*n*	Mean	*SD*	*p*-Value	*n*	Mean	*SD*	*p*-Value
Socioeconomic												
Sex				.277				.284				.825
Male	24	781.04	423.43		24	1,346.25	473.49		24	36.00	17.71	
Female	75	937.79	659.08		75	1,475.84	524.36		75	36.82	15.06	
Income				.051				.879				.307
<$39,999	22	1,101.95	901.47		22	1,435.23	504.38		22	39.62	19.45	
>$40,000	76	821.04	460.66		76	1,418.04	455.16		76	35.71	14.51	
Obesity				.629				.011*				.093
No	61	876.16	530.86		61	1,547.26	433.48		61	34.53	14.21	
Yes	38	937.71	729.99		38	1,279.34	589.39		38	39.98	17.39	
Education				.001**				.294				.002**
High school	14	1,520.14	1,016.76		14	1,280.21	478.29		14	50.92	17.23	
Some college	19	712.16	446.57		19	1,351.95	443.05		19	32.49	14.53	
Graduated college	37	813.27	497.95		37	1,457.78	604.31		37	35.09	15.19	
Graduate degree	29	833.62	391.82		29	1,567.24	429.71		29	34.38	12.86	
Work walkability												
Perceived[a]				.466				.027*				.953
Low	40	826.05	484.49		40	1,358.30	358		40	36.05	14.98	
Medium	32	894.44	746.68		32	1,362.22	509		32	37.19	17.79	
High	27	1,015.37	610.73		27	1,669.44	647		27	36.80	14.42	
Objective[b]				.856				.453				.937
Low	35	847.80	427.97		35	1,381.69	398		35	36.68	14.34	
Medium	36	895.78	792.55		36	1,423.69	502		36	35.73	16.26	
High	26	935.23	532.44		26	1,547.77	666		26	37.12	17.07	
Objective[c]				.321				.047*				.718
Low	36	842.58	510.29		36	1,285.39	372		36	37.52	14.90	
Medium	37	1,019.16	782.93		37	1,577.35	627		37	37.26	16.75	
High	26	809.12	432.44		26	1,475.46	458		26	34.47	15.45	

continued ▸

Hipp, Marx, Yang, & Brownson, 2016). The majority of the existing research linking the built environment around the workplace with actual PA while at work, however, has used self-reported measures of PA (Barrington, Beresford, Koepsell, Duncan, & Moudon, 2015; Cronin, 2016) or used proxies other than PA (Hoehner, Allen, Marx, Barlow, & Brownson, 2012; Moore et al., 2013). Most studies have used perceived and self-reported measures of walkability (Adams et al., 2016; Carlson et al., 2012), with results suggesting that perceived walkability around the workplace can be an even stronger predictor of PA than walkability around home.

Our study used three different measures of walkability and one measure of greenness to try to understand the role of the environment around work on promoting or discouraging PA during the workday. On top of controlling for the influence of the home environment and personal characteristics of the participants, we followed Faghri and coauthors' (2008) recommendation and used the type of work one does as a control variable in the models. In the same line, we also took into account the total PA that each participant is gaining outside work to help control for potential compensation dynamics on which highly active people outside work do not have a need to be active while at work (Carlson et al., 2012).

TABLE 1 continued

Associations Between Environment Settings and Physical Activity

	Average Minutes of Work Physical Activity				Average Minutes of Outside Work Physical Activity				Share of Work Physical Activity Over Total Physical Activity (%)			
	n	Mean	*SD*	*p*-Value	*n*	Mean	*SD*	*p*-Value	*n*	Mean	*SD*	*p*-Value
Home walkability												
Perceived[a]				.820				.002**				.098
Low	36	934.81	548.66		36	1,349.94	375.75		36	38.94	16.24	
Medium	33	914.15	734.13		33	1,306.85	524.22		33	38.76	17.82	
High	30	841.97	550.28		30	1,709.13	557.85		30	31.49	10.95	
Objective[b]				.341				.389				.542
Low	34	963.79	588.19		34	1,363.53	371.74		34	38.99	14.12	
Medium	29	973.48	816.40		29	1,542.76	623.31		29	35.91	16.56	
High	36	779.97	407.85		36	1,441.61	530.94		36	34.96	16.42	
Objective[c]				.098				.032*				.084
Low	36	1,053.97	815.43		36	1,283.69	406.66		36	41.15	16.73	
Medium	35	882.14	483.65		35	1,600.74	603.02		35	34.83	14.59	
High	28	723.61	372.85		28	1,455.68	466.19		28	33.05	14.60	
Greenness												
Around work: NDVI				.786				.628				.752
Low	29	834.66	407.42		29	1,484.62	524.10		29	35.97	16.50	
Medium	34	938.85	816.93		34	1,480.35	611.10		34	35.52	16.78	
High	36	915.36	530.77		36	1,378.11	398.00		36	38.19	14.08	
Around home: NDVI				.143				.099				.105
Low	32	724.94	364.15		32	1,562.72	498.18		32	31.83	14.56	
Medium	33	970.70	781.97		33	1,295.94	455.87		33	39.41	17.62	
High	34	995.53	592.39		34	1,477.21	557.39		34	38.43	13.92	

NDVI = normalized difference vegetation index.
*Significant at $p = .05$.
**Significant at $p = .01$.
[a]Subjective walkability measured with the method from Sallis et al., 2010.
[b]Objective walkability measured with Smart Location Database.
[c]Objective walkability measured with Walk Score.

Conclusion

Overall, worksite was an important venue for PA, as work PA represented 36.9% of the total PA gained. We found both subjective and objective measures of walkability to be associated with higher PA while at work, meaning that working in more walkable environments can have important benefits in terms of health through the promotion of PA. These results could encourage local planners and business leaders to invest in providing walkable environments around workplaces as a measure to contribute to their employees' health.

Our results encourage further actions towards improving worksite environments to promote PA. Worksites health programs, traditionally oriented towards promoting PA through participation and engagement in programs and activities, should be complemented with investments in the walkability of the worksite environment.

This study is not without limitations. Environment variables could not be ground-truthed, and the use of NDVI as a measure of greenness—although often used in the literature—could be masking other relevant relationships between greenness and PA.

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TABLE **2**

Associations Between Active Minutes at Work and Environment Settings

	Model 1			Model 2		
Walkability Measure	**Coef.**	***p*-Value**	**95% *CI***	**Coef.**	***p*-Value**	**95% *CI***
Subjective[a]	3.978	.027*	0.463, 7.492	4.680	.050*	1.485, 7.875
Objective[b]	-2.340	.230	-6.182, 1.500	-1.449	.423	-5.024, 2.127
Objective[c]	1.999	.287	-1.704, 5.701	2.930	.102	-0.598, 6.458
Greenness[d]	1.027	.572	-2.565, 4.620	0.330	.845	-5.044, 8.094
	Model 3			**Model 4**		
Walkability Measure	**Coef.**	***p*-Value**	**95% *CI***	**Coef.**	***p*-Value**	**95% *CI***
Subjective[a]	4.936	.003**	1.743, 8.130	5.056	.002**	1.840, 8.273
Objective[b]	-0.515	.784	-4.242, 3.211	-0.520	.783	-4.269, 3.229
Objective[c]	4.235	.022*	0.637, 7.833	4.234	.022*	0.615, 7.854
Greenness[d]	-1.019	.579	-4.656, 2.619	-1.050	.572	-4.725, 2.625

CI = confidence interval.
*Significant at p = .05.
**Significant at p = .01.
[a]Subjective walkability measured with the method from Sallis et al., 2010.
[b]Objective walkability measured with Smart Location Database.
[c]Objective walkability measured with Walk Score.
[d]Greenness cover measured using the normalized difference vegetation index.
Note. Model 1: unadjusted; Model 2: adjusted by sex, body mass index (BMI), income, work type, outside work physical activity (binary, meeting/not meeting Centers for Disease Control and Prevention [CDC] physical activity recommendations); Model 3: adjusted by sex, BMI, income, work type, home walkability (three levels: low, medium, and high); Model 4: adjusted by sex, BMI, income, work type, home walkability (three levels: low, medium, and high), outside work physical activity (binary, meeting/not meeting CDC physical activity recommendations).

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References

Adams, E.J., Bull, F.C., & Foster, C.E. (2016). Are perceptions of the environment in the workplace 'neighbourhood' associated with commuter walking? *Journal of Transport & Health*, *3*(4), 479–484.

Adlakha, D., Hipp, J.A., & Brownson, R.C. (2016). Adaptation and evaluation of the Neighborhood Environment Walkability Scale in India (NEWS-India). *International Journal of Environmental Research and Public Health*, *13*(4), 401.

Baicker, K., Cutler, D., & Song, Z. (2010). Workplace wellness programs can generate savings. *Health Affairs*, *29*(2), 304–311.

Balseviciene, B., Sinkariova, L., Grazuleviciene, R., Andrusaityte, S., Uzdanaviciute, I., Dedele, A., & Nieuwenhuijsen, M.J. (2014). Impact of residential greenness on preschool children's emotional and behavioral problems. *International Journal of Environmental Research and Public Health*, *11*(7), 6757–6770.

Barrington, W.E., Beresford, S.A., Koepsell, T.D., Duncan, G.E., & Moudon, A.V. (2015). Worksite neighborhood and obesogenic behaviors: Findings among employees in the Promoting Activity and Changes in Eating (PACE) trial. *American Journal of Preventive Medicine*, *48*(1), 31–41.

Carlson, J., Frank, L., Sallis, J., Conway, T., Cain, K., & Saelens, B. (2012). Contribution of perceived built environment attributes

References

around the worksite to active transportation and physical activity. *Journal of Science and Medicine in Sport*, *15*(Suppl. 1), S70.

Cronin, J. (2016). Audit of workplace walkability in an Irish healthcare setting. *Health Promotion International*, *31*(4), 849–856.

Faghri, P.D., Omokaro, C., Parker, C., Nichols, E., Gustavesen, S., & Blozie, E. (2008). E-technology and pedometer walking program to increase physical activity at work. *Journal of Primary Prevention*, *29*(1), 73–91.

Forsyth, A. (2015). What is a walkable place? The walkability debate in urban design. *Urban Design International*, *20*(4), 274–292.

Forsyth, A., & Oakes, J. (2014). Workplace neighborhoods, walking, physical activity, weight status, and perceived health. *Transportation Research Record: Journal of the Transportation Research Board*, *2452*(December), 98–104.

Gazmararian, J.A., Elon, L., Newsome, K., Schild, L., & Jacobson, K.L. (2013). A randomized prospective trial of a worksite intervention program to increase physical activity. *American Journal of Health Promotion*, *28*(1), 32–40.

Gehrke, S.R., & Welch, T.F. (2017). The built environment determinants of activity participation and walking near the workplace. *Transportation*, *44*(5), 941–956.

Goetzel, R.Z., & Ozminkowski, R.J. (2008). The health and cost benefits of work site health-promotion programs. *Annual Review of Public Health*, *29*, 303–323.

Hipp, J.A., Becker, H.V., Marx, C.M., Tabak, R.G., Brownson, R.C., & Yang, L. (2016). Worksite nutrition supports and sugar-sweetened beverage consumption. *Obesity Science & Practice*, *2*(2), 144–153.

Hipp, J.A., Dodson, E.A., Lee, J.A., Marx, C.M., Yang, L., Tabak, R.G., . . . Brownson, R.C. (2017). Mixed methods analysis of eighteen worksite policies, programs, and environments for physical activity. *International Journal of Behavioral Nutrition and Physical Activity*, *14*(1), 79.

Hipp, J.A., Reeds, D.N., van Bakergem, M.A., Marx, C.M., Brownson, R.C., Pamulapati, S.C., & Hoehner, C.M. (2015). Review of measures of worksite environmental and policy supports for physical activity and healthy eating. *Preventing Chronic Disease*, *12*(5), 140410.

Hirsch, J.A., Winters, M., Ashe, M.C, Clarke, P., & McKay, H. (2016). Destinations that older adults experience within their GPS activity spaces: Relation to objectively measured physical activity. *Environment and Behavior*, *48*(1), 55–77.

Hoehner, C.M., Allen, P., Marx, C.M., Barlow, C.E., & Brownson, R.C. (2012). Built environment features in the home and worksite neighborhood are associated with cardiorespiratory fitness. *Journal of Science and Medicine in Sport*, *15*(1), S100.

Hoehner, C.M., Budd, E.L., Marx, C.M., Dodson, E.A., & Brownson, R.C. (2013). Development and reliability testing of the Worksite and Energy Balance Survey (WEBS). *Journal of Public Health Management and Practice*, *19*(3, Suppl. 1), S105–S113.

Howell, N.A., Farber, S., Widener, M.J., & Booth, G.L. (2017). Residential or activity space walkability: What drives transportation physical activity? *Journal of Transport & Health*, *7*(B), 160–171.

James, P., Banay, R.F., Hart, J.E., & Laden, F. (2015). A review of the health benefits of greenness. *Current Epidemiology Reports*, *2*(2), 131–142.

James, P., Hart, J.E., Hipp, J.A., Mitchell, J.A., Kerr, J., Hurvitz, P.M., . . . Laden, F. (2017). GPS-based exposure to greenness and walkability and accelerometry-based physical activity. *Cancer Epidemiology Biomarkers and Prevention*, *26*(4), 525–532.

James, P., Jankowska, M., Marx, C., Hart, J.E., Berrigan, D., Kerr, J., . . . Laden, F. (2016). “Spatial energetics”: Intergrating data from GPS, accelerometry and GIS to address obesity and inactivity. *American Journal of Preventive Medicine*, *51*(5), 792–800.

Langlois, M., Wasfi, R.A., Ross, N.A., & El-Geneidy, A.M. (2016). Can transit-oriented developments help achieve the recommended weekly level of physical activity? *Journal of Transport & Health*, *3*(2), 181–190.

Marquet, O., Floyd, M.F., James, P., Glanz, K., Jennings, V., Jankowska, M.M., . . . Aaron Hipp, J. (2018). Associations between worksite walkability, greenness, and physical activity around work. *Environment and Behavior*. Retrieved from https://journals.sagepub.com/doi/10.1177/0013916518797165

Marquet, O., & Miralles-Guasch, C. (2015). The walkable city and the importance of the proximity environments for Barcelona’s everyday mobility. *Cities*, *42*(B), 258–266.

McMorris, O., Villeneuve, P.J., Su, J., & Jerrett, M. (2015). Urban greenness and physical activity in a national survey of Canadians. *Environmental Research*, *137*, 94–100.

Moore, K., Diez Roux, A.V., Auchincloss, A., Evenson, K.R., Kaufman, J., Mujahid, M., & Williams, K. (2013). Home and work neighbourhood environments in relation to body mass index: The Multi-Ethnic Study of Atherosclerosis (MESA). *Journal of Epidemiology and Community Health*, *67*(10), 846–853.

Mujtaba, B.G., & Cavico, F.J. (2013). Corporate wellness programs: Implementation challenges in the modern American workplace. *International Journal of Health Policy and Management*, *1*(3), 193–199.

Parry, S., Straker, L., Gilson, N.D., & Smith, A.J. (2013). Participatory workplace interventions can reduce sedentary time for office workers—A randomised controlled trial. *PLOS ONE*, *8*(11), e78957.

Quintiliani, L., Sattelmair, J., & Sorensen, G. (2007). *The workplace as a setting for interventions to improve diet and promote physical activity: Background paper prepared for WHO/WEF Joint Event on Preventing Noncommunicable Diseases in the Workplace*. Geneva,

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References *continued from page 25*

Switzerland: World Health Organization. Retrieved from https://www.who.int/dietphysicalactivity/Quintiliani-workplace-as-setting.pdf

Ramsey, K., & Bell, A. (2014). *Smart location database: Version 2.0 user guide*. Washington, DC: U.S. Environmental Protection Agency. Retrieved from https://www.epa.gov/sites/production/files/2014-03/documents/sld_userguide.pdf

Sallis, J.F., Kerr, J., Carlson, J.A., Norman, G.J., Saelens, B.E., Durant, N., & Ainsworth, B.E. (2010). Evaluating a brief self-report measure of neighborhood environments for physical activity research and surveillance: Physical Activity Neighborhood Environment Scale (PANES). *Journal of Physical Activity & Health*, *7*(4), 533–540.

Sliter, M., & Yuan, Z. (2015). Workout at work: Laboratory test of psychological and performance outcomes of active workstations. *Journal of Occupational Health Psychology*, *20*(2), 259–271.

Sugiyama, T., Cerin, E., Owen, N., Oyeyemi, A.L., Conway, T.L., Van Dyck, D., . . . Sallis, J.F. (2014). Perceived neighbourhood environmental attributes associated with adults' recreational walking: IPEN adult study in 12 countries. *Health & Place*, *28*, 22–30.

Tabak, R.G., Hipp, J.A., Marx, C.M., Yang, L., & Brownson, R.C. (2016). Which worksite supports for healthy weight do employees use? *Environment and Behavior*, *48*(1), 131–149.

Troiano, R.P., Berrigan, D., Dodd, K.W., Mâsse, L.C., Tilert, T., & McDowell, M. (2008). Physical activity in the United States measured by accelerometer. *Medicine and Science in Sports and Exercise*, *40*(1), 181–188.

Voss, C., Sims-Gould, J., Ashe, M.C., McKay, H.A., Pugh, C., & Winters, M. (2016). Public transit use and physical activity in community-dwelling older adults: Combining GPS and accelerometry to assess transportation-related physical activity. *Journal of Transport & Health*, *3*(2), 191–199.

Yang, L., Hipp, J.A., Adlakha, D., Marx, C.M., Tabak, R.G., & Brownson, R.C. (2015). Choice of commuting mode among employees: Do home neighborhood environment, worksite neighborhood environment, and worksite policy and supports matter? *Journal of Transport & Health*, *2*(2), 212–218.

Yang, L., Hipp, J.A., Marx, C.M., & Brownson, R.C. (2014). Occupational sitting and weight status in a diverse sample of employees in Midwest metropolitan cities, 2012–2013. *Preventing Chronic Disease*, *11*, E203.

SPECIAL REPORT

Reduction in the Lead Content of Candy and Purses in California Following Successful Litigation

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Abstract **Lead exposure causes an array of significant health problems in adults and especially in children. Therefore, reducing lead exposure is an important public health goal. Here, we analyzed data collected about the lead content in two product types, candy and purses. We show that following litigation, the prevalence of these products containing lead in California declined significantly. Results from products purchased online suggest that the decline was national, not just limited to California. Our results indicate that state consumer protection laws can be successful in reducing exposure to hazardous chemicals.**

Introduction

The consequences of children's exposure to lead are significant, well documented, and widely recognized. They include hyperactivity, attention deficits, reductions in IQ test scores, and reductions in academic achievement. The consequences of adult exposure to lead are less widely recognized but also significant. For women, these include hypertension, coronary heart disease, and cognitive decline. Exposure in pregnant women causes an increase in allergy and asthma in their children (U.S. Environmental Protection Agency [U.S. EPA], 2013). In addition, Hu and coauthors (2006) showed that prenatal exposure to lead results in IQ test score declines similar to those caused by early childhood exposure and Silver and coauthors (2016) showed that prenatal lead exposure resulted in delayed maturation of auditory and visual systems in newborns. Consequences of lead exposure for men include hypertension, coronary heart disease, and decreased semen quality (U.S. EPA, 2013). Common sources of lead exposure include paint in older buildings, lead-contaminated drinking water, and lead-based glazes on some ceramic dishware (Centers for Disease Control and Prevention, 2012).

In 2004, the Center for Environmental Health, a California nonprofit, tested a popular chili-coated tamarind candy for lead. California agencies and media outlets were also conducting similar testing, so our results were not unexpected: some of these products contained significant amounts of lead. We were particularly concerned because children commonly eat these candies.

We began exploratory screening in 2007 of hundreds of popular consumer products for lead. We were surprised to discover that the use of lead-based pigments was common in purses, wallets, handbags, and similar items that were made from brightly colored polyurethane or polyvinyl chloride fabric. In this special report, we use the generic term "purses" to refer to these items. Because women handle purses and similar items frequently, we were concerned about potential hand-to-mouth exposure, especially for women of childbearing age.

The Center for Environmental Health is experienced in using a California law, the Safe Drinking Water and Toxic Enforcement Act (1986), as a tool to improve product safety. In 2004, in collaboration with the California Department of Justice, we initiated litigation with dozens of candy manufacturers. This litigation was concluded in 2006 with consent judgments that set a health protective limit of 100 ppb for lead contamination of chili-coated tamarind candies. The limits were later added to California law (California Department of Public Health, 2018). The California Department of Public Health (CDPH) subsequently conducted regular monitoring of candies for compliance with the law. In 2009, we initiated legal proceedings to enforce the Safe Drinking Water and Toxic Enforcement Act with hundreds of fashion retailers and vendors. The legal actions were mostly completed in 2010 and 2011 and resulted in court-approved consent judgments that set strict standards for lead content (generally 300 ppm) for these products. In 2012, we began a systematic effort to monitor compliance with the legal agreements.

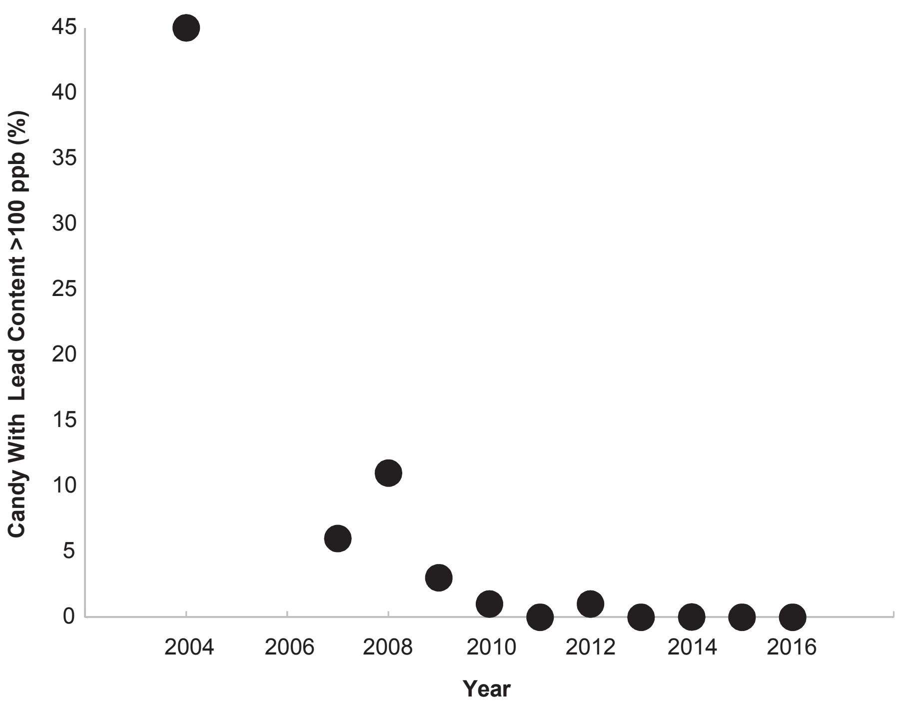
Here, we present data about the prevalence of lead-containing candy and purses in the years following our legal actions. While litigation is commonly used to address hazardous products, there has been little quantitative data to support the efficacy of this approach to increase the availability of safer products. We are aware of only one previous study, our analysis of lead in jewelry (Cox & Green, 2010).

Methods

We analyzed publicly available data from CDPH regarding lead contamination in candies, limiting our analysis to the chili-coated tamarind candies that were the focus of our litigation. CDPH purchased a convenience

FIGURE **1**

Occurrence of Lead-Contaminated Chili-Coated Tamarind Candies in California After Litigation and Legislation in 2006



sample of candy throughout California and the department's internal laboratory tested the candy with a detection limit that varied, but typically was 50 ppb. We used data from 2004 as baseline data, and data from 2007–2016 as post-litigation compliance data. The number of chili-coated tamarind candies tested was 151 in 2004, 532 in 2007, 245 in 2008, 306 in 2009, 337 in 2010, 202 in 2011, 275 in 2012, 268 in 2013, 106 in 2014, 180 in 2015, and 40 in 2016. The data are available at www.cdph.ca.gov/Programs/CEH/DFDCS/Pages/FDBPrograms/FoodSafetyProgram/LeadInCandy.aspx.

In addition, this study analyzed data about purses from 15 major retailers. The Center for Environmental Health purchased purses in California and online in 2009, and then again in 2012–2016. The 2009 purchases were prior to our litigation and thus provide baseline data; the other years were after the compliance date in our legal agreements. The 15 retailers included 6 department stores, 3 specialty fashion retailers, 3 online retailers, and 6 discount retailers (numbers do not add up to 15 as stores in the online retailer category overlap with some of the other categories.) We also purchased purses at online sites for the department stores and specialty and discount retailers. We purchased 130–370 purses each year: 137 purses in 2009, 366 in 2012, 279 in 2013, 226 in 2014, 239 in 2015, and 173 in 2016.

There are an enormous number of purses available for purchase, so we did not attempt to use a random purchasing strategy. Instead, we purchased items that were 1) brightly colored and 2) made of polyurethane or polyvinyl chloride fabric. Our purchasing strategy was similar across the years of this study, so we believe this protocol is adequate to detect time trends.

We screened the fabric components of each purse using an X-ray fluorescence analyzer (Olympus Delta Classic) to identify components with lead-containing pigments. The limit of detection for this instrument was <10 ppm. Typically, the lead pigment was in a surface layer bonded to a thicker layer of uncolored material. When we identified lead-containing pigments, one of two independent commercial laboratories determined the lead concentration of the lead-containing layer. One laboratory used the National Institute for Occupational Safety and Health (NIOSH) Method 7082 with inductively coupled plasma mass spectrometry substituted for atomic absorption spectrophotometry (Ashley & O'Connor, 2016); the second laboratory used U.S. Environmental Protection Agency Methods 3050B and 6010B (U.S. EPA, 1996a, b). Both methods are similar and use an acid digestion process to extract lead from the fabric.

We used Spearman's rank correlation coefficient to evaluate the relationship between the proportion of candy or purses with lead-containing pigments and year of purchase. We used an online calculator to do the rank correlation coefficient calculations and evaluate significance levels (Lowry, 2018).

Results

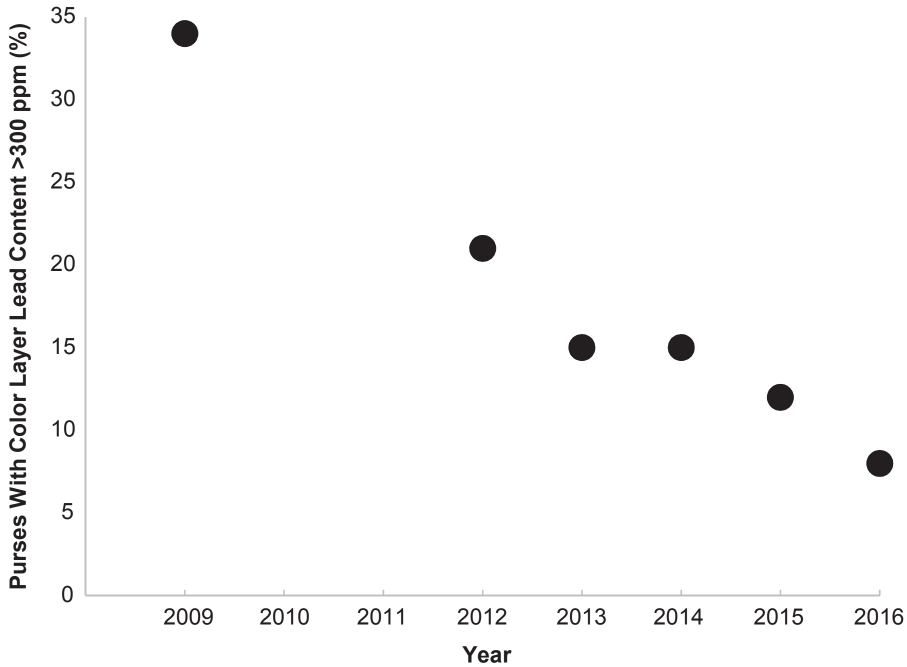
Lead content of chili-coated tamarind candies in the CDPH study varied from below the limit of detection to 1,100 ppb. Overall, the lead content of 5% of the candies was >100 ppb. In 2004, the baseline year, the lead content of 45% of the candies tested was above the 100 ppb standard. Then, 5 years later, the proportion of candies above the lead content standard had fallen to 3%, and in 4 of the 7 subsequent years no candy with lead content >100 ppb was found. The relationship between year and the proportion of candies above the lead content standard (Figure 1), as evaluated by Spearman's rank correlation coefficient, was negative ($r = -.81$) and significant ($p < .01$). The results suggest that litigation, followed by state-level legislation, was effective in reducing the prevalence of lead contamination in these candies.

Lead content of the pigmented surface layer of purses in this study varied from below the limit of detection to 26,100 ppm. Overall, 17% of the purses contained >300 ppm of lead in the pigmented surface layer. In 2009, the baseline year, 34% of the purses were above the 300 ppm lead content standard. In the 5 years after our litigation, the proportion of purses that were above the 300 ppm standard was approximately half (16%) of the baseline level. In 2016, the final year of the study, only 8% of the purses were above the lead standard. Two brands, each sold at one retailer, accounted for 10 of the 15 purses with high lead content found in 2016. The relationship between year and proportion of purses above the lead content standard (Figure 2), as evaluated by Spearman's rank correlation coefficient, was negative (r = -.94) and significant ($p < .05$). The results suggest that our litigation was an effective tool to reduce the use of lead-containing pigments in this product type.

Although we did not purchase products outside California, we used our online purchasing to measure the changes that occurred on a national scale after our litigation. The numbers of products purchased online were 51 in 2009, 37 in 2012, 134 in 2013, 102 in 2014, 120 in 2015, and 93 in 2016. The patterns we observed with the online products were similar to those in our complete sample, but with more variability due to the smaller sample size. Overall, 24% of the purses contained >300 ppm lead in the pigmented surface layer. In the baseline year, 2009, 33% of the purses were above the lead content standard while in the 5 years post-litigation, the proportion of noncompliant purses was 23%. In 2016, 15% of the purses were above the lead content standard and 10 of these items were from two brands, each sold at one retailer. The relationship between year of purchase and proportion of purses above the lead content standard (Figure 3) was negative (r = -.89) and significant ($p < .05$). The results suggest that litigation based on a state law was an effective tool to reduce the use of lead-containing pigments on a national scale.

FIGURE **2**

Proportion of Purses With Lead-Containing Pigments Sold by 15 Major Retailers in California



Note: Legal limits on lead content were set in 2010 and 2011.

Discussion

State consumer protection laws related to hazardous chemicals in products, including California's Safe Drinking Water and Toxic Enforcement Act, are controversial. For example, Fischer (2016) suggested, because of the perception that the law is costly for business and not effective, that

References

Ashley, K., & O'Connor, P.F. (Eds.). (2016). *NIOSH manual of analytical methods* (5th ed.). Atlanta, GA: Centers for Disease Control and Prevention and National Institute for Occupational Safety and Health. Retrieved from https://www.cdc.gov/niosh/nmam/pdfs/NMAM_5thEd_EBook.pdf

Burchfield, C. (2013). Taking "baby" steps towards protecting our children: Why Proposition 65 does not do enough to protect infants from lead exposure. *San Joaquin Agricultural Law Review*, *23*, 75–102.

California Department of Public Health. (2018). *Lead in candy*. Retrieved from https://www.cdph.ca.gov/Programs/CEH/DFDCS/Pages/FDBPrograms/FoodSafetyProgram/LeadInCandy.aspx

Centers for Disease Control and Prevention. (2012). *Low level lead exposure harms children: A renewed call for primary prevention*. Atlanta, GA: Advisory Committee on Childhood Lead Poisoning Prevention, Centers for Disease Control and Prevention. Retrieved from https://www.cdc.gov/nceh/lead/acclpp/final_document_030712.pdf

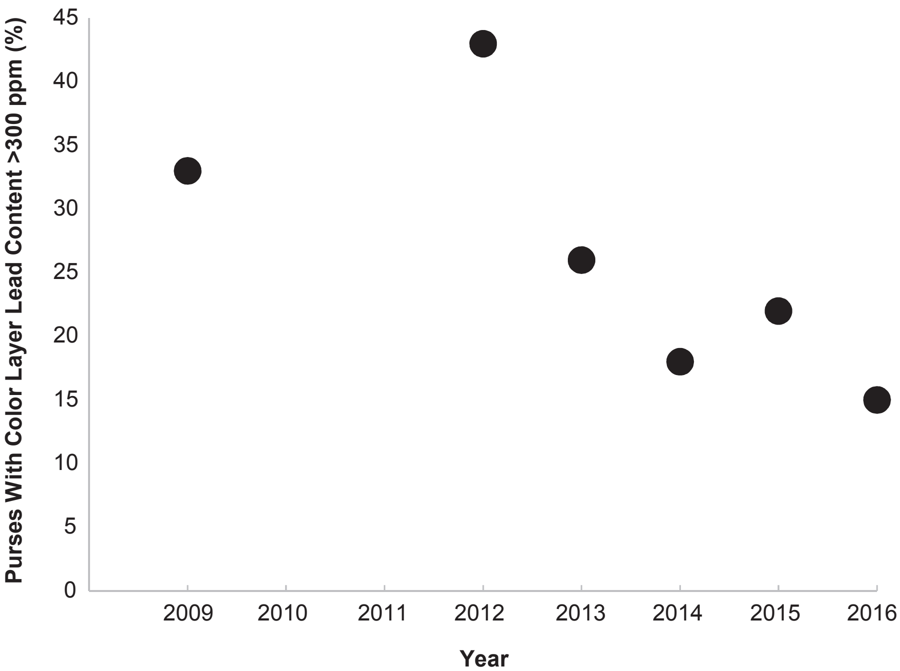
Cox, C., & Green, M. (2010). Reduction in the prevalence of lead-containing jewelry in California following litigation and legislation. *Environmental Science & Technology*, *44*(16), 6042–6045.

Fischer, D.B. (2016). Proposition 65 warnings at 30—Time for a different approach. *Journal of Business & Technology Law*, *11*(2), 131–152. Retrieved from https://digitalcommons.law.umaryland.edu/jbtl/vol11/iss2/2

Hu, H., Téllez-Rojo, M.M., Bellinger, D., Smith, D., Ettinger, A.S., Lamadrid-Figueroa, H., . . . Hernández-Avila, M. (2006). Fetal lead exposure at each stage of pregnancy as a predictor of infant mental development. *Environmental Health Perspectives*, *114*(11), 1730–1735.

FIGURE **3**

Proportion of Purses With Lead-Containing Pigments Purchased From Online Retailers



Note: Legal limits on lead content were set in 2010 and 2011.

the law "should be sunset to give way to a different approach." Suggested alternatives from this author include ecolabels and voluntary ingredient disclosure. From an opposite perspective, Burchfield (2013) suggested that the California statute does not go far enough. This author suggested that the law should provide special protections for children because of their increased susceptibility to some hazardous chemical exposures. Quantitative demonstrations of the efficacy of the law in reducing hazardous exposures, like this study, are necessary to resolve this controversy.

Conclusion

We have previously looked at the prevalence of lead-containing jewelry and concluded "litigation and legislation have been effective tools for reducing the prevalence of jewelry with high lead content in California" (Cox & Green, 2010). The two studies presented here, the CDPH data about lead contamination of candy and our study of lead pigments in purses, show similar results. Thus, they provide an important addition to the literature supporting the efficacy of California's Safe Drinking Water and Toxic Enforcement Act, and by extension, other state-level consumer protection laws.

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References

Lowry, R. (2018). *Spearman rank-order correlation coefficient.* Retrieved from http://vassarstats.net/corr_rank.html

Safe Drinking Water and Toxic Enforcement Act (1986). Chapter 6.6. Safe Drinking Water and Toxic Enforcement Act of 1986 [25249.5 - 25249.14]. Retrieved from http://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=HSC&division=20.&title=&part=&chapter=6.6.&article

Silver, M.K., Li, X., Liu, Y., Li, M., Mai, X., Kaciroti, N., . . . Lozoff, B. (2016). Low-level prenatal lead exposure and infant sensory function. *Environmental Health*, *15*(1), 65.

U.S. Environmental Protection Agency. (1996a). *EPA method 3050B: Acid digestion of sediments, sludges, and soils* [Revision 2]. Washington, DC: Author. Retrieved from https://www.epa.gov/homeland-security-research/epa-method-3050b-acid-digestion-sediments-sludges-and-soils

U.S. Environmental Protection Agency. (1996b). *EPA method 6010B: Inductively coupled plasma-atomic emission spectrometry.* [Revision 2]. Washington, DC: Author. Retrieved from https://archive.epa.gov/epawaste/hazard/testmethods/web/pdf/method%206010b,%20revision%202%20-%201996.pdf

U.S. Environmental Protection Agency. (2013). *Integrated science assessment (ISA) for lead* (Final report EPA/600/R-10/075F). Washington, DC: Office of Research and Development, National Center for Environmental Assessment–RTP Division, U.S. Environmental Protection Agency. Retrieved from https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=255721

DIRECT FROM AEHAP


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Mentoring: What Is Your Role?

Editor's Note: In an effort to promote the growth of the environmental health profession and the academic programs that fuel that growth, NEHA has teamed up with the Association of Environmental Health Academic Programs (AEHAP) to publish two columns a year in the *Journal*. AEHAP's mission is to support environmental health education to ensure the optimal health of people and the environment. The organization works hand in hand with the National Environmental Health Science & Protection Accreditation Council (EHAC) to accredit, market, and promote EHAC-accredited environmental health degree programs.

This column provides AEHAP with the opportunity to share current trends within undergraduate and graduate environmental health programs, as well as their efforts to further the environmental health field and available resources and information.

Clint Pinion is the current president of AEHAP and an assistant professor at Eastern Kentucky University. Jamie Hisel is the president-elect of AEHAP and is a clinical faculty member at Eastern Kentucky University.

Mentoring is defined as "a nurturing relationship that is based on mutual trust that leads to the development and professional growth of both the mentor and mentee" (Russel & Russell, 2011). Mentoring can lead to increased academic skillset development and positive attitudes regarding academics, as well as can assist students in transitioning from the classroom to the work environment (Bernier, Larose, & Soucy, 2005). Students need and benefit from positive relationships with nonfamilial adults such as faculty and internship preceptors. In fact, Bernier and coauthors (2005) believe positive engagement between faculty and students lead to positive outcomes regarding a student's academic performance, collegiate retention, career goals, and contentment with collegiate life. Rhodes and coauthors (2006) note that mentoring affects students by enriching their psychosocial well-being, enhancing their reasoning abilities, and assisting in identity development by observing positive attributes of their mentors.

Students completing a bachelor's or master's degree in environmental health science (EHS) from a National Environmental Health Science & Protection Accreditation Council (EHAC)-accredited school have many opportunities to engage with mentors. In fact, students from EHAC-accredited schools can engage with mentors through the NSF International Scholarship Program, the National Environmental Public Health Internship Program, and the Association of Environmental Health Academic Programs Student Research Competition. Not all mentoring experiences, however, are created equal. The outcome of mentoring for a mentee often depends on the quality of the mentor.

To better understand what students seek from their mentors, 40 EHS students from an EHAC-accredited undergraduate program were asked three questions (adapted from Russell & Russell, 2011). The questions were: 1) what is a mentor, 2) what is the role of a mentor, and 3) what characteristics should a mentor exhibit.

What Is a Mentor?

EHS students see mentors as competent individuals in their respective fields who guide mentees through interactive learning experiences.

What Is the Role of a Mentor?

EHS students offered a variety of role descriptors for mentors, most of which could be grouped into three major categories: professional development, personal support, and role modeling.

Professional Development

Students noted the importance of the mentor in facilitating mentee professional development through hands-on experiences. Professional development of mentees can be enhanced when mentors provide intellectually challenging tasks, guide mentees through the tasks using a scaffolding approach, and

TABLE **1**

Characteristics of Successful Mentors

Personal Qualities	Professional Skills
Accountable	Experienced
Approachable	Orator
Available	Organized
Caring	
Compassionate	
Confident	
Empathetic	
Honest	
Humble	
Integral	
Patient	
Relatable	
Reliable	
Resourceful	
Understanding	

provide feedback for improvement (Russell & Russell, 2011). Students cited provision of constructive criticism and feedback as important aspects of their professional development. Criticism can be used by mentees as they progress from assessing and addressing introductory to complicated EHS issues through collaborative work with mentors. Mentors can assess a student's professional development needs by ascertaining what the student expects to gain from the mentoring experience. Goals or outcome expectations of the mentoring process must be shared at the commencement of the mentoring experience (Fifolt & Searby, 2010; Russell & Russell, 2011).

Personal Support

EHS students noted the importance of the mentor being supportive, sharing in the learning experience, being approachable, and being present. Johnson and coauthor (2008) note that when mentors are accessible and make time for mentees, the mentoring experience is enhanced. For example, by being present, the mentor reiterates to the mentee that they are valuable and the mentoring experience is worthwhile. Furthermore, by being present, mentors gain insight into a mentee's abilities (i.e., strengths and weaknesses), as well as their career goals. Mentees are more likely to seek advice, take risks, and be confident in their ability to succeed when mentors are approachable, encouraging, and open (Johnson & Ridley, 2008). Mentees will develop competence, knowledge, and skills when their mentor is dependable, supportive, and protective (Russell & Russell, 2011). Transparent and clear communication between a mentor and mentee is critical to the mentoring process (Russell & Russell, 2011).

Role Modeling

Students believe mentors should serve as good role models. Mentors may encourage or enable a mentee to develop or modify their identity as an EHS professional. The mentee may look to the mentor to perceive their future career. Mentors may help mentees build cultural and social capital by encouraging and enabling mentees to use available community resources and by providing occupational or educational opportunities (Russell & Russell, 2011). It is important for mentors to understand the impact they have on mentees and work to provide a positive outlook to enhance the quality of the mentoring experience, which will in turn enhance the profession.

What Characteristics Should an Effective Mentor Exhibit?

The personal characteristics of mentors is important when considering the effectiveness or outcomes of the mentoring process (Bernier, Larose, & Soucy, 2005). Russell and coauthor (2011) note that there are six characteristics of successful mentors: 1) capacity to engage directly with mentee, 2) willingness to pass on knowledge, 3) willingness to enable mentee growth, 4) competency, 5) willingness and capacity to provide constructive feedback, and 6) honesty.

The list noted by EHS students was more exhaustive (Table 1) and could be defined by two categories—personal qualities and professional skills. Personal qualities included accountable, approachable, available, caring, compassionate, confident, empathetic, honest, humble, integral, patient, relatable, reliable, resourceful, and understanding. Professional skills included experienced in field, good orator, and organized. Based upon defined characteristics, students placed emphasis on the personal qualities, which might speak to a student's need to have a connection with their mentor. Rhodes and coauthors (2006) note that without a connection, the relationship dynamics needed for successful mentoring outcomes might not come to fruition.

Conclusion

Mentoring is a two-way street that involves the mentor and mentee working together to establish goals, exchange ideas, express opinions, and modify behaviors. In all regards, mentoring is an organic process requiring inputs and outputs from both parties. As EHS professionals, mentoring the next generation is an important part of our duties to the profession. We must take this role seriously to ensure competent EHS professionals in the future. As Pressley (2018) notes, "a good mentor must also be a good mentee and be able to assume a number of changing roles."

What is your role as a mentor?

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References

Bernier, A., Larose, S., & Soucy, N. (2005). Academic mentoring in college: The interactive role of student's and mentor's interpersonal dispositions. *Research in Higher Education*, *46*(1), 29–51.

Fifolt, M., & Searby, L. (2010). Mentoring in cooperative education and internships: Preparing proteges for STEM professions. *Journal of STEM Education: Innovations and Research*, *11*(1–2), 17–26.

Johnson, W.B., & Ridley, C.R. (2008). *The elements of mentoring* (Rev. 2nd ed.). New York, NY: Palgrave Macmillan.

Pressley, S.D. (2018). Mentoring is for everyone—Make a plan find your role. *Florida Journal of Environmental Health*, *217*.

Rhodes, J.E., Spencer, R., Keller, T.E., Liang, B., & Noam, G. (2006). A model for the influence of mentoring relationships on youth development. *Journal of Community Psychology*, *34*(6), 691–707.

Russell, M.L., & Russell, J.A. (2011). Mentoring relationships: Cooperating teachers' perspectives on mentoring student interns. *The Professional Educator*, *35*(2).

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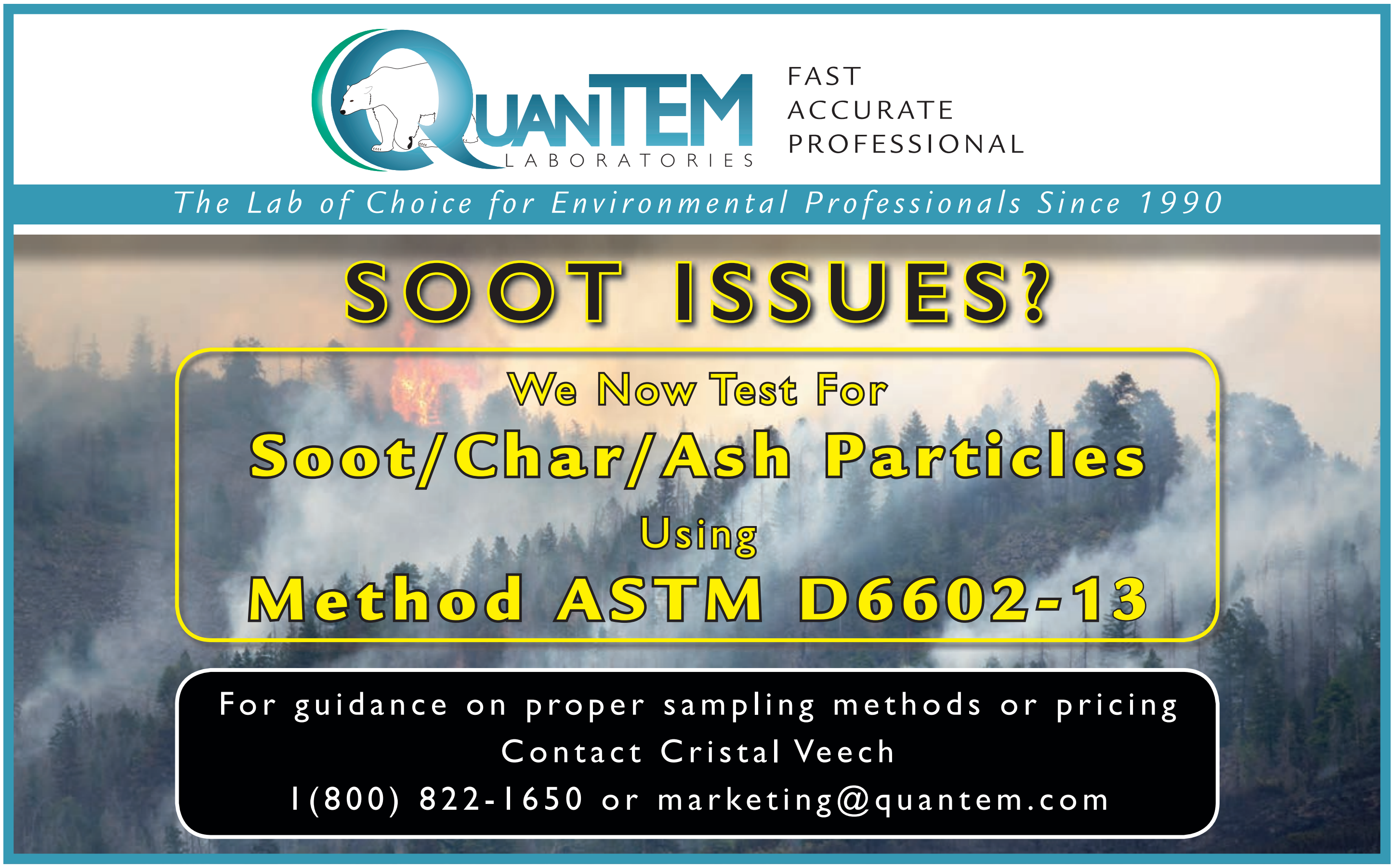
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Tick Talk: Keeping Environmental Health Up With Current Trends

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 this column on environmental health services from the Centers for Disease Control and Prevention (CDC) in every issue of the *Journal*.

In these columns, authors from CDC's Water, Food, and Environmental Health Services Branch, as well as guest authors, will share insights and information about environmental health programs, trends, issues, and resources. The conclusions in these columns are those of the author(s) and do not necessarily represent the official position of CDC.

Christine Vanover is a public health analyst at the National Center for Environmental Health (NCEH) and works on vector control issues. Andrew Ruiz is a health scientist at NCEH and also works on vector control issues.

Tickborne diseases are on the rise in the U.S. A recent article shows that the number of reported cases of tickborne disease doubled from 22,527 cases in 2004 to 48,610 cases in 2016 (Figure 1) (Rosenberg et al., 2018). Lyme disease makes up 82% of all reported tickborne disease cases and the geographic area at risk for Lyme disease has been expanding (Kugeler, Farley, Forrester, & Mead, 2015). Data from clinical and laboratory diagnoses suggest that approximately 300,000 Americans are infected with Lyme disease each year (Hinkley et al., 2014; Nelson et al., 2015). In the past 13 years, 7 new tickborne diseases affecting humans were identified in the U.S. (Rosenberg et al., 2018).

There are currently no vaccines available in the U.S. to prevent tickborne diseases. A recent study suggests that although pesticide application alone decreased the number of ticks in residential settings, it was not an effective method for preventing Lyme disease and other tickborne diseases (Hinckley et al., 2016). Current tickborne disease control strategies heavily rely on personal protective behaviors at the individual and household level, which poses a challenge for environmental health professionals who are often called upon to address tickborne disease concerns in their communities.

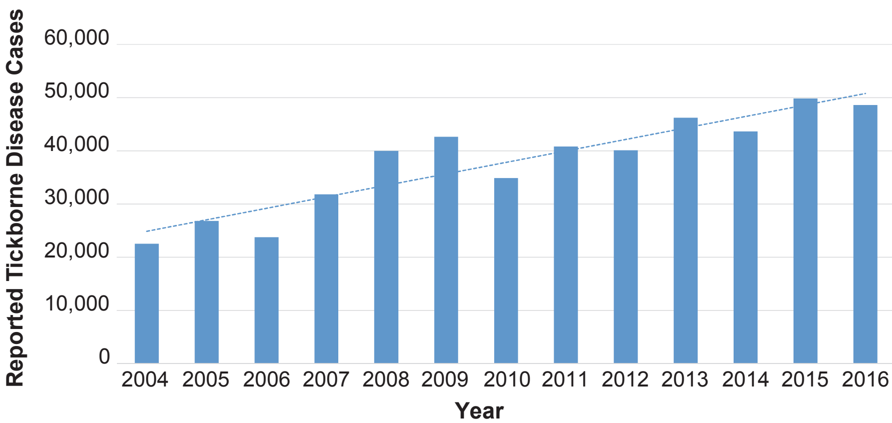
Approximately half of all state and local health departments provide vector control services that are commonly under the purview of environmental health programs (Association of State and Territorial Health Officials, 2016; National Association of County and City Health Officials [NACCHO], 2016; Ruiz et al., 2018). While vector control might be a priority for many health departments, there is a need to strengthen and build vector control capacity. For example, an assessment of health department and other local agency vector control programs found that 84% of the programs needed improvement and were not prepared to respond to a mosquito-borne disease outbreak (NACCHO, 2017). These results highlight the need to support vector control programs and assure a competent workforce capable of facing growing vector-borne disease challenges.

Environmental health professionals should be aware of two federal initiatives that could enhance vector control services in the U.S.: the Tick-Borne Disease Working Group and the establishment of Regional Centers of Excellence in Vector-Borne Diseases. The U.S. Congress enacted the 21st Century Cures Act in 2016 that authorized the U.S. Department of Health and Human Services secretary to form the Tick-Borne Disease Working Group. The working group is made up of federal and public sector clinicians, tick researchers, and patient advocates with the purpose of reviewing ongoing research and advances in control, diagnosis, and treatment of tickborne disease. This working group will also ensure interagency coordination and minimize duplication of efforts (U.S. Department of Health and Human Services, 2017). They released their first report to Congress in November 2018, publicly available at www.hhs.gov/ash/advisory-committees/tickbornedisease/index.html. Their reports will help shape the nation's tickborne disease priorities.

The second initiative began in 2017 when the Centers for Disease Control and Prevention (CDC) created five Regional Centers of Excellence in Vector-Borne Diseases to coordinate vectorborne disease research in their respective regions. Their focus is on not only developing new vector control tools and technologies but

FIGURE **1**

Tickborne Disease Cases Reported to the National Notifiable Disease Surveillance System—United States, 2004–2016



Note. Adapted from Rosenberg et al., 2018. Lyme disease reporting changed in 2008 to include probable cases in addition to confirmed cases.

FIGURE **2**

VeCtoR: Vector Control Tools & Resources

also training the next generation of vector control professionals and bolstering state and local vector control programs (Centers for Disease Control and Prevention, 2018). Developments from these two initiatives could mean more opportunities for environmental health professionals to engage in tick control activities and expand existing programs.

The need to increase tick services in the U.S. will likely lead to more environmental health agencies participating in tick surveillance and control. Ideally, a tick control program should adopt a comprehensive approach to controlling ticks, which includes education and outreach on personal protection behaviors, tick surveillance to identify high risk areas in the community, and the use of surveillance data to inform environmental and chemical control strategies. The 10 Essential Environmental Public Health Services (EEPHS) provide a framework that can be used to encourage a comprehensive and programmatic approach to providing tick control services and building capacity. To learn more about the 10 EEPHS and how to improve to your vector control program and tick control services, check out CDC's resources and tools available at www.cdc.gov/nceh/ehs/activities/vector-control.html. For resources on tick control and tickborne disease prevention, visit www.cdc.gov/ticks and www.cdc.gov/lyme/index.html.

CDC and partners continue to support environmental health programs and professionals by creating vector control tools and resources such as the e-Learning course titled Vector Control for Environmental Health Professionals (www.cdc.gov/nceh/ehs/elearn/vcehp.html). This course includes a module specifically covering tick biology, tickborne diseases, and tick management. The National Environmental Health Association (NEHA) released a new resource called VeCtoR: Vector Control Tools & Resources (Figure 2). This innovative toolkit provides access to a wide range of resources, organized by the 10 EEPHS, which includes templates, guidance, and best practices (www.neha.org/eh-topics/vectors-and-pest-control-0/essential-services). NEHA's interactive vector map (www.neha.org/vector-map) is another valuable tool for learning more about the ticks, mosquitos, and pests in your state. This resource provides a general overview of distribution, surveillance, and control of a variety of vectors and pests.

Environmental health professionals are encouraged to leverage these resources to enhance their knowledge of vectors and control strategies, as well as strengthen their vector control programs.

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References

Association of State and Territorial Health Officials. (2017). *ASTHO profile of state and territorial public health, volume 4*. Retrieved from http://www.astho.org/Profile/Volume-Four/2016-ASTHO-Profile-of-State-and-Territorial-Public-Health/

Centers for Disease Control and Prevention. (2018). *Preparing the nation for vector-borne diseases*. Retrieved from https://www.cdc.gov/ncezid/dvbd/about/prepare-nation.html

Hinckley, A.F., Connally, N.P., Meek, J.I., Johnson, B.J., Kemperman, M.M., Feldman, K.A., . . . Mead, P.S. (2014). Lyme disease testing by large commercial laboratories in the United States. *Clinical Infectious Diseases*, *59*(5), 676–681.

Hinckley, A.F., Meek, J.I., Ray, J.A., Niesobecki, S.A., Connally, N.P., Feldman, K.A., . . . Mead, P.S. (2016). Effectiveness of residential acaricides to prevent Lyme and other tick-borne diseases in humans. *The Journal of Infectious Diseases*, *214*(2), 182–188.

Kugeler, K.J., Farley, G.M., Forrester, J.D., & Mead, P.S. (2015). Geographic distribution and expansion of human Lyme disease, United States. *Emerging Infectious Diseases*, *21*(8), 1455–1457.

National Association of County and City Health Officials. (2016). *2016 national profile of local health departments*. Retrieved from http://nacchoprofilestudy.org/wp-content/uploads/2017/10/ProfileReport_Aug2017_final.pdf

National Association of County and City Health Officials. (2017). *Mosquito control capabilities in the U.S.* Retrieved from https://www.naccho.org/uploads/downloadable-resources/Mosquito-control-in-the-U.S.-Report.pdf

Nelson, C.A., Saha, S., Kugeler, K.J., Delorey, M.J., Shankar, M.B., Hinckley, A.F., & Mead, P.S. (2015). Incidence of clinician-diagnosed Lyme disease, United States, 2005–2010. *Emerging Infectious Diseases*, *21*(9), 1625–1631.

Rosenberg, R., Lindsey, N.P., Fischer, M., Gregory, C.J., Hinckley, A.F., Mead, P.S., . . . Petersen, L.R. (2018). Vital signs: Trends in reporting vectorborne disease cases—United States and territories, 2004–2016. *Morbidity and Mortality Weekly Reports*, *67*(17), 496–501.

Ruiz, A., Vanover, C., Parale, A., & Gerding, J. (2018). A web-based review of environmental health vector control services in the United States. *Journal of Environmental Health*, *80*(8), 36–38.

U.S. Department of Health and Human Services. (2017). *21st Century Cures Act*. Retrieved from https://www.hhs.gov/ash/advisory-committees/tickbornedisease/about/21-century-cures-act/index.html

Did You Know?

National Groundwater Awareness Week is March 10–16. This year marks the 20th anniversary of the observance. This year's theme is "Think." Think about this, 44% of the U.S. population depends on groundwater for its drinking water supply. And think about this, the U.S. uses 349 billion gallons of freshwater every day. Learn more about this observance and how you can get involved at www.ngwa.org/get-involved/groundwater-awareness-week/groundwater-awareness-week-2019.

EH CALENDAR

UPCOMING NEHA CONFERENCES

July 9–12, 2019: NEHA 2019 Annual Educational Conference & Exhibition, Nashville, TN. For more information, visit www.neha.org/aec.

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

July 12–15, 2021: NEHA 2021 Annual Educational Conference & Exhibition, Spokane, WA.

NEHA AFFILIATE AND REGIONAL LISTINGS

Arizona
March 6–7, 2019: Annual Spring Conference, hosted by the Arizona Environmental Health Association, Phoenix, AZ. For more information, visit www.azeha.org.

California
April 8–11, 2019: Annual Educational Symposium, hosted by the Mission Chapter of the California Environmental Health Association, Ventura, CA. For more information, visit www.ceha.org.

Florida
July 30–August 2, 2019: Annual Education Meeting, hosted by the Florida Environmental Health Association, Howey in the Hills, FL. For more information, visit www.feha.org/events.

Georgia
June 12–14, 2019: Annual Education Conference, hosted by the Georgia Environmental Health Association, Stone Mountain, GA. For more information, visit www.geha-online.org.

Idaho
March 12–14, 2019: Annual Education Conference, hosted by the Idaho Environmental Health Association, Boise, ID. For more information, visit https://ieha-idaho.com.

Illinois
April 25–26, 2019: North Chapter Annual Educational Conference, hosted by the North Chapter of the Illinois Environmental Health Association, Elgin, IL. For more information, visit http://ieha.coffeecup.com/calendar.html.

April 30–May 1, 2019: Central Chapter Annual Educational Conference, hosted by the Central Chapter of the Illinois Environmental Health Association, Normal, IL. For more information, visit http://ieha.coffeecup.com/calendar.html.

Indiana
April 11, 2019: Spring Conference, hosted by the Indiana Environmental Health Association, Greenwood, IN. For more information, visit www.iehaind.org/Conference.

Michigan
March 20–22, 2019: Annual Education Conference, hosted by the Michigan Environmental Health Association, Battle Creek, MI. For more information, visit www.meha.net/AEC.

New Jersey
March 3–5, 2019: Educational Conference & Exhibition, hosted by the New Jersey Environmental Health Association, Atlantic City, NJ. For more information, visit www.njeha.org.

Ohio
April 11–12, 2019: 73rd Annual Educational Conference, hosted by the Ohio Environmental Health Association, Worthington, OH. For more information, visit www.ohioeha.org.

Utah
May 8–10, 2019: Spring Conference, hosted by the Utah Environmental Health Association, Cedar City, UT. For more information, visit www.ueha.org/events.html.

Washington
May 6–8, 2019: 67th Annual Educational Conference, hosted by the Washington State Environmental Health Association, Yakima, WA. For more information, visit www.wseha.org.

TOPICAL LISTING

Public Health
April 23–24, 2019: Iowa Governor's Conference on Public Health, Des Moines, IA. For more information, visit www.ieha.net/IGCPH.

JEH QUIZ

FEATURED ARTICLE QUIZ #5

Legionnaires' Disease at a Hotel in Missouri, 2015: The Importance of Environmental Health Expertise in Understanding Water Systems

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 found at www.neha.org/publications/journal-environmental-health,
   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 March 1, 2019 (first day of issue).
5. Check your continuing education account online at www.neha.org.
6. You're on your way to earning CE hours!

Quiz Registration

Name

NEHA Member No.

E-mail

JEH Quiz #3 Answers

December 2018

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

➔ Quiz deadline: June 1, 2019

1. Approximately __ of Legionnaires' disease (LD) cases are fatal.
   a. 3%
   b. 6%
   c. 9%
   d. 12%

2. The rate of reported LD cases in the U.S. rose nearly __ from 2000–2014.
   a. 100%
   b. 200%
   c. 300%
   d. 400%

3. The U.S. rate increase of LD is likely due to
   a. increased awareness with improved testing and reporting.
   b. aging infrastructure leading to increased opportunities for *Legionella* growth.
   c. an increase in susceptible populations.
   d. all of the above.
   e. none of the above.

4. In a review of LD outbreaks reported to the Centers for Disease Control and Prevention (CDC) during 2000–2014, __ of outbreaks were caused by problems that effective water management could have prevented.
   a. 65%
   b. 75%
   c. 85%
   d. 95%

5. The review also found that hotels and resorts account for __ of LD outbreaks.
   a. 44%
   b. 49%
   c. 54%
   d. 59%

6. The hotel under investigation had a water management program.
   a. True.
   b. False.

7. A total of __ bulk and swab samples were collected from the pool and spa, potable water system, and hot water storage tank.
   a. 30
   b. 40
   c. 50
   d. 60

8. *Legionella pneumophila* serogroup 1 was recovered from __ guest room sink and shower fixtures.
   a. two
   b. three
   c. five
   d. six

9. The absence of *Legionella* detection during the initial investigation might be a result of
   a. the small number of samples collected from the potable water system for testing.
   b. disinfection of the spa before sampling.
   c. all of the above.
   d. none of the above.

10. Hotel staff were advised to
    a. eliminate low-flow areas by routinely flushing water fixtures in vacant rooms.
    b. remove sedimentation from aerators.
    c. increase hot water temperatures outside the *Legionella* amplification range in the presence of thermostatic mixing valves.
    d. all the above.
    e. none of the above.

11. In this case, initially local public health officials considered __ to be the most likely source of *Legionella*.
    a. spas
    b. pools
    c. potable water systems
    d. cooling towers

12. A more comprehensive environmental assessment revealed *Legionella* growth in the
    a. spa.
    b. pool.
    c. potable water system.
    d. cooling tower.

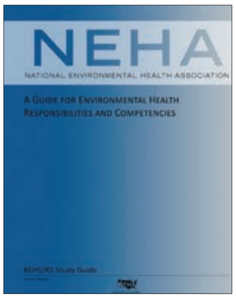
RESOURCE CORNER

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

NEHA BOOKSTORE
www.neha.org/store

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)

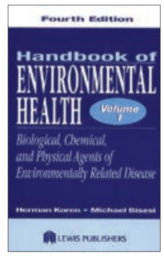
National Environmental Health Association (2014)

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

Handbook of Environmental Health, Volume 1: Biological, Chemical, and Physical Agents of Environmentally Related Disease (4th Edition)

Herman Koren and Michael Bisesi (2003)

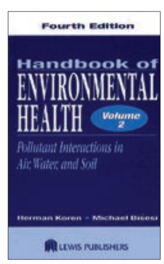


A must for the reference library of anyone in the environmental health profession, this book focuses on factors that are generally associated with the internal environment. It was written by experts in the field and copublished with the National Environmental Health Association. A variety of environmental issues are covered such as food safety, food technology, insect and rodent control, indoor air quality, hospital environment, home environment, injury control, pesticides, industrial hygiene, instrumentation, and much more. Environmental issues, energy, practical microbiology and chemistry, risk assessment, emerging infectious diseases, laws, toxicology, epidemiology, human physiology, and the effects of the environment on humans are also covered. Study reference for NEHA's Registered Environmental Health Specialist/Registered Sanitarian credential exam.

790 pages / Hardback
Volume 1: Member: $195 / Nonmember: $215
Two-Volume Set: Member: $349 / Nonmember: $379

Handbook of Environmental Health, Volume 2: Pollutant Interactions With Air, Water, and Soil (4th Edition)

Herman Koren and Michael Bisesi (2003)



A must for the reference library of anyone in the environmental health profession, this book focuses on factors that are generally associated with the outdoor environment. It was written by experts in the field and copublished with the National Environmental Health Association. A variety of environmental issues are covered such as toxic air pollutants and air quality control; risk assessment; solid and hazardous waste problems and controls; safe drinking water problems and standards; onsite and public sewage problems and control; plumbing hazards; air, water, and solid waste programs; technology transfer; GIS and mapping; bioterrorism and security; disaster emergency health programs; ocean dumping; and much more. Study reference for NEHA's Registered Environmental Health Specialist/Registered Sanitarian credential exam.

876 pages / Hardback
Volume 2: Member: $195 / Nonmember: $215
Two-Volume Set: Member: $349 / Nonmember: $379

IN MEMORIAM

RADM Jerrold Mark Michael

On July 24, 2018, RADM Jerrold Mark Michael passed away. He was a legend of public health and of the Commissioned Corps of the U.S. Public Health Service (USPHS). Born in 1927, RADM Michael enlisted in the U.S. Navy after high school. He served as a hospital corpsman at the end of World War II. In 1951, he married Lynn Simon in Washington, DC.

RADM Michael began his 20-year career in the Commissioned Corps as an ensign assigned by the Centers for Disease Control and Prevention to work on a polio research project in Arizona. Rising to rear admiral upper half, RADM Michael left the Commissioned Corps and moved to Hawaii. He served for 25 years as a professor and then as dean of the School of Public Health at the University of Hawaii. He then served 14 years as a professor of global health at George Washington University.

A prolific writer, RADM Michael was recognized for his work in health policy analysis and the politics of health, comparative health systems, global health, health management, health leadership, and academic management. He received many honors including the Walter S. Mangold Award from the National Environmental Health Association (NEHA) and the John Shaw Billings Award from AMSUS, The Society of Federal Health Professionals. He was twice awarded the USPHS Meritorious Service Medal and Commendation Medal, as well as two Brutsche Awards from the Commissioned Officers Association.

RADM Michael had been a member of NEHA since 1951. He was also the founding president of the USPHS Commissioned Officers Foundation for the Advancement of Public Health and an active participant in the national public health political process.

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

Editor's Note: The *Journal* would like to thank the Commissioned Officers Association for allowing us to reprint the above text. If you would like to share information about the passing of an environmental health professional to be mentioned in a future In Memoriam, please contact Kristen Ruby-Cisneros at kruby@neha.org.

NEHA ORGANIZATIONAL MEMBERS

Sustaining Members

Advanced Fresh Concepts Corp.
www.afcsushi.com

Allegheny County Health Department
www.achd.net

American Chemistry Council
www.americanchemistry.com

Arlington County Public Health Division
www.arlingtonva.us

Baltimore City Health Department, Office of Chronic Disease Prevention
https://health.baltimorecity.gov/programs/health-resources-topic

Bureau of Community and Children's Environmental Health, Lead Program
www.houstontx.gov/health/Environmental/community_childrens.html

Chester County Health Department
www.chesco.org/health

City of Independence
www.ci.independence.mo.us

City of Racine Public Health Department
http://cityofracine.org/Health

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

Coconino County Public Health
www.coconino.az.gov/221/Health

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

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www.diversey.com

DuPage County Health Department
www.dupagehealth.org

Eastern Idaho Public Health Department
www.phd7.idaho.gov

Ecobond LBP, LLC
www.ecobondlbp.com

Ecolab
www.ecolab.com

EcoSure
adolfo.rosales@ecolab.com

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

Giant Eagle, Inc.
www.gianteagle.com

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

GOJO Industries, Inc.
www.gojo.com/foodservice

Green Home Solutions
www.greenhomesolutions.com

Health Department of Northwest Michigan
www.nwhealth.org

HealthSpace USA Inc
www.healthspace.com

Hedgerow Software US, Inc.
www.hedgerowsoftware.com

IAPMO R&T
www.iapmort.org

Industrial Test Systems, Inc.
www.sensafe.com

Jackson County Environmental Health
www.jacksongov.org/442/Environmental-Health-Division

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

Kanawha-Charleston Health Department
http://kchdwv.org

LaMotte Company
www.lamotte.com

Louisiana State Board of Examiners for Sanitarians
www.lsbes.org

Maricopa County Environmental Services
www.maricopa.gov/631/Environmental-Services

Multnomah County Environmental Health
https://multco.us/health

Nashua Department of Health
http://nashuanh.gov/497/Public-Health-Community-Services

New Mexico Environment Department
www.env.nm.gov

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

Nova Scotia Environment
https://novascotia.ca/nse

NSF International
www.nsf.org

Oklahoma Department of Environmental Quality
www.deq.state.ok.us

Oneida Indian Tribe of Wisconsin
https://oneida-nsn.gov/resources/environmental

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www.buildingperformancecenter.org

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Texas Roadhouse
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www.tchd.org

Tyler Technologies
www.tylertech.com

Washington County Environmental Health (Oregon)
www.co.washington.or.us/hhs/environmentalhealth

Yakima Health District
www.yakimacounty.us/275/Health-District

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Colorado State University
http://csu-cvmbs.colostate.edu/academics/erhs

University of Illinois Springfield
www.uis.edu/publichealth

Western Carolina University, School of Health Sciences
www.wcu.edu

Note. As of October 1, 2018, NEHA no longer offers organizational memberships. We will continue to print this section in the Journal *to honor the membership benefits due to these listed organizations until their memberships expire. For more information about NEHA membership, visit www.neha.org/membership-communities/join.*

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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adamelondon@gmail.com

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Region5RVP@neha.org
Arkansas, Kansas, Louisiana, Missouri, New Mexico, Oklahoma, and Texas. Term expires 2020.

Region 6—Lynne Madison, RS, Environmental Health Division Director, Western UP Health Department, Hancock, MI.
Region6RVP@neha.org
Illinois, Indiana, Kentucky, Michigan, and Ohio. Term expires 2019.

Region 7—Tim Hatch, MPA, REHS, Deputy Director and Director of Logistics and Environmental Programs, Alabama Department of Public Health, Center for Emergency Preparedness, Montgomery, AL.
Region7RVP@neha.org
Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, and Tennessee. Term expires 2020.

Region 8—LCDR James Speckhart, MS, USPHS, Health and Safety Officer, FDA, CDRH-Health and Safety Office, Silver Spring, MD.
Region8RVP@neha.org
Delaware, Maryland, Pennsylvania, Virginia, Washington, DC, West Virginia, and members of the U.S. armed forces residing outside of the U.S. Term expires 2021.

Region 9—Larry Ramdin, REHS, CP-FS, HHS, Director of Public Health, Watertown Health Department, Watertown, MA.
Region9RVP@neha.org
Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. Term expires 2019.

Affiliate Presidents

Alabama—Camilla English, Environmental Supervisor, Baldwin and Escambia County Health Depts., Robertsdale/Brewton, AL.
camilla.english@adph.state.al.us

Alaska—Lief Albertson, University of Alaska Fairbanks Cooperative Extension Service, Bethel, AK.
liefalbertson@gmail.com

Arizona—Cheri Dale, MEPM, RS/REHS, Planner, Maricopa County Air Quality, Phoenix, AZ.
cheridale@mail.maricopa.gov

Arkansas—Richard Taffner, RS.
richard.taffner@arkansas.gov

Business and Industry—Traci Slowinski, REHS, CP-FS, Dallas, TX.
nehabia@outlook.com

California—Jahniah McGill, Vallejo, CA.
president@ceha.org

Colorado—Ben Metcalf, Tri-County Health Department, Greenwood Village, CO.
bmetcalf@tchd.org

Connecticut—Jessica Fletcher, RS, REHS, Environmental Health Specialist, Mohegan Tribal Health Dept., Uncasville, CT.
jfletcher@moheganmail.com

Florida—Latoya Backus, Largo, FL
latoya.backus@gmail.com

Georgia—Jessica Badour.
jessica.badour@agr.georgia.gov

Idaho—Sherise Jurries, Environmental Health Specialist Sr., Public Health–Idaho North Central District, Lewiston, ID.
sjurries@phd2.idaho.gov

Illinois—David Banaszynski, Environmental Health Officer, Hoffman Estates, IL.
davidb@hoffmanestates.org

Indiana—JoAnn Xiong-Mercado, Marion County Public Health Dept., Indianapolis, IN.
jxiong@marionhealth.org

Iowa—Don Simmons, Laboratory Manager, State Hygienic Laboratory, Ankeny, IA.
donald-simmons@uiowa.edu

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

Kansas—Robert Torres, Pratt County Environmental Services, Pratt, KS.
rtorres@prattcounty.org

Kentucky—Jessica Davenport, Kentucky Dept. of Public Health.
jessica.davenport@ky.gov

Massachusetts—Robin Williams, REHS/RS, Framingham Dept. of Public Health, Marlborough, MA.
robinliz2008@gmail.com

Michigan—Brian Cecil, BTC Consulting.
bcecil@meha.net

Minnesota—Caleb Johnson, Planner Principal, Minnesota Dept. of Health, St. Paul, MN.
caleb.johnson@state.mn.us

Missouri—Brian Keller.
briank@casscounty.com

Montana—Dustin Schreiner.

National Capital Area—Kristen Pybus, MPA, REHS/RS, CP-FS, Fairfax County Health Dept., VA.
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Nebraska—Sue Dempsey, MS, CPH, Administrator, Nebraska Dept. of Health and Human Services, Lincoln, NE.
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Nevada—Anna Vickrey.
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New Jersey—Lynette Medeiros, Hoboken Health Dept., Hoboken, NJ.
president@njeha.org

New Mexico—Cecelia Garcia, MS, CP-FS, Environmental Health Specialist, City of Albuquerque Environmental Health Dept., Albuquerque, NM.
cgarcia@cabq.gov

North Carolina—Nicole Thomas.
nthomas@moorecountync.gov

North Dakota—Grant Larson, Fargo Cass Public Health, Fargo, ND.
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Northern New England Environmental Health Association—Brian Lockard, Health Officer, Town of Salem Health Dept., Salem, NH.
blockard@ci.salem.nh.us

Ohio—Garrett Guillozet, MPA, RS/REHS, Franklin County Public Health, Columbus, OH
garrettguillozet@franklincountyohio.gov

Oregon—William Emminger, REHS/RS, Corvallis, OR.
bill.emminger@co.benton.or.us

Past Presidents—David E. Riggs, MS, REHS/RS, Longview, WA.
davidriggs@comcast.net

Rhode Island—Dottie LeBeau, CP-FS, Food Safety Consultant and Educator,

SPECIAL EVENTS

Attending our social and networking events is the best way to meet and interact with your fellow peers, prominent environmental health professionals and leaders, and NEHA team members.

Exhibition Grand Opening & Party

Tuesday, July 9

Come check out the latest environmental and public health products and services that will help you be more productive and efficient in your career. Our exhibitors are excited to meet face-to-face and connect with you!

Cost: Included in all full conference registrations.
Additional tickets $55 each.

General Jackson Showboat

Wednesday, July 10

Cruise down the Cumberland River through Nashville aboard the General Jackson Showboat! This fun-filled evening will be filled with local Tennessee flavors, music, and dancing!

Cost: Included in all full conference registrations.
Additional tickets $65 each.

Fun Fact: The General Jackson Showboat is named in honor of the first steamboat to operate on the Cumberland River in 1817.

Grand Ole Opry House UL Event

Sponsored by Underwriters Laboratories, Inc.

Thursday, July 11

Join us for a fun-filled special evening onstage at the historic Grand Ole Opry House. The evening will feature an onstage dinner reception followed by exclusive backstage tours of the home of Country Music. This event typically sells out, so purchase tickets in advance.

Cost: $75 per person.

NEHA SECOND VICE-PRESIDENTIAL CANDIDATE PROFILES

NEHA is governed by a corporate board of directors that oversees the affairs of the association. The board is made up of two groups: national officers and regional vice-presidents. NEHA elects its national officers through a ballot that goes to all active and life members prior to the annual conference. Among other things, the ballot features the election for the position of NEHA second vice-president. The person elected to this position begins a 5-year commitment to NEHA that involves advancing each year to a different national office, eventually to become NEHA's president.

Election policy specifies that candidate profiles for the second vice-president be limited to 800 words in total length. If a candidate's profile exceeds that limit, the policy requires that the profile is terminated at the last sentence before the 800-word limit is exceeded. In addition, the submitted profiles have not been grammatically edited but presented as submitted and within the 800-word limitation. This year, NEHA presents two candidates for the office of second vice-president. The candidates are listed alphabetically.

D. Gary Brown, DrPH, CIH, RS, DAAS

If I am fortunate enough to be elected as the National Environmental Health Association's Second Vice President, I will work diligently to promote NEHA and more importantly our wonderful profession. We are a hidden treasure, a profession which allows us to make a good living while ensuring people have clean air, food, water and proper waste disposal along with a healthy and safe place to live, work and play.

I am the Graduate Program Coordinator and Professor at Eastern Kentucky University (EKU) in the EHS Department. I am a certified industrial hygienist, registered sanitarian and a diplomate of the American Academy of Sanitarians. I have been a member of NEHA since 2001.

I have over 25 years of professional experience with a diverse background in environmental health starting at the entry level as a laboratory technician eventually working my way into management possessing an intimate knowledge of the requirements at all job levels. In addition, I have worked for both public and private entities including owning my own business. I am originally from Buffalo, New York but have lived in New York City, Birmingham, Alabama and am now a Kentuckian. In addition, through my work with the University of West Indies at Mona and the Jamaican Association of Public Health Inspectors, I have spent over a year of my life in Jamaica. The deep range of my professional experience throughout the U.S. and in several other parts of the world will be an asset if I am fortunate to become NEHA's second Vice President.

Besides my roles as a teacher, I actively serve as a professional consultant for government and private entities. Prior serving as a professor at EKU, I had over 10 years of professional experience in the environmental health arenas.

I have been actively involved with NEHA along with leadership roles in the Kentucky affiliate. In addition, I have been involved in leadership positions with the Association of Environmental Health Academic Programs and National Environmental Health Science & Protection Accreditation Council (EHAC).

My motivation for running is because I believe the REHS is the benchmark of achievement in environmental health, ensuring competence in education, knowledge and professional practice. With Your Support, I will work diligently to increase awareness of the importance and value of the REHS credential among policy makers and the general public. With Your Support, I would will also ensure the certification maintenance program is a value added process not only for the profession, but also be value added for our credential holders on an individual level.

As a Diplomate of the American Academy of Sanitarians (AAS), I know the value of membership in this prestigious organization along with the benefits of belonging to the Academy. AAS is an organization that provides the benchmark for standards, improving the practice, advancing the professional proficiency and promoting the highest levels of ethical conduct among professional sanitarians. I would like to increase membership in AAS, especially among the growing number of young professionals in our field. Possibilities to increase visibility while getting younger people involved may be through the use of electronic marketing and social media.

In my opinion, one of the greatest challenges is the lack of knowledge by the public of our profession. I believe that we need to build upon our progress and do even more to educate the public about the value of our profession. Increasing communication and cooperation with other environmental/occupational health and safety organizations will enable us to not only increase visibility for all involved, but also increase our effectiveness in our ever-improving communication with elected officials.

This increased awareness of environmental health will also help to reverse the trend of fewer students pursuing a formal education in environmental health science. I believe the students are the future of environmental health. As a profession, we need to spread the word, far and wide, about this exciting, fulfilling and meaningful career. I believe an increased awareness will also lead to increased diversity in our field, an area that most definitely needs to be improved upon.

I have a passion for assisting people all over the World to have clean air, food, and water along with a healthy and safe place to live, work and play. I believe NEHA can help to increase international participation, and in turn, we will all learn from each other helping to improve environmental health and overall quality of life for humanity on a global scale. We are a cure to many of the world's ills and we all know it, we need everyone else to know it.

We are making progress as an association and I hope to help is us make even more progress. This is environmental health's time. Our communities, here and worldwide, need us, the environmental health leaders here in the U.S. to be bold.

Shelly Wallingford, MS, REHS

Shelly Wallingford is a Registered Environmental Health Specialist that has worked in the public, private, and non-Profit sectors and has over twenty years of experience. Shelly has a passion for environmental health and furthering the profession. Shelly feels it is even more important than ever that we strengthen the association to help the profession as we continue to encounter different and challenging issues.

The work environmental health professionals do every day is so important to the safety and wellbeing of our communities and the association plays a very important role in helping all of us provide the best service we can. If I am elected, I will always do the best I can to help all of you with the important work you do every day by looking for new and better ways to provide services that you value, finding ways that members can volunteer and or get involved, providing information on best practices, etc. We are an amazing group of talented, dedicated, and passionate professionals and together we can make a difference in people's lives. Proud to be a NEHA member and I hope that you will give me the honor to serve on the board and I promise I will always go the extra mile for our members.

Did You Know?

You can stay in the loop every day with NEHA's social media presence. Find NEHA at

- Facebook: www.facebook.com/NEHA.org
- Twitter: https://twitter.com/nehaorg
- LinkedIn: www.linkedin.com/company/national-environmental-health-association

Follow us, like us, and join in on the conversation!

NEHA REGIONAL VICE-PRESIDENTIAL CANDIDATE PROFILES

NEHA is governed by a corporate board of directors that oversees the affairs of the association. The board is made up of two groups: national officers and regional vice-presidents (RVPs). NEHA has nine different regions. See page 46 for a listing of the regions and the states/groups each region represents. RVPs are elected by NEHA active and life members in their respective regions. RVPs serve a 3-year term.

Election policy specifies that candidate profiles for RVPs be limited to 400 words in total length. If a candidate's profile exceeds that limit, the policy requires that the profile is terminated at the last sentence before the 400-word limit is exceeded. In addition, the submitted profiles have not been grammatically edited but presented as submitted and within the 400-word limitation. Three regions are up for election this year. The candidates are listed alphabetically by region.

Region 4

Kimberley (Kim) Carlton, MPH, REHS, CFOI

Kim Carlton is the supervisor of the Partnership and Workforce Development Unit (PWDU) in the Environmental Health Division at the Minnesota Department of Health (MDH). Her team provides training, program evaluation, outreach activities and resources, technical expertise, and outbreak coordination to state and local environmental health programs statewide. Before joining MDH, she worked for a variety of local public health agencies for more than fifteen years. Her varied work experience has created opportunities to build strong relationships with environmental health professionals throughout the country.

A career highlight has been her service to the Minnesota Environmental Health Association (MEHA). She received the Environmental Health Specialist of the Year award from MEHA in 2015, in recognition of her outstanding contributions to environmental health in Minnesota. She held several roles on the Board of Directors over nine years, including a progressive 5-year term as President. She also served for several years on the outreach committee and as the chair of the technology committee. During her tenure on the Board, MEHA implemented several technological solutions to increase efficiency, connectedness and transparency. Thanks to deliberate efforts to reach out to environmental health students from middle school through graduate school, as well as environmental health practitioners entering the field, MEHA's membership consistently grew under Kim's leadership. She also served as the conference chair for the 2017 Region 4 Biennial Educational Conference/FDA Central Region Food Safety Seminar joint event in Minneapolis, which brought together more than 400 environmental health and food safety professionals from seventeen states.

Kim has served on an interim basis as the Region 4 Vice President for the past year, finishing the previous RVP's term. She is excited by the current Board's vision of elevating the status of environmental health in the public's eye. Like many environmental health professionals, Kim had never encountered the term "environmental health" until she entered the workforce. She fully supports NEHA's efforts to educate and inform policy-makers, professional associations, practitioners, students, and the general public of the critical functions that environmental health provide. She is honored to work with such a talented, motivated, forward-thinking group of environmental health professionals, and welcomes the opportunity to continue in this role.

Region 6

Nichole (Niki) D. Lemin, MS, RS/REHS, MEP

Niki Lemin joined Franklin County Public Health, in Columbus, Ohio, as Assistant Health Commissioner and Environmental Health Director in 2013. Prior to that, Niki served as the Safety Engineer of the Wexner Medical Center at The Ohio State University; a program manager for The Ohio State University College of Public Health; and, as Director of Emergency Response at Allen County Public Health (Lima, Ohio). She is a graduate and past mentor of the Centers for Disease Control and Prevention Environmental Public Health Leadership Institute, as well as a graduate of the Ohio Environmental Leaders Institute and the Ohio Preparedness Leadership Institute.

Niki has a passion for furthering environmental health leadership and workforce development initiatives. Recently, she represented Ohio on the Great Lakes Public Health Training Collaborative Environmental Health Inquiry Project and facilitated statewide conversations about approaches to addressing environmental public health workforce initiatives and training needs. Niki was recently appointed by the Director of the Ohio Department of Health to serve on the Ohio Lead Advisory Council and also serves as Chair of the Ohio Public Health Association Environmental Public Health Section. She is the past-Director of the Southeast District of the Ohio Environmental Health Association and is also a member of the Ohio Public Health Climate Resiliency Coalition, the National Environmental Health Association Climate Change Committee, the Great Lakes Public Health Training Collaborative Advisory Committee, the National Association of County and City

Health Officials' Environmental Public Health Workgroup, and the Ohio Environmental Protection Agency Health Department Advisory Panel.

Niki earned her Master of Science degree in Environmental, Health and Safety Management from The University of Findlay and Bachelor of Science Degree in Environmental Studies from Ohio Northern University. She is a Registered Sanitarian with the State of Ohio, a Registered Environmental Health Specialist with the National Environmental Health Association, and a Master Exercise Practitioner.

Jason W. Marion, MSB, MSPH, PhD

Jason Marion is running for regional vice president to (1) support NEHA outreach to state affiliates, (2) increase and celebrate membership of young professionals, (3) to enhance student membership growth and participation, (4) to support NEHA's improving reputation as a national leader with elected officials and public health organizations, (5) to promote our profession's value to the broader public health community, and (6) to make EH more visible to society. Marion will communicate with the region's state affiliates and seeks to attend their meetings once during the term. Currently, Dr. Marion is an associate professor of environmental health at Eastern Kentucky University (EKU). Marion has an Associate's Degree in wildlife management, B.S. and M.S. degrees in environmental science and biology from Morehead State University, and M.S. and Ph.D. degrees from The Ohio State University (OSU) in public health (EHS and epidemiology). Marion's work experience includes 13 years with the Ohio Department of Natural Resources and the Ohio Department of Agriculture, internship experience with U.S. EPA's National Risk Management Research Laboratory in Cincinnati and the U.S. Forest Service on the Daniel Boone National Forest, and two fire seasons as a Kentucky Division of Forestry wildland firefighter. At OSU, Marion was an infectious diseases fellow, post-doc, and graduate assistant for five years. Marion's professional service includes co-directing the One Health Conference (onehealthconference.com), past-president of the Association of Environmental Health Academic Programs, and membership in the Kentucky Academy of Science, the National Environmental Health Association, the American Public Health Association, and the Kentucky Environmental Health Association. Marion has served as a technical advisor for NEHA for five years. Marion's research includes students studying water quality (natural and drinking water) domestically and abroad. Marion has presented at multiple meetings, including to NEHA and the International Federation. Marion's dissertation, "Protecting Public Health and Ohio's Inland Beaches" supported EPA's continued use of *E. coli* as a water quality indicator, and led to greater understanding of harmful cyanobacteria blooms. Marion's board experience has included membership on the Board of Regents at Morehead State University and The OSU Board of Trustees. In Kentucky, Marion is a Kentucky Colonel and was appointed by the Governor to the Board of Certification of Wastewater System Operators and by the Cabinet Secretary to the Board of Certification of Water Treatment and Distribution System Operators. At EKU, Marion has received awards as the distinguished educational leader and critical thinking teacher of the year.

Jason Ravenscroft, MPH, REHS

Since I was a little boy I have been fascinated by science, especially the life sciences. I began my career as an environmental public health professional after graduating from college with a degree in Biology. In this field I have found a rewarding 20-year career so far working at the local level of government. I enjoy the interaction with the public and the practical application of my science education. In addition to my primary job, I've been able to pass on some of my knowledge and experience to the next generation of professionals through my role as adjunct faculty at the Indiana University Fairbanks School of Public Health. I have also enjoyed involvement with several professional organizations, most of all the Indiana Environmental Health Association. I am the current President of the Association and have enjoyed conferences, chapter meetings, committee chairmanships, and the education and networking the Association provides.

Region 9

Larry A. Ramdin, REHS, CP-FS, HHS

Larry Ramdin began his career in Public Health 40 years ago in a mosquito control program in the Republic of Trinidad and Tobago. He has worked as a Public Health Inspector (PHI) in the Borough of Point Fortin Trinidad (part of an initial group of PHI's in a newly formed municipality), A Senior Food and Drug Inspector with the Massachusetts Department of Public Health, Director of Quality Control at a Food Manufacturing Facility. Larry was Manager of Audit and Technical Services at a Food Safety consulting company. He also worked as an Environmental Health Specialist with the City of Newton, MA and is currently the Health Agent in Salem MA.

NEHA REGIONAL VICE-PRESIDENTIAL CANDIDATE PROFILES

In recognition of his contributions to Environmental Health, he was awarded the NEHA Certificate of Merit in 2005, he was also awarded the Robert Periello Award and Dr. Joseph Goldfarb Awards for outstanding contributions to Environmental Health in Massachusetts and the Dr. Leon Bradley Award for contributions to EH in New England. Larry is a past President of the Massachusetts Environmental Health Association.

Larry graduated from the Barbados Community College Public Health Inspection program where he was the first placed student, he also holds a Diploma in the Inspection of Meat and other Foods. He earned a Master of Public Health and a Master of Arts – Public Administration. He is a 2009 Scholar of the Northeast Public Health Institute and is the current NEHA Region 9 Regional Vice-President.

As the Region 9 Vice President, I was happy to see many changes in member outreach, by hosting multiple webinars, development of new Policy statements, engagement with affiliates at a greater level than in past. I hope to continue the work on the Board and continue advocating advocate for a national campaign on the profession. That will enable the general public and other stakeholders to gain a greater awareness of the profession and promote pride in the practitioner community. Additionally creating better collaboration within and outside the region to enable sharing of knowledge and building.

Did You Know?

This year you can strengthen NEHA by participating in the Be a Beacon for NEHA Membership campaign! A growing NEHA means greater prominence for environmental health, more resources and support for members, and a larger community of professionals. We are asking members to reach out to their environmental health networks to tell them how NEHA has helped their careers and recruit them to join NEHA. Learn more about the campaign at www.neha.org/nehabeacon.

NEHA NEWS

NEHA Staff Profiles

As part of tradition, the National Environmental Health Association (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. This month we are pleased to introduce you to two NEHA staff members. Contact information for all NEHA staff can be found on page 47.

Allison Schneider

I joined NEHA in October 2017 through the Public Health Associate Program, a training program run through the Centers for Disease Control and Prevention. My main role at NEHA is to expand our work in private water by building capacity for environmental health professionals who work with private well and septic system owners. Over the past year I have researched how water quality testing regulations impact health, created emergency preparedness resources focused on septic systems and private wells, and aided in projects ranging from body art regulation to vector control. Environmental health was a new frontier for me when I started but I have come to love working in a field that is always changing and keeps me on my feet.

I was born and raised in Lakewood, Colorado, and I grew up spending my free time hiking, skiing, and enjoying the outdoors. I moved to Portland, Oregon, to pursue my bachelor's degree at Lewis and Clark College, graduating in 2017 with a degree in political science and economics. While in school I worked with various senators and nonprofits to understand the relationship between policy and health and how research can be used to create and implement policies that benefit communities.

As I reflect on the past year, I cannot help but look forward to the challenges and opportunities my next year at NEHA will bring. With a year of experience under my belt, I am excited to continue advocating for environmental health and finding new ways to use my skills to elevate the field. I look forward to working with you in 2019!

Robert Stefanski

I joined the NEHA team as the marketing and communications manager in March 2018. I oversee all marketing initiatives and functions of NEHA and coordinate with all departments within the organization to communicate and promote their projects. My role is very diverse—every day I work and interact with different departments and team members on a variety of projects ranging from marketing virtual conferences, writing website and social media posts, and designing marketing materials such as brochures, flyers, and advertisements. No two days are the same, which is one of the things I like best about my role! My work has a great impact on NEHA as my duties and responsibilities extend to most areas of the organization.

My background started in graphic design, not marketing. I received a bachelor's of fine arts degree with an emphasis in communication and graphic design from Metropolitan State University of Denver. I thoroughly enjoy creating unique and visually interesting designs that educate and inform people. Early on in my career, I began to develop marketing skills. Because of my strong writing and editing abilities, I noticed that there was an opportunity to stand out by adding marketing skills to my repertoire. I was able to not only write and develop marketing plans and initiatives but also execute those plans by designing the materials. Doing both has allowed me to become a one-stop shop that streamlines the marketing process. Joining NEHA was a natural fit for me and has allowed me to continue many of my interests and passions.

One of my main goals here at NEHA is to create consistent brand standards for the organization. I will be working with departments in the coming months to develop guidelines and standards that give NEHA a single voice. This work will include developing consistent marketing collateral and materials for staff to use. I will also be working to develop marketing plans to guide the organization in our marketing efforts and outline strategies and action steps to ensure our success. Another goal during my time here has been to improve the look and quality of our marketing materials. I have worked with staff to produce the NEHA 2018 Annual Educational Conference (AEC) & Exhibition brochure, 2019 AEC branding and collateral, and AEC advertisements that appear right here in the *Journal* (see page 48 for this month's 2019 AEC advertisement). I am really pleased with how our materials have turned out and I hope that you enjoy them, too!

I am very proud to be a part of this great organization. NEHA is doing wonderful things to become the leading voice and essential partner in the environmental health profession and I am honored to be a part of it. Here's to an exciting 2019 and I look forward to working with many of you!

ACCEPTING NOMINATIONS NOW

2019 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.

The Mangold is NEHA's most prestigious award and while it recognizes an individual, it also honors an entire profession for its skill, knowledge, and commitment to public health.

Nomination deadline is March 15, 2019.

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For application instructions, visit www.neha.org/about-neha/awards/walter-s-mangold-award.

2019 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, 2019.

To access the online application, visit www.neha.org/about-neha/awards/joe-beck-educational-contribution-award.

NATIONAL ENVIRONMENTAL HEALTH ASSOCIATION

DirecTalk
continued from page 58

tion, assistance, and resources in the postdisaster response and recovery environment.

I founded the Institute for Childhood Preparedness to empower early childhood professionals with resiliency and preparation. With my background as a firefighter-paramedic (who has delivered three babies), turned attorney, turned public health professional with expertise in environmental health and emergency preparedness, I have a strong passion for supporting those who cannot advocate for themselves. In recent years, I have dedicated my career towards preparing workforces to help young children grow into healthy lives. The institute offers workshops and trainings created specifically for the early child care workforce with key lessons learned from public health emergencies, natural disasters, and mass shootings, with a focus on improved safety and disaster prevention. Given my background and expertise, and NEHA's mission and connection to its members, it made perfect sense that we would team up together on this important work.

The work of protecting the youngest generation is important as they cannot advocate for themselves. Our efforts are unique in that

The National Environmental Health Association and Region II Head Start convened a focus group in San Juan, Puerto Rico, with child care professionals from the private and public sectors. Photo courtesy of David Dyjack.

we are looking out for infants through age 5, a time when the brain develops the most in an individual's life and when they are most impressionable.

Our work takes place against a backdrop of many challenges—from working in areas that are still in the midst of recovering from one of the worst hurricane seasons on record to the restarting of one of the world's largest oil refineries in St. Croix. Throughout it all, one theme prevails: the protection of children's health is of the utmost importance.

We are working each day with those who are caring for children to better equip them to protect children from environmental and public health contaminants, chemicals, exposures, and threats. The national scope and application of the tools and resources we are creating is enormous. Consider that more than 60% of children attend child care before entering kindergarten and there are approximately 5 million child care workers in the U.S. These hard-working professionals will benefit directly from our projects and the lessons we are learning in the posthurricane Caribbean. Most notably, by benefiting child care workers, we can strive toward improving the care and health of children nationwide.

As a professional, I can think of no higher calling than to help protect those who are unable to protect themselves. This project does just that and it helps to ensure our children have safe and healthy environments in which to play, learn, and grow.

I appreciate the continued dedication, commitment, and professionalism of NEHA's members and staff who help support this project. I am grateful for our partnership with NEHA, which allows us to work on these important issues. As our work continues in the Caribbean, we will be sharing more of our findings and lessons learned. We encourage NEHA members to reach out if they would like to become more intimately involved.

DirecTalk MUSINGS FROM THE 10TH FLOOR

David Dyjack, DrPH, CIH

Every Child Deserves a Head Start

Our association is actively supporting the Centers for Disease Control and Prevention's (CDC) effort to rebuild the environmental health workforce in the U.S. Virgin Islands. Aligned with that effort, the National Environmental Health Association (NEHA) has received an award from the Agency for Toxic Substances and Disease Registry (ATSDR) to lead efforts in the Choose Safe Places for Early Care and Education initiative, with a primary emphasis in Puerto Rico and the U.S. Virgin Islands. We have contracted the Region II Head Start Association (www.region2headstart.org) to assist us in advancing that effort. Our aim is to ensure that every child reaches their full potential by being provided healthy, safe, and secure conditions during their youth. We are privileged and thankful to be involved in this effort. Our new partnership with Head Start represents a departure from our more traditional work and illustrates the value of our association in building bridges across disciplines in support of the most vulnerable among us—children.

I invited Andy Roszak, the principal contractor to Region II Head Start, to share his thoughts on the project. I trust you will enjoy hearing directly from him.

ddyjack@neha.org
Twitter: @DTDyjack

Our new partnership with Head Start represents a departure from our more traditional work.

Building Resilience in Puerto Rico and the U.S. Virgin Islands

Andrew Roszak, MPA, JD, EMT-Paramedic
Institute for Childhood Preparedness
www.childhoodpreparedness.org

In November 2018, Dr. Dyjack shared that NEHA had been entrusted with a multimillion dollar federal award to rebuild environmental health in Puerto Rico and the U.S. Virgin Islands. This work is well underway and I am writing to you from the Caribbean to share a brief update regarding a portion of that work. Through this grant, NEHA is supporting the U.S. Virgin Islands Department of Health and the Puerto Rico Department of Health, while also developing tools and resources that will have national-level applicability.

Through support from CDC and ATSDR, we have begun providing technical assistance and have also hired full-time staff who are actively working on the islands and aiding in the recovery process.

As you may expect, the impact of the 2017 hurricane season, which caused an estimated $282.27 billion in damages, has been and will continue to be long lasting. In the U.S. Virgin Islands, many buildings were damaged, destroyed or later condemned, including the hospitals that serve St. Thomas and St. Croix, as well as several of the Department of Health's buildings, clinics, and offices. More than a year after the hurricane passed, the Department of Health continues to work out of temporary space as their main office building undergoes repair and rehabilitation.

NEHA's work has been instrumental in supplying subject matter expertise and capacity to the impacted jurisdictions. Further, three of the NEHA projects focus on protecting children from harmful postdisaster exposures to chemicals, contaminants, and other hazards. Building off ATSDR's existing initiative, Choose Safe Places for Early Care and Education, NEHA has engaged in a collaborative effort with the Region II Head Start Association and my organization, the Institute for Childhood Preparedness. Together, we are working with environmental health, early childhood, and child care licensing professionals to develop tools and resources to help identify those facilities that might require additional atten-

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