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ABOUT THE COVER



In the Building Capacity column this month, "Embracing a Unified Brand Builds Capacity for Health Departments," Darryl Booth discusses the importance of a consistent

brand and a unified message across health departments and uses the example of restaurant inspections and the success of grading systems in various departments throughout the country. His column is a call to action to NEHA, its members, leaders, and staff to develop a unified placard or grading system for restaurant inspections that can be applied everywhere.

See page 34.

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of Environmental Health

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- > Arsenic Content in American Wine
- Presence of Pathogenic Bacteria and Viruses in the Daycare Environment
- October Prepublished Online Article: Measurements of Arsenic in the Urine and Nails of Individuals Exposed to Arsenic in Drinking Water From Private Wells

Erratum

In the Direct From CDC/EHSB column in the July/ August 2015 issue of the *Journal*, the Wisconsin Department of Health was inadvertently left off the list of state programs in Table 1.

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William A. Adler, MPH, RS Retired (Minnesota Department of Health), Rochester, MN

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Thomas H. Hatfield, DrPH, REHS, DAAS California State University, Northridge, CA

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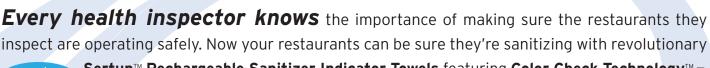
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PRESIDENT'S MESSAGE



Bob Custard, REHS, CP-FS

On the Shoulders of Giants

he environmental health profession is going through a generational change. The "Baby Boom Generation" is retiring and large numbers of leadership positions are opening up throughout our profession. Never have there been so many opportunities for young environmental health professionals to advance their careers.

Recently I was asked by a young environmental health specialist what they should do to prepare for promotion. My response was, "Find great mentors." The environmental health specialist seemed surprised by the brevity of my response. There was no checklist of the 10 most important things to do. There was no recommended course to take. There was no specific book to read, just the counsel to find great mentors.

As I explained to my young colleague, one's career journey is a lot like jungle exploration. A reliable guide will help you prepare to meet the challenges of the jungle environment. They will recommend the best paths. They will share the survival skills they have gained from decades of experience. A reliable guide will encourage you when the trek is difficult. Most importantly though, a guide will instill in you a passion for exploring new areas so that one day you can confidently lead others in exploring uncharted territory.

In the course of my own life and career I have been blessed by a number of great mentors. Early in my career, Larry Yates (former NEHA Region 8 RVP) encouraged me and helped me see environmental health as not just a job, but as a calling to service. I was inspired when Larry volunteered for an expedition to South America to study mercury

You can be the giant on whose shoulders they stand.

poisoning in gold miners deep in the jungle. Later Larry volunteered to help design and build a water system for a small rural community high in the Andes Mountains. I wanted to emulate Larry, so I began working as a volunteer on drinking water projects in small villages in sub-Saharan Africa.

In the 1990s, I met Vince Radke. (Vince is now NEHA second vice president.) Vince's passion for environmental health was downright contagious. Vince became a good friend and mentor. His nationwide contacts in environmental health helped me expand my professional network. Often when I was wrestling with a unique problem, Vince was able to direct me to the person with just the right expertise.

Later in my career, Brian Collins (former NEHA president) became one of my mentors. Brian confronted issues head on while working hard to build consensus. Although he was flexible on how the groups he led solved problems, his commitment to integrity and professionalism was unwavering. Brian's steady hand as NEHA's interim executive director saw NEHA through the organization's first leadership transition in more than 30 years. From Brian I learned a lot about leadership in difficult times.

Isaac Newton once said, "If I have seen further than others, it is by standing upon the shoulders of giants." He recognized that his success was built on the achievements of those who had gone before him. Even for those of unquestioned genius, mentors are critical to success.

In seeking the giants on whose shoulders you wish to stand, consider looking for people who will

- provide a model for you to emulate;
- encourage you to grow;
- challenge you to get the training and earn the credentials you need for the next step in your career;
- share their knowledge;
- expand your network of professional contacts;
- kindle your passion for your work;
- provide a broader perspective or vision;
- open doors for you to new and more challenging opportunities;
- give you honest counsel and feedback;
- applaud your successes; and
- help you learn from your mistakes.

Mentors will not flock to you. You must seek them out. Find people who are passionate about what they do. Think about the people you most admire who are doing what you want to do. Boldly ask them to share in your career journey.

NEHA is full of great potential young mentors. (For me, Stephen Hughes, Shelly Wallingford, Eric Myers, Kristin Garcia, Tom Gonzalez, Shannon McKeon, Roy Kroeger, Scott Fincham, Tim Hatch, and Rachel Stradling all come to mind.) Undoubtedly there are many more.

ACTION ITEM: Take time this month to seek out great mentors who will help you grow personally and professionally.

As people invest in you and your career, take time to thank them. Let them know the difference they have made.

ACTION ITEM: Take a few minutes to write five short thank you notes to people who have encouraged you in some way during your career.

Here are mine.

Gary and Holly Coleman—Thank you for making me feel so welcome as a NEHA member. I fondly remember your invitation to join you for the fireworks on Lake Michigan after the Annual Educational Conference (AEC) & Exhibition in Chicago. Your kindness has kept me coming back for 20 years!

Charles Felix—Thank you for selecting an article I wrote for my affiliate newsletter for publication in the *Environmental News Digest*. It was my first article in a national publica-

tion. What a great encouragement it was to me as a writer!

Bob Powitz—Thank you for introducing me to the history of environmental health through your AEC presentation and our conversation afterwards. It is now the starting point of every presentation I give to the general public about environmental health. Understanding where our profession came from and what it has accomplished has given context and perspective to my daily work.

Larry Gordon—Thank you for taking the time to write a note of encouragement to someone you had never met. You were (and are) a giant in our profession. I was a young environmental health specialist from Virginia who was both honored and humbled by your kind words about my article on environmental advocacy.

Doug Ebelherr—Thank you for choosing my presentation on training environmental health specialists in onsite wastewater treatment system design for presentation at the Denver AEC. I was an unknown to whom you gave an opportunity. It was my first presentation at a national conference.

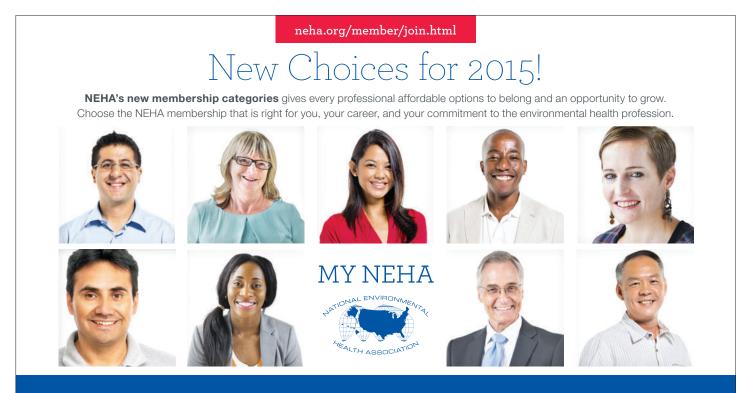
Lastly, as you think about the people who have helped you along the way, consider whom you should be helping. Remember that many of your young colleagues may be too shy to "bother" you. Don't underestimate how much you have to offer.

Who among your colleagues are the emerging leaders of the next generation of environmental health professionals? What can you do to encourage them? You can be the giant on whose shoulders they stand.

ACTION ITEM: Identify emerging environmental health leaders around you and encourage them. Be the giant.

Bob Custard

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Characterization of "Hydrocarbon" Dry Cleaning in King County, Washington

Abstract In King County, Washington, the most frequently used alternative solvent to perchloroethylene is a hydrotreated petroleum hydrocarbon. The objectives of the authors' study were to 1) determine the frequency of use of process chemicals used in "hydrocarbon" dry cleaning and gather other operational information; 2) chemically characterize the process chemicals; 3) characterize the still bottoms and separator water wastes according to dangerous waste and wastewater discharge regulations; 4) identify linkages between work practices, process chemicals, and the chemical composition of the waste streams; and 5) evaluate the aquatic toxicity of the hydrocarbon solvent and detergent. Many hydrocarbon dry cleaners are using process chemicals that contain hazardous substances, including trichloroethylene. One sample of separator water contained 13,000 µg/L trichloroethylene. This sample was determined to be federal hazardous waste, state-only dangerous waste (i.e., according to Washington statespecific regulations), and failed wastewater discharge thresholds. All still bottoms were determined to be state-only dangerous wastes. Efforts should be directed towards replacing hazardous spot cleaning chemicals with safer alternatives and ensuring that wastes are disposed of appropriately.

Introduction

In 2010, the Local Hazardous Waste Management Program in King County, Washington (LHWMP), conducted a survey of the dry cleaning industry, which revealed that the use of perchloroethylene (PERC) as a dry cleaning solvent has diminished in recent years (Whittaker & Johanson, 2011, 2013). The survey revealed that the most common solvent alternative to PERC was "hydrocarbon," which was used in 21% of the approximately 200 shops in King County.

Modern petroleum-based "hydrocarbon" dry cleaning solvents are high flash point,

hydrotreated aliphatic hydrocarbons, and include Shell Hydroclene, ExxonMobil DF-2000, and Chevron-Phillips EcoSolv (State Coalition for Remediation of Drycleaners [SCRD], 2009). The hydrocarbon solvent used by most shops in King County is ExxonMobil DF-2000, which has a flash point of 147°F (ExxonMobil, 2001; SCRD, 2009).

According to the material safety data sheets (MSDS) for these solvents, exposure above recommended levels can precipitate skin and eye irritation, drowsiness, dizziness, and other central nervous system effects, including death (Chevron Phillips, 2008; ExxonMobil, 2001).

Stephen G. Whittaker, PhD Jessie Taylor, MS Linda M. Van Hooser, MS Local Hazardous Waste Management Program in King County Public Health–Seattle & King County

As volatile organic compounds (VOCs), these solvents may contribute to ozone formation (California Air Resources Board, 2008).

The Dry Cleaning Process

Prior to being placed in the dry cleaning machine, stained fabrics may be precleaned or "prespotted" with spot treatment products, which are formulated according to the type of stains to be removed. Wet-side spotting agents are generally aqueous products that are used to remove water-soluble stains from clothing. Dry-side agents are used to remove stains comprised of oils, fats, waxes, grease, cosmetics, paints, and plastics. These products are generally based on nonaqueous solvents and alcohols, including PERC, trichloroethylene (TCE), methylene chloride, amyl acetate, acetone, ethanol, methanol, isopropyl alcohol, and petroleum solvents (SCRD, 2009).

Following spot treatment, the fabrics are placed in the dry cleaning machine where they are agitated with liquid solvent and a detergent. Additives like "sizing" may also be introduced, which is used to restore shape, body, and texture to fabrics (SCRD, 2009). When the cleaning cycle has completed, the solvent is drained and the fabrics are placed under vacuum, heated, and tumbled to remove any remaining solvent.

Reclamation of solvent within the machine via condensation and distillation generates a liquid waste and semisolid waste referred to as "separator water" and "still bottoms," respectively (Whittaker, Taylor, & Van Hooser, 2013).

Many PERC shops reduce the concentration of hazardous chemicals in their separator water via charcoal filtration. The efficacy of this treatment method for separator water

TABLE 1

Waste Designation Thresholds for Select Endpoints Used in Washington State

Endpoint	State-Only Persistence	Federal Toxicity (TCLP) ^a	Federal Toxicity (TCLP)	Federal Corrosivity	Federal Ignitability	State-Only Toxicity (Fish Bioassay)
Dangerous Waste (DW) threshold	HOC⁵ 0.01%–1.0%	TCE ^c > 0.5 mg/L	PERC ^d > 0.7 mg/L	$pH \le 2 \text{ or } \ge 12.5$	Flash point < 140°F	LC50* ≤ 100 mg/L
Extremely Hazardous Waste (EHW) threshold	HOC > 1.0%	Not applicable	Not applicable	Not applicable	Not applicable	LC50* ≤ 10 mg/L
^a TCLP = toxicity charact ^b HOC = halogenated org ^c TCE = trichloroethylene ^d PERC = perchloroethyle *Median lethal concentra	ne.					

derived from hydrocarbon machines has not been critically evaluated, however.

Waste Characterization

In Washington State, generators of hazardous waste must abide by the federal regulations described in the Resource Conservation and Recovery Act and more stringent "state-only" rules, which are specified in Chapter 173-303 of the Washington Administrative Code. Federal hazardous wastes and state-only dangerous wastes are further designated as DW (dangerous waste) or EHW (extremely hazardous waste). The terms DW and EHW are used only in Washington State. DW or EHW designation, together with waste amounts, determines a site's generator status and waste management options.

As shown in Table 1, applicable categories include the federal characteristics of ignitability (i.e., flash point), corrosivity (i.e., pH), and toxicity (i.e., the toxicity characteristic leaching procedure concentrations of PERC and TCE), and the state-only criteria for toxicity (i.e., fish bioassay) and persistence (i.e., halogenated organic compound [HOC] concentration).

Sewer Discharge Limits

The King County Industrial Waste Program (KCIW) sets a sewer discharge limit for nonpolar fats, oils, and grease (FOG) of 100 mg/L (King County Industrial Waste Program [KCIW], 2010) and administers screening levels for PERC (0.24 mg/L) and TCE (0.5 mg/L) (KCIW, 2009).

Current Study

The goals of our study were to gather information about 1) the frequency of use of process chemicals and other operational details; 2) the chemical characteristics of the process chemicals; 3) the composition of the still bottoms and separator water wastes; 4) linkages between work practices, process chemicals, and the chemical composition of the waste streams; and 5) the aquatic toxicity of the most commonly used hydrocarbon solvent and detergent in a fish bioassay.

Methods

A detailed description of the methods used in our study was provided previously (Whittaker et al., 2013).

Thirteen local shops participated in our study. At the initial site visit, a questionnaire was administered verbally and an inventory was conducted of all products used in the process. Samples were collected of every product and MSDSs were retrieved.

Samples of separator water and still bottoms were also collected from these shops. One dry cleaner treated their separator water with a ZeroWASTE filtration device, which is comprised of a particulate filter and two carbon filters (ZeroWASTE, 2013). At this shop, samples of both unfiltered and filtered separator water were collected to evaluate the efficacy of the treatment unit. The separator water collected from all other shops was untreated/unfiltered.

The waste characterization methods conformed to Washington State Department of Ecology's (2009a, 2009b) procedures and waste codes were assigned according to both federal and Washington state-only regulations. Chemical concentrations in separator water were also compared to KCIW discharge limits and screening levels.

The fish bioassays performed on the hydrocarbon solvent and detergent conformed to Washington State Department of Ecology's (2009a) procedures. Products were purchased from a local vendor for testing.

Statistical Analyses

Statistical analyses were conducted by The Mountain-Whisper-Light Statistics using R (The R Foundation for Statistical Computing, version 2.15.2). Methodological details are provided in Whittaker and co-authors (2013). Correlations between process parameters (i.e., work practices and process chemicals) and the chemical composition of the waste streams were plotted and evaluated using the Mann-Whitney test and the Spearman correlation coefficient.

Results

Questionnaire Results

The questionnaire results are summarized in Table 2. Four shops were disposing of their separator water improperly because it is inappropriate to filter and then discharge to the sewer without first testing the waste. It is also inappropriate to evaporate waste to an interior workspace or add it to a cooling tower. One shop was improperly disposing of their still bottoms in the municipal solid waste stream.

Product Inventory and Analysis

An inventory of the products used in the 13 shops is presented in Appendix G of Whittaker and co-authors (2013). The products used by these businesses varied considerably. For example, eight different types of detergent and 25 unique spot cleaning products were identified. The number of spot cleaners used by a single shop ranged from zero (two shops) to five (three shops). The median number of spot cleaners used by a shop was two. Spot cleaners were manufactured by nine different companies; the most frequently represented manufacturer was R.R. Street & Co., Inc. (seven products). The most frequently used spot cleaner was Street's Picrin, which was used by three shops. According to the MSDS, this product is "~100%" TCE (R.R. Street, 2000).

Chemical analysis of the products revealed that the highest concentration of chlorinated hydrocarbon was detected in Street's Picrin, which was confirmed to contain almost 100% TCE. One or more chlorinated hydrocarbons were also detected in samples of Adco-Laidlaw Pull-Out Premium-V, Street's MultiSpot, and Street's Spotless. While the MSDS for Pull-Out Premium-V listed methylene chloride as an ingredient at ">75%" (Adco Cleaning Products, 2010), the Street's MSDSs referred to their products' compositions as "trade secret" (R.R. Street, 2008, 2010).

Still Bottom Analysis and Waste Designation

Seventeen still bottom samples were collected from the 13 shops. Still bottoms were collected from four shops on two separate occasions and the remaining shops were sampled once. Complete analytical data are presented in Whittaker and co-authors (2013).

A full suite of analytical data is available only for 14 samples because of technical difficulties with preparing three samples. Only VOC data are available for two shops because of insufficient sample volume.

No still bottom samples exhibited the federal characteristics of toxicity or corrosivity. When complete data were available, however, all still bottoms were determined to be federal hazardous wastes or state-only dangerous wastes according to at least one of the following endpoints: state-only toxicity (fish bioassay), state-only persistence (HOCs), and the federal characteristic of ignitability (flash point) (Table 3).

TABLE 2

Questionnaire Results

Question	Response
Machine manufacturer	
Bioclean	1 (8%)
Bowe	6 (46%)
Firbimatic	1 (8%)
Realstar	1 (8%)
Satec	1 (8%)
Union	3 (23%)
Machine capacity (pounds)	
Range	26–80
Median	40
Loads run per week	
Range	8–24
Median	17
Length of time any dry cleaner at this location (years)	
Range	5–63
Median	12
Age of dry cleaning machine (years)	
Range	1–10
Median	7
Dry cleaning machine purchased new	
Yes	12 (92%)
No	1 (8%)
Length of time current dry cleaning machine owned (years)	
Range	1–10
Median	6
Machine ever converted from PERC ^a	
Yes	0 (0%)
No	13 (100%)
	continued on page

Separator Water Analysis and Designation

One sample of pretreatment, unfiltered separator water was collected from the shop that used a ZeroWASTE filtration device in addition to two filtered samples ("filtered" data are reported separately below). For the remaining shops, two samples were collected at three shops and a single sample was collected at seven shops.

Unfiltered Samples

Fish toxicity testing was conducted on a subset of the samples because of resource constraints. No unfiltered separator was state-only dangerous waste using the fish toxicity test (Table 3). No samples exceeded the KCIW discharge limit for nonpolar FOG and none exhibited the federal characteristic of corrosivity or the state-only criteria for persistence.

Only one sample was federal hazardous waste; the TCE concentration (13,000 µg/L) exceeded the maximum concentration for the federal toxicity characteristic (i.e., DW, D040) and the KCIW screening level. This sample also exhibited the federal characteristic of ignitability (i.e., DW, D001). This sample was also unique in that it contained several other VOCs, including 1,2-dichlorobenzene (140 µg/L), toluene (240 µg/L), and naphthalene (150 µg/L). Acetic acid-pentyl ester was detected at 23,000 µg/L, and likely originated from the amyl acetate spot cleaner used at this shop (acetic acid-pentyl ester is a synonym for

TABLE **2** continued from page 10

Questionnaire Results

lestion	Response
Jse products containing PERC	
Yes	2 (15%)
No	11 (85%)
Ever a PERC machine at location	
Yes	5 (38%)
No	8 (62%)
Who cleans out still bottoms	
Owner	9 (69%)
Employee	4 (31%)
Frequency of still bottom clean out (times per month)	
Range	1.5–30
Median	4
How still bottoms are disposed of	
Placed in waste drum and hauled	12 (92%)
Treated and placed in trash	1 (8%)
How separator water is disposed of	
Placed in waste drum and hauled	9 (69%)
Filtered and discharged to sewer	1 (8%)
Evaporated in shop (no treatment)	2 (15%)
Added to cooling tower water	1 (8%)
Percentage of dry cleaning from repeat customers	
Range	10–95
Median	75
Percentage of items requiring prespotting	
Range	0–50
Median	10

amyl acetate). This sample also contained the highest detected concentrations of 1,2,4-trimethylbenzene (200 μ g/L), methyl isobutyl ketone (10,000 μ g/L), isopropyl alcohol (1,200,000 μ g/L), and ethanol (480,000 μ g/L).

Filtered Samples

Neither of the filtered samples were federal hazardous waste or state-only dangerous waste or exceeded KCIWs discharge levels.

Linkages Between Process Characteristics and Waste Composition

Plots of process characteristics vs. chemical components of the waste streams were reviewed, with consideration of the resulting correlation coefficients and associated *p*-values. The HOC concentration was negatively correlated with the machine size (Spearman's rho = -0.71, p = .007). No other statistically significant correlations were found between the characteristics of the shops and the chemical composition of the waste streams (p < .05). Field observations suggested, however, that the single shop with overt deficiencies in business management and machine maintenance generated the most chemically complex separator water that also exceeded regulatory thresholds.

Fish Bioassays of Products

The DF-2000 solvent failed to kill fish at 100 mg/L, whereas the Street's Pinnacle detergent killed fish at 10 mg/L. Consequently, unused or off-specification Pinnacle detergent that requires disposal would be regarded as extremely hazardous waste (EHW, WT01) in Washington State.

Discussion

Dry Cleaning Operations

Several shops were disposing of their wastes improperly because they had not characterized their waste streams before selecting a method of disposal. Many shop owners assume that these waste streams are "nontoxic" and can be disposed of without characterization because the separator water generated by hydrocarbon machines typically contains relatively low concentrations of hazardous chemicals.

Process Chemicals

Product Inventory

Many shops use spot cleaning products that contain very high concentrations of chlorinated hydrocarbons. When chlorine-free dry cleaning solvents like DF-2000 are used, these products increase the probability that the waste streams will fail regulatory benchmarks. While the separator water from several study shops that use chlorinated spot cleaners did not contain detectable concentrations of chlorinated hydrocarbons, the use of Picrin in one shop was likely responsible for the exceedence of wastewater discharge limits and the designation as federal hazardous waste.

When spot cleaning, workers may potentially be exposed to very hazardous chemicals, including TCE (in Picrin), methylene chloride (in Pull-Out Premium-V), and hydrofluoric acid (in A.L. Wilson's RustGo [A.L. Wilson, 2007]). It is noteworthy that several businesses were observed to successfully spot clean exclusively with consumergrade aqueous products.

Product MSDS

Because the ingredients of many products were labeled as "trade secrets," product users were not aware of their chemical composition. This lack of information also presents challenges when designating products according to state-only dangerous waste regulations.

Waste Characteristics

Still bottom samples were determined to be state-only dangerous wastes and 56% exhibited the federal characteristic of ignitability. A separator water sample from a single shop was federal hazardous waste and failed the KCIW discharge screening levels. The separator water from this shop was unique in that it had a ~5 mm immiscible solvent layer at the surface.

The finding that most unfiltered separator water passed regulatory benchmarks calls into question the utility of the ZeroWASTE machine; this treatment appears unnecessary for most shops that use DF-2000.

A small study of the health and environmental characteristics of the hydrocarbon process conducted in California involved sampling four dry cleaners that used "tonsil" filtration media and four that used a distillation process (Institute for Research and Technical Assistance [IRTA], 2005). This investigation revealed that the still bottoms from cleaners that used the distillation process elicited fish toxicity at test concentrations <500 mg/L, which is consistent with the findings of our study. Samples derived from shops that used the tonsil filtration process failed to elicit fish toxicity, however. Because detergents are not used in the tonsil cleaning process, the study authors postulated that detergents were responsible for the aquatic toxicity of still bottoms from machines that employed distillation.

None of the California separator water samples elicited fish toxicity at test concentrations of 500 mg/L, which is consistent with our current study. Considering only the waste samples collected from shops that used distillation, the California study detected PERC in three of the four separator water samples, with concentrations ranging from 17 to 16,000 µg/L (parts per billion). PERC was also detected in three of the four still bottom samples, with concentrations ranging from 2 to 130 mg/kg (parts per million).

Disparities in the analytical results between the California study and our study likely reflect differences in sample handling, preparation, and analysis, in addition to differences in equipment and work practices. It is noteworthy that the California study authors postulated that a source of PERC in the waste streams could be spot cleaning chemicals, whereas PERC was detected only in two of the products sampled in King County.

Limitations and Strengths

Limitations

The sample size of 13 shops was insufficient to identify causal relationships between work practices, product usage, and waste characteristics. The participating shops had pre-

TABLE 3

Waste Designation Summary^a

9/16 (56%): D001	1/14 (7%): D001
0/14 (0%)	1/14 (7%): D040
5/6 (83%): WT02	0/4 (0%)
12/17 (71%): WP02	0/14 (0%)
	0/14 (0%) 5/6 (83%): WT02

D040: >0.5 mg/L trichloroethylene (federal hazardous waste, Washington state-only DW)

WT02: LC50 \leq 100 mg/L (Washington state-only DW)

WP02: 0.01%-1.0% halogenated organic compounds (Washington state-only DW)

*Data presented only for unfiltered/untreated separator water.

viously received technical assistance from LHWMP and therefore may not be representative of King County's dry cleaning industry.

Several questions presented difficulties to the interviewee, largely because many business owners and employees have limited English language skills. These difficulties would likely have been mitigated by conducting additional pretesting of the questions, translating the questionnaire into Korean and Spanish, and employing interpreters during the field visits.

The same products found at different shops could not be sampled and analyzed more than once. We also could not be certain that product containers actually contained the product described on the label. This concern could have been alleviated by sampling the same product at multiple business locations or purchasing unused products to sample.

Because the products are typically concentrated solutions, the analytical methods could not identify relatively low concentrations of constituents that may ultimately contaminate the waste streams.

Because the separator water typically accumulated for several days in a bucket external to the dry cleaning machine, we could not exclude the possibility of adulteration prior to sampling. Although still bottoms were sampled when the machine was opened for routine cleaning, the heterogeneity of this waste stream meant that the composition of the sample may not have been entirely representative. Strengths

This was the first comprehensive evaluation of the products used by hydrocarbon dry cleaners in King County and the waste streams generated by this process. Specific strengths of this study include the following: 1) the excellent working relationships developed between LHWMP and King County dry cleaners facilitated the recruitment efforts, 2) analyzing both the products and the waste streams allowed identification of the source of chlorinated hydrocarbon contamination in a separator water sample, 3) the use of a ZeroWASTE device at one shop permitted evaluation of the efficacy of separator water treatment prior to disposal, and 4) data of sufficient quality were generated to support specific recommendations for product selection and waste disposal.

Conclusion and Recommendations

The overall conclusions of our study of hydrocarbon dry cleaning operations are 1) several shops appeared to be disposing of their wastes improperly, 2) still bottoms were state-only dangerous waste and frequently federal hazardous waste, 3) separator water typically was not federal hazardous waste or state-only dangerous waste and did not exceed wastewater discharge levels, 4) deficiencies in dry cleaning equipment may allow contamination of separator water with spot cleaning chemicals, 5) visual inspection of separator water may be a valuable indicator of the potential for failure of regulatory benchmarks, and 6) treatment of separator water prior to disposal is unnecessary in properly functioning DF-2000 dry cleaning machines.

Specific recommendations resulting from our findings are 1) efforts should be directed towards removing hazardous spot cleaning chemicals from hydrocarbon dry cleaners; 2) unused or off-specification process chemicals should be disposed of as dangerous waste in Washington State; 3) chemical analyses of separator water may be limited to determining the concentrations of PERC, TCE, and nonpolar FOG, in addition to flash point; 4) dry cleaners should not add separator water to cooling towers or evaporate it into indoor workspaces and still bottoms should not be disposed of in the municipal waste stream; 5) sewer districts should allow most hydrocarbon dry cleaners to discharge their separator water to the sewer.

Other more general recommendations include 1) OSHA programs should provide assistance to all owner-operated businesses to correct the deficiencies in health and safety practices observed in many shops; 2) the quality of the MSDS for dry cleaning process chemicals requires significant improvementinformation must be provided in a culturally appropriate format; 3) the toxicological properties of hydrocarbon solvents should be critically evaluated by independent investigators so that local programs can make definitive recommendations concerning adoption of this technology; 4) independent exposure assessments should be conducted to inform the selection of gloves, coveralls, and respiratory protection; and 5) local agencies and programs should engage the dry cleaning community and work collaboratively to develop consistent messaging regarding regulatory requirements and best management practices.

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Corresponding Author: Stephen G. Whittaker, Local Hazardous Waste Management Program in King County, Public Health– Seattle & King County, 401 Fifth Ave., Suite 1100, Seattle WA 98104-1818. E-mail: steve.whittaker@kingcounty.gov.

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Methyl Iodide Fumigation of Bacillus anthracis Spores

Abstract Fumigation techniques such as chlorine dioxide, vaporous hydrogen peroxide, and paraformaldehyde previously used to decontaminate items, rooms, and buildings following contamination with Bacillus anthracis spores are often incompatible with materials (e.g., porous surfaces, organics, and metals), causing damage or residue. Alternative fumigation with methyl bromide is subject to U.S. and international restrictions due to its ozone-depleting properties. Methyl iodide, however, does not pose a risk to the ozone layer and has previously been demonstrated as a fumigant for fungi, insects, and nematodes. Until now, methyl iodide has not been evaluated against Bacillus anthracis. Sterne strain Bacillus anthracis spores were subjected to methyl iodide fumigation at room temperature and at 55°C. Efficacy was measured on a log-scale with a 6-log reduction in CFUs being considered successful compared to the U.S. Environmental Protection Agency biocide standard. Such efficacies were obtained after just one hour at 55°C and after 12 hours at room temperature. No detrimental effects were observed on glassware, PTFE O-rings, or stainless steel. This is the first reported efficacy of methyl iodide in the reduction of Bacillus anthracis spore contamination at ambient and elevated temperatures.

Introduction

Following the Amerithrax attacks in 2001, a variety of federal, postal, and privately owned buildings in Washington, DC; New York; New Jersey; and Florida were contaminated with resilient *Bacillus anthracis* spores (*B. anthracis*, the causative agent of "anthrax"). Three gases were used to fumigate those facilities—chlorine dioxide gas, vaporous hydrogen peroxide, and paraformaldehyde (Canter et al., 2005). Chlorine dioxide gas penetrates into porous surfaces (U.S. Environmental Protection Agency [U.S. EPA], 2005), but reacts with a wide range of materials (National Research Council, 2005) and is known to cause corrosion of some metals

including aluminum, iron, and copper found in plumbing and electrical equipment (U.S. EPA, 1999). Vaporous hydrogen peroxide (H₂O₂, VHP) penetrates poorly into porous surfaces, may react with organics (U.S. EPA, 2005), and is known to cause corrosion of some metals including those important to plumbing and electrical infrastructure (U.S. EPA, 1999). Paraformaldehyde (PFA, nominally OH[CH,O] H where n = 8 to 100) offers high penetration into porous materials and is relatively unreactive with most materials. PFA gas reacts with oxidizers and some organics (Centers for Disease Control and Prevention [CDC], 2005); however, it is a probable human carcinogen (U.S. Depart-

Mark Sutton, PhD Staci R. Kane, MS, PhD Jessica R. Wollard Lawrence Livermore National Laboratory

ment of Health and Human Services [DHHS], 2011) and may leave a residue on surfaces.

Methyl bromide (CH,Br, MeBr) has been shown to be effective in the fumigation of insect and fungal infestations and has been used experimentally for the fumigation of B. anthracis spores (Corsi, Walker, Liljestrand, Hubbard, & Poppendieck, 2007; Juergensmeyer, Gingras, Scheffrahn, & Weinberg, 2007; Kolb & Schneiter, 1950; U.S. EPA, 2010). MeBr penetrates into porous surfaces and does not typically react with organics, making it an attractive method for the fumigation of buildings and agricultural areas. MeBr may react with unprotected aluminum and may react with rubber and sulfur-containing articles depending on the delivery method. It is a neurotoxin and an animal carcinogen, although not proven in humans (DHHS, 2011). Additionally, MeBr is subject to the Montreal Protocol on Substances That Deplete the Ozone Layer (Albritton & Watson, 1992) and its use has largely been phased out (with exceptions for importing and exporting of goods and certain critical uses) through the Clean Air Act (2004).

Methyl iodide (CH₂I, iodomethane, MeI) is a commercially available alternative to MeBr for fumigation (Ohr, Sims, Grech, Becker, & McGiffen, 1998) and is a registered pesticide in several countries around the world with fungicide, herbicide, insecticide, nematicide, and soil disinfectant properties similar to those of MeBr. In September 2006, U.S. EPA granted the Japanese company Arysta LifeScience, Inc., an experimental use permit for MIDAS (methyl iodide) in seven U.S. states. In October 2007, U.S. EPA approved the use of MeI across the U.S. By 2010, Arysta registered MeI use in Japan, Turkey, New Zealand, Morocco, and Mexico, with planned registration in other countries including Guatemala, Australia, Israel, Chile, Egypt, and South Africa. In October 2012, following significant pressure from

TABLE 1

Published Inhalation Exposure Health, Regulatory, and Advisory Standards for Methyl Bromide (MeBr) and Methyl Iodide (Mel)

Inhalation Exposure Limits	MeBr, mg/m³	Mel, mg/m³	Reference
LC50 mice ^a	1540	5000	U.S. Department of Health and Human Services, 1993
LC50 rats ^a	1173	1300	U.S. Department of Health and Human Services, 1993
OSHA PEL ^b	80	28	Occupational Safety and Health Standards, Toxic and Hazardous Substances, 1998
AIHA ERPG-2°	195	290	American Industrial Hygiene Association, 1998
ACGIH TLV ^d	4	10	American Conference of Governmental Industrial Hygienists, 1999

^aThe calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of mice and rats.

^bOccupational Safety and Health Administration's permissible exposure limit.

^cAmerican Industrial Hygiene Association's emergency response planning guidelines.

^dAmerican Conference of Governmental and Industrial Hygienists' threshold limit value.

health professionals, environmental experts, and communities (*San Jose Mercury News*, 2011; *The New York Times*, 2012), Arysta LifeScience withdrew their product from U.S. markets and voluntarily requested the cancelation of MIDAS registration in the U.S. citing economic viability concerns in the U.S. marketplace (Arysta Life-Science, 2012; U.S. EPA, 2012).

A comparison of the inhalation exposure standards for both MeBr and MeI is shown in Table 1. The calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of mice and rats (LC50) for MeI is higher than that for MeBr. This health standard suggests that higher concentrations of MeI are needed to cause death compared to MeBr. The regulatory standard of time-weighted permissible exposure limit given by the Occupational Safety and Health Administration suggests that MeBr represents a slightly lower risk of illness compared to MeI, perhaps because of limited evidence of cancer in animals exposed to subcutaneous and intraperotoneal MeI (International Agency for Research on Cancer, 1977) compared to no evidence of cancer in animals exposed to MeBr in an inhalation study (National Toxicology Program, 1992). Advisory standards such as the American Industrial Hygiene Association's emergency response planning guidelines and the time-weighted American Conference of Governmental and Industrial Hygienists' threshold limit value suggest that workers may be exposed to higher concentrations of MeI without irreversible or adverse health effects compared to MeBr.

The boiling point of MeI is 42.4°C and the liquid density is 2.28 g/cm³ at 20°C (Hayes, 2013). The compound has restrictions on both the shipment volume and method (no aircraft transport). MeI is not subject to the Montreal Protocol or the U.S. Clean Air Act. In fact, U.S. EPA found that "Once volatilized, iodomethane degrades rapidly in the lower atmosphere via direct photolysis and lasts in the atmosphere less than 12 days, as compared with two years for methyl bromide. Therefore, iodomethane is unlikely to the reach upper atmosphere to have an impact upon the ozone layer. However, global uncertainty on volatilization rates, residence time in soil, photolytic degradation of iodomethane, and the removal of iodine radicals from the troposphere means that the possibility of detrimental effects of iodomethane on ozone layer and a contribution to global warming cannot be excluded entirely (U.S. EPA, 2007)."

Despite withdrawal of MeI from the U.S. agricultural market, MeI may prove to be a useful replacement for MeBr in the fumigation of *B. anthracis* spores due to the strict control and use of MeBr. A study was commissioned to evaluate the efficacy of MeI fumigation, including whether a 6-log reduction in viable *B. anthracis* CFUs could be achieved at two different temperatures, namely room

temperature and an elevated temperature that would lead to higher gas-phase concentrations of MeI. Such a reduction would meet U.S. EPA's biocide standard.

Experiments were performed using the *B. anthracis* Sterne strain (34F2) (CDC, 2009) on stainless steel at ambient room temperature and elevated temperature (55°C) corresponding to below and above the boiling point of MeI. It should be noted that in a sealed vessel, a liquid cannot completely evaporate; rather, the concentration in the gas phase increases until equilibrium is reached between the gas phase and the remaining liquid.

Methods, Materials, and Equipment

Materials

MeI (99% stabilized with copper/silver, 141.97 g/mol) was stored in an amber glass bottle.

Biological indicator ribbons were used (304 stainless steel ribbon) containing 3×10^{6} B. anthracis Sterne spores.

Equipment

Pressure-rated glassware (heavy-walled borosilicate glass, 48-mL capacity) was used to contain MeI gas during fumigation. Vessels were sealed with accompanying PTFE screw caps and front-seal FETFE O-rings (#15) and vessels were wrapped with aluminum foil to prevent light from causing photodegradation of the MeI. The reaction of short-wavelength photons leads to the formation of methanol, iodide ions (I⁻), and protons (H⁺) in moist/ wet environments (Gan & Yates, 1996).

A generic 5-L digital water bath with a secondary National Institute of Standards and Technology (NIST)–traceable digital thermometer (-50°C to 300°C) was used to verify the water temperature and provide an alarm against overheating.

The work was performed in a Class-II type B2 cabinet that was vented directly outside the building because of the combined hazards of *B. anthracis* and volatile MeI.

Mel Fumigation

Undiluted MeI (20 mL) was placed in the pressure-rated glassware and the biological indicator ribbon was suspended above the solution using a PTFE sample holder or nylon thread. The vessel was then sealed and (in the case of the elevated temperature experiment) lowered into a 5-L digital water bath set to 55°C such that the water was level with the bottom of the screw cap (minimizing condensation of MeI at the top of the vessel). Ambient (room temperature) experiments determined to be between 19.4°C and 21.1°C were placed in an unheated water bath. A NIST-traceable digital thermometer was used to verify the water temperature and provide an alarm against overheating. Once the desired reaction time was achieved, the vessel was removed from the water bath and the samples were removed.

The vapor pressure of MeI was calculated from a previously published relationship (Lorenz, Osborne, Collins, Manning, & Malinauskas, 1976), which states that

$$\log_{10} P(mm) = \frac{1475}{T} + 7.56$$

where P(mm) is the vapor pressure in mmHg and *T* is the temperature in Kelvin. The corresponding concentration of MeI in the gas phase was calculated using

$$P(p)V = nRT$$

where P(p) is the vapor pressure of MeI (Pascals), V is the volume of gas above the MeI liquid in the pressure-vessel, n is the number of moles of MeI in the gas phase, R is the molar gas constant (8.314 m³.Pa.K⁻¹.mol⁻¹), and T is the temperature (Kelvin). The number of moles of MeI in the gas phase was then converted to a mass (mg) per volume (L) using the molar mass (141.9 g/mol) and accounting for the headspace volume above the liquid in the pressure vessel (28 mL). Partial pressures (and therefore molar ratios) were subsequently determined by comparing the number of moles of MeI to the sum of the number of moles of an ideal gas (0.044 mol/L). The theoretical concentration of MeI gas in the experiments can then be plotted (Figure 1).

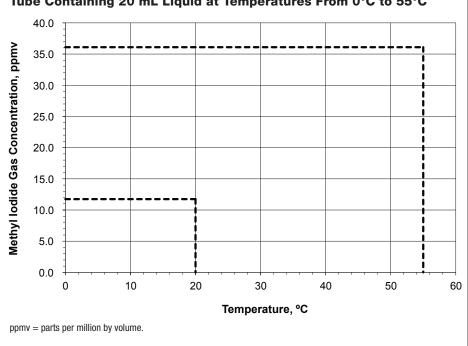
Several control samples were evaluated during each test, including vessels containing water and others vessels containing no liquid to study the relative effect of temperature without MeI.

Measurement of MeI Fumigation Efficacy

A strict aseptic technique was used during all of the procedural steps involving sample handling and dilutions. After exposure to MeI, the ribbons containing *B. anthracis* spores were placed into individual sterile test tubes con-

FIGURE 1

Theoretical Gas-Phase Concentration of Methyl lodide in a 48-mL Tube Containing 20 mL Liquid at Temperatures From 0°C to 55°C



taining 10 mL of sterile distilled water. Using sterile forceps, the ribbon was first bent into a coil such that the spores were on the inside edge at the end of the coil (this had previously facilitated placement in the pressure vessel for MeI fumigation). The coiled ribbons were soaked for one hour followed by sonication for one hour. Tenfold serial dilutions were then performed using vortex-mixing (high speed for 10 seconds) prior to removing aliquots. Dilutions of 10⁻¹ (ribbon in 10 mL) to 10⁻⁴ were plated as 100 µL each onto duplicate tryptic soy agar (TSA) plates. The remaining liquid from each 10⁻¹ suspension (nominally 8.9 mL) was filtered through a 0.45-um filter and the filter was placed onto a TSA plate. Plates were incubated overnight at 30°C.

B. anthracis colonies on the TSA plates were counted manually by visual inspection after 16 hours of incubation at 30°C. Colonies were confirmed to have morphology consistent with *B. anthracis*, namely flat or slightly convex colonies with irregular borders and ground-glass appearance. The colony counts were multiplied by the dilution factor to give the total number of CFUs for each biological indicator.

The efficacy of MeI fumigation was then calculated and expressed as a "log-reduction" value by subtracting the average log CFU measured on samples after fumigation (CFU_f) from the average log CFU on unexposed positive control samples (CFU_c), as follows:

$$Efficacy = log_{10}CFU_{c} - log_{10}CFU_{f}$$

Results and Discussion

The effects of exposure times (and therefore of gas-phase MeI dosage) from one hour (11.7 parts per million per hour [ppm-hr] MeI) to 72 hours (842.4 ppm-hr MeI) at ambient room temperature are shown in Table 2 and Figure 2. The number of CFU was reduced by almost 50% after one hour (12 ppm-hr). A further reduction in the number of CFU was observed after four hours (50 ppm-hr) and the U.S. EPA biocide standard 6-log reduction was achieved (leaving no viable spores to measure) after 12 hours of MeI exposure at room temperature (141 ppm-hr). As expected, no significant reduction in CFU was observed in experiments containing water, and no dry experiments were performed at room temperature because no additional heat was applied.

TABLE 2

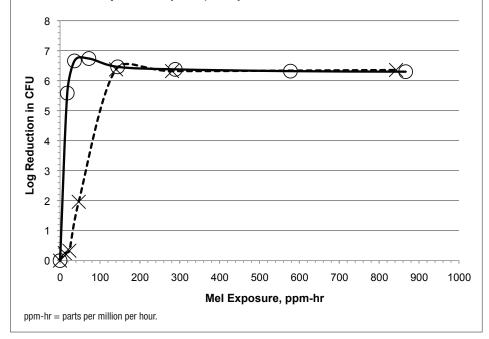
Average Number of *B. anthracis* CFU Surviving After Exposure to 12 Parts per Million by Volume Methyl Iodide (Mel) at Room Temperature (~20°C)

Time (hrs)	Average Positive Control, CFU (<i>SD</i>)	Average Water Control, CFU (<i>SD</i>)	Average Post-Mel Exposure, CFU (<i>SD</i>)	Average Log Reduction From Mel
1	2.28 x 10 ⁶ (±8.31 x 10 ⁴)	2.23 x 10 ⁶ (±2.83 x 10 ⁴)	1.28 x 10 ⁶ (±3.82 x 10⁵)	0.25
2	2.27 x 10 ⁶ (±3.25 x 10 ⁵)	2.07 x 10 ⁶ (±2.12 x 10 ⁴)	1.06 x 10 ⁶ (±4.23 x 10 ⁵)	0.33
4	2.27 x 10 ⁶ (±3.25 x 10 ⁵)	2.14 x 10 ⁶ (±7.42 x 10 ⁴)	2.48 x 10 ⁴ (±3.35 x 10 ⁴)	1.96
12	2.38 x 10 ⁶ (±N/D ^a)	2.31 x 10 ⁶ (±N/D)	0 (±0)	6.38
24	2.09 x 10 ⁶ (±N/D)	2.74 x 10 ⁶ (±7.78 x 10 ⁴)	0 (±0)	6.32
72	2.27 x 10 ⁶ (±N/D)	2.14 x 10 ⁶ (±N/D)	0 (±0)	6.36

 $^{a}N/D = not determined.$

FIGURE 2

Efficacy of Methyl Iodide (MeI) Gas-Phase Exposure on *B. anthracis* Sterne Strain Spores ($3 \times 10^{\circ}$) at Room Temperature ($\sim 20^{\circ}$ C, -X-) and Elevated Temperature (55° C, -O-)



In some cases (noted by a standard deviation of N/D), duplicate samples were not determined.

Table 3 and Figure 2 show that at 55° C, a 5.6-log reduction in CFUs was observed after

only 30 minutes (18 ppm-hr Mel). Efficacies greater than U.S. EPA's biocide standard 6-log reduction were achieved after just one hour, corresponding to a 36 parts per million by vol-

ume per hour (ppmv-hr) exposure, leaving no viable spores to measure. Analysis of the dry air controls at elevated temperature show that the increased efficacy at higher temperature is not due to heat-inactivation of the spores, and as such the increase in efficacy gained by using elevated temperature is due to the increased concentration of MeI in the gas phase. Despite some level of humidity inside the vessel, the humidity was certainly less than 100% (experiments were performed in a laboratory with no forced humidity control, not a saturated environment). A reduction of less than one order of magnitude was observed in some of the samples suspended above water in the method control samples and subjected to 55°C. These results are consistent with those at 90% RH and 60°C for 24 hours (Buhr et al., 2012) causing an average log reduction in Sterne spores from 0.2 to 2.7 on a variety of materials. Comparing the results from both room temperature and elevated temperature exposure experiments (Figure 2) shows how temperature affects the required time to achieve reduction in CFU. Not surprisingly, at higher temperatures (and therefore higher concentrations of MeI in the gas phase), shorter exposure times are required. Increasing the temperature to 55°C over room temperature increased the concentration in the gas phase threefold.

Elevated temperatures such as 55°C (131°F) would be difficult to achieve for large buildings and may only be practical for small items that can be placed inside heated chambers. It is important to note, however, that military equipment such as planes and vehicles are likely to withstand more extreme elevated temperatures, suggesting that rapid fumigation could be achieved.

In the first documentation of MeBr fumigation of B. anthracis (Juergensmeyer et al., 2007) a 7-log reduction in spores was achieved using 80 mg/L for 48 hours (~984,600 ppmhr). Room temperature MeBr fumigation tests performed by U.S. EPA (2010) at 25°C for nine hours at 211 mg/L (~14,769,200 ppmhr) did not meet a 6-log efficacy standard for B. anthracis spores. Instead, an 18-hour exposure was required at 37°C to achieve a 6-log reduction in their experiments. The work presented here shows that MeI achieved a 6-log reduction in spores, meeting U.S. EPA's biocide standard at a lower temperature and with a significantly lower concentration compared to MeBr. It should be noted, however,

that the demonstrations by both previous studies of MeBr fumigation of *B. anthracis* involved significantly larger volumes than the 28 mL headspace in which the biological indicator strips were suspended in this work. Additionally, the effect (and control) of relative humidity was not evaluated in our study.

The mode of action for MeI on *B. anthracis* spores is assumed to be the same as that for MeBr, namely DNA alkylation. The alpha/ beta-type small, acid-soluble spore proteins do not protect the spore DNA against alkylating agents (Setlow, Tautvydas, & Setlow, 1998).

Further tests should evaluate fumigation of spore control strips in larger enclosures with controlled temperature and relative humidity as well as material compatibility studies. Since MeI is a liquid at room temperature, mitigating condensation during or after fumigation will be an important factor in implementing future tests and scaled up field testing. Field tests should be directed at small rooms, enclosures, or military vehicles to demonstrate efficacy and practicality on scales larger than bench-top experiments. Potential users of MeI for *B. anthracis* fumigation include U.S. EPA and military organizations, or their international equivalents.

Conclusion

The scoping study described in this article clearly shows that MeI is an efficient sporicide in the neutralization of *B. anthracis* Sterne spores. Efficacy was measured on a log scale and 6-log spore reduction in spores was observed after one hour at 55°C and after 12 hours at room temperature, making MeI a viable alternative to current fumigation techniques such as chlorine dioxide, vaporous hydrogen peroxide, paraformaldehyde, and MeBr. Recommended follow-on studies include examination of efficacy in the presence of organic materials and evaluation of the effect of MeI on simple electronic equip-

TABLE 3

Average Number of *B. anthracis* CFU Surviving After Exposure to 36 Parts per Million by Volume Methyl Iodide (MeI) at 55°C

Time (hrs)	Average Positive Control, CFU (<i>SD</i>)	Average Water Control, CFU (<i>SD</i>)	Average Dry Control, CFU (<i>SD</i>)	Average Post- Mel Exposure, CFU (<i>SD</i>)	Average Log Reduction From Mel
0.5	2.28 x 10 ⁶ (±8.13 x 10 ⁴)	2.11 x 10 ⁶ (±2.40 x 10 ⁵)	2.30 x 10 ⁶ (±1.06 x 10 ⁵)	7.75 x10º (±5.91 x10º)	5.59
1	2.28 x 10 ⁶ (±8.13 x 10 ⁴)	2.25 x 10 ⁶ (±3.89 x 10 ⁴)	2.28 x 10 ⁶ (±1.98 x 10 ⁵)	2.50 x10 ⁻¹ (±5.00 x10 ⁻¹)	6.66
2	2.74 x 10 ⁶ (±0)	1.85 x 10 ⁶ (±2.65 x 10 ⁵)	2.43 x 10 ⁶ (±3.18 x 10 ⁴)	2.50 x10 ⁻¹ (±5.00 x10 ⁻¹)	6.74
4	2.89 x 10 ⁶ (±8.49 x 10 ⁴)	2.85 x 10⁵ (±1.11 x 10⁵)	1.28 x 10 ⁶ (±2.09 x 10 ⁵)	0 (±0)	6.46
8	2.38 x 10 ⁶ (±2.79 x 10 ⁵)	1.39 x 10 ⁶ (±1.41 x 10 ⁴)	1.40 x 10 ⁶ (±2.47 x 10 ⁵)	0 (±0)	6.38
16	2.08 x 10 ⁶ (±1.17 x 10 ⁵)	6.88 x 10⁵ (±1.17 x 10⁵)	2.47 x 10 ⁶ (±7.42 x 10 ⁴)	0 (±0)	6.32
24	1.99 x 10 ⁶ (±1.06 x 10 ⁴)	3.56 x 10⁵ (±1.05 x 10⁵)	N/D ^a	0 (±0)	6.30

ment and on valuable materials such as paper documents. The effect of relative humidity on MeI efficacy should also be subject to investigation.

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Corresponding Author: Mark Sutton, Program Leader, Scientist, Lawrence Livermore National Laboratory, 7000 East Avenue, Livermore, CA 94550. E-mail: sutton18@llnl.gov.

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INTERNATIONAL PERSPECTIVES

Characteristics of Noncompliant Food Handling Establishments and Factors That Inhibit Compliance in a Regional Health Authority, Jamaica

Norbert Campbell, MPH University of the West Indies, Mona

Jeffericia Johnson, MPH University of Technology, Jamaica

Henroy Scarlett, MPH, DrPH University of the West Indies, Mona

Sylvanus Thompson, MSc, PhD Toronto Public Health

Abstract The Jamaican food safety regulatory framework is embodied in the Public Health Act of 1974 with public health inspectors/ environmental health officers (PHIs/EHOs) empowered with its enforcement. The North East Regional Health Authority (NERHA) has consistently faced challenges in achieving national certification targets for food-handling establishments (FHEs). The aim of the authors' study was to identify and describe noncompliant FHEs and to identify factors influencing their noncompliance. FHEs (N = 248) were randomly selected and each owner/ operator targeted for interview. Substantially more FHEs were compliant and respondents from compliant FHEs were more likely to have a valid food handlers' permit. Urban FHEs were less likely to be compliant than rural. The major barriers to compliance were forgetting to apply for a license and lack of money to correct infractions. NERHA should encourage FHE owners/operators to assume greater responsibility for the certification of their premises and to hold PHIs more accountable.

Introduction

The assurance of safe food along the "farm to fork" continuum is an increasing global demand. Food safety regulations are geared towards protecting consumers' health, increasing economic viability, preventing fraudulent practices, harmonizing well-being, and engendering fair trade in foods within and between nations (Garcia Martinez, Fearne, Caswell, & Henson, 2007; Ozekie, 2005; U.S. Department of Agriculture, 1997). Food safety regulations will only be effective if operators fully understand their benefits, and they are actively reinforced by managerial control with staff playing an integral role (Jones, Parry, O'Brien, & Palmer, 2004). Hence in recognizing the responsibility of industry for the production of safe foods, Tompkin (2001) and Hutter and Amodu (2008) argued that selfregulating systems seem to influence industry in accepting their responsibilities. With stateadministered standards, the perception of responsibility for risk management standards is shifted to the regulatory authorities (Fairman & Yapp, 2004) especially if the regulations are deemed to be vague (Genn, 1993). Consequently some operators equate compliance with adhering to instructions given by environmental health officers (EHOs) upon the completion of an inspection (Fairman & Yapp, 2004). Additionally, many operators are ignorant of food safety risks and prefer this prescriptive approach (Henson & Heasman, 1998; Yapp & Fairman, 2004).

Small businesses tend to be less compliant due to the associated costs in attaining and maintaining compliance (Hutter & Jones, 2006; Yapp & Fairman, 2006), which is worst in very competitive markets with small profit margins. Where compliance costs are shared with consumers, however, increased willingness to comply has been observed (Kagan & Scholz, 1984).

Yapp and Fairman (2004) found lack of money, time, experience, access to information, support (from regulators), interest, and knowledge to be primary barriers to compliance. Regarding "lack of access to information" they noted that small- and mediumsized establishments were overwhelmed by the abundance of information as they were unable to determine what was relevant to them. They noted substantial "knowledge" differences between medium-sized establishments and regulators as to what constituted compliance with the former limiting it to conformance with all the requirements made by the EHOs. They also found lack of motivation (99%), lack of trust in the EHOs and their requirements (81%), and lack of management systems (75%) as principal inhibiting factors among medium-sized establishments in the United Kingdom (Yapp & Fairman, 2006).

Numerous other factors adversely impact compliance such as the tendency for EHOs to focus more on urban areas (Hutter, 1988). Additionally, lack of or informal documentation of the registration/compliance procedures, inadequate surveillance activities on the identification of noncompliant establishments, limited assessment of food safety enforcement strategies, failure to inspect all food-handling establishments (FHEs) annually, and poor follow-up of noncompliant establishments have inhibited compliance even when the regulatory framework was deemed appropriate (Auditor General, 2002).

Training of food handlers followed by verification inspections proved effective in reducing infractions related to food handlers' behavior (Averett, Nazir, & Neuberger, 2011) while the introduction of new food safety standards resulted in significant improvements in safe food handling knowledge and practices (Food Standards Australia New Zealand, 2008). Training of restaurant managers was found to positively impact sanitation (Cates et al., 2009; Hedberg et al., 2006). Yapp and Fairman (2004) noted that educational interventions that increased specific food safety knowledge and formal enforcement were among the most effective in improving inspection scores and compliance levels. Fraser and Nummer (2010) found "experience as a trainer" (27%) and "experience working in the retail food service industry" (24%) among the most effective characteristics of an effective food safety trainer, while teaching content using activities and demonstrations (46%) and trainers' experience with the regulations (23%) best enhanced training effectiveness.

Having a good reputation is critical in a competitive food industry (Gunningham, Thornton, & Kagan, 2005). This is so especially where consumers recognize the weight of their purchasing power and the negative impact that published inspection scores and enforcement activities can have on businesses (Thompson, De Burger, & Kadri, 2005), compounded by feelings of shame and even fear of a tarnished image (Parker, 2002). Together these can favorably influence compliance.

Jamaican Situation

In Jamaica, responsibility for food safety is shared among multiple ministries and is a priority program of the Ministry of Health (MOH). The program is primarily administered by public health inspectors (PHIs)/EHOs under the Public Health Act (1974) and Regulations. The primary regulations, the Food Handling Regulations (1998) and the Tourist Establishments Regulations (2000), were promulgated after 1996-1997 when studies revealed a high incidence of diarrhea among visitors to Jamaica. Approximately 74% of visitors from North America who responded to a questionnaire prior to their departure from Jamaica reported experiencing diarrhea (Paredes et al., 2000). Steffen and co-authors (1999) reported on an airport survey of over 30,000 visitors to Jamaica in which the incidence of diarrhea overall was 23.6% while that of classically defined traveler's diarrhea was 11.7%. Swift response by the government of Jamaica resulted in the establishment of a structured national program for the inspection and annual certification of FHEs.

This decisive government action can be readily understood as tourism is extremely critical to Jamaica's economy, accounting on average for 6.9% of its GDP annually for 2007-2012 (Statistical Institute of Jamaica, 2014). It also effectively placed food safety on the national agenda, since prior to 1998 no specific regulations existed governing FHEs. The food handlers' certification program was standardized nationally, training manuals and materials were developed, and applicants were required to attend training sessions and obtain a minimum of 70% in the exam. Similarly, FHEs had to obtain a passing inspection score of 70%, which must include the full score for all the critical items. Regional Health Authorities were expected to attain an FHE certification target of 70% in 2000-2006, 80% in 2007, and 90% since 2008.

The North East Regional Health Authority (NERHA)

NERHA is one of four Regional Health Authorities comprising three of Jamaica's 14 parishes and has 14% (356,000) of the national population. It has a regional food safety officer, three parish food safety coordinators, and 58 EHOs/PHIs, many of whom work in food safety. NERHA has consistently faced challenges in meeting the national targets for certification of FHEs. The aim of our study was to identify and describe noncompliant FHEs in NERHA and to identify the factors influencing their noncompliance.

Methods

The study protocol was approved by the ethics committee of the University of the West Indies, Mona. A cross-sectional design was utilized incorporating a mixed-methods approach. For the quantitative component, multistage sampling was used to select 7% (248) of the 3,427 FHEs, which were first stratified by parish and then by health districts. Two health districts were randomly selected per parish. FHEs were randomly selected from each health district to satisfy a predetermined quota. The person-incharge of each FHE was asked to complete an interviewer-administered questionnaire. Additionally, the most recent food safety inspection report for each FHE was reviewed.

The qualitative component involved two focus group discussions involving 15 participants, one comprised of owners/operators from compliant FHEs who were selected from the zone with the highest certification status and the other comprising noncompliant operators from the zone with the lowest compliance rates. Additionally, key informant interviews were conducted with key administrators of the food safety program.

Data Analysis

Quantitative data were analyzed using SPSS (version 16.0). Descriptive statistics such as mean, mode, median, and variance were generated and reported. The differences between respondents of compliant and noncompliant establishments and the establishments themselves were determined by Chi-square analyses while logistic regression was used to identify the factors that were predictive of compliance.

The framework approach was used to analyze qualitative data, which were summarized and grouped under specific themes.

Results

Sociodemographic and Employment Characteristics of Respondents

Two hundred and thirty-two persons-in-charge of FHEs participated, giving a response rate of

93.5%. Respondents were primarily females (71.1%), had a mean age of 43.4 ± 10.7 years with 38% being 39 years or younger and secondary education (61.2%) being the highest level attained by most. Just under 87% owned and managed the FHEs with 34.5% reporting having worked in the industry for more than 10 years. Fifty-four percent were from urban areas (Table 1).

While substantially more FHEs were compliant (69.4%), noncompliant establishments differed significantly from compliant only in the educational status (p < .05) and possession of a valid food handlers' permit (p < .001) by the person-in-charge. Noncompliant FHEs employed more females (69%) than males (31%) and were more likely to employ persons aged 40 years and older or report primary education. Persons-in-charge of noncompliant establishments were more likely to have been working in the industry for less than 10 years while those of compliant establishments were more likely to have worked in the industry for 10 or more years. Approximately 60% (38) of respondents from noncompliant establishments demonstrated correct knowledge of the compliance process despite 95.8% (68) reporting that they did (Table 2).

Apart from the mandatory food safety training obtained at the health departments' food handlers' training sessions, only 8% (18) of all respondents indicated having additional food safety training. Training was reportedly received in hazard analysis and critical control points (HACCP) and food and beverage management. While 92% (213) reported having been issued a food handlers' permit, only 57.8% (134) were valid. Respondents from compliant FHEs were more likely to have a valid food handlers' permit than their counterparts from noncompliant FHEs (p < .001). Also, respondents in rural areas were more likely to have valid food handlers' permits than their urban counterparts (p = .015).

Significantly more noncompliant FHE were found in urban areas (67.6%) than rural (32.4%) (Table 3). Approximately one-half of these establishments were in operation for five or fewer years and 78.9% operated with three or fewer workers. The majority of respondents reported inconsistent compliance with instructions issued by PHIs, with only 14.1% reportedly complying all the time.

TABLE 1

Characteristics of Person-in-Charge of Food Handling Establishments

Characteristics	%	#
Total	100.0	232
Gender		
Male	28.9	67
Female	71.1	165
Age group (yrs.; mean: 43.4 ± 10.7 ; range: 2	0–73)	
20–29	10.0	23
30–39	27.7	64
40–49	32.9	76
≥50	29.4	68
Education		
Primary/all age	26.7	62
Secondary	61.2	142
Tertiary	12.1	28
Person-in-charge		
Owner and manager	86.6	201
Manager	6.5	15
Supervisor	6.9	16
Years working in food service industry		
≤5	35.0	81
6–10	30.6	71
>10	34.5	80
Status of food handlers' permit		
Valid	62.9	134
Invalid	37.1	79
Location		
Urban	54.3	126
Rural	45.7	106

Approximately 54% of noncompliant establishments had not applied for renewal of licenses despite the licenses of 24.3% having been expired for more than six months prior to the survey. Among the establishments that had not applied for licenses, newer establishments (five years or less in operation) were more likely not to have applied while a few establishments (4.6%) had never applied.

Variables that were statistically significant on univariate analysis as associated with noncompliance were entered into logistic regression to determine their association with compliance. Only location, however, was found to be associated with compliance as urban establishments were less likely to be compliant than rural establishments (odds ratio [OR] = 0.45, 95% confidence interval [CI]: 0.25–0.81).

Factors Inhibiting Compliance

The factors inhibiting compliance were categorized as social, economic, and regulatory (Table 4). Forgetting to apply for a license (61%) was the primary social factor inhibiting compliance followed by the lack of time to correct infractions (15.3%) and the lack of time to make application (15.3%). The lack of money to correct infractions cited by the PHI (46%) and lack of money to pay for the license (35.9%) were the two economic factors that inhibited compliance. A significant difference occurred between compliant and noncompliant FHEs in relation to ability to pay for the license (p = .01). Respondents from compliant FHEs were more likely to afford the cost for the license. The lack of understanding of recommendations made by PHI to correct infractions (32.9%) and inconsistencies in PHIs'

TABLE 2

Characteristics of Respondents by Compliance Status of Food-Handling Establishments (FHEs)

Characteristics	Noncompliant FHEs % (#)	Compliant FHEs % (#)	<i>p</i> -Value
Compliance status	30.6 (71)	69.4 (161)	NS℃
Gender			NS
Male	31.0 (22)	28.0 (45)	
Female	69.0 (49)	72.0 (116)	
Age (years) ^a			NS
20–29	8.5 (6)	10.6 (17)	
30–39	21.1 (15)	30.6 (49)	
40–49	40.8 (29)	29.4 (47)	
≥50	29.6 (21)	29.4 (47)	
Education			<.05
Primary/all age	33.8 (24)	23.6 (38)	
Secondary	57.7 (41)	62.7 (101)	
Tertiary	8.5 (6)	13.7 (22)	
Person-in-charge			NS
Owner and manager	91.5 (65)	84.5 (136)	
Manager/supervisor	8.5 (6)	15.5 (25)	
Number of years working in food service industry			NS
≤5	36.6 (26)	34.2 (55)	
6–10	31.0 (22)	30.4 (49)	
>10	32.4 (23)	35.4 (57)	
Status of food handlers' per	mit ^b		<.001
Valid	46.9 (30)	69.8 (104)	
Invalid	53.1 (34)	30.2 (45)	
Additional food safety training	ng		NS
Yes	7.0 (5)	8.1 (13)	
No	93.0 (66)	91.9 (148)	
Understanding of the compl	iance process		NS
Self-reported	95.8 (68)	91.3 (147)	
Established from knowledge test	55.9 (38)	79.6 (117)	

recommendations (30.7%) were the major regulatory factors cited. Respondents from compliant FHE were more likely to understand PHIs' recommendations (p = .02).

Qualitative

Focus Group Discussions

Focus group discussions explored reasons for noncompliance and related program management issues. No member of the two focus groups was able to identify the correct regulations governing FHEs. Typical responses were "oh....Bureau of Standards...," "....the health department ...," and "consumer protection agency." All but one participant, however, demonstrated good knowledge of the registration process and all agreed that each establishment should meet public health standards before receiving a license. Regarding the value of compliance, one operator of a certified restaurant responded, "I think it is good... for the owner and the consumer." Some indicated that complying gave them self-satisfaction and confidence to conduct business with pride, as compliance was deemed an asset in attracting customers.

The majority lacked understanding of how FHE inspections were scored, and all indicated that all food safety practices were equally important. The approach to the prioritization of corrective measures to be implemented was that those that could affect the health of the consumers should be given priority treatment followed by those that were very conspicuous. All participants from compliant establishments reported that they relied on the PHI/ EHO to advise on the requirements for the attainment and maintenance of compliance. This was aptly described by a female operator of a certified restaurant: "...my inspector tells you exactly what is expected of you..."

Participants identified double standard, bias in targeting compliant establishments, inconsistencies, and lack of adequate monitoring as PHI/EHO-related barriers to compliance. Some participants also indicted the health department for ineffective management of the licensing process, stating that PHIs/EHOs sometimes serve notices for failure to reapply when the license was still in force or for closure when no outstanding infractions existed.

Key Informant Interviews

Interviews were held with the three parish food safety coordinators and the regional food safety officer to determine initiatives implemented to enhance the registration and certification process. These included extensive sensitization meetings, media campaigns, a regional survey to determine the number of operating FHEs, and the reasons for the low rate of application. In direct response to the findings of the survey, decentralization of the application registration centers, increased provision of monitoring tools for the PHIs, and the instituting of the triplicate inspection forms (whereby a copy was left at the establishment for the guidance of the person-incharge) occurred. One coordinator reported hosting an annual seminar for persons-incharge of FHEs that enhanced compliance levels, while all interviewees reported that the issuing of closure notices especially at the initial stages increased application rates. As one interviewee reported, "...when you close them, at that time you will find that they comply... that's what they usually do...."

Regarding noncompliance, they noted that some PHIs did not do follow-up on a timely basis or that "...standards are not equally applied across the board..." and as one interviewee indicated, "there is too much leniency on the part of some PHIs " All key informants opined that retroactivity should be available in the renewal of licenses such that operators will be penalized for any period for which they had failed to apply. Concern was also expressed about the currency of the existing information management system that had resulted in embarrassment for health departments that had erroneously issued closure notices to licensed establishments that were not in breach. Some operators reportedly made good efforts to receive the license that was not subsequently maintained.

Discussion

The survey was carried out by PHIs and respondents could have deliberately withheld information relating to compliance due to fear of reprisals.

About one-third of noncompliant FHEs tended to be newer, with the majority located in urban areas. This contrasts with other studies that argued that compliance is usually greater in urban areas as enforcers tend to be more lenient in rural areas as they get to know the people well and fear negative consequences in their relationship with them (Black, 1971; Hutter, 1988, 1997; Hutter & Amodu, 2008). The better compliance among rural FHEs in NERHA, however, could simply be due to their recognition of the potential adverse impact on business in a rural setting if word gets around about enforcement action(s).

Food safety training in NERHA needs urgent attention as it is mostly limited to that received at food handlers' clinics, which only last for 60-90 minutes and are limited in both coverage and depth. NERHA could target managers and supervisors in FHEs for a comprehensive trainer-of-trainers food safety program. The efficacy of this approach in ensuring compliance in FHEs is well established (Cates et al., 2009; Hedberg et al., 2006). This could result in a better trained workforce in FHEs and lessen the pressure on NERHA in affording greater concentration by PHIs on compliance-related issues. If NERHA were constrained in doing so then it could consider the divestment of this aspect of food handlers' training to a competent agency that

TABLE 3

Characteristics of Noncompliant and Compliant Food Establishments

Variable	Noncompliant Establishments % (#)	Compliant Establishments % (#)	<i>p</i> -Value
Location			<.007
Rural	32.4 (23)	51.6 (83)	
Urban	67.6 (48)	48.4 (78)	
Type of establishment			NS ^a
Food/snack shop	66.2 (47)	66.5 (107)	
Restaurant	22.5 (16)	22.4 (36)	
Supermarket	11.2 (8)	11.2 (18)	
Years in operation	· · · · ·		NS
≤5	53.5 (38)	50.9 (82)	
6–10	23.9 (17)	29.8 (48)	
>10	22.5 (16)	19.3 (31)	
Size of workforce			NS
≤3 workers	78.9 (56)	68.3 (110)	
4–5 workers	11.3 (8)	9.3 (15)	
6–10 workers	5.6 (4)	11.2 (18)	
≥11 workers	4.2 (3)	11.2 (18)	
Person-in-charge	· · · · ·		NS
Owner and manager	8.5 (6)	84.5 (136)	
Manager/supervisor	8.5 (6)	15.5 (25)	
Compliance with recomm	nendations given by health departme	nt	NS
All of the time	14.1 (10)	28.6 (46)	
Most of the time	50.7 (36)	49.1 (79)	
Sometimes	33.8 (24)	21.7 (35)	
Seldom	1.4 (1)	0.6 (1)	

should provide more in depth and categoryspecific training. NERHA would retain the responsibility to certify food handlers and PHIs would have more time to concentrate on the certification process inclusive of the maintenance of an effective information management system.

Several barriers to compliance were identified in our study that can be categorized as social, economic, and regulatory (Canadian Food Inspection Agency, 2013). Lack of money, time, and interest as barriers to compliance have also been identified by Fairman and Yapp (2004), Yapp and Fairman (2006), and Canadian Food Inspection Agency (2013). Smaller FHEs may lack the financial and technical resources to understand the requirements (Grabosky & Braithwaite, 1986; Hutter & Jones, 2006) and therefore can experience difficulties in complying (Hutter & Amodu, 2008). Compliance costs can be onerous especially on small establishments hence efforts could be made to assist them to determine such costs and their impact on these small businesses.

Interestingly, some respondents inferred that some PHIs were themselves barriers to compliance describing their recommendations as "unreasonable," "inconsistent," and expressed their lack of understanding of them. Similar findings were reported in the Auditor General's report (2008) and Yapp and Fairman (2004). Since no member of the focus groups was able to identify the correct food safety regulations, it is quite possible that respondents were also not aware of the regulations governing their businesses, which could perhaps explain their reliance on PHIs. Yapp and Fairman (2004) found similar reliance on EHOs for instructions about the correction of infractions and interpretation of the regulations by small- and medium-

TABLE 4

Factors Inhibiting Compliance Among Food-Handling Establishments (FHEs)

Inhibiting Factors	Noncompliant FHEs % (#)	Compliant FHEs % (#)	Total % (#)	<i>p</i> -Value
Social				
Lack of time to correct infractions ($n = 176$)	23.0 (14)	20.0 (23)	15.3 (37)	NS ^a
Lack of time to make application $(n = 131)$	15.8 (9)	14.9 (11)	15.3 (20)	NS
Lack of interest ($n = 176$)	8.2 (5)	14.8 (17)	12.5 (22)	NS
Problems with workmen ($n = 176$)	6.6 (4)	4.3 (5)	5.1 (9)	NS
Did not remember to apply for license $(n = 131)$	49.1 (28)	70.3 (52)	61.0 (80)	NS
Application process deemed a waste of time ($n = 131$)	7.0 (4)	4.1 (3)	5.3 (7)	NS
Did not remember to implement recommendations made by public health inspector (PHI) $(n = 176)$	1.6 (1)	3.5 (4)	2.8 (5)	NS
Economic				
Lack of money to correct infractions cited by PHI ($n = 176$)	54.1 (33)	41.7 (48)	46.0 (81)	NS
Lack of money to pay for the license $(n = 131)$	42.1 (24)	31.1 (23)	35.9 (47)	.01
Regulatory				
Did not understand recommendations made by PHI to correct infractions ($n = 176$)	44.3 (27)	27.0 (31)	32.9 (58)	.02
Utilized 30-day grace period ($n = 131$)	31.6 (18)	23.0 (17)	26.7 (35)	NS
Inconsistencies in PHIs' recommendations ($n = 176$)	31.1 (19)	30.4 (35)	30.7 (54)	NS
PHI did not provide reminder ($n = 176$)	15.8 (9)	23.0 (17)	14.8 (26)	NS
No follow-up by PHI ($n = 176$)	9.8 (6)	13.0 (15)	11.9 (21)	NS
Did not implement recommendations to correct infractions as the health department is not strict ($n = 176$)	0.0 (0)	6.1 (7)	4.0 (7)	NS

sized establishments. Operators should be encouraged to procure the regulations and understand the requirements for compliance and reduce their reliance on PHIs. The majority of respondents from noncompliant FHEs accused PHIs of not following up on noncompliance issues and this could have led them to conclude that the health departments were not serious about compliance. Similar findings were reported in the Auditor General's report (2008). PHIs charged with enforcing food regulations must demonstrate their seriousness quite unambiguously so that the wrong signals are not sent to FHEs, which could cause them to lose confidence in the regulatory process and undermine its credibility. Operators' forgetting to, or not having the time to, apply for a license or to implement corrective actions is suggestive of the need for enforcement. PHIs must be mindful of this very important option in securing compliance among the deliberately noncompliant, lest they be deemed to be barriers to compliance as was insinuated. Simple precursory measures, however, such as providing operators with a checklist and providing timely reminders about outstanding compliance requirements and deadlines should be explored.

Interestingly, the focus groups identified several barriers to compliance related to PHIs, which mirrored sentiments expressed by respondents such as inconsistency, failure to monitor, and follow-up. They also accused PHIs of bias and double standards. PHIs interviewed were also critical of some of their peers for not doing follow-ups on a timely basis and being too lenient with some clients.

Conclusion and Recommendations

The issues relating to noncompliance are related to social, economic, and regulatory factors involving both the regulated and the regulator. Where breakdowns and/or weaknesses exist in compliance, the public is at risk of foodborne illnesses. Considering that NERHA is one of Jamaica's most popular tourist destinations, foodborne disease outbreaks involving tourists could be disastrous to the country's delicate tourism sector. NERHA should promote greater understanding of the food regulations and a more proactive approach to compliance. Owners/ operators of FHEs should be encouraged to assume greater responsibility for the certification of their establishments and NERHA should hold PHIs more accountable for the certification of FHEs. The implementation of an expanded program for the training of food handlers involving a public/private partnership is proffered as well as the implementing of a grading system for restaurants and hotels and the publication of inspection scores together with retroactivity in licensing.

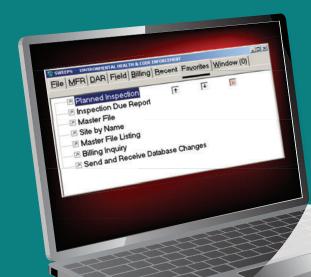
Corresponding Author: Norbert Campbell, Lecturer, Department of Community Health and Psychiatry, Faculty of Medical Sciences, The University of the West Indies, Mona, Kingston 7, Jamaica, West Indies. E-mail: norbert.campbell02@uwimona.edu.jm.

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The 2014 Dallas, Texas, Ebola Incident: Global Implications to All-Hazards Preparedness and Health Care Worker Protection

Christopher Eddy, MPH, REHS, RS, CP-FS College of Science, Engineering, and Technology Grand Canyon University

Eriko Sase, PhD Graduate School of Medicine University of Tokyo

Ebola and Risk

The Ebola virus is a zoonotic, nosocomial, and priority bioterrorism agent that is categorized under the rubric "viral hemorrhagic fevers (Centers for Disease Control and Prevention [CDC], 2013, 2015; Institute of Medicine, 2009)." In this article, we examine the personal protective equipment (PPE) utilized in U.S. hospitals during viral hemorrhagic fever (VHF) outbreaks by reviewing applicable, relevant, and appropriate guidance, published scientific literature, and other available information sources.

We examined a series of well-documented nosocomial VHF outbreaks, including the 2014 U.S. Ebola incident in Dallas, Texas, and a single nurse assistant in Madrid, Spain. They share common epidemiological attributes and indicate that a rapidly evolved Ebola patient viral load (which approximates 5-8 days of first symptom) causes a very short period between diagnostic recognition to response and opportunity for PPE escalation (Locsin, Barnard, Matua, & Bongomin, 2003; Towner et al., 2004). Infective dose is in the virus particle range (<10 virions); late stage infections render the patient increasingly contagious (Burd, 2015; Henderson, Inglesby, & O'Toole, 2002). Patient signs, including the loss of up to 8 L of highly viremic vomit and diarrhea daily (CDC, 2015; Kreuels et al., 2014), may present challenges to traditional hospital emergency room PPE procedures and practices. Terminal stage patients with VHF may present a severe risk to health care workers exposed to blood and other bodily fluids, both by direct and cutaneous contact (Mardani, Keshtkar-Jahromi, Ataie, & Adibi, 2009). Further, scientific consensus on the viability of Ebola transmission by aerosol/respiratory pathways remains equivocal (Brosseau & Jones, 2014; Osterholm et al., 2015). Hospitals are required to assess workplace hazards and control risk by the hazard vulnerability analysis assessment process (Pandemic and All-Hazards Preparedness Reauthorization Act [PAHPRA], 2013), including the selection of worker PPE based upon those evaluated hazards.

Nosocomial VHF

Historically, VHFs have caught health care facilities off guard. From seven documented outbreaks of nosocomial VHF (Ebola nonendemic countries), 27 secondary or tertiary nosocomial infections occurred. The outbreaks are significant to the Ebola 2013-2014 epidemic globally and to the 2014 Dallas, Texas, Ebola incident specifically due to instances of misdiagnosis, patient morbidity, and the secondary infection of health care workers wearing various levels of PPE. The outbreaks involved dengue, Crimean-Congo hemorrhagic fever (CCHF), or Ebola, all of which are designated as Category A bioweapons agents (CDC, 2013; Henderson et al., 2002). The pathogens were determined to be primarily vectored by tick bites or direct human contact or needle stick accidents in Russia, Turkey, Iran, Germany, Pakistan, and Afghanistan. An American soldier was misdiagnosed with foodborne illness and later tested positive for CCHF (bitten by a tick in Afghanistan), and after infecting two military medical workers who did not wear respirators during aerosol-generating processes (bronchoscopies), he died (Conger et al., 2015). A Madrid nurse assistant wearing standard precaution PPE became infected with Ebola from an unconfirmed transmission pathway, while involved in the disposal of liquid Ebola waste "absorptive material (Parra, Salmeron, & Velasco, 2014)."

Transmission Pathways

Although the Centers for Disease Control and Prevention (CDC) advise that Ebola cannot be transmitted by airborne pathways, the routes of transmission are unclear (Brosseau & Jones, 2014). Ebola has long been known to be transmissible by aerosol (Henderson et al., 2002; U.S. Army Medical Research Institute of Infectious Diseases, 2011). Recent research by Osterholm and co-authors suggests that Ebola is potentially transmissible as a "respiratory pathogen with primary respiratory spread (Osterholm et al., 2015)." Other VHF transmission pathways include person-to-person (bodily fluids), arthropod (insect) vectors, nosocomial, laboratory accident, fomite (contaminated environmental surfaces), humananimal contact, and the intentional use as bioweapons (Osterholm et al., 2015).

The VHF outbreaks throughout Eurasia show that an all-hazards preparedness scope must go beyond Ebola to include all VHFs due to natural vector transmission, accident, and potential intentional attacks through bioweapons. Environmental health risk factors, social and physical vulnerabilities, and individual susceptibility should be analyzed for patients admitted into the hospital during diagnostic evaluation: travel to endemic countries, contact with diseased live or dead animals, contact with sick humans, and bites from insects (Henderson et al., 2002). The same risk factors previously listed may be completely absent in the case of an intentional act of terrorism or war, and further complicates the task of diagnosing and managing emergency patients (Henderson et al., 2002).

Clinical Crisis, Dallas, Texas, 2014

Based on the ASTM Standard Guide for Hospital Preparedness and Response, the 2014

U.S. Ebola incident could not be defined as a disaster by local officials. The ASTM standard defines a disaster as "...an event that exceeds (or might exceed) the resources for patient care at that time, for a community, a hospital, or both (ASTM, 2004)." On October 8, 2014, however, the Dallas Ebola index case, a Liberian man, died of hemorrhagic fever 14 days after being originally diagnosed with a sinus infection (Sack, 2014; Texas Health Resources, 2014). The Dallas Ebola index case progressed from first symptoms to explosive diarrhea and projectile vomiting in three days (Nina Pham v. Texas Health Resources, Inc., 2015). A series of errors, including misdiagnosis, miscommunication, and treatment delay, may have irreversibly impacted the fate of the patient and the health of two nosocomially infected nurses (CNN, 2014; Gillman, 2014; House Energy and Commerce Committee Subcommittee on Oversight and Investigations, 2014; Texas Health Resources, 2014). In addition, the two nurses were flown separately from Dallas to research hospitals at the National Institutes of Health in Bethesda, Maryland, and CDC in Atlanta, Georgia (equipped for emergency Ebola treatment) (Texas Health Resources, 2014).

All-Hazards Disaster Preparedness

Hazard Vulnerability Assessment

All-hazards disaster preparedness, required by the Joint Commission and the Pandemic and All-Hazards Preparedness and Response Act (PAHPRA) (2013), is accomplished by a broadly designed hazard vulnerability assessment (HVA) tool. It includes the designation of appropriate health care worker PPE based upon that assessment of risk (ASTM, 2004; Austin, Nitta, Picanzo, Schramm, & Wasielewski, 2013; Campbell, Trockman, & Walker, 2011; U.S. Department of Homeland Security, 2008, 2014). Many key elements of an effective hospital emergency plan are driven by the correct assessment of "worstcase-scenario" hazards; emergency plan; hospital incident command system (HICS) structure and operating and communication procedures; selection and designation of employee PPE; and systematic disaster simulation drills with community first responders and other stakeholders (ASTM, 2004). The key is to be able to provide a "rapid and effective all-hazards response to any event (ASTM, 2004)." It has been documented, however, that hospitals do not follow standardized methods for performing HVAs, and a high degree of variation exists in scope and process (Campbell et al., 2011).

The PAHPRA reauthorized to include an emphasis on national public health security and hospital preparedness in 2013, also focuses on emerging threats, biosurveillance, and necessary funding to accomplish allhazards objectives (PAHPRA, 2013). Nevertheless, many HVA models assume that low probability events merit lower priority, while it is suggested that high consequence events must be emphasized, regardless of estimated probability of occurrence (ASTM, 2004; Eddy & Sase, 2015). The costs of the U.S. Ebola incident to the Dallas hospital managing entity and the communities involved around the world, in terms of human harm and economic loss, include the following:

- Three hundred forty-three patient contact cases (eight Madrid contacts subtracted from total) were monitored by health care professionals in Texas and Ohio.
- Ninety-three people were either self-quarantined, legally isolated under order, or "placed under controlled movement restrictions."
- A financial settlement with the Dallas index case family was established.
- The temporary closure of the emergency department at the Dallas hospital occurred.
- A public relations firm was hired by the Dallas hospital managing entity (McCarty et al., 2014; *Nina Pham v. Texas Health Resources, Inc.*, 2015; Smith et al., 2015; Texas Health Resources, 2014; Washkuch, 2014).

Occupational Safety and Health Administration (OSHA) and Relevant and Appropriate PPE Guidance

Regulatory and nonregulatory reasons cited above compel the reevaluation of PPE for VHFs potentially encountered in the health care environment. Ebola is listed as a priority bioterrorism agent due to the following criteria: ease of transmission between people; high mortality rate; threat to public health and potential for disturbance of society; and the requirement for "special action for public health preparedness (CDC, 2015)."

OSHA governs worker PPE regulation by requiring the employer to assess the hazards present in the workplace and provide appropriate levels of protection (CFR 1910.120). In the event that hazards are unknown, OSHA requires the provision of level B PPE, including a self-contained breathing apparatus (Occupational Safety and Health Administration [OSHA], 2005). Because Ebola pathogen modes of transmission are not well understood, morbidity is high, and proven treatment and vaccines do not exist (Brosseau & Jones, 2014), consideration should be given to classifying them as unknown hazards. Further, The InterAgency Board (IAB), a collaboration of "all levels of government" that specializes in all-hazards preparedness, assigns Ebola a "high risk" classification when exposure potential is severe, and suggests the "highest recommended protection level," based upon proximity and "the likelihood for any exposure to body fluids or contaminated waste as part of operations (The InterAgency Board [IAB], 2014)." Based upon the individual assessment of potential worker exposure, IAB recommends specific combinations of PPE such as a fully encapsulated worker garment (with covered, virusresistant seams) and a respirator with a sealed hood (or helmet) that has overlapping protective covers (IAB, 2014). It also states that higher levels of PPE for high-risk scenarios are acceptable, such as the self-contained breathing apparatus and chemical, biological, radiological, nuclear, and explosive protection-qualified PPE (IAB, 2014). Additionally, evidence indicates the successful protection of health care workers utilizing "pressurized suits equipped with HEPA filtered ventilators," when working in high viral load environments (Kreuels et al., 2014).

Hospital PPE: Standard Precautions

Standard precaution PPE (gowns, gloves, surgical mask, and eye protection), may also include the N-95 paper filter respirator and the purified air powered respirator for contact and airborne precautions (Conger et al., 2015; Kortepeter et al., 2008). The U.S. Department of Health and Human and Services (DHHS), however, provides written PPE guidance that states both the N-95 and powered air-purifying respirators: both can allow contaminants to breach the units (DHHS, 2014). Some entities advise against the automatic assumption of PAPRs as protective for hazardous hospital

environments, while advocating the performance of a full HVA to assess the adequacy of PPE against potential health care worker hazards (OSHA, 2005).

Additionally, surveyed health care workers show uncertainty about all respirator usage, including equipment donning and doffing. Administrators consider PAPRs favorable to N-95 paper respirators, due to the absence of required fit testing, despite superior protection (Liverman, Domnitz, & McCoy, 2015). Fewer than 1% of all the U.S. surveyed hospitals, however, had PAPRs in emergency caches (Association of State and Territorial Health Officials [ASTHO], 2014). The costs of PPE fit-testing and training have driven hospital administrator's decisions when considering PPE selection (Liverman et al., 2015). The annual calculated costs of reusable and cleanable elastomeric respirators and PAPRs are actually less than the disposable (and less effective) N-95 paper filter respirators (ASTHO, 2014; Brosseau & Jones, 2014).

Biosurveillance, **Early Event Detection**, **and Prevention**

The International Health Regulations (IHR) overseen by the World Health Organization (WHO) are chartered to prevent the transnational movement of infectious diseases (World Health Organization, 2008). Yet WHO has received some criticism for delaying the

declaration of a "public health emergency of international concern" in 2014, causing it to be less effective than intended (Gostin & Friedman, 2014). As were the cases in Dallas and Madrid, biological agents are often first detected in the hospital, not through biosurveillance systems (Austin et al., 2013; U.S. Department of Homeland Security, 2014), which indicates a diminished preparedness capacity. Early-detection biosurveillance systems, however, are presently incompletely formed (Eddy, Sase, & Schuster, 2010; Eddy, Stull, & Balster, 2013; Gates, 2015; *The Lancet*, 2014; World Health Organization, 2008).

Conclusion

The hazard vulnerability assessment, required to be performed internally by all hospitals (Austin et al., 2013; PAHPRA, 2013), provides hospitals an opportunity to reevaluate their emergency plan and strengthen preparedness by applying the lessons learned from the 2014 U.S. Ebola incident. Paper filter N-95 respirators, even when utilized with face shields, may be challenged to dependably protect the worker in such an extremely hazardous occupational exposure environment. Due to the volume and infectivity of bodily fluids, the late stage, highly viremic, and hemorrhagic patient environment may present a hazard to health care workers similar to hazardous material exposures that first responders might experience. The PAPR should also be revisited for effectiveness via the HVA, in addition to fullbody garment protection.

U.S. national guidance requires the preparedness for terrorism and other disasters (ASTM, 2004; PAHPRA, 2013; U.S. Department of Homeland Security, 2008, 2014), which could involve the natural or intentional introduction of VHFs with high human and economic consequence into the hospital and community. To adequately assess the potential risk to workers, Ebola ecology, epidemiology, and transmission modality must be better understood. Yet, early VHF signs and symptoms are not easily distinguishable from many other communicable infectious diseases. Therefore, the following must be established to assure that health care workers become well-prepared for all-hazards: biosurveillance information, correct and immediate diagnosis, algorithms to determine the potential for zoonotic or other specific environmental contact sources, operational and practiced HICS systems including effective internal and external communications, and appropriate PPE for health care workers.

Corresponding Author: Christopher Eddy, Adjunct Faculty, Grand Canyon University College of Science, Engineering and Technology, 3300 West Camelback Rd., Phoenix, AZ 85017. E-mail: chris.eddy@my.gcu.edu.

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NEHA NEWS

Note of Thanks to Departing Board Members

We would be remiss if we did not acknowledge the dedication, hard work, and efforts of two members of the NEHA board of directors on the occasion of their departure from the board: Immediate Past President Alicia Collins and Region 2 Vice President Marcy Barnett.



Immediate Past President Alicia Collins leaves the board after 10 years of dedicated service and leadership. In 2010, she was elected second vice president and served as president of NEHA in 2013–2014. Prior to that Alicia served as NEHA's Region 2 vice president from 2005 to 2010. Preceding to her work on the board, she chaired NEHA's air/land

technical section from 2002 to 2005.

Alicia is a food safety program manager with The Steritech Group, Inc., and works closely with Chick-fil-A, Inc.'s, Food Safety Team at their headquarters in Atlanta. From 2006 to 2013, she was employed by the Sacramento County Environmental Management Department where she served as the deputy chief of the Environmental Health Division. During this time the Sacramento County Environmental Management Department was awarded the Samuel J. Crumbine Consumer Protection Award in 2008 with Alicia acting as team lead for planning and implementation of food program enhancements. Alicia was also the recipient of the California Conference of Directors of Environmental Health's Manager of the Year, Robert Merryman Award for 2006–2007.

Although her time on the NEHA board is at an end, she is still active within the association. Alicia is currently the president of the Past Presidents affiliate and is a member of NEHA's new Industry Affiliate. Reflecting upon her experience, Alicia states, "It has been an honor to serve NEHA and our profession alongside so many esteemed and dedicated professionals who are committed to protecting the health and well-being of our communities. Thank you for your service to NEHA and for using your expertise to protect humankind. I extend my deepest gratitude to our members, who are talented, caring, unsung, everyday heroes."



Region 2 Vice President Marcy Barnett leaves the board after two years of dedicated service and leadership.

Marcy is currently an emergency preparedness liaison for the California Department of Public Health Center for Environmental Health in Sacramento. In this capacity she works with the state and local environmental health

programs to expand capacities for disaster response and recovery.

As a board member, Marcy represented NEHA members on matters of policy, governance, and oversight of the association. She served on the finance, nominations, and AEC committees.

Marcy states, "I am proud to have served NEHA and its members at a time of significant change for the organization. The board has worked diligently for the past two years to adapt to changes in our profession and technology to ensure that NEHA remains a leader in environmental health and continues to offer high quality services and training for environmental health professionals across the country and the world. I have enjoyed my time on the board and deeply respect the work of the dedicated members of the NEHA board of directors."



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BUILDING CAPACITY



Darryl Booth, MBA

Embracing a Unified Brand Builds Capacity for Health Departments



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

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

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

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

Darryl Booth is senior vice president and general manager of environmental health at Accela and has been monitoring regulatory and data tracking needs of agencies across the U.S. for 18 years. He serves as technical advisor to NEHA's technology section, which includes computers, software, GIS, and management applications.

posted letter grade. A colored placard. A numeric inspection score. The weekly Dirty Dozen on the local news. Each intends to intervene—to prompt restaurant operators to manage their kitchens within the confines of known safe food handling practices. In turn, they work to avoid critical violations, a subpar grade on the window, and the resulting loss of customers and revenue.

This often-debated topic draws strong opinions from consumers, restaurateurs, and health inspectors. Is this intervention more effective than any other? Its critics say it is imprecise: the score only captures a moment in time, a virtual click of the camera's shutter. Its advocates say it's the quickest and most effective way to achieve compliance.

This column, however, is not about the practice of posting grades or placards, or its efficacy. This article is about how local health departments go about developing such a program. Are local health departments protecting their capacity to prevent foodborne illnesses if this project consumes staff and other resources? From my unique perspective as a data manager and a software provider to some of the largest local health departments in the nation, I advise and assist health departments as they implement a grading and placarding program for their restaurants.

Each project begins similarly, with dawning awareness. Perhaps a citizen, civic leader, or local news reporter asks, why not us? A conference presentation might catch the attention of a food program manager. The notion grows into discovery—learning what neighboring jurisdictions have done and what works well. Once choices are weighed, there is resolve to pursue it. Resources are allocated. Committees are formed. Meetings held. Work assigned.

But, here's the rub. The implementation, by my observation, is never a direct reproduction of the model. Even in geographically adjacent jurisdictions, the implementation varies, like a copy of a copy of a copy. The formula, the policy, the visuals, the thing must get injected with local flavor. Inspectors are often pulled from the field or consultants hired at great cost, to research, advise, ponder, debate, and design the new program.

Consider the city of Pasadena and Los Angeles County Environmental Health Departments. They share a geographic border and, no doubt, restaurants and commuting citizens routinely cross this boundary without even knowing it. Both jurisdictions start an inspection with 100 points and dock points based on the severity of violations cited. From there, though, the methods start to diverge, from what resulting number counts for what score, to the score itself: LA County issues a letter grade and Pasadena a "pass/conditional pass/closed" placard. Some jurisdictions post a numbered score with pass/

COUNTY ENVIRONMENTAL HEALTH SERVICES DIVISION
PASS
FACILITY NAME:
ADDRESS:
This facility was inspected by COUNTY in accordance with the California Retail Food Code and has satisfactorily PASSED.
INSPECTED BY:ONON
NAME TITLE COUNTY Visit example.com for inspection results. A copy of the most recent inspection report is available at this location upon request.
COUNTY Environmental Health Services Division ADDRESS CITY, STATE ZIP PHONE example.com

conditional pass/close placard, and others use different phrasing ("consumer alert" instead of "conditional pass") or different colors (blue instead of yellow).

What accounts for these customizations and do they deliver a measurable improvement over any other? Are consumers experiencing foodborne illnesses at a reduced rate due to the nuanced differences across the freeway?

In some cases, the agency chooses to put its own "stamp" on the project, so that it can be better defended ahead of detractors. In others, local politics rule. For example, councils in Champaign-Urbana, Illinois, and Allegheny, Pennsylvania, rejected letter grading after several false starts and debating the topic for years and \$75 per hour for a consultant to study the issue for three months (http://tinyurl.com/nczb5gc), with one council member quoted as saying, "I'm not convinced this proposal increases food safety."

At a minimum, regions should work together and expect a common standard. I understand that the state of Hawaii and at least five counties in California have all adopted Sacramento County's placard (Figure 1), which was a major factor in Sacramento County earning the Samuel Crumbine Award for Excellence in Food Protection in 2008 (http://tinyurl.com/ oa9bw29). I applaud these programs and hope to see this well-developed brand spread.

Here's our call to action. Imagine a situation where a County Board of Supervisors is presented with a vetted, science-based standard published by a nationally recognized and respected environmental health organization. We need a standard that would guide the program manager or director through every step of implementation and presentation. This package would arguably carry a great deal more weight in convincing stakeholders of the best approach—the research has been done, the design is complete—add your county seal here and go. Most importantly, the cost should be minimal and the impact the same.

By this column, I call upon NEHA, its members, leaders, and staff, to develop and present this standard, entirely compatible with the Food and Drug Administration *Food Code*, by which a health department can quickly and efficiently launch a grading or placarding program. The scoring method and placard design should be professional, defensible, and specific—let us settle the questions of simple math once and for all and embrace a brand.

Corresponding Author: Darryl Booth, Senior Vice President and General Manager of Environmental Health, Accela, 1195 W. Shaw, Fresno, CA 93711. E-mail: dbooth@accela.com.

Did You Know?

The *Journal* is always looking for your feedback! We want to know what you like (or don't like) about each issue. Submit any feedback to jeh@neha.org.

DIRECT FROM AEHAP



Jason W. Marion, PhD



Health Professionals and the Role of EHAC-Accredited Programs in Increasing the Pool

The Need for Environmental Public

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

This column will provide AEHAP with the opportunity to share current trends within undergraduate and graduate environmental health programs, as well as their efforts to further the environmental health field and available resources and information. Furthermore, professors from different EHACaccredited degree programs will share with the *Journal's* readership the successes of their programs and the work being done within academia to foster the growth of future environmental health leaders.

Jason Marion is an assistant professor of environmental health science at Eastern Kentucky University and is currently president-elect of AEHAP. Yalonda Sinde is the executive director of both AEHAP and EHAC.

ntroduction

As early as 1990, Larry Gordon was communicating concern for the nation's health and a potential decline in the rate of improvement in U.S. environmental health due to a decline in the number of and/or a lack of awareness of the value brought by interdisciplinarytrained environmental health science practitioners to public health problems (Gordon, 1990). His concerns have again been echoed more recently in governmental decision making related to current environmental public health affairs (Goldstein, Kriesky, & Pavliakova, 2012). The likely cause for the absence of environmental health as pointed out by Gordon (1990) is a growing disconnect between life, physical, and health scientists failing to receive adequate interdisciplinary training needed to solve the complex public health problems of today both domestically and abroad. Emerging from the expectations set forth by Gordon (1990), core competencies were established for environmental health practitioners (American Public Health Association & Centers for Disease Control and Prevention, 2001), which have continued to evolve.

The efforts of establishing and maintaining the essential interdisciplinary framework that includes the requisite coursework related to air, water, and food quality as well as epidemiology, toxicology, chemistry, biology, and much more are of little value to the public health workforce unless the training is actually provided to future practitioners. The need for a skilled environmental health workforce has been well articulated over the last decade by the broad public health community (Council for State Governments & Association of State and Territorial Health Officials, 2004; Perlino, 2006), and the shortage has resulted in at least temporary additional federal investment in training above and beyond the previous support for improving the nation's public health surveillance workforce (Drehobl, Roush, Stover, & Koo, 2012). If the workforce shortage continues or grows, the environmental health positions will still be filled, but possibly with biologists, wildlife/conservation scientists, zoologists, and maybe even nonscience personnel, all of whom may have little or no public health background. An interdisciplinary-trained environmental health professional is the desirable choice, however, in filling environmental public health positions.

The questions now remaining before our profession and our leaders are as follows:

TABLE 1

Employment Summary for Environmental Health–Related Fields From 2012 Projected to 2022

Occupation Classification Title	2012 Employment ^a	2022 Employmentª	New Positionsª (2012–2022)	% Growth	Job Openingsª (2012–2022)	2012 Median Annual Wage	Rank of 166 Job Titles
Environmental scientists and specialists, including health	90	103.2	13.2	14.6	39.7	63,570	33
Environmental engineers	53.2	61.4	8.1	15.3	21.1	80,890	35
Geoscientists	38.2	44.2	6	15.8	17.3	90,890	37
Chemists	87.9	92.9	5	5.6	27.8	71,770	70
Occupational health and safety specialists	62.9	67.1	4.2	6.6	21.3	66,790	71
Food scientists and technologists	19.4	21.5	2.1	10.8	8.5	58,070	87
Microbiologists	20.1	21.6	1.4	7	7.1	66,260	99
Soil and plant scientists	16.3	17.6	1.2	7.5	6.7	58,740	111
Life scientists	9.9	10.9	1	10.2	3.1	65,330	115
Biological technicians	80.2	88.3	8	10	32.1	39,750	116
Zoologists and wildlife biologists	20.1	21.1	1	4.9	6.7	57,710	128
Foresters	12	12.8	0.7	6.1	4.2	55,950	131
Biological scientists	34.3	34.1	-0.2	-0.6	9.8	72,700	132
Forensic science technicians	12.9	13.7	0.7	5.8	5.8	52,840	136
Emergency management directors	9.9	10.7	0.8	8.3	2.2	59,770	137
Conservation scientists	22.1	22.3	0.1	0.5	6.6	61,100	142
Recreation workers	345.4	394.4	49	14.2	89.7	22,240	145

Note: Ranked using a rank-based formula considering median annual wage, percentage growth, and new openings. Source: Bureau of Labor Statistics, 2015a. ^aIn thousands.

How great is the need for interdisciplinary EH professionals and are we meeting that need? Furthermore, what can we do to strengthen our profession to ensure our profession remains competent in the applied science areas of the profession while protecting our core public health backbone that unites us? To address these questions, we look at the most current data on employment in our profession and related occupations as well as the ongoing work of the Association of Environmental Health Academic Programs (AEHAP).

Employment Outlook

The U.S. Department of Labor Bureau of Labor Statistics (BLS) (2015a) provides employment and projected employment statistics for 818 occupations according to their respective standard occupation classification (SOC) system code. Among these 818 occupations, 166 are designated as having a typical entry-level education of a bachelor's degree. "Environmental scientists and specialists, including health," are included in this group of 166 as SOC 19-2041. Also in this group of 166 is the "occupational health and safety specialists" occupation, which is a different classification (SOC 29-9011). Several of the job titles BLS associates with the environmental science code include environmental analyst. environmental scientist, hazardous substances scientist, health environmentalist, water pollution scientist, and water quality analyst. In the occupational health code, titles such as industrial hygienist, health and safety inspector, and environmental health sanitarian are listed. Based upon the diversity of the professions represented as environmental health scientists, it is difficult to specifically identify a single job code representative of the profession as a whole (Massoudi, Blake, & Marcum, 2012; Sumaya, 2012). Additionally, the data are representative of the nation, and may not reflect all local or regional workforce conditions.

In reviewing the BLS employment outlook data, three key measures of great interest to prospective environmental health professionals, including students, stand out: annual wages, number of job openings, and employment growth. The annual wage data are based upon the median earnings in the profession in 2012. The job openings data represent the number of job openings due to growth and replacement from 2012 through 2022. In this data, replacement includes the number of persons leaving the profession including retirement whose positions will need to be replaced. The third data piece, growth of the profession, represents the percentage growth in total number of persons projected to be working in the field in 2022 compared to 2012. Using these data, we ranked 166 programs from 1 to 166 in each area. We then multiplied the rankings of each of these three areas to provide an overall rank that accounts for earnings, job growth, and job availability to enable a comparison of the various related professions and to compare the environmental health

TABLE 2

Employment Summary for Environmental Scientists and Specialists, Including Health, in the Nongovernmental Professional, Scientific, and Technical Services Fields From 2012 Projected to 2022

Area and Area of Industry	20)12	20	022	% Growth	Employment Changeª	
	Employment ^a	% of Occupation	Employment ^a	% of Occupation			
Professional, scientific, and technical services	36.3 40.3		47.5	46.0	30.9	11.2	
Architectural, engineering, and related services	12.9	14.4	15.7	15.2	21.3	2.8	
Engineering services	9.0	9.9	10.9	10.5	21.1	1.9	
Testing laboratories	3.8	4.2	4.6	4.4	21.5	0.8	
Management, scientific, and technical consulting services	19.2	21.3	27.0	26.1	40.8	7.8	
Scientific research and development services	3.6	4.0	4.1	4.0	12.5	0.5	
Research and development in the physical, engineering, and life sciences	3.4	3.8	3.8	3.7	12.4	0.4	
Source: Bureau of Labor Statistics, 2015a. aln thousands.							

profession to the nation's fastest growing, well-paying occupations.

In terms of median earning potential for environmental scientists and specialists, including health, we see the 2012 median wages were \$63,570 (Table 1). A slightly higher median wage was observed for the occupational health classification at \$66,970 (Table 1). In terms of the 166 occupational classifications, both occupational codes rank in the top half of all baccalaureate degree requiring jobs with rankings of 71 and 78, respectively, of the 166 programs. Compared to the environmental-related occupations listed on Table 1, the wages for these two occupational codes are in the top quartile.

Although pay is important, the ability to secure employment is also of importance. With respect to job openings, when combining the two occupational codes, 61,000 new professionals will be needed to replace retirees and fill the new positions produced by growth demands. The environmental scientist and specialist, including health, classification is among the top one-third of baccalaureate degree-based occupations in the country for number of projected job openings, and occupational health and safety specialists are in the top half. Both occupational classifications present very large numbers of openings compared to many of the other environmental-related occupations, with environmental scientists and specialists, including health, being the leader in this group (Table 1).

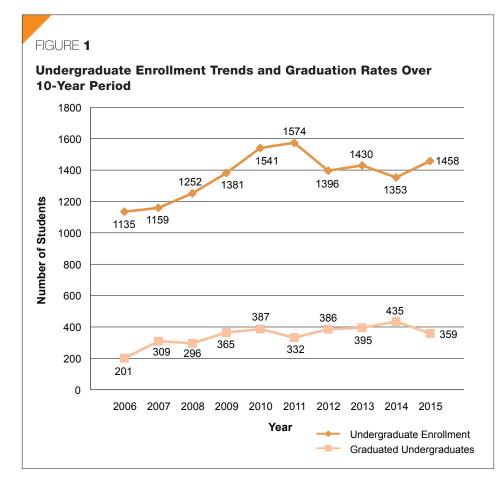
In terms of growth, the environmental scientist and specialist, including health, classification is growing in terms of new positions with a 15% growth rate. This rate is greater than the national average of 10.5%. The occupational health and safety classification is growing slower than the national average, with decreases in federal employment and manufacturing projected. Among all 166 occupations assessed, environmental scientists and specialists, including health, as an occupation is growing faster than 123 other occupations requiring a baccalaureate degree for job entry.

A detailed look at the location of much of this growth shows significant new jobs and demand for environmental health personnel in areas related to professional, scientific, and technical services and health care (BLS, 2015a). The majority of the growth in the professional, scientific, and technical services area is likely to occur in management, scientific, and technical consulting services, where 41% growth is projected to occur (Table 2; BLS, 2015b). Similar large gains in the same consulting services area of the industry are also projected in the occupational health and safety occupation, again with 41% growth projected (BLS, 2015b). In total, in the environmental scientists and specialists, including health occupation, an additional 7,800 new consultants are expected between 2012 and 2022. Additionally, 1,700 new consultants are expected in the occupational health and safety occupation.

With respect to the public workforce, the environmental scientists and specialists, including health, occupation currently represents 38,500 persons and is expected to grow by 1,000 state and local government positions, while decreasing by 700 federal positions (BLS, 2015b). In the occupational health classification, a total of 20,100 persons are employed, and a loss of 1,000 federal positions is projected by 2022, with a gain of 400 local and state positions (BLS, 2015b). When combined, the two occupational classifications represent 58,600 current public sector employees in these occupations.

Meeting Educational Needs

Despite much progress in recruiting and graduating more students, the private sector of environmental health continues to



grow quickly, contributing to a shortfall of qualified environmental health professionals. AEHAP formed in 1999 in response to a national shortage of highly trained environmental health professionals, and due to growth in the field, this response is still warranted. AEHAP's primary focus is to support, enhance, and diversify the student body of environmental health degree programs accredited by the National Environmental Health Science and Protection Accreditation Council (EHAC). For ensuring a healthy environmental health workforce, AEHAP is charged with three primary objectives: (1) to increase the number of EHAC-accredited programs, (2) to increase the number of students enrolled in these programs, and (3) to increase the diversity of the student body in EHAC-accredited programs.

New program recruitment is AEHAP's primary activity. AEHAP has greatly increased marketing to potential environmental health science academic programs via e-mail, social media, face-to-face outreach through exhibiting at conferences, and direct mail. Increased outreach has led to a total of 23 programs currently interested in joining the ranks of EHAC's 39 accredited programs. Programs seeking accreditation are supported with mentoring from volunteer faculty in EHAC programs. By growing the number of programs, the opportunity to attract more students to the profession increases.

Among the EHAC-accredited programs, the 2014-15 undergraduate enrollment increased from 1,353 to 1,458, representing an 8% increase from the 2013-14 academic year (Figure 1). Furthermore, an 11% increase in graduate enrollment was observed from 260 last year to 289 current graduate students. The total enrollment for this year was 1,757 students, which is an increase of 4% as compared to 1,683 students enrolled in the 2013-2014 academic year. The 2014-2015 undergraduate enrollment rate is currently 7% above the 10-year enrollment average. Graduate enrollment is at an all-time high. This year also resulted in the graduation of a total of 436 students—359 undergraduates and 77 graduates.

Student diversity has seen a steady rise for the past 10 years. Currently, 38% of students enrolled in EHAC-accredited programs are minorities. Diversity trends have largely increased or decreased according to the number of Minority Serving Institutions that are accredited by EHAC. Overall, diversity has increased by 91% since the academic year 2005–2006.

Promoting the Profession

The environmental health profession is an indemand profession, particularly in the private sector. This trend is likely to continue, with greater than 40% growth anticipated in consulting by 2022. Higher paying cooperative education opportunities with large companies and consulting firms are aimed at training and enticing environmental health students into jobs, leading environmental health students into respectable careers. Low pay or no pay for internships with public health agencies, particularly state and local agencies, creates a selection pressure that may discourage some of the best students from seeking the public opportunities. Some progress has been made in recent years with paid internships provided by the Centers for Disease Control and Prevention and other agencies; however, the profession has further to go and should not be shy in using data to make a case about the environmental health profession's unique position in the public health landscape. Furthermore, the profession ought to also continue to tout the value that is also brought by private sector environmental health practitioners in promoting and protecting the nation's health (Roberts, 2009).

Practitioners and local leaders in the environmental health field can play a critical role in promoting the profession and should be comfortable championing the opportunities available to college-seeking students and adults, as well as current college students who may have an interest in pursuing a degree in environmental health. Many entering college students are often unaware of the employment outlook and salary profile of their chosen majors, and when given factual data in low wage fields, these students prefer to seek out more lucrative options (Arcidiacono, Hotz, & Kang, 2012). For university partners, many of the courses required for an environmental health major are often offered, and by working with AEHAP, a university can pursue the opportunity to establish an

accredited program in this growth area. For students desiring a favorable occupational outlook in an environment outside information technology and full-time office settings in the finance industry, few careers offer the diversity of daily duties and balance as the environmental health profession (Table 3).

Lastly, promoting the public environmental health profession does not stop with promoting education or training, but also promoting competitive pay in the public workforce. As private sector opportunities increase, the need for greater resources for maintaining a highquality public sector workforce is worthy of consideration or further research. When students graduate, multiple occupations are considered, with public- and private-sector jobs and careers both being viable options, more so in environmental health than in any of the other public health professions. Therefore, true understanding of our profession requires not only understanding of the public sector environmental health employment outlook, but also the important and ever-growing role of private-sector environmental health.

Corresponding Author: Yalonda Sinde, Executive Director, AEHAP, P.O. Box 66067, Burien, WA 98166. E-mail: ysinde@aehap.org.

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TABLE 3

Employment Summary for Top 33 Job Titles According to a Rank Order Considering Median Annual Wage, Percentage Growth, and Number of New Job Openings in Thousands

Occupational Classification Title	% Growth	Job Openingsª (2012– 2022)	2012 Median Annual Wage	Rank of 166 Titles
Software developers, applications	22.8	218.5	90,060	1
Software developers, systems	20.4	134.7	99,000	2
Medical and health services managers	23.2	149.9	88,580	3
Computer and information systems managers	15.3	97.1	120,950	4
Computer systems analysts	24.5	209.6	79,680	5
General and operations managers	12.4	613.1	95,440	6
Management analysts	18.6	245.2	78,600	7
Construction managers	16.1	154.6	82,790	8
Civil engineers	19.7	120.1	79,340	9
Information security analysts	36.5	39.2	86,170	10
Marketing managers	12.7	61.7	119,480	11
Financial analysts	15.5	100.9	76,950	12
Personal financial advisors	27	96.4	67,520	13
Human resources managers	13.2	40.6	99,720	14
Computer network architects	14.6	43.5	91,000	15
Market research analysts	31.6	188.5	60,300	16
Financial managers	8.9	146.9	109,740	17
Logisticians	21.9	42.2	72,780	18
Petroleum engineers	25.5	19.6	130,280	19
Administrative services managers	12.2	79.9	81,080	20
Architects	17.3	44.1	73,090	21
Sales managers	8.3	106.9	105,260	22
Operations research analysts	26.7	36	72,100	23
Database administrators	15.1	40.3	77,080	24
Cost estimators	26.2	118	58,860	25
Accountants and auditors	13.1	544.2	63,550	26
Securities, commodities, and financial services agents	11.2	122.6	71,720	27
Network and computer systems administrators	11.7	100.5	72,560	28
Sales representatives	9.7	111.8	74,970	29
Social and community service managers	20.8	55.1	59,970	30
Public relations and fundraising managers	12.9	21.3	95,450	31
Actuaries	26.1	13.2	93,680	32
Environmental scientists and specialists, including health	14.6	39.7	63,570	33
^a In thousands.				

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The following colleges and universities offer accredited environmental health programs for undergraduate and graduate degrees (where indicated). For more information, please contact the schools directly, visit the National Environmental Health Science and Protection Accreditation Council (EHAC) Web site at www.ehacoffice.org, or contact EHAC at ehacinfo@aehap.org.

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Boise State University Boise, ID Dale Stephenson, PhD dalestephenson@boisestate.edu

California State University at Northridge[†] Northridge, CA Thomas Hatfield, DrPH, REHS thomas.hatfield@csun.edu

California State University at San Bernardino San Bernardino, CA Lal S. Mian, PhD Imian@csusb.edu

Central Michigan University Mount Pleasant, MI Rebecca Uzarski, PhD uzars2rl@cmich.edu

Colorado State University Fort Collins, CO David Gilkey, DC, PhD, CPE dgilkey@colostate.edu

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[†]University also has an accredited graduate program. ^{††}Accredited graduate program only.

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East Central University Ada, OK Doug Weirick, PhD dweirick@ecok.edu

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Ohio University Athens, OH Michele Morrone, PhD morrone@ohio.edu

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Texas Southern University Houston, TX Judith Mazique, MPH, JD mazique_jx@tsu.edu

The University of Findlay[†] Findlay, OH Timothy Murphy, PhD murphy@findlay.edu

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University of Illinois Springfield⁺⁺ Springfield, IL Sharron LaFollette, PhD slafo1@uis.edu

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DIRECT FROM ATSDR

The Navajo Birth Cohort Study

LCDR Candis M. Hunter, MSPH, REHS Johnnye Lewis, PhD, DABT RADM (Ret.) Douglas Peter, MD Mae-Gilene Begay, MSW Angela Ragin-Wilson, PhD

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

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

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

LCDR Candis M. Hunter is a U.S. Public Health Service Commissioned Corps environmental health officer and environmental epidemiologist at ATSDR and serves as division project officer for the Navajo Birth Cohort Study. Johnnye Lewis is a toxicologist and professor in the College of Pharmacy at the University of New Mexico Health Sciences Center and has active community-based research programs on heavy metal exposures and health in Native American communities. RADM (Ret.) Douglas Peter is the deputy director/chief medical officer for the Navajo Area Indian Health Service and is responsible for public health administration of all contracted and directly operated clinical and preventive health programs serving over 246,000 Indian beneficiaries. Mae-Gilene Begay directs the Navajo Nation Community Health Representative/Outreach program and currently chairs the American Public Health Association Community Health Worker Section. As chief of the Environmental Epidemiology Branch in the Division of Toxicology and Human Health Sciences at ATSDR, Angela Ragin-Wilson manages several programs and projects including the Great Lakes Biomonitoring Program, Navajo Prospective Birth Cohort Study, and Calcasieu PCB/VOC Exposure Studies.

ackground The Navajo Nation encompasses more than 24,000 square miles across three states-New Mexico, Utah, and Arizonaand is the largest Alaska Native/American Indian Reservation in the U.S. From 1944 to 1986, hundreds of uranium mining and milling operations extracted an estimated 400 million tons of uranium ore from Navajo lands. These mining and processing operations have left a legacy of potential exposures to uranium waste from abandoned mines/ mills, drinking water and soil contamination, and homes and structures built with mining waste (U.S. Environmental Protection Agency [U.S. EPA], 2014).

Uranium is a naturally occurring radioactive metal and may cause adverse health effects related to both its radiological and chemical properties. As a heavy metal, uranium damages the kidneys at higher exposure doses and accumulates in kidney tissue and bone (Agency for Toxic Substances and Disease Registry [ATSDR], 2013). Several research studies have examined environmental and occupational exposure to uranium and associated renal effects (Arzuaga, Rieth, & Cooper, 2010; Hund et al., 2015). Limited and inconsistent data exist, however, concerning uranium exposure and adverse birth and reproductive health outcomes (Brugge & Buchner, 2011; Domingo, 2001; Hindin, Brugge, & Panikkar, 2005). More research is needed to understand if environmental uranium exposure may pose health risks during critical windows of human development. These investigations are particularly critical in populations that are disproportionately affected by heavy metal environmental exposures or who have a history of adverse pregnancy and birth outcomes.

American Indians and Alaska Natives experience considerable disparities in maternal and infant health outcomes compared to the general U.S. population (Alexander,



Wingate, & Boulet, 2008). Compared with non-Hispanic whites, American Indians/ Alaska Natives have a higher prevalence of birth defects and infant, neonatal, and postneonatal mortality (Canfield et al., 2014; Wong et al., 2014). In the Navajo Nation, the infant mortality rate is 8.5 deaths per 1,000 live births, compared to 6.9 deaths per 1,000 live births among all races in the U.S. population. In addition, postnatal mortality rates for Navajo infants are 2.1 times higher than the U.S. (Indian Health Service, 2003).

Study Overview

The Agency for Toxic Substances and Disease Registry (ATSDR) and its collaborating partners-the University of New Mexico Community Environmental Health Program (UNM-CEHP), the Navajo Nation Department of Health (NNDOH), and the Navajo Area Indian Health Service (NAIHS)-are conducting a prospective birth cohort study to better understand the potential relationship between exposure to environmental contaminants (i.e., uranium and other heavy metals) and reproductive birth outcomes in the Navajo Nation. Known as the "Navajo Birth Cohort Study (NBCS)," this collaborative research effort is being conducted under approval and review of Navajo Nation human research review board (NNHRRB). As the

FIGURE 1

Study Logo Created by Navajo Birth Cohort Study Team Member Sandy Ramone



funding agency, ATSDR provides oversight, epidemiological support, and biomonitoring analysis through the Centers for Disease Control and Prevention's Division of Laboratory Sciences. NBCS is a cooperative research agreement, and UNM-CEHP serves as the principal investigator institution. To conduct this large-scale study, ATSDR has also partnered with the NNDOH and NAIHS (Table 1). Additional study collaborators include the Southwest Research and Information Center (SRIC), Navajo Nation Growing in Beauty Program (GIB), Navajo culture and language specialists, Navajo Nation Environmental Protection Agency, ATSDR Region 9, and the U.S. Environmental Protection Agency (U.S. EPA) Region 9. SRIC, through a UNM-CEHP sub award, conducts home environmental assessments and community outreach. GIB provides coordination and early intervention for infants with identified birth defects and developmental delays. Study questionnaires, outreach materials, and logo (Figure 1) were specifically developed for this study in collaboration with Navajo media and cultural specialists. UNM's Navajo multimedia specialist, in conjunction with NNHRRB review, regularly develops and ensures that social media and other outreach materials are culturally appropriate. All questionnaires and outreach materials have been field tested for cultural/language appropriateness and are reviewed by NNHRRB.

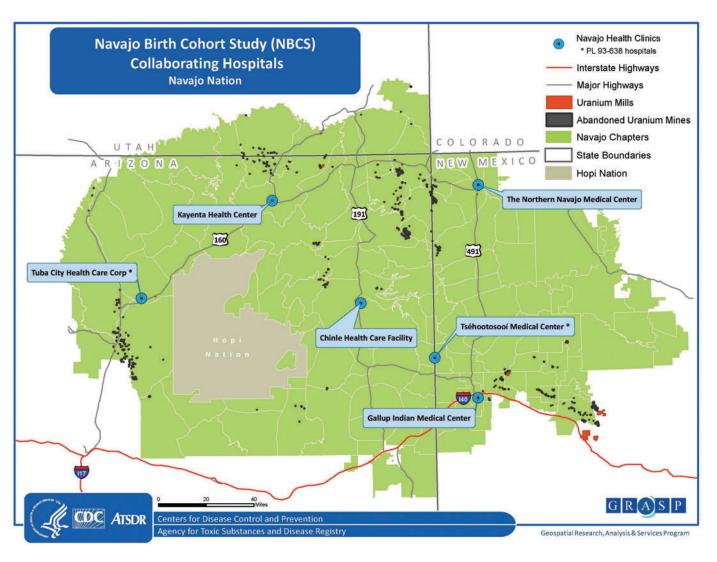
NBCS is the first prospective epidemiologic study of pregnancy and neonatal outcomes in a uranium-exposed population. The study involves recruiting Navajo mothers, assessing their exposure to uranium and other heavy metals during pregnancy, and conducting follow-up assessments of their children post birth to evaluate any associations with birth defects or developmental delays. Potential NBCS participants must be pregnant, between the ages of 14 and 45, have lived on Navajo Nation for at least five years, and plan to deliver at one of the five Indian Health Service (IHS)/PL638 hospitals (Figure 2) in the study. They also must agree to have their child assessed for developmental delays at 2, 6, 9, and 12 months post birth. The IHS/PL638 hospitals were chosen to represent the range of exposures to abandoned uranium mines and the highest frequency of deliveries on the reservation. Fathers also have the option to consent to participate in the study and complete an enrollment survey.

Exposures are assessed through biomonitoring, environmental home assessments, and questionnaires. The results of the biomonitoring analysis of 36 metals/metalloids such as uranium, arsenic, lead, and mercury are reported to each participant and added to their medical records with consent. Home environmental assessments include gamma radiation surveys, indoor air radon tests, and dust wipe analysis. Questionnaires include questions on demographics, occupational history, water use, diet, and other confounding factors. Pregnancy, birth, and infant health outcome data are obtained from participants' medical records, postpartum surveys, and infant developmental assessments such as the Ages and Stages Questionnaire.

NBCS is the primary epidemiological study of a five-year multiagency plan to address health and environmental impacts of uranium contamination on the Navajo Nation. Initiated in 2008, this plan includes partners from U.S. EPA, Bureau of Indian Affairs, Nuclear Regulatory Commission, Department of Energy, IHS, and ATSDR. In September 2014, a second five-year plan was renewed with the goals to continue to investigate environmental health risks on the Navajo Nation (U.S. EPA, 2014).

FIGURE 2

Map of Navajo Nation With Study Clinics and Former Uranium Mining/Mill Sites



Study Accomplishments

Since initiation of study recruitment in February 2013, over 450 mother-infant pairs and over 100 fathers have been enrolled. Study participants receive report-back letters on their biomonitoring and home environmental assessments results to inform them of uranium and other heavy metals in their bodies and in and around their home environment. Various culturally appropriate study outreach methods have been conducted including Facebook posts, YouTube videos, newsletters, public service announcements, radio ads, chapter meetings, health fairs, conferences, and community awareness walks. It is estimated that these targeted outreach events have reached more than 30,000 people since September 2013. To facilitate appropriate cultural sensitivity and to promote community engagement in the study, over 20 local Navajo professionals have been hired and extensively trained on environmental home assessments, uranium environmental health impacts, and survey administration. These trainings may contribute to capacity building and sustainability of future community-based participatory comprehensive research studies initiated by the Navajo Nation. NBCS provides several benefits to participants and to the Navajo community. Direct participant benefits include the following: 1) home and biological assessments to identify any serious contamination, and if identified, the family will be referred to the appropriate agency for further environmental testing and consultation; 2) information on communitybased infant services and programs, including Women, Infants, and Children and First Things First; and 3) referrals to GIB, the Navajo Nation early intervention program for children with identified developmental delays. The study will also provide broad public health benefits for Navajo communities through outreach and education on the importance of prenatal care, investigation of environmental prenatal risks, earlier assessment and referral for infants with suspected developmental delays, and a comprehensive assessment of nutrient values and reproductive health outcomes. The information generated by this study may be of value in developing programs and policies to mitigate environmental uranium exposure and to implement effective public health prevention and intervention strategies.

Corresponding Author: LCDR Candis M. Hunter, Epidemiologist, ATSDR, Division of Toxicology and Human Health Sciences, Environmental Epidemiology Branch, 4770 Buford Hwy. NE, Mailstop F-57, Atlanta, GA 30341. E-mail: HLB8@cdc.gov.

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Did You Know?

September is National Preparedness Month. You can find many great resources and valuable information that can be applied to preparedness plans at www.ready.gov.



DIRECT FROM CDC ENVIRONMENTAL HEALTH SERVICES BRANCH





Wendy McKelvey, MS, PhD

Melissa R. Wong, MPH Bailey Matis, MPH

Letter Grading and Transparency Promote Restaurant Food Safety in New York City

New York City Department of Health and Mental Hygiene

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

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

Wendy McKelvey is principal investigator for two CDC grants that promote environmental public health—one from the Environmental Health Specialists Network (EHS-Net) and the other from the Environmental Public Health Tracking Program. Melissa Wong had been project director for the NYC EHS-Net Program for the past five years. Bailey Matis is the current project director.

ach year in New York City (NYC), more than 6,000 people end up hospitalized for foodborne illness (New York City Department of Health and Mental Hygiene, 2014). Although the proportion of illness caused by food prepared away from the home is uncertain, the food service setting is associated with 68% of nationally reported foodborne illness outbreaks where food was prepared in one place (Gould et al., 2013). New Yorkers eat out nearly one billion times a year (New York City Department of Health and Mental Hygiene, 2011), and two-thirds eat meals from a restaurant, deli, coffee shop, or bar at least once per week, so the potential public health impact of unsafe food handling practices in NYC restaurants is enormous (Wong et al., 2015).

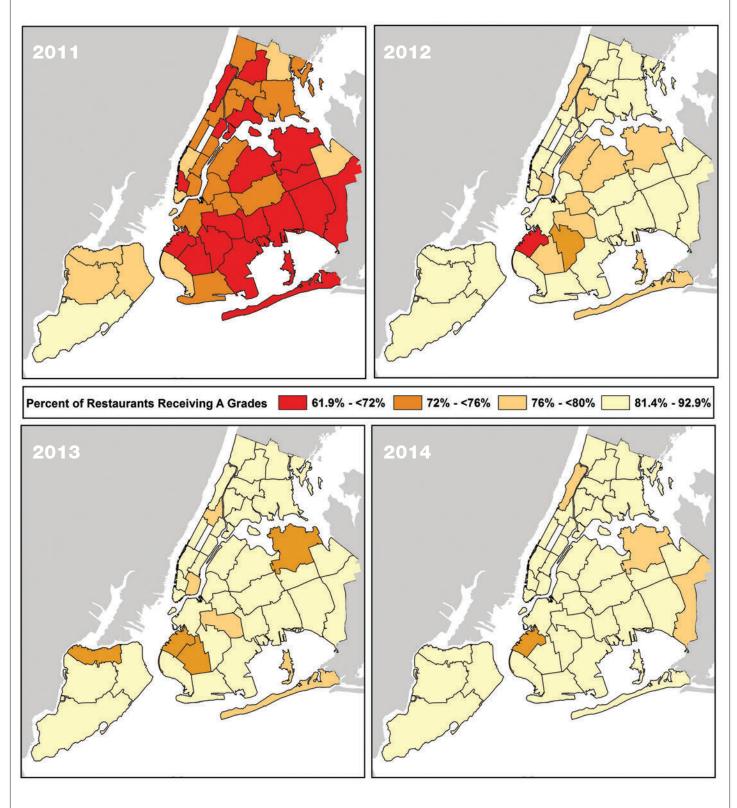
Improving food handling practices across the approximately 24,000 restaurants that operate in NYC on any given day can reduce risks of foodborne illness. Not having a certified kitchen manager on site, employees working while ill, limited food handler knowledge of food safety, and food workers touching food with their bare hands have been identified as factors that increase the risk of restaurantrelated foodborne illness (Gould et al., 2013; Hedberg et al., 2006). In an effort to prevent these and other unsafe food handling practices, the New York City Department of Health and Mental Hygiene launched the restaurant letter grading program in July 2010. The program requires restaurants to post a letter grade that reflects their most recent sanitary inspection results in a visible window location. It also targets the poorest performers with more frequent inspections.

The premise of the NYC letter grading program is that consumer access to inspection results will encourage restaurant operators to better comply with food safety rules. In addition to a conspicuously posted letter grade, the NYC Health Department has increased the transparency of restaurant inspection results by making them available in detail on a searchable Web site and a free smartphone app ("ABCEats," available for download on iTunes and Google Play). Both of these data resources provide maps and street views of establishments and allow users to filter restaurants by zip code, cuisine type, and grade.

The NYC letter grading program also supports industry by using a dual inspection approach that allows restaurants to improve before being graded. If a restaurant does not earn an A grade on its initial unannounced inspection, it receives a reinspection approximately 7–30 days later, at which point the grade is issued. Restaurants that earn an A grade at initial or reinspection do not pay fines for sanitary violations cited. Those that do not earn an A grade have the

FIGURE 1

Percentage of Restaurants Achieving A Grades by New York City Neighborhood, 2011–2014



right to contest their grade and fines at an administrative tribunal.

As a part of the Centers for Disease Control and Prevention's Environmental Health Specialists Network (EHS-Net) cooperative agreement, we evaluated the impact of the NYC restaurant letter grading program on health hazard reduction (Wong et al., 2015). We tracked scores on initial inspection before and after grading began in July 2010 and measured a 35% increase in the probability of a restaurant practicing A-grade hygiene by 2013. Specifically, we observed more food safety certified managers on site, better worker hygiene, more restaurants with proper hand washing stations, and fewer restaurants with mice. We also measured public response to restaurant letter grades in two population-based telephone surveys conducted 12 and 18 months after the program began. In both surveys, more than 90% of respondents said they approved of restaurant letter grading, and 88% said they considered the grades in dining decisions.

Restaurant sanitary conditions have been steadily improving in NYC since implementation of letter grading (Figure 1). In 2011, 72% of restaurants were posting A grades, and by 2014, after four years, 85% were posting A grades (New York City Department of Health and Mental Hygiene, 2015). Findings from our evaluation suggest that increasing transparency of restaurant inspection results and providing the public with these results in the form of an easily interpreted letter grade posted at the point of consumer decision making is an effective regulatory approach.

Corresponding Author: Wendy McKelvey, Director of Environmental Health Surveillance, Bureau of Environmental Surveillance and Policy, New York City Department of Health and Mental Hygiene, 125 Worth St., 3rd floor, CN-34E, New York, NY 10013. E-mail: wmckelve@health.nyc.gov.

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Did You Know?

The U.S. Environmental Protection Agency's third annual SepticSmart Week is September 21–25. Check out www.epa.gov/septicsmart for planned activities and valuable educational materials.



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NEHA's new Web site will be launched this month! In mid-August when you visit www.neha.org you will find our long-awaited, newly redesigned Web site. Keep in mind that we will be in beta testing for the first month and welcome your feedback on the new site.

DIRECT FROM HUD



HUD's Healthy Homes Program: Progress and Future Directions

Peter J. Ashley, MPH, DrPH

Editor's Note: The home environment is important to all of us. We spend a great amount of time in our homes and it's important for our homes to be free from hazards that may be detrimental to health. Environmental health plays an important role in the healthy homes approach—a coordinated, comprehensive, and holistic approach to preventing diseases and injuries that result from housing-related hazards and deficiencies.

In pursuit of providing relevant information on this topic, NEHA is pleased to feature a new column from the U.S. Department of Housing and Urban Development's (HUD's) Office of Lead Hazard Control and Healthy Homes (OLHCHH). The mission of OLHCHH is to help ensure that all Americans, but especially low-income households and other vulnerable population, live in homes that are free of significant health and safety hazards. OLHCHH does this by awarding grants to create lead-safe healthy housing, supporting healthy housing research, enforcing federal regulations, conducting outreach and education, and promoting healthy homes issues such as smoke-free housing and the use of integrated pest management.

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

Peter Ashley directs the Policy and Standards Division within HUD's OLHCHH. The division manages the award of grants and contracts for research on residential hazard assessment and control methods and it contributes to policy development for OLHCHH's programs.

hat conditions in a home pose the most significant health risk to residents? How are these potentially hazardous conditions/risk factors distributed among both the U.S. housing stock and the U.S. population? What are cost-effective protocols for identifying and mitigating these hazards? These are questions that the U.S. Department of Housing and Urban Development's (HUD's) Office of Lead Hazard Control and Healthy Homes (OLHCHH)

has grappled with since the inception of the Healthy Homes Initiative (now Program) in 1999. The Healthy Homes (HH) Initiative was a supplement to the Office's Lead Hazard Control Program, which was created in 1993 with the mission of reducing the risk of childhood lead poisoning by providing grants to state and local governments to create leadsafe housing for low-income families with young children.

In establishing the HH Initiative, HUD was directed by Congress to obtain the advice of experts in order to "develop and implement a program of research and demonstration projects that would address multiple housingrelated problems affecting the health of children." The health effects of mold exposure were of particular interest to some members of Congress at the time, and a portion of HUD's initial appropriation for HH activities was to fund research and demonstration projects on residential mold. The HH movement was initiated by residential hazard control professionals who became aware of the fact that homes with lead hazards often had other hazardous conditions as well (e.g., mold, pests).

The experts who were engaged by HUD identified a list of priority issues that included lead, allergens, mold and moisture, pests and pesticides, radon, asbestos, indoor air quality (IAQ), injury and fire hazards, and drinking water contamination (U.S. Department of Housing and Urban Development [HUD], 1999). The panel further identified the following cross-cutting interventions that, when implemented, could each address multiple hazards: moisture control, dust control, IAQ improvements, and resident education. For example, reducing excess moisture can prevent paint failure (a lead hazard), reduce the likelihood of mold growth, and prevent the amplification of allergens such as dust mite and cockroach. Dust control can reduce exposure to lead, allergens, and toxins (e.g., pesticides) that can be tracked into the home from the outside. In this way, the HH model promotes the movement away from single-issue programs (e.g., radon, lead hazard control) towards a more integrated model that includes a thorough home assessment followed by interventions to address multiple priority hazards. As identified by the expert panel, resident education is a key program component because of the important influence residents have on indoor environmental quality (e.g., food storage, cleaning habits, smoking behavior).

An increased focus on the issue of health disparities (i.e., the fact that lower socioeconomic status populations have a disproportionately high burden of disease) in recent years has also helped to focus attention on the home environment as an important "social determinant of health." Childhood lead poisoning is a clear example of how substandard housing can adversely affect the health of disadvantaged populations. Since national level data have been available, children in poor households have been at the highest risk of lead exposure, with African-American children being at greatest risk among this group. Childhood lead exposure also represents an example of a public health success story resulting from the efforts of sustained and coordinated actions by federal, state, and local governments and nongovernmental organizations (NGOs). Through the concerted efforts of government to remove lead from house paint, gasoline, food containers, and consumer products, and support for blood lead surveillance in children and targeted interventions to create lead-safe housing, the geometric mean blood lead level in children fell from 15 µg/dL in 1976–1980 to 1.3 µg/dL in 2007-2010 (Centers for Disease Control and Prevention [CDC], 2013). This also resulted in a reduction in the disparities of childhood lead exposure by race and income and saved billions in averted costs in areas such as health care and special education and preventing the productivity losses attributable to lead-induced IQ reductions.

A Centers for Disease Control and Prevention analysis of data from the American Housing Survey (AHS) also identified disparities in the distribution of homes with moderate or severe physical problems (e.g., deficiencies in plumbing, heating, electrical systems) (CDC, 2011). In the 2009 survey, approximately 5.7 million homes (5.2% of housing) were considered inadequate because of the presence of moderate or severe physical problems. A significantly higher risk for housing inadequacy was identified by race/ethnicity (higher among Hispanic and African-American, non-Hispanic households), lower educational attainment, and lower income. A similar, although less pronounced, pattern was reported for survey variables grouped to create an "unhealthy housing" index (i.e., observation of rodents, water leaks, peeling paint, lack of a working smoke alarm). The OLHCHH organized the inclusion of additional questions on residential health hazards in the 2011 AHS. Initial data analysis identified a higher frequency of risk factors such as mold, fall and fire hazards, and cockroach infestation in households the lowest income quartile (Ashley, Cox, Kaufman, & Pinzer, 2014).

Annual funding for HUD's HH Program has ranged from approximately \$8 million to \$20 million, with a fiscal year 2015 budget of \$15 million. The program has been implemented through competitively awarded demonstration, research, and production grants; interagency agreements (i.e., formal contractual agreements between federal agencies); and contracts. The grants have been instrumental in developing local capacity and knowledge, demonstrating and evaluating different program models, and supporting key research in areas such as integrated pest management, IAQ, and home interventions to improve the health of children with poorly controlled asthma. One of the first program grants supported a randomized controlled trial that targeted children with asthma living in homes with mold and moisture problems. Medical care was optimized for children in both control and intervention groups and both received education; however, only the intervention group received mold mitigation. The remediation group had a significant reduction in symptom days and in the need for acute asthma care (Kerscmar et al., 2006). Other grant-supported research has demonstrated elevated concentrations of nitrogen dioxide and carbon monoxide in homes with unvented gas fireplaces and the efficacy of integrated pest management in controlling cockroaches in multi-unit housing (Francisco, Gordon, & Rose, 2010; Wang & Bennett, 2009).

In 2009, HUD published an HH strategic plan that incorporated the experience gained over the previous decade and identified goals and strategies for the program to pursue (HUD, 2009). The plan identified four broad goal areas: improving partnerships among federal agencies and with NGOs, supporting key research activities, strategically incorporating HH principles into existing programs and movements, and developing local capacity to create and sustain HH programs. Actions taken by OLHCHH to implement this plan include the creation of a federal Healthy Homes Work Group to foster partnership and coordination among federal agencies.

The HH movement was given a boost by the publication of the Surgeon General's Call to Action to Promote Healthy Homes in 2009 (U.S. Department of Health and Human Services, 2009). The document identifies priority residential hazards and actions to mitigate the hazards, summarizes key research needs, and identifies actions that can be taken by individuals, housing providers, governmental agencies, and NGOs for "ensuring healthy, safe, affordable, and accessible homes." In the area of research, the document cites the need for developing new methods for housing intervention research (i.e., acknowledging the ethical and design challenges of conducting housing intervention research using randomized controlled trials), developing better cost-benefit data on HH interventions, and improving our understanding in areas such as the impact of the residential environment on mental health. noise and health, and the health effects from exposure to chemicals in the home.

Because of the importance of residential exposures in exacerbating asthma (and possibly contributing to its development), program-supported activities have frequently focused on this issue. The National Survey of Lead and Allergens in Housing (1999-2000), sponsored by HUD and the National Institute of Environmental Health Sciences, included the collection of settled dust samples for allergen analysis and the assessment of homes for the presence of one or more lead-based paint hazards. The presence of multiple allergens was common; 51.5% of homes had at least six detectable allergens and 45.8% had at least three allergens at elevated concentrations (Salo et al., 2008). Among asthmatic residents with a doctor-diagnosed allergy (77%), the odds of having recent asthma symptoms were 81% greater in homes with high allergen burdens. The classification of households as white was one of the strongest predictors of high allergen burden (driven by higher concentrations of Alternaria, dust mite, cat, and dog allergens). Elevated levels of cockroach and mouse allergen were significantly higher in non-white and poor households, which suggests that exposure to these allergens is likely a contributing factor to the disproportionately high burden of asthma among African-American children and children from poor households (President's Task Force on Environmental Health Risks and Safety Risks to Children, 2012).

A similar national survey (the American Healthy Homes Survey) was conducted by HUD (teaming with the U.S. Environmental Protection Agency [U.S. EPA]) in 2006 (HUD, 2011). A unique aspect of this survey was an analysis of mold in dust samples using a polymerase chain reaction-based method developed by U.S. EPA researchers in a previous HUD-sponsored study (Vesper et al., 2004). This resulted in a national distribution of dust samples based on the environmental relative moldiness index (ERMI), an index that is based on 36 mold species, representing both common background molds and molds that are indicative of wet or damp conditions (Vesper et al., 2007). More recent HUD-sponsored research included ERMI analysis of dust samples from a longitudinal study of asthma development, and found that mold exposures during the first year of life predicted the presence of asthma in the children at age seven (Reponen et al., 2011).

Grant-funded demonstration projects and studies have illustrated the value of using community health workers (i.e., trained members of the target community), nurses, environmental specialists, and others to conduct in-home interventions, with some also reporting a positive return on investment from the interventions (Polivka, Chaudry, Crawford, Bouton, & Sweet, 2011). For example, the Multnomah County (Oregon) Health Department used two demonstration grants to assess the benefits of in-home interventions for children with asthma and reported a reduction in emergency department visits and hospitalizations following interventions, resulting in significant medical cost savings (Harris-Tierney, 2014). The program leveraged these findings to receive reimbursement for home asthma visits through the state's Medicaid program under the category of "targeted case management."

Although the examples of program-sponsored activities discussed above focused on specific research findings or health outcomes (i.e., asthma), it is important not to lose sight of the HH paradigm of reducing residential

hazards (and the associated adverse health outcomes) through integrated interventions that address multiple hazards. This can only be accomplished through the coordinated efforts of federal agencies; work that is being guided by a strategy that was developed by the Federal Healthy Homes Work Group under the auspices of the President's Task Force on Environmental Health Risks and Safety Risks to Children (Federal Healthy Homes Work Group, 2013). One current example of interagency coordination is support for research on IAQ by a team of agencies including HUD, U.S. EPA, and the Department of Energy. The research, conducted by scientists at the Lawrence Berkeley National Laboratory, has resulted in publications on priority IAQ hazards, the potential health impacts from exposure to indoor air pollutants (IAPs), and the need for improvements in kitchen range exhaust hoods. Among the findings of this effort was that the cumulative modeled health impact of IAPs was driven by exposure to several common pollutants (e.g., PM₂₅, acrolein, and formaldehyde) and that the modeled health impact was similar or greater to the impacts from exposure to secondhand tobacco smoke and radon (Logue, Price, Sherman, & Singer, 2012).

Federal agencies can help establish the infrastructure, support research, and develop policies and tools to promote healthy housing in the U.S., but systems change will be needed to significantly increase the supply and equitable distribution of healthy housing. State and local governments and NGOs must recognize the value of healthy housing and strategically and creatively target resources to create sustainable supplies of quality, healthy housing. Increased public knowledge and awareness is needed to create the demand for green and healthy housing, in both the context of new construction and housing rehabilitation. Building and housing codes need to be modified to better protect the health of residents and the codes need to be widely adopted and effectively enforced. Finally, we are seeing changes in the health care sector that will facilitate coverage of the costs of some evidence-based in-home interventions (e.g., for poorly controlled asthma) by insurers when a clear return on investment is evident. The healthy homes movement is indeed gaining momentum and the American public will benefit through improvements in both health and quality of life.

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Corresponding Author: Peter J. Ashley, Director, Policy and Standards Division, Office of Lead Hazard Control and Healthy Homes, U.S. Department of Housing and Urban Development, 451 7th St., SW, Room 8236, Washington, DC 20410. E-mail: Peter.J.Ashley@hud.gov.

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Did You Know?

A wrap-up summary of the NEHA 2015 AEC will be printed in the October *Journal*. You can read about the amazing events, phenomenal education offered, and all the other happenings that took place in Orlando. And, if you attended, you might even see a photo of yourself!

EH CALENDAR

UPCOMING NEHA CONFERENCE

June 14–16, 2016: NEHA's 80th Annual Educational Conference & Exhibition, San Antonio, TX.

NEHA AFFILIATE AND REGIONAL LISTINGS

Alaska

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

Colorado

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

Indiana

September 21–23, 2015: Fall Conference, hosted by the Indiana Environmental Health Association, Notre Dame, IN. For more information, visit www.iehaind.org.

Iowa

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

Massachusetts

September 16–17, 2015: 53rd Annual Yankee Conference, Salem, MA. For more information, visit www.MEHAOnLine.net.

Montana

September 22–24, 2015: Annual Education Conference, hosted by the Montana Environmental Health Association, Helena, MT. For more information, visit www.mehaweb.org.

Nebraska

October 21, 2015: Fall Education Conference, hosted by the Nebraska Environmental Health Association, Ashland, NE. For more information, visit www.nebraskaneha.com.

North Dakota

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

Texas

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

Wisconsin

September 21–22, 2015: Joint Education Conference, hosted by the Wisconsin Environmental Health Association, Milwaukee, WI. For more information, visit www.weha.net.

Wyoming

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

TOPICAL LISTINGS

Aquatic Venues/Recreational Health

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

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

Food Safety

November 17–20, 2015: Integrated Foodborne Outbreak Response and Management (InFORM) Conference, sponsored by the Centers for Disease Control and Prevention, Enteric Diseases Laboratory Branch and Outbreak Response and Prevention Branch; Association of Public Health Laboratories; U.S. Department of Agriculture, Food Safety and Inspection Service; and the Food and Drug Administration, Phoenix, AZ. For more information, visit www.aphl.org/conferences/Pages/ InFORM.aspx.

Did You Know?

NEHA will be returning to San Antonio, Texas, to host the 2016 Annual Educational Conference (AEC) & Exhibition. Check out pages 66 and 67 for more information about the 2016 AEC and the Call for Abstracts.

PEOPLE ON THE MOVE

People on the Move is designed to keep NEHA members informed about what their peers in environmental health are up to. If you or someone you know has received a promotion, changed careers, or earned a special recognition in the profession, please notify Kristen Ruby-Cisneros at kruby@neha.org. It is our pleasure to announce the achievements and new directions of fellow environmental health professionals. This feature will run only when we have material to print—so be sure to send in your announcements!

CAPT Michael Herring Retires



CAPT Herring accepts NEHA's highest honor, the Walter S. Mangold Award, at the 2013 Annual Educational Conference & Exhibition in Washington, DC.

After a remarkable career with the U.S. Public Health Service (USPHS) of nearly 27 years, CAPT Michael Herring, MPH, REHS, retired from the Centers for Disease Control and Prevention's (CDC's) Environmental Health Services Branch in August 2015. In a career that has spanned over three decades, CAPT Herring has made a lasting and impactful impression on the environmental health profession through his leadership, dedication, expertise, and professionalism.

CAPT Herring began his professional career in 1980 as a sanitarian with the Durham County Health Department in North Carolina. In the fall of 1988, he accepted a commission as an environmental health officer with USPHS and departed for his first assignment in Fairbanks, Alaska. CAPT Herring earned an MPH degree from the University of Texas Health Science Center at Houston in 1993. After graduation, he was assigned to a dual position with the Environmental Management Branch of Indian Health Service (IHS) Headquarters West and the Albuquerque Area Office of IHS in Albuquerque, New Mexico. He led the effort for a major revision of the IHS *Handbook of Environmental Health*, a detailed technical guide for IHS environmental health professionals that is used by other federal agencies and organizations. In 1995, CAPT Herring reported to the U.S. Coast Guard Support Center in Elizabeth City, North Carolina, to serve as chief of the Environmental Compliance Division.

In December 2001, CAPT Herring accepted a position as a senior environmental health scientist at CDC's National Center for Environmental Health (NCEH) within the newly created Environmental Health Services Branch (EHSB). His work at CDC has resulted in numerous advancements and programs for the profession. He served as the EHSB lead for all workforce development activities. CAPT Herring worked closely with the Association of Environmental Health Academic Programs to increase enrollment, graduation rates, diversity, and the number of accredited environmental health academic programs throughout the U.S. He led the development of CDC's Summer Undergraduate Program in Environmental Health and formed the Uniformed Services Environmental Public Health Careers Work Group. While at CDC, he also served as chair of the USPHS Environmental Health Officer Professional Advisory Committee and was president of the Uniformed Services Environmental Health Association.

CAPT Herring served as innovation team leader for EHSB and was the lead subject-matter expert on vector control and integrated pest management (IPM) at NCEH. He has done extraordinary work promoting the science and principles of IPM to health professionals throughout the U.S. and abroad. He led the development of the highly successful course, "Biology and Control of Vectors and Public Health Pests: The Importance of Integrated Pest Management." He also played important roles in the development of CDC's Environmental Health Training in Emergency Response course, the Environmental Public Health Online Courses.

During the course of his career, CAPT Herring received numerous awards from multiple federal agencies along with national and state associations and academia. He is one of the most highly decorated environmental health officers in USPHS. He was awarded the Walter S. Mangold Award, NEHA's highest honor, in 2013. More recently, he was awarded the 2015 John G. Todd Award, the highest honor given by the USPHS Environmental Health Officer Professional Advisory Committee.

NEHA was fortunate to have worked closely with CAPT Herring on numerous projects and to have benefited from his support, expertise, and passion for the profession. "Mike is a true steward for the environmental health profession. Many of us at NEHA have had the honor of working with Mike over the years, and it has been an absolute honor. His breadth of knowledge is so impressive, and we have all been positively impacted through his natural ability to effectively communicate and his passion to educate professionals around the world," stated Elizabeth Landeen, NEHA's assistant manager of research and development.

A retirement celebration was held for CAPT Herring on July 30 at CDC's Chamblee campus. Coworkers, colleagues, and family came together from all over the country to celebrate his extraordinary career. CAPT Herring will be moving to Surf City, North Carolina, where he plans to spend his days fishing and enjoying his family. NEHA congratulates Mike on this milestone event and thanks him for his incalculable contribution to the profession. From everyone at the NEHA office, we wish Mike the best of luck in future endeavors! Don't be a stranger and happy fishing!

Editor's Note: We would like to acknowledge CDC's Maggie Byrne and other staff for their contribution in providing text and information for this piece. Thank you!

YOUR ASSOCIATION

SUPPORT THE NEHA ENDOWMENT FOUNDATION

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

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

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mchester@mail.maricopa.gov Arkansas—Jeff Jackson, Camden, AR. jeff.jackson@arkansas.gov

California—Matthew Reighter, MPH, REHS, Environmental Health Specialist, County of Orange, Santa Ana, CA. president@ceha.org

Colorado—Lane Drager, Consumer Protection Program Coordinator, Boulder County Public Health, Boulder, CO. ldrager@bouldercounty.org

Connecticut—Stephen Civitelli, RS, Town of Wallingford, Wallingford, CT. wlfdsan@yahoo.com

Florida—Trisha Dall, Crestview, FL. trisha.dall@flhealth.gov

Georgia—Maggie Rickenbaker, Agriculture Compliance Specialist, Georgia Dept. of Agriculture, Savannah, GA. maggie.rickenbaker@agr.georgia.gov

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

Idaho—Patrick Guzzle, MA, MPH, REHS, Food Protection Program Manager, Idaho Dept. of Health and Welfare, Boise, ID. guzzlep@dhw.idaho.gov

Illinois—Lenore Killam, Clinical Instructor, University of Illinois Springfield, Springfield, IL. Ikill2@is.edu

Indiana—Denise Wright, Training Officer, Indiana State Dept. of Health, Indianapolis, IN. dhwright@isdh.in.gov

Industry—Shelly Wallingford, MS, REHS, Retail Quality Assurance Manager, Starbucks, Denver, CO. swalling@starbucks.com

Iowa—James Hodina, MS, QEP, Manager, Environmental Public Health, Linn County Public Health, Cedar Rapids, IA. james.hodina@linncounty.org

Jamaica—Steve Morris, Chief Public Health Inspector, Ministry of Health, St. Catherine, Jamaica. president@japhi.org.jm

Kansas—Ann Mayo, MS, RS, Elmdale, KS. Indiangrass1@gmail.com

Kentucky—D. Gary Brown, DrPH, CIH, RS, DAAS, Professor and Graduate Program Coordinator, Eastern Kentucky University, KY. gary.brown@eku.edu Louisiana—Bill Schramm, Louisiana Dept. of Environmental Quality, Baton Rouge, LA. bill.schramm@la.gov

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

Massachusetts—Alan Perry, REHS/RS, Health Agent, City of Attleboro, Attleboro, MA.

healthagent@cityofattleboro.us Michigan—Christine Daley,

Environmental Health Supervisor, Chippewa County Health Dept., Sault Ste. Marie, MI. cdaley@meha.net

Minnesota—Sadie Pulk, MA, REHS, Process Analyst, Target Corporation, Minneapolis, MN. sadie.pulk@target.com

Mississippi—Patrick Grace, MSEH, Public Health Environmentalist, Mississippi State Dept. of Health, Cleveland, MS. patrick.grace@msdh.state.ms.us

Missouri—Chelsea Chambers. cmchambe@gocolumbiamo.com

Montana—Erik Leigh, RS, Public Health Sanitarian, State of Montana DPHHS, Helena, MT. eleigh@mt.gov

National Capitol Area—Shannon McKeon, Environmental Health Specialist, Fairfax, VA. smckeon@ncaeha.com

Nebraska—Allen Brown, REHS, Environmental Health Inspector, Douglas County, Omaha, NE.

allen.brown@douglascounty-ne.gov Nevada—Tamara Giannini,

Environmental Health Supervisor, Southern Nevada Health District, Las Vegas, NV. giannini@snhdmail.org

New Jersey—Robert Uhrik, Senior REHS, South Brunswick Township Health Dept., Township of South Brunswick, NJ. ruhrik@sbtnj.net

New Mexico—Esme Donato, Environmental Health Scientist, Bernalillo County, Albuquerque, NM. edonato@bernco.gov

New York—Contact Region 9 Vice President Edward L. Briggs. eb.health@ridgefieldct.org

North Carolina—Lillian Henderson, REHS, Davidson County Health Dept., Lexington, NC.

lillian.henderson@davidsoncountync.gov North Dakota—Jane Kangas,

Environmental Scientist II, North Dakota Dept. of Health, Fargo, ND. jkangas@nd.gov

Northern New England Environmental Health Association—Co-president Brian Lockard, Health Officer, Town of Salem Health Dept., Salem, NH. blockard@ci.salem.nh.us

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Ohio—Jerry Bingham, RS, Supervisor, Toledo-Lucas County Health Dept.,

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binghamj@co.lucas.oh.us Oklahoma—James Splawn, RPS, RPES, Sanitarian, Tulsa City-County Health Dept., Tulsa, OK.

tsplawn@tulsa-health.org

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

Past Presidents—Alicia Collins, REHS, Lilburn, GA. enriqueza@comcast.net

Pennsylvania—TBD

Rhode Island—Dottie LeBeau, CP-FS, Food Safety Consultant and Educator, Dottie LeBeau Group, Hope, RI. deejaylebeau@verizon.net

Saudi Arabia—Zubair M. Azizkhan, Environmental Scientist, Saudi Arabian Oil Company, Saudi Arabia. Zubair.azizkhan@aramco.com.sa

South Carolina—Timothy Kinney, Environmental Health Manager, SCDHEC-BEHS Enforcement Section, Columbia, SC. kinneyte@dhec.sc.gov

South Dakota—John Osburn, Pierre, SD. john.osburn@state.sd.us

Tennessee—Larry Manis, Loudon County Health Dept., Loudon, TN. larry.manis@tn.gov

Texas—Joanna Meyer, RS, Regional QA Manager, MBM, Ft. Worth, TX. jmeyer@mbmfoodservice.com

Uniformed Services—MAJ Joseph Hout, MSPH, PhD, REHS, CPH, Industrial Hygiene Chief, Academy of the Health Sciences, Ft. Sam Houston, TX. joseph.j.hout.mil@mail.mil

Utah—Michelle Cooke, LEHS, Program Manager, Weber-Morgan Health Dept., Ogden, UT. mcooke@co.weber.ut.us

Virginia—Mark Cranford, REHS, CP-FS, Environmental Health Specialist, Virginia Dept. of Health, Charlottesville, VA. mark.cranford@vdh.virginia.gov

Washington—Michael Baker, MS, PhD, Dept. of Environmental Health Director, Whitman County Public Health, Pullman, WA. michael.baker@whitmancounty.net

West Virginia—Ronald Dellinger, REHS/ RS, WVDHHR/BPH/OEHS/PHS, Beckley, WV. jarod.r.dellinger@wv.gov

Wisconsin—Laura Temke, REHS, CP-FS, HHS, Environmentalist, City of West Allis Health Dept., West Allis, WI. Itemkc@westalliswi.gov

Wyoming—Tiffany Gaertner, REHS, CP-FS, EHS II, Cheyenne-Laramie County Health Dept., Cheyenne, WY. tgaertner@laramiecounty.com

NEHA Historian

Dick Pantages, NEHA Past President, Fremont, CA. dickpantages@comcast.net

Technical Advisors

Air Quality—David Gilkey, PhD, Associate Professor, Colorado State University, Ft. Collins, CO. deilkev@colostate.edu

Aquatic Venues/Recreational Health— Tracynda Davis, MPH, President, Davis Strategic Consulting, LLC, Colorado | Springs, CO. | tracynda@gmail.com

> Aquatic Venues/Recreational Health— Colleen Maitoza, REHS, CPO, Retired (Sacramento County Environmental Management Dept.), Sacramento, CA. maitozac@gmail.com

Children's Environmental Health—Anna Jeng, MS, ScD, Associate Professor and Graduate Program Director, Old Dominion University, Norfolk, VA. hjeng@odu.edu

Drinking Water/Environmental Water Quality—Sharon Smith, REHS/RS, Sanitarian Supervisor, Minnesota Dept. of Health, Fergus Falls, MN. sharon.1.smith@state.mn.us

Emergency Preparedness and Response—Martin Kalis, Public Health Advisor, CDC, Atlanta, GA. mkalis@cdc.gov

Emergency Preparedness and Response—Vince Radke, MPH, RS, CP-FS, DAAS, CPH, Sanitarian, CDC, Atlanta, GA. vradke@cdc.gov

Emerging Pathogens—Lois Maisel, RN, CP-FS, Environmental Health Specialist, Fairfax County Health Dept., Fairfax, VA. lois.maisel@fairfaxcounty.gov

Environmental Justice—Welford Roberts, PhD, DAAS, RS, REHS, Subject Matter Expert, Office of the Air Force Surgeon General and ERP International, LLC, South Riding, VA. welford@erols.com

Food (including Safety and Defense)— Eric Bradley, MPH, REHS, CP-FS, DAAS, Environmental Health Coordinator, Scott County Health Dept., Davenport, IA. eric.bradley@scottcountyiowa.com

Food (including Safety and Defense)— John Marcello, CP-FS, REHS, Regional Retail Food Specialist, FDA, Tempe, AZ. john.marcello@fda.hhs.gov

General Environmental Health—ML Tanner, HHS, Former Program Manager, Columbia, SC. mlacesmom@gmail.com

Global Climate Change and Health— Norbert Campbell, Lecturer, University of the West Indies, Kingston, Jamaica. norbert.campbell02@uwimona.edu.jm

Hazardous Materials/Toxic Substances—Priscilla Oliver, PhD, Life Scientist/Regional Program Manager, U.S. EPA, Atlanta, GA. POliverMSM@aol.com

Hazardous Materials/Toxic Substances— Sarah Keyes, MS, Health, Safety, and Environmental Manager, Peter Cremer North America, LP, Cincinnati, OH. skeves@petercremerna.com

Healthy Homes and Healthy Communitics—Sandra Whitehead, MPA, PhD, Director of Healthy Community Design, National Association of County and City Health Officials, Washington, DC. whitehead.sandra.l@gmail.com

Injury Prevention—Alan Dellapenna, RS, Branch Head, Injury and Violence Prevention Branch, North Carolina Division of Public Health, Raleigh, NC. alan.dellapenna@dhhs.nc.gov International Environmental Health— Rachel Stradling, JD, CP-FS, REHS, MCIEH, Environmental Health Manager, Alexandria Health Dept., Alexandria, VA. rachel.stradling@vdh.virginia.gov

International Environmental Health— Sylvanus Thompson, PhD, CPHI(C), Associate Director, Toronto Public Health, Toronto, ON, Canada. sthomps@toronto.ca

Land Use Planning/Design—Felix Zemel, MCP, MPH, REH5/RS, CEHT, HHS, DAAS, Health Agent, Cohasset Board of Health, Cohasset, MA. felix.zemel@gmail.com

Legal—TBD

Occupational Health/Safety—D. Gary Brown, DrPH, CIH, RS, DAAS, Professor and Graduate Program Coordinator, Eastern Kentucky University, Richmond, KY. gary.brown@eku.edu

Onsite Wastewater—Samendra Sherchan, PhD, Assistant Professor, California State University-Fresno, Fresno, CA. ssherchan@csufresno.edu

Onsite Wastewater—Joelle Wirth, RS, Program Manager III, Environmental Quality Division, Coconino County Health Dept., Flagstaff, AZ. jwirth@coconino.az.gov

Radiation/Radon—Tara Gurge, MS, RS, Environmental Health Agent, Town of Needham Public Health Dept., Needham, MA. tgurge@needhamma.gov

Risk Assessment—Jason Marion, PhD, Assistant Professor, Eastern Kentucky University, Richmond, KY. jason.marion@eku.edu

Schools/Institutions—Stephan Ruckman, Environmental Health Manager, Worthington City Schools, Dublin, OH. mphosu@yahoo.com

Sustainability—Tom Gonzales, MPH, REHS, Deputy Director, El Paso County Public Health, Colorado Springs, CO. tomgonzales@elpasoco.com

Sustainability—Timothy Murphy, PhD, REH5/RS, DAAS, Associate Professor and Dept. Chair, The University of Findlay, Findlay, OH. murphy@findlay.edu

Technology (including Computers, Software, GIS, and Management Applications)—Darryl Booth, MPA, Senior Vice President/General Manager Environmental Health, Accela, Fresno, CA. dbooth@accela.com

Vector Control & Zoonotic Diseases— Zia Siddiqi, PhD, BCE, Director of Quality Systems, Orkin/Rollins Pest Control, Atlanta, GA.

zsiddiqi@rollins.com

Workforce Development, Management, and Leadership—CAPT Michael Herring, MPH, REHS, Senior Environmental Health Specialist/Training and Technical Assistance Team Leader, CDC, Atlanta, GA. mherring@cdc.gov

Workforce Development, Management, and Leadership—George Nakamura, MPA, REHS, RS, CP-FS, DAAS, CEO, Nakamura Leasing, Sunnyvale, CA. gmlnaka@comcast.net

NEHA Staff: (303) 756-9090

Rance Baker, Program Administrator, NEHA Entrepreneurial Zone (EZ), ext. 306, rbaker@neha.org

Trisha Bramwell, Customer & Member Services Specialist, ext. 336, tbramwell@neha.org

Ginny Coyle, Grants/Projects Specialist, Research and Development (R&D), ext. 346, gcoyle@neha.org

Vanessa DeArman, Project Coordinator, R&D, ext. 311, vdearman@neha.org

Cindy Dimmitt, Customer & Member Services Specialist, ext. 309, cdimmitt@neha.org

Elizabeth Donoghue-Armstrong, Copy Editor, Journal of Environmental Health, nehasmtp@gmail.com

David Dyjack, Executive Director, ext. 301, ddyjack@neha.org

Eric Fife, Learning Content Producer, NEHA EZ, ext. 344, elife@neha.org

Soni Fink, Strategic Sales Coordinator, ext. 314, sfink@neha.org

Michael Gallagher, IFSS Logistics and Training Coordinator, NEHA EZ, ext. 343, mgallagher@neha.org

Laura Gallaher, Interim Education Coordinator, ext. 313, lgallaher@neha.org

TJay Gerber, Credentialing Coordinator, ext. 328, tgerber@neha.org

Arwa Hurley, Website and Digital Media Specialist, ext. 327, ahurley@neha.org

Dawn Jordan, Customer Service Manager, Office Coordinator, HR Liaison, ext. 312, djordan@neha.org

Erik Kosnar, Learning Content Production Assistant, NEHA EZ, ext. 318, ekosnar@neha.org

Elizabeth Landeen, Assistant Manager, R&D, (702) 802-3924, elandeen@neha.org

Matt Lieber, Marketing and Communications Assistant, ext. 338, mlieber@neha.org

Marissa Mills, Project Assistant, R&D, ext. 304, mmills@neha.org

Eileen Neison, Credential Department Customer Service Representative, ext. 310, eneison@neha.org

Carol Newlin, Credentialing Specialist, ext. 337, cnewlin@neha.org

Barry Porter, Financial Coordinator, ext. 308, bporter@neha.org

Kristen Ruby-Cisneros, Managing Editor, Journal of Environmental Health, ext. 341, kruby@neha.org

Joshua Schrader, Sales & Training Support, NEHA EZ, ext. 340, jschrader@neha.org

Clare Sinacori, Marketing and Communications Manager, ext. 319, csinacori@neha.org

Christl Tate, Project Coordinator, R&D, ext. 305, ctate@neha.org

NEHA NEWS

Industry-Foodborne Illness Investigation Training and Recall Response (I-FIIT-RR): A Three-Year Project of Collaboration

Industry has a lot of responsibility to maintain high levels of food safety, comply with changing regulations, and manage food costs and staffing challenges. These are just some areas that often keep managers and owners up at night. And the increasing numbers of foodborne illness outbreaks and food recalls simply add to their unending list of concerns that must be taken seriously. Foodservice professionals understand that there are high consequences if they don't act responsibly, take preventive measures, and respond to these food-related crises appropriately.

In 2012, as part of the Food Safety Modernization Act, NEHA received Food and Drug Administration (FDA) support to develop a Recall Training course for the retail food industry to help food establishments prepare and respond more appropriately to food recalls. The food recall training seemed to be a natural extension of NEHA's existing IFIIT course, a comprehensive training for industry on the foodborne illness outbreak investigation process, which highlighted the benefits of industry and regulatory agencies working cooperatively for more effective outcomes. The resultant training was named I-FIIT-RR (Industry-Foodborne Illness Investigation Training and Recall Response) with a target audience of retail food operations. Though designed for industry, regulators would be invited to attend the training sessions for information exchange and to encourage communication between the groups.

As a food safety consultant and educator for the food service and regulatory industries, I was excited to serve as the technical advisor and trainer for NEHA during this three-year I-FIIT-RR project. I knew that industry was about to receive a unique training opportunity that would empower them to be more prepared to respond to food recalls and be a more informed participant in the often-dreaded illness investigation process. And so the three-year project began.

Year One

NEHA first did a needs assessment survey of several hundred people from industry and regulatory agencies to see how the food recall process was currently working and what areas needed strengthening. It revealed some real challenges in both groups, as seen in Table 1. Many food establishments reported a delay or no methods at all for receiving recall notices (56%) and communication barriers (29%.) Also, they claimed difficulty in identifying recalled goods from the recall notices (71%,) especially with bulk produce that often lost critical identifying information as it was dispersed throughout a facility. Smaller establishments seemed to have the greatest challenges and needed more assistance from their health departments during a food recall. They reported more constraints on time, resources, and staffing as opposed to chains or multi-unit operations that often have corporate support systems and procedures in place.

TABLE **1**

Challenges With Recall Process

Industry		Health Agency				
Delay/lack of receiving notices	56%	Delay in receiving notices	55%			
Communication barriers	29%	Communication barriers	28%			
Difficulty identifying affected products	71%	Issues with product segregation and removal	34%			
Time constraints	21%	Limited resources to follow up	64%			

And health departments reported their own challenges, with delays in receiving notices (55%) and limited resources for following up on actions of food establishments during a recall (64%). It seemed that collaboration would be beneficial to alleviate challenges of both groups and possibly result in a more effective recall process.

Armed with this information, the Food Recall Response module was developed. It discusses the common reasons and classifications of a food recall, the roles of food regulatory agencies and industry in issuing and responding to food recalls, and the importance for communicating and working cooperatively during a food recall for a speedy resolution. It includes appropriate response procedures, recordkeeping forms, and information to help food establishments develop or strengthen their own recall plan.

NEHA conducted a pilot I-FIIT-RR training in 2013 at the Annual Educational Conference (AEC) & Exhibition in Washington, DC, which included representatives and quality assurance directors from supermarket chains, caterers, and restaurants large and small. Regulators from the Centers for Disease Control and Prevention, FDA, and local and state departments were there for support, and shared information regarding outbreak investigations and food recall procedures from their perspectives. A mock recall exercise was incorporated into the training, adapted from FDA's FREE-B Exercise Food Defense bundle, where participants walked through a mock candy recall, working in groups and identifying their own potential response steps in such a situation.

Year Two

Three more I-FIIT-RR workshops were conducted in the second year, hosted by different organizations: Contra Costa Health Services in California; Massachusetts Restaurant Association; and the NEHA AEC in Las Vegas. We had tremendous participation in each of these workshops, with a wide range of attendees: owners, managers, and quality assurance directors from restaurant chains; supermarkets; casinos; hotels; wineries; small mom and pop stores; and even an insurance carrier, all hoping to come away with more information than they came in with about illness investigation pro-

NEHA NEWS

cedures and food recall process. Valuable participation from health agents, epidemiologists, lab personnel, state and federal regulators, were there in each course, to share their perspective in their jurisdiction and answer questions from industry. The result was a feeling of collaboration, working together towards a common goal, and a greater appreciation for each other's roles and challenges.

Year Three

The fifth and final FDA-funded I-FIIT-RR training was conducted and recorded at the city of Plano, Texas, health department in January 2015. This training is accessible in its entirety from the NEHA Web site, available as an online course (www.neha.org). Additionally, four live food recall webinars, "Is Your Establishment Recall Ready?" were conducted and recorded for continued use by the host health departments of State of Alaska; Somerset County, New Jersey; and County of Monterey, California; and the National Restaurant Association.

Long-Lasting Outcomes

This training has shown to be a unique opportunity for industry to interact with state and local regulators to ask questions and share information about illness investigations and recalls and to build or improve relationships.

And some long lasting benefits resulted. Pre- and post-tests pertaining to the food recall process were conducted at each of the trainings and demonstrated a 46% increase in knowledge overall as a result of the food recalls training module. Also, course evaluations by participants were enthusiastic: "Wish I had this information when we were going through our outbreak investigation a few years ago." "As a result of this course, we completed a corporate policy for food recalls, and set up a system to send all recall info to food safety managers, chefs, and VP of F & B." "When we found ourselves in a suspected outbreak, shortly after this course, I pulled out my course materials and knew just what to do." One state regulator praised the course as a "rare opportunity for industry and regulators to interact."

Return on investment forms were filled out at the end of each class with the intent of having participants note any behavioral or program changes post workshop. Some notable changes in procedures are below:

- · Trained staff on illness and food safety
- Developed an outbreak toolbox
- Recall procedures have been reviewed and improved to ensure greater efficiency and detail in reporting to regulatory agency
- Developed chain of custody and sampling protocols
- Enhanced our current process on recalls, allowing more efficient processing and communication of recall information to our retail stores, and ultimately, our shoppers
- Complied emergency contact list
- · Used recordkeeping documents provided in course
- Reevaluated complaint logs

Going forward, the NEHA I-FIIT-RR Project Team would like to spread the word to industry and regulators alike about the free online I-FIIT-RR training, so that they may be better prepared for a foodborne illness investigation or food recall. Also, a full-day training may be arranged for a company wishing to host a course. The big takeaway from these trainings is the understanding that both industry and regulatory partners have their own roles in the process and can work cooperatively before, during, and after outbreak investigations and food recalls to be successful and protect the public's health.

For more information about NEHA's I-FIIT-RR project, please contact Elizabeth Landeen at elandeen@neha.org.

Text written by Cindy Rice, RS, Eastern Food Safety

NATIONAL ENVIRONMENTAL HEALTH ASSOCIATION



Ensuring food safety has been an integral function of NEHA credential holders since 1937. Building upon this core knowledge to encompass the modern-day, global food delivery system challenges gave impetus to the **Certified Professional - Food Safety (CP-FS)** credential and the **Certified in Comprehensive Food Safety (CCFS)** credential. Learn more about CP-FS in the food safety regulatory settings at **neha.org/credential/cpfs.html**. Professionals in food industry settings and the complete food chain delivery can explore the CCFS at **neha.org/credential/ccfs**.



NEHA's Annual Financial Statement

7979 E. Tutts Avenue, Suite 400 Denver, Colorado 80237-2521 P: 303-740-9400 F: 303-740-9400

EKS&H

INDEPENDENT AUDITORS' REPORT

To the Board of Directors National Environmental Health Association Denver, Colorado

REPORT ON THE FINANCIAL STATEMENTS

We have audited the accompanying financial statements of National Environmental Health Association (the "Association"), which are comprised of the statements of financial position as of September 30, 2014 and 2013, and the related statements of activities and cash flows for the years then ended, and the related notes to the financial statements.

MANAGEMENT'S RESPONSIBILITY FOR THE FINANCIAL STATEMENTS

Management is responsible for the preparation and fair presentation of these financial statements in accordance with accounting principles generally accepted in the United States of America; this includes the design, implementation, and maintenance of internal control relevant to the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error.

AUDITORS' RESPONSIBILITY

Our responsibility is to express an opinion on these financial statements based on our audits. We conducted our audits in accordance with auditing standards generally accepted in the United States of America and the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial attements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditors' judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or eror. In making those risk assessments, the auditors consider internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. Accordingly, we express no such opinion. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of significant accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

To the Board of Directors National Environmental Health Association Page Two

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

OPINION

In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of National Environmental Health Association as of September 30, 2014 and 2013, and the changes in its net assets and its cash flows for the years then ended in accordance with accounting principles generally accepted in the United States of America.

OTHER MATTERS

Our audits were conducted for the purpose of forming an opinion on the financial statements as a whole. The accompanying schedule of expenditures of federal awards, as required by the Office of Management and Budget Circular A-133, Audits of States, Local Governments, and Non-Profit Organizations, is presented for purposes of additional analysis and is not a required part of the financial statements. Such information is the responsibility of management and was derived from and relates directly to the underlying accounting and other records used to prepare the financial statements or to the financial actatements derived fitonal procedures applied in the audits of the financial statements and certain additional procedures, including comparing and reconciling such information directly to the underlying accounting and other records used to prepare the financial statements or to the financial statements themselves, and other additional procedures in accordance with auditing standards generally accepted in the United States of America. In our opinion, the schedule of expenditures of federal awards is fairly stated, in all material respects, in relation to the financial statements an whole.

OTHER REPORTING REQUIRED BY GOVERNMENT AUDITING STANDARDS

In accordance with Government Auditing Standards, we have also issued our report dated April 9, 2015 on our consideration of the Association's internal control over financial reporting and on our tests of its compliance with certain provisions of laws, regulations, contracts, grant agreements, and other matters. The purpose of that report is to describe the scope of our testing of internal control over financial reporting and compliance and the results of that testing and not to provide an opinion on internal control over financial reporting or on compliance. That report is an integral part of an audit performed in accordance with Government Auditing Standards in considering the Association's internal control over financial reporting and compliance.

> EKS+H LLLP EKS&H LLLP

EKSAHLI

April 9, 2015 Denver, Colorado

NATIONAL ENVIRONMENTAL HEALTH ASSOCIATION

Statements of Activities

						For the Ye	ears E	Ended				
			Septer	nber 30, 2014					Sep	tember 30, 2013		
			Te	mporarily						Temporarily		
	U	nrestricted	R	estricted	-	Total		Unrestricted		Restricted		Total
Revenues and gains												
Research and development	S	2,298,570	S	-	\$	2,298,570	\$	1,892,576	\$	-	S	1,892,576
Annual Educational Conference		648,293		-		648,293		486,639		-		486,639
Credentialing and education		810,735		-		810,735		603,713		3. - 3		603,713
Membership dues		361,012		-		361,012		321,787		-		321,787
Journal of Environmental Health		208,796		-		208,796		206,141		-		206,141
Special projects		1,714,680		-		1,714,680		3,280,923		-		3,280,923
Contributions		5,527		-		5,527		17,965				17,965
Publications and module contracts		74,896		-		74,896		99,059				99,059
Miscellaneous income		34,042		-		34,042		21,324				21,324
Investment income	-	8,106		237	6.05	8,343		3,165		254		3,419
Total revenues and gains		6,164,657		237		6,164,894	_	6,933,292	_	254	_	6,933,546
Expenses												
Research and development		2,219,717		-		2,219,717		1,971,835		-		1,971,835
Annual Educational Conference		748,982		-		748,982		583,730		-		583,730
Journal of Environmental Health		377,208		-		377,208		317,909		-		317,909
Credentialing and education		614,076		-		614,076		492,643		-		492,64
Membership		187,088		-		187.088		233,606		-		233,600
Publications and module contracts		72,326		-		72.326		117,981		-		117,98
Special projects		1,483,341		-		1,483,341		2,556,157		-		2,556,157
Continuing education		17,996		-		17,996		101,304		-		101,304
Administration and general		760,414		-		760,414		439,921		-		439,921
Total expenses		6,481,148		-	_	6,481,148		6,815,086	_		_	6,815,080
Change in net assets		(316,491))	237		(316,254)		118,206		254		118,46
Net assets at beginning of year		1,403,718		80,276		1,483,994	_	1,285,512		80,022		1,365,534
Net assets at end of year	<u>s</u>	1,087,227	<u>s</u>	80,513	\$	1,167,740	5	1,403,718	\$	80,276	S	1,483,994

The information in this statement is derived from audited financials; the entire audited report can be obtained by contacting NEHA.

RESOURCE CORNER

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



Certified Professional-Food Safety Manual (Third Edition)

National Environmental Health Association (2014)



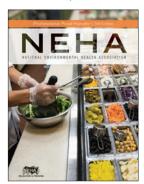
The Certified Professional-Food Safety (CP-FS) credential is well respected throughout the environmental health and food safety field. This manual has been developed by experts from across the various food safety disciplines to help candidates prepare for NEHA's CP-FS exam. This book contains science-based,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

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

358 pages / Spiral-bound paperback / Catalog #EZ9020 Member: \$179 / Nonmember: \$209

Professional Food Handler (Third Edition)

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



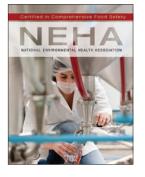
NEHA's *Professional Food Handler* textbook provides food handlers access to essential knowledge and understanding of fundamental food safety practices that they need to carry out their work safely. Concise, brightly illustrated, and written at the eighth-grade level, this student textbook has proved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

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

55 pages / Paperback / Catalog #EZ6010 Member/Nonmember: \$7.50

Certified in Comprehensive Food Safety Manual

National Environmental Health Association (2014)



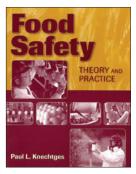
The Food Safety Modernization Act has recast the food safety landscape, including the role of the food safety professional. To position this field for the future, NEHA is proud to announce its newest credential— Certified in Comprehensive Food Safety (CCFS). The CCFS is a midlevel credential for food safety professionals that demonstrates expertise in how to ensure food is safe

for consumers throughout the manufacturing and processing environment. It can be utilized by anyone wanting to continue a growth path in the food safety sector, whether in a regulatory/ oversight role or in a food safety management or compliance position within the private sector. The *CCFS Manual* has been carefully developed to help prepare candidates for the *CCFS* exam and deals with the information required to perform effectively as a *CCFS*.

356 pages / Spiral-bound paperback / Catalog #EZ5020 Member: \$179 / Nonmember: \$209

Food Safety: Theory and Practice

Paul L. Knechtges (2012)



Authored by a NEHA member! Written from a "farm-to-fork" perspective, this book provides a comprehensive overview of food safety and discusses the biological, chemical, and physical agents of foodborne diseases. Topics covered include risk and hazard analysis of goods; the prevention of foodborne illnesses and diseases; safety management of the food supply; food safety laws, regulations, enforcement,

and responsibilities; and the pivotal role of food sanitation/safety inspectors. Early chapters introduce readers to the history and fundamental principles of food safety. Later chapters provide an overview of the risk and hazard analysis of different foods and the important advances in technology that have become indispensable in controlling hazards in the modern food industry. 460 pages / Paperback / Catalog #1120 Member: \$78 / Nonmember: \$83



CALL FOR ABSTRACTS Visit neha.org/aec for information on abstract submissions.

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NEHA is seeking abstracts that bring the latest advances in environmental health, as well as unique responses to environmental health and protection problems. Practical applications in both the public and private sectors should be emphasized along with the latest in proven emerging technologies.

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- Poster presentations
- Other interactive and innovative presentation formats

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AEC Recorded Sessions for Continuing Education from the NEHA 2015 AEC

You can access valuable educational content from the NEHA 2015 AEC to view on demand. If you attended the 2015 AEC, the recorded sessions are *free* as a benefit of attending the conference!

For those who did not attend, the recorded sessions can be purchased for **\$99** members/**\$215** nonmembers.

Recorded sessions include:

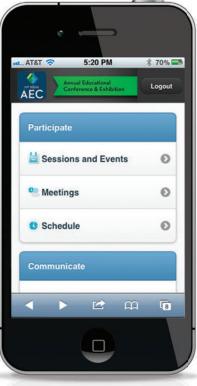
- an archive of more than 30 educational sessions that were recorded at the 2015 AEC
- the ability to view sessions on demand at your convenience
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- an incredibly low rate of approximately \$4 per CE for members and about \$8.50 per CE for nonmembers

Recorded sessions will be available approximately two weeks after the conclusion of the AEC.

Details on recorded sessions can be found at: http://neha2015aec.org/recorded-sessions

To purchase, please visit: http://bit.ly/1GflgU6 or search "2015 AEC Recorded Sessions" from the NEHA.org store.





DirecTalk

continued from page 70

age-friendly city that will keep me vibrant? For starters, well-designed housing, access to transportation, and proximity to clinical services. Those clinical services will ideally be free of health care–acquired infections and modern antibiotic-resistant superbugs. A new generation of environmental health professionals will be needed to assess these innovative, space conscious, built environments, not as they exist today, but the highly integrated ones of the not-so-distant future.

Urban green space is another area where the environmental health professional of the future may create and deliver value. Research has shown that children of color and low-income communities who have more access to green space have lower rates of obesity than children whose activities are limited to streets and sidewalks. In a country inundated with chronic disease and health disparities, this is a no-brainer. Before urban or industrial space is reclaimed for recreation, environmental health professionals are essential promoters and protectors of the public's health through careful real estate assessments and brownfields approaches, as necessary. This has our profession written all over it.

We also need to prepare ourselves and future practitioners to engage in policy issues related to sustainability. While conducting a Council on Education in Public Health (CEPH) site visit recently I stayed at a hotel that was hosting a well-known global health product provider, who evidently was convening their annual technical meeting. I was delighted to see that they had added an "s" on the end of their division. They are no longer limited to the traditional environmental health and safety (EHS); they had taken on sustainability as part of their corporate mission (EHS&S). Urbanization will benefit from our policy contributions to the sustainability conversation. These policies will promote employment opportunities, adequate infrastructure for water and sanitation, renewable energy, and active living. All the while working to preserve natural assets within the city and surrounding areas that are vital to our spiritual, physical, and mental health. Sustainability is central to our emerging roles and responsibilities and our profession needs to claim this space.

The fact is, cities are at the crossroads of social, cultural, and economic innovation. People increasingly want to live in cities, bringing new challenges to our profession and way of life. As my friend Shelley Hearne, director of the National Association of County and City Health Officials Big City Health Coalition, recently conveyed to me: "Place matters. And cities are becoming the lead innovators in how to make their places the healthiest possible. Often environmental health programs are leading the pack and helping drive health into all aspects of city life—from housing to transportation to local food systems. You might almost say it's 'environmental health in all policies."

Urban infrastructure should be designed and renovated sensibly to accommodate the "new normal" associated with climate change and shifting demographics. Yes indeed, Shelley is correct. In public health place does matter, and society will benefit when environmental health in all polices is the standard bearer in the age of Big Cities.



NEHA NEWS



Dr. Pat Breysse (back row, second to the right) stops to take a photo with NEHA Executive Director Dr. David Dyjack (back row, third to the right) and many of the staff during his July visit.

VIP Visitor at the NEHA Office

NEHA was honored on July 7, 2015, with a visit from Dr. Pat Breysse and several of his staff. Breysse, director of the National Center for Environmental Health/Agency for Toxic Substances and Disease Registry (NCEH/ATSDR) at the Centers for Disease Control and Prevention (CDC), took time out of his busy schedule to meet with Dr. David Dyjack, NEHA's new executive director, and address the NEHA staff. Breysse joined CDC in December 2014 and leads its efforts to investigate the relationship between environmental factors and health. He has an impressive and broad environmental health background and shared with NEHA that he is carrying on the "family business" as his dad was a sanitarian.

Breysse discussed with NEHA a few of the priorities within NCEH/ATSDR such as asthma health disparities and the importance of the Environmental Public Health Tracking Program. He went on to emphasize that environmental health needs to be more vocal in telling its stories and educating the public on the importance of environmental health.

NEHA was privileged to have Breysse attend the recent 2015 Annual Educational Conference (AEC) & Exhibition in Orlando and provide the opening welcome. We are grateful to Breysse for taking the time to address the AEC attendees and our staff. We look forward to collaborating more closely with Breysse and NCEH/ATSDR in the future with the combined goal of advancing the environmental health profession.

YOUR ASSOCIATION

DirecTalk MUSINGS FROM THE 10TH FLOOR



Go Big or Go Home

David Dyjack, DrPH, CIH

y rickshaw driver weaved in and out of traffic with the skill and agility of Houdini, skirting high impact collisions by mere millimeters. What in the world was I doing in Bangladesh? I represented NEHA and moderated a panel session at the International Conference on Urban Health in Dhaka, May 24-27, 2015. In the midst of the inner city bedlam I marveled that 1,000 people a day move to Dhaka, a teeming metropolis of some 18 million, most who are seemingly committed to being on the road all at the same time. One thousand people a day. That's one city absorbing more people per day than the number who migrate to the entire state of Colorado, over the same time period.

We find ourselves in the midst of the Century of Urbanization. Today, for the first time in history, more than half of the world's population resides in cities, with an estimated migration trend inflating that number to 70% by 2050. For the record, this is not news. Today, 5% of the nation's 2,800 local health departments provide services to 50% of the U.S. population, which suggests that most of us already prefer to reside in large urban areas.

This reversal of suburbanization creates a wealth of opportunities and challenges for those of us in the environmental health professions, bringing new significance to trans-disciplinary collaboration. Ironically, this lesson came home to roost recently during a torrential downpour here in Denver. As shown at right bottom, the vehicle I was in stalled in three feet of water just outside an apartment complex in the downtown area of Cherry Creek,



The streets of Dhaka fill with frantic activity and numerous people.



Flooding in the streets of Denver creates numerous challenges.

a hop, skip, and jump from NEHA's office. As the water gushed in through the seams of the vehicle door, I opted to partially disrobe and escape the deluge through an open window. The city estimates it will require a \$1.5 billion investment to redesign the drainage system to accommodate heavy downpours, just like those predicted by climate change models. A good land use planner with an environmental health orientation would be a welcomed addition to the design and development team dedicated to urban conditions that maximize percolation and minimize run-off during torrential precipitation. That's environmental health in the great outdoors; the indoor environment merits its own consideration.

Indoor air quality specialists take note. Forty percent of global energy consumption originates in buildings, producing some 40% of the CO₂ emissions, a major greenhouse gas. Undoubtedly greater emphasis on heating, ventilating, and air conditioning (HVAC) system efficiency will be achieved over the near term, which will drive a commensurate demand in preventive environmental health services as each of us takes some 23,000 breaths a day in highly sealed, energy efficient building conditions. Ironically, building ventilation systems frequently use public water as a source of humidification and cooling. Many U.S. water distribution systems are plagued by biofilm, a product of aging pipes. Again, environmental health professional skills and sensibilities will be highly desired at the intersection of engineering and health in the modern built environment. Speaking of aging, the silver tsunami is upon us.

In 2010 roughly 13% of the world's population was over the age of 65. By 2050 that proportion is estimated to be roughly 20%. That's a boatload of old folks, of which I will be one. What are the characteristics of an *continued on page 69*

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