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Volume 75, No. 8 April 2013

WIND TURBINES:

is there a human health risk?

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ABOUT THE COVER

In 2009, a book was published that introduced the term "Wind Turbine Syndrome," which is thought to be characterized by headache and dizziness that result from the low frequency sound (LFS) generated by wind turbines. In our cover article this month, "Wind Turbines: Is There a Human Health Risk?", the authors present a literature review to determine whether LFS leads to negative human health effects. In the reviewed studies the authors found that annoyance plays a large role in people's perception of wind turbines and additional research is warranted.

See page 8.

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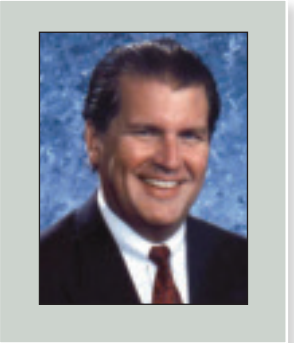

Brian Collins,
MS, REHS, DAAS

Tell Me—What Do You Do?

In my first president's message last July, I mused about making a career choice based upon what I knew and had learned about environmental health. "I reveled in the thought of preventing or mitigating illness and injury while promoting well-being and balance within a healthy environment." As I learned more about environmental health, I realized the related body of knowledge and science, not to mention the scope of practice, was enormous and evolving. As a result, and throughout the years, I often struggled to concisely answer a common question in social and professional circles, "What do you do?" It seems a simple and succinct articulation evades me and by extension, the profession, whenever I hear myself or others in the field attempt to describe the nature of our jobs. The NEHA board of directors recently took occasion to address the quandary!

Help us help you tell others what you do!

In spring 2012 under tutelage of then-President Mel Knight, a committee was appointed to again take up the question, "Who are we and what do we do?" This attempt was to be framed in a relevant and contemporary context and include the definition and scope of practice for environmental health. Committee appointees included a number of esteemed environmental health leaders: Keith Krinn, NEHA past president and Columbus Health environmental health administrator; Alicia Enriquez Collins, NEHA president elect and Sacramento County environmental health deputy chief; Dr. Carolyn Hester Harvey, NEHA first vice president and professor of environmental health; Adam London, Sandra Long, and David Riggs, NEHA regional vice presidents (RVPs) and local environmental health practitioners; and Dr. Michael Besisi, senior associate dean for academic affairs at The Ohio State University and director of the

Environmental health is the science and practice of promoting optimal human health, well-being, and preventing illness and injury by

- identifying and evaluating sources of threat to human health and the environment and
- limiting exposures to physical, chemical, and biological agents in air, water, soil, food, and other media that may adversely affect human health or the environment.

An environmental health professional is a practitioner with appropriate training and credentials whose duties are to lead, administer, implement, teach, or research environmental health activities.

The scope of duties include many of the essential services of public health and may include the following:

- air quality and noise;
- disaster sanitation and emergency planning†;
- food protection;
- general environmental health‡;
- hazardous materials;
- housing;
- institutions and licensed establishments;
- occupational safety and health;
- potable water;
- radiation protection;
- solid and hazardous wastes;
- statutes, regulations, and standards;
- swimming pools and recreational facilities;
- vectors, pests, and poisonous plants; and
- wastewater.

†Adapted from National Environmental Health Association, "2006 REHS/RS Job Task Analysis," retrieved from http://www.neha.org/credential/REHS_RS_JA_Update.shtml.

‡General environmental health includes investigating, auditing, inspecting, sampling, and measuring levels of agents and factors in environmental media; controlling contamination; applying environmental microbiology; and reviewing construction and land use plans.

Center for Public Health Practice. The work group was expertly chaired by U.S. Public Health Service Captain (Ret.) John Steward, NEHA Region 7 vice president, who is currently with the Institute of Public Health at Georgia State University and formerly of the Centers for Disease Control and Prevention. The group was specifically charged with providing considered revisions to the definition of environmental health and its scope of practice with a contemporary inclination.

Over ensuing months, the work group reviewed and analyzed many definitions of environmental health. Some were opinions published by iconic leaders in the practice and others were memorialized in government documents or academic literature. Once the literature search was complete, information was sifted and a revised definition of environmental health and its scope of practice were derived (see sidebar).

As members of NEHA and as vested and invested members and practitioners of the profession, I invite you to play a crucial role in the evolution of environmental health by assisting to articulate and memorialize a contemporary and relevant definition and scope of practice. Please go to **www.surveymonkey.com/s/26FT75S** and provide your input. The proposed definition and scope of practice are outlined, opportunity for feedback exists, and of course, you can even suggest we stand with current definitions. Please make sure you have provided feedback by May 1, 2013. Upon analysis of results, the NEHA board will adopt a revised definition and scope of practice for environmental health or take no action, allowing current articulations to stand.

I would again like to say thank you to RVP John Steward and his committee for their hard work and I look forward to a great deal of feedback so you can help us help you tell others what you do!

brianc@plano.gov

Did You Know?

NEHA's currently approved definition of environmental health is, "Environmental health and protection refer to protection against environmental factors that may adversely impact human health or the ecological balances essential to long-term human health and environmental quality, whether in the natural or man-made environment."

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- Plus two online articles available on NEHA's Members Only site

Errata

In the January/February issue (75[6]), the article "Fish Consumption Patterns and Mercury Exposure Levels Among Women of Childbearing Age in Duval County, Florida," had two errors:

Page 8, first paragraph in the Background section, "0.3 µg/g (3 parts per million)" should have been stated "0.3 parts per million, wet weight." Page 12, column 1, first full paragraph, "the 90% of women who were surveyed" should have been stated "the 90 pregnant women who were surveyed."

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Given in honor of NSF International's co-founder and first executive director, the *Walter F. Snyder Award* recognizes outstanding leadership in public health and environmental health protection. The annual award is presented jointly by NSF International and the National Environmental Health Association.

❖ ❖ ❖

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- outstanding accomplishments in environmental and public health protection,
- notable contributions to protection of environment and quality of life,
- demonstrated capacity to work with all interests in solving environmental health challenges,
- participation in development and use of voluntary consensus standards for public health and safety, and
- leadership in securing action on behalf of environmental and public health goals.

❖ ❖ ❖

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The 2013 Walter F. Snyder Award will be presented during NEHA's 77th Annual Educational Conference (AEC) & Exhibition to be held in Washington D.C., July 9 - 11, 2013.

For more information or to download nomination forms, please visit www.nsf.org or www.neha.org or contact Stan Hazan at NSF at 734-769-5105 or hazan@nsf.org.

SPECIAL REPORT

Wind Turbines: Is There a Human Health Risk?

Jennifer D. Roberts, MPH, DrPH
F. Edward Hébert School of Medicine
Uniformed Services University

Mark A. Roberts, MD, PhD
Exponent®

Abstract **The term "Wind Turbine Syndrome" was coined in a recently self-published book, which hypothesized that a multitude of symptoms such as headache and dizziness resulted from wind turbines generating low frequency sound (LFS). The objective of this article is to provide a summary of the peer-reviewed literature on the research that has examined the relationship between human health effects and exposure to LFS and sound generated from the operation of wind turbines.**

At present, a specific health condition has not been documented in the peer-reviewed literature that has been classified as a disease caused by exposure to sound levels and frequencies generated by the operation of wind turbines. Communities are experiencing a heightened sense of annoyance and fear from the development and siting of wind turbine farms. High-quality research and effective risk communication can advance this course from one of panic to one of understanding and exemplification for other environmental advancements.

Introduction

Humans have been using wind power since 500–900 A.D. when the first windmills were developed in Persia (Dodge, 2006). Wind, a form of solar energy, is altered in its flow pattern by the earth's land and water surfaces. Through these flow patterns, humans have developed highly sophisticated techniques and machinery to harness wind energy for several purposes such as sailing, pumping water, cutting lumber, and even generating electricity. One such machine is the wind turbine, which is a rotary device that extracts and converts the kinetic energy from the wind into mechanical power and then transforms this power into electricity through the use of a generator.

In the 2011 State of the Union address, President Obama set a new goal for America's energy future and stated that 80% of electricity should come from clean energy sources by 2035, including wind energy. As the use of wind energy and the emphasis on renewable energy have continued to grow, concerns have been raised regarding the impacts of these wind turbines on human health and well-being.

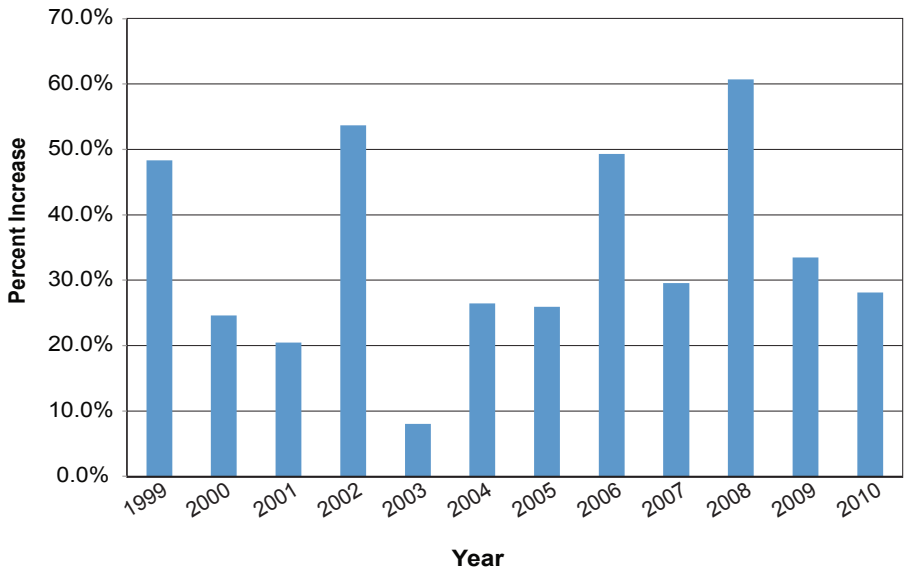
Wind Turbine Trends in the U.S.

By the end of 2011, the U.S. had over 46,900 megawatts (MW) of installed wind power, yet wind power accounts for less than 3% of the country's total net electric generation (U.S. Energy Information Administration [EIA], 2011a, 2011b, 2011c, 2011d). According to the American Wind Energy Association (AWEA), a 35% increase in new wind power capacity occurred over the past five years (AWEA, 2011, 2012). And at the end of 2011, it was also determined that 38 states had utility-scale wind installations with 14 of those having more than 1,000 MW of wind power capacity (AWEA, 2011, 2012). Furthermore, the top five states with the highest number of wind project installations through the first quarter of 2012 were Texas (10,648 MW); Iowa (4,419 MW); California (4,287 MW); Illinois (2,852 MW); and Minnesota (2,718 MW) (AWEA, 2012; EIA, 2011b, 2011d). As of today, the U.S. represents more than 20% of the world's installed wind power (AWEA, 2012).

For several years, wind energy has been the fastest growing source of new electric power generation (EIA, 2011b). Compared to the prior year, in 2006, 2007, 2008, 2009, and 2010 the generation from wind power increased by 49.3%, 29.6%, 60.7%, 33.5%, and 28.1%, respectively (Figure 1) (EIA, 2011b). The current wind energy capacity in the U.S. has generated enough electricity to power the equivalent of nine million homes (EIA, 2011a). And since 1999 the wind power in the U.S. has increased exponentially from 2,472 to 46,918 MW in 2011 with GE Energy being the

FIGURE **1**

Yearly Wind Generation Gains



largest domestic wind turbine manufacturer (AWEA, 2009; EIA, 2011d).

Typically in the U.S., small turbines have been used to power a single home or business and larger turbines have often been grouped into wind farms that can provide power to the electrical grid. The smaller wind turbines have a capacity of less than 100 kilowatts while larger commercial sized turbines may have a capacity of 5 MW.

Sound and Human Perception

The two components of sound, which allow for its perception and recognition, are frequency and pressure. The indicator of pressure or loudness is the decibel (dB), which is a logarithmic ratio of sound pressure level to a reference level. Likewise, the frequency or pitch of sound is expressed in Hertz (Hz), a unit defined as the number of cycles per second.

Human hearing of sound loudness ranges between 0 dB, a threshold of sound for humans, and 140 dB, a sound level that is very loud and painful for most humans (Baker & National Agricultural Safety Database, 1993; Navy and Marine Corps Public Health Center, 2009). Sound pressures are not all perceived as being equally loud by the human ear. This is because the human ear does not respond equally to all frequencies and the perception is less sensitive to lower and higher frequency sounds. For young individuals, the frequency range of human hearing has been found to be between 20 and 20,000 Hz with an inverse relationship between the upper frequency range and age (Berglund, Hassmen, & Job, 1996). Again, since the human ear does not have a flat spectral sensitivity or frequency response, sound pressures have regularly been frequency weighted so that the measured level corresponds to loudness as perceived by the average human ear.

Several weighting networks, such as A-weighting or C-weighting, have been defined by the International Electrotechnical Commission (IEC) in the IEC 60651 and American National Standards Institute (ANSI S1.1-1994) standards (British Wind Energy Association [BWEA], 2005; Hansen & World Health Organization [WHO], 1995). These networks filter the contributions of the varying frequencies to the overall sound level by reducing or increasing the sound pressure as a function of frequency (Hansen & WHO, 1995). Thus, A-weighting, labeled dB(A), approximates the response of the human ear to moderate sound levels and has been the most commonly used network (BWEA, 2005). C-weighting (dB[C]) is used to measure peak levels and G-weighting (dB[G]) is specifically designed for infrasound (BWEA, 2005).

Ultrasound or sound frequencies above 20,000 Hz and infrasound, which is approximately between 0 and 20 Hz, are generally considered to be inaudible (Berglund et al., 1996). Low frequency sound (LFS) in the range of 10–20 Hz and 100–250 Hz includes a field of audibility (Table 1) (Berglund et al., 1996; Leventhall, 2007). The audibility of LFS is often dependent on the individual. Furthermore, in order for infrasound to be audible at frequencies lower than 20 Hz, a very high-pressure level is required. Infrasound detection by the human ear has been theorized to result from nonlinearities of conduction in the middle and inner ear, which produces a harmonic distortion in the higher frequency range in addition to subjective reactions and through the resonance of other body organs (Berglund et al., 1996).

Wind Turbine Sound

One type of sound generated from wind turbines is a mechanical sound, which originates from the mechanical components of the turbines (e.g., gearbox). Aerodynamic sound is the other type of sound; the source of this sound is the flow of air around the blades and tower that produces a "whooshing" sound in the range of 500 to 1000 Hz (Hau, 2006). Manufacturers have improved the engineering of wind turbines and have been able to reduce the mechanical sound. Thus, the aerodynamic sound is now typically the dominant component of wind turbine sound (Pedersen & Waye, 2004; Rogers, Manwell, Wright, & Renewable Energy Research Laboratory, 2006). A great deal of variability exists in the whooshing sound, which is dependent upon mechanical and atmospheric conditions.

Many of the modern wind turbines are now upwind and the size of the turbine is variable. The earlier turbines were often downwind devices with the blades and rotor positioned on the downwind side of the tower. LFS with a range of 20 to 100 Hz was most commonly produced by downwind turbines when the turbine blade encountered localized flow deficiencies due to the

flow around a tower (Rogers et al., 2006). The new upwind turbines minimize LFS and infrasound (Musial, Ram, & National Renewable Energy Laboratory, 2010; Szasz & Fuchs, 2010).

Wind Turbine Syndrome

"Wind Turbine Syndrome: A Report on a Natural Experiment" was self-published in late 2009 by Nina Pierpont, MD, PhD, a pediatrician, who coined the term "Wind Turbine Syndrome." In the book, Dr. Pierpont theorized how a multitude of symptoms such as headache and dizziness resulted from wind turbines generating LFS that "scrambled" the body's balance, motion, and position sensors. The reported symptoms, gathered from a case series study design, were based on a collection of subjective responses from 37 participants (age <1 to 75 years) comprised from 10 families who resided (1,000 to 4,900 ft.) near wind turbines erected since 2004 in Canada, Ireland, the United Kingdom, Italy, and the U.S. The study participants, who were not masked from the purpose of the study, were interviewed by telephone by Dr. Pierpont to collect a narrative account, symptom checklist, and past medical history (Pierpont, 2009). Accordingly, this "Wind Turbine Syndrome" phenomenon has instigated a heightened level of panic and fear with respect to living near wind turbines.

The purpose of our article is to provide a summary of the peer-reviewed literature on the research that has examined the relationship between human health effects and exposure to sound in the lower frequency range as well as sound generated from the operation of wind turbines. An objective of this review is to infer conclusions through weighing the evidence from this research about the theory of "Wind Turbine Syndrome" and this possible association.

Methods

In 2009, we were commissioned to write a white paper by the Wisconsin Public Service Commission on the scientific literature regarding health effects associated with wind turbines and LFS (Roberts & Roberts, 2009). This article expounds on the research of that white paper and further examines the currently available research in the peer-reviewed literature that addresses the possible association between human health effects and LFS or noise generated by wind turbines. The PubMed search engine, maintained by the U.S. National Library of Medicine, was the source of this peer-reviewed literature and the search terms used were as follows: (1) "Infrasound AND Health Effects"; (2) "Low-Frequency Noise AND Health Effects"; (3) "Low-Frequency Sound AND Health Effects"; (4) "Wind Power AND Noise"; (5) "Wind Turbines"; (6) "Wind Turbines AND Noise."

It should be noted that the word "sound" and "noise" are terms that can be used interchangeably. "Noise" often implies an unwanted sound and often depends on the intensity of the sound. The classification of a "sound" or "noise" may also depend on cultural factors, the receiver, or the time and circumstance (Berglund et al., 1996). Likewise, both terms were used as search criteria for this research review.

TABLE **1**

Sound Frequency Spectrum

Frequency (Hz)				
0	**10**	**20**	**100-250**	**20,000**
Infrasound (with body resonance)	Infrasound	Low frequency sound	Non-low frequency audible sound	Ultrasound
Range of infrasound		Range of human hearing		Inaudible

Note. Adapted from Berglund et al., 1996.

Results

When this literature search was conducted, 16, 59, 40, 18, 20, and 3 articles using the "Infrasound AND Health Effects"; "Low-Frequency Noise AND Health Effects"; "Low-Frequency Sound AND Health Effects"; "Wind Power AND Noise"; "Wind Turbines"; and "Wind Turbines AND Noise" search terms were identified, respectively. A portion of these search results contained overlapping articles and many of the articles in the search output were not relevant because they focused on animal and not human responses or the sound studied was above the established range of LFS. Likewise, of the original 156 articles, nearly 30 articles (n = 28) were identified that addressed any human health effects associated with LFS and that were relevant to wind sound using the previously mentioned search terms.

Research on Human Health Effects and LFS

LFS is often accompanied by vibrations (Maschke, 2004). High levels of LFS, at a frequency of 50 to 80 Hz, can excite body vibrations (e.g., chest resonance vibration) (Leventhall, 2007). Additionally, these chest wall and body hair vibrations have also been shown to occur in the infrasonic range (Mohr, Cole, Guild, & Vongierke, 1965; Schust, 2004). A human tendency often occurs to confuse vibration with sound on its own, which results in people "hearing" more sound than is actually present. Likewise the reverse has been shown to occur as evident by the association found between motion sickness and LFS even without accompanying vibration (Berglund et al., 1996; Yamada, Sueki, Hagiwara, Watanabe, & Kosaka, 1991).

Castelo Branco and Rodriguez first documented vibroacoustic disease among airplane technicians, commercial and military pilots, mechanical engineers, restaurant workers, and disc jockeys for exposure to large pressure amplitude and low frequency sound (≥90 dB sound pressure level, ≤500 Hz) (Castelo Branco & Rodriguez, 1999; Maschke, 2004). Vibroacoustic disease was described as a thickening of cardiovascular structures, such as cardiac muscle and blood vessels. Castelo Branco and Rodriguez revealed that workers who were exposed to high-level LFS for more than 10 years exhibited extra-aural symptoms (Castelo Branco & Rodriguez, 1999; Maschke, 2004; Takahashi, Yonekawa, & Kanada, 2001). A causal asso-

ciation and a dose response relationship were not established.

Takahashi and co-authors have explored the effects of both human body vibration and LFS (Takahashi et al., 2001; Takahashi, Kanada, Yonekawa, & Harada, 2005; Takahashi, Yonekawa, Kanada, & Maeda, 1999). In a small study, six male subjects were exposed to pure tones in the 20 to 50 Hz frequency range, and vibration was measured on the chest and abdomen of the subjects. It was determined that sound-induced vibration was inversely correlated with the body mass index of the subject. Takahashi and co-authors concluded that the health effects of LFS depended on the physical constitution of the human body, yet it was still unclear if or how vibrations measured on the body surface related to vibrations in the body's internal organs (Takahashi et al., 1999). No conclusions could be determined as to the possible chronic health effects caused by long-term exposure to LFS (Takahashi et al., 1999).

Takahashi and co-authors also examined the level of unpleasantness of human body vibration and LFS and identified a significant correlation between the measured body surface vibration induced by the LFS and the rating of unpleasantness (Takahashi et al., 2005). Inukai and co-authors found a similar association previously (Inukai, Nakamura, & Taya, 2000). The research findings of Takahashi and co-authors and Inukai and co-authors supported the notion that hearing sensation was an influential component in the perception of unpleasantness or annoyance among those exposed to LFS (Inukai et al., 2000; Takahashi et al., 2005). It was also found that the perception of unpleasantness was independent of the audibility of the sound. Inukai and co-authors qualified three factors: (1) sound pressure, (2) vibration, and (3) loudness in addition to hearing sensation to be predictors for the human psychological responses to LFS, such as unpleasantness or annoyance (Inukai, Taya, Miyano, & Kuriyama, 1986; Takahashi et al., 2005).

Cardiovascular and respiratory effects have also been a focus of research with respect to LFS exposure. Studies have shown changes in heart rate in subjects who were exposed to LFS (Berglund et al., 1996; Yamada, Watanabe, Kosaka, Negishi, & Watanabe, 1986). Respiratory effects such as suspended or reduced respiration, gagging, and coughing have been documented in humans after exposure to LFS, but only with a sound pressure of 150–154 dB (Berglund et al., 1996; von Gierke & Nixon, 1976).

Studies conducted by Karpova and co-authors and Slarve and Johnson indicated that study subjects reported aural complaints after exposure to industrial infrasound below 20 Hz (Karpova et al., 1970; Slarve & Johnson, 1975). Increased diastolic blood pressure, decreased systolic blood pressure, and significantly decreased respiration rate were a few examples of reported nonaural effects (Karpova et al., 1970; Schust, 2004). Karpova and co-authors reported complaints of fatigue, feelings of apathy, loss of concentration, somnolence, and depression following exposure to LFS. Furthermore, a relationship between fatigue and tiredness after work and increasing LFS exposure was found among 439 employees working in offices, laboratories, and industries in a later study (Schust, 2004; Tesarz, Kjellberg, Landstroem, & Holmberg, 1997).

Some studies have looked at the effect of LFS on nighttime sleep in adults and children (Ising, Lange-Asschenfeldt, Moriske, Born, & Eilts, 2004; Maschke, 2004). Ising and co-authors found that children (aged 5–12 years) who were highly exposed to truck noise at a maximum of 100 Hz had a significantly increased morning saliva cortisol concentration compared to a control population. This increased cortisol concentration indicated an activation of the hypothalamus-pituitary-adrenal axis and thus an indication of restless sleep and a further aggravation of bronchitis in the children (Ising et al., 2004). Adult case studies have reported that LFS affects sleep quality and results in insomnia and concentration problems (Berglund et al., 1996; Waye, 2004). In a cross-sectional study of 279 individuals, however, it was determined that no significant differences were detected in reported sleep among those exposed to a high level of LFS compared to those exposed to a medium level of LFS from ventilation and heat pumps (Waye & Rylander, 2001).

Annoyance, which will be discussed later, seemed to play a role in these findings. Fatigue, difficulty falling asleep, and feeling tense and irritable were reported significantly more often among those individuals who were annoyed by LFS than those who were exposed to the same sound but did not report being annoyed. Lastly, a study that exposed sinusoidal tones, or pure tones at a single frequency of 10, 20, 40, and 63 Hz with sound pressure levels ranging from 75 to 105 dB for 10 Hz and 20 Hz and 50 to 100 dB for 40 Hz and 63 Hz to six participants found no significant difference between the exposure and control nights in sleep efficiency index, number of changes in sleep state, or changes in the proportion of each sleep stage evaluated by electroencephalogram recordings (Gage, 2010; Inaba & Okada, 1988; Waye, 2004).

Research on Wind Turbines, Health Effects, and Annoyance

Health Effects

Most recently some research has been done specifically on sound produced by wind turbines and the possible association of a human health risk (Salt & Kaltenbach, 2011; Smedley, Webb, & Wilkins, 2010). Salt and Kaltenbach concluded that A-weighting wind turbine sound was not appropriate because A-weighted sounds present a misleading representation of whether the sound affects the human ear or if it is physiologically mediated by the outer hair cells (OHC). OHC have demonstrated stimulation by LFS as low as 3 to 4 Hz, but the A-weighted spectrum arrest measurement of all sound components below 14 Hz (Salt & Hullar, 2010; Salt & Kaltenbach, 2011). A proposed alternative to A-weighting is to use G-weighted measurements, a weighting curve based on the human audibility curve below 20 Hz and with a steep cutoff above 20 Hz (Salt & Kaltenbach, 2011). It was determined, however, that with the use of G-weighed sound measurements, the level of infrasound produced by wind turbines is often too low to be heard by the human ear even though the level is still sufficient to cause OHC stimulation (Jakobsen, 2005; Salt & Hullar, 2010; Salt & Kaltenbach, 2011; Schust, 2004).

Other researchers have examined the possible association of sound produced by wind turbines and epileptic seizures. Through modeling, Smedley and co-authors found that, unlike smaller wind turbines, larger 2 MW wind turbines with a blade width of

2m and a height of 120 m were unlikely to rotate fast enough to induce epileptic seizures due to shadow flicker (Smedley, Webb, & Wilkins, 2010).

Annoyance

The World Health Organization (WHO) considers annoyance an adverse health effect of noise in addition to sleep disturbance, performance effects, and psychological effects such as irritability (WHO, 2001). Annoyance was also defined as a feeling of displeasure with varying tolerance levels. WHO characterized annoyance as a feeling that increases with noise impulses as opposed to a steady noise (WHO, 2001). Likewise, the primary, and most frequently reported, perceived effect of LFS is annoyance as opposed to the loudness or noisiness (Berglund et al., 1996; Broner, 1978).

To date, four epidemiological studies have specifically examined the effects of sound generated by wind turbines on human health (Pedersen, van den Berg, Bakker, & Bouma, 2009; Pedersen & Waye, 2004, 2007; Shepherd, McBride, Welch, Dirks, & Hill, 2011). Pedersen and Waye identified a dose response relationship between calculated A-weighted sound pressure levels from wind turbines and noise annoyance in a cross-sectional study (N = 351) that was conducted in five dwelling areas in Sweden. The study respondents were annoyed by the upwind wind turbines, which had a blade passage frequency of 1.4 Hz, at a higher level than other community noises, such as road traffic (Pedersen & Waye, 2004). Noise annoyance was also found to be related to visual or aesthetic interference and attitude or sensitivity toward the wind turbine (Pedersen & Waye, 2004).

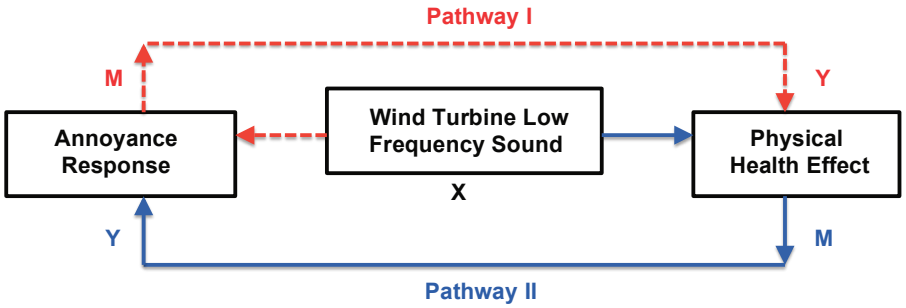
In another Swedish cross-sectional study (N = 754), the relationship between wind turbine noise and self-reported health and well-being factors was also examined (Pedersen & Waye, 2007). No correlation existed between A-weighted sound pressure levels from wind turbines and any health or well-being factors, such as the respondent's status of chronic disease, diabetes, or cardiovascular disease (Pedersen & Waye, 2007). Nevertheless, 31 out of 754 respondents stated that they were annoyed by the wind turbine noise and among this subset 55% reported being tired or that their sleep was disturbed (Pedersen & Waye, 2007). These findings were statistically significantly higher in comparison to those respondents who were not annoyed. Noise annoyance was also found to be associated with a negative attitude toward the visual impact of wind turbines in this study (odds ratio [*OR*] = 14.4, 95% confidence interval [*CI*]: 6.37–32.44) as well as another field study conducted (N = 725) in The Netherlands (*OR* = 2.8, $p < .001$) (Pedersen et al., 2009; Pedersen & Waye, 2007). Living in a rural area compared to an urban area increased the risk of perceiving wind turbine noise and annoyance, especially at sound levels above 40dB(A) (Pedersen & Waye, 2007).

Most recently Pedersen analyzed the self-reported health status among the participants in both the aforementioned Swedish and Dutch cross-sectional studies (Pedersen, 2011). The prevalence of diabetes was found to be weakly associated with A-weighted sound pressure levels due to wind turbines (*OR* = 1.13, 95% *CI*: 1.00–1.27) in addition to outdoor (*OR* = 1.70, 95% CI: 1.14–2.56) and indoor (*OR* = 1.62, 95% *CI*: 1.10–2.40) annoyance (Pedersen, 2011).

Finally, a cross-sectional study in New Zealand reported a lower mean physical health-related quality of life (HRQOL) domain score (F [1, 194] = 5.816, p = .017) among "The Turbine Group" as compared to "The Comparison Group" (Shepherd et al., 2011). HRQOL measured general well-being and well-being in the physical, psychological, and social domains (Shepherd et al., 2011).

FIGURE **2**

Mediation Model of Wind Turbine Low Frequency Sound, Annoyance Response, and Physical Health Effect



Note. M = third variable; X = independent variable; and Y = dependent variable.

Discussion

A rapid growth of wind generation capacity has occurred throughout various parts of the world. In 1970, virtually no wind power existed as a source of renewable energy in the U.S. Despite this rapid growth over that last 40 years, a very minimal amount of effort has been put into researching the human health impacts of wind power development until recently. The National Research Council (NRC) published a report in 2007 that reviewed the positive and negative environmental impacts of wind energy development, including effects on landscapes, views, wildlife, habitats, air pollution, and greenhouse gases. NRC noted that the potential impacts on human health and well-being were those from noise and from shadow flicker, economic and fiscal impacts, and the potential for electromagnetic interference with television and radio broadcasting, cellular phones, and radar (NRC, 2007). NRC also stated that the effects of sound below 20 Hz on humans have not been well documented or understood, but then concluded that the noise produced by wind turbines is generally not a major concern beyond one half-mile (NRC, 2007).

At present, a specific health condition or collection of symptoms has not been documented in the peer-reviewed, published literature that has been classified as a "disease" caused by exposure to sound levels and frequencies generated by the operation of wind turbines. It can be theorized that reported health effects are a manifestation of the annoyance that individuals experience as a result of the presence of wind

turbines in their communities. As described previously, it has been found in the peer-reviewed literature that the presence of wind turbines or wind turbine sound is statistically significantly associated with being annoyed. Thus, the annoyance response that many residents and others have experienced as a result of being exposed to LFS may act as a mediator to other adverse physical effects. In this proposed mediation model and as illustrated in Figure 2 (Pathway I), annoyance can be the third variable (M), which intervenes in the relationship between the wind turbine LFS, the independent variable (X), and a physical health outcome, the dependent variable (Y), such as headache and dizziness. Alternatively, it can also be theorized that annoyance is the dependent variable (Y), which has been mediated by a physical health outcome, or a third variable (M), as result of LFS exposure generated by wind turbines (Figure 2 [Pathway II]).

Takahashi and co-authors and Inukai and co-authors characterized a pathway to annoyance or unpleasantness through body surface vibrations induced by LFS (Inukai et al., 2000; Takahashi et al., 2005). Although the sample size was small in their studies, a significant correlation was found between the measured body surface vibration and the rating of unpleasantness. This finding supports this alternative theory, which is that the response of annoyance resulting from LFS exposure can occur after an adverse physical effect, such as body surface vibration, has already occurred.

The underlying complaint of annoyance is not a disease, but instead a universal human response to a condition or situation that is not positively appreciated by the human receptor. Annoyances are highly variable in type (e.g. noise, smell, temperature) and vary from person to person. One can be annoyed by the action of others in addition to their own individual actions. WHO considers annoyance an adverse health effect of noise. Based on this definition and the incomprehension of the role of annoyance in the association between LFS and physiological or physical symptoms, exploring whether or not wind turbine sound is a human health risk through additional research is warranted. Such research should be conducted by a method that minimizes biases among the study participants (e.g., use of objective vs. subjective metrics) and in the selection of participants (e.g., randomization). None of the epidemiological studies, to date, have collected objective measurements, such as blood pressure readings or other biomarkers, to support or attenuate the subjective responses provided in questionnaires by the participants.

In addition to using objective measurements, it would also be beneficial to identify some participants who are not visually impacted by wind turbines because their level of annoyance may be minimized or mitigated, which would in effect create a control-like quality of a portion of the participant sample. Lastly, studies on this highly debated subject matter should employ a single or if possible a double-blinded process of data collection. For example, Pedersen and co-authors (2004, 2007, 2009) concealed the study purpose from the participants in their studies, which was essential because the variability of annoyance and its link to undesirable factors make it a prime indicator for the possibility of recall bias. Like so many outcomes, the effects of LFS on annoyance are challenging to establish because of differences in confounding and biases between exposed and non-exposed populations to LFS, which is precisely why further research is recommended.

Our review explored and summarized the peer-reviewed literature on the research that has examined the relationship between human health effects and exposure to LFS and sound generated from the operation of wind turbines (Table 2 on pages 14 and 15). One of the main limitations of our study involved the use of the search terms. Although all efforts were employed to create search terms that were the most inclusive as well as overlapping, a chance existed that some articles were missed in the search. In order to abate this shortcoming, additional searches were conducted in multiple time periods. Furthermore, the only search engine that was used was PubMed, which created a limitation to accessing foreign articles. By using the reference list of retrieved articles, some additional articles, but not all, were identified. Finally, the use of human only as opposed to animal-based research articles was limiting. Animal models and research can often be very useful in gaining an understanding of the pathway from exposure to health outcome especially when the epidemiological data are scarce.

Conclusion

The answer to the question of whether or not exposure to wind turbine sound is a human health risk is still under review and warrants further research. Although limited, research has demonstrated that LFS can elicit adverse physical health effects, such as vibration or fatigue, as well as an annoyance or unpleasantness response. The current research on exposure to wind turbine sound and the mere presence of wind turbines have also demonstrated a significant annoyance response among study participants. But the association and particular pathway between LFS specifically generated from wind turbines, annoyance, and adverse physical health effects have yet to be fully characterized. What is known is that communities are experiencing a heightened sense of annoyance and fear from the development and siting of wind turbine farms, which seems to be more than just "NIMBYism" (not in my back yard). Hence, the research on the potential health effects, including annoyance-associated health effects, claimed as a result of exposure to sound generated by wind turbines is essential to determine if an actual risk exists. An actual risk versus a perceived risk is very much the same for some communities. High-quality research and effective risk communication can advance this course from one of panic to one of understanding and exemplification for other environmental advancements and developments. As we push to a more sustainable environment, efforts will continue to use and rely on alternative and renewable energy sources, such as wind.

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TABLE **2**

Reviewed Literature

Year	Author	Title	Study Design	Study Population
1965	Mohr, G.C. et al.	Effects of low frequency and infrasonic noise on man	Experimental: Subjects (noise-experienced officers) were exposed to high intensity broad-band, narrow-band, and pure-tone low frequency noise (1–100 cps [cycle/second = hertz]) for two minutes to observe the effect on cardiac rhythm, hearing threshold, visual acuity, fine motor control, spatial orientation, speech intelligibility, and subjective tolerance.	Male and female volunteers ($N = 5$)
1970	Karpova, N.I. et al.	Early response of the organism to low frequency acoustical oscillations	Experimental: Subjects were exposed to industrial infrasound (5, 10 Hz/100, 135 dB) for 15 minutes.	Male volunteers ($N = 3$)
1975	Slarve, R.N. & Johnson, D.L.	Human whole-body exposure to infrasound	Experimental: Subjects were exposed to infrasound ranging 1 to 20 Hz for a period of eight minutes up to levels of 144 dB re 20 micropascal.	Male Volunteers ($N = 4$)
1978	Broner, N.	The effects of low frequency noise on people—a review	Review: The effects of low frequency noise are reviewed.	N/A
1986	Inukai, Y. et al.	A multidimensional evaluation method for the psychological effects of pure tones at low and infrasonic frequencies	Experimental: Subjects were exposed to pure low and infrasonic (3–40 Hz) tones generated by loudspeakers in a pressure chamber and then rated the tones on a response device.	Male and female volunteers ($N = 17$)
1986	Yamada, D. et al.	Physiological effects of low frequency noise	Experimental: Subjects were exposed to both rattling noises and to unspecified signals at frequencies between 16 and 125 Hz, at levels between 60 and 100 dB in a test chamber and electrophysiological measurements were collected.	Male and female volunteers/ complainants ($N = 21$)
1988	Inaba, R. & Okada, A.	Study on the effects of infra and low frequency sound on the sleep by EEG recordings	Experimental: Subjects were exposed to sinusoidal tones at 10, 20, 40, and 63 Hz with sound pressure levels ranging 75 to 105 dB for 10 and 20 Hz and 50 to 100 dB for 40 and 63 Hz.	Male and female volunteers ($N = 6$)
1996	Berglund, B. et al.	Sources and effects of low-frequency noise	Review: The sources of human exposure to low-frequency noise and its effects are reviewed.	N/A
1997	Tesarz, M. et al.	Subjective response patterns related to low frequency noise	Cross-sectional: The relationship between low frequency noise exposure and subjective symptoms were studied in a group of persons working in offices, laboratories, and industries.	Male and female workers ($N = 439$)
1999	Castelo Branco, N.A. et al.	The vibroacoustic disease—an emerging pathology	Cross-sectional: Analyzed the medical files of 140 patients (male aircraft technicians) with vibroacoustic disease (VAD) in order to classify VAD by a function of time.	Male workers ($N = 140$)
1999	Takahashi, Y. et al.	A pilot study on the human body vibration induced by low frequency noise	Experimental: Subjects were exposed to pure tones in the frequency range of 20 to 50 Hz using a designed measuring method with a miniature accelerometer and vibration was measured on the chest and abdomen of subjects.	Male volunteers ($N = 6$)
2000	Inukai, Y. et al.	Unpleasantness and acceptable limits of low frequency sound	Experimental: Subjects were exposed to pure tones at 16 one-third octave band center frequencies between 20 and 500 Hz and then rated the tones on a five-category scale, of which the highest two categories were "quite unpleasant" and "very unpleasant."	Male and female volunteers ($N = 39$)
2001	Waye, K.P. & Rylander, R.	The prevalence of annoyance and effects after long-term exposure to low-frequency noise	Cross-sectional: A cross-sectional questionnaire and noise measurement survey was undertaken among randomly chosen persons exposed to noise (low frequency or middle frequency noise) from heat pump/ventilation installations in their homes.	Male and female volunteers ($N = 279$)
2001	Takahashi, Y. et al.	A new approach to assess low frequency noise in the working environment	Experimental: Subjects were exposed to 15 kinds of low frequency noise stimuli (5 frequencies x 3 sound pressure levels) reproduced by 12 loudspeakers installed in the wall in front of the subject in order to collect measurements of noise-induced vibration on the body surface and to estimate the equal acceleration level contours of the vibration.	Male volunteers ($N = 9$)
2004	Ising, H. et al.	Low frequency noise and stress: Bronchitis and cortisol in children exposed chronically to traffic noise and exhaust fumes	Cross-sectional: To examine the correlation of respiratory diseases to traffic related air pollution and noise, nitrogen dioxide as an indicator for vehicle exhausts and the mean nighttime noise level were measured outside children's windows.	Male and female volunteers ($N = 68$)

TABLE **2**

Reviewed Literature (continued)

Year	Author	Title	Study Design	Study Population
2004	Maschke, C.	Introduction to the special issue on low frequency noise	Review: An introduction and overview of human exposure to low-frequency noise.	N/A
2004	Pedersen, E. & Waye, K.P.	Perception and annoyance due to wind turbine noise—a dose-response relationship	Cross-sectional: In order to evaluate the prevalence of annoyance due to wind turbine noise and to study dose response relationships, responses were obtained through questionnaires and doses were calculated as A-weighted sound pressure levels.	Male and female volunteers ($N = 351$)
2004	Schust, M. et al.	Effects of low frequency noise up to 100 Hz	Review: This review concentrates on the effects of low frequency noise up to 100 Hz on selected physiological parameters, subjective complaints, and performance.	N/A
2004	Waye, K.P.	Effects of low frequency noise on sleep	Review: An overview of the effects of low frequency noise on sleep.	N/A
2005	Jakobsen, J.	Infrasound emission from wind turbines	Review: A critical survey of all known published measurement results of infrasound from wind turbines.	N/A
2005	Takahashi, Y. et al.	A study on the relationship between subjective unpleasantness and body surface vibrations induced by high-level low-frequency pure tones.	Experimental: Subjects were exposed to high-level low-frequency pure tones and body surface vibrations were measured at the chest and the abdomen. At the same time, the subject rated the unpleasantness that he had just perceived during the exposure to low-frequency noise stimulus.	Male volunteers ($N = 9$)
2007	Pedersen, E. & Waye, K.P.	Wind turbine noise, annoyance, and self-reported health and well-being in different living environments	Cross-sectional: In order to evaluate the prevalence of perception and annoyance due to wind turbine noise among people living near the turbines, a cross-sectional study was carried out in seven areas in Sweden across dissimilar terrain and different degrees of urbanization through a postal questionnaire and measurements of outdoor A-weighted sound pressure levels were calculated for each respondent.	Male and female volunteers ($N = 754$)
2009	Pedersen, E. et al.	Response to noise from modern wind farms in The Netherlands	Cross-sectional: To assess possibly unacceptable adverse health effects, a field study exploring the impact of wind turbine sound on people living in the vicinity of wind farms was carried out in The Netherlands in 2007.	Male and female volunteers ($N = 725$)
2010	Salt, A.N. & Hullar, T.E.	Responses of the ear to low frequency sounds, infrasound, and wind turbines	Review: An overview of the responses of the ear to low frequency sounds, infrasound, and wind turbines.	N/A
2010	Smedley, A.R. et al.	Potential of wind turbines to elicit seizures under various meteorological conditions	Experimental: To determine the risk of seizures from wind turbines in persons with photosensitive epilepsy, the light-dark contrasts of turbine shadows for worst case conditions were modeled.	N/A
2011	Pedersen, E.	Health aspects associated with wind turbine noise—results from three field studies	Meta analysis: Data from three cross-sectional studies comprising A-weighted sound pressure levels of wind turbine noise and subjectively measured responses from 1,755 people were used to systematically explore the relationships between sound levels and aspects of health and well-being.	Male and female volunteers ($N = 1,755$)
2011	Salt, A.N. & Kaltenbach, J.A.	Infrasound from wind turbines could affect humans	Review: An overview of the responses of the ear to infrasound generated by wind turbines.	N/A
2011	Shepherd, D. et al.	Evaluating the impact of wind turbine noise on health-related quality of life	Cross-sectional: To compare the health-related quality of life of individuals residing in the proximity of a wind farm to those residing in a demographically matched area sufficiently displaced from wind turbines, a cross-sectional study was conducted in semirural New Zealand.	Male and female volunteers ($N = 197$)

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Hand Washing Practices in a College Town Environment

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Abstract **Many people do not wash their hands when the behavior in which they engage would warrant it. Most research of hand washing practices to date has taken place in high-traffic environments such as airports and public attraction venues. These studies have established a persistent shortcoming and a gender difference in hand washing compliance. Using field observations of 3,749 people in a college town environment, the research described in this article replicates and extends earlier work while identifying potential environmental and demographic predictors of hand washing compliance. Additionally, the authors' research suggests that proper hand washing practices, as recommended by the Centers for Disease Control and Prevention, are not being practiced. Finally, the authors' research raises a question as to the accuracy of earlier measurements of "proper" hand washing practices, suggesting that compliance rates are inflated. The results can help increase hand washing rates for the general public and thus decrease the risk of transmitting disease.**

Introduction

Many individuals take hand washing for granted and do not consider how essential hand washing is in the prevention of infections and disease. Thus they often fail to wash their hands when they engage in activity that would warrant or require hand washing. Research has established that people generally overstate the degree to which they wash their hands; that women are much more likely to wash their hands than men; and that while hand washing compliance appears to have increased in recent years much room for growth still exists. According to the Centers for Disease Control and Prevention (CDC) (Mead et al., 1999), failing to wash or insufficiently washing hands contributes to almost 50% of all foodborne illness outbreaks. Additionally, Curtis and Cairncross (2003) performed a meta-analysis that suggests that hand washing with soap can reduce diarrheal disease risks by more than 40% and that hand washing interventions could save one million lives annually. Yet we do not know why people fail to wash their hands at recommended rates and in the proper fashion. Our research attempted to establish predictors of hand washing that can be used to induce higher rates of hand washing compliance.

Current Hand Washing Practices

Recent surveys establish that U.S. adults claim to wash their hands after using public restrooms at very high rates. In 2009, 94% (N = 2,516) suggested that they consistently wash their hands (QSR Magazine, 2009), while in 2010, 96% (N = 1,006) stated that they always wash their hands after using a public restroom (Harris Interactive, 2010). Self-reports of hand washing behavior have been criticized as unreliable as hand washing is a socially desirable activity (Judah, Aunger, Schmidt, Granger, & Curtis, 2009) and observational research suggests these high self-report rates are inflated (Harris Interactive, 2010).

The potential discrepancy aside, it is important to note that hand washing rates have trended upwards in recent years. The American Society for Microbiology and the American Cleaning Institute have studied hand washing practices since 1996. Most recently they reported on hand washing in restrooms at public attractions in five cities across the U.S. The restroom locations included Turner Field in Atlanta, the Museum of Science and Industry and Shedd Aquarium in Chicago, Penn Station and Grand Central Terminal in New York, and the Ferry Terminal Farmers Market in San Francisco (Harris Interactive, 2010). All locations experience high volumes daily, and at the composite level, the 2010 data (N = 6,028) establishes that 85% of the observed adults wash their hands after using a public restroom. This is an increase from 77% in 2007 (N = 6,076), which was somewhat lower than the 2005 rate of 83% (N = 6,336). With the exception of the Shedd Aquarium, which has seen a 3% dip in hand washing rates since 2005, all the venues saw a slight upward trend in observed hand washing rates (Harris Interactive, 2010). In 2003, hand washing rates were also observed across six North American airports, averaging 74% compliance (N = 4,046). The highest hand washing rates were obtained in Toronto with 95% while Chicago had the lowest rate at 62% (American Society for Microbiology, 2003).

The research consistently finds a gender bias in hand washing practices. Women wash their hands more frequently than men. In the 2003 study (American Society for Microbiology) it was observed that 83% of women washed their hands after using the restroom,

whereas only 74% of the men did so. In a multi-year study across public attractions, women consistently wash more than men across all years and venues (Harris Interactive, 2010). The average observed hand washing rates for women were 93% in 2010, 88% in 2007, and 90% in 2005. The equivalent rates for men were 77%, 66%, and 75%, respectively.

A study of 120 secondary school students (Guinan, McGuckin-Guinan, & Sevareid, 1997) found that 58% of female students and 48% of male students washed their hands after using the restroom, although only 28% of the female students and 8% of the male students used soap. In a university campus public restroom study (Johnson, Sholoscky, Gabello, Ragni, & Ogonosky, 2003), 61% of women and 37% of men (N = 175) were observed washing their hands, while the hand washing rate climbed to 97% for women and fell to 35% of men when a sign was introduced to encourage hand washing. Similarly, in a British 32-day study of highway service station restrooms (N = 198,000) that observed entry and soap use with electronic sensors, it was found that 65% of women and 32% of men washed their hands, but that the hand washing rate increased to as much as 71% for women and 35% for men when messages designed to encourage hand washing were displayed using electronic dot matrix screens (Judah et al., 2009).

A study of the hand washing practices of university students living in a dormitory found that women wash their hands after urinating 69% of the time and after bowel movements 84% of the time, whereas the corresponding figures for males were 43% and 78% (Thumma, Aiello, & Foxman, 2008). In a study of restaurant food workers (Green et al., 2006), food handlers washed their hands only 32% of the time when their behaviors made such hand washing required.

A review of the literature on foodborne disease outbreaks from 1975 to 1998 identified 81 foodborne disease outbreaks involving 14,712 people within which 93% of the foodborne outbreaks involved infected food workers transmitting pathogens to the food with their unwashed hands (Guzewich & Ross, 1999). An observation of 80 women in a bar bathroom (Hayes, 2002) found that only 40% washed their hands; when the researcher engaged the subject and modeled hand washing, the hand washing rate increased to 56%, while it dropped to 27% when the researcher appeared to be simply talking on her cell phone. This research also noted that the female subjects were less likely to wash their hands later in the night than earlier in the evening (r = -.44, p < .01).

It is evident from the reviewed research that room for improvement exists in hand washing practices. Additional research is needed to further understand how and why hand washing rates differ and if such rates can be influenced by environmental factors within the restroom. Gender is associated with marked differences in hand washing rates. Are other demographic variables such as age also associated with hand washing rates? Furthermore, evidence exists that environmental variables such as signage and posters influence hand washing rates and other health-related behaviors (Etter & Laszlo, 2005; Judah et al., 2009). Do other environmental variables, such as sink conditions and type of faucet impact hand washing rates? Does the hand washing rate on campus differ from the rate off campus?

It is unclear from the reviewed literature whether the various reported rates of hand washing reflect hand washing with soap as recommended by the CDC or if the rates incorporate practices somewhat inconsistent with the established recommendations. As such, our study used three measures of hand washing, defined as 1) no washing—leaving the restroom without washing or rinsing hands, 2) attempted washing—wetting hands but not applying soap, and 3) washing hands with soap, in addition to measuring the duration of washing. This added distinction is important because Burton and co-authors (2011) reported that washing with soap and water is more effective at removing fecal bacteria from hands than washing with water alone.

Methods

Participants and Procedures

Direct observations of hand washing behaviors were conducted by 12 research assistants in restrooms located across a college town. Observers were instructed to be unobtrusive and disguise their observation of hand washing behaviors. To ensure this and ensure accurate measurement and coding consistency, each of the observers met researchers individually for training and attended training meetings as a group.

All observations were recorded according to a standard coding form. The coding form consisted of the subject ID, date, subject's age group, observation time, gender, hand washing behaviors, the type and availability of drying mechanisms (i.e., not available, hot air, paper towel, or both), location of restrooms (off campus versus on campus), type of faucet (standard faucet versus motion detection), the cleanliness of sink conditions, and availability of hand washing signage.

Washing behaviors were recorded into three categories: no washing (leaving the restroom without washing or rinsing their hands), attempted hand washing (wetting hands without using soap), and washing hands with soap. Observers also discreetly measured the total length of time in terms of the number of seconds subjects' hands were placed under running water during washing, lathering, and rinsing. The time of observation was collected and nominal time categories were formed for the purpose of analyses. Due to the unobtrusive nature of our observations, the subject's age group was estimated using the trained observers' subjective evaluations and the subject was placed into one of two groups: college age or younger and older than college age. The cleanliness of sink conditions had three categories including dirty, reasonable, and clean, which was also based on the subjective evaluation of observers. The presence of a hand washing sign was added to the coding form later based on observer feedback.

Statistical Analysis

Descriptive data were compiled and further analyzed using Chi-square analysis and ANOVA. Specifically, Chi-square analysis was used to identify statistically significant differences in subjects' demographic variables, environmental variables in the restrooms, and among hand washing behaviors. ANOVA was used to establish mean differences in the length of time hands were placed under running water across the above specified variables. Kappa and paired t-test statistics were calculated, using a subsample (n = 90) to evaluate inter-rater reliability.

Results

Inter-Rater Reliability

Evaluation of inter-rater agreement is an important step in ensuring reliability in observa-

tional studies, especially when studies involve multiple observers. We selected four different restrooms (n = 44, located in two off-campus restrooms; and n = 46, located in two on-campus restrooms) to determine the inter-rater reliability among observers. The observers agreed 100% on the environmental variables. For the two dependent variables, the time spent washing time and other washing behaviors, paired-samples t-tests (Fleiss, 1981), and Cohen's Kappa (Cohen, 1960) were used. A Kappa statistic of more than .8, more than .6, and more than .4 is considered to have "almost perfect," "substantial," and "moderate" agreement, respectively (Landis & Koch, 1971). Excellent inter-rater reliability was demonstrated as indicated by nonsignificant paired t-test result in estimating washing time (p > .01) and Kappa of .89 in evaluating washing behaviors.

Characteristics of Sample and Overall Findings

Table 1 presents characteristics of the sample and observation settings. Of the 3,749 subjects observed, approximately 54% of observations took place in restrooms located off campus. Sixty-two percent of observations took place in the afternoon, followed by evening/night (23.6%) and morning (14.4%). Of all subjects, 60.5% of the observed subjects were women. About 62% (61.6%) of the subjects were estimated as college age or younger, with the remainder estimated to be older than college. Nearly all restrooms had a mechanism for drying hands (98.7%). About 64% of the restrooms in the study contained signs encouraging hand washing. Seventy-seven percent of the restrooms were equipped with a standard faucet while 22.9% had motion detection faucets.

Overall, 66.9% of the subjects used soap when washing their hands. Of these, 1.2% did not dry their hands, but left the restrooms with wet hands. About 23% attempted to wash their hands, that is, they wet their hands but did not use soap. A total of 10.3% did not wash their hands *at all* after using the restroom. CDC (2012) recommends that people should rub their soaped hands for 15 to 20 seconds before rinsing thoroughly. Our measure of duration included the length of time placed under running water while subjects were washing, rubbing, and rinsing their hands. Nonetheless, as shown in Table 2, only 5% or so spent more than 15 seconds in combined washing, rubbing, and rinsing of their hands.

TABLE **1**

Characteristics of Sample and Restroom Settings (*N* = 3,749)

Variables	*n*	%
Observation time		
Morning	538	14.4
Afternoon	2,326	62.0
Evening/night	885	23.6
Gender		
Male	1,479	39.5
Female	2,270	60.5
Age		
College group and younger than college group	2,310	61.6
Older than college group	1,439	38.4
Drying		
Not available	47	1.3
Only paper	2,799	74.7
Only air dryer	331	8.8
Both paper and air dryer	572	15.3
Faucet		
Standard faucet	2,889	77.1
Motion detection	860	22.9
Sink condition		
Dirty	219	5.9
Reasonable	1,779	47.5
Clean	1,750	46.7
Location		
On campus	1,755	46.8
Off campus	1,994	53.2
Sign		
Sign	1,548	63.7
No sign	882	36.3

Results From Chi-Square Analysis

The Chi-square analysis revealed statistically significant differences in hand washing behaviors across time of observation, gender, age, sink condition, and hand washing signage (Table 3). For example, 12.4% observed during evenings did not wash their hands while the morning and afternoon rates of leaving the restroom without attempting to wash were 8.6% and 9.4%, respectively. Subjects washed their hands significantly more with soap during mornings (70.6%) than during afternoons (66.4%) and evenings (67%). The gender difference was confirmed with women using soap and engaging in proper hand washing behavior significantly more (77.9%) than men (50.3%). About 7% of the women and 14.6% of the men did not wash their hands at all, while 15.1% of the women and 35.1% of the men simply wet their hands with water. Those estimated to be older than college (70.3%) washed their hands with soap significantly more than the college age and younger group (64.8%).

When restrooms contained hand washing signs, subjects used soap more (68.5%) than subjects in restrooms that had no such signs (60.5%). Sink cleanliness influenced hand washing behaviors as well. When sinks were clean, 73.9% washed their hands using soap, while the rate for reasonably clean and dirty sinks was 61.2% and 59.4%, respectively. No

TABLE **2**

Overall Hand Washing Behavior and Length of Hand Washing Time (*N* = 3,749)

Variables	*n*	%
Washing behavior		
Not washing	384	10.3
Wetting hands without soap	856	22.8
Washing hands with soap	2,509	66.9
Length of hand washing time		
0 seconds	384	10.3
1–4 second(s)	824	22.0
5–8 seconds	1,432	38.2
9–14 seconds	911	24.2
15 seconds or longer	198	5.3

TABLE **3**

Chi-Square Test: Comparison of Hand Washing Behavior by Sample Demographics and Restroom Settings (*N* = 3,749)

Variables	Not Washing	Wetting Hands Without Soap	Washing With Soap	χ^2
	10.3% (*n* = 384)	22.8% (*n* = 856)	66.9% (*n* = 2,509)	
	%	%	%	
Observation time				13.2*
Morning	8.6	20.8	70.6	
Afternoon	9.4	24.2	66.4	
Evening/night	12.4	20.6	67.0	
Gender				311.3*
Male	14.6	35.1	50.3	
Female	7.1	15.1	77.9	
Age				12.9*
College group and younger than college group	10.6	24.6	64.8	
Older than college group	9.7	20.0	70.3	
Faucet				0.8
Standard faucet	9.8	22.9	67.3	
Motion detection	10.8	23.0	66.2	
Sink condition				91.2*
Dirty	19.6	21.0	59.4	
Reasonable	10.7	28.1	61.2	
Clean	8.1	17.9	73.9	
Location				4.8
On campus	10.3	24.3	65.4	
Off campus	9.7	21.6	68.6	
Sign				17.4*
Sign	9.7	21.7	68.5	
No sign	10.7	28.8	60.5	

*$p < .01$.

statistically significant differences in subjects' hand washing behavior were found across faucet type (standard faucet versus motion detection) or restroom location (on campus versus off campus).

Results From ANOVA

Multi-way ANOVA was conducted to evaluate the mean differences among identified factors in terms that may influence the length of washing time (Table 4). Statistically significant differences were found for gender, age group, type of faucet, sink condition, and hand washing signage. The average washing time for men and women, although short for both, was 6.27 seconds for men and 7.07 seconds for women. The gender effect persists. The age group older than college spent significantly more time washing their hands (mean = 6.93 seconds) than did college group and younger than college group (mean = 6.48 seconds). The presence of a sign also influenced washing time; the mean score in the presence of a sign was 7.08 seconds and 6.50 seconds without. Subjects spent significantly more time washing their hands when the sink condition was clean (mean = 7.20 seconds), compared to when the sink appeared reasonably clean (mean = 6.36 seconds) or dirty (mean = 6.16 seconds). No significant differences in hand washing time were found across time of observation or restroom locations.

Discussion

Hand washing is the most effective thing one can do to reduce the spread of infectious diseases according to CDC (CDC, 2012; Mead et al., 1999). Our study provided detailed information about how long and in what environments different groups engaged in various hand washing behaviors. While earlier research reported that not all wash their hands, prior studies have not identified factors associated with proper hand washing behaviors. Additionally, previous studies did not clearly distinguish between washing with and without soap. Our study recognizes the importance of environmental factors that promote proper hand washing behaviors. To our knowledge, our study was one of the first studies to focus on hand washing behaviors and the length of time spent washing while incorporating environmental factors and the time of observation.

The observed hand washing behaviors and the length of time washing hands relate differently to different factors. Our study supports earlier work in observing that men need more encouragement than women to engage in proper hand washing behaviors, although most men and women do wash their hands using soap. Nonetheless, the percentages who simply wet their hands was significantly higher for men (35.1%) than for women (15.1%).

While our study was not specifically designed to test for the intervention effect of a hand washing sign, the study did find that the presence of a sign influenced both hand washing behaviors and the length of washing time. This is an important finding as a high percentage of people fail to wash their hands properly, and signs that include messages highlighting correct hand washing or reminders to use soap may increase compliance. It appears that this kind of explicit reminder may be particularly useful in men's restrooms, given that more than one-third of men simply wet their hands without using soap.

In previous studies the automated and sequenced phases of the device/sink resulted in significant improvement in hand washing practices (Larson, Bryan, Adler, Lee & Blane, 1997; Larson, McGeer, & Quiaishi, 1991). Our study showed that the type of faucet itself (standard faucet versus motion detection) did not impact hand washing behaviors. Care must be taken in the interpretation of washing time, as it is possible to equate washing time with the motion-detected dispensing of water, much as our study did in terms of manual water flow.

More importantly, the findings of our study showed that it is important to maintain clean sink conditions, as clean sinks promoted proper hand washing procedures as well as increased length of time washing hands. When sinks are dirty, some may choose not to wash their hands, despite knowing they should. Studying the effect of time of day on hand washing behavior, a relatively new research focus, showed that hand washing generally decreased as the evening progressed.

The most important findings of our research relate to the distinctions among hand washing behaviors and the length of time hands were washed. Specifically, less than 6% of the sample approached the recommended hand washing duration. Furthermore, our study identified that a large proportion of subjects engaged in hand washing behavior that did not involve the use of soap. It is interesting to note that if the proportion of people who were observed using soap when washing their hands were combined with those who only used water, the hand washing rates reach the higher levels reported in other studies. This raises the question of whether hand washing compliance rates have been inflated by way of definition in earlier work.

TABLE **4**

Multi-Way ANOVA: Hand Washing Time by Demographics and Restroom Settings (*N* = 3,749)

Variables	Hand Washing Time Mean (Seconds)	*F*	η^2
Observation time		.92	.022
Morning	6.50		
Afternoon	6.81		
Evening/night	6.77		
Gender		25.21*	.082
Male	6.27		
Female	7.07		
Age		8.14*	.058
College group and younger than college group	6.48		
Older than college group	6.93		
Faucet		49.29*	.114
Standard faucet	6.45		
Motion detection	7.74		
Sink condition		15.76*	.091
Dirty	6.16		
Reasonable	6.36		
Clean	7.20		
Location		2.23	.024
On campus	6.63		
Off campus	6.86		
Sign		7.97*	.057
Sign	7.08		
No sign	6.50		

Note. Total mean = 6.75 (*SD* = 4.76), mean = 7.52 (*SD* = 4.41).
*$p < .01$.

Limitations and Future Research

While the data from our study are informative, it should be noted that observations only took place in one college town environment. Care should be therefore taken in generalizing the findings.

As an alternative to the self-reporting method, direct and unobtrusive observations of hand washing were used as a way to enhance reliability and validity. It should be recognized, however, that even an apparent unobtrusive observation may influence hand washing behaviors, as the simple presence of others in a restroom may lead to increased compliance (Bittner, Rich, Turner, & Arnold, 2002; Drankiewicz & Dundes, 2003; Edwards et al., 2002; Nalbone, Lee, Suroviak, & Lannon, 2005).

While our study attempted to investigate the role that a hand washing sign would have on hand washing behavior, the subjects were not asked whether they recalled seeing the sign or whether they could recall the messages. Future research should consider sign content, design, and placement.

In our study the act of drying was measured. Approximately 2% of subjects who

attempted to wash their hands (i.e., wetting hands without soap) or washed hands with soap did not dry their hands at all, but we do not know if those who attempted to dry their hands achieved dry hands. This would be good to include in future studies as studies have demonstrated that the transfer of microorganisms is more likely to occur from wet skin than from dry skin (Mackintosh, & Hoffman, 1984; Merry, Millder, Findon, Webster, & Neff, 2001; Patrick, Miller, & Findon, 1997).

Conclusion

Our study replicated and extended earlier work on hand washing practices. While past studies have focused on high-traffic venues such as transportation hubs and stadiums, our study focused on hand washing behaviors in a college town environment. Field observations by trained observers in a variety of restrooms provided a sample of 3,739 people who were unobtrusively watched to note their hand washing behaviors.

The findings were consistent with earlier research in that a significant gender bias was found. Women wash their hands significantly more often, use soap more often, and wash their hands somewhat longer than men. Both men and women fell far short, however, of CDC-recommended hand washing durations, averaging 6.27 and 7.07 seconds, respectively. Only 5.3% of the sample washed their hands for 15 seconds or more. Considering the definition of hand washing and the careful training of observers, this particular finding raises the specter of significant inflation in earlier reported hand washing compliance rates. Future studies need to measure hand washing compliance carefully.

Additionally, our study established that restroom environmental conditions and signage are important. Specifically, hand washing compliance was greater when restroom sinks were clean and when signs encouraging hand washing were posted.

Hand washing compliance and practices as reported in this and previous studies fall short of the ideal. The public needs to be continuously encouraged to engage in proper hand washing practices. In addition, careful attention to restroom environmental conditions and signage may help increase compliance. Given the established gender bias, consideration should be given to the content of the messages targeting men and women. Perhaps men and women would respond differently to gender-targeted messages.

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Primary Amebic Meningoencephalitis in Florida: A Case Report and Epidemiological Review of Florida Cases

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Abstract **Primary amebic meningoencephalitis (PAM) is a rare but nearly always fatal infection of the central nervous system caused by the thermophilic, free-living ameba *Naegleria fowleri*. Since its first description in 1965 through 2010, 118 cases have been reported in the U.S.; all cases are related to environmental exposure to warm freshwater; most have occurred in children and adolescents and are associated with recreational water activities, such as swimming, diving, or playing in freshwater lakes, ponds, or rivers. Over one-fourth of all national PAM cases have occurred in Florida. The authors describe here a fatal case of PAM in a resident of northeast Florida and the ensuing environmental and public health investigation; they also provide a review of all cases of PAM in Florida from 1962 to 2010 and discuss public health responses to PAM in Florida, highlighting opportunities for positive collaboration between state and local environmental health specialists, epidemiologists, and the Centers for Disease Control and Prevention.**

Introduction

Primary amebic meningoencephalitis (PAM) is a severe infection of the central nervous system (CNS) caused by *Naegleria fowleri,* a thermophilic, free-living ameba found worldwide (Visvesvara, Moura, & Shuster, 2007). *N. fowleri* was first reported as the cause of PAM in 1965 in Australia (Fowler & Carter, 1965), and almost simultaneously in Florida in 1966 (Butt, 1966). *N. fowleri* thrives in warm freshwater and all known U.S. cases of PAM have been associated with water exposure. The majority are associated with recreational water activities, such as swimming, diving, or playing in freshwater lakes, ponds, or rivers (Yoder, Eddy, Visvesvara, Capewell, & Beach, 2009). Infection is thought to occur via direct inoculation into the nose, after which the ameba enters the CNS by translocation through the cribriform plate (Visvesvara et al., 2007). Activities that increase the likelihood of having water forced up the nose are thought to increase the risk of contracting PAM. Infections occur primarily in otherwise healthy adolescent males, but can also occur in females and other age groups (Yoder et al., 2009). Cases are rare but devastating: in the U.S. a total of 118 infections were reported between 1962 and 2010 (unpublished Centers for Disease Control [CDC] data; Yoder et al., 2009), with only one patient surviving (Seidel et al., 1982; Yoder et al., 2009).

Here we describe a fatal case of PAM in a resident of northeast Florida and the ensuing public health investigation. We wish to emphasize the importance of investigating PAM cases and to highlight the positive collaboration that developed in this joint investigation among state and local environmental health specialists and epidemiologists and the Centers for Disease Control and Prevention (CDC).

Case History

On July 9, 2009, a county health department (CHD) employee notified the local epidemiology program of a child with meningitis of unknown origin at a northeast Florida hospital. The local CHD's epidemiologic interview

with the patient's parents revealed that he and his family had recently returned from vacationing at a lakeside campground in Madison County, Florida, from June 27 to July 5.

The case patient's first reported symptom was right ear pain, which he developed at the campground on July 2. On July 6, he saw his primary care physician for headache, nausea, vomiting, and continued ear pain and was given azithromycin for otitis media. On July 7, he developed fever and photophobia and was admitted to the hospital. At admission, his cerebrospinal fluid (CSF) showed normal glucose (69 mg/dL), mildly elevated protein (79 mg/dL), and highly elevated leukocytes (985 cells/mm^3, with 79% neutrophils). He received empiric treatment for bacterial meningitis but did not improve. On July 8, he experienced decreased responsiveness; initial CT scan of the brain showed mild cerebral edema but no focal lesions. On July 9, the patient had seizure-like activity with loss of consciousness and was transferred to the hospital's intensive care unit, where the possibility of PAM was considered and amphotericin was added to his antibiotic regimen. Unfortunately, a repeat CT scan showed massive cerebral edema and bilateral uncal herniation. On July 10, the patient was pronounced brain dead, and artificial life support was withdrawn. CDC was contacted for diagnostic assistance, and polymerase chain reaction testing (Qvarnstrom, Visvesvara, Sriram, & da Silva, 2006) of CSF obtained at autopsy detected *N. fowleri* DNA, confirming PAM as the cause of death.

Given the risk that other campers might be exposed while swimming in the same lake, the Florida Department of Health (FDOH) requested epidemiological assistance from CDC and a joint investigation was conducted.

Methods

Survey

Interviews were conducted with immediate and extended family members who vacationed with the case patient from June 27 to July 5. Only family members were interviewed, since they were likely to have shared exposures, were highly motivated to participate in the investigation, and were willing to provide blood samples for serologic testing. Over 600 guests were at the park concurrent with the family and extensive interviews of all guests were felt to be impractical. No other PAM cases were reported to public health authorities or identified through case-finding efforts conducted by the park's management.

Each family member who participated in the study signed informed consent prior to interview. Family members were asked about their activities while at the park, the nature and duration of all water exposures, their current health status, and past medical histories. For family members younger than 12 years of age, interviews were conducted in the presence of a parent or guardian to assist with recall. Children aged 12–18 were interviewed individually at the family's home with the presence of other family members in close proximity.

Laboratory Testing

Serum samples were collected from family members aged 13 or older to test for anti-*N. fowleri* antibody titers (Visvesvara et al., 1987). After informed consent was obtained, venous samples were drawn by a registered nurse or physician and sent to CDC's Free-living Amebae Laboratory for analysis.

Environmental Assessment

On August 19, 2009, an environmental assessment was conducted at the campground by the joint CDC/FDOH investigation team with assistance from the Madison County Health Department (MCHD). The team met with the park owners and managerial staff and toured the facilities. Data were collected on water management practices, occupancy of the park at time of exposure, and water treatment methods. Campground management was asked to refer any persons with meningitis-like illness to the investigation team for follow-up.

Historical Summary of Florida Cases

Data regarding Florida PAM cases from 1962 to 2010 were drawn from CDC's national PAM surveillance database (unpublished CDC data; Yoder et al., 2009).

Results

Interviews were conducted with 18 family members of the case patient (10 children and 8 adults). Family members surveyed ranged in age from 8 months to 54 years with a median of 13 years. The amount of time family members stayed at the park ranged from five to nine days. The case patient's immediate family stayed for the longest duration—a total of nine days.

Water Exposures

The campground maintains a chlorinated swimming pool and a human-made freshwater "swimming lake" with a 60-foot waterslide. Several back water ponds and a large boating lake are not approved for swimming. Seventeen of the 18 family members surveyed had exposure to the freshwater swimming lake and all family members entered the chlorinated swimming pool. Thirteen family members spent at least 10 total hours in the swimming lake during the course of their stay. Family members estimated that the case patient spent approximately 38 hours in the swimming lake over the duration of the trip, which was nearly twice the amount of time of any other family member. No family members reported more than 30 minutes' water exposure to the backwater ponds or boating lake.

Table 1 shows the activities in which family members participated while in the water. Rough play in the water was the most commonly reported activity (n = 15, 83%). Fourteen family members (77%) reported having their head "dunked" under water and 11 (61%) used the waterslide. The number of times an individual used the slide ranged from 2 to 42 (mean = 19, median = 16). Family members estimated that the case patient used the slide about 17 times. The case patient did not use any nose clips or hold his nose while in the water, nor did 16 of the 18 other family members surveyed.

Illness Among Family Members

Interviewers asked family members to report illness symptoms they developed during or shortly after their stay at the park; they also asked about antecedent symptoms that may have contributed to exposure risk. Sixteen of 18 family members reported at least one symptom with onset during or shortly after their trip (Table 2), but only one family member reported a combination of symptoms potentially consistent with meningitis. This individual reported fever, malaise, nausea, vomiting, stiff neck, headache, abdominal pain, and diarrhea with onset the day prior to arrival at the campground. These symptoms resolved spontaneously within 2–4 days of onset and medical attention was not sought. Two other persons reported fevers within two days of leaving the park; both also reported sunburn and gastrointestinal illness. Aside

from the case patient, only one family member, an infant diagnosed with gastritis, sought medical attention.

Laboratory Results

Blood samples collected from nine family members and one former park employee were tested for anti-*N. fowleri* antibody titers. Serum from the case patient, drawn on the day of his death, was obtained from the hospital and was also tested. None of the samples had titers higher than 1:32, indicating no specific anti-*Naegleria* antibody response among those tested.

Environmental Assessment

The swimming lake at the campground covers approximately 1.5 acres, is filled from a deep well, and is treated with a copper-based algaecide and a dye-based herbicide (photosynthesis inhibitor). It is not thermally polluted. MCHD routinely conducts environmental assessments of this lake and the park's chlorinated swimming pool. Inspection of the swimming pool on June 22, 2009, found it to be well maintained with sufficient free chlorine levels. Lake water samples collected July 2, 2009, had 10 fecal CFUs/100mL, which is within acceptable limits. On July 21, 2009, the water temperature in the swimming lake was 86.7ºF at 2 inches depth and 84.0ºF at 40 inches. Water turbidity, measured by Secchi disk, was in the clear range, with visibility ending at 30 inches. Park management estimated the lake had a depth of 3.5 to 4 feet at the time of assessment, which is within the normal water range. No testing was done on bodies of water at the park that are not approved for swimming.

Historical Perspective on PAM in Florida

Collectively, from 1962 to 2010, 32 cases of PAM were identified in 15 Florida counties (Figure 1) (unpublished CDC data; Yoder et al., 2009). Thirty-one (97%) of the case-patients were male and the majority of the cases (72%) occurred in children or adolescents between the ages of 5 and 17 years (Table 3). Most (75%) of Florida's PAM cases occurred during the months of July and August (Table 4), and the majority (65%) of primary exposures occurred in freshwater lakes (Table 5). All 32 Florida cases have been fatal.

TABLE **1**

Type and Frequency of Water Exposures of Family Members, June 27–July 5, 2009

Activity	Family Members Participating	
	n	%
Exposure to swimming lake	17	94
Exposure to swimming pool	18	100
Water in (up) nose	11	61
Splashing/rough play in water	15	83
Head submerged in water (i.e., dunked)	14	77
Use of waterslide	11	61

TABLE **2**

Characteristics of Clinical Symptoms Experienced by Family Members, July 2009

Symptom	Family Members Affected	
	n	%
Diarrhea	9	50
Nausea	8	44
Malaise	8	44
Fatigue	6	33
Abdominal cramping	5	27
Fever	2	11

Discussion

Over half of the 118 PAM cases (*n* = 63, 53%) identified in the U.S. from 1962 to 2010 occurred in two states: Florida (*n* = 32, 27%) and Texas (*n* = 31, 26%) (unpublished CDC data; Yoder et al., 2009). Florida, and Orange County in particular, bear a disproportionate burden in terms of PAM cases nationally, but the range of the pathogen may be expanding, with cases reported as far north as Minnesota (Kemble et al., 2012).

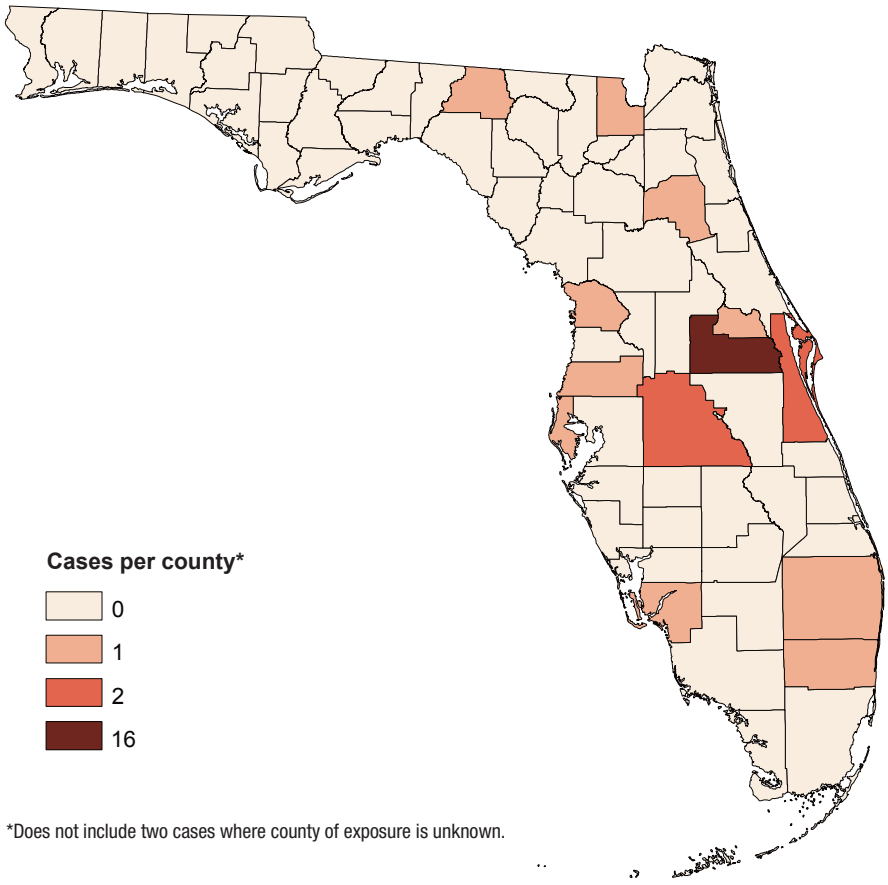
N. fowleri is very common in warm freshwater environments (Visvesvara et al., 2007; Wellings, Amuso, Chang, & Lewis, 1977; Wellings, Lewis, Farmelo, Moody, & Osikowicz, 1979; Yoder et al., 2009) and should be assumed present in any body of warm, untreated freshwater during summertime, especially in southern tier states. Yet exposure rarely leads to infection. One study estimated that over one billion exposures to *N. fowleri*-contaminated waters in Florida occurred over a 14-year period, yet only seven cases of PAM occurred during this time (Wellings et al., 1977). The case presented here illustrates the same principle: over 600 persons had exposure to the lake during the week the case patient had exposure, yet only one developed disease. Whether this was related to a higher level of exposure (the case patient spent much more time in the water than others in his family group) or to other factors is unclear.

Clinical Presentation

The clinical progression in this case is typical; patients usually present with headache, fever, nausea, vomiting, and stiff neck. Initial misdiagnosis as bacterial meningitis is common, particularly if the history of warm freshwater exposure is not elicited. Symptoms start an average of five days (range: 1–7 days) postexposure and progress rapidly, typically resulting in death within 10 days (range: 6–17 days) of exposure (Yoder et al., 2009). Death is usually due to brainstem herniation secondary to massive cerebral edema.

FIGURE **1**

Florida Primary Amebic Meningoencephalitis Cases by County of Exposure, 1962–2010



*Does not include two cases where county of exposure is unknown.

It is interesting that the case patient's first symptom appeared to be otitis related. The implications of this are unknown; at least two prior cases of PAM have been associated with ruptured tympanic membranes (CDC, 2008), and trans-tympanic inoculation can transmit PAM in guinea pigs (Wellings et al., 1979). The idea that ear infections or ear trauma might contribute to an individual's risk of contracting PAM warrants further investigation and consideration during autopsies.

Public Health Response and Awareness

Following the occurrence of three fatal PAM infections in Florida in 2007, FDOH established a Florida *Naegleria* work group and assisted in establishing a national *Naegleria* work group sponsored by the Council of State and Territorial Epidemiologists (CSTE) and CDC (CSTE, 2011). The objectives of the national work group were to 1) create a national database of PAM cases; 2) develop standard case definitions and case reporting forms for PAM; 3) advocate adding PAM to the list of nationally notifiable diseases; 4) identify areas for research, particularly the role of environmental testing; 5) develop evidence-based risk reduction information for the public; and 6) increase education of health care providers on diagnosis and treatment of PAM (CSTE, 2011). Progress has been made towards meeting these objectives. The CSTE work group finalized a national database kept at CDC that was used to write a complete review of U.S. PAM cases from 1962 to 2008 (Yoder et al., 2009). A case definition and case reporting form were created for use by states to voluntarily report cases to CDC. Although not nationally notifiable, PAM was made a state-notifiable disease in Florida in 2008. Because *N. fowleri* is so common in the environment and no practical strategy for its removal is available, little utility currently exists for routine environmental testing. Future development of rapid quantitative methods, however, may allow researchers to study environmental factors facilitating growth and amplification of the organism.

Crafting appropriate public health messages for PAM is extremely challenging. No evidence-based prevention measures exist and the low incidence of disease makes it unlikely that evidence-based guidelines can easily be developed. The only certain preventive measure is to refrain from water-related recreational activities during warm summer months, a measure unlikely to be adopted on a large scale. FDOH currently promotes public awareness of the risk of PAM using a variety of methods prior to the summer swim season. For example, the Orange County school system, in coordination with the CHD, provides "backpack" brochures that are distributed to school children at the end of the school year and conducts a "reverse 411" call to all student homes regarding PAM prevention measures. Signs are also posted at many Orange County lakes advising swimmers on water safety and potential *N. fowleri* infection prevention measures.

Increasing public knowledge of PAM may have a secondary benefit of raising awareness in health care providers, which may increase early case detection and allow more rapid treatment. While it has not been proven that earlier detection and treatment would improve clinical outcome, early detection and treatment may have contributed to the survival of the lone documented survivor of PAM (Seidel et al., 1982). In that case an early diagnosis of PAM was made via an astute technician's visualization of ameba on a wet-mount of CSF, and aggressive antiamebic therapy was started promptly. Similar treatment has been unsuccessfully attempted in many subsequent cases; whether treatment failure is due to poor efficacy of the antibiotic regimen or initiation of specific therapy too late in the course of disease is unknown. To assess this, a clinical review of all documented cases and associated clinical management is underway at CDC. In the event that the currently used treatment regimen is shown to be ineffective, new drugs and combinations should be tested for *in vitro* and *in vivo* efficacy against *N. fowleri* (Kim et al., 2008).

Collaboration Between FDOH and CDC

Deaths caused by PAM are emotionally devastating to family members, since the disease primarily affects young, otherwise healthy and active children. Community and family members naturally want to know why the disease that took their loved one could not have been prevented. In our experience, the partnership created between CDC, the CHD, and the FDOH during this investigation was mutually beneficial to all parties involved. The family of the case patient benefited from the responsiveness and personal attentiveness of the CHD, but also appreciated the opportunity to speak with FDOH and CDC staff, who could answer their questions about policy issues and current *Naegleria* research. The CHD and FDOH benefited from the extra manpower and technical support provided by the CDC team that assisted in the investigation; the CHD and FDOH also appreciated the opportunity to give CDC direct feedback on how the state would like to see PAM investigation protocols evolve. CDC benefited from the positive relationship that the CHD had built with the family, which contributed to the family's willingness to participate in interviews and give sera for antibody testing. CDC also greatly appreciated the local feedback on how it can improve its approach to PAM case investigations.

TABLE **3**

Florida Primary Amebic Meningoencephalitis Cases by Age, 1962–2010

Age (Years)	Number of Cases
0–4	2
5–12	14
13–17	9
18–22	5
>22	2
Total	32

TABLE **4**

Florida Primary Amebic Meningoencephalitis Cases by Month, 1962–2010

Month	Number of Cases
June	1
July	10
August	14
September	3
October	2
Unknown	2
Total	32

TABLE **5**

Exposure Sites of Florida Primary Amebic Meningoencephalitis Cases, 1962–2010

Exposure Site	Number of Cases
Freshwater lake	20
Canal	3
Freshwater water park/sports facility	1
Freshwater sinkhole	1
Puddle	1
Sprayed water up nose from hose	1
Unknown	5
Total	32

Conclusion

Currently, the only certain way to prevent PAM is to avoid water-related recreational activities in warm freshwater environments. All recreational water users should assume a low level of risk is present when entering warm freshwater, especially in southern tier states. To reduce PAM risk, CDC recommends avoiding recreational activities in warm freshwater, hot springs, and thermally polluted water around power plants, particularly during periods of high water temperature and low water levels. Other measures that might reduce risk include swimmers preventing water from entering the nose by holding their noses shut or using nose clips. The ubiquitous presence of *N. fowleri* in lake sediment (Wellings et al., 1977; Wellings et al., 1979) also suggests that recreational water users should avoid digging in or stirring up the sediment while swimming in warm freshwater areas.

The transmission of disease requires the presence of the pathogen, a susceptible host, and a permissive environment. To date, it is unclear what can be done to predict or control the presence of the pathogen, but development of specific, rapid, and simple environmental detection methods might allow identification of key factors leading to amplification of the organism in the environment and allow improved predictive models for assessing the risk of infection (Cabanes, Wallet, Pringuez, & Pernin, 2001). Host factors predisposing to PAM are also poorly understood. Given the rare nature of the disease the public health community must collect as much information as possible from each case to enlarge the knowledge base about the disease. For this reason, CDC is developing an enhanced case investigation package, piloted during this case investigation, that includes the collection or distribution of the following elements: 1) detailed information about the patient's demographics, medical history, water-related exposures and activities, clinical course, and treatment information; 2) similar information from those who have shared the same exposure but did not develop PAM; 3) data about environmental conditions, including location and time of exposure, air and water temperatures, water depth, and other environmental markers; and 4) guidance for physicians on when to suspect PAM, how to rapidly diagnose and treat PAM, and, when necessary, guidance for autopsies.

CDC is eager to assist states in conducting PAM diagnostics and case investigations using this expanded approach, and encourages local and state health departments to request CDC assistance with future investigations.

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The Use of Deer Vehicle Accidents as a Proxy for Measuring the Degree of Interaction Between Human and Deer Populations and Its Correlation With the Incidence Rate of Lyme Disease

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Abstract **The study described in this article examined the relationship between the incidence rate of deer vehicle accidents (DVAs), a proxy for measuring the interaction between populations of humans and deer, and human Lyme disease incidence rate. The authors also examined the relationship between deer population density and human Lyme incidence rate. They analyzed data from Connecticut's Department of Environmental Protection and the Department of Public Health from 1999 through 2008 by deer management zone (DMZ) and town. For DVA incidence rate versus Lyme incidence rate for both DMZs and towns, most of the correlation coefficients computed yearly were moderate to strong and all of the *p*-values were significant. A weak correlation was observed between deer population density and Lyme disease incidence rate by DMZ. The authors propose DVAs as a proxy for measuring the interaction between coexisting populations of humans and deer. The authors' study suggests that additional investigations of DVAs and their relationship to Lyme disease to further assess the utility of public health interventions are warranted.**

Introduction

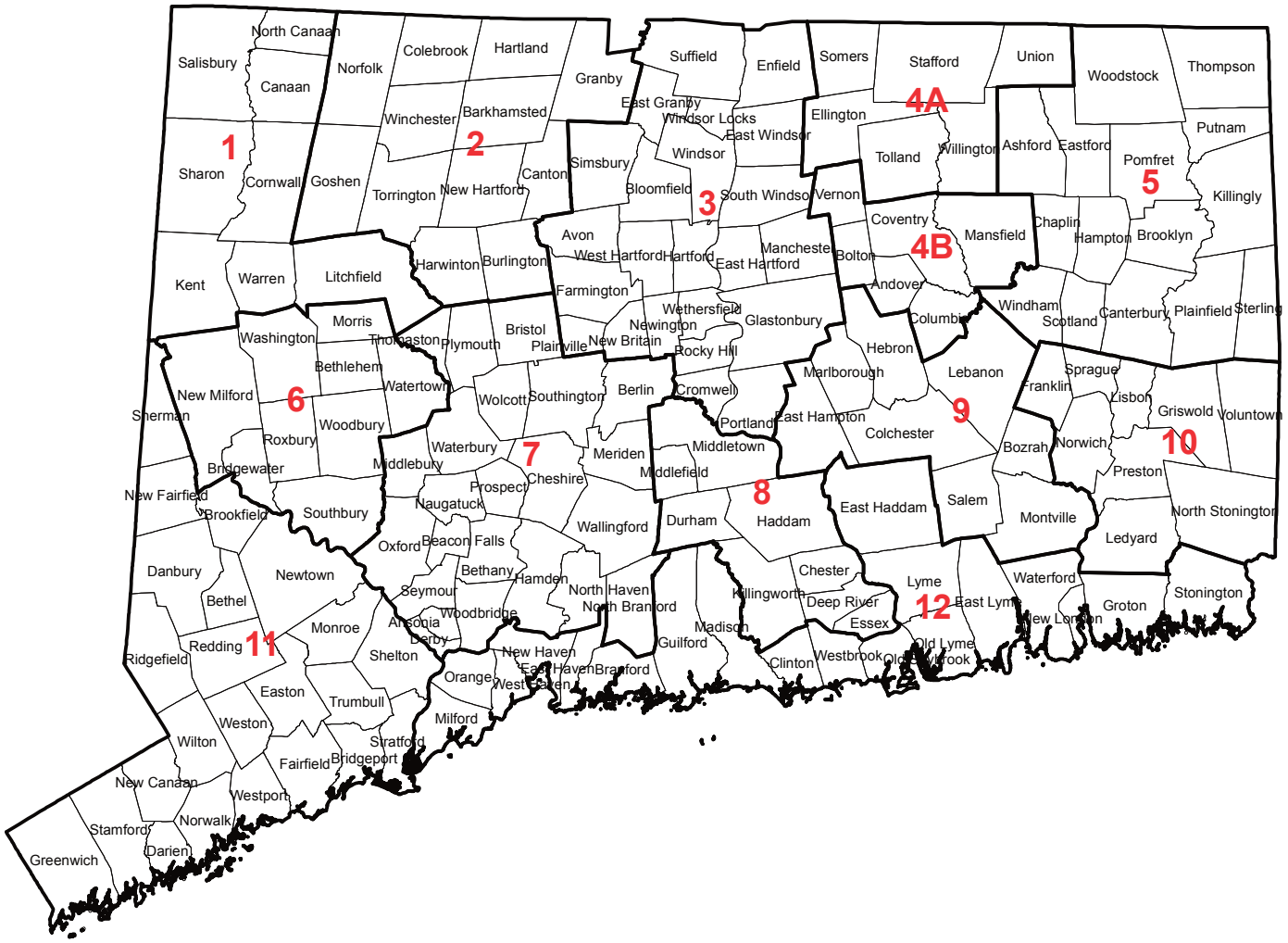
The transmission of Lyme disease is well documented. The spirochete that causes Lyme disease, *Borrelia burgdorferi*, is transmitted by ticks of the genus *Ixodes* (Burgdorfer et al., 1982; Spielman, Wilson, Levine, & Piesman, 1985; Steere, Broderick, & Malawista, 1978) specifically *Ixodes scapularis* in the north central and northeastern U.S., and *Ixodes pacificus* in the western U.S. (Oliver et al., 1993). In the northeast, white-footed mice (*Peromyscus leucopus*), the major reservoir for *B. burgdorferi*, are the host to immature *I. scapularis*, while white-tailed deer (*Odocoileus virginianus*) are the primary host to adult *I. scapularis* (Bosler, Ormiston, Coleman, Hanrahan, & Benach, 1984; Spielman et al., 1985). White-tailed deer are an incompetent reservoir for *B. burgdorferi*, but serve as the primary blood meal for most adult female *I. scapularis* in the northeast (Rand et al., 2003; Wilson, Telford, Piesman, & Spielman, 1988).

The incidence and geographical distribution of Lyme disease in humans has been correlated with the distribution, abundance, and annual fluctuations in *I. scapularis* populations infected with *B. burgdorferi* (Mather, Nicholson, Donnelly, & Matyas, 1996; Stafford, Cartter, Magnarelli, Ertel, & Mshar, 1998). The nymphal *I. scapularis* become active during the summer months, and Lyme disease symptoms are seen approximately 7–21 days later in humans following a tick bite (Bacon, Kugeler, Mead, & Centers for Disease Control and Prevention [CDC], 2008). Lyme disease features a common clinical characteristic, a target lesion called erythema chronicum migrans and manifests symptoms of arthritis, myocarditis, uveitis, and meningoneuritis (Steere, 1986, 1994; Steere et al., 1977). The abundance of *I. scapularis* has been correlated with the number of deer in a geographic region (Wilson, Adler, & Spielman, 1985). As the deer population is a proxy for the presence of tick vectors, the presence of deer among humans has been hypothesized to be a risk of Lyme disease infection (Steere, Taylor, Wilson, Levine, & Spielman, 1986).

Much of New England has the four critical components necessary for human infection of *B. burgdorferi*: a population of *I. scapularis*, a population of white-tailed deer, a prevalence of *B. burgdorferi* in white-footed mice, and a human population that lives in proximity with deer. In areas in which Lyme

FIGURE **1**

Connecticut's Deer Management Zones, 2008



disease is prevalent, specifically in forested residential areas, exposure to *I. scapularis* often occurs in the vicinity of people's homes (Lastavica, Wilson, Berardi, Spielman, & Deblinger, 1989; Steere, 1986). The number of deer living near these homes should influence the number of adult *I. scapularis* and the incidence of Lyme disease in the human population (Lastavica et al., 1989).

An accurate method for quantifying the interaction between humans and deer in a geographic area has been lacking. Interaction between humans and deer simply means the co-residence of deer and humans and the inevitable resulting indirect contact, such as exposure to the same or bordering habitats. Currently, the main methods of documenting human and deer interaction are through hunter and residential deer surveys (Rand et al., 2003; Rand, Lacombe, Smith, Gensheimer, & Dennis, 1996; Wilson, Levine, & Spielman, 1984). Human-to-deer interaction surveys are the only measure that correlates with the incidence of Lyme disease in humans; all other measures found to correlate with Lyme disease are specific to *Ixodes* spp., and therefore only serve to explain the relationship of Lyme disease within a habitat and do not correspond to the human population. A useful correlative measure of Lyme disease incidence would be significant as it would have many public health implications in relation to the control of Lyme disease. Public health departments could direct Lyme prevention resources toward specific geographic areas based on the degree of correlation of the measure.

Our objectives were to use deer vehicle accidents (DVAs) as another metric to measure the interaction between deer and humans. Recent research has investigated how animal vehicle collision databases can be used to improve pedestrian and vehicle operator safety (Sullivan, 2011). DVAs are automobile accidents in which a deer has been struck by an automobile. We propose that DVAs are a proxy measure of deer and human interaction. It is hypothesized that geographic areas of high

DVAs are locations with coexisting dense populations of both humans and deer, while in geographic areas of low DVAs it is hypothesized that few humans or few deer live there and that the interaction between the two is minimal. We evaluated the ecological hypothesis that the incidence rate of DVAs (number of DVAs per human population) strongly correlates with the incidence rate of Lyme disease (number of cases per human population) in humans in specified geographic areas (i.e., an ecological correlation).

In addition, it is hypothesized that a weak ecological correlation would exist between the Lyme disease incidence rate and aerial deer population estimates. Presumably, the disease is affected by deer/human interaction so a measure of only the correlation between the deer population and the Lyme disease incidence rate would be low. The primary ecological correlation of interest in our study has no direct equivalent at the individual level. Note that the "incidence rate" of Lyme disease in a given population is an ecological measure because it is a summary rate for a population. Our study does not hypothesize a link between DVA and Lyme disease at the individual level. DVA is an ecological variable that potentially exerts structural and contextual effects on Lyme disease development in an entire human population, not just the individuals experiencing the DVA. As a result, the ecological fallacy, a typical limitation in studies that use ecological data to measure individual-level correlations, is not a concern in our study (Schwartz, 1994).

Connecticut was chosen as a study site because of its high incidence rate of Lyme disease. Between the years 1992 and 2006, 10 states reported Lyme incidence rates greater than 10/100,000 (Connecticut, 73.6; Rhode Island, 45.8; Delaware, 27.4; New Jersey, 24.6; New York, 24.3; Pennsylvania, 23.0; Massachusetts, 14.5; Wisconsin, 13.5; Maryland, 12.2; and New Hampshire, 10.7) (Bacon et al., 2008).

TABLE **1**

Deer Vehicle Accidents Versus Lyme Disease Incidence Rates by Town

Year	Pearson Correlation Coefficient (*r*)	*p*-Value
1999	.49	<.0001
2000	.45	<.0001
2001	.59	<.0001
2002	.60	<.0001
2003	.61	<.0001
2004	.52	<.0001
2005	.58	<.0001
2006	.28	<.0001
2007	.63	<.0001
2008	.52	<.0001

TABLE **2**

Deer Vehicle Accidents Versus Lyme Disease Incidence Rates by Deer Management Zone

Year	Pearson Correlation Coefficient (*r*)	*p*-Value
1999	.82	.001
2000	.67	.02
2001	.86	<.0001
2002	.83	<.0001
2003	.90	<.0001
2004	.71	.007
2005	.78	.002
2006	.66	.01
2007	.90	<.0001
2008	.88	<.0001

Methods

Yearly DVA data for each Connecticut town from 1999 to 2008 were obtained from the state of Connecticut's Department of Environmental Protection (DEP). The DVAs database is maintained by the DEP's Wildlife Division. The data are a compilation of deer kill incident reports that are completed by either DEP conservation officers, local police, or state police, and routed to the DEP by the officer within 30 days. The report was expanded to include and differentiate between white-tailed deer, moose, and black bear in 2009 (Connecticut General Statutes, 2009). The typical DVA is reported when a deer is killed by a vehicle, and the database does not include deer who survived an accident or who may have died far from the road (Kilpatrick & LaBonte, 2007).

Connecticut has a total of 169 towns, which in aggregate cover the entire surface of Connecticut and do not overlap. The state is 5,543 square miles and was populated by 3,405,565 people according to the 2000 Census. The DEP has grouped the towns into 13 deer management zones (DMZ) (Figure 1). Because deer populations vary across the state, Connecticut developed different DMZs, and each zone has a unique deer management strategy depending on population objectives. Each DMZ has 6 to 25 towns; the largest zone is 655 square miles and the smallest zone is 151 square miles.

In addition, the DEP conducts aerial deer surveys every three years for each DMZ. Aerial surveys were conducted in the winter after a snowfall to maximize visibility. Surveys were conducted from a height of approximately 70 m (200 ft.) and a speed of approximately 16–24 km/hr (10–15 mph). Attempts were made to place three stratified 16-km transects oriented east-west in each of the 12 DMZs. All transects extend in an easterly direction for 16 km with an approximate width of 0.16 km (0.1 mile). Transect placement was determined by placing three evenly spaced points, which served as the center of each transect, vertically aligned in the center of each zone. All zones except 3 and 7 follow these criteria.

The number of annual Lyme disease cases by town for the state of Connecticut from 1999 to 2008 was supplied by the Connecticut Department of Public Health (DPH) epidemiology and emerging infections program. The data are compiled from reports completed by the patient's physician. Reporting Lyme cases has been mandatory for Connecticut health care providers since 1987. Lyme disease can be difficult to diagnose, and the data do not include unreported or undiagnosed cases. Annual rates in Connecticut were variable because of changes in surveillance practices begun in 2003 (Bacon et al., 2008). The DPH also supplied Connecticut town populations from the 1990 and 2000 national census.

Human Lyme disease incidence rates (number of cases per human population) for each town and each deer management zone were calculated using total Lyme cases by town for 1999 using 1990 census data and for 2000 through 2008 based on 2000 census data. DVAs incidence rates (number of DVAs per human population) for each town and each deer management zone were calculated for 1999 using 1990 census data and for 2000 through 2008 using 2000 census data.

The Pearson correlation coefficient (r) was calculated to assess the linear relationship between DVA incidence rates and human Lyme disease incidence rates in DMZs and towns at the ecological level. All correlation analyses were performed separately for each year, 1999 through 2008. Deer population density per square mile for each DMZ was calculated from aerial survey data for the years 2000, 2003, and 2006. Deer population density versus incidence rate of Lyme disease by town was plotted by DMZ. The Pearson correlation coefficient was also calculated to assess the linear relationship between deer population density and human Lyme disease incidence rates by DMZ at the ecological level. All p-values are two-sided with statistical significance evaluated at the .05 alpha level. All analyses were performed in SPSS v. 18.

Results

The total annual incidence rate of Lyme disease in Connecticut during the study years ranged from 40 in 2004 to 136 in 2002 (per 100,000 population) and ranged from 0 to 5,000 for towns (per 100,000 population). The total annual incidence rate of DVAs in the state ranged from 60 in 2006 to 91 in 2000 (per 100,000 population) and ranged from 0 to 1,200 for towns (per 100,000 population).

For both the towns (Table 1) and the DMZs (Table 2), almost all of the calculated ecological correlation coefficients computed within each year (i.e., correlation between DVA incidence rate and human Lyme disease incidence rate by year) were moderate to strongly positive, and all of the resulting p-values were significant (Tables 1 and 2). This demonstrates that a strong positive correlation exists between DVAs and Lyme disease incidence rates in towns and DMZs at the ecological level. The DMZ data demonstrated stronger correlation coefficients for all years between DVAs and Lyme disease incidence rates as compared to the individual town data. Weak correlation coefficients were observed between deer population density and Lyme disease incidence rate by deer management zone; the Pearson correlation coefficients were calculated for years 2000, 2003 and 2006 (year 2000, r = .30, p = .35; year 2003, r = .07, p = 0.84; year 2006, r = .27, p = .40).

Discussion

The principal finding of our study is that a strong linear ecological correlation appears to exist between DVAs and human incidence rate of Lyme disease by DMZ, although a slightly weaker ecological correlation at the town level. As deer are a reservoir for ticks, and DVAs are a proxy for human/deer interactions, DVAs may be seen as a proxy of human/tick interaction. Our results suggest that DVAs quantify the ecological interaction between coexisting populations of humans and deer: geographic locations that have high DVAs should have a large number of human vehicle operators driving within the range of a concentrated deer population.

Locations with high DVAs would most likely be wooded rural environments that support a deer population as well as a coexisting human population. By contrast, geographic locations that have low DVAs would be expected to be areas that have a high human population but very few deer, such as a suburban community or major city; areas that have a low human population but many deer, such as a state or national forest; or areas that have both low human and low deer populations. DVAs will be influenced by the highway density of a town and the unique road infrastructure that facilitate the crossing of animals. In locations where roadside fencing or other means of physically restricting deer crossing, DVAs may not serve well as a Lyme disease indicator. Deer are notorious for not being restricted by fences due to their jumping ability (Curtis & Richmond, 1996), however, and highway density and road infrastructure influences appear to be negligible in Connecticut, as the correlation between DVAs and human Lyme disease incidence rate was consistently high across all regions of the state (Figure 2) for all years.

Our results demonstrate that the total deer population as measured by aerial surveys does not correlate with the Lyme disease incidence rate within a DMZ. This can be explained by acknowledging that deer population numbers do not provide much insight into whether a coexisting human population is present. For example, a high deer density does not mean that a corresponding human population lives in the same zone, whereas a high DVA rate indicates that humans and deer are interacting. Both a high deer density and a high human population are required for towns to have high DVAs, and this degree of interaction accounts for the strong correlation between high DVAs and a high incidence rate of Lyme disease.

The evidence of the role of deer in Lyme disease, the role of *I. scapularis* as a vector of Lyme disease, as well as the competence of white-footed mice as hosts for the spirochete *B. burgdorferi* have been clearly established (Matuschka & Spielman, 1986). Size and microgeographic distributions of *I. scapularis* have been positively correlated with the density of *O. virginianus*, and increases in *I. scapularis* populations have been linked to increases in white-tailed deer populations (Barbour & Fish, 1993; Rand et al., 2003; Wilson, Ducey, Litwin, Gavin, & Spielman, 1990). Following a controlled reduction of deer in a costal Massachusetts site, the *I. scapularis* population declined by approximately half (Wilson et al., 1988). In another study that conducted a survey of six islands in Rhode Island, *I. scapularis* was found on two of the islands that supported deer populations, while *I. scapularis* was absent on four islands that did not have deer populations (Anderson, Johnson, Magnarelli, Hyde, & Myers, 1987).

In another experiment, when *O. virginianus* was removed from Monhegan island off the coast of Maine, populations of *I. scapularis* disappeared after four years (Rand, Lubelczyk, Holman, Lacombe, & Smith, 2004). The density of *I. scapularis* and Lyme disease infection among rodents initially increased for the first two to three years as *I. scapularis* sought out other large mammalian hosts before becoming extinct from a presumed lack of adequate hosts (Rand et al., 2004). Adult *I. scapularis* reproduce based on the availability of deer as hosts, and *I. scapularis* populations increase with deer density (Rand et al., 2003).

In addition, significant evidence exists linking deer population to the incidence rate of Lyme disease (Stafford, 2001), although our data does not support this view. In areas in which Lyme disease is prevalent, specifically in forested residential areas, *I. scapularis* exposure often occurs in the vicinity of people's homes (Lastavica et al., 1989; Steere, 1986). The number of deer living near these homes should influence the number of adult *I. scapularis* and consequently Lyme disease incidence rate in the human population

(Lastavica et al., 1989). Therefore, a metric that quantifies the interaction between humans and deer in a geographic area would be valuable for predicting the incidence rate of Lyme disease.

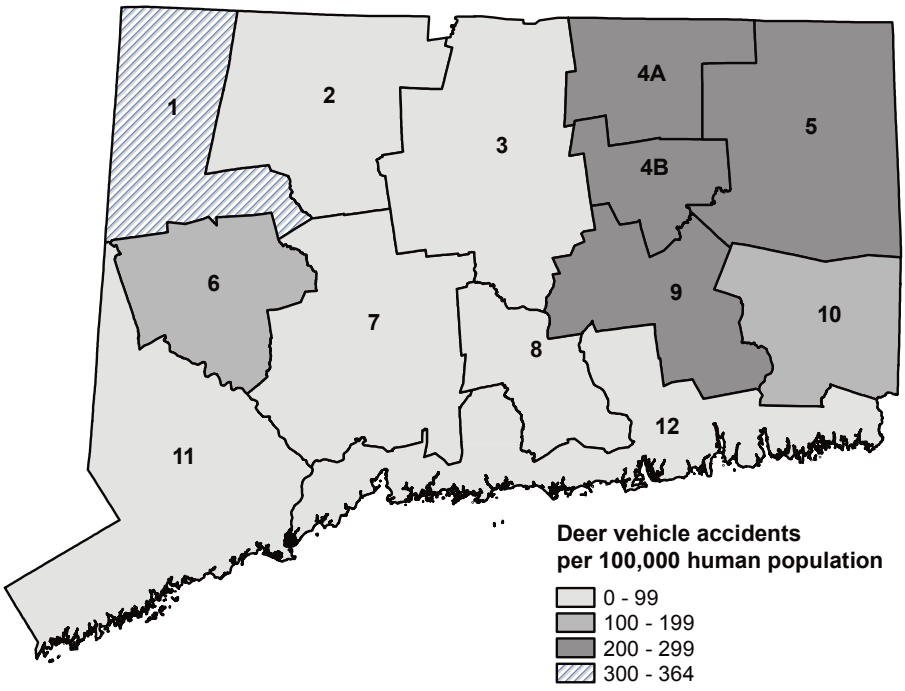
Results of our analysis demonstrate that DVAs strongly correlate with the human incidence rate of Lyme disease at the ecological level, and that DVAs can be used as a metric to measure the interaction between deer and humans, in addition to hunter and residential homeowner observation surveys. Further studies are required to calibrate the DVA data, such as defining what upper limit of DVA is high enough to warrant a public health intervention.

Currently, tick identification and serology, the human Lyme disease incidence rate, and animal studies provide information for Lyme disease risk assessment, but these sampling approaches are not ideal. Human case data can be valuable in highlighting Lyme disease hotspots. Case data are inexact, however, because individuals may have been exposed to Lyme disease away from their residence or home, and the source is not always known. In addition, tick or small animal capture, identification, and serology can be time consuming, are limited to the specific locations in which samples are collected, and do not correlate with the estimated risk of Lyme disease (Daniels et al., 1998). Another approach involves white-tailed deer serologies. Serologic analysis for *B. burgdorferi* using *O. virginianus* has been shown to be an accurate and sensitive surveillance method for determining whether *B. burgdorferi* is present in a specific geographic location (Gill, McLean, Shriner, & Johnson, 1994). While serologic analysis of *O. virginianus* provides information regarding the presence of *B. burgdorferi,* it does not indicate the risk of Lyme disease in the human population, as the deer population may or may not coexist with a human population. In addition, deer serologies for a specific area are difficult to obtain.

Local deer population reductions in areas that have high DVAs should reduce tick density, which in turn should decrease the risk of Lyme disease. It has already been shown that reducing the deer population, fencing deer from specific areas, or treating deer with acaricidal chemicals controls the population of *I. scapularis* and the incidence rate of Lyme disease in areas that experience human activity (Daniels,

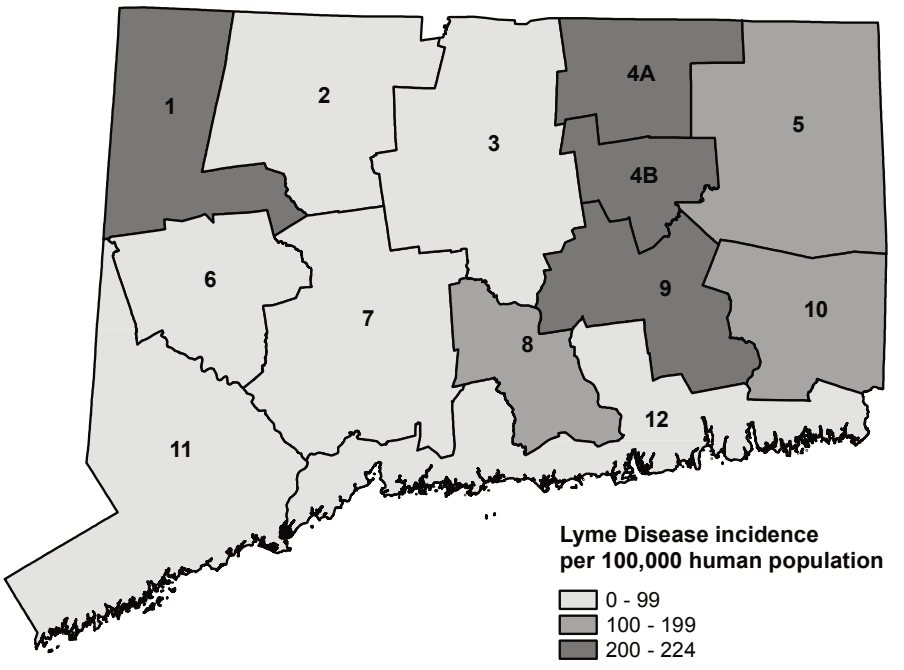
FIGURE **2**

a. Deer Vehicle Accident Incidence, 2008



Per 100,000 by deer management zone, 2008.

b. Lyme Disease Incidence, 2008



Per 100,000 by deer management zone, 2008.

Fish, & Schwartz, 1993; Deblinger, Wilson, Rimmer, & Spielman, 1993; Hoen et al., 2009; Pound, Miller, & George, 2000; Rand et al., 2004; Stafford, 1993; Stafford, Denicola, & Kilpatrick, 2003; Wilson et al., 1988).

Evidence exists that deer population by itself has no predictive power of tick population or the reduction of Lyme disease (Jordan, Schulze, & Jahn, 2007; Ostfeld, Canham, Oggenfuss, Winchcombe, & Keesing, 2006). Several studies have indicated that populations of species that support the *I. scapularis* in its juvenile stages, such as *P. leucopus*, strongly correlate with tick population and the prevalence of *B. burgdorferi* while populations of species that support the *I. scapularis* in its adult stage, such as the white-tailed deer, do not (Buskirk & Ostfeld, 1995; Ostfeld et al., 2006). A recent study has determined that deer populations must be maintained at low densities indefinitely to reduce tick populations; during the first few years following a deer reduction, the adult tick population will seek other large hosts, such as humans, but then collapse within two to three years as the adult tick population crashes (Rand et al., 2004).

Several limitations should be noted about the data used in our study. First, many DVAs are not reported to the Connecticut authorities and therefore are not included in the database. It is not possible to accurately establish the number of DVAs that are not reported, but this missing data could be assumed to affect all 169 towns equally. In Connecticut, it is estimated that for every DVA that is reported an additional five go unreported (Kilpatrick & LaBonte, 2007). Second, within the Lyme disease incidence rate data supplied by the Connecticut DPH, a large increase of Lyme disease cases was reported with a missing location (patient's town of residence) in the years 2007 and 2008. Lyme disease incidence rate data is reported by physicians, and this increase in cases missing a location is due to incomplete data from the reporting physician. Third, aerial deer density estimates are merely a tool used in evaluating trends in deer populations and therefore are not expected to provide an exact count of deer (Kilpatrick, 2010; Kilpatrick, Spohr, & Lima, 2001). A more accurate method of recording DVAs and Lyme disease cases would greatly improve the validity of the datasets and further strengthen the relationship we found between DVA and Lyme disease incidence rates. Finally, as our methodology is using DVA as a proxy for human/deer interactions, it is important to acknowledge a number of factors that might confound the observed ecological correlations, such as changes in traffic patterns, weather, new construction, physical barriers such as road fencing, and so on.

Conclusion

The results of our study demonstrate that DVAs hold promise to be used as an indicator of where deer populations need to be managed and for determining where Lyme disease risk mitigation should be undertaken. Further investigation is required, however, before changes in public health policy can be implemented, as our study is not sufficient to prescribe changes in public policy. Our results will hopefully encourage additional research to evaluate DVA data in assessing the risk of contracting Lyme disease in specific geographic regions. To start, public health departments can analyze their state's DVA and Lyme disease incidence rate data for correlations.

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GUEST COMMENTARY

2011 NEHA Sabbatical Report

From Then to Now, and Here to There: A Glimpse at Contaminated Lands and Environmental Health Issues in the UK

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I chose to conduct my sabbatical for three weeks in the UK to study landfills and brownfields in a high-precipitation, high-groundwater-table, limited-land-space environment. I chose to look at the environmental factors, sociocultural factors, and community involvement in the UK.

Environmental health issues arise as populations expand and contract (or vacate): subdivisions may encroach on an old landfill as they grow into suburbs, whereas the number of people living near brownfields may increase as people move back into cities. In both scenarios, a potential exists for residents to be exposed to chemicals in soil, groundwater, and indoor air.

What challenges await us as old landfills leak or brownfields are not remediated, and what preventive measures can help assure the protection of human health from environmental contamination or vectorborne disease? Given a high-precipitation island environment, what are the differences between American and British approaches to protecting public health?

Both the UK and the U.S. struggle with increased waste production and consumption, environmentally persistent chemicals, and bioaccumulation. Increases in population size, consumption, and waste production require both countries to consider location disparities. Environmental health professionals are responsible for ensuring protective measures, investigating human health hazards, and conducting community education; therefore, addressing community concerns and involvement will be core functions of the environmental health profession.

By studying well-established communities in highly populated regions tempered by ocean currents and constant precipitation, much can be learned about the changes in environmental dynamics of landfills or brownfields, health risks, and community involvement. By investigating the culture and actions of British communities, land (re)use engineering and technology, and health outcome information, we can gain insight to better address similar issues in the U.S.

While in the UK, I visited environmental health professionals regulating contaminated lands in Glasgow, Edinburgh, northwest England, and London. I was also fortunate enough to meet with members of parliament to learn more about the political side of regeneration and housing. The various projects included redevelopment of industrial sites and dilapidated social housing to welcome the 2012 Olympic and Paralympics Games in London and the 2014 British Commonwealth Games in Glasgow. (See photos on page 41.) Both regeneration sites had extensive contamination issues, close proximity to high density living, and a history of industrial use unfolding over hundreds of years. One only had to see the London 2012 Olympic Games opening ceremonies to gain better understanding of this legacy. To answer my questions about landfilling, I also had the privilege of touring an impressive and cutting-edge municipal solid waste materials reclamation facility in Lancashire, a county in northwest England. There I also enjoyed the opportunity to observe inspectors for the UK Housing Health and Safety Rating System.

Contamination Remediation and Prevention

Contaminated lands in the UK must be researched, sampled, and characterized before redevelopment. Regulatory requirements are derived through risk-based assessment dependent on the reuse of the land. Landfills must be properly engineered and regulated as outlined in guidance established by the British Environment Agencies and the Chartered Institute of Environmental Health, the British equivalent to NEHA. Remediation techniques used in a high-precipitation, high-groundwater-table environment like at the 2014 Glasgow Commonwealth Games' site are similar to those used here in the U.S.: remove the contamination source to cease contaminating further. Therefore, the cheapest and most common remediation method used is the "dig-and-dump" method in which the contaminated soil is removed and properly disposed of. Groundwater and surface water is left to naturally attenuate with the rain.

The 2012 Olympics site in London, however, used a different approach to remediation. In their effort to be sustainable, contaminated soil was removed and "washed" on site. The removed soil was decontaminated then reused on site to level out the area under

View from the Commonwealth Games site.


Local public housing to be removed and replaced.

the Olympic stadium. This reduced the need for fresh soil while also protecting public health by cleaning and capping any residual contamination in the soil. On-site groundwater is being treated through the pump-and-treat method, and the original wetlands are being restored.

The UK manages and disposes of solid waste using the same methods as in the U.S.: recycling and reclamation, incineration, and landfilling. Limited land space, however, compels the need for materials reclamation and reuse. The Farington Waste Reclamation Center is a large facility designed to sort and reclaim waste materials that can be recycled and reused before waste goes to a landfill. The facility separates out the wastes from household garbage, reclaims some materials, and composts the rest. Gases produced throughout composting are reused for energy on site, in addition to solar and wind energy sources. It is one of the few facilities spearheading measures to prevent landfilling as a contamination source and to educate residents about pollution prevention and the environment.

Community Involvement and Culture

Community involvement activities are less common for contaminated lands and redevelopment in the UK. Typically, local environmental health officers (EHOs) work with concerned residents to answer their questions; however, when residents are extremely concerned about health and contamination, experts may travel cross-country and "across the pond" to assist. Environmental agencies offer technical expertise to local EHOs when residents still have health concerns about contamination, redevelopment, and vacant land sites. Innovative planning projects are now doing more community involvement and education about contamination regulations for residents and on-site workers. For example, health impact assessment (HIA) is commonly used throughout Europe and the UK to identify community health problems associated with planning decisions and community design.

At the 2012 Olympic site in London, regulators used a new strategy to achieve compliance with on-site environmental health and safety regulations during redevelopment. Through professional education, on-site workers became informed professionals who took responsibility for their health and safety. Regulators achieved greater success with compliance, and the number of on-site injuries and sick days were further reduced compared with previous projects.

Lessons Learned

The lesson learned is that despite our differences, public health issues remain the same, and that both the UK and the U.S. have similar approaches to redevelopment and health. The greatest differences between our countries are the approach to community involvement and the efforts made toward alternative energy and climate change.

In the UK, community involvement activities for environmental contamination and health concerns are most often conducted by EHOs at the local councils. Also, with already very wet and often extreme weather over limited land space, the UK is very conscientious about climate change, pollution prevention, and sustainability.

Environmental health specialists in the U.S. have an opportunity to further establish our role in waste prevention and promote recycling or reclamation programs. We can add HIA as another tool to use for communities concerned about redevelopment, and we can consider the UK's creative land reuse and sustainability efforts as model approaches, learning from each others' experiences. Regardless of which country we call home, we all have expertise that we benefit from sharing.

Editor's Note: A version of this article was previously published in the *Georgia Environmentalist* (September 2012), *34*, 29–30. To view the complete report submitted to the National Environmental Health Association, go to www.neha.org/about/Awards/SabbaticalExchangeAward.html.

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DIRECT FROM CDC ENVIRONMENTAL HEALTH SERVICES BRANCH

Roger S. Nasci, PhD

Monitoring and Controlling West Nile Virus: Are Your Prevention Practices in Place?

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

In this column, EHSB and guest authors from across CDC will highlight a variety of concerns, opportunities, challenges, and successes that we all share in environmental public health. EHSB's objective is to strengthen the role of state, local, and national environmental health programs and professionals to anticipate, identify, and respond to adverse environmental exposures and the consequences of these exposures for human health. The services being developed through EHSB include access to topical, relevant, and scientific information; consultation; and assistance to environmental health specialists, sanitarians, and environmental health professionals and practitioners.

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

Roger S. Nasci is chief of the Arboviral Diseases Branch in CDC's National Center for Emerging and Zoonotic Infectious Diseases, Division of Vector-Borne Diseases.

In a remarkable demonstration of the potential for invasive organisms to spread and establish in new, permissive habitats, West Nile virus (WNV) expanded from a small area in New York City in 1999 and is now found across much of the western hemisphere from central Canada to southern Argentina. Enzootic WNV transmission and human WNV disease have been reported from all 48 of the continental United States. The disease burden imposed by this new addition to the U.S. public health scene has been equally remarkable. During 1999–2012, more than 36,000 cases of human disease were reported to the Centers for Disease Control and Prevention (CDC), including approximately 16,000 cases of neuroinvasive disease and 1,500 deaths (Petersen & Fischer, 2012). Some models estimate that between two million and four million people have been infected with WNV since 1999, and 400,000 to 1 million people may have experienced some degree of illness due to the infection (Petersen et al., 2012).

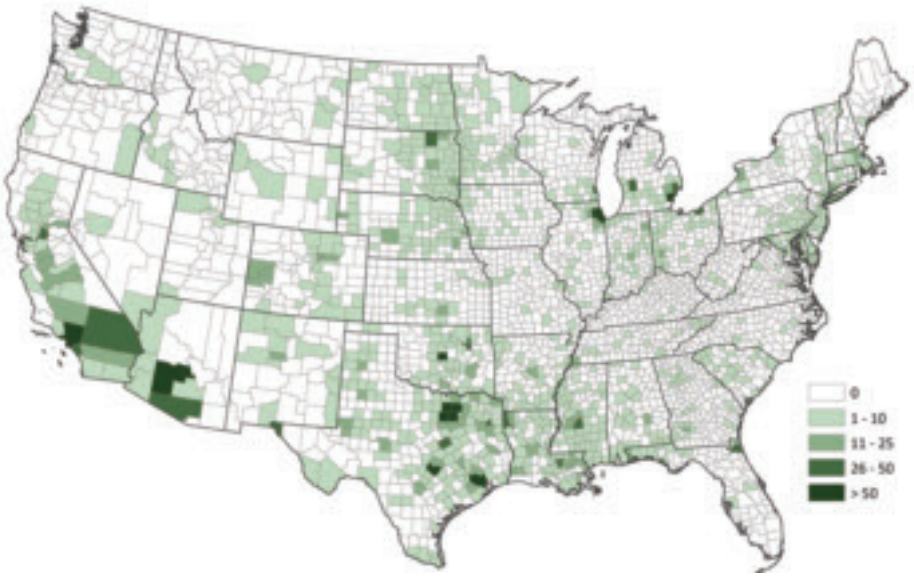
WNV cases peaked during 2002 and 2003 when large, regional outbreaks occurred as the virus expanded across the midsection of the country (Hayes et al., 2004). In recent years, the number of reported cases declined (Lindsey, Staples, Lehman, & Fischer, 2010) and outbreaks became more focal and sporadic, leading to speculation that WNV transmission was subsiding in the U.S.

The WNV epidemic of 2012 demonstrated that WNV remains an important zoonotic disease. During 2012, WNV transmission remained widespread with 48 states reporting infections in people, birds, or mosquitoes. As of November 27, 2012, a total of 5,245 cases of WNV disease in people, including 236 deaths, have been reported to CDC. Of these, 2,663 (51%) were classified as neuroinvasive disease (i.e., meningitis or encephalitis) and 2,582 (49%) were classified as non-neuroinvasive disease. This is the highest annual number of WNV disease cases reported to CDC since 2003. The 2012 outbreaks remained focal and spatially restricted rather than regional, with almost 75% of the reported cases coming from 10 states (Texas, California, Louisiana, Mississippi, Illinois, South Dakota, Michigan, Oklahoma, Nebraska, and Colorado) and one-third of all reported cases coming from Texas (Figure 1). Just over half of the 1,714 cases in Texas occurred in just four counties located in the Fort Worth-Dallas region (Dallas, Tarrant, Denton, and Collin counties).

Though several potential WNV vaccines have completed phase I or phase II human clinical trials and results suggested good safety and immunogenicity, none of the vaccine candidates has progressed to phase III trials (Beasley, 2011). Thus, preventing WNV depends on measures to keep infected mosquitoes from biting people. This can be accomplished through personal protection activities and integrated mosquito manage-

FIGURE **1**

Distribution of the 5,245 West Nile Virus Human Disease Cases Reported to ArboNET, by County, 2012



As of November 27, 2012.

ment programs targeting vector mosquitoes. Numerous personal mosquito repellent products are commercially available, and some are quite effective at preventing mosquito biting for long periods (Centers for Disease Control and Prevention [CDC], 2012). Repellent use has been associated with reduced risk of WNV infection (Mostashari et al., 2001). Unfortunately, even during WNV outbreaks, relatively few people actually use repellents (McCarthy et al., 2001) despite aggressive promotion of personal protection by health departments. This leaves community-based, integrated mosquito management programs as the best WNV prevention tool available (CDC, 2003).

The integrated mosquito management concept currently employed by many mosquito abatement districts is an evidence-based decision support system anchored by a monitoring program providing data that describe

- the conditions and habitats that produce vector mosquitoes,
- the abundance of those mosquitoes over the course of a season,
- the infection rate of WNV in mosquito vectors, and
- other parameters that influence local mosquito populations and WNV transmission.

These data inform decisions about implementing mosquito control activities appropriate to the situation, such as

- source reduction through habitat modification where feasible;
- larval mosquito control using predators, biologicals, or pesticides; and
- adult mosquito control using pesticides applied from trucks or aircraft.

The objective is to use source reduction and larval control to maintain vector mosquito populations below levels at which they support intense WNV transmission, and to respond with effective adult mosquito control efforts when adult mosquito abundance, and particularly the incidence of WNV-infected mosquitoes increases in an area (CDC, 2003).

Maintaining these monitoring systems is costly, but essential. Predicting where and when WNV outbreaks will occur is difficult. While much has been discovered about the vector mosquitoes, birds, and environmental components of the WNV transmission ecology, the interplay among the many biotic and abiotic elements that drive WNV amplification is a complex, stochastic process that makes long-term prediction of where and when outbreaks will occur quite difficult (Kilpatrick et al., 2005). The best WNV indicators currently available provide 2–4 weeks lead time in advance of human cases (Carney et al., 2011; Jones et al., 2011; Kwan et al., 2012). Where adequate surveillance is maintained, this is sufficient lead time to implement adult mosquito control efforts that have demonstrated success in reducing human risk, resulting in fewer WNV cases (Carney, 2008).

CDC has collaborated with the Association of State and Territorial Health Officials (ASTHO) to provide guidance to communities wishing to establish or expand integrated mosquito control programs (ASTHO, 2005) and is currently working with state health departments and local mosquito control agencies to evaluate monitoring systems to improve the ability to detect and prevent WNV outbreaks. State and local environmental health programs can reduce the risk of WNV in their communities by including integrated mosquito management as part of their core public health services.

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Did You Know?

You can access an updated West Nile virus (WNV) fact sheet, access the 2012 WNV data and maps online, as well as view archived information on WNV from 1999 to 2011 at cdc.gov/ncidod/dvbid/westnile/index.htm.

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Association of Environmental Health Academic Programs

ANNOUNCES

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For additional information and research submission guidelines, please visit www.aehap.org.

AEHAP gratefully acknowledges the support of the National Center for Environmental Health, U.S. Centers for Disease Control and Prevention, for this competition.

Did You Know?

Earth Day is April 22. This year's theme is "The Face of Climate Change" and will tell the world stories of people, animals, and places affected by climate change—and of those stepping up to do something about it. For more information, please go to earthday.org.

DEMYSTIFYING THE FUTURE

Thomas Frey

Four Unexpected Macro Trends for 2013 and Beyond: The First Two

Editor's Note: Significant and fast-paced change is occurring across society in general and our profession in particular. With so much confusion in the air, NEHA is looking for a way to help our profession better understand what the future is likely to look like. The clearer our sense for the future is, the more able we are to both understand and take advantage of trends working their way through virtually every aspect of our lives today. To help us see what these trends are and where they appear to be taking us, NEHA has made arrangements to publish the critical thinking of the highly regarded futurist, Thomas Frey.

The opinions expressed in this column are solely that of the author and do not in any way reflect the policies and positions of NEHA and the *Journal of Environmental Health*.

Thomas Frey is Google's top-rated futurist speaker and the executive director of the DaVinci Institute®. At the Institute, he has developed original research studies enabling him to speak on unusual topics, translating trends into unique opportunities. Frey continually pushes the envelope of understanding, creating fascinating images of the world to come. His talks on futurist topics have captivated people ranging from high-level government officials to executives in Fortune 500 companies. He has also authored the book *Communicating with the Future*. Frey is a powerful visionary who is revolutionizing our thinking about the future.

There is great value in the unknown. My good friend Jeff Samson put it this way, "If I am ignorant of something and it is suddenly presented to me, I may find it innovative. The other option is that I will be annoyed by it, but eventually when enough others have accepted it, I will buy in and consider it innovative. So ignorance is as important to innovation as knowledge!"

Ignorance is also a valuable part of the future. Once a future is known, we quickly lose interest. For this reason, our greatest motivations in life come from NOT knowing the future.

So why, as a futurist, do I spend so much time thinking about the future?

Very simply, since no one has a totally clear vision of what lies ahead, we are all left with degrees of accuracy. Anyone with a higher degree of accuracy, even by only a few percentage points, can offer a significant competitive advantage.

Using this as a backdrop, here are two of four unexpected macro trends that I see dramatically influencing our future.

1.) The Shift to Natural Gas Vehicles

Every year we hear the predictions about changes in the energy landscape, but we are finally seeing hard evidence that the shift has already begun, but in far different ways than most have predicted.

Here are a few recent headlines:

- *"Coal to challenge oil as top energy source"*—Global coal demand will rise 2.6% annually in the next six years and challenge oil as the top energy source, according to the International Energy Agency.
- *"U.S. to overtake Saudi as top oil producer"*—Projections show the U.S. will overtake Saudi Arabia and Russia as the world's top oil producer by 2017.
- *"Japan commits to eliminating nuclear power"*—The Japanese government is making plans to eliminate nuclear power by the 2030s.
- *"All roads lead to natural gas–fueled cars and trucks"*—Royal Dutch Shell plans to invest heavily in liquefied natural gas.

The last headline talks about a topic I've been following closely for the past year.

With the recent boom in natural gas production, Shell is taking the lead on creating an infrastructure to offer a natural gas option at its fueling stations.

It's important to understand the two different kinds of natural gas—liquid natural gas (LNG) and compressed natural gas (CNG).

LNG is being rolled out at truck stops for long-haul, heavy-duty trucks with the advantage of longer driving ranges while not impacting tractor weight and other incremental costs.

CNG is primarily used in cars, buses, and smaller trucks.

Here are some of the key trends driving this change:

- Shell projects global demand for LNG to double to 400 million tons by 2020 and to potentially as much as 500 million tons by 2025.
- Clean Energy Fuels recently bought two plants for producing liquefied natural gas for long-haul trucks from GE. These plants have the capability of producing 500,000 gallons a day. The company currently has 70 stations up and running with plans for another 64 in the works for next year.
- In 2013, four major manufacturers will introduce a 12-liter LNG engine, which is the optimum size for heavy-duty 18-wheeler trucks.
- LNG costs the equivalent of $1.50/gallon.
- About 112,000 natural gas–powered vehicles are already in use in the U.S., mostly delivery trucks and other "local" vehicles.
- FedEx and UPS are continually switching more vehicles in their fleet over to CNG.
- Waste Management announced it is converting 80% of its trash trucks to CNG.
- Only 540 CNG fuel stations are currently open to the public in the U.S. but that will soon change.
- Eaton Corp. and General Electric are currently in development on a $500 home refueling station for CNG.

A Note About the Phill CNG Refueling Station

In 2004, Toronto-based Fuelmaker worked with Honda to develop a CNG refueling station for the home. The product they developed was called "Phill," a small compressor appliance mounted on a garage wall that would enable someone to refuel overnight. It was priced around $4,500.

Honda pulled the plug on this venture in 2009, however, and the company was sold to Fuel Systems Solutions. New efforts in this space by Eaton and GE will force a dramatically lower price point.

Hurricane Sandy showed us how unreliable our current systems can become in the event of a natural disaster. We now know that we have too many choke points and natural gas cars and generators that can be refueled at home will dramatically change that equation.

The transition, however, will be slow because we're dealing with the physical world. Building momentum will take time, but this train is already rolling.

2.) The Great Insourcing Movement—The Pendulum Swings Back Again

In the 1970s and 1980s strikes by union members were a commonplace occurrence. Fights between management and workers were very contentious, causing business owners to plot out ways to circumvent union influence.

As companies grew more multinational in scope, it became an easy decision to move factories overseas. Dramatically lower salaries, increasingly competent workforces, and the elimination of in-house labor issues made it relatively painless to send jobs to other countries.

But those days are quickly coming to an end. A recent article by Charles Fishman in *The Atlantic* titled "The Insourcing Boom" (www.theatlantic.com/magazine/archive/2012/12/the-insourcing-boom/309166/2/?single_page=true) identifies some of the key changes that are driving many companies to rethink their outsourcing strategies.

Here are some of the reasons why "insourcing" will become the next macro trend in business:

- Between 2000 and 2010, over six million factory jobs were lost in the U.S. Between 2010 and 2012, 500,000 new jobs were created.
- Oil prices are three times what they were in 2000, making cargo-ship fuel and transportation costs far more expensive.
- A weaker U.S. dollar against a stronger Chinese yuan makes China less competitive.
- The natural-gas boom in the U.S. has dramatically lowered the cost for running a factory (Natural gas now costs four times as much in Asia as it does in the U.S.).
- Wages in China are five times higher than what they were in 2000, and are expected to keep rising 18% per year.
- American unions are changing their priorities. GE's Appliance Park's union was so divisive in the '70s and '80s that the place was known as "Strike City." That same union agreed to a two-tier wage scale in 2005—and today, 70% of the jobs there are on the lower tier, which starts at just over $13.50 an hour, almost $8 less than what the starting wage used to be.
- U.S. productivity continues to find gains through efficiency, and labor costs have become a smaller and smaller proportion of the total cost of finished goods. It's far more difficult to save money by chasing wages anymore.
- Shipping products from overseas requires one to two months' worth of inventory in the pipeline before it reaches a customer. With rapidly fluctuating consumer demands, pipeline inventory can be very expensive and hard to manage.
- Product development cycles have grown increasingly impatient. The additional time involved in working with foreign manufacturers makes companies less competitive.
- The rise of the American craftsman: engineers who work directly with manufacturing personnel are able to build a far better product. In one example, Fishman describes how a design team was able cut the work hours necessary to assemble a water heater from 10 hours in China to two hours in Louisville, Kentucky.

Look for "insourcing" to be a long-term trend. It certainly won't work in all industries, and it may not even work in most. But the playing field has shifted, and those who aren't paying close attention may soon end up as little more than a footnote in the annals of business history.

Next month's column—Four Unexpected Macro Trends for 2013 and Beyond: The Last Two

Interested in sharing your thoughts? Go to www.FuturistSpeaker.com.

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LEGAL BRIEFS

Drew Falkenstein

Raw Milk: An Issue of Safety or Freedom?

Editor's Note: The *Journal* recognizes the importance of providing readers with practical and relevant legal information and is pleased to publish the popular Legal Briefs column. In every other issue of the *Journal* this information will be presented by the attorneys at Seattle-based Marler Clark, LLP, PS (www.marlerclark.com). Marler Clark has developed a nationally known practice in the field of food safety. They represent people who have been seriously injured or the families of those who have died after becoming ill with foodborne illness during outbreaks traced to restaurants, grocery chains, and other food suppliers.

Drew Falkenstein joined Marler Clark in 2004 and has concentrated his practice in representing victims of foodborne illness. He has worked on landmark cases that have helped shape food safety policy, HACCP protocol, and consumer rights, such as the *E. coli* outbreak in fresh spinach in 2006, the 2008 Peanut Corporation of America outbreak of *Salmonella*, and the nationwide outbreak of *Salmonella* in Iowa eggs in 2010.

Is there any one food that is as frustrating as raw milk? Is there any other food that is a subject of so much passion, politics, and attempted persuasion? Have you ever wondered whether sale of the product could simply be outlawed entirely—or, for that matter, legalized everywhere?

The raging debate over raw milk is largely the product of a grassroots campaign aimed at food decentralization, which has gained a much larger voice in the wake of a long list of food poisoning outbreaks linked to mass-produced food products, including ground beef, baby spinach, cookie dough, and countless others. The brief discussion that follows is intended as a short critique on the authority of state and federal legislatures to do as they choose with this lighting-rod food item.

The federal government's stand on raw milk is unequivocal. The Food and Drug Administration bans the interstate trade of raw milk entirely, and most states heavily regulate the production and intrastate sale of raw milk, if they permit it at all. But many raw milk proponents feel individually, and very personally, wronged by what they see as governmental meddling in private affairs—some going so far as to call the ability to purchase and consume raw milk a fundamental constitutional right:

> According to the founding documents of the United States, personal liberties are self-evident and inalienable rights, not privileges endowed by state health departments, federal bureaucracies, or personal injury lawyers. There is no scientific evidence to justify the singling out of raw milk from among other foods for prohibition or damaging regulation, and there is no legitimate constitutional or philosophical basis on which Americans or anyone else should be deprived of the basic human right to determine what to eat and drink.[1]

Regardless of whether one believes he should be allowed to eat whatever he wants, no tool exists to prevent the several states and the federal government from regulating the production and distribution of raw milk. States have the authority in the exercise of their general police powers to enact measures to protect the health, safety, and welfare of their citizens.[2] This power is bounded only by principles of federalism, generally, and by the protections afforded all persons within a state's borders by the equal protection and due process clauses of the 14th Amendment.

The federal government, in contrast, is one of enumerated powers, meaning that it can act only where it has the constitutional authority to do so. As James Madison wrote,

> The powers delegated by the proposed Constitution to the federal government are few and defined. Those which are to remain in the State governments are numerous and indefinite.[3]

Among the powers specifically delegated to the federal government is the power "[t]o regulate Commerce with foreign Nations, and among the several States, and with the Indian Tribes."[4] The "commerce clause" has, of course, become a particularly potent regulatory enabler that, as a result, has spawned a notoriously complex body of case law.[5] For present pur-

poses, however, it suffices to say that the commerce clause has provided the constitutional authority for a great many landmark legislative and regulatory measures.

The commerce clause unquestionably gives Congress the authority to prohibit the interstate distribution of raw milk, by sale or otherwise, even without resort to the Supreme Court's historically disjointed commerce clause analysis. The reason is that the interstate distribution of raw milk is, in and of itself, "commerce . . . among the several States." As a result, it can be regulated "to its utmost extent."[6] Congress has done exactly this in enacting 21 CFR 1240.61(a), which prohibits the delivery "in interstate commerce [of] any milk or milk product in final package form for direct human consumption unless the product has been pasteurized."

But the more intriguing question is how far Congress's regulatory power actually extends with respect to the manufacture and distribution of raw milk. Is it broad enough to outlaw the sale of raw milk entirely? Stated another way, does the fact that raw milk is produced, and frequently even sold only locally (i.e., not interstate commerce per se) insulate it from Congress's potentially, if not theoretically, apocalyptic reach?

Out of the difficult analytical framework has emerged a line of precedents approving Congress's regulatory efforts, even with respect to intrastate commerce, that has a "substantial economic effect on *interstate commerce* [emphasis added]."[7] "[E]ven if appellee's activity be local and though it may not be regarded as commerce, it may still, whatever its nature, be reached by Congress if it exerts a substantial economic effect on interstate commerce."[8]

Thus, under the Court's current commerce clause analysis at least, the question is ultimately whether local production and distribution of raw milk "substantially affects" interstate commerce. Notably, there have been many seemingly local endeavors that did not harmoniously persist as "merely local" upon Supreme Court scrutiny.[9]

Without predicting the precise boundaries of Congress's power to regulate the production and distribution of raw milk, it suffices to say that it has not come close to exhausting its potential reach by merely enacting 21 CFR 1240.61(a). Again, the shipment of raw milk across state lines is interstate commerce in and of itself, and the power of Congress over that particular species of raw milk distribution is bounded only by an as-yet undefined, and at best highly nebulous, personal freedom to consume raw milk. The better question is how far Congress's reach actually extends into the modes and channels of production and distribution; and the answer is that the power is potentially very broad.

Disclaimer: Legal Briefs is published for information purposes only; none of the information is intended to be, nor is, formal legal advice. NEHA and the *Journal of Environmental Health* are not liable or responsible for actions taken on the basis of the information contained in these columns.

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1 See http://realmilk.com/documents/ResponsetoMarlerListofStudies.pdf.
2 Brecht v. Abrahamson, 507 U.S. 619, 635, 123 L. Ed. 2d 353, 113 S. Ct. 1710 (1993); *see also* Sligh v. Kirkwood, 237 U.S. 52, 59-60, 35 S.Ct. 501 (1915) ("The power of the State to . . . prevent the production within its borders of impure foods, unfit for use, and such articles as would spread disease and pestilence, is well established").
3 The Federalist No. 45, pp. 292-293 (C. Rossiter ed. 1961).
4 U.S. CONST. art. I, § 8, cl. 3.
5 *See* generally United States v. Lopez, 514 U.S. 549 (1994) (Kennedy, J., concurring).
6 Gibbons v. Ogden, 9 Wheat. 1, 196 (1824).
7 *See* Wickard v. Filburn, 317 U.S. 111, 125 (1942).
8 Id.
9 *See* e.g., Wickard, 317 U.S. 111 (1942) (the production and consumption of home-grown wheat); Katzenbach v. McClung, 379 U.S. 294 (1964) (restaurants utilizing substantial interstate supplies); and Heart of Atlanta Motel, Inc. v. United States, 379 U.S. 241 (1964) (inns and hotels catering to interstate guests).

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April 3–4, 2013: 2013 Annual Education Conference, sponsored by the Alabama Environmental Health Association in conjunction with the AlPHA Annual Meeting. For more information, visit www.aeha-online.com/5522.html.

California
April 1–4, 2013: 62nd Annual Educational Symposium, sponsored by the California Environmental Health Association, Sheraton Hotel at Universal Studios, Universal City, CA. For more information, visit www.ceha.org.

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June 6–7, 2013: 2013 Annual Education Conference, sponsored by the Georgia Environmental Health Association. For more information, visit www.geha-online.org.

Indiana
April 18, 2013: IEHA Spring Educational Conference, sponsored by the Indiana Environmental Health Association, Fort Harrison State Park, Indianapolis, IN. For more information, visit www.iehaind.org.

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TOPICAL LISTINGS

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neha.org

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Safe and Healthy School Environments

Edited by Howard Frumkin, Robert J. Geller, I. Leslie Rubin, and Janice Nodvin (2006)

Millions of children and adults across the nation spend their days in school buildings, and they need safe, healthy environments to thrive, learn, and succeed. This book explores the school environment using the methods and perspectives of environmental health science. Though environmental health has long been understood to be an important factor in workplaces, homes, and communities, this is the first book to address the same basic concerns in schools. Each section of this book addresses a different environmental health concern facing schools today. The entire book is evidence-based, readable, generously illustrated, and practical—an indispensable resource for parents, school staff, administrators, government officials, and health professionals.

480 pages / Hardback / Catalog #631
Member: $49 / Nonmember: $54

A Worm in the Teacher's Apple: Protecting America's School Children from Pests and Pesticides

Marc L. Lame (2005)

A substantial movement is growing to create safer learning environments in our nation's schools—not just in terms of violent acts, but in terms of environmental quality. Many school districts across the nation, however, are not implementing cost-effective pest management programs so as to minimize the problem of pests and pesticides. This book provides solutions to creating a safer learning environment in terms of pest control in a way that not only provides scientific information, but also deals with people management and communication problems.

238 pages / Paperback / Catalog #1100
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Daniel Strickman, Stephan P. Frances, and Mustapha Debboun (2009)

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323 pages / Paperback / Catalog #756
Member: $20 / Nonmember: $24

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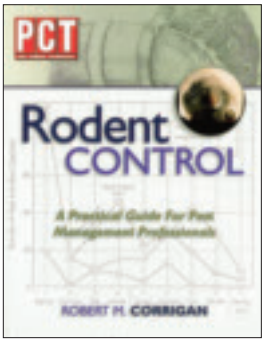
Robert M. Corrigan (2001)



This book emphasizes a hands-on, practical approach to rodent pest management in structural environments. It is written for pest management professionals and other personnel involved in rodent control work. The integrated pest management (IPM) approach is stressed throughout the text, beginning with a detailed chapter on conducting inspections, followed by individual chapters addressing the importance of sanitation and rodent proofing of our buildings to manipulate environments and render them less attractive and conducive for rodent infestations.

355 pages / Hardback / Catalog #1101
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3. Continues to improve oneself through involvement in continuing education type programs to keep abreast of new developments in environmental and public health.
4. Is of such excellence to merit academy recognition.

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3. A description of the nominee's employment history, including the scope of responsibilities.
4. A narrative statement of specific accomplishments and contributions on which the nomination is based, including professional association activities, publications, and community/civic activities.
5. Three endorsements (an immediate supervisor and two other members of the professional staff or other person as appropriate).

NOMINATIONS MUST BE RECEIVED BY APRIL 15, 2013. THREE COPIES OF THE NOMINATION DOCUMENT MUST BE SUBMITTED TO:

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www.sanitarians.org/davis_calvin_wagner_award_process.pdf

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NEHA **NEWS**

NEHA Supports National Healthy Schools Day

National Healthy Schools Day (NHSD) is April 30, 2013. NEHA is pleased to partner again with the Healthy Schools Network (www.healthyschools.org) in supporting and promoting this event. NHSD is a national partnership campaign for indoor air quality in schools coordinated by the Healthy Schools Network with involvement from the U.S. Environmental Protection Agency (U.S. EPA), other federal agencies, and numerous organizations.

The Healthy Schools Network is the leading national voice for children's environmental health in schools and an award-winning 501c3 nonprofit environmental health organization. Founded in 1995, the network launched the national healthy schools movement with comprehensive state policy recommendations and a model coalition and has since fostered reform coalitions in many states and localities.

NHSD promotes the use of U.S. EPA's IAQ Tools for Schools guidance (www.epa.gov/iaq/schools/index.html) as well as other U.S. EPA environmental health guidelines and programs for schools and children's health.

NEHA Government Affairs and Research and Development Managing Director Larry Marcum stated, "NEHA and the thousands of practitioners we represent in the environmental health profession recognize children's environmental health issues as being one of our core priority areas. Our work in the area of school food safety, indoor air quality in schools, asthma trigger risk reduction, and smoking cessation are all reflective of that concern. NEHA is proud to join our colleagues in many other organizations in offering its strong support of this year's National Healthy Schools Day."

For more information about NHSD, please visit www.nationalhealthyschoolsday.org.

Bid for a Good Cause

NEHA is donating a full 2013 AEC registration to be auctioned off and sold to the highest bidder (a $725 value)! Proceeds from the winning bid will go to support NEHA's Endowment Fund, which supports special projects and programs for NEHA to carry out for the sole purpose of advancing the profession and its practitioners.

To win the registration, all you have to do is participate in the online auction. Visit neha2013aec.org/OnlineAuction and complete the online bid form. You will then receive an e-mail notice that verifies your bid amount. NEHA will post updates of the highest bid on its Web site every Monday and Friday. Check back often to see if your bid is the highest. If not, consider submitting a new bid.

The deadline to submit a bid is **Monday, April 1, 2013**. Bids received after this date will be invalid. In the event of a tie, the earliest submitted bid will be the winner. If you have any questions, please e-mail Terry Osner at tosner@neha.org.

IN MEMORIAM

Ward Duel

NEHA was saddened to learn that Ward Duel passed away on January 12, 2013. Duel was a distinguished leader in environmental health. He served as NEHA's president in 1985–86. He was president of the Illinois Environmental Health Association in 1962–63 and president of the Wisconsin Environmental Health Association in 1957–58. He was named recipient of NEHA's highest honor, the Walter S. Mangold Award, in 1978. Duel's long career in environmental public health spanned across 45 states, starting as a sanitarian for the city of Kenosha, Wisconsin, and ending as assistant director of health for the city of Chicago.

"In all my years at NEHA, I know of no one who kept involved for as long as Ward did. Aging never stopped Ward from remaining part of the energy flow within this organization. I was inspired by his lifelong commitment to NEHA and to the professional practice of this profession," stated NEHA Executive Director Nelson Fabian.

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

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

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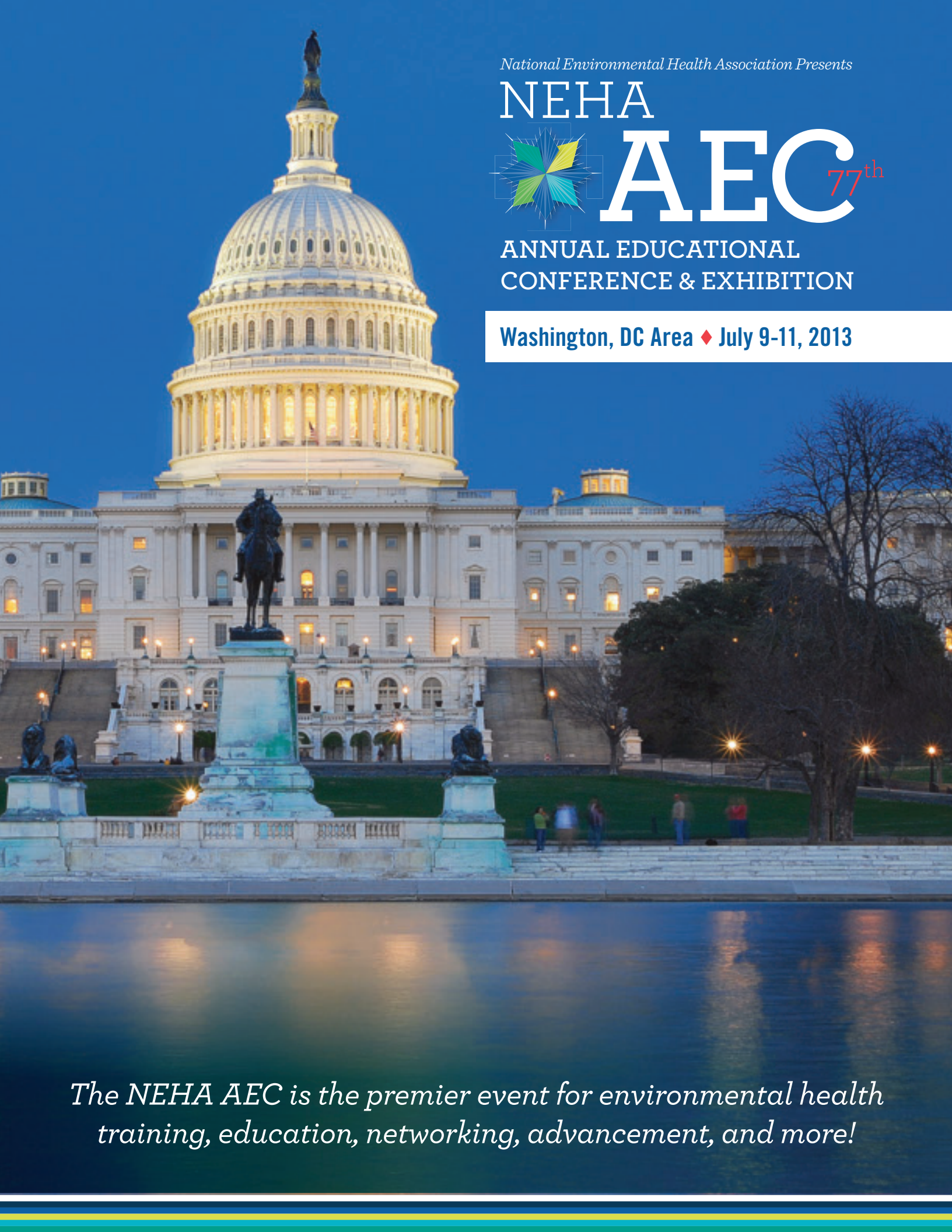

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NEHA 2013 AEC

Preliminary Schedule

The AEC schedule, sessions, and events are subject to change at anytime without prior notification.

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Pre-Conference Workshops	Pre-Conference Workshops	1st Time Attendee Workshop	Town Hall Assembly	Educational Sessions
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	Community Volunteer Event	Educational Sessions	Poster Session	President's Banquet
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	Virtual AEC Includes access to 20–30 sessions, networking, and speaker materials as provided.	$99/$215	
	Virtual AEC Group Registration (Must register via the Registration Coordinator)	$500 organization fee + $19/person	
CREDENTIAL COURSES AND EXAMS	**CP-FS Review Course** Sunday & Monday, July 7 & 8. *Limit 45 people.* Includes CP-FS review course and CP-FS Study Package. *Additional application and fee required to sit for exam.*	$299/$399	
	REHS/RS Review Course Sunday & Monday, July 7 & 8. *Limit 50 people.* Includes REHS/RS review course and the REHS/RS Study Guide. *Additional application and fee required to sit for exam.*	$429/$529	
	HACCP Manager Certification Course Monday, July 8. *Limit 45 people.* Includes NEHA's HACCP: *Managing Food Safety Hazards at the Retail Level* and national HACCP Certification Exam.	$249/$299	
PRE-CONFERENCE WORKSHOPS	**EHTER Awareness Level Course** Sunday & Monday, July 7 & 8. *Limit 50 people.*	$139/$239	
	Industry-Foodborne Illness Investigation Training-Recall Response Sunday & Monday, July 7 & 8. *Limit 30 people.*	$69	
	Can Justice Prevail? Where Outbreak Investigations and Lawsuits Collide Monday, July 8. *Space is limited.*	$99/$199	
	Conflict Analysis and Resolution in the Practice of Environmental and Occupational Health Monday, July 8. *Space is limited.*	$99/$199	
	How to Make Public Participation Work For You Monday, July 8. *Space is limited.*	$39	
	National Environmental Health Aquatic Symposium Monday, July 8. *Space is limited.*	Free with full conference or one-day conference registration.	

neha2013aec.org/register.html

CUSTOMIZE YOUR LEARNING EXPERIENCE

The NEHA AEC offers so many different facets for you to choose from to customize your own learning experience. From the multitude of environmental health topics discussed to the different learning environments of the Lecture and Learning Lab to the option to attend in-person or virtually, the NEHA AEC offers a fresh, progressive, and modern approach to training and education.

TRAINING

LEARNING LAB SESSIONS

Productivity. Efficiency. Effectiveness.

Hands-on training and real-world experience to help you cultivate new skills and bolster your proficiency.

CHILDREN'S EH/SCHOOLS

- Preventing Foodborne Illness with the *Food-Safe Schools Action Guide:* Creating a Culture of Food Safety
- The Virtual School Walk-Through: Identifying and Solving Common Indoor Air Quality Problems

ENVIRONMENTAL JUSTICE

- Advancing Environmental Justice at the U.S. Department of Health and Human Services

FOOD PROTECTION AND DEFENSE

- National Voluntary Environmental Assessment Information System: The Next Generation of Environmental Assessments
- Preventing Norovirus Outbreaks: Applying the Science to Food Safety Programs

HAZARDOUS MATERIALS AND TOXIC SUBSTANCES

- Revitalizing EPA's Integrated Risk Information System Program: Improving Assessment Products, Enhancing Transparency, and Meeting Stakeholder Needs

LAND USE DESIGN/PLANNING

- Public Health and Land Use/Redevelopment: Creating Community Health Indicators

LEADERSHIP/MANAGEMENT

- Essential Communication Strategies for Environmental Public Health Professionals Who Don't Have a Background in Communication
- Public Health Department Accreditation and Environmental Public Health: A Logical Collaboration

ONSITE WASTEWATER

- (Field Trip) Chesapeake Bay Total Maximum Daily Load

POLICY

- Capitol Hill Visits: How to Make the Case for Environmental Health

POLICY FOR AN INTEGRATED FOOD SAFETY SYSTEM

- Practical Advice and Materials to Help You Meet the FDA Voluntary National Retail Food Regulatory Program Standards

SUSTAINABILITY/CLIMATE CHANGE

- Building Capacity at Local Public Health Departments Around Climate Change and Human Health

TECHNOLOGY AND EH

- 90 Minutes for Nano: Will Emerging Technologies Redefine Roles for EH Professionals in the 21st Century?

WATER QUALITY

- Emerging Contaminants: Pharmaceuticals in the Environment

The sessions below are a special group of Learning Labs that are scheduled for several hours each day during the AEC that you can drop into. At any one time, there will be multiple sessions taking place. Like other Learning Labs, these sessions will have a presenter and will be highly interactive. However, you are in charge of when you want to attend and the pace at which you wish to learn about a particular topic.

CHILDREN'S EH/SCHOOLS

- Don't Mess With Mercury: A Social Media Tool Kit for Environmental Health Practitioners, School Administrators, and Youth

EMERGING EH ISSUES

- Electromagnetic Frequency Measurement & Mitigation in the Bedroom
- What's Hiding in Your Personal Care Products?

Be sure to also visit the Exhibition on Tuesday and Wednesday to learn about the latest products, services, and tools offered by exhibitors to help you be more productive in your job.

COMPLETE AND UP-TO-DATE INFORMATION CAN BE FOUND ONLINE AT NEHA2013AEC.ORG.

Sessions and schedule are subject to change.

Acquire comprehensive information from subject matter experts and industry leaders, and learn from your peers.

LECTURE SESSIONS

Knowledge. Understanding. Expertise.

AIR QUALITY

- Designing a Successful Collaboration Between State and Local Partners to Assess and Cleanup Former Dry Cleaners
- The Dairy Air and the EH Response to Industrial Food Animal Production

CHILDREN'S EH/SCHOOLS

- Children and Environmental Chemicals: Are They More Vulnerable?
- Smog in the Classroom: Power Plant Emissions, Pediatric Asthma, and School Attendance—A New Strategy

EH HEALTH IMPACT ASSESSMENTS (HIA)

- A Critical Review of Health Impact Assessment Guidance Documents
- Health Impact Assessments and Exposure Monitoring From a Community Protection Standpoint During Bridge Demolition

EMERGING EH ISSUES

- Final Barrier: A New Global Approach to Water Treatment
- Hookahs: An Emerging Public Health Issue

ENVIRONMENTAL JUSTICE

- Human Rights and the Environmental Health Practice: The Lessons Learned From the Fukushima Nuclear Disaster

FOOD PROTECTION AND DEFENSE

- Building Partnerships with the Medical Community in Foodborne Illness Surveillance
- CIFOR Industry Foodborne Outbreak Investigation Guidelines and the CIFOR Law Project
- Collaboration Underlies the Success of the Outbreak Investigation Team in Contra Costa County, California
- Epidemiology, Sampling, and Traceback Working Synergistically
- Food Safety Knowledge and Attitudes: Hands-on Food Safety Training for Folklorama, a Temporary Food Service Event
- How the Corporate Board Room Uses YOUR Inspection Data: Ecolab ActiveView HDI—Trusted Health Department Intelligence
- Lessons From a Collaborative Effort: The 2012 Democratic National Convention
- Making It Stick: How to Prepare a Bulletproof Outbreak Report
- The FDA *Food Code* at 20 Years

HAZARDOUS MATERIALS AND TOXIC SUBSTANCES

- Superfund Sites, Community Education, and Population Migration: An Econometric Analysis

HEALTHY HOMES AND COMMUNITIES

- A Systems-Based Approach: Integrating Environmental Health in Healthy Homes Policies and Programs
- Healthy Housing: Status, Trends, and Opportunities
- How to Run an Effective Healthy Homes Program with Positive Environmental Health and Public Policy Outcomes
- Indoor Environmental Quality Complaints to State Health Departments: The Unrecognized Challenge
- The Healthy Home Rating System: A Proven Health and Safety Assessment Model to Achieve Prevention and Wellness Under the Affordable Care Act

INTERNATIONAL EH

- Environmental Health and the Prevalence of Parasites in Children: A Case-Control Study in Lima, Perú, South America
- Evaluation of the Quality of Drinking Water Sources and Obstacles to Potable Drinking Water in West Point and Suburban Monrovia, Liberia

LAND USE DESIGN/PLANNING

- People Active and Out in Nature: Roles for Environmental Health Professionals

LEADERSHIP/MANAGEMENT

- After Occupy L.A. Came The Skid Row Assistance Project: Innovations and Creative Interventions That Changed How Local Government Responded to an Environmental Health Crisis
- Integrating Health in All Policies Into Environmental Health Agency Work: Examples of Successful Cross-Sectoral Collaborations

ONSITE WASTEWATER

- An Approach for Protecting Unconfined Drinking Water Aquifers Against Effluent Contamination
- Potential for Campus Water Reuse in the United States
- Standardized Testing Methods for Aerated Wastewater Systems
- To Nitrogen and Beyond

PATHOGENS AND OUTBREAKS

- *Mycobacterium* Tattoo-Associated Outbreaks
- The Environmental Epidemiology of a Large Outbreak of *Clostridium perfringens* in a Correctional Facility
- Workers on the Front Line: Pathogen Exposures and Injuries in Swine Slaughter and Processing

POLICY

- Does Regulation Support Economic Growth or Is It Just Red Tape?
- Enforcement Case Studies Using California's Unified Approach of Administrative Enforcement
- The 2013 State Legislative Landscape: Political and Fiscal Implications for Environmental Health Policy Making

POLICY FOR AN INTEGRATED FOOD SAFETY SYSTEM

- Assessing Food Safety Trends Within Food Service and Retail Food Facilities
- (Food Safety Focus Series) The Food Safety Modernization Act: State of the Implementation of an Integrated Food Safety System
  Session sponsored by Prometric and Skillsoft
- Making FSMA Real: Integrating Local, State, and Federal Food Emergency Response Capabilities

RECREATIONAL WATERS

- Beneath The Surface: The Hazards of Pool Chemicals
- How to Reduce Violations at Aquatic Venues by 50%
- I Get Funny Colors When I Test: Recognizing and Overcoming Interferences in Water Testing
- Rapid Indicator Methods: Same Day Results of Ocean Water Quality Testing

SUSTAINABILITY/CLIMATE CHANGE

- Climate Change and Sustainability: Where Environmental Health Practitioners Can Lead in Developing Solutions for Protecting the Public's Health
- Confronting Climate Change Heat-Health Risks in the Pacific Northwest
- Establishing Comprehensive American National Product Sustainability Standards for the Water Treatment and Distribution Industries

TECHNOLOGY AND EH

- Advancing the Business of EH: A Look Inside Los Angeles County Environmental Health's Project to Reengineer Its Business Services
- Developing Maps of Occupational Risk Factors for Heat-Related Illness in Alabama
- Environmental Health: There's an App for That!
- EPA's Toxics Release Inventory: A Public Database of Toxic Chemical Releases

TERRORISM/ALL-HAZARDS PREPAREDNESS

- Community-Based Water Resiliency and All-Hazards Preparedness
- Development of a Radiological and Chemical Emergency Preparedness Course: Agents of Opportunity
- Disaster Debris Management: Lessons Learned From the March 2011 Great East Japan Earthquake and Tsunami
- Emergency and Risk Communication: Ten Things You Should NEVER Say on Television
- Environmental Health Strike Teams: An All-Hazards Approach to Environmental Health Emergency Preparedness
- Plans and Planning: Why Both Matter
- Urban Wildfire: Devastation, EH Response, and Community Recovery
- USPHS Community Health and Service Missions: The Lakota Sioux Experience

VECTOR CONTROL AND ZOONOTIC DISEASES

- A Regional Strategy to Address Bed Bugs: A Diverse Partnership Model for Addressing Emerging Public Health Issues
- Do You Want Flies with That?
- Integrated Pest Management: Creating Plans and Relationships That Work
- One-Health and All-Hazards: The New Environmental Health
- Pet Business Regulation and Education in Seattle & King County, Washington

WATER QUALITY

- A Rise in Chlorides: A Case For Reducing Road Salt Application
- Bioretention Media Modification for Heavy Metal Removal in Stormwater: A Field Study in North Carolina
- Ground Water Ammonia: A Minnesota Case Study

Be a voice.

NEHA gives you the opportunity to tell us what you'd like to experience each year at the AEC. We ask you to tell us topics you'd like to hear about and speakers you'd like to see. We also give you the opportunity to review abstracts and provide input to help NEHA develop a training and education experience that continues to advance the proficiency of the environmental health profession AND helps create bottom-line improvements for your organization!

Through our blog and market research surveys, you have told us some of the topics and sessions that you want at the NEHA 2013 AEC. NEHA listened and put some of the more popular sessions—as rated by you, the attendee—into this year's training and education program.

Making FSMA Real: Integrating Local, State, and Federal Food Emergency Response Capabilities

Climate Change and Sustainability: Where Environmental Health Practitioners Can Lead in Developing Solutions for Protecting the Public's Health

The Dairy Air and the EH Response to Industrial Food Animal Production

Assessing Food Safety Trends within Food Service and Retail Food Facilities

Emerging Contaminants: Pharmaceuticals in the Environment

Electromagnetic Frequency Measurement & Mitigation in the Bedroom

Smog in the Classroom: Power Plant Emissions, Pediatric Asthma, and School Attendance—A New Strategy

Mycobacterium *Tattoo-Associated Outbreaks*

Potential for Campus Water Reuse in the United States

Food Safety Knowledge and Attitudes: Hands-on Food Safety Training for Folklorama, a Temporary Food Service Event

Voice. Collaboration. Influence.

Policy Involvement

At this year's NEHA AEC, there will be a focused exploration into the facet of Policy Involvement. Approximately 20% of this year's AEC training and educational sessions (highlighted below and on the following pages) will discuss the impacts of policy making and how it may affect environmental health around the country and in your community.

When you attend this year's policy-focused sessions you will:

- Be exposed to the rationale behind public policy decisions that impact the field of environmental health
- Discover fresh ways to build capacity, find authority, and leverage unconventional partnerships to advance environmental health and protect human health
- Hone your skills in communication, conflict resolution, and collaboration, and learn communication techniques to influence policy within your agency from the local to the national level
- Take home best practices and lessons learned from others to streamline and optimize the implementation of policy decisions within your workplace
- See how the Food Safety Modernization Act is being implemented on the ground floor and the implications it has for policy at the state and local level
- Be empowered to create policy that leverages resources efficiently and embraces the "newer frontiers" of environmental health

NEHA supports a robust program of policy involvement on behalf of both the cause of environmental health and of every person—like you—who practices in it.

AIR QUALITY

The Dairy Air and the EH Response to Industrial Food Animal Production

Evidence continues to accumulate regarding environmental public health concerns associated with air and water pollution from industrial food animal production (IAFP). The first part of this session will provide a short recap of findings from a study on engagement and limitations of government agencies with environmental public health issues surrounding IAFP in eight states. Then the session will more deeply explore an exposure investigation of environmental monitoring for formaldehyde at Vermont Farm manure sites conducted by the Agency for Toxic Substances and Disease Registry, in cooperation with the Vermont Department of Health and the Vermont Agency for Agriculture, Food, and Markets. This investigation came at the request of residents who believed their illnesses were being caused by exposure to a formaldehyde-manure mixture being spread as fertilizer. Possible health effects, lessons learned, and strategies for multi-agency collaboration with positive results will be highlighted in this session.

EH HEALTH IMPACT ASSESSMENTS (HIA)

A Critical Review of Health Impact Assessment Guidance Documents

Over the last 20 years, HIA has been developing as an analytical tool, typically as part of an environmental impact assessment process during the planning phase to evaluate proposed projects and policies. During this presentation, the presenters will provide a critical review of North American and select international HIA guidance documents. The documents will be compared as to methodology, range of options presented, applicability, and other key criteria. Suggestions will be offered to attendees as to which documents would be best referenced depending on the specific purpose of the HIA to be performed.

EMERGING EH ISSUES

Hookahs: An Emerging Public Health Issue
Waterpipes, also known as hookah, shisha, narghile, goza, or hubble bubble, have been used for centuries to smoke tobacco, particularly in North Africa, the eastern Mediterranean, and areas of southeast Asia. Recently, waterpipe smoking has emerged as a popular new trend among young adults worldwide. Learn the hazards associated with hookahs and explore some of the public health challenges faced by tobacco enforcement officers and public health units. A discussion of needed adaptations in legislation, policies, and practices will also be held during this session.

ENVIRONMENTAL JUSTICE

Advancing Environmental Justice at the U.S. Department of Health and Human Services
During this session, attendees will learn how the U.S. Department of Health and Human Services (HHS) is addressing the environmental justice concerns of low-income, minority, and tribal populations. The presenters will describe how this is being accomplished via new policies, training and education, new research and data, and more effective services. Attendees will also learn how stakeholder engagement is critical to defining the appropriate environmental justice actions to meet the needs of disadvantaged communities.

HEALTHY HOMES AND COMMUNITIES

Indoor Environmental Quality Complaints to State Health Departments: The Unrecognized Challenge
State health agencies often respond to requests for assistance from businesses, schools, the general public, and government agencies on a variety of issues related to poor indoor environmental quality (IEQ), often in the absence of authority and resources. During this session, the presenters will discuss the implications and need for authority, available federal and state resources, and strategies for state and local health departments to partner with other entities to respond to IEQ complaints.

The Healthy Home Rating System: A Proven Health and Safety Assessment Model to Achieve Prevention and Wellness Under the Affordable Care Act
The National Prevention Strategy, established by the Affordable Care Act, recommends that we design and promote affordable, accessible, safe, and healthy housing. The Strategy noted that, "how homes are designed, constructed, and maintained, their physical characteristics, and the presence or absence of safety devices have many effects on injury, illness, and mental health," and that, "housing free of hazards, such as secondhand smoke, pests, carbon monoxide, allergens, lead, and toxic chemicals, helps prevent disease and other health problems." But how do we ensure that our homes are protecting and promoting health, and thereby reducing the costs of providing healthcare? This session will demonstrate that using the Healthy Home Rating System can reduce the incidence of housing-related health and safety injuries and subsequent health costs.

LAND USE DESIGN/PLANNING

Public Health and Land Use/Redevelopment: Creating Community Health Indicators
Because of real or perceived contamination, brownfields/land reuse sites can adversely impact community well-being. There is a need to measure community health in these areas and evaluate the benefits gained by redevelopment. In this session, attendees will practice using the grassroots ATSDR Brownfields/Land Revitalization Action Model, which employs a diverse development community comprised of residents, city planners, government, non-profits, public health, and environmental health stakeholders to help develop revitalization approaches to address community issues, identify corresponding health benefits, and create additional indicators to measure community health status over time.

LEADERSHIP/MANAGEMENT

Integrating Health in All Policies into Environmental Health Agency Work: Examples of Successful Cross-Sectoral Collaborations
Health in All Policies (HiAP) has recently emerged as a new way to describe a collaborative approach that integrates and articulates health considerations into policy making across sectors, and at all levels, to improve the health of all communities and people. This session will discuss some of the HiAP work occurring in state environmental health departments in the key topic areas of food, water, energy, housing, and transportation. The best practices presented will include examples of partnership building through program development, assessment and data sharing, program development, and policy approaches.

POLICY

Capitol Hill Visits: How to Make the Case for Environmental Health
Meeting with your members of Congress is one of the most important and high-impact ways of effecting policy change. For rookies or old pros, this session will prep you on EH issues, help sharpen your pitch, and get you ready for tough questions. During this session, you will practice how to prepare and be impactful when visiting Capitol Hill and meeting with lawmakers and staffers. (Note, a field trip to do a Hill visit is also pending and will be announced once confirmed. Registration will be required for the Hill visit field trip.)

Does Regulation Support Economic Growth or Is It Just Red Tape?
During this session, take an irreverant look at the relationship between central government policy making on regulation and the sensible delivery of regulation to protect the consumer and support compliant businesses. The experiences of someone who has spent time working with government and delivering services will illustrate how this agenda has developed over the last ten years and the survival strategies to keep environmental health on the map.

Enforcement Case Studies Using California's Unified Approach of Administrative Enforcement
California created a unique and successful approach to implementing six hazardous materials programs, which include the Hazardous Waste Generation program and the Community Right-to-Know EPCRA/Hazardous Materials Business Plan Program. In this session, you will learn how a unified, streamlined approach to enforcement is used to protect public health and safety, to restore and enhance environmental quality, and to sustain economic vitality by promoting coordination among other key agencies and keeping a level playing field among businesses within the regulated community. The application of the administrative enforcement process will also be discussed while reviewing actual enforcement case studies involving hazardous materials and waste violations.

The 2013 State Legislative Landscape: Political and Fiscal Implications for Environmental Health Policy Making
What changes to environmental health legislation has your state legislature

enacted in the last year? How will the 2012 election results impact prospects for state environmental health policy making in the coming year? Attend this session to explore how the current state political and budgetary landscape may affect environmental health policy making around the country and in your community.

POLICY FOR AN INTEGRATED FOOD SAFETY SYSTEM

(Food Safety Focus Series) The Food Safety Modernization Act: State of the Implementation of an Integrated Food Safety System

The Policy for an Integrated Food Safety System educational track is designed to focus on active implementation progress of the Food Safety Modernization Act (FSMA) from the national level to the local level. This kickoff session will begin with **FDA Deputy Commissioner for Foods Michael Taylor, JD,** giving an update on where the FDA is on objectives of FSMA. Then, **FDA Senior Director for Intergovernmental Affairs Dr. Jeff Farrar** will co-present with **Mr. Oscar Garrison, division director at the Georgia Department of Agriculture and AFDO past president**, on further details of implementation of FSMA objectives. To conclude this first session in the Policy for an Integrated Food Safety System educational track, a member of the NEHA's board of directors will facilitate a conversation/questions and answers. After attending this session, you will have a high-level understanding of the scope and progress of the FSMA implementation.

Be sure to attend the rest of the Policy for an Integrated Food Safety System educational track to see how environmental health officials and agencies nationwide are "Making FSMA Real" through pilot projects at the state level and partnerships with local health agencies. Follow the track through to see: 1) how risk is being assessed for risk-based inspections, 2) what you need to meet the FDA Voluntary National Retail Food Regulatory Program Standards, and 3) training and credentials being vetted and developed to support professionals working to implement an integrated food safety system.

Assessing Food Safety Trends Within Food Service and Retail Food Facilities

In 2013, FDA initiated its second 10-year study on the occurrence of foodborne illness risk factors within food service and retail food facilities. This session will provide industry and regulatory food safety professionals with information on specific food safety practices and procedures that are in most need of attention within the retail food segment of the industry. Attendees will be able to assess the underlying issues that impact employee behaviors and food safety practices, and to identify potential intervention strategies that are also being assessed as part of the study.

Making FSMA Real: Integrating Local, State, and Federal Food Emergency Response Capabilities

Our increasingly globalized food supply means that contamination problems originating in remote regions of the world can rapidly impact communities in the U.S. During this session, the presenter will summarize the lessons learned during the first year of a pilot project in Michigan that was funded by an FDA grant under the FSMA to further develop and better integrate local, state, and federal food emergency response capabilities.

Practical Advice and Materials to Help You Meet the FDA Voluntary National Retail Food Regulatory Program Standards

Attend this hands-on session to learn about how local health departments can work together to help each other achieve success with the FDA Voluntary National Retail Regulatory Program Standards. Following a brief presentation, participants will have the opportunity to sit down with mentorship participants to work on the self assessment and Program Standards 2, 4, 5, and 6. Each table will be led by a mentorship participant with firsthand experience working on meeting the standards.

SUSTAINABILITY/CLIMATE CHANGE

Building Capacity at Local Public Health Departments Around Climate Change and Human Health

Does climate change seem irrelevant to your daily work? Or, does it sound like another unfunded mandate that will add unwanted work to your already stretched department? Join us at this highly interactive session to explore how climate change may already be compromising health in your community, what you can do to address this emerging public health threat without compromising already stretched resources, and where to find (sometimes unlikely) allies.

TERRORISM/ALL-HAZARDS PREPAREDNESS

Emergency and Risk Communication: Ten Things You Should NEVER Say on Television

Whether for preparedness, safety and wellness, or response, engaging the public is a necessity and a challenge requiring well-defined objectives and a clear message. Even experienced professionals can defeat their own purpose by erecting barriers between themselves and their audiences. During this session, the presenter will help you identify essential considerations for effective message delivery, avoid common pitfalls and assumptions about risk perception, and discover how policy relates to risk communication strategies.

VECTOR CONTROL AND ZOONOTIC DISEASES

Pet Business Regulation and Education in Seattle & King County, Washington

Trends in pet ownership and an ever-expanding array of services available for pets bring new challenges to zoonotic disease control and prevention. Comprehensive pet business regulations were developed by Public Health—Seattle & King County and were codified by the King County Board of Health in early 2010 to address these trends. This session will identify the key elements of the regulation related to education. Attend this session to learn how an infection control plan can promote disease prevention and education through regulation within your community.

WATER QUALITY

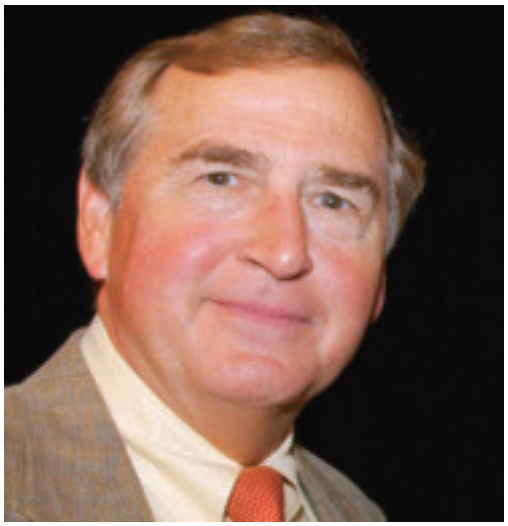
Emerging Contaminants: Pharmaceuticals in the Environment

Pharmaceuticals are emerging contaminants in water and, to date, cannot be removed as part of wastewater treatment options. So, what can be done to mitigate their effects upon the environment, yet maintain their efficacy for human and animal use? In this session, the presenters examine this topic from a lifecycle approach using hands-on demonstrations, and discuss several solutions and policies you can take home to mitigate and address these contaminants in your community.

KEYNOTE SPEAKER

NEHA is honored to announce Dr. Graham Allison as the keynote speaker at the 2013 AEC. Dr. Allison will speak on the topic, "What Do the Cuban Missile Crisis and Environmental Health Have in Common?"

This is a unique opportunity to hear from an expert with experience at the highest level of government discuss policy and share lessons learned in decision making. Register today for the 2013 AEC so you don't miss this opportunity!



The keynote speaker is sponsored by NSF International.

Additional information about Dr. Allison and all of the fantastic session speakers that are conducting training and education at the NEHA AEC is available at neha2013aec.org.

Dr. Allison has served as Special Advisor to the Secretary of Defense under President Reagan and as Assistant Secretary of Defense for Policy and Plans under President Clinton, where he coordinated Department of Defense strategy and policy towards Russia, Ukraine, and other states of the former Soviet Union. During his keynote presentation at the NEHA 2013 AEC, Dr. Allison will talk about decision making in the most extreme of circumstances where literally the fate of the planet hangs in balance. The insights that he has learned about decision making will be shared to benefit each and every environmental health professional who is involved daily in decisions regarding politics, policies, finances, technology, human resources, legal considerations, liabilities, and of course, environmental health!

Dr. Allison has the sole distinction of having twice been awarded the Department of Defense's highest civilian award, the Distinguished Public Service Medal. In addition, he is the author of *Essence of Decision: Explaining the Cuban Missile Crisis*, an all-time bestseller, and *Nuclear Terrorism: The Ultimate Preventable Catastrophe*, which was selected by *The New York Times* as one of the "100 most notable books of 2004."

PRE-CONFERENCE WORKSHOPS

Environmental Health Training in Emergency Response (EHTER) Awareness Level Course

Sunday & Monday, July 7 & 8, 8:00am–5:00pm

CDC and NEHA are pleased to offer a condensed version of the EHTER Awareness Level course for environmental health professionals. This two-day, 16-hour course provides an overview of the environmental health roles and responsibilities, issues, and challenges faced during emergency preparedness, response, recovery, and mitigation. The purpose of the course is to increase the level of emergency preparedness of environmental health practitioners and other emergency response personnel by providing them with the necessary knowledge, skills, and resources to address the environmental health impacts of emergencies and disasters.

Applicants are encouraged to complete basic NIMS/ICS trainings prior to attendance.

Cost is $139 for members and $239 for nonmembers.
Limit 50 people.

Industry-Foodborne Illness Investigation Training-Recall Response (I-FIIT-RR) Workshop

Sunday, July 7, 1:00–5:00 pm and
Monday, July 8, 8:00am–5:00 pm

I-FIIT-RR is a one and a half day face-to-face workshop that will provide a better understanding and clarification of the investigation process by identifying roles and responsibilities, discussing recall response and early detection strategies, and establishing and implementing control measures based on model practices. The workshop is designed to bring together the retail food industry with local and state regulatory officials in an effort to create stronger working relationships prior to a potential foodborne incident occurring, so that if and when it does, the foundation is already set for a collaborative effort. By providing this training, I-FIIT-RR aims to assist industry and regulatory officials in building capacity for a more rapid, efficient, and effective response to recalls and foodborne illness incidents.

The target audience for this workshop is mid-to-upper level management from retail food service stores and restaurants.

Cost is $69 for both members and nonmembers.
Limit 30 people.

How to Make Public Participation Work For You

Monday, July 8, 8:00am–5:00pm

NEHA and U.S. EPA are offering this eight-hour training course for technical staff that will examine basic elements of public participation, teach you to design a successful public participation program, and teach essentials of effective communication with the public. The workshop will be held offsite at the U.S. EPA's Potomac Yards location, which is nearby in the DC area.

Cost is $39 for both members and nonmembers.
Space is limited.

Can Justice Prevail? Where Outbreak Investigations and Lawsuits Collide

Monday, July 8, 1:00–5:00pm

This workshop introduces attendees to the battleground where outbreak investigations, regulatory enforcement activities, and civil litigation intersect. The workshop will explore a mock outbreak, simulated governmental investigation, and mock lawsuit aimed at both regulators and industry. You will learn what to expect from the key depositions in the case including the plaintiff, health department investigators, and the company CEO. The workshop will also explore common areas of improvement for regulators and the consequences that result when mistakes are made.

Cost is $99 for members and $199 for nonmembers.
Space is limited.

Conflict Analysis and Resolution in the Practice of Environmental and Occupational Health (EOH)

Monday, July 8, 1:00–5:00pm

This workshop introduces EOH professionals to the theory and practice of conflict analysis and resolution. Two hours are reserved for lecture and class discussion with an emphasis on conflict analysis models and integration of a) conflict analytical skills, b) negotiation techniques, and c) conflict resolution methods into the practice of EOH. The two remaining hours are devoted to simulation exercises in which the concepts and methods are demonstrated and practiced. One hands-on hour is reserved for exercises that demonstrate conflict dissection. The second hands-on hour is devoted to mediation and negotiation exercises. Attendees will need to bring notebooks and pens to complete the exercises.

Cost is $99 for members and $199 for nonmembers.
Space is limited.

National Environmental Health Aquatic Symposium: Launch of Version 1.0 of the Model Aquatic Health Code (MAHC)

Monday, July 8, 1:00–5:00pm

Over the past five years a group of public health, academic, and industry experts have been working with CDC to develop a set of public health standards to improve health at aquatic venues. This workshop will launch the results of this effort with the first completed version of the MAHC being released for a final round of public comment to the audience at the NEHA 2013 AEC. Experts from CDC, U.S. EPA, U.S. Consumer Product Safety Commission, National Conference of State Legislatures, and the MAHC committee will present and answer questions on this vital effort, which can help prevent outbreaks, drowning, and chemical injuries at aquatic facilities.

Cost is free with a full conference or one-day conference registration to the NEHA 2013 AEC.
Space is limited.

Leave the NEHA AEC much better prepared to realize your career goals and personal aspirations. Also be positioned to contribute even more greatly to both your organization and your profession!

Careers. Aspirations. Respect.

Advancement

CREDENTIAL/ CERTIFICATION COURSES AND EXAMS

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

Separate applications are required prior to registering for courses and exams. Additional fees also apply. For applications, deadlines to apply, and information on eligibility, visit neha2013aec.org.

Certified Professional of Food Safety (CP-FS)

Sunday, July 7, 8:00am – 5:00pm and
Monday, July 8, 8:00am – 5:00pm

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

Cost: $299 for members and $399 for nonmembers, which includes the CP-FS Study Package (*CP-FS Study Guide [2010 Edition]*, *NEHA's Professional Food Manager [Third Edition]* book, and *2005 and 2009 FDA Food Codes* on CD), a $145 value. *Limit 45 people.*

Exam: Tuesday, July 9, 8:00 – 10:00am

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

Sunday & Monday, July 7 and 8, 8:00am – 5:00pm

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

Cost: $429 for members and $529 for nonmembers, which includes the *REHS/RS Study Guide,* a $179 value. *Limit 50 people.*

Exam: Tuesday, July 9, 8:00am – 12:00noon

Hazard Analysis and Critical Control Points (HACCP) Manager Certification Course

Monday, July 8, 8:00am – 5:00pm

Managing food safety risks in a food service or food manufacturing setting has never been more important. With new mandates on preventive controls, food operations need to protect their liability and livelihood by implementing food safety management plans to reduce the risk of becoming involved in a food safety outbreak. This course will provide participants with the information necessary to implement an effective and dynamic HACCP program in any food operation. The course will teach students how to identify, assess, and reduce or eliminate potential food hazards by utilizing the principles of HACCP. Students will gain the understanding to develop and manage preventive control plans. Participants are expected to have prior food safety knowledge. Previous training with a minimum of Certified Professional Food Manager is recommended.

Cost: $249 for members and $299 for nonmembers, which includes NEHA's HACCP: Managing Food Safety Hazards at the Retail Level, and the national HACCP Manager Certification Exam, a $79 value. *Limit 45 people.*

Exam: Tuesday, July 9, 8:00 – 10:00am

CONTINUING EDUCATION (CE) CREDITS

Earn up to 24 hours of CE contact hours (enough to meet your full two-year NEHA professional credential requirement) by attending and participating in the NEHA AEC. CEs can be fulfilled by attending:

- Training and educational sessions
- The Keynote Session
- Pre-Conference Workshops
- Credential Review Courses
- Educational sessions via the Virtual AEC while they are being shown live during the AEC or as an archive after the AEC is over

For specific information about obtaining CEs at the AEC, visit neha2013aec.org.

Friends. Contacts. Connections.

Networking

At the NEHA AEC, network with not only your environmental health peers, but other experts and professionals from across related industries (such as retail food, onsite wastewater, and sustainability) and government.

Strengthen your business and personal relationships and build a network of colleagues you can call on at anytime!

How Can You Network at the NEHA AEC?

- Set up meetings with people you would like to meet before arriving at the AEC by utilizing the **Virtual AEC** networking features
- Participate in the **Community Volunteer Event** on Monday afternoon. This is the perfect opportunity to give back to the community hosting the AEC while working with and getting to know your environmental health peers.
- Meet new people and enjoy time outside on the golf course during the **Golf Tournament** Monday afternoon
- Reunite with friends at the always-exciting **UL Event** on Monday night
- Connect with exhibitors that will help you be more productive in your job during the **Exhibition Grand Opening & Party** Tuesday night, and during exhibit hall hours on Wednesday
- Collaborate with other environmental health professionals during policy discussions at the **Town Hall Assembly** on Wednesday morning
- While at the **Networking Luncheon** on Thursday, discuss with other environmental health professionals all that you've learned so far and what you're excited to implement when you return to work
- During the final event of the AEC—the **President's Banquet**—reconnect with everyone you have met throughout the AEC and make a plan for staying connected
- Stay connected to your friends and contacts after leaving the conference using the networking features of the **Virtual AEC**

neha2013aec.org

3rd Annual Community Volunteer Event

For more details and to sign up as a volunteer, visit neha2013aec.org

FOUR MILE RUN CLEANUP
Monday, July 8, from 1:00– 4:30pm

The volunteer event is designed to give back to the AEC host city community and enhance NEHA's "green" efforts by helping to offset the energy expenditures and greenhouse gas emissions of holding a large conference. It is also a great opportunity to get to know your environmental health peers.

This year's event will be a cleanup of a nearby stretch of the Four Mile Run tidal stream, which has been adopted by the neighboring U.S. EPA's Potomac Yards Green Team. This portion of Four Mile Run is contained in a hardened flood control channel and marks a rough boundary between Arlington County and the City of Alexandria. Along this stretch of Four Mile Run are neighborhoods, commercial districts, and some industrial facilities, including the Arlington County Water Pollution Control Plant. NEHA will be coordinating this community event with the U.S. EPA Potomac Yards Green Team and the City of Arlington, Virginia.

Volunteers will don work gloves and hiking gear to remove litter and trash from the banks and riparian habitat adjacent to the stream. This is an important intervention in protecting downstream areas, which include the Potomac River, Chesapeake Bay, and the Atlantic Ocean, from litter, debris, and pollution.

NETWORKING

Friends. Contacts. Connections.

Annual UL Event

Experience the sights of Washington, DC, from a different point of view at the Annual UL Event.

Monday, July 8 from 6:30 – 9:30pm

Join us for the Annual UL Event aboard a cruise ship similar to the riverboats of Europe. Experience the sights of Washington, DC, as the ship glides past the Washington Monument, Jefferson and Lincoln Memorials, and the Kennedy Center. Take in the beauty of a centuries-old center of commerce, as seen from the decks of merchant ships long ago. See the sights of Georgetown as the ship turns around and heads back to the pier, but not before you venture out onto the 464 square-foot marble dance floor to dance to the best music of every generation. Or, for a more low-key end to the evening, enjoy the monuments one more time from the quiet solitude of the 3,700 square-foot open upper deck.

The UL Event is not included in the registration pricing for the AEC. There is a separate cost to attend this event and registration is required. To register for this event, visit neha2013aec.org/register.html.

The Virtual Experience

VIRTUAL AEC

Go Mobile!
Your smartphone provides you easy access to all the same information that you can access via the Web. With the Virtual AEC mobile app your personalized schedule, session information, interactive maps, and attendee profiles, and exhibitor lists are available in the palm of your hand!

Tips for Using the Virtual AEC
For a step-by-step guide on how to use the NEHA Virtual AEC, visit neha2013aec.org/virtual_experience.html.

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

Register to attend the AEC in-person or virtually and use the Virtual AEC to:

- Create your own schedule. Browse a list of conference sessions and events, add them to your schedule with the click of a button, export the schedule to your Outlook calendar, and access via your mobile device.
- (For virtual attendees only) View 20–30 educational sessions live as they happen at the AEC, and participate in sessions almost as if you were sitting in the room by submitting your questions via chat
- Network with other environmental health professionals, speakers, and exhibitors before, during, and after the conference
- Ask questions of other attendees, contribute to discussions, and post comments for specific sessions using the discussion features
- Access video archives of educational sessions, as well as speaker presentations and other materials after the AEC concludes
- Earn Continuing Education Credits

COMPLETE AND UP-TO-DATE INFORMATION CAN BE FOUND ONLINE AT NEHA2013AEC.ORG.

Customize Your Learning Experience

The NEHA AEC offers so many different facets for you to choose from to customize your own learning experience. From the multitude of environmental health topics discussed to the different learning environments of the Lecture and Learning Lab to the option to attend in-person or virtually, the NEHA AEC offers a fresh, progressive, and modern approach to training and education.

TRAINING *Productivity. Efficiency. Effectiveness.*

EDUCATION *Knowledge. Understanding. Expertise.*

NETWORKING *Friends. Contacts. Connections.*

POLICY INVOLVEMENT *Voice. Collaboration. Influence.*

ADVANCEMENT *Careers. Aspirations. Respect.*

MOTIVATION AND INSPIRATION *Perspective. Leadership. Excellence.*

WATCH

Join us online to learn what environmental health professionals are saying about the NEHA AEC.

The NEHA AEC is so much more than a conference. It is the nexus for environmental health training, education, networking, and advancement. It is the event environmental health professionals attend to acquire practical and real-world information and expertise. It is the event from which environmental health professionals leave trained, motivated, inspired, and empowered to further advance their organizations and themselves.

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Managing Editor's Desk
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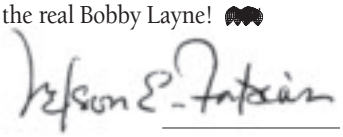
what he will say! Though the point of his presentation will be on lessons learned on how to make decisions under stress (a situation that environmental health professionals face daily, which is why we asked Dr. Allison to speak), I can only imagine what else I will learn from him. Dr. Allison also talks from an incredible experience base that includes time advising U.S. presidents on strategy and policy toward Russia and Eastern Bloc nations and being a founding dean of the Kennedy School at Harvard.

- Michael Taylor, Jeff Farrar, and Oscar Garrison
  Michael Taylor is deputy commissioner for foods at the Food and Drug Administration (FDA), Dr. Jeff Farrar is the senior director for intergovernmental affairs at FDA, and Oscar Garrison is the division director at the Georgia Department of Agriculture and past president of the Association of Food and Drug Officials. Since the implementation of the Food Safety Modernization Act (FSMA)—the most sweeping new food safety law in decades—we are watching and even influencing the emergence of a remarkable and unprecedented integrated food safety system. These speakers will share with us how this system is unfolding and what is expected of food programs as they present on the details of how FSMA is now being implemented—knowledge that anyone in a food safety program will find valuable.
- Rebecca Morley and Eric Hornbuckle
  Rebecca Morley is the executive director of the National Center for Healthy Housing and Eric Hornbuckle is the special assistant to the director at the U.S. Department of Housing and Urban Development. In these two well informed and experienced housing experts, attendees will have the opportunity to learn about how housing can protect and promote health and reduce costs under the new and ambitious Affordable Care Act. Housing is a huge issue when it comes to health and we have two prominent experts who will be with us to talk to you about what healthy housing entails.
- Janet Russell
  Janet Russell is the president of NEHA's sister environmental health association in England, the Chartered Institute of Environmental Health. In England, the environmental health workforce has been cut by an astounding 25%–35%. Janet has experience working with the government and delivering services and she will talk about survival strategies to keep environmental health alive and how services can be sensibly delivered to protect the public.
- Adele Houghton
  Adele Houghton is the president of Biositu and she comes to our conference to talk to us about how to build capacity within local health departments around climate change and human health, which is arguably one of the most pressing of all environmental issues health today. Her session has been designed to be highly interactive. She will explore with you how this issue can be addressed without compromising already stretched resources and where we can find allies (some unlikely) to work with.
- Julie Becker
  Dr. Julie Becker is an assistant professor at the University of the Sciences of Philadelphia. She will be with us for two sessions: one on what sustainability means and the other on the scary and challenging issue of pharmaceuticals in our environment. Julie will help us to understand policies and solutions that attendees can take home to mitigate and address these contaminants in their communities.
- Shawn Stevens
  Shawn Stevens is a national food safety lawyer with Gass Weber Mullins LLC. He will conduct a preconference workshop about the battleground where outbreak investigations, regulatory enforcement, and civil litigation intersect. He will also conduct a session that will teach how to do a bulletproof outbreak report that will withstand legal scrutiny and be a model for others to follow. Hearing a lawyer of his distinction will enable attendees to really understand many of the legal implications to their everyday work.

If space allowed, I could lay out similar such profiles for all of our speakers as they are all "noteworthy people." Nonetheless, I hope this highlighting of a few of our speakers stirs you enough to realize that it's you who stands to gain from this experience we call a conference.

I'd be lying to you if I suddenly got dramatic and said something like after shaking Bobby Layne's hand, I didn't wash my hand for a week! I can truthfully say, however, that I left my little encounter with Bobby Layne a changed person. In addition to claiming bragging rights among my friends that I had met the great Bobby Layne, I also remember a couple of other things about that encounter that have never left me. One was that he talked to me! Having a famous (noteworthy) person actually talk to and show an interest in me gave me a heightened sense of affirmation, which made me feel really good. I also remember having the realization that Bobby Layne was actually a real living human being. In other words, he wasn't a god. Rather he was just a man … but a man who had applied himself in extraordinary ways to reach the pinnacle of his profession. The lesson that made me a richer person was the understanding that if he could do that, so too could anyone else.

By the same token, in listening to and meeting many of the Bobby Laynes that we feature on our program, the opportunity is there for you as well to go way beyond simply learning some new trick or kernel of knowledge. The opportunity is there for you to better understand not only environmental health but also the world and your place in it. That's a very personal dividend and something you seldom see noted in the reams of promotional literature that accompany the marketing of all kinds of conference events. And yet in the end, I can think of no more compelling a reason to attend an event like this than the opportunity it affords for meaningful personal growth. Here's hoping that the Bobby Layne factor is as strong for you as it has been for me ever since I first met the real Bobby Layne!



nfabian@neha.org

MANAGING EDITOR'S DESK

Nelson Fabian, MS

The Bobby Layne Factor, the NEHA Annual Educational Conference, and You!

There I was, at nine years of age, shaking the hand and getting the autograph of Bobby Layne, a Detroit Lions football legend. Layne was the first "famous" person I had ever met. My dad had taken me to some local event at a car dealership. To attract more people, the dealership had brought several Detroit Lions football players in to meet and greet the public. It was clearly an experience I have never forgotten.

Even though I was so young at that time, I can still remember how excited I was. There is just something exhilarating that goes with meeting someone who has achieved some kind of fame.

As the years have passed, I've never lost that sense of excitement that attaches to meeting famous, or perhaps better said, "noteworthy people." I will admit that my definition of "noteworthy people" has changed considerably. For a nine-year-old boy, Bobby Layne was a god! Rest assured that I long ago left behind that kind of hero worship.

But I haven't left behind that feeling of anticipation and excitement that goes with meeting, and *especially listening to,* people who have something special or illuminating to say. Even better are those rare opportunities when I actually have the chance to ask these people questions that are meaningful to me. *Somehow, these experiences make my life richer and more informed.* And if growth is truly one of the greatest fulfillments to life, how can one not be grateful for such experiences? I certainly am.

I mention all this as a way to talk to you on a more personal level about what NEHA's upcoming Annual Educational Conference (AEC) really offers you. Yes, our conference offers what you would expect, such as a healthy measure of important networking, training, and learning opportunities, as well as the chance to become involved in a wide assortment of association undertakings that this year (since we are in Washington, DC) will focus heavily on policy development. But as worthy as these and other related benefits are (such as the experience of just being in our nation's capital, where one can access more spectacular free experiences than in any other city in America), that's not where I'm going with this column. Rather there's something much more personal that makes for the ultimate take away from a conference experience such as the one NEHA puts on. Drawing from my life story, I'm going to call it the Bobby Layne factor! The Bobby Layne factor represents nothing less than the opportunity to enrich one's life.

The Bobby Layne factor represents nothing less than the opportunity to enrich one's life.

What many people don't know is how deliberate we are in developing our AEC program. Trust me, randomly selected names aren't just put into available slots. Rather, we very carefully consider the topics we want to cover and then who the right people are for those topics. More to the point, we've been looking for (and finding) almost 200 different Bobby Laynes for you to meet, ask questions of, learn from … and to be transformed by.

Let me be as clear as I can be on this point. We take seriously our responsibility to provide a training and educational experience that will ensure that your knowledge of, and skills in, environmental health (and related relevant topics) remain solid. In addition, as we are in Washington, DC, this year, we have made the extra effort to enlighten you on environmental health policy (policy is one of the facets that makes up our entire AEC program and this year we are giving that facet extra attention).

But more than anything else, we've worked this year to field a slate of speakers who are "noteworthy" and who afford you the very personal opportunity for growth, and quite frankly, a richer life. For example:

- Graham Allison
  In the history on humankind, no event has ever occurred where the stakes were higher and the very survival of the human race was at stake than the Cuban missile crisis. The world's foremost authority on that crisis will be delivering the keynote speech at our conference. Already I can't wait to hear

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Photo of Bobby Layne provided by the Pro Football Hall of Fame.

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