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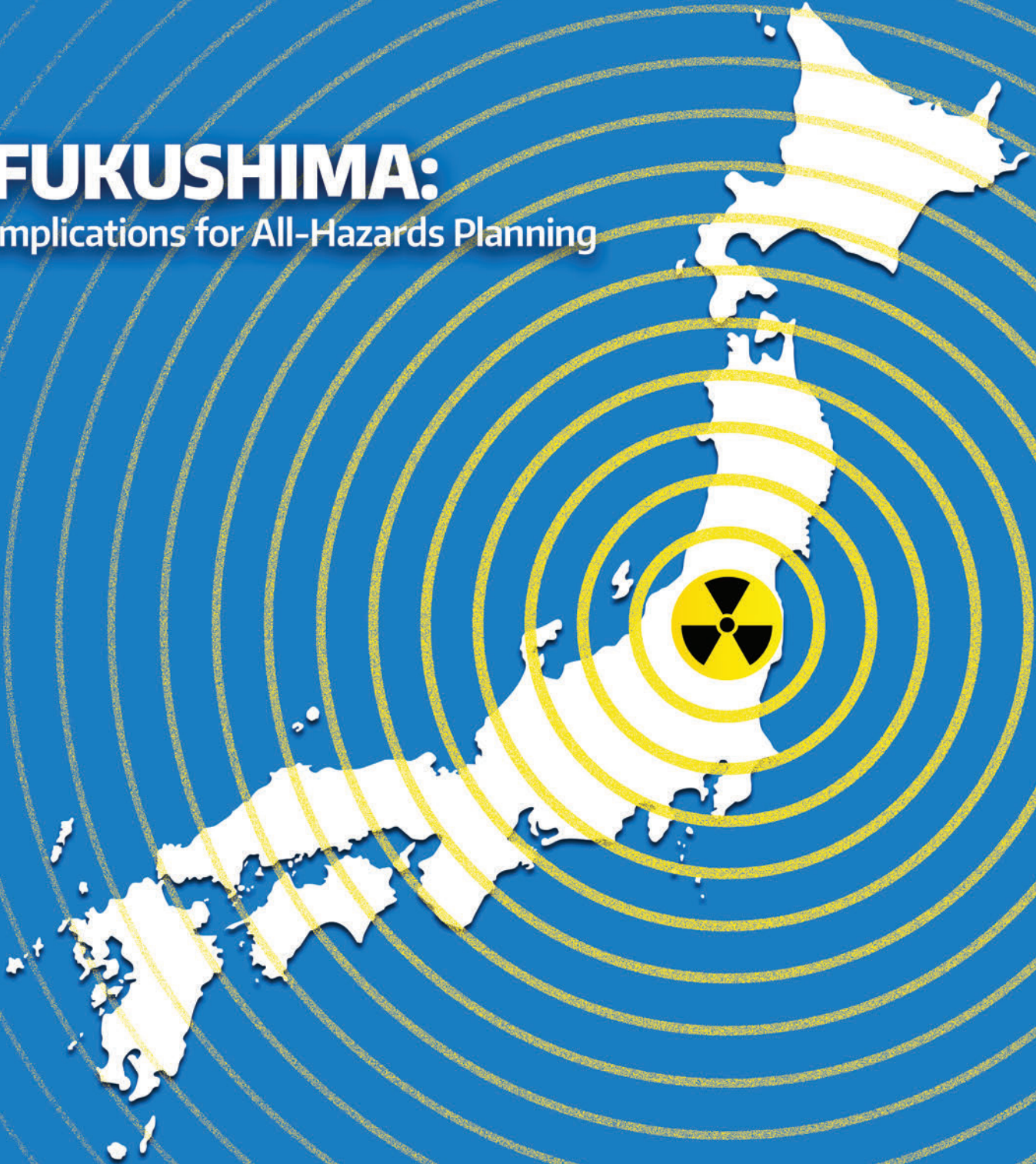
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ABOUT THE COVER



The Fukushima nuclear disaster triggered by the magnitude 9.0 Great East Japan Earthquake and tsunami on March 11, 2011, reminded the world that nuclear power plant

accidents like the Chernobyl and Three Mile Island disasters can still occur. In this feature article, “Implications of the Fukushima Nuclear Disaster: Man-Made Hazards, Vulnerability Factors, and Risk to Environmental Health,” the authors examined the risk of radiation from the Fukushima nuclear disaster to environmental health and how that risk was communicated to the public. Their examination of the literature resulted in an “All-Hazards Planning Reference Model” that distinguishes three planning categories—Disaster Trigger Event, Man-Made Hazards, and Vulnerability Factors.

See page 26.

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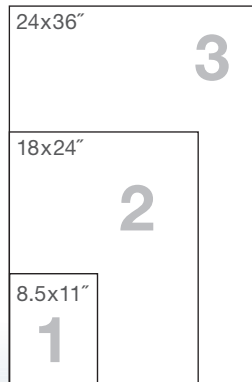


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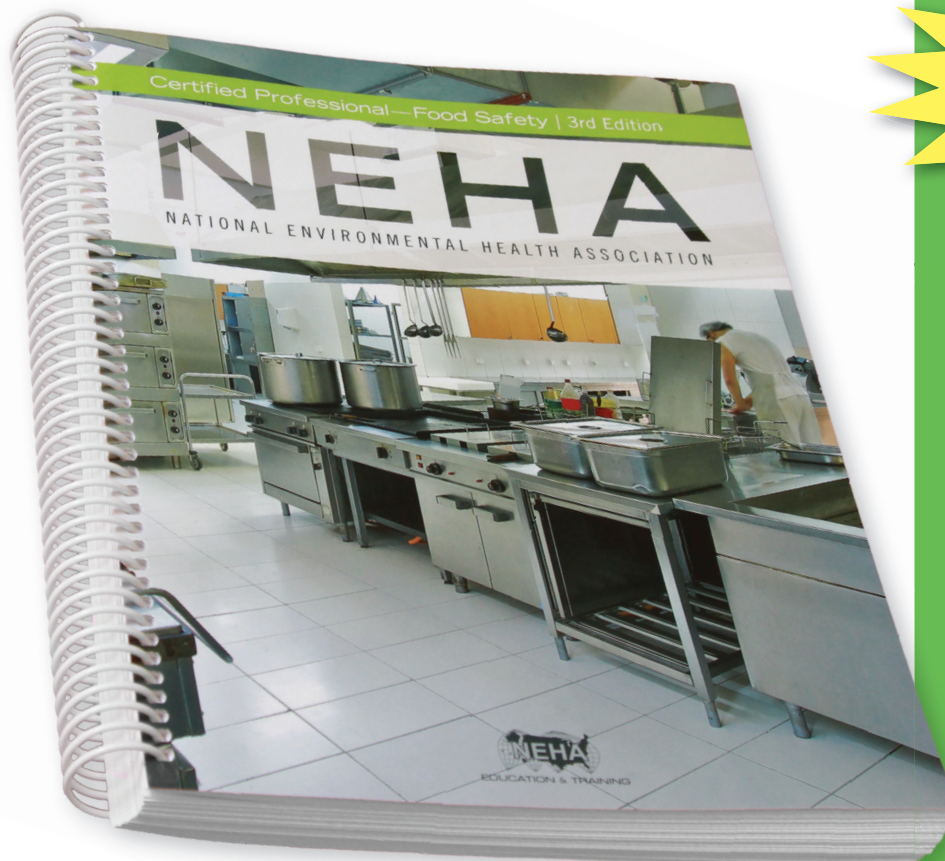
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▶ PRESIDENT'S MESSAGE



Bob Custard,
REHS, CP-FS

Charles Kettering once said, “The world hates change, yet it is the only thing that has brought progress.” We dread change because we fear that we will lose what is familiar and comfortable. Our tendency is to cling to the certainty of the present rather than to reach out and grasp a promising, but uncertain, future.

When I think of change, I visualize my grandson playing on monkey bars. If he is hesitant when he starts, his arms grow tired and he has difficulty reaching the next rung. In contrast, when he starts boldly, he has momentum to swing himself towards the next rung and he develops a rhythm of letting go of one bar and reaching for the next one. His success lies in letting go. Without letting go, he loses momentum and he can't reach forward very far.

NEHA is changing. In the last several years we have intentionally let go of some of our familiar and comfortable ways and have reached for new ways to serve our members. For example, NEHA has accomplished the following:

- Published the *Journal of Environmental Health* in an electronic format. Now about 75% of our renewing members receive the *Journal* only electronically. This supports NEHA's sustainability efforts and helps keep NEHA dues low.
- Created a new membership category—International Members. This was made economically possible by our new digital *Journal* and recognizes the global nature of environmental health.
- Transformed NEHA's Annual Educational Conference (AEC) & Exhibition section

Imagining the New NEHA

*I would like you
to join with me
in imagining the
new NEHA.*

chairs into “technical advisors” that now serve as year-round subject-matter experts for NEHA.

- Enhanced the NEHA *E-News* that brings time-sensitive information to our members more quickly than our *Journal* can.
- Downsized the NEHA bookstore. Although NEHA will continue to sell the training materials and study guides that we author or that are recommended references for our credentials, we will stop selling many books authored by others. Frankly, we can't compete with Amazon and other online booksellers that can deliver books to your doorstep faster and cheaper than NEHA can.

I am honored to have the opportunity to serve as your NEHA president for the next year. It is an exciting time of change. As your president, I would like to focus on six primary objectives for the coming year. They are as follows:

1. Expansion of NEHA's capacity to use the Internet to distribute publications and information, to provide distance learning, and to link environmental health professionals via social media. NEHA needs to fully embrace the digital age.

2. Expansion of NEHA's influence in Washington, DC, as an advocate for environmental health and the environmental health profession. NEHA needs to be at the table whenever and wherever environmental health policy is being discussed. We need to actively partner with other organizations with similar goals. Eventually I hope that NEHA will have a satellite office in the Washington, DC, area.
3. Expansion of NEHA's international presence. As chikungunya, dengue fever, and Ebola have shown us, few environmental health issues are geographically limited. It is increasingly important that NEHA be globally engaged on issues of international importance.
4. Engage and mentor the next generation of environmental health professionals. As the baby boom generation retires, a huge leadership transition is occurring in environmental health. NEHA should actively seek to develop and mentor young environmental health leaders.
5. Engage NEHA affiliates and support them in becoming strong state and local advocates for environmental health. NEHA long ago recognized that it did not have the resources to research and weigh in on every state or local environmental health issue. NEHA should play a bigger role, however, in encouraging the growth of healthy affiliates and in providing them with position papers and materials documenting the value of environmental health so that they can effectively address state and local environmental health issues.

6. Engage NEHA members in imagining the new, member-centered NEHA. Members are more than just NEHA's customers. They are stakeholders that deserve (and should expect) a return on their investment in NEHA.

Over the coming months you will see a number of new initiatives based on the feedback we have already received from NEHA members. In particular, watch for the following:

- A new and improved NEHA Web site.
- Revision of our Articles of Incorporation and Bylaws to shorten NEHA's election process for second vice president.
- A new document outlining NEHA's vision, mission, and core values.
- An updated document outlining NEHA's strategic directions.
- More frequent position papers on cutting edge environmental health issues.
- A NEHA annual report to our stakeholders.

J.K. Rowling once said, "We do not need magic to change the world. We carry all the power we need inside ourselves already. We have the power to imagine better." Together with our new Executive Director Dr. David Dyjack, I want to engage NEHA's members more than ever before. I would like you to join with me in imagining the new NEHA—a NEHA with increasing momentum reaching boldly for a member-centered future.

Specifically, I invite you to participate in one or more of the following opportunities to share your vision of the new NEHA:

- The Town Hall Assembly at the AEC (all members).

Brief Biographical Sketch—Bob Custard, NEHA President

Bob Custard, NEHA's new president, has served on the NEHA board of directors for the past 12 years. For the past year he has chaired NEHA's bylaws and finance committees. Bob has been a frequent speaker on food safety, environmental health program management, and the history of environmental health at NEHA's annual educational conferences.

Bob is passionate about mentoring emerging environmental health leaders. Recently he created Environmental Health Leadership Partners, a consulting firm specializing in environmental health leadership development and management.

Until last December, Bob served as an environmental health professional at the state and local levels in Virginia. For the 13 years prior to his retirement from the Virginia Department of Health, Bob was the Environmental Health Manager for the City of Alexandria. Before that, Bob coordinated Virginia's statewide environmental health training program for 10 years.

Bob has made six trips to Africa to assist various charitable organizations with drinking water issues. In 2010, Bob and his wife, Rosalind, a public health laboratory scientist, formed Global Environmental Health Partnerships in order to leverage their work in the developing world.

- An electronic survey that will come out with the July NEHA *E-News* (all members).
 - Engage your regional vice president via e-mail or at the AEC or at an affiliate conference (all members).
 - The Council of Delegates meeting at the AEC (affiliate presidents).
 - An electronic survey of affiliate presidents (affiliate presidents).
 - The meeting of the National Environmental Health Science and Protection Accreditation Council (EHAC) at the AEC (academics).
 - The annual meeting of the American Academy of Sanitarians at the AEC (academy members).
 - The annual meeting of the Past Presidents Affiliate at the AEC (past presidents).
- NEHA is your association. Boldly imagine the new NEHA and take the time to share that vision with NEHA's leadership. 🌍

Bob Custard

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How Clean Are Hotel Rooms?

Part I: Visual Observations vs. Microbiological Contamination

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Abstract Current evidence of hotel room cleanliness is based on observation rather than empirically based microbial assessment. The purpose of the study described here was to determine if observation provides an accurate indicator of cleanliness. Results demonstrated that visual assessment did not accurately predict microbial contamination. Although testing standards have not yet been established for hotel rooms and will be evaluated in Part II of the authors' study, potential microbial hazards included the sponge and mop (housekeeping cart), toilet, bathroom floor, bathroom sink, and light switch. Hotel managers should increase cleaning in key areas to reduce guest exposure to harmful bacteria.

Introduction

It is ironic that no universal standards currently exist for cleaning hotel rooms, a procedure that is repeated thousands of times every day in the hotel industry. Typically, cleanliness is based on observation. Although this provides for an aesthetic evaluation, it does not address issues related to microbial contamination and the possibility of acquiring an illness from contaminated surfaces. Studies have shown that contact with contaminated surfaces in hotels may be a likely source of transmission of infectious disease during some outbreaks (Kimura et al., 2011; Love, Jiang, Barrett, Farkas, & Kelly, 2002).

Several issues would suggest that observational standards for cleanliness in the hotel industry may no longer be adequate. Global travel has expanded so that the spread of infectious disease may occur on an international scale. For example, global business travel accounted for \$1 trillion in 2011 in spite of the influence of a poor global economy (Jonas, 2011). In addition, greater awareness exists of the modes of infectious disease transmis-

sion including transfer of microorganisms by touching fomites. The common cold, athletes' foot, influenza, herpes, *Staphylococcus* infections, *Streptococcus* infections, hepatitis, salmonellosis, acute gingivitis, intestinal flu, mononucleosis, tuberculosis, and Legionnaires' disease are just some of the common diseases that travelers can be exposed to while in a hotel (Dykstra, 1990).

Several types of equipment have been used to assess of cleanliness in research studies (Aycicek, Oguz, & Karci, 2006; Cunningham, Rajagopal, Lauer, & Allwood, 2011; Griffith, Cooper, Gilmore, Davies, & Lewis, 2000; Lueck, 2010; Moore & Griffith, 2002; Worsfold & Griffith, 1996). The efficacy of both aerobic plate/colony counts (APC) and adenosine triphosphate (ATP) has been evaluated and both are thought to offer important applications in cleanliness assessment. Research studies often use APC as the first test to compare surfaces to determine areas of greatest contamination, focusing on particular areas that are considered high touch or wet sites that may be overlooked in typical

cleaning (Mulvey et al., 2011; Scott, Duty, & McCue, 2009). Assessment using ATP meters is also common in research studies suggesting that they are also well accepted although they lack specificity in that they also assess organic residues (Worsfold & Griffith, 1996). Their advantages are that they offer more rapid results, are easier to use, and do not require a laboratory for analysis.

The purpose of our study was to determine if observational standards provide an accurate indicator of hotel room cleanliness. More specifically, APC is used to determine the levels of microbial contamination in hotel rooms and evaluate whether observational standards provide an accurate indicator of hotel room cleanliness. Recommendations for further research are also suggested including the need for testing standards in hotel rooms.

Methods

Hotel Sampling

Microbial sampling of 19 hotel guest room surfaces was conducted by independent trained

TABLE 1

Surfaces Sampled Within Hotel Guest Rooms

Room door handle (internal)	Bathroom door handle	Mug (when used in room)
Main light switch	Bathroom floor	Glove from maid cart
Entry carpet	Bathroom faucet	Mop from maid cart
Headboard	Bathroom sink	Sponge from maid cart
Bedside lamp switch	Shower floor	Curtain rod
Telephone keypad	Toilet paper holder	
TV remote keypad	Toilet basin	

TABLE 2

Mean Total Aerobic Bacteria Counts (CFU/cm²)

Item Rank (Clean to Least Clean)	Mean (Samples 1–9)	SD
Curtain rod	0.5	0.6
Headboard	0.5	1.0
Bathroom door handle	3.9	9.8
Shower floor	4.0	6.4
Room door handle	5.7	7.6
Bathroom faucet	6.5	13.9
Mug	9.1	14.2
Toilet paper holder	10.6	15.1
Entry carpet	11.2	8.3
Glove FMC*	18.2	15.9
Telephone keypad	20.2	25.0
Bedside lamp switch	21.7	39.4
TV remote keypad	67.6	109.2
Main light switch	112.7	332.7
Bathroom sink	117.8	331.0
Bathroom floor	119.0	330.6
Toilet basin	225.1	439.4
Mop FMC*	270.1	451.5
Sponge FMC*	505.1	529.2

Note. For the purpose of these calculations, counts of too numerous to count were replaced with 1,000 CFU/cm².

*FMC indicates that the item is from the maid cart used to clean the room.

researchers using three rooms and housekeeping carts in three hotels in Texas, Indiana, and South Carolina (one hotel per state) for a total of nine rooms. Because some hotel rooms did not have all of the sampling surfaces (e.g., mugs) a total of 162 samples were collected.

Hotel properties represented typical guest rooms that can be found in midscale hotels throughout the U.S. Properties ranged from approximately 100 to 200 rooms and included one full-service hotel with a restaurant and conference meeting space. Properties catered

primarily to business travelers and some leisure travelers. Because of the controlled conditions used for sampling and the careful selection of hotel properties, the small number of rooms used in this study was deemed to be adequate to explore the possibility of microbial contamination in typical hotel rooms.

The hotel rooms in each hotel were also expected to represent typical rooms for that property. They were randomly selected by the general managers of the hotels based on guest departures and were cleaned by three different

housekeepers in each of the hotels. The rooms were sampled after the rooms were cleaned and classified as vacant and ready to rent.

Surfaces that were selected for sampling in the hotel rooms included both bathroom areas as well as areas that would be considered “high touch” or “hand touch” in the bedroom area as these are considered in other locations such as hospitals to be habitually contaminated with pathogens (Dancer, 2009). Sites included floors, handles, switches, keypads, sinks, faucets, and toilets in the guest rooms, and three sites from the housekeeping cart including a used glove, mop, and sponge. The sites are listed in detail in Table 1.

Sampling Protocol

To avoid cross contamination during the data collection process prior to each sampling, the researchers washed their hands thoroughly and used a new set of sterile gloves prior to collecting data in each room. Using standard microbial techniques (Davidson, Griffith, Peters, & Fielding, 1999), each surface was swabbed aseptically in a 5-cm² area with sterile cotton swabs moistened in phosphate buffered saline (PBS) solution using sterile aluminum foil templates to define the area to be swabbed. After sampling, the wood handle of each swab was snapped off to ensure aseptic practices and to keep the cotton portion in the PBS-filled 15-mL centrifuge tubes after they were capped. This procedure was done to allow sampled microorganisms to remain viable until microbial testing was performed. The samples were then placed into insulated boxes with refrigerant and shipped overnight to the Food Microbiology Laboratory at the University of Houston for testing.

Bacterial Quantification

APC was used to assess levels of (general) bacterial contamination using standard techniques. APC is one of the most commonly used methods of microbial testing and has been used in studies related to cleaning, as described previously (Cunningham et al., 2011; Yoon et al., 2008). APC was conducted using Petrifilm aerobic count plates to determine the aerobic bacteria population. The microbial samples were vortexed in 15-mL centrifuge tubes for 10 seconds using a fixed speed vortex mixer to release any bacteria from the swab. One mL of the PBS solution from the vortexed tubes was then pipetted

onto the APC Petrifilm. A plastic spreader disc was placed on top of the film to disperse solution (as per the manufacturer's instructions) and the film was incubated for 24 hours at 37°C and the colonies were quantified.

E. coli/coliform counts were also conducted as additional indicators of contamination. Coliform bacteria live in the intestines of warm blooded animals and are therefore often used as an indicator of sewage or fecal contamination. For this test, prepared samples as previously described were plated on Petrifilm *E. coli*/coliform count plates, incubated at 35°C for 24 hours, and quantified.

Results

APC

A total of 160 useable samples from surfaces from the nine hotel rooms and housekeeping carts were obtained and tested for aerobic bacteria using the APC method. Two samples were returned with an inadequate volume of PBS to complete this test and were deemed unusable. The mean and standard deviation of the bacteria counts for samples 1–9 are given in Table 2.

Highest levels of contamination were found with two items from the housekeeping cart, three areas in the bathroom, and one high-touch area in the main room. In terms of the mean aerobic bacterial count, highest levels were found for the sponge, mop, toilet basin, bathroom floor, bathroom sink, and main light switch. In support of this, sporadic very high levels (“too numerous to count” or TNTC) were found four times for the sponge, twice for the mop and toilet basin, and once each for the main light switch, the bathroom floor, and the bathroom sink. As found with other research studies discussed in the literature review, results varied widely.

Coliform Counts

A total of 159 useable samples from surfaces within nine different hotel rooms were obtained and tested for total coliform bacteria counts. After conducting the APC, one additional sample had an inadequate volume of PBS to complete this test and was deemed unusable. The mean and standard deviation of the coliform bacteria counts for samples 1–9 are given in Table 3.

Coliform count results identified some of the same sites as the APC as being heavily

TABLE 3

Mean Total Coliform Bacteria Counts (CFU/cm²)

Item Rank (Clean to Least Clean)	Mean (Samples 1–9)	SD
Room door handle	0.0	0.0
Bathroom faucet	0.0	0.0
Bathroom door handle	0.1	0.2
Toilet basin	0.1	0.2
Toilet paper holder	0.1	0.2
Curtain rod	0.1	0.2
Headboard	0.1	0.4
Bedside lamp switch	0.1	0.3
TV remote keypad	0.1	0.4
Shower floor	0.1	0.4
Bathroom floor	0.2	0.6
Entry carpet	0.3	0.5
Mug	0.6	1.0
Glove FMC*	1.2	2.5
Telephone keypad	1.3	3.8
Main light switch	111.1	333.3
Bathroom sink	111.2	333.3
Mop FMC*	125.2	353.5
Sponge FMC*	500.1	534.4

Note: For the purpose of these calculations, counts of too numerous to count were replaced with 1,000 CFU/cm².
*FMC indicates that the item is from the maid cart used to clean the room.

contaminated, although lower overall counts were found in coliform testing as compared to the APC testing. This would be expected due to the more specific nature of microbial contamination associated with the coliform count. Highest mean coliform counts were found for the sponge, mop, bathroom sink, and main light switch. Again, sporadic very high levels (TNTC) were found four times for the sponge, and once each for the main light switch, bathroom sink, and mop. In addition, as reported with other research studies, results varied considerably.

Because industry standards are not yet developed for the hotel industry, an exploratory approach was employed similar to the Scott and co-authors (2009) cleaning study, which drew comparisons at the 25th and 75th percentiles based on median levels of contamination. In our study, the exploratory approach was used to assess how many samples would meet the aerobic plate count standards of 5 CFU/cm², 10 CFU/cm², and 50 CFU/cm² (Table 4). In addition, a comparison was also made to how many samples

would meet the coliform count standards of 1 CFU/cm², 2 CFU/cm², and 10 CFU/cm² (Table 5). As can be observed from these tables, numerous surface samples were still above these levels of contamination.

Discussion

Although this research suggests a potential starting point for further research in industry standards, industry applications may already be drawn. First of all, results of our study suggest that potential microbial hazards may exist in some hotel rooms. Secondly, surface sampling results may be used as a starting point to determine levels of bacterial contamination in hotel rooms and point to specific areas of the hotel room that may require greater attention for cleaning. Rooms division managers or executive housekeepers might consider these areas more closely in their cleaning protocols. Room attendants should focus their limited time in the guest room to cleaning those surfaces that are more likely to be contaminated. In addition, if supervisors are monitoring or evaluating hotel room cleaning done by room

TABLE 4

Number of Samples Passed Based on Proposed Critical Limits for Aerobic Plate Counts

Surface Type	# Items Pass/Total # Samples		
	5 CFU/cm ²	10 CFU/cm ²	50 CFU/cm ²
Room door handle	6/9	6/9	9/9
Main light switch	6/9	8/9	8/9
Entry carpet	3/9	4/9	9/9
Headboard	9/9	9/9	9/9
Bedside lamp switch	5/9	5/9	7/9
Telephone keypad	2/9	3/9	8/9
TV remote keypad	4/9	4/9	7/9
Bathroom door handle	8/9	8/9	9/9
Bathroom floor	5/9	6/9	8/9
Bathroom faucet	7/9	8/9	9/9
Bathroom sink	4/9	6/9	8/9
Shower floor	7/9	7/9	9/9
Toilet paper holder	4/9	7/9	9/9
Toilet basin	5/9	6/9	7/9
Mug	2/3	2/3	3/3
Glove FMC*	2/9	4/9	9/9
Mop FMC*	3/8	3/8	4/8
Sponge FMC*	2/8	2/8	4/8
Curtain rod	6/6	6/6	6/6

Note: For the purpose of these calculations, counts of too numerous to count were replaced with 1,000 CFU/cm².

*FMC indicates that the item is from the maid cart used to clean the room.

attendants, they may wish to focus their attention on these more critical areas.

As research progresses in hotel cleaning, the areas identified in our study should be further evaluated. As to the room surfaces tested in our study, many areas presented relatively low or infrequent bacterial contamination. Other areas presented very high levels, particularly from the housekeeping cart. This evaluation is beneficial in identifying areas of consistently high levels of bacterial contamination and routes of possible transmission. It is important to note that the risk of contracting illness or disease from an environmental surface is dependent on what type of bacteria are present and the levels of contamination. While APC does not indicate whether the microorganisms are pathogenic or not, it can be used as an indicator of the overall level of cleanliness of a surface by enumerating the total aerobic microbial load. In addition, coliform bacteria (indicating fecal contamination) were isolated from at least

one sample of each item sampled except for the internal room door handle and bathroom faucet. Relatively high levels of contamination were found at some point on nearly all surface areas sampled.

Based on the mean aerobic bacteria counts, the high-risk items were the sponge and mop from the housekeeping cart, the toilet basin, the bathroom floor, the bathroom sink, and the main light switch. It is interesting to note that high-touch areas such as the door handles and the telephone keypad were not classified as high risk according to this analysis, as frequently touched surfaces have been cited as likely reservoirs of bacteria (Lueck, 2010). Based on the mean aerobic bacteria counts, the low risk items were the curtain rod, the headboard, the bathroom door handle, the shower floor, the room door handle, the bathroom faucet, and the mug.

Based on mean coliform bacteria counts, the high-risk areas were the sponge and mop from the housekeeping cart, the bathroom

sink, the main light switch, the telephone keypad, the glove from the housekeeping cart, and the mug. Based on mean coliform bacteria counts, the surfaces presenting the lowest risk of contamination included the internal room door handle, the bathroom faucet, the bathroom door handle, the toilet basin, the toilet paper holder, the curtain rod, and the headboard. It is interesting to note that the majority of the lowest risk contaminated items were located in the bathroom. This could be attributed to the use of more stringent cleaning chemicals and the smooth nonporous nature of such surfaces.

The mop and sponge from the housekeeping carts demonstrated consistently high levels of both aerobic and coliform bacteria counts. These findings support previous studies indicating that sponges and cloths used for cleaning purposes are capable of sustaining the growth and survival of bacteria (Hilton & Austin, 2000; Mattick et al., 2003; Sun-Young, 2010). One of these studies also observed that rinsing the cloth between usages resulted in a significantly lower rate of transfer, while rinsing the sponge between usages did not (Hilton & Austin, 2000). The ability to transfer bacteria from sponges during cleaning to surfaces has been shown (Hilton & Austin, 2000; Kusumaningrum, Riboldi, Hazeleger, & Beumer, 2003; Mattick et al., 2003). Also, the transfer of bacteria from surface to hand and hand to mouth has been demonstrated (Rusin, Maxwell, & Gerba, 2002). Contact with contaminated surfaces has been cited as a possible mode of disease acquisition (Barbut & Petit, 2001; Jones, Kramer, Gaither, & Gerba, 2007).

While the mops and sponges from housekeeping carts had high levels of aerobic and coliform bacteria, the gloves sampled from housekeeping carts had significantly lower counts. This difference could be attributed to the use of a new pair of gloves for each room cleaned, as opposed to the continued use of the mop and sponge in different rooms. Proper use of disposable gloves has been shown to be an effective means of reducing the cross transmission of microorganisms (Berthelot et al., 2006; Larson, 1995). Hotel managers may wish to consider the use of more disposable items (including cleaning supplies) to help lower microbial counts. Further research is recommended on the effectiveness of cleaning or disinfecting the cleaning supplies for repeated use.

Conclusion

Even though all of the rooms in this sample appeared visually clean, APC tests confirmed that some areas of the guest rooms, as well as the maid carts, had high levels of contamination. Visual inspection does not appear to be a reliable indicator of cleanliness.

Although our study provides an assessment of the potential for microbial contamination in hotel rooms, one limitation of the study is the sample size of only nine rooms. A greater sample size would perhaps have provided a more accurate depiction of the hotel room cleaning. In addition, it is important to note that a high level of standard deviation occurred in the results for the tested items. Because actual hotel rooms were tested after having been cleaned, however, the large standard deviation might also suggest the need for more standardization of cleaning practices. One additional limitation of our study is that no testing standards exist for interpretation of our data. The concept of hotel room cleanliness will be discussed in part II of this study.

Protecting the health and safety of hotel guests is clearly important for hotel managers and for travelers who stay in their hotels. Research can help hotel managers more objectively evaluate cleaning rather than relying on visual assessment. Plainly, the time has come for more information about to how effectively clean hotel rooms, a routine practice done hundreds of thousands of times a day, but still needing improvement. 🐞

TABLE 5

Number of Samples Passed Based on Proposed Critical Limits for Coliform Bacteria

Type of Surface	# Samples Pass/Total # Samples		
	1 CFU/cm ²	2 CFU/cm ²	10 CFU/cm ²
Room door handle	9/9	9/9	9/9
Main light switch	8/9	8/9	8/9
Entry carpet	7/9	9/9	9/9
Headboard	8/9	9/9	9/9
Bedside lamp switch	9/9	9/9	9/9
Telephone keypad	8/9	8/9	8/9
TV Remote keypad	8/9	9/9	9/9
Bathroom door handle	9/9	9/9	9/9
Bathroom floor	8/9	9/9	9/9
Bathroom faucet	9/9	9/9	9/9
Bathroom sink	8/9	8/9	8/9
Shower floor	8/9	9/9	9/9
Toilet paper holder	8/8	8/8	8/8
Toilet basin	9/9	9/9	9/9
Mug	2/3	3/3	3/3
Glove FMC*	7/9	7/9	9/9
Mop FMC*	7/8	7/8	7/8
Sponge FMC*	4/8	4/8	4/8
Curtain rod	6/6	6/6	6/6

Note: For the purpose of these calculations, counts of TNTC were replaced with 1,000 CFU/cm².
*FMC indicates that the item is from the maid cart used to clean the room.

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References

Aycicek, H., Oguz, U., & Karci, K. (2006). Comparison of results of ATP bioluminescence and traditional hygiene swabbing methods for the determination of surface cleanliness at a hospital kitchen. *International Journal of Hygiene and Environmental Health*, 209(2), 203–206.

Barbut, F., & Petit, J.C. (2001). Epidemiology of *Clostridium difficile*–associated infections. *Clinical Microbiology and Infection*, 7(8), 405–410.

Berthelot, P., Dietemann, J., Fascia, P., Ros, A., Mallaval, F.O., Lucht, F., Pozzetto, B., & Grattard, F. (2006). Bacterial contamination of nonsterile disposable gloves before use. *American Journal of Infection Control*, 34(3), 128–130.

Cunningham, A.E., Rajagopal, R., Lauer, J., & Allwood, P. (2011). Assessment of hygienic quality of surfaces in retail food service establishments based on microbial counts and real-time detection of ATP. *Journal of Food Protection*, 74(4), 686–690.

Dancer, S. (2009). The role of environmental cleaning in the control of hospital-acquired infection. *The Journal of Hospital Infection*, 73(4), 378–385.

Davidson, C.A., Griffith, C.J., Peters, A.C., & Fielding, L.M. (1999). Evaluation of two methods for monitoring surface cleanliness—ATP bioluminescence and traditional hygiene swabbing. *Luminescence*, 14(1), 33–38.

Dykstra, J. (1990). *Infection control for lodging and food service establishments*. New York: John Wiley & Sons.

Griffith, C.J., Cooper, R.A., Gilmore, J., Davies, C., & Lewis, M. (2000). An evaluation of hospital cleaning regimes and standards. *The Journal of Hospital Infection*, 45(1), 19–28.

References

- Hilton, A.C., & Austin, E. (2000). The kitchen dishcloth as a source of and vehicle for foodborne pathogens in a domestic setting. *International Journal of Environmental Health Research*, 10(3), 257–261.
- Jonas, D. (2011). Study: Despite soft spots, 2011 global business travel poised to surpass \$1 trillion. *Business Travel News*, 28(12), 10.
- Jones, E.L., Kramer, A., Gaither, M., & Gerba, C.P. (2007). Role of fomite contamination during an outbreak of norovirus on houseboats. *International Journal of Environmental Health Research*, 17(2), 123–131.
- Kimura, H., Nagano, K., Kimura, N., Shimizu, M., Ueno, Y., Morikane, K., & Okabe, N. (2011). A norovirus outbreak associated with environmental contamination at a hotel. *Epidemiology and Infection*, 139(2), 317–325.
- Kusumaningrum, H.D., Riboldi, G., Hazeleger, W.C., & Beumer, R.R. (2003). Survival of foodborne pathogens on stainless steel surfaces and cross-contamination to foods. *International Journal of Food Microbiology*, 85(3), 227–236.
- Larson, E.L. (1995). APIC guidelines for hand washing and hand antisepsis in health care settings. *American Journal of Infection Control*, 23(4), 251–269.
- Love, S.S., Jiang, X., Barrett, E., Farkas, T., & Kelly, S. (2002). A large hotel outbreak of norwalk-like virus gastroenteritis among three groups of guests and hotel employees in Virginia. *Epidemiology and Infection*, 129(1), 127–132.
- Lueck, J. (2010). Infection control of high-touch surfaces. *Facility Care*, 15(6), 14–18.
- Mattick, K., Durham, K., Domingue, G., Jørgensen, F., Sen, M., Schaffner, D.W., & Humphrey, T. (2003). The survival of foodborne pathogens during domestic washing-up and subsequent transfer onto washing-up sponges, kitchen surfaces and food. *International Journal of Food Microbiology*, 85(3), 213–226.
- Moore, G., & Griffith, C. (2002). A comparison of traditional and recently developed methods for monitoring surface hygiene within the food industry. An industry trial. *International Journal of Environmental Health Research*, 12(4), 317–329.
- Mulvey, D., Redding, P., Robertson, C., Woodall, C., Kingsmore, P., Bedwell, D., & Dancer, S.J. (2011). Finding a benchmark for monitoring hospital cleanliness. *Journal of Hospital Infection*, 77(1), 25–30.
- Rusin, P., Maxwell, S., & Gerba, C. (2002). Comparative surface-to-hand and fingertip-to-mouth transfer efficiency of gram-positive bacteria, gram-negative bacteria, and phage. *Journal of Applied Microbiology*, 93(4), 585–592.
- Scott, E., Duty, S., & McCue, K. (2009). A critical evaluation of methicillin-resistant *Staphylococcus aureus* and other bacteria of medical interest on commonly touched household surfaces in relation to household demographics. *American Journal of Infection Control*, 37(6), 447–453.
- Sun-Young, L. (2010). Survival and growth of *Escherichia coli* on various commercial dish sponge/dishcloths and inhibitory effect of UV sterilization with or without moderate heat. *Journal of Food Safety*, 30(3), 721–731.
- Worsfold, D., & Griffith, C.J. (1996). An assessment of cleanliness in domestic kitchens. *Hygiene and Nutrition in Foodservice and Catering*, 1, 163–173.
- Yoon, Y., Kim, S.R., Kang, D.H., Shim, W.B., Seo, E., & Chung, D.H. (2008). Microbial assessment in school foodservices and recommendations for food safety improvement. *Food Microbiology and Safety*, 73(6), M304–M313.

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How Clean Are Hotel Rooms? Part II: Examining the Concept of Cleanliness Standards

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Abstract Hotel room cleanliness is based on observation and not on microbial assessment even though recent reports suggest that infections may be acquired while staying in hotel rooms. Exploratory research in the first part of the authors' study was conducted to determine if contamination of hotel rooms occurs and whether visual assessments are accurate indicators of hotel room cleanliness. Data suggested the presence of microbial contamination that was not reflective of visual assessments. Unfortunately, no standards exist for interpreting microbiological data and other indicators of cleanliness in hotel rooms. The purpose of the second half of the authors' study was to examine cleanliness standards in other industries to see if they might suggest standards in hotels. Results of the authors' study indicate that standards from other related industries do not provide analogous criteria, but do provide suggestions for further research.

Introduction

Environmental surfaces have been demonstrated to be reservoirs for infection (Hota, 2004; Kim et al., 1981; Lueck, 2010; Talon, 1999). The presence of specific pathogenic (disease-causing) microorganisms on surfaces has also been demonstrated (Dancer, 2009; Dyskra, 1990; Evans et al., 2002; Galimore et al., 2006; Wu et al., 2005) and these microorganisms are known to survive for extended periods of time (Cheesbrough, Barkess-Jones, & Brown, 1997). One study on environmental cleaning demonstrated that methicillin-resistant *Staphylococcus aureus* (MRSA) survived in dust for as long as one year (Wagenvoort, Sluijman, & Penders, 2000).

Disease outbreaks in hotels have been reported widely in news stories. Legionnaires' disease, an uncommon pneumonia with serious consequences especially for older age groups (Centers for Disease Control and Prevention [CDC], 2012), was identified as early as 1976 at a hotel in Philadelphia (Freije, 2006). Recent Legionnaires'

disease outbreaks have been reported in a 4,000-room hotel on the Las Vegas Strip in July 2011 (Ritter, 2011) and a Marriott Hotel in Chicago in summer 2012 (Smith, 2012). Another prominent disease linked to hotels was caused by the severe acute respiratory syndrome (SARS) virus. The origin of the spread of SARS was a single guest and a doctor who spent the night in a Hong Kong hotel in February 2003 (Bell, 2004; World Health Organization, 2004). This resulted in the spread of a global flu epidemic that devastated the Asian tourism industry.

More recently, norovirus has been linked to the cruise ship industry as well as hotels. It is considered highly contagious and resilient (Associated Press, 2004; CDC, 2013). Moreover, norovirus can survive in a dried state at room temperature for up to 28 days (MacCannell et al., 2011). Last but not least, bed bugs (*Cimex lectularius*), parasites of warm-blooded animals traveling around the world in luggage and on clothing (Shoemaker, 2011), are now considered to possibly harbor diseases such as hepatitis (James, 2003)

and have been found to be vectors for MRSA (Lowe & Romney, 2013).

Part of the challenge in defining appropriate cleaning is that cleaning of hotel rooms presents some unique management issues. In addition to staffing challenges such as the limited amount of time available for hotel room cleaning, the surfaces to be cleaned are different than in other industries. For example, environmental surfaces in hotels include electronics and textiles as well as hard non-porous surfaces. These surfaces may require special handling because they may be uneven (e.g., a touchpad or keypad on telephone or television remotes), damaged by liquids, or susceptible to discoloration or bleaching from certain detergents or sanitizers.

At the same time, little academic research has been done to assist managers in the hotel industry with these challenges. If hotels knew the areas presenting the highest risk of contamination, cleaning protocols could be targeted for these areas. In addition, the rooms division manager or executive housekeeper needs more information about how

to set standards for acceptable (or unacceptable) levels of contamination, rather than reliance on visual inspection. The purpose of our study was to examine cleaning standards from other industries to see if analogous criteria might be used in the hotel industry. This information is needed for interpreting research assessing hotel room cleanliness. In particular, part one of our study conducted exploratory research to determine if contamination of hotel rooms occurs and whether observation levels are accurate indicators of hotel room cleanliness. Data suggested that contamination occurred and that it was not reflective of observational assessments. Examination of standards in part II is needed to interpret data from part I as well as other future studies. Part II will also suggest recommendations for hotel managers based on interpretation of cleanliness data.

Methods

Literature Review

Current Cleaning Procedures in Hotel Rooms

Cleaning of hotel rooms occurs thousands of times per day. Based on the American Hotel and Lodging Association's (AH&LA's) number of guestrooms and average occupancy for 2011, this would translate to over 1.06 million guest rooms cleaned in the U.S. that year (AH&LA, 2013). In the U.S., room attendants or housekeepers clean between 12 (Casado, 2000) and 20 (Jones, 1986) rooms per eight-hour shift with an average of 14–16 rooms (Casado, 2000; Jones, 1986). Ironically, even though management expends incredible time, effort, and money cleaning hotel rooms, current practices for cleaning hotel rooms remain unstandardized and vary among properties and brands. In fact, differences in cleaning procedures (including rinsing the cloths between wipes or choice of chemicals such as detergent-based or hypochlorite/detergent-based solutions) can affect the efficacy of surface disinfection (Cogan, Slader, Bloomfield, & Humphrey, 2002). Currently, the most common method of evaluating hotel room cleanliness is a visual assessment.

Assessment of Cleanliness in Other Industries

General agreement exists in several research studies on the ineffectiveness of visual or personal assessments of cleanliness (Al-Hamad

& Maxwell, 2008; Griffith, Cooper, Gilmore, Davies, & Lewis, 2000; Malik, Cooper, & Griffith, 2003; Sherlock, O'Connell, Creamer, & Humphreys, 2009). Ineffectiveness of visual observations has been cited in butchers' shops (Worsfold & Griffith, 2001), private homes (Worsfold & Griffith, 1996), hospitals (Griffith et al., 2000; Mulvey et al., 2011), and retail food service establishments (Cunningham, Rajagopal, Lauer, & Allwood, 2011).

It would seem intuitive that cleanliness (or lack of cleanliness), microbial contamination, and rates of infection would be correlated and some research has therefore suggested that infection rates should be used to assess appropriate cleaning. Results, however, are mixed (Dancer, 2009). One systematic review of the literature (Dettenkofer et al., 2004) found no difference in infection rate when disinfectants (vs. cleaning without the use of disinfectants) were used in the four cohort studies that they evaluated. Additionally, a study by Dettenkofer and co-authors (2004) suggested that microbial contamination in a patient's hospital room may be only a minor causative factor in acquired infections, although they admit that this effect has not been well studied.

Other methods to better assess cleanliness have also been suggested. At least one study has suggested the use of "best practices" in cleaning to determine appropriate levels (Worsfold & Griffith, 2001). In that research study of butchers' shops, microbial levels were compared before and after "best practices" cleaning was performed. Post-cleaning levels using "best practices" were suggested to set the standards for cleanliness, in contrast to periodic cleaning. The implication is that the highest standards of cleaning should be used when establishing appropriate microbial standards.

A related study using an assessment of cleanliness based on "normal clean" vs. "rigorous clean" standards was conducted in kitchens in private homes (Worsfold & Griffith, 1996). In this study "normal clean" was established by asking subjects to clean their kitchen according to their normal practices. "Rigorous clean" levels were defined when the surfaces were re-cleaned and disinfected by the researcher using a sanitizer (which may be perceived as similar to the "best practices" described in the previous research study). Significantly improved dif-

ferences in cleaning were achieved with the "rigorous clean" methods and were thought to represent more appropriate cleaning. At the same time, that study suggested that acceptable levels of hygiene in domestic kitchens should take into account the nature of the (food) soil, the construction materials (environmental surfaces), the inter-cycle cleaning conditions (what happens in that environment when food is not being prepared), the variety of domestic cleaning products used, and the training of those who clean.

In summary, many industries no longer consider visual assessment adequate for assessment of cleaning and other more objective standards are being researched. Although the correlation between microbial contamination and infection rates would appear to provide the strongest evidence for where to set the objective standards for cleaning levels, research results on the relationship is mixed. The concept of looking at microbial levels after "best practices" or "rigorous" cleaning, however, may be useful. Research in at least two areas where cleaning is essential to prevent the spread of disease (butcher shops and home kitchens) found this approach to be a good method.

Types of Microbiological Assessment and Examples of Criteria Used

Different types of microbial assessment have been suggested and offer the potential for standard testing methodologies for cleanliness if appropriate standards can be set for hotel rooms (Aycicek, Oguz, & Karci, 2006; Cunningham et al., 2011; Griffith et al., 2000; Lueck, 2010; Moore & Griffith, 2002a; Worsfold & Griffith, 1996). They include the evaluation of general microbial contamination, specific types of microbial contamination relevant to that environment, or the use of adenosine triphosphate (ATP) bioluminescence. General microbial contamination has been quantified through aerobic plate counts (APC). Results are reported as CFU/cm². These tests give specific information relative to bacterial contamination, but are more expensive and time consuming than ATP tests. ATP tests are also thought to give a good indication of cleanliness (Griffith et al., 2000). They measure ATP (an energy-containing substance present in cells) from microorganisms, food residues (or other organic material), and humans (Worsfold &

Griffith, 1996). Results are reported as relative light units (RLU). They offer rapid results (within minutes), but do lack specificity for bacterial contamination as they also measure organic soil contamination. For example, one study found that microorganisms represented 33% of the ATP readings as compared to non-microbial sources (Griffith et al., 2000). It has also been suggested that although ATP readings lack specificity, they provide a better assessment of cleaning because organic residues provide a food source to bacteria (Worsfold & Griffith, 1996). Finally, some studies have suggested an integrated method incorporating visual assessments, ATP testing, and periodic microbial assessments (Aycicek et al., 2006; Cunningham et al., 2011; Moore & Griffith, 2002a). Occasionally, specific types of microbial contamination are further evaluated, such as generic *E. coli* and coliform counts (which may indicate sewage or fecal contamination) (Moore & Griffith, 2002b), *Campylobacter jejuni* on cutting boards (Cools et al., 2005), and *Staphylococcus aureus* (Scott, Duty, & McCue, 2009), among others.

Cleanliness standards for interpretation of APC or ATP results vary among research studies. Worsfold and Griffith (1996) used the following ATP standards in their study on home kitchens: <128 RLU for work surfaces, <114 for (cutting) boards, <27 for the tap, <154 for the drainer, and <58 for the refrigerator door handle. Manufacturer's recommendations for acceptable ATP levels were used by Cunningham and co-authors (2011). In this restaurant kitchen study, ATP levels exceeding 199 RLU were considered unacceptable for all surfaces except for cutting boards and bathroom door handles. The pass/fail level was set at 1,000 RLU for these two areas. When APC were assessed, surfaces with more than 125 CFU/50 cm² or those that tested positive for enteric (intestinal) bacteria were considered unclean.

Scott and co-authors (2009) sampled 32 surfaces for bacterial contamination in 35 homes. Highest counts were associated with potentially wet sites including kitchen drains, sponges, tubs, floor around the toilet, and kitchen faucet handles. Lowest counts were found on toilet seats and the toilet bowls. Because the purpose of that study was to determine areas of greatest contamination for specific microorganisms in rela-

tion to household demographics, they did not attempt to set acceptable levels, but drew comparisons at the 25th and 75th percentiles based on median levels of contamination. Their conclusions were that many surfaces were highly contaminated, bacterial counts varied extremely, moisture had an impact on microbial counts, and most importantly, a potential existed for spread of fecal pathogens via hand-contact surfaces.

An in-depth hospital cleaning study by Mulvey and co-authors (2011) looked at ATP levels and their relationship to microbial growth as assessed by APC. Correlation of ATP levels with a recently suggested APC hospital standard of 2.5 CFU/cm² (reduced from 5 CFU/cm²) was assessed using samples taken from patient rooms including the floor underneath the patient's bed, bedside table, bed frame, and locker. An ATP benchmark value of 100 RLU offered the closest correlation with microbial growth levels <2.5 CFU/cm², although the researchers noted that this level was based on the use of the Hygiene brand ATP meter. Their overall conclusion was that more research is needed to determine appropriate cleanliness, particularly for high-risk (hand-touch) areas.

Another hospital study by Griffith and co-authors (2000) evaluated 29 ward locations and suggested realistic benchmark values after best practice cleaning and disinfection. These were 500 RLU for ATP assessment and 2.5 CFU/cm² for APC testing. The researchers noted that most sites that were assessed as visually clean would have failed using these benchmark values. More specifically, ATP tests would have failed an average of 76% of the sites that would have visually passed and APC would have failed an average of 70% of the sites. This disparity was striking as visually clean surfaces had more than 40 CFU/cm² in some sampling areas. These results offer useful information for the hotel industry because many cleaning sites would be considered "wet" hand-contact surfaces.

Significant differences in microbial contamination were also found in a study done in hotel food services in Spain based on the type of surfaces and the time parameters used (Domenech-Sanchez, Laso, Perez, & Berrocal, 2001). The standard used in that study was <1.3 log CFU/cm² for food contact surfaces as suggested by Henroid and co-authors (2004).

Results and Discussion

If the APC level of <2.5 CFU/cm² from other cleaning studies (Griffith et al., 2000; Mulvey et al., 2011) is used as a hotel cleaning benchmark, almost all tested surfaces (headboard, bathroom and room door handles, bathroom and shower floors, bathroom sink and faucet, mug, toilet paper holder, entry carpet, telephone and TV remote keypad, bedside and main light switches, toilet basin, and three items from the maid cart including a glove, mop, and sponge) from part I of our study would have failed for at least one sample. The one exception was the curtain rod that was only sampled in three rooms (Table 4, part I).

The meaning of coliform counts is even more difficult to assess. Dancer (2004) suggested that coliform count levels less than 2 CFU/cm² should be used as the standard in hospitals. Using this standard, most of the surfaces tested in part I of our study would have passed with the exception of some samples taken from the main light switch, telephone key pad, bathroom sink, glove, mop, and sponge. It is surprising, however, that any level of coliform contamination was found on a mug (1.8 CFU/cm²). As in other studies, results varied widely with the samples. When mean coliform counts were calculated, four surfaces again exceeded the 2 CFU/cm² standard. They were the main light switch, the bathroom sink, the mop, and the sponge (Table 5, part I).

While the results might suggest potential concerns, the application of these standards may not be appropriate. Worsfold and Griffith's (1996) research states that situational variables need to be considered that are unique to the environment being cleaned. In the case of hotels, this might include the nature of the soil, type of materials being cleaned, cleaning frequency, room cleaning process, types of cleaning products used, and room attendants' training.

In addition, while the food industry has heavily researched acceptable levels, environmental surfaces in food establishments are regulated to be smooth, easily cleanable, durable, and most importantly, non-porous. In addition, access to kitchens in food establishments is limited to employees. Similarly, hospitals are also actively seeking to set standards; however, conditions may differ as to the pathogens present, stringent need for antiseptic conditions (e.g., surgery),

and the immune-compromised condition of patients (which may require higher levels of “cleanliness”).

Conclusion

Almost all hotel room surfaces failed when microbiological standards set in other industries were used for the hotel rooms. Use of these other industry standards may not be suitable, however. Hotel rooms differ from food establishments, hospitals, and other areas in their types of surfaces, presence of hotel guests living in these spaces (as compared to employees working in an environment), pathogens, need for antiseptic or sterile conditions, and immune status of people in their environment. Although comparing the standards from other industries is a starting point to establishing standards for the hotel industry, it appears that cleaning standards from other industries may not be appropriate.

Our study also reviewed relevant literature to determine how standards were set for cleaning in other industries. Previous

research has focused on acceptable levels after thorough cleaning has been performed. By analogy, guest room cleaning standards should be based on evaluations after best cleaning practices have been conducted. Recommendations for future hotel room studies include “before and after” testing using best cleaning practices. The type of assessment (APC or ATP testing) that is most appropriate, operationally feasible, and cost-effective should also be considered.

Hotel managers might use these to develop cleaning policies that assure satisfactory cleaning of guest rooms. Housekeepers clean an average of 14–16 rooms per eight-hour shift (Casado, 2000; Jones, 1986). Because of this time limitation it is essential that areas with the greatest contamination be addressed. Rooms division managers or executive housekeepers may wish to emphasize cleaning the dirtiest areas when developing cleaning protocols or policies to ensure that rooms are cleaned in the most efficient and most effective manner. Additionally, it would be use-

ful to determine the value of disinfectants in room cleaning. As compared to restaurants where the use of disinfectants is common, hotel managers have to consider the damaging effect of these products on textiles and other surfaces specific to hotel rooms.

Clearly, visual assessment of hotel room cleaning does not represent the level of microbial contamination that may be present. Visual cleanliness is aesthetically important, but doesn't necessarily reduce the risk of infection. Additional research will help hotel owners and managers assure that people staying in hotels are provided a safe and clean environment, just as people are in restaurants, hospitals, or anywhere else where services are provided for eating or sleeping. 🍷

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References

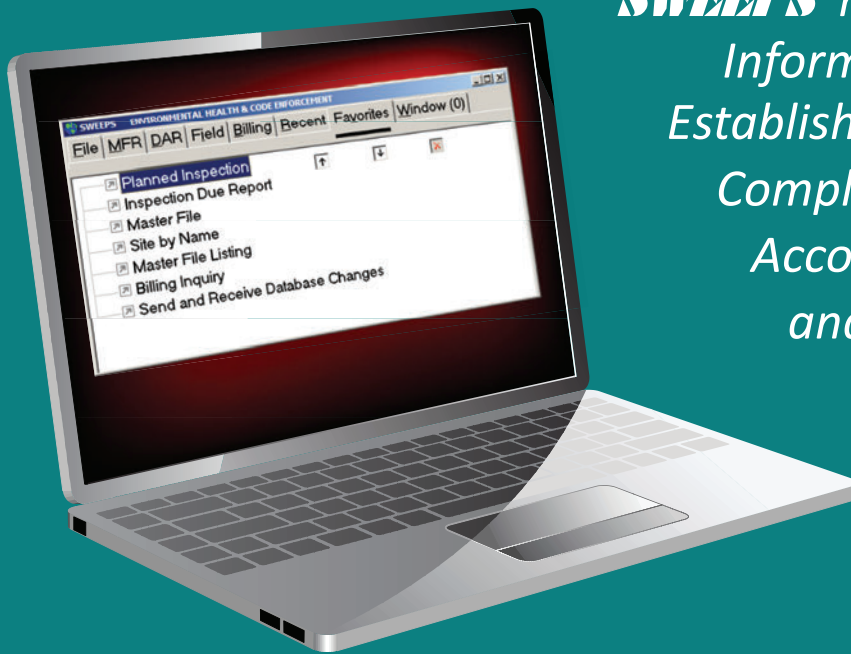
- Al-Hamad, A., & Maxwell, S. (2008). How clean is clean? Proposed methods for hospital cleaning assessment. *The Journal of Hospital Infection*, 70(4), 328–334.
- American Hotel and Lodging Association. (2013). *Ask us anything*. Retrieved from <http://www.ahla.com/information/>
- Associated Press. (2004). *Las Vegas hotels tied to Norwalk outbreak*. Retrieved from <http://www.nbcnews.com/id/4546611/#.USKmXVrFl1Y>
- Aycicek, H., Oguz, U., & Karci, K. (2006). Comparison of results of ATP bioluminescence and traditional hygiene swabbing methods for the determination of surface cleanliness at a hospital kitchen. *International Journal of Hygiene and Environmental Health*, 209(2), 203–206.
- Bell, D.M., & the World Health Organization Working Group on Prevention of International and Community Transmission of SARS. (2004). Public health interventions and SARS spread, 2003. *Emerging Infectious Diseases*, 10(11). Retrieved from http://wwwnc.cdc.gov/eid/article/10/11/04-0729_article
- Casado, M. (2000). *Housekeeping management*. New York: John Wiley & Sons.
- Centers for Disease Control and Prevention. (2012). *Legionella (Legionnaires' disease and Pontiac fever)*. Retrieved from <http://www.cdc.gov/legionella/index.html>
- Centers for Disease Control and Prevention. (2013). *Norovirus U.S. trends and outbreaks*. Retrieved from <http://www.cdc.gov/norovirus/trends-outbreaks.html>
- Cheesbrough, J.S., Barkess-Jones, L., & Brown, D.W. (1997). Possible prolonged environmental survival of small round structured viruses. *The Journal of Hospital Infection*, 35(4), 325–326.
- Cogan, T.A., Slader, J., Bloomfield, S.F., & Humphrey, T.J. (2002). Achieving hygiene in the domestic kitchen: The effectiveness of commonly used cleaning procedures. *Journal of Applied Microbiology*, 92(5), 885–892.
- Cools, I., Uyttendaele, M., Cerpentier, J., D'Haese, E., Nelis, H.J., & Debevere, J. (2005). Persistence of *Campylobacter jejuni* on surfaces in a processing environment and on cutting boards. *Letters in Applied Microbiology*, 40(6), 418–423.
- Cunningham, A.E., Rajagopal, R., Lauer, J., & Allwood, P. (2011). Assessment of hygienic quality of surfaces in retail food service establishments based on microbial counts and real-time detection of ATP. *Journal of Food Protection*, 74(4), 686–690.
- Dancer, S. (2004). How do we assess hospital cleaning? A proposal for microbiological standards for surface hygiene in hospitals. *Journal of Hospital Infection*, 56(1), 10–15.
- Dancer, S. (2009). The role of environmental cleaning in the control of hospital-acquired infection. *The Journal of Hospital Infection*, 73(4), 378–385.

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References continued from page 17

- Dettenkofer, M., Wenzler, S., Amthor, S., Antes, G., Motschall, E., & Daschner, F.D. (2004). Does disinfection of environmental surfaces influence nosocomial infection rates? A systematic review. *American Journal of Infection Control*, 32(2), 84–89.
- Domenech-Sanchez, A., Laso, E., Perez, M.J., & Berrocal, C.I. (2011). Microbiological levels of randomly selected food contact surfaces in hotels located in Spain during 2007–2009. *Foodborne Pathogens and Disease*, 8(9), 1025–1029.
- Dykstra, J. (1990). *Infection control for lodging and food service establishments*. New York: John Wiley & Sons.
- Evans, M.R., Meldrum, R., Lane, W., Gardner, D., Ribeiro, C.D., Gallimore, C.I., & Westmoreland, D. (2002). An outbreak of viral gastroenteritis following environmental contamination at a concert hall. *Epidemiology and Infection*, 129(2), 355–360.
- Freije, M. (2006). Legionnaires' contamination preventable at reasonable cost. *Hotel & Motel Management*, 221(7), 8–17.
- Gallimore, C.I., Taylor, C., Gennery, A.R., Cant, A.J., Galloway, A., Iturriza-Gomara, M., & Gray, J.J. (2006). Environmental monitoring for gastroenteric viruses in a pediatric primary immunodeficiency unit. *Journal of Clinical Microbiology*, 44(2), 395–399.
- Griffith, C.J., Cooper, R.A., Gilmore, J., Davies, C., & Lewis, M. (2000). An evaluation of hospital cleaning regimes and standards. *The Journal of Hospital Infection*, 45(1), 19–28.
- Henroid, D.H., Mendonca, A.F., & Sneed, J. (2004). Microbiological evaluation of food contact surfaces in Iowa schools. *Food Protection Trends*, 24(9), 682–685.
- Hota, B. (2004). Contamination, disinfection, and cross-colonization: Are hospital surfaces reservoirs for nosocomial infection? *Clinical Infectious Diseases*, 39(8), 1182–1189.
- James, M.S. (2003). *Easterners battle bloodsucking bed bugs*. Retrieved from <http://abcnews.go.com/US/story?id=90005>
- Jones, T. (1986). *Professional management of housekeeping operations* (5th ed.). Hoboken, NJ: John Wiley & Sons.
- Kim, K.H., Fekety, R., Batts, D.H., Brown, D., Cudmore, M., Silva, J.J., & Waters, D. (1981). Isolation of *Clostridium difficile* from the environment and contacts of patients with antibiotic-associated colitis. *The Journal of Infectious Diseases*, 143(1), 42–50.
- Lowe, C., & Romney, M. (2011). Bedbugs as vectors for drug-resistant bacteria. *Emerging Infectious Diseases*, 17(6), 1132–1134.
- Lueck, J. (2010). Infection control of high-touch surfaces. *Facility Care*, 15(6), 14–18.
- MacCannell, T., Umscheid, C.A., Agarwal, R.K., Lee, I., Kuntz, G., & Stevenson, K.B. (2011). Guideline for the prevention and control of norovirus gastroenteritis outbreaks in healthcare settings. *Infection Control and Hospital Epidemiology*, 32(10), 939–69.
- Malik, R.E., Cooper, R.A., & Griffith, C.J. (2003). Use of audit tools to evaluate the efficacy of cleaning systems in hospitals. *American Journal of Infection Control*, 31(3), 181–187.
- Moore, G., & Griffith, C. (2002a). A comparison of traditional and recently developed methods for monitoring surface hygiene within the food industry. An industry trial. *International Journal of Environmental Health Research*, 12(4), 317–329.
- Moore, G., & Griffith, C. (2002b). A comparison of surface sampling methods for detecting coliforms on food contact surfaces. *Food Microbiology*, 19(1), 65–73.
- Mulvey, D., Redding, P., Robertson, C., Woodall, C., Kingsmore, P., Bedwell, D., & Dancer, S.J. (2011). Finding a benchmark for monitoring hospital cleanliness. *Journal of Hospital Infection*, 77(1), 25–30.
- Ritter, K. (2011). *Guests slap resort with \$337.5 million lawsuit over illness*. Retrieved from http://seattletimes.com/html/nationworld/2015999894_apuslegionnairesdiseasearia.html
- Scott, E., Duty, S., & McCue, K. (2009). A critical evaluation of methicillin-resistant *Staphylococcus aureus* and other bacteria of medical interest on commonly touched household surfaces in relation to household demographics. *American Journal of Infection Control*, 37(6), 447–453.
- Sherlock, O., O'Connell, N., Creamer, E., & Humphreys, H. (2009). Is it really clean? An evaluation of the efficacy of four methods for determining hospital cleanliness. *Journal of Hospital Infection*, 72(2), 140–146.
- Shoemaker, D. (2011). Singing the bed bug blues. *Executive Housekeeping Today*, 33(5), 5–18.
- Smith, M. (2012). *Two dead in Legionnaires' outbreak in downtown hotel*. Retrieved from http://articles.chicagotribune.com/2012-08-28/news/chi-4-more-legionnaires-cases-tied-to-downtown-hotel-20120827_1_legionella-bacteria-legionnaires-downtown-hotel
- Talon, D. (1999). The role of the hospital environment in the epidemiology of multi-resistant bacteria. *Journal of Hospital Infection*, 43(1), 13–17.
- Wagenvoort, J.H., Sluijmsmans, W., & Penders, R.J. (2000). Better environmental survival of outbreak vs. sporadic MRSA isolates. *Journal of Hospital Infection*, 45(3), 231–234.
- World Health Organization. (2004). *WHO guidelines for the global surveillance of severe acute respiratory syndrome (SARS)*. Retrieved from http://www.who.int/csr/resources/publications/WHO_CDS_CSR_ARO_2004_1.pdf
- Worsfold, D., & Griffith, C.J. (1996). An assessment of cleanliness in domestic kitchens. *Hygiene and Nutrition in Foodservice and Catering*, 1, 163–173.
- Worsfold, D., & Griffith, C.J. (2001). An assessment of cleaning regimes and standards in butchers' shops. *International Journal of Environmental Health Research*, 11(3), 245–256.
- Wu, H.M., Fornek, M., Schwab, E., Schwab, K.J., Chapin, A.R., Gibson, K., & Henning, K. (2005). A norovirus outbreak at a long-term-care facility: The role of environmental surface contamination. *Infection Control and Hospital Epidemiology*, 26(10), 802–810.

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Prevalence, Knowledge, and Concern About Bed Bugs

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Abstract Recent research suggests that the resurgence of bed bugs in the U.S. has occurred at an alarming rate. Assumptions have been made that socioeconomic status is not associated with the prevalence of bed bug infestations. Little information is available at the local level, however, about the prevalence of bed bugs in private homes. The authors' pilot study aimed to identify prevalence, knowledge, and concern about bed bugs in one higher income village in Ohio utilizing survey methodology. Responses from 96 individuals who completed the Prevalence, Knowledge, and Concern About Bed Bugs survey were utilized for analysis. The majority of the sample respondents were white and 95% reported that they owned their residence. Only 6% knew someone with bed bugs. Additionally, 52% reported they were somewhat concerned about bed bugs. About 46% reported that they had changed their behavior. For a higher income area, the prevalence was dissimilar to the rate reported in the general public (about 20%). This suggests that bed bugs may be an environmental issue effecting low-income populations disproportionately. Further research is needed in areas of differing socioeconomic levels.

Introduction

While modern day sanitation and public health sciences have created living environments in developed countries with near elimination of inhabitation by insects and rodents, the prevalence of infestations of bed bugs is on the rise in the U.S. Health departments in the U.S. have been overwhelmed by bed bugs as their resurgence has occurred at an alarming rate (Centers for Disease Control and Prevention & the U.S. Environmental Protection Agency, 2010). This fact, coupled with recent research reporting that bed bugs may be possible vectors for transmitting medication-resistant bacteria (*Staphylococcus aureus* and

vancomycin-resistant *Enterococcus faecium*), make understanding the prevalence of infestations and increasing the public's knowledge and behaviors related to prevention critical public health issues (Lowe & Romney, 2011).

The puritus that results from the bite of the bug, leaving papules or maculae, is often the first sign of the infestation. Generally, bites are large and they rise well above the dermis. Blood spots may also be noted on individuals who do not experience a reaction to the bite. Secondary infections of the skin can occur as a result of scratching and after repeated exposure the individual may develop a varying level of allergic reaction (Sutton & Thomas,

2008). Other issues from bed bug infestations can include emotional stress and disrupted sleeping patterns (Heymann, 2009).

Legal disputes and discourse over who is economically responsible for the treatment of bed bugs infestations are commonplace, especially in rental housing. Local health departments often place bed bugs low on the priority list, especially since bed bugs have historically not been considered efficient disease vectors. Additionally, public agencies are incurring costs to prevent and treat bed bugs in their own facilities. Individuals with scant socioeconomic resources often have limited support in handling bed bug eradications. Individuals may resort to over-the-counter or "home-grown" materials, most of which are ineffective and may be toxic. Bed bugs have been noted to be one of the most difficult infestations to treat by pest management professionals because effective pesticides are not readily available (National Pest Management Association [NPMA], 2011a) Improperly applied pesticides promote greater bed bug resistance to treatment/pesticides and increase the risk of negative health effects among residents, especially vulnerable populations such as children and the elderly (Rossi & Jennings, 2010).

In 2003, Orkin reported that they responded to almost 400 calls in more than 30 states in the U.S. (CNN, 2004). Additionally, from 2004 to 2006 the reported number of infestations doubled in San Francisco (May, 2007). Many of these cases were noted by travelers staying in "upscale hotels" (May, 2007). Bed bugs have become a noted problem in Toronto; a study by Hwang and co-authors (2005) of 34 pest management companies found that 847 bed bug infestations were treated in 2003.

TABLE 1

Prevalence, Knowledge, and Concern About Bed Bugs Questions

1. Do you know anyone who currently has bed bugs?
2. Who do you know who currently has bed bugs?
3. How were the bed bugs identified?
4. How have you treated for bed bugs?
5. Have you been in contact with bed bugs in any place outside of your home?
6. How concerned are you about bed bugs?
7. How much do you feel you know about bed bugs? Would you say...
8. Have you changed any behaviors (such as going to the movies, going to garage sales, self inspection at hotels, etc.) because of bed bugs?
9. What behaviors have you changed (circle all that apply)?
10. Who would you call if you thought you had bed bugs in your home?
11. What kind of home do you reside in?
12. Approximately how many units are in your apartment building?
13. Do you rent or own your home?
14. How many children under age 18 reside in your home?
15. How many people over age 65 reside in your home?
16. How would you describe your race?
17. What is your household income?
18. How many people reside in your home?
19. What is your zip code?

Approximately 85% of the responding pest management companies reported an increase in bed bug treatments since 2002. Researchers identified that 31% of the homeless shelters in Toronto had been previously or were currently infested with bed bugs (Hwang, Svoboda, De Jong, Kabasele, & Gogosis, 2005).

While the magnitude of the reemergence of bed bugs in the U.S. is difficult to quantify (due to the lack of coordinated national and international surveillance), compelling evidence exists that infestations are on the rise. The 2010 Comprehensive Global Bed Bug Study was completed by the National Pest Management Association (NPMA, 2010) in conjunction with researchers from the University of Kentucky to explore the extent of bed bug infestations in the U.S. Approximately 1,000 U.S. and international pest management companies were surveyed. The most significant finding was that about 95% of the pest management companies responded that they have been called to address a bed bug infestation in the past 12 months. Approximately 25% of the participating companies reported coming in con-

tact with a bed bug infestation before 2000. The survey also showed that individuals with infestations are emotionally disturbed by the situation. The respondents reported that 99% of their clients who had bed bugs were “upset and concerned,” with 77% being “very upset and concerned.”

NPMA (2011b) conducted a second study of bed bugs, “Bed Bugs in America,” with the intent of focusing on the general public. The study found that “one out of five Americans has had an infestation in their home or they know someone who has encountered bed bugs at home or in a hotel (NPMA, 2011b).” That study also showed that about 80% of respondents were concerned with encountering bed bugs at hotels, 52% were concerned about encountering them in public transportation, and 49% were concerned about encountering them in movie theaters. It was also revealed that Americans are changing their behaviors to decrease their risk of bed bug infestations. Over a quarter of respondents have inspected or washed clothing after traveling, 25% have inspected their hotel room, and 12% have altered or canceled

arrangements to travel due to concerns about bed bugs (NPMA, 2011b).

Public health officials generally agree that bed bugs are a public health issue. The Centers for Disease Control and Prevention and the U.S. Environmental Protection Agency declared bed bugs a public health pest of concern in 2010. A survey of public health officials found that 90% of respondents believed bed bugs to be a public health concern. Additionally, 73% of the respondents considered bed bugs to be an environmental justice issue (Eddy & Jones, 2011).

Despite what is known about bed bugs, public health agencies’ ability is limited to track the prevalence in bed bugs at the local level in the U.S. At this time neither a required reporting system for bed bug infestations nor legal authority for health departments to require private pest management companies to provide data exist. Private home owners are not required to inform the health department or any other governmental entity. Local health departments are typically contacted by low-income individuals who are either unable to pay for the extermination of the infestation or because the landlord is unwilling to provide treatment. At this time, the assumption exists that socioeconomic status is not associated with bed bugs (Shindelar & Kells, 2012). The purpose of our study was to examine the prevalence, knowledge, concern, and behavioral changes related to bed bugs in a higher income community. Our study was designed to answer the following research questions:

1. What is the prevalence of bed bugs in a selected higher income village in Ohio?
2. What is the level of concern about bed bugs in a selected higher income village in Ohio?
3. What is the level of knowledge about bed bugs in a selected higher income village in Ohio?
4. Have individuals changed their behavior due to bed bugs in a selected higher income village in Ohio?

Materials and Methods

Design

Our study utilized a descriptive cross-sectional design to examine the prevalence, knowledge, and concern about bed bugs in a selected higher income village. The study included primary data collection through two phases: tele-

phone survey and mailed survey. Human subject approval was obtained from the Wright State University institutional review board (IRB) prior to the start of the research.

Sampling

The sample for our study included men and women (age 18 and over) who reside in a higher income village in Ohio. The sample was selected unsystematically. The village is a suburb of Columbus with a population of approximately 7,724 people. The median yearly income of residents is over \$150,000 and over 75% of the residents hold at least a baccalaureate degree (U.S. Census Bureau, 2012). Two hundred phone numbers were selected for phase one of the study. Two hundred addresses were selected from the Ohio State Auditor’s Web site for phase two of the study.

Instrumentation/Measurement

The Prevalence, Knowledge, and Concern about Bed Bugs (PK CABB) survey was utilized in our study. This survey consisted of 19 multiple choice and fill-in-the-blank questions. The survey was designed by the principal investigator. Face validity was established for the tool through consultation with professionals in the academic setting as well as in practice (Polit & Beck, 2010). The survey consisted of five general sections: prevalence, concern, knowledge, behaviors, and demographics. See Table 1 for survey questions.

Procedures

Phase One Procedures: Telephone

Individuals were selected randomly to participate in the study utilizing an online version of the white pages. Utilizing an IRB-approved script, a research associate asked survey questions via telephone. Participants were contacted from a university phone line. In the event that the individual did not answer, another attempt to contact the individual was made (up to three times) in order to obtain participation in the survey. Participant calls occurred on weekends, evenings, and during the daytime to maximize the response rate.

Phase Two Procedures: Mail

A modified version of the Total Design Method (Dillman, 2000) was utilized in phase two of the study. Each chosen participant was sent up to three letters. The letters were per-

TABLE 2
Demographics of Sample Completing the Bed Bug Survey (N = 96)

Demographic	#	%
Residence		
House	90	93.8
Condo	2	2.1
Apartment	4	4.2
Home ownership		
Own	92	95.9
Rent	3	3.1
Refused to answer	1	1.0
Children under 18		
None	44	45.8
1	11	11.5
2	26	27.1
3 or more	15	15.6
People over the age 65		
None	79	82.3
1	8	8.3
2	8	8.3
Refused to answer	8	1.0
Number of people in the house		
1	9	9.4
2	27	28.1
3	11	11.5
4	23	24.0
More than 4	26	27.0
Race		
White non-Hispanic	85	88.5
White Hispanic	3	3.1
African-American	4	4.2
Asian	2	2.1
Refused to answer	2	2.1
Income (\$)		
10,000–20,000	4	4.2
20,001–40,000	1	1.0
40,001–60,000	5	5.2
60,001–100,000	8	8.3
100,001–200,000	25	26.0
Greater than 200,000	23	24.0
Refused to answer	30	31.2

sonally addressed to each participant in blue ink. The first letter contained a signed cover letter which clearly explained the purpose of the study, how the participant was chosen, and why their participation in the study is needed. The participant was provided with a self-addressed stamped envelope to utilize to return the survey. Nonrespondents were sent an identical packet of information after

two weeks (if they had not responded to the survey). A modified letter was utilized in the second mailing thanking those who already completed the survey and asking them to disregard the letter. Approximately two weeks after the second packet was mailed, a third and final packet was mailed that contained another copy of the survey and invitation to participate. In the event that a packet was

TABLE 3

Prevalence, Knowledge, and Concern About Bed Bugs (N = 96)

Survey Question	#	%
Do you know someone with bed bugs?		
No	89	92.7
Neighbor	1	1.1
Friend	1	1.1
Relative	1	1.1
Other	3	3.0
Level of concern		
Very concerned	18	19.3
Somewhat concerned	50	53.7
Not at all concerned	25	26.9
Missing	3	3.2
Level of knowledge		
A lot	8	8.4
Moderate amount	33	34.7
A little	51	53.7
Nothing	3	3.2
Made a behavior change		
Yes	44	45.8
No	52	54.2
Type of behavior changes		
Not traveling certain places	3	3.1
Not going to movie theaters	3	3.1
Checking bed/sleeping area when away from home	40	41.7
Inspecting items before purchasing	9	9.4
Not going to garage sales	5	5.2
Not going to thrift/secondhand stores	5	5.2
Other	10	10.4

returned by the post office, a new address was selected, until 200 valid addresses were mailed packets.

Data Analysis

Results from the phone and mail survey were entered into SPSS version 18.0. The data from SurveyMonkey were downloaded as an Excel document from www.surveymonkey.com and recoded to be placed in PASW version 18.0 for data analysis. Descriptive statistics were utilized to answer the research questions. Frequencies were calculated for each of the responses.

Results**Demographics**

About 90% of the respondents in the survey lived in a house. Additionally, 95% reported that they owned their residence. A little less

than half of the survey participants reported that they did not have anyone under the age 18 living in their home. About 80% reported that they did not have anyone over the age of 65 living in the home. The self-reported household income was greater than \$100,000 a year for more than half of the sample and no one reported an income less than \$10,000 a year. The vast majority were non-Hispanic white (almost 90%). Almost 40% of the sample had one or two individuals in the household (Table 2).

Research Question One: Self-Reported Prevalence

Research question one examined the self-reported prevalence of bed bugs. Six out of the 95 individuals who responded to the survey item for this question reported that they knew someone who had bed bugs. Out

of these six individuals, one was a neighbor, one was a friend, one was a relative, and the other three responded "other." Of those who responded other, one individual reported that he/she has been in contact with bed bugs in the work environment and two individuals reported that they had been in contact with bed bugs in an undisclosed setting (Table 3).

Research Question Two: Level of Concern

The second research question focused on the level of concern of the participants. About 20% (18 people) of the respondents reported that they were very concerned about bed bugs. Additionally, 50 people (53.7%) responded that they were somewhat concerned about bed bugs. About a quarter of the sample reported that they were not at all concerned about bed bugs (Table 3).

Research Question Three: Level of Knowledge

When asked about their knowledge related to bed bugs, approximately 43% of the sample responded that they knew a lot or a moderate amount. About one-half of the sample reported that they knew a little about the insect. Only about 3% said that they knew nothing about bed bugs (Table 3).

Research Question Four: Behavior Change

Finally, when asked if they had changed any behavior because of bed bugs, about 46% of people reported that they had. Of those that reported they had changed their behavior, about 40% stated that they checked bed and sleeping areas when away from home (i.e., at a hotel). About 10% reported inspecting items before purchasing and 10% reported changing another behavior (Table 3).

Discussion

In this study only 6% of the sample (6 out of 96 people) reported that they knew anyone with bed bugs and no one reported bed bugs in their own home. This is surprising as it is notably less than the 20% prevalence of bed bugs reported in the literature (NPMA, 2011b). The results do support the argument by Eddy and Jones (2011) that bed bugs are an environmental justice issue because about half of the sample in this study reported an income of \$100,000 a year or more. Due to the fact that the area is

a higher income area, if bed bugs were discovered, it is reasonable they could be exterminated in a timely manner, preventing persistent reservoirs of the pest. Therefore, financial and educational resources aimed at areas of lower economic status may be necessary.

Our study also found that almost 75% of the sample reported that they were somewhat or very concerned about bed bugs, which is similar to the reported concern level in the NPMA survey (NPMA, 2011b). This shows that considerable concern exists about bed bugs among this population. Over half of the participants, however, reported they knew little or nothing about bed bugs. Due to public concern, general education about bed bugs is critically needed (Lowe & Romney, 2011). Information about how to prevent bed bugs does seem to be reaching some of the public, as evidenced by the fact that about half of the individuals in the sample have changed behavior because of bed bugs. A need for public health education exists related to the need for inspecting purchases and checking bedding when sleeping away from home.

Limitations

This survey had several limitations. First, the sample size in the project was small. The sample obtained was not necessarily sufficient to provide a “representative sample” of the general population. This limits the generalizability of the results. It may be that those who had bed bugs chose not to participate at a disproportionate rate due to stigma. Further studies are needed with a larger sample size to validate the findings of this study.

Another limitation of the study was that it utilized a self-reporting survey tool. The individual may not be willing to admit via phone or in writing that they have had bed bugs in their home due to embarrassment. This would result in an underrepresentation of the prevalence of bed bugs in the community. An additional limitation of this study was related to the village utilized in the study. The village is an area of higher income. Therefore, the results may not be generalizable to cities where income levels are lower. Future studies are needed with a variety of socioeconomic areas to validate findings or identify differ-

ences. Additionally, more research is needed in areas where multifamily housing is common.

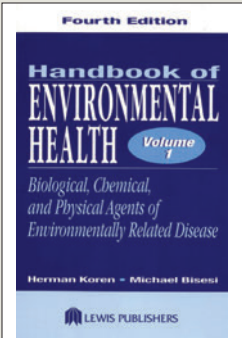
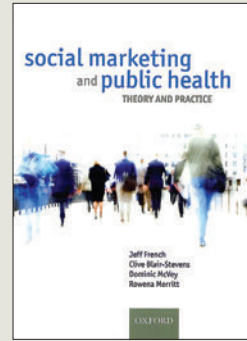
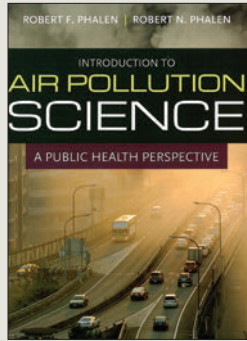
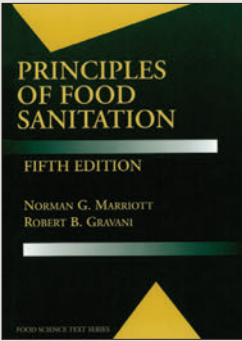
Conclusion


In conclusion, it does not appear that a safe, inexpensive, and effective treatment for bed bugs will arrive in the near future. Additionally, on top of the well-known physiological and psychological effects, more evidence is surfacing relating to bed bugs’ efficiency as a disease vector. Therefore, it is necessary to educate the general public about prevention. This research adds to the evidence that bed bugs are a social justice issue in the U.S. Assistance for treatment of infestations and education for the low income and elderly who may live in areas of persistent bed bug infestations may be an important key to addressing the public health impact of bed bugs. 🐛

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References

- Centers for Disease Control and Prevention, & U.S. Environmental Protection Agency. (2010). *Joint statement on bed bug control in the United States from the U.S. Centers for Disease Control and Prevention and the U.S. Environmental Protection Agency*. Atlanta: U.S. Department of Health and Human Services.
- CNN. (2004). *While on vacation, don't let the bed bugs bite*. Retrieved from <http://www.cnn.com/2004/TRAVEL/ADVISOR/02/17/hln.adviser.bedbugs/index.html>
- Dillman, D. (2000). *Mail and Internet surveys: The tailored design method* (2nd ed.). New York: John Wiley & Sons.
- Eddy, C., & Jones, E. (2011). Bed bugs, public health, and social justice: Part 2, an opinion survey. *Journal of Environmental Health*, 73(8), 15–17.
- Heymann, W.R. (2009). Bed bugs: A new morning for the nighttime pests. *Journal of the American Academy of Dermatology*, 60(3), 482–483.
- Hwang, S.W., Svoboda, T.J., De Jong, I.J., Kabasele, K.J., & Gogosis, E. (2005). Bed bug infestations in an urban environment. *Emergent Infectious Diseases*, 11(4), 533–538.
- Lowe, C.F., & Romney, M.G. (2011). Bedbugs as vectors for drug-resistant bacteria. *Emerging Infectious Diseases*, 17(6), 1132–1134.
- May, M. (2007, April 8). Bed bugs bounce back: Outbreaks in all 50 states. *San Francisco Chronicle*, A1, A8.
- National Pest Management Association. (2010). *The NPMA releases first-ever comprehensive global bed bug study to determine extent of resurgence*. Retrieved from <http://www.pestworld.org/bedbug>
- National Pest Management Association. (2011a). *Bed bug information*. Retrieved from <http://www.pestworld.org/bed-bugs>
- National Pest Management Association. (2011b). *Bed bugs in America: New survey reveals impact on everyday life*. Retrieved from <http://www.pestworld.org/bedbugs-in-america>
- Polit, D., & Beck, C. (2010). *Essentials of nursing research: Appraising evidence for nursing practice* (7th ed.). Philadelphia: Lippincott, Williams & Williams.
- Rossi, L., & Jennings, S. (2010). Bed bugs: A public health problem in need of a collaborative solution. *Journal of Environmental Health*, 72(8), 34–35.
- Shindelar, A., & Kells, S. (2012). *Guidelines for dealing with bed bugs in a school setting*. Retrieved from <http://www.bedbugs.umn.edu/public-facilities/bed-bugs-in-school/>
- Sutton, D., & Thomas, D. (2008). Don't let the bed bugs bite: Identifying and managing infestations. *The Nurse Practitioner*, 33(8), 28–32.
- U.S. Census Bureau. (2012). *State and county quick facts*. Retrieved from <http://quickfacts.census.gov/qfd/states/39/3953970.html>





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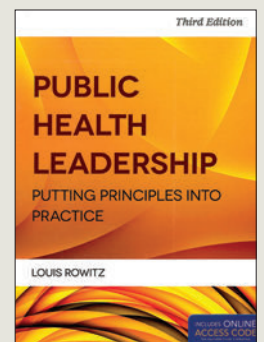
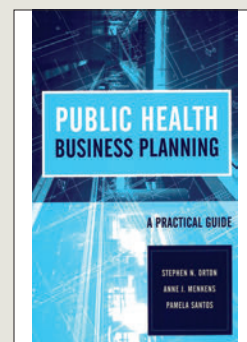
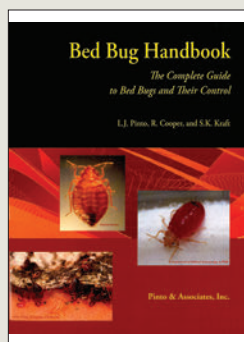
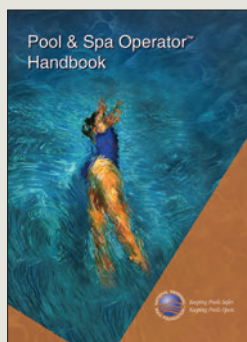
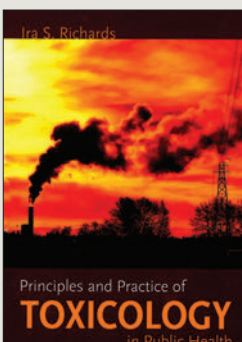
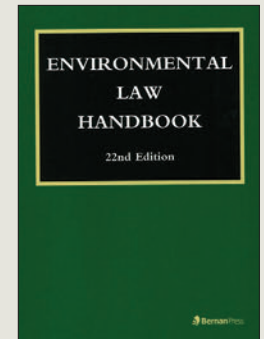
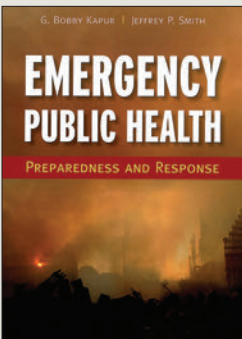
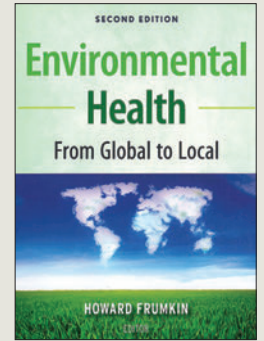
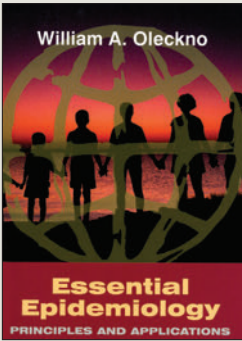
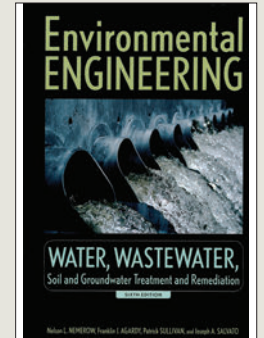
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Implications of the Fukushima Nuclear Disaster: Man-Made Hazards, Vulnerability Factors, and Risk to Environmental Health

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Abstract The objective of this article was to examine the environmental health implications of the 2011 Fukushima nuclear disaster from an all-hazards perspective. The authors performed a literature review that included Japanese and international nuclear guidance and policy, scientific papers, and reports on the Chernobyl and Three Mile Island disasters while also considering all-hazards preparedness rubrics in the U.S. The examination of the literature resulted in the following: a) the authors' "All-Hazards Planning Reference Model" that distinguishes three planning categories—Disaster Trigger Event, Man-Made Hazards, and Vulnerability Factors; b) the generalization of their model to other countries; and c) advocacy for environmental health end fate to be considered in planning phases to minimize risk to environmental health. This article discusses inconsistencies in disaster planning and nomenclature existing in the studied materials and international guidance and proposes new opportunity for developing predisaster risk assessment, risk communication, and prevention capacity building.

Introduction

The Fukushima nuclear disaster triggered by the magnitude 9.0 Great East Japan Earthquake and tsunami on March 11, 2011, reminded the world that nuclear power plant accidents like the Chernobyl and Three Mile Island disasters can still occur. Cascading electrical systems failures resulted in a massive expulsion of stored radioactive hazards, including varying concentrations of strontium, cesium, plutonium, americium, iodine isotopes, and radioactive noble gases to the

environment (International Atomic Energy Agency [IAEA], 2011a; National Diet of Japan, 2012; Physicians for Social Responsibility [PSR], 2011; Stohl et al., 2012). Foods, agricultural animals, and fish were restricted from shipping in many prefectures, though many Japanese affected by the radiation stated that they did not understand the risk as communicated by the Japanese government (National Diet of Japan, 2012). The disaster is not over: highly radioactive waters are discharging into the Pacific Ocean continuously, and "ice wall"

mitigation technologies are faltering (Tokyo Electric Power Company, 2014a). Over 120,000 people remain evacuated from their homes and live with fear of radiation (Sase & Ojino, 2014). Some will never return home (Reconstruction Agency of Japan, 2014). The radiological impact upon environmental health is not certain. Four years from the disaster start, the risk to environmental health continues and the disaster is ongoing.

Therefore, we sought an understanding of the risk of radiation from the Fukushima nuclear disaster to environmental health and to learn how that risk was communicated to the public. Further, we aimed to gain an understanding of the Fukushima Daiichi nuclear power plant preparedness and response challenges that led to the Fukushima nuclear disaster and the associated risk to environmental health. We studied the Fukushima nuclear disaster and its effect upon environmental health through an all-hazards lens. We analyzed the known risk of radiation to environmental health, the factors that led to its release, and concepts of environmental health end fate as relational to disaster planning. We cross-examined whether the Fukushima nuclear disaster would apply to disaster planning, risk communication, and consequence management rubrics in other countries including the U.S. This article attempts to clarify disaster planning challenges to all-hazards identification and vulnerability analysis processes. It also discusses how our research led us to understand the risk to environmental health by distinguishing man-

made hazards and vulnerability factors from a natural disaster trigger event.

Methods

We conducted a literature review of publications germane to the Fukushima nuclear disaster including the following subject matter: national and international nuclear industry standards; the site operator, Tokyo Electric Power Company (TEPCO); international and American nuclear associations; Fukushima nuclear disaster scientific papers; and reports referencing the Chernobyl nuclear disaster and nuclear accidents at other sites in the world.

Research Questions

- 1) How did the natural disaster trigger event, man-made hazards, and vulnerability factors impact risk assessment and communication capacity and heighten the risk to environmental health?
- 2) What do the environmental health implications of the Fukushima nuclear disaster add to all-hazards planning and response capacity opportunity, including concepts of environmental end fate, in and outside Japan?

From an all-hazards/CBRNE (chemical, biological, radiological, nuclear, and explosive) preparedness perspective, we sought to understand and differentiate the hazards existing at the Fukushima Dai-ichi nuclear power plant at the time of the Great East Japan Earthquake and tsunami. We intended to explore the application of that knowledge to disaster planning processes in and outside Japan, including the U.S., to prevent the risk of radiation to environmental health, defined as air, water, soil, and environmental media (Bisesi, Long, London, Hester Harvey, & Enriquez Collins, 2013).

Results

Our analysis of the Fukushima nuclear disaster found that risk to environmental health profoundly associates with disaster trigger events, man-made hazards, vulnerability factors, and level of preparedness and adequacy of response. The Fukushima nuclear disaster provides insight into the risk of man-made hazards and nuclear plant vulnerabilities.

Disaster Trigger Event

The Fukushima nuclear disaster was triggered by linked natural disasters, both of which were probabilistically analyzed

according to geographic and geological metrics by Japanese risk assessment authorities (National Diet of Japan, 2012). TEPCO estimated that the probability of natural disasters (earthquake, tsunami) exceeding plant design safety margins would be low (National Diet of Japan, 2012). Likewise, the International Atomic Energy Agency (IAEA) considered a nuclear release a low probability event prior to the Fukushima nuclear disaster (IAEA, 2010). The March 11, 2011, Great East Japan Earthquake and tsunami exceeded estimations, however.

Other international preparedness perspectives such as the Hyogo Framework, which is hailed as the lead international disaster driver, are natural-disaster focused (Maurice, 2013). The Hyogo Framework, predominantly focused on external disaster events (Maurice, 2013), has led to response, or event-based planning paradigms. Other international sources warned that secondary technological and infrastructure failure events can be initiated by a natural disaster trigger event, causing secondary hazards release as its consequence (Cruz, Steinberg, Arellano, Nordviuk, & Pisano, 2004; United Nations, 2005).

The Fukushima nuclear disaster stands apart from the Chernobyl and Three Mile Island nuclear disasters: it involved the first-ever reactor core melt (three separate core reactor meltdowns) triggered by a natural disaster. The man-made Chernobyl and Three Mile Island disasters remind the world that Fukushima nuclear disaster-like scenarios can be caused by intentional (e.g., terrorism), accidental, and natural disasters.

Vulnerability Factors

Specific vulnerability factors heightened the risk of man-made hazards stored at the Fukushima Dai-ichi nuclear power plant early in the disaster event horizon: multi-unit reactor configuration, spent nuclear fuel pools, risk assessment and communication, and incident command system execution.

Multi-Unit Reactor Configuration

The near proximity of six nuclear reactor units caused one to directly affect the others, compounding the severity of systems failures and response difficulty (U.S. Nuclear Regulatory Commission [NRC], 2011, 2014a). The radiological complexities of the multi-unit

reactor configuration and the adjacent spent nuclear fuel pools exceeded the capacity of the on-site sampling equipment placed by the U.S. Nuclear Regulatory Commission (NRC) after the disaster (NRC, 2011). The vulnerability dense design configuration also directly impacted reactor unit #3, which contained an additional plutonium content. NRC later ordered U.S. licensees to “modernize monitoring equipment to insure multi-unit site monitoring capability” as a result of the lessons learned from the Fukushima nuclear disaster (NRC, 2011).

Spent Nuclear Fuel

The open-water storage vessels containing thermally hot, high-level radioactive spent nuclear fuel were of particular concern early in the event. Spent nuclear fuel is not stored within the fortified containment units that safeguard reactor fuel release. Spent nuclear fuel, the “most hazardous of all man-made wastes,” must be managed for 200,000 years, essentially “forever,” due to the lack of disposal options presently challenging the U.S. and other nations (PSR, 2011; Rosenbaum, 2014; Taebi & Klosterman, 2008). Dependent upon constant cooling processes that require complex and integrated electrical systems to maintain safe cooling temperatures, spent nuclear fuel pools lost mechanical cooling capacity at the Fukushima Dai-ichi nuclear power plant for over three weeks. IAEA records show that power was restored at least partially to all nuclear reactor units and spent nuclear fuel pools on April 3, 2011 (IAEA, 2011b). Spent nuclear fuel is capable of killing a human within minutes in near-direct contact (PSR, 2011).

Spent nuclear fuel rod assemblies, which contain hundreds of rods, must be stored in carefully spaced containers to prevent a spontaneous nuclear reaction. Spent nuclear fuel in Japan, as well as in the U.S., is stored such that coolant loss would cause immediate safety concerns and the resulting spontaneous fires could result in a contamination zone as large as 188 square miles (Alvarez, 2011). The March 14, 2011, IAEA Fukushima Nuclear Accident Update Log, published on their Web site immediately after the Fukushima nuclear disaster, described the first appearance of burning spent nuclear fuel and stated that radiation was being released “directly into the atmosphere (IAEA,

2011c).” Cyclone-transported radiation later fell with rain upon the streets of Tokyo (the world’s largest metropolitan area, less than 200 km from Fukushima nuclear disaster evacuation zones) on March 14, 15, and 19, 2011 (Stohl et al., 2012).

Risk Assessment and Communication

The site power blackout rendered real-time monitoring equipment incapable of measuring radiological hazard inventories released to the environment, impeding accurate risk assessment, safety measures, and communication (American Nuclear Society [ANS], 2012; National Diet of Japan, 2012; NRC, 2011, 2014b; PSR, 2011). It was determined that accurate real-time analysis of radiation releases was impossible, even under nondisaster event conditions (NRC, 2011). The Japanese early alert system known as SPEEDI (System for Prediction of Environmental Emergency Dose Information), overburdened by weather shifts and multiple and prolonged points of hazard releases, provided “probabilistic” data only after the initial disaster, creating uncertainties that further complicated dose estimation (NRC, 2014a). The SPEEDI was not understood by TEPCO technicians, data were not retrievable to make timely evacuation and other safety-related decisions, and the public was confused by the delayed, probabilistic dose estimations and guidance (National Diet of Japan, 2012).

Incident Command System Execution

Incompetent incident command execution prolonged response time and decreased radiation containment performance and safety margins (National Diet of Japan, 2012; NRC, 2011). With the loss of cooling capacity (ANS, 2012), TEPCO employees were directly endangered by the lack of accurate radiological data and safety information. Further, TEPCO employees did not practice simulated site blackout disaster scenarios previous to the disaster event (ANS, 2012), and were inadequately trained in the SPEEDI evacuation forecasting system (National Diet of Japan, 2012). Site personnel were not trained in incident command system (ICS) methodologies, and many were unfamiliar with the physical plant layout (NRC, 2014a). Core to ICS training are standardized planning processes and centralized public health communications. The lack of standardized training among TEPCO

employees manifested in response delays, causing further deterioration of nuclear fuel cooling processes (NRC, 2014a).

Man-Made Hazards

National and international nuclear oversight agencies provide focus for nuclear site safety programs in general. The IAEA lists three primary nuclear plant safety functions: prevention of criticality, removal of fuel heat, and the mitigation of radioactive releases (IAEA, 2011d). The Japan Atomic Energy Agency (JAEA) lists six primary risk considerations regarding nuclear power generation: nuclear fuel cycling, treatment and disposal of waste, proliferation, terrorism, and accidents (JAEA, 2009). Population vulnerabilities from undervalued factors associated with disasters, however, such as agency governance capacity and the role of public health in defining disaster risks, remain undefined in disaster planning processes internationally (Maurice, 2013).

Japan

The National Diet of Japan report on the Fukushima nuclear disaster contained the following language, “although triggered by these cataclysmic events, the subsequent accident at the Fukushima Dai-ichi nuclear power plant cannot be regarded as a natural disaster. It was a profoundly man-made disaster—that could and should have been foreseen and prevented. And its effects could have been mitigated by a more effective human response (National Diet of Japan, 2012).” According to Japanese occupational safety experts, Japan had no regulations on the dispersal of radiation outside the controlled areas of the Fukushima Dai-ichi nuclear power plant (Yasui, 2013), leading to inadequate consideration for radiation environmental health end fate. The National Diet of Japan report also stated that TEPCO had no “countermeasures” in place for a severe accident (National Diet of Japan, 2012).

United States

In the U.S., all-hazards preparedness was originally driven by pre-1996 Federal Emergency Management Agency (FEMA) Civil Preparedness Guides (Bokman, 2003). After the terrorist attacks on September 11, 2001, disaster planning emphasis shifted towards terrorism (Bokman, 2003). Site-specific hazard analysis is now emphasized (Pandemic

and All-Hazards Preparedness Reauthorization Act [PAHPRA], 2013). All-hazards readiness is defined by being prepared for chemical, biological, radiological, and nuclear threats, whether naturally occurring, unintentional, or deliberate (including man-made acts of terrorism) (PAHPRA, 2013). Therefore, man-made hazards can be exacerbated unintentionally (by accident), by intention (such as an attack on a power grid), and by a natural disaster trigger event. U.S. regulations do not adequately address a natural disaster-triggered hazardous material release, however, and fail to require prevent evaluation and planning (Cruz et al., 2004).

The terms risk and hazard should not be interchangeable (Royal Society of Chemistry, 2013), though it is agreed that hazards create the risk of a disaster (Bolz, Dudonis, & Schulz, 2005). Both terms are tied to probabilistic notions associated with the severity of a disaster event impact (Royal Society of Chemistry, 2013). A broad spectrum of terms are used by FEMA, the Department of Homeland Security, NRC, presidential directives, and other sources to describe a disaster: risk event, significant event, extreme event, catastrophic event, incident, incident of national significance, risk and threat and hazard, all-risk, all-hazard, natural hazard, technological hazard, natural disaster, and natural and technological disaster (NA-TEK).

According to the 2012 National Academy report on disaster resilience, gaps exist in all phases of disaster “preparedness, response, recovery, mitigation, and adaptation, as well as research, planning, and community assistance (National Academies, 2012).” Additionally, U.S. emergency responders, overwhelmed by natural disaster, may fail in response to secondary hazards released in the case of NA-TEK disasters by a natural disaster trigger (Cruz et al., 2004). Occupational Safety and Health Administration (OSHA)—evaluated safety systems do not apply to disaster mitigation environments (Cruz et al., 2004). An August 2014 guidance document from NRC also recognized that U.S. nuclear plants are not prepared for “many hazards.” NRC further urged a “better account for plant system interactions and the performance of plant operators and other critical personnel in responding to such events; and [a] better estimate [of] the broad range of offsite health, environmental,

economic, and social consequences that can result from such events (NRC, 2014a)."

After discovering significant post-Fukushima nuclear disaster vulnerability assessment inconsistencies in U.S. licensee processes, the NRC provided them a new definition: "plant specific vulnerabilities are those features that are important to safety that when subjected to an increased demand, due to the newly calculated hazard evaluation, have not been shown to be capable to perform their intended functions (NRC, 2012)." The NRC Fact Sheet on Probabilistic Risk Assessment states that the U.S. nuclear facilities pose "no undue risk to public health and safety (NRC, 2014c)." The General Electric–designed boiling water nuclear reactors at the Fukushima Dai-ichi nuclear power plant, however, presently provide energy at 23 locations in the U.S. (NRC, 2014b).

Because intentional attacks can cause a site blackout, the Fukushima nuclear disaster lessons learned are applicable to attack-prone sites in the world. For example, infrastructure vulnerability to cyber attacks could result in power-grid loss and other systems failures. South Korean hydro and nuclear plant security was maliciously breached in December 2014 (BBC News, 2014; Reuters, 2014). South Korean plans for nuclear reactor cooling processes were obtained by an unauthorized entity (BBC News, 2014; Reuters, 2014).

Risk to Environmental Health

NEHA's definition of environmental health includes the evaluation of hazardous agents in "air, water, soil, food, and other environmental media (Bisesi et al., 2013)." The Fukushima nuclear disaster caused a catastrophic release of radiological hazards into the ecosystem (IAEA, 2011; National Diet of Japan, 2012; PSR, 2011; Stohl et al., 2012). Extremely high levels of strontium, a bone-seeking radionuclide with a half-life of 28 years, are currently increasing in soil, groundwater, and ocean samples near the Fukushima Dai-ichi nuclear power plant (TEPCO, 2014b). The possibility for bioaccumulation of radiation in predatory fish may present in other parts of the world in the future (Sutton & Cassalli, 2011).

The Fukushima nuclear disaster caused the largest discharge of radiation into an ocean in the history of the world (Sutton & Cassalli, 2011); yet ocean discharges were moni-

tored in a "rushed" and "panicky" manner by TEPCO personnel. TEPCO also focused exclusively on iodine and cesium (House of Commons, 2013). Other radioactive components, such as plutonium, americium, and curium, with half-lives of "thousands of years," were not addressed at all (House of Commons, 2013). All five of the radionuclides are specifically listed by the Codex Alimentarius Commission as radiological concerns in foods following a nuclear accident (National Council on Radiation Protection and Measurements, 2010).

The World Health Organization (WHO) published a dose estimation report in January 2012, however, finding that the Fukushima nuclear disaster presented a limited, even small risk, to Japan and the world. The report stated that a "probable partial melting of the core of the three reactors" occurred (World Health Organization [WHO], 2012). The report may have led the world to underestimate the disaster (Mousseau, 2013; Perrow, 2013), while significant radiation releases to the environment were ongoing.

The WHO International Health Regulation (IHR), which was revised in 2005, seeks to "...provide a public health response to the international spread of disease..." It includes the natural, accidental, and deliberate release of radiologically contaminated materials (underlined by authors). The IHR legally binds 196 countries around the world, including Japan and the U.S. (WHO, 2005). WHO describes the IHR as event-based surveillance (WHO, 2014). Its language does not advocate the predisaster analysis of radiological hazard inventory end-fate consequences to environmental health. U.S. hazard vulnerability assessment processes also do not focus on the environmental health end fate of stored hazard inventories, potentially externalized to the community (NRC, 2014a), opening the door to disaster response and consequence management uncertainty.

The environmental health problems generated by the Fukushima nuclear disaster are also of a global nature. The Fukushima nuclear disaster produced "likely the largest radioactive noble gas release" to the air in history (Stohl et al., 2012). The Fukushima Dai-ichi power plant continues to discharge dangerous levels of radiation into the Pacific Ocean. Significant land, aquifer, and ocean contamination continues and is acknowl-

edged by the site operator (TEPCO, 2014b). The consequences of the Fukushima nuclear disaster are also ongoing. The "ice wall" technology, engineered to contain the flow of ground water in contact with radioactive reactor building materials and potentially in direct proximity to highly radioactive molten reactor core content, was not working as planned (TEPCO, 2014a).

The Fukushima Nuclear Disaster: An All-Hazards Planning Reference Model

We present the disaster planning model below, established from Fukushima nuclear disaster lessons learned. We segment "Disaster Trigger Event," "Man-Made Hazard," and "Vulnerability Factors" to enable differentiation of independent vulnerability analyses. In this model, we follow the WHO preparedness equation denominator standard "Level of Preparedness" (WHO, 2007) and add "Adequacy of Response."

$$\text{Risk to Environmental Health} = \frac{[\text{Disaster Trigger Event}] + [\text{Man-Made Hazards} \times \text{Vulnerability Factors}]}{\text{Level of Preparedness and Adequacy of Response}}$$

We find that the "Risk to Environmental Health" is a consequence of the "Disaster Trigger Event" plus "Man-Made Hazards," exacerbated by "Vulnerability Factors." The impact of radiation release ("Risk to Environmental Health"), triggered by earthquake and tsunami ("Disaster Trigger Event"), caused the release of the radiation ("Man-Made Hazard"), which was precipitated by site blackout and subsequent loss of cooling system capacity ("Vulnerability Factors"). The consequences of a "Disaster Trigger Event," "Man-Made Hazards," and "Vulnerability Factors" present the independent opportunity for modification (or mitigation) to prevent the "Risk(s) to Environmental Health." The model reflects our analysis that "Man-Made Hazards" and "Vulnerability Factors" may interact in multiplicative fashion.

Given the analysis of the Fukushima nuclear disaster, "Risk to Environmental Health" must be ameliorated by the division of plant supply chain and continuity of operations-based (internal) concerns from "Man-Made Hazards," which may be potentially externalized to the community. Further, we posit that the

Fukushima Dai-ichi power plant operational resilience was dependent upon the denominator of our model, i.e., “Level of Preparedness” and “Adequacy of Response.”

Discussion

What Was Known

Cascading electrical systems failures of the Fukushima Dai-ichi nuclear power plant resulted in a massive expulsion of stored radioactive hazards, including varying concentrations of strontium, cesium, plutonium, americium, iodine isotopes, and radioactive noble gases to the environment (IAEA, 2011; National Diet of Japan, 2012; PSR, 2011; Stohl et al., 2012). As three of the four clustered Fukushima Dai-ichi nuclear power plant nuclear reactor cores melted (releasing massive quantities of radiation into the local communities), over 120,000 people evacuated their homes (Reconstruction Agency of Japan, 2014) and some will never return home. Foods, agricultural animals, and fish were restricted from shipping in many prefectures, though many Japanese affected by the radiation did not understand the risk as communicated by their government (National Diet of Japan, 2012). Reports of high levels of cesium, strontium, and plutonium in groundwater and ocean samples began to surface in 2012, followed by TEPCO confirmations that remediation processes were in doubt (TEPCO, 2014a).

What We Found

We exhibited in our model that interacting “Vulnerability Factors” exacerbated the power blackout-initiated release of “Man-Made Hazards” at the Fukushima Dai-ichi nuclear power plant, though the magnitude of “Risk to Environmental Health” is uncertain. “Level of Preparedness” and “Adequacy of Response”-related disaster planning and technology barriers (including the inability to record real-time emissions) prevented effective radiation risk assessment, which affected the quality of public health risk communication and hazard mitigation processes. Planned releases and uncontrolled leaks from storage vessels discharged radiation into the Pacific Ocean in enormous volume.

The process of hazard vulnerability assessment focuses on specific internal hazards that are likely to be present for a facility, and external events that are geographically, mete-

orologically, and even biologically predictable (American Standards and Testing Material International, 2004; Occupational Safety and Health Administration, 2005). For example in the U.S., Oklahoma is vulnerable to tornadoes, Florida is vulnerable to hurricanes, and California is vulnerable to earthquakes.

In addition, all geographic locations in the world are potentially vulnerable to intentional man-made acts of terrorism or other adverse event occurrences that are likely to occur in that community. The hazard vulnerability assessment tool combines notions of event probability and severity. Some hazard vulnerability assessment standards specifically advise, however, to “minimize planning for unlikely events (American Standards and Testing Material International, 2004).” The high consequence risk of an off-site radiation release due to a site power blackout was determined to be a low probability occurrence during hazard vulnerability assessments performed by Japanese officials and plant operators (National Diet of Japan, 2012). The man-made radioactive hazards did not receive disaster planning and response assessment priority. Japanese officials did not plan adequately for the off-site dispersion of radiation (Yasui, 2013), therefore the estimation of environmental health end fate was disregarded. The implications of this finding (and accounted for in our “All-Hazards Planning Reference Model,” though beyond the scope of this article, may provide important insight for future studies of community resilience that are not yet well formed on disaster planning for man-made hazards. Certainly, the resilience of a community is dependent upon the operational resilience (and required safety margins and environmental regulation) of corporations that create and process man-made hazards.

The lessons learned from the Fukushima nuclear disaster can also apply to other sites and nations. We discovered that U.S. hazard vulnerability assessment processes share similar disaster planning challenges, including the following paradigm groups: event, natural disaster, probability, supply chain, and continuity of operations-driven planning foci. Low-probability high-consequence disaster events receive lower priority in general. We found that OSHA-driven approaches, common to U.S. response rubrics, are likely inadequate (Cruz et al., 2004). We also found agency-specific and unstandardized disaster

terminologies that merge concepts of hazard and risk. This may hamper hazard vulnerability assessment processes by minimizing focus on man-made hazards. We learned from the Fukushima nuclear disaster that the probability estimation of a disaster trigger event whether natural (such as severe weather), intentional, or accidental, may overshadow planning considerations for stored hazards. In reaction to the disaster, NRC moved to ensure that U.S. nuclear sites were prepared for flooding and communication failures, both considered the major vulnerabilities of the Fukushima Dai-ichi nuclear power plant (NRC, 2012). The General Electric–designed boiling water reactors (Organization for Economic Coordination and Development Nuclear Agency, 2011) are in use at 23 U.S. nuclear plants (NRC, 2014b), further underscoring the significance of the Fukushima nuclear disaster to the U.S.

Limitations

This analysis was based upon documents published by the time of the submission of the manuscript. Thus, unpublished documents and internal reports were not reviewed. In our Fukushima nuclear disaster analysis, the natural disaster trigger event refers to a double natural disaster (earthquake and tsunami) that caused the site blackout and instantaneously resulted in the release of radiation. We acknowledge the specificity of the conditions that we describe relevant to the Fukushima nuclear disaster. Because accidental and man-made disasters can also cause site blackouts, this limitation does not weaken our findings. Instead, we discussed the strength of our findings and their relevance to vulnerabilities that exist at most industrial plant locations.

Conclusion

Extensive barriers to risk assessment and communication existed prior to the Fukushima nuclear disaster that impeded disaster “Level of Preparedness” and “Adequacy of Response,” resulting in heightened “Risk to Environmental Health,” as we presented in the above model. Specific “Vulnerability Factors” unique to the Fukushima nuclear disaster, exacerbated the release of “Man-Made Hazards” as a result of a “Disaster Trigger Event”: multi-unit reactor configuration, spent nuclear fuel pools, risk assessment and communication capacity, and incident command system execution.

A uniform lexicon for disaster planning descriptions that effectively defines and standardizes concepts of risk, hazard, vulnerability, and natural disaster trigger event should be established internationally. The U.S. hazard vulnerability assessment process must additionally emphasize the estimation of, and planning for, the environmental health end-state consequences of industrial hazard inventories potentially released off site. Contamination considerations for food, water, and human evacuation and other safety restrictions should be made jointly by industry, the government, and the community, in event planning, assurance, and oversight phases.

The selection of “Man-Made Hazard” and “Vulnerability Factor” modification, substi-

tution, reduction, or elimination processes will require a reexamination of nuclear power feasibility on social, environmental, and economic perspectives. Benefit margins should be compared to the potential risk to environmental health. This process may lead towards environmental justice for vulnerable populations, though such concepts are not yet well formed. Environmental health professionals, well trained in all-hazards disaster preparedness principles, understand the environmental health consequences potentiated by industry. Environmental health professionals should be involved in hazard vulnerability assessment, disaster planning, emergency response, and consequence management processes. 🌐

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References

- Alvarez, R. (2011). *Spent nuclear fuel pools in the U.S.: Reducing the deadly risk of storage*. Retrieved from <http://www.environmental-defense-institute.org/publications/News.11.June.Final.pdf>
- American Nuclear Society. (2012). *Fukushima Dai-ichi: ANS committee report*. Retrieved from http://fukushima.ans.org/report/Fukushima_report.pdf
- American Standards and Testing Material International. (2004). *Standard guide for hospital preparedness and response* (Standard E 2413). West Conshohocken, PA: Author.
- BBC News. (2014). *South Korea's Park Geun-hye orders cyber security boost*. Retrieved from <http://www.bbc.com/news/world-asia-30585036>
- Bisesi, M., Long, S., London, A., Hester Harvey, C., & Enriquez Collins, A. (2013). New perspectives in environmental health: The approval of new definitions. *Journal of Environmental Health*, 76(3), 72.
- Bokman, L. (2003). All-hazards preparedness: What does it mean? *Natural Hazards Observer*, 27(4), 10–11.
- Bolz, F., Dudonis, K., & Schulz, D. (2005). *The counterterrorism handbook* (pp. 58–59). Boca Raton, FL: CRC Press, Taylor & Francis Group.
- Cruz, M., Steinberg, L.J., Arellano, A.L.V., Nordviuk, J., & Pisano, F. (2004). *State of the art in natech risk management*. Retrieved from http://www.unisdr.org/files/2631_FinalNatechStateofthe20Art_corrected.pdf
- House of Commons Energy and Climate Change Committee. (2013). *Building new nuclear: The challenges ahead*. Retrieved from <http://www.publications.parliament.uk/pa/cm201213/cmselect/cmenergy/117/117.pdf>
- International Atomic Energy Agency. (2010). *Joint radiation emergency management plan of the international organizations*. Retrieved from http://www-pub.iaea.org/MTCD/Publications/PDF/EPRJplan_2013_web.pdf
- International Atomic Energy Agency. (2011a). *Fukushima nuclear accident update log*. Retrieved from <http://www.iaea.org/newscenter/news/2011/fukushima020511.html>
- International Atomic Energy Agency. (2011b). *Fukushima nuclear accident update log*. Retrieved from <http://www.iaea.org/newscenter/news/2011/fukushima030411.html>
- International Atomic Energy Agency. (2011c). *Fukushima nuclear accident update log*. Retrieved from <http://www.iaea.org/newscenter/news/2011/fukushima150311.html>
- International Atomic Energy Agency. (2011d). *Fukushima nuclear accident update log*. Retrieved from <http://www.iaea.org/newscenter/news/tsunamiupdate01.html>
- Japan Atomic Energy Commission. (2009). *White paper on nuclear energy 2008. Summary*. Retrieved from http://www.aec.go.jp/jicst/NC/about/hakusho/index_e.htm
- Maurice, J. (2013). Mitigating disasters—a promising start. *The Lancet*, 381, 1611–1613.
- Mousseau, T. (2013). Perspectives on Chernobyl and Fukushima health effects: What can be learned from eastern European research? *Journal of Health Pollution*, 5, 2–6.
- National Academies. (2012). *Disaster resilience: A national imperative*. Washington, DC: National Academies Press.
- National Council on Radiation Protection and Measurements. (2010). *Responding to a radiological or nuclear terrorism incident: A guide for decision makers* (pp. 144–145). Bethesda, MD: Author.
- The National Diet of Japan. (2012). *The official report of the Fukushima Nuclear Accident Independent Investigation Commission*. Retrieved from http://www.nirs.org/fukushima/naic_report.pdf

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References *continued from page 31*

- Occupational Safety and Health Administration. (2005). *OSHA best practices for hospital-based first receivers. Hazard and vulnerability assessment tool*. Retrieved from https://www.osha.gov/dts/osta/bestpractices/firstreceivers_hospital.pdf
- Organization for Economic Coordination and Development Nuclear Agency. (2011). *Basic design information for boiling water reactors—BW/R3, BW/R4*. Retrieved from http://www.oecd-nea.org/press/2011/BWR-basics_Fukushima.pdf
- Pandemic and All-Hazards Preparedness Reauthorization Act, 42 USC 201 (2013).
- Perrow, C. (2013). Nuclear denial: From Hiroshima to Fukushima. *Bulletin of the Atomic Scientists*, 69(5), 66–67. Retrieved from http://sociology.yale.edu/sites/default/files/nuclear_denial.pdf
- Physicians for Social Responsibility. (2011). *Lessons learned from Fukushima and Chernobyl for U.S. public health*. Retrieved from <http://www.psr.org/assets/pdfs/fukushima-and-chernobyl.pdf>
- Reconstruction Agency of Japan. (2014). *The number of evacuees (in Japanese)*. Retrieved from http://www.reconstruction.go.jp/topics/main-cat2/sub-cat2-1/20141226_hinansha.pdf
- Reuters. (2014, December 22). *North Korea nuclear plant operator says hacked, raising alarm*. Retrieved from <http://uk.reuters.com/article/2014/12/22/uk-southkorea-nuclear-idUKKBN0K008G20141222?feedType=RSS&feedName=worldNews&rpc=477>
- Rosenbaum, W. (2014). *Environmental politics and policy* (pp. 157–158). Thousand Oaks, CA: Sage/CQPress.
- Royal Society of Chemistry. (2013). *Environmental risk assessment*. Retrieved from http://www.rsc.org/images/Environmental%20Risk%20Assessment%20Version%202_tcm18-236384.pdf
- Sase, E., & Ojino, M. (2014). *Study on the right to health in the post-Great East Japan earthquake, tsunami and the Fukushima Dai-ichi nuclear accident (in Japanese)*. Retrieved from <http://www.jmari.med.or.jp/download/WP312.pdf>
- Stohl, A., Seibert, P., Wotawa, G., Arnold, D., Burkhart, J.F., Eckhart, S., Tapia, C., Vargas, A., & Yasunari, T.J. (2012). Xenon-133 and cesium-137 releases into the atmosphere from the Fukushima Dai-ichi nuclear power plant: Determination of the source term, atmospheric dispersion, and deposition. *Atmospheric Chemistry and Physics*, 12(5), 2313–2343.
- Sutton, K.G., & Cassalli, J.A. (2011). *Catastrophe in Japan: The earthquake and tsunami of 2011* (pp. 77–83). Hauppauge, NY: Nova Science Publishers.
- Taebi, B., & Klosterman, J.L. (2008). To recycle or not to recycle: An intergenerational approach to nuclear fuel cycles. *Science and Engineering Ethics*, 14(2), 177–200.
- Tokyo Electric Power Company. (2014a). *Fukushima Dai-ichi nuclear power stations prompt report 2014 Fukushima Dai-ichi NPS prompt report, recent topics: TEPCO exploring new approaches to removing trench water*. Retrieved from http://www.tepco.co.jp/en/press/corp-com/release/2014/1239539_5892.html
- Tokyo Electric Power Company. (2014b). *Detailed analysis results in the port of Fukushima Dai-ichi NPS, around discharge channel and bank protection, (sampling locations of underground water obtained at bank protection)*. Retrieved from http://www.tepco.co.jp/en/nu/fukushima-np/f1/smp/2014/images/2tb-east_14112701-e.pdf
- United Nations. (2005). *Review of the Yokohama strategy and plan of action for a safer world*. Retrieved from <http://www.unisdr.org/2005/wcdr/intergover/official-doc/L-docs/Yokohama-Strategy-English.pdf>
- U.S. Nuclear Regulatory Commission. (2011). *Recommendations for enhancing reactor safety in the 21st century. The near-term task force review of insights from the Fukushima Dai-ichi accident*. Retrieved from <http://pbadupws.nrc.gov/docs/ML1125/ML112510271.pdf>
- U.S. Nuclear Regulatory Commission. (2012). *Request for information pursuant to title 10 of the code of federal regulations 50.54(f) regarding recommendations 2.1, 2.4, and 9.3, of the near-term task force review of insights from the Fukushima Dai-ichi accident*. Retrieved from http://www.fukuleaks.org/web/wp-content/uploads/2012/07/NRC_Request_for_Information_Fukushima_Daiichi1.pdf
- U.S. Nuclear Regulatory Commission. (2014a). *Lessons learned from the Fukushima nuclear accident for improving safety of U.S. nuclear plants*. Retrieved from <http://www.preventionweb.net/english/professional/publications/v.php?id=38756&hid=103>
- U.S. Nuclear Regulatory Commission. (2014b). *List of power reactor units*. Retrieved from <http://www.nrc.gov/reactors/operating/list-power-reactor-units.html>
- U.S. Nuclear Regulatory Commission. (2014c). *Fact sheet on probabilistic risk assessment*. Retrieved from <http://www.nrc.gov/read-ing-rm/doc-collections/fact-sheets/probabilistic-risk-asses.html>
- World Health Organization. (2005). *International health regulations* (2nd ed.). Retrieved from http://www.who.int/topics/international_health_regulations/en/
- World Health Organization. (2007). *Risk reduction and emergency preparedness, WHO six-year strategy for the health sector and community capacity development*. Retrieved from <http://www.preventionweb.net/english/professional/publications/v.php?id=2023>
- World Health Organization. (2012). *Preliminary dose estimation from the nuclear accident after the 2011 Great East Japan earthquake and tsunami*. Retrieved from http://whqlibdoc.who.int/publications/2012/9789241503662_eng.pdf
- World Health Organization. (2014). *Alert response and capacity building under the international health regulations*. Retrieved from http://www.who.int/ihr/alert_and_response/en/
- Yasui, S. (2013). Establishment of new regulations for radiological protection for decontamination work involving radioactive fallout emitted by the Fukushima Dai-ichi APP accident. *Journal of Occupational and Environmental Hygiene*, 10(9), D119–D124.

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▶ DIRECT FROM AAS



Felix I. Zemel,
MCP, MPH, REHS/RS,
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What Is a Diplomate, and What Does It Do?



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

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

Felix Zemel received his undergraduate degree from Wentworth Institute of Technology and his graduate degrees from Boston University. He is a practicing sanitarian, with a private consulting practice in Needham, Massachusetts.

When you read your issue of the *Journal*, do you—like me—look at the authors' credentials and affiliation(s)? I admit it; I provide different weights to articles based upon these factors. For practice-based articles, I look at both the academic and the professional credentials of the author(s). Last year, Ken Runkle used the term “pracademic” in describing an individual who crossed the boundaries of academia and practice (Runkle, 2014). One way

to spot a pracademic at least in the *Journal* is by seeing the letters DAAS or DLAAS in an author's listing of credentials. These credentials are bestowed upon qualified sanitarians that meet the requirements or certification as a Diplomate and/or Diplomate Laureate of the American Academy of Sanitarians (AAS).

What Is a Diplomate?

DAAS and DLAAS are two levels of certification as a Diplomate of the AAS. In April, Rob-

ert Powitz described those who achieve the Diplomate certification as attaining “achievement of a high standard of professionalism with marked distinction, and ... a record of accomplishment in the field of environmental health (Powitz, 2015).” In addition to certification by examination, which is required to become registered as a sanitarian, the AAS requires applicants for the Diplomate certification to meet certain additional professional and academic criteria. Prior to starting the application process toward certification as a Diplomate, one may ask oneself (as I did on many occasions, prior to applying for certification): “What will certification as a Diplomate of the AAS do for my career?”

Your Career as a Diplomate

As I read an article written by a Diplomate of the AAS, I assign a certain, higher level of credibility to the authors, knowing what it means to earn this certification. Diplomates are the embodiment of pracademics in the environmental health profession. In addition to spotting their frequent articles in the *Journal*, Diplomates can be found throughout the ranks of the U.S. Public Health Service Commissioned Corps; in leadership positions at NEHA (nearly 2/3 of the NEHA presidents over the past 20 years have been Diplomates of the AAS); various positions within federal agencies (Centers for Disease Control and Prevention, Food and Drug Administration, Indian Health Service, etc.); holding management roles in public and environmental health departments across the U.S.; and as senior management in environmental health-related organizations, like Underwriters Lab-

oratories and NSF. Diplomates truly are leaders within the sanitarian profession.

Becoming a Diplomate

Diplomate of the AAS (DAAS)

In addition to the academic and professional experience needed in order to qualify for the Registered Environmental Health Specialist/Registered Sanitarian (REHS/RS) examination, currently licensed sanitarians must meet additional requirements to be selected as a DAAS. The criteria for selection, beyond those required for licensure as a sanitarian, are as follows:

1. Possession of a master's or higher degree in public health, the environmental health sciences, or in an area of scientific or administrative specialization bearing upon environmental management.
2. Dedication to protecting and promoting the health and quality of the life of mankind.
3. Legal registration as a registered sanitarian or environmental health specialist in a state or registered by NEHA.
4. At least seven years of acceptable experience in one or more of the various fields of environmental health, with at least five years of full-time work at the professional level, and two or more years above the staff level.
5. Possession of writing quality that is acceptable for publication in a national journal of environmental health, which can be documented by past publication or submission of an article that meets this standard.

Applications for certification as a Diplomate also need to be accompanied by a short personal biography and the names of at least three professional references (in addition to an applicant's supervisor) who would be willing to provide a letter of recommendation in support of the applicant. Once selected by the certification committee, Diplomates are able to use the DAAS in their title(s). As of the 2014 Annual Meeting of the AAS, 585 individuals have been selected as Diplomates of the AAS (American Academy of Sanitarians, 2014).

Diplomate Laureate of the AAS (DLAAS)

In order to become a DLAAS, potential candidates need to be a member of the academy for at least five years prior to application. They must also have 25 years of experience in the environmental health profession, with at least 15 as a credentialed environmental health

professional. Applicants must also meet at least five of the following eight requirements:

1. Possession of an advanced degree beyond the master's level.
2. Five or more technical publications in the field of environmental health.
3. Possession of one or more competency-based professional credentials in an environmental health and safety allied science.
4. Possession of one or more patents or copyrights related to public or environmental health.
5. Membership on a professional examination, licensing, or other environmental health credentialing board.
6. Membership on a national or international advisory board or standard committee in the environmental health sciences.
7. Hold or have held an elective office in an environmental health organization.
8. Recipient of a professional state or national environmental health award.

As of the 2014 Annual Meeting of the AAS, eight individuals have earned the Laureate level of certification by the Academy.

The Need for More Diplomates

As can be seen, Diplomates have historically held many prestigious positions within the environmental health profession. Although 585 individuals became certified over the past four decades, the number of applicants in recent years has significantly decreased. This is not due to a lack of qualified individuals, but may be due to a lack of aware individuals.

The academy is a group of leaders in the environmental health sciences whose goal is to continue elevating the environmental health profession through high academic standards and encouragement of the elevation of professional practices and technical knowledge of sanitarians across the country (and throughout the world).

In recent years, members of AAS have continued to make many significant advances in their long-standing tradition as leaders in the environmental health profession. Over the past few years, members of the academy have actively pursued mentoring opportunities for early career professionals, as well as current students, in the environmental health sciences (which will be discussed further in the next installment of this column). The academy has entered into an agreement to publish regu-

lar columns in the *Journal* that will discuss important topics and emerging trends in the environmental health profession. The academy recently updated its Web site in order to provide more information about the academy, its achievements, and its membership.

As AAS continues on its path toward leading the environmental health profession into the future, we need more help. If you meet the qualifications for membership, please consider applying for membership to the academy. Applications for membership can be obtained at <https://aaosi.wildapricot.org/Membership-Application>. 🐾

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References

- American Academy of Sanitarians. (2014). *Register of diplomates: 2014*. Retrieved from <https://aaosi.wildapricot.org/Resources/Documents/2014-Register-of-Diplomates.pdf>
- Powitz, R. (2015). An introduction and history of the American Academy of Sanitarians. *Journal of Environmental Health*, 77(8), 34–35.
- Runkle, K. (2014). I am an environmental health pracademic (and so can you!). *Journal of Environmental Health*, 76(10), 42–43.

Did You Know?

NEHA and AAS are giving out four scholarships to undergraduate and graduate students at the NEHA 2015 Annual Educational Conference & Exhibition in Orlando, Florida, this July. A total of \$5,000 will be awarded to the recipients.

► DIRECT FROM CDC ENVIRONMENTAL HEALTH SERVICES BRANCH



Erik W. Coleman, MPH

Equipping Environmental Health Workers With Environmental Assessment Tools

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

In this column, EHSB and guest authors from across CDC will highlight a variety of concerns, opportunities, challenges, and successes that we all share in environmental public health. EHSB’s objective is to strengthen the role of state, local, tribal, and national environmental health programs and professionals to anticipate, identify, and respond to adverse environmental exposures and the consequences of these exposures for human health.

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

Erik W. Coleman is a health scientist (informatics) in EHSB’s Division of Emergency and Environmental Health Services at the National Center for Environmental Health.

Food-related illnesses affect tens of millions of people and kill thousands in the U.S. each year. They also cause billions of dollars in health care-related and industry costs annually. As a result, the Centers for Disease Control and Prevention (CDC) have identified reducing foodborne diseases as a “winnable battle (CDC, 2013).” To address this issue, in April 2014 CDC’s National Center for Environmental Health launched two food safety tools that are transforming how environmental health workers conduct foodborne illness environmental assessments as part of an outbreak

response and how they report these data to prevent future outbreaks.

Tool #1

The first tool is the e-Learning on Environmental Assessment of Foodborne Illness Outbreaks (www.cdc.gov/nceh/ehs/elearn/ea_fio). This free online training is designed to improve environmental health workers’ competency with foodborne illness outbreak environmental assessments. These assessments, conducted as part of outbreak response, can help identify environmental causes of outbreaks. The clues and data gathered from environmental assess-

ments identify how and why germs got into the environment and spread to make people sick (e.g., improper hand washing resulting from lack of food safety training). Environmental health workers typically conduct environmental assessments and use the information gathered to stop the current outbreak and prevent future ones. Users of the e-Learning tool acquire in-depth skills and knowledge to

- investigate foodborne illness outbreaks as a member of a larger outbreak response team,
- identify an outbreak’s environmental causes, and
- recommend appropriate control measures.

Currently, over 1,900 users in 49 states, the District of Columbia, and over 50 countries throughout the world have registered and begun using the e-Learning tool. Over 60% of federal, state, local, territorial, or tribal government users ($n = 1,188$) are environmental health workers ($n = 762$) who conduct routine inspections, plan reviews, complaint investigations, or outbreak response within their respective government agencies (Figure 1).

Additionally, the e-Learning tool is being used in academic settings and professional training programs throughout the country. Over 200 students have used it to meet their educational and academic requirements (e.g., Bachelor of Science, nursing, and Master of Public Health degree course requirements). CDC programs like the Public Health Associate Program, in which associates are assigned to public health agencies and nongovernmental organizations, encourage associates working in environmental health to use the e-Learning tool.

CDC Environmental Assessment Tools

The **e-Learning on Environmental Assessment of Foodborne Illness Outbreaks** provides training on how to conduct foodborne illness outbreak environmental assessments.
www.cdc.gov/nceh/ehs/elearn/ea_fio

The **National Voluntary Environmental Assessment Information System** is a national effort to systematically collect, analyze, interpret, and disseminate environmental data from foodborne illness outbreak investigations.
www.cdc.gov/nceh/ehs/nveais

NVEAIS is available to federal, state, local, territorial, and tribal food regulatory agencies throughout the U.S. Data reported to NVEAIS will be used to

- characterize food vehicles and monitor trends;
- identify and monitor contributing factors and environmental causes;
- generate hypotheses;
- guide planning, implementation, and evaluation of food safety programs; and
- prevent future outbreaks.

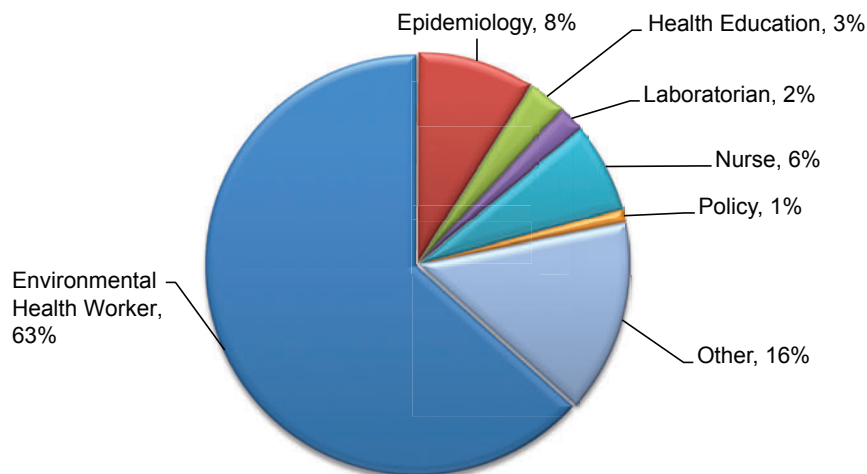
CDC encourages all food safety programs to use NVEAIS to improve food safety in the U.S. Currently, eight state and three local health departments report environmental assessment data to NVEAIS (Table 1).

By participating in NVEAIS, food safety programs provide critical environmental assessment data that can be used to prevent and reduce future outbreaks. CDC will analyze standardized data from NVEAIS to understand how and why outbreaks occur, share findings and recommend actions from this analysis to improve outbreak response, and prevent future outbreaks.

Environmental health workers in food safety programs play an essential role in the effort to reduce foodborne illnesses. CDC wants federal, state, local, territorial, and tribal food safety programs to use the e-Learning tool and NVEAIS to assist in winning the battle on food safety (www.cdc.gov/winnablebattles/foodsafety). The use of these tools can improve knowledge on how to conduct environmental assessments, help

FIGURE 1

e-Learning on Environmental Assessment of Foodborne Illness Outbreaks Government Users: Job Functions



Percentages may equal >100% because of rounding.

TABLE 1

National Voluntary Environmental Assessment Information System Users

State Programs	Local Programs
California Department of Health Connecticut Department of Health Minnesota Department of Health New York State Health Department North Carolina Department of Health and Human Services Rhode Island Department of Health Tennessee Department of Health	Davis County Health Department (Utah) Fairfax County Health Department (Virginia) New York City Department of Health and Mental Hygiene

The increasing enrollment of the e-Learning tool by environmental health workers is encouraging. The National Association of County and City Officials (NACCHO), however, estimates 13,300 environmental health workers are employed at local health departments across the country (NACCHO, 2014). To target more environmental health workers and increase awareness of the e-Learning tool, CDC anticipates strategically working with federal, state, local, territorial, and tribal food safety programs to reach additional environmental health workers.

Tool #2

The second tool launched by CDC, the National Voluntary Environmental Assessment Information System (NVEAIS; www.cdc.gov/nceh/ehs/nveais), is a surveillance system that collects foodborne illness outbreak environmental assessment data. It enables ongoing, systematic collection, management, analysis, interpretation, and dissemination of foodborne illness outbreak environmental assessment data (e.g., detailed food vehicle information, contributing factors, establishment description and categorization, etc.).

to better understand how and why outbreaks occur, and influence food safety policies and practices so that future outbreaks are reduced and ultimately eliminated. 🐷

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gency and Environmental Health Services, 4770 Buford Highway NE, MS F-58, Atlanta, GA 30341. E-mail: HYE1@cdc.gov.

References

Centers for Disease Control and Prevention. (2013). *Winnable battles: Food safety*. Retrieved from <http://www.cdc.gov/winnablebattles/foodsafety>

National Association of County and City Health Officials. (2014). *2013 National profile of local health departments*. Washington, DC: Author. Retrieved from <http://www.naccho.org/topics/infrastructure/profile/upload/2013-National-Profile-of-Local-Health-Departments-report.pdf>

Did You Know?

Individuals or local, state, tribal, or territorial environmental public health jurisdictions that have demonstrated exceptional collaboration and multidisciplinary teamwork in detection, response, or prevention of foodborne illness in 2014–2015 are eligible for the John J. Guzewich EH Team Award for Environmental Public Health Professionals. The award will be presented at the 2015 InFORM (Integrated Foodborne Outbreak Response and Management) Conference being held November 17–20 in Phoenix, Arizona. Please contact Ginny Coyle at gcoyle@neha.org for more information. Applications are due by August 1, 2015.

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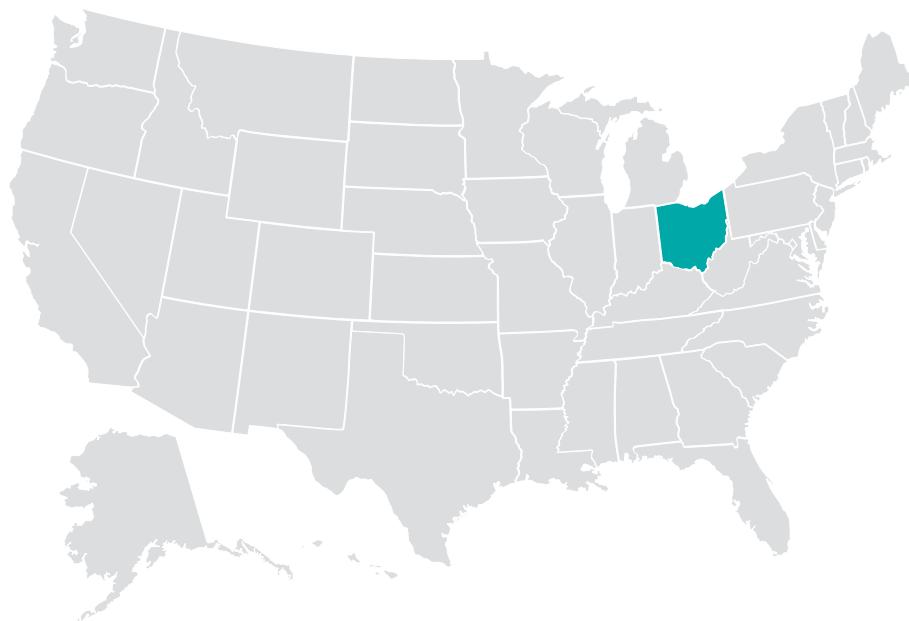


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▶ ACROSS THE COUNTRY WHAT'S HAPPENING IN ENVIRONMENTAL HEALTH



Editor's Note: This feature in the *Journal* is intended to provide readers with interesting and novel stories of environmental health being practiced across the country and to offer an avenue for story sharing and community building. Do you have a story to share? Please send your story ideas to jeh@neha.org.

OHIO

Earth Day Drive-Through Protects Residents and Waterways

An innovative Earth Day partnership among local public health, law enforcement officials, a local television station, and a national health care services company diverted hundreds of pounds of chemicals from area waterways and reduced a health and safety threat in area homes. Columbus Public Health's Office of Environmental Protection and Sustainability (EP&S), housed in the Environmental Health Division, coordinated the April 22 "Drug Drop-off" to collect expired or unwanted prescription and over-the-counter medicines from community residents.

Over 420 pounds of material were collected during the drive-through event by Columbus Police officers. These medicines can pose a risk to both people and ecosystems. Items left in home medicine cabinets pose accidental poisoning or intentional abuse risks. According to the Centers for Disease Control and Prevention (CDC), more than 130,000 children were seen in U.S. emergency rooms in 2011 for unintentional poisonings. In addition, the CDC says over 7% of kids 12–17 years of age reported prescription drug misuse in the past year. Studies also have shown that the chemicals in pharmaceutical and personal care products can harm fish and other aquatic life if flushed down toilets or drains because the water that leaves the home eventually makes its way into area water systems. Furthermore, those same compounds can wind up in our drinking water.

The event was designed to make it as easy as possible for participants. Columbus Public Health staff acted as material screeners, greeting the 218 drivers and informing them of the items (dry material only) that would be accepted at the drop-off. Columbus Police officers—the only individuals who could legally handle and dispose of the material—accepted the medicines from drivers, separating pills from any included bottles or packaging. Promotional assistance was provided by Cardinal Health, a Fortune 500 company specializing in the manufacture and distribution of pharmaceuticals and medical products. Cardinal Health promoted the event among its pharmacy clients. ABC 6 (WSYX) served as media sponsor, promoting the event through both newscast stories on the importance of proper disposal in the days before the drop-off and live coverage of the event. Columbus Public Health staff members also did radio interviews and promoted the event through social media.

The risks from expired and unwanted medicines will likely increase given the aging baby boom generation and the overall increase in the use of medications. "Our office was developed to help people understand the link between the health of the people and the health of our environment," said Richard Hicks, EP&S director. "We want to help people learn to dispose of these materials in the safest and most environmentally responsible way possible, and what would be a better day than Earth Day to make that point?"

Source: Columbus Public Health

▶ DIRECT FROM CDC ENVIRONMENTAL PUBLIC HEALTH TRACKING NETWORK



Shana Eatman

A Millennial's Take on CDC's Environmental Public Health Tracking Network

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

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

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

Shana Eatman is a project officer in the Environmental Public Health Tracking Program of CDC's Environmental Health Services Branch.

Fifteen years ago, the Pew Environmental Health Commission detailed in a report the lack of basic information available to document linkages between environmental exposures and the health of the public. The commission found that there was "no cohesive national strategy to identify environmental hazards, measure population exposures, and track health conditions that may be related to the environment (Pew Environmental Health Commission, 2000)."

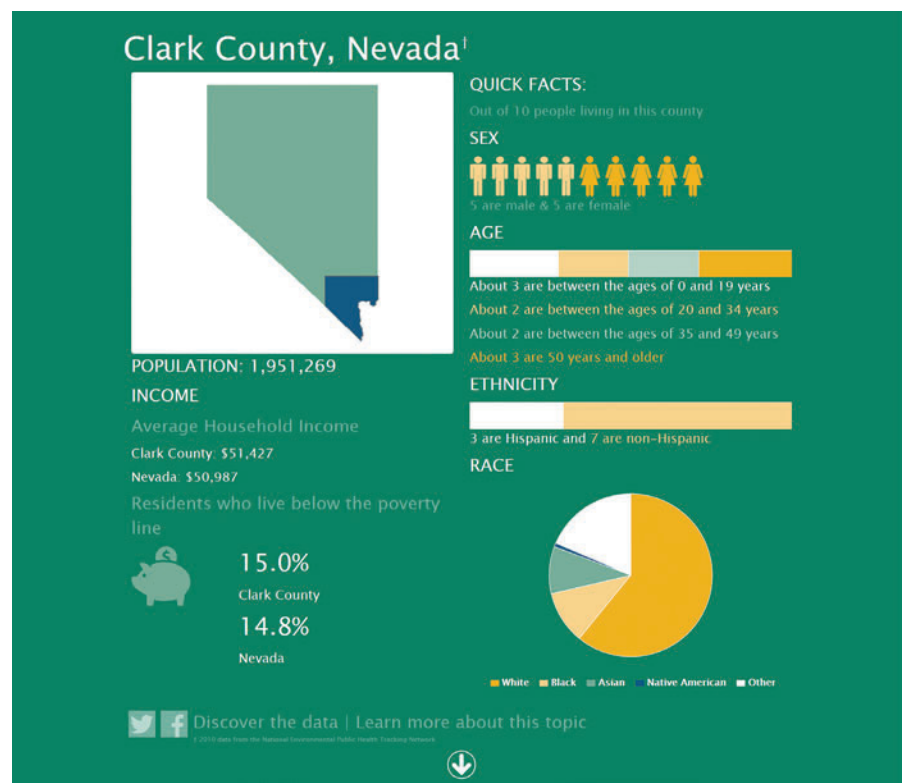
This report served as the impetus for the creation of the Centers for Disease Control and Prevention's (CDC's) Environmental Public Health Tracking Program (Tracking Program). Before the Tracking Program was funded in 2002, no integrated systems existed at the national or state level that tracked exposures to environmental hazards and potential health effects. In 2002, the Massachusetts Department of Public Health was one of the first state health departments to receive

CDC funding for local tracking projects. At this time, I was a preteen in Massachusetts, also connecting the pieces to a bigger picture; but in my case this meant playing Tetris® on my handheld Game Boy®.

In 2009, the National Environmental Public Health Tracking Network (Tracking Network) launched, becoming the first-of-its-kind surveillance system to provide environmental data and public health data in a one-stop shop (Environmental Public Health Tracking Program, 2010). Just as the Tracking Network was maturing and developing into the surveillance system it is now, millennials were being shaped by connectivity and technical advances. Millennials have had access to information at our fingertips since elementary school through the use of computers and smartphones. Today, as a user of the Tracking Network, I can attest to its user-friendly functionality and wealth of data. With just a few strokes on the keyboard, data on environmental hazards and exposures and data on diseases can be pulled up quickly. This system provides interactive and customizable tools to make sense of the data. The younger generation is adept at navigating new platforms and technologies; our brains are trained to adapt to new information-processing skills. We are the first generation to have had access to the Internet during our formative years, which molded the way in which we interact with technology. We also care deeply about the environment, our health, and social determinants of health. The Tracking Network is not only designed in a way that is appealing to millennials like me, but the content it houses is equally as important to my generation.

FIGURE 1

Info by Location (Demographics Section Screenshot)



CDC's Tracking Program funds health departments in 25 states and one city to build and maintain local tracking networks. These local networks in turn feed data to the national system. The Tracking Program also acquires data from other federal and professional organizational partners. Many far-reaching applications of this data occur: the data help individuals observe trends of exposures and health outcomes, identify at-risk populations, advance research on linkages, and help people develop and evaluate public health actions to control or prevent environment-related diseases.

Millennials and Technology

In the age of instant gratification, this dynamic web-based surveillance system is the kind of product that can be attractive to millennials. As a newly minted 26-year-old adult, I identify as a millennial. Millennials, roughly defined as people born from 1981 to 1997, want information—but we want it fast and easily accessible. Young people are

able to rapidly surf and search, synthesize vast amounts of information, and make rapid decisions. Many experts see us as nimble analysts and decision makers (Anderson & Rainie, 2012).

By visiting the Tracking Network, I can quickly gather information on a number of different areas. The Tracking Network's data are divided into three content sections: Health Effects, Environments, and Population Health. The Health Effects section includes data on asthma, birth defects, cancer, carbon monoxide poisoning, childhood lead poisoning, heart disease, reproductive and birth outcomes, and developmental disabilities. The Environments section includes data on climate change, community design, homes, toxic substance releases, outdoor air, water, and pesticide exposures. Finally, the Population Health section includes data on socioeconomics, demographics, children's environmental health, health impact assessments, biomonitoring, and lifestyle risk factors. Data on the Tracking Network are presented as measures and

organized by indicator for each content section. For Tracking, an indicator is one or more item, characteristic, or something else that will be assessed and that provides information about a population's health status, their environment, and other factors. This is assessed through direct and indirect measures (e.g., levels of a pollutant in the environment as a measure of possible exposure) that describe health or a factor associated with health in a specified population.

A variety of features make this surveillance system stand out. The Tracking Network includes interactive maps, charts, and tables; a wide-range of vibrant infographics, and a new function called "Info by Location (Figure 1)." This tool allows the user to get quick, customized information on a specific county or state. This feature is convenient to millennials as we are accustomed to "quick-fix" information. Another new feature recently released on the Tracking Network is the multiple measure query function (Figure 2). Now, Tracking Network users are able to query and view multiple measures simultaneously using maps. This means users are now able to display multiple data types and are able to explore trends and possible associations by comparing these multiple measures. Millennials are quick-acting multitaskers, so this functionality fits our needs perfectly.

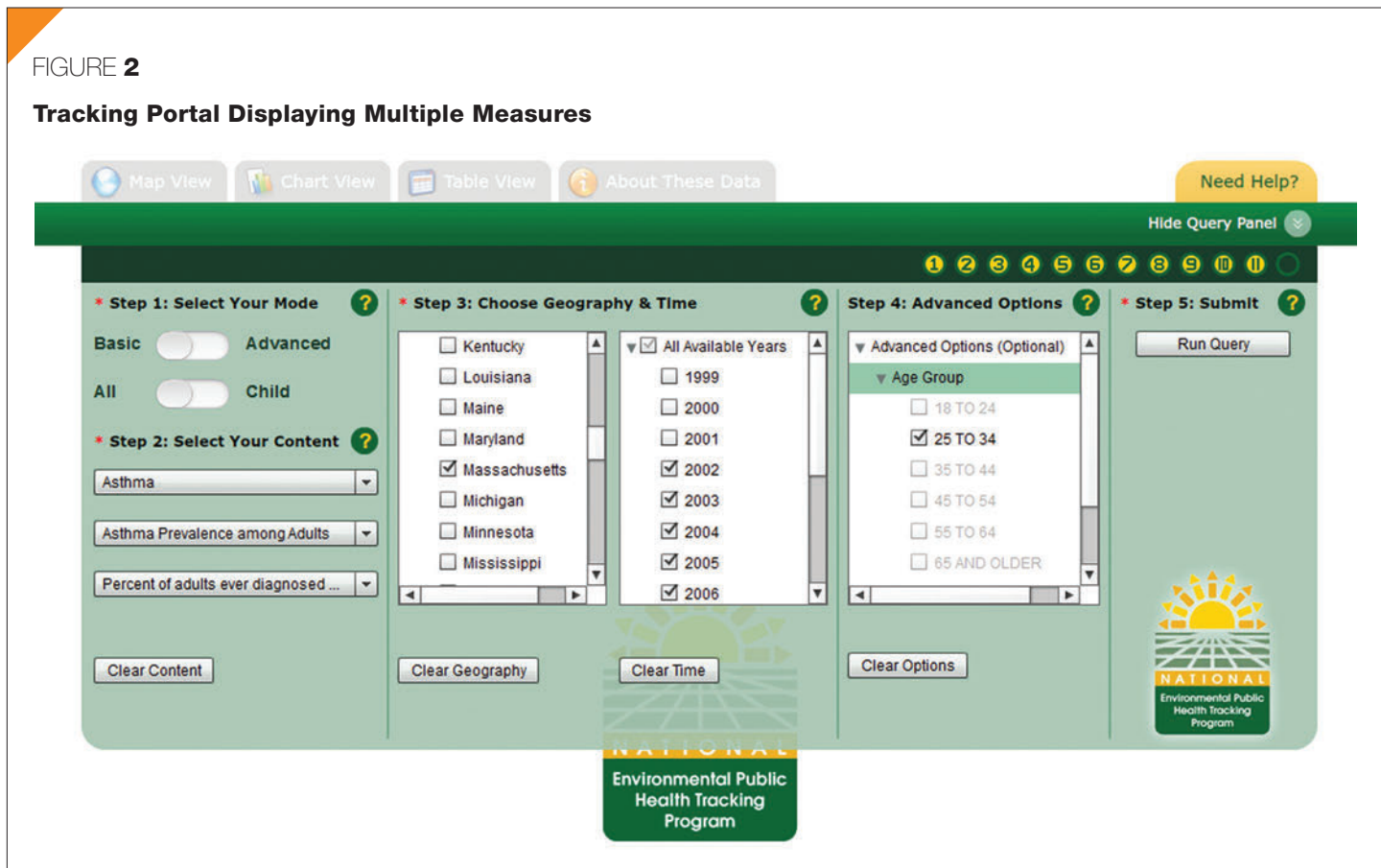
Millennial Values

Of particular importance to some millennials (like me) are the population characteristics and environmental health data found on the Tracking Network. Our diversity sets us apart from other generations. We are the most racially diverse generation in U.S. history, with some 43% of millennial adults being non-white. (Doherty, Krishnamurthy, Parker, & Taylor, 2014). Many of us are immigrants, or like me, a child of immigrants. Millennials born outside of the U.S. now make up 15% of the population (White House Council of Economic Advisors, 2014). The U.S. Census Bureau projects the full U.S. population will be majority non-white by 2043 (U.S. Census Bureau, 2012). By using the Tracking data, millennials can advance environmental justice and health disparity issues affecting our generation.

Also of importance is our view of the physical environment. A great area of concern to millennials is climate change, something I see

FIGURE 2

Tracking Portal Displaying Multiple Measures



as one of my generation's greatest challenges. With the Tracking Program's expanded data on climate change, millennials are able to delve into more than 40 years of weather data about extreme heat days and events and temperature distribution. The data on extreme heat days and events include temperature, heat index, and number of days to define extremely hot days and extreme heat events. The temperature distribution data allows for daily temperature and heat index by county (Figure 3). With 70 years of projected heat data, users are able to inform climate adaptation strategies for the future. These data, paired with historical hospitalization data, allow the user to make comparisons between environmental conditions and health problems.

Conclusion

Living in a well-connected world, we are already in an environment saturated with data that can be retrieved easily. The Tracking Network is different; it is the nation's most comprehensive environmental public health surveillance system. The data in this system

come from a variety of national, state, and city sources but are conveniently housed in one place.

By 2020, millennials will make up more than one of three adult Americans. Also predicted, 75% of the U.S. workforce will be comprised of millennials by 2025 (Hais & Winograd, 2014). The Tracking Network has been designed to be used by and responsive to the needs of users like me. As we begin to saturate the workforce, millennials will be the next generation's thinkers and movers and decision makers. As the Tracking Network also continues to expand, adding new areas of application and increasing functionality, millennials will have no trouble being able to navigate this important surveillance tool to help advance their generation's public health.

To learn more on the Tracking Program's work, visit us online at www.cdc.gov/epht tracking. To further stay connected with the Tracking Program and get updates on the newest data, tools, and resources, join our LIST-SERV by e-mailing epht@cdc.gov.

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References

Anderson, J.S., & Rainie, L. (2012). *Millennials will benefit and suffer due to their hyperconnected lives*. Retrieved from http://www.pewinternet.org/files/old-media/Files/Reports/2012/PIP_Future_of_Internet_2012_Young_brains_PDF.pdf

Doherty, C., Krishnamurthy, V., Parker, K., & Taylor, P. (2014). *Millennials in adulthood: detached from institutions, networked with friends*. Retrieved from http://www.pewsocialtrends.org/files/2014/03/2014-03-07_generations-report-version-for-web.pdf

Hais, M., & Winograd, M. (2014). *How millennials could upend Wall Street and corporate America*. Retrieved from <http://www>

FIGURE 3

Climate Change Section of Tracking Program Web Site



brookings.edu/~media/research/files/papers/2014/05/millennials-wall-st/brookings_winogradfinal.pdf

National Environmental Public Health Tracking Program. (2010). *CDC's strategy for the National Environmental Public Health Tracking Program, fiscal years 2005–2010*. Atlanta, GA: Centers for Disease Control and Prevention. Retrieved from <http://www.cdc.gov/nceh/tracking/pdfs/strategy.pdf>

Pew Environmental Health Commission. (2000). *America's environmental health gap: Why the country needs a nationwide health tracking network*. Retrieved from <http://healthyamericans.org/reports/files/healthgap.pdf>

U.S. Census Bureau. (2012). *U.S. Census Bureau projections show a slower growing, older, more diverse nation a half century from now* [Press Release]. Retrieved from <https://www.census.gov/newsroom/releases/archives/population/cb12-243.html>

White House Council of Economic Advisers. (2014). *15 economic facts about millennials*. Retrieved from https://www.whitehouse.gov/sites/default/files/docs/millennials_report.pdf

CMAHC

Conference for the Model Aquatic Health Code

Calling all...

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- Aquatic & public health experts
- Interested members of the public



Meet CMAHC

CMAHC is a new non-profit organization that collects and relays national input on needed changes to CDC's Model Aquatic Health Code. It relies on members and sponsors who recognize the benefits of free guidance based on science and best practices to reduce outbreaks, drowning, and chemical poisoning.

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CAREER OPPORTUNITIES

Food Safety Inspector

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Buffalo, NY	Owatonna, MN
Butte, MT	Pittsburgh, PA
Chattanooga, TN	Pocatello, ID
Cleveland, OH	Portland, OR
Grand Junction, CO	Puerto Rico
Jackson, MS	Rapid City, SD
Jacksonville, FL	Rochester, NY
	San Jose, CA

Canada Listings

Sioux Falls, SD
Spearfish, SD
St. Louis, MO
St. Paul, MN
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Did You Know?

NEHA has partnered with the Centers for Disease Control and Prevention to explore health department awareness levels of the Model Aquatic Health Code (MAHC). The goal is to understand the current interest in the MAHC and standardized inspections for aquatic facilities. Please help us by taking a brief survey at www.surveymonkey.com/s/NJF7SB2. Survey closes August 1.

NATIONAL ENVIRONMENTAL HEALTH ASSOCIATION



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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.



EH CALENDAR

UPCOMING NEHA CONFERENCE

July 13–15, 2015: NEHA's 79th Annual Educational Conference & Exhibition, Renaissance Orlando at SeaWorld, Orlando, FL. For more information, visit www.neha2015aec.org.

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/aehtest/>.

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.

Kentucky

July 29–31, 2015: 69th Annual Interstate Environmental Health Seminar, hosted by the Kentucky Association of Milk, Food, and Environmental Sanitarians, Corbin, KY. For more information, visit www.wvdhhr.org/wvas/IEHS/index.asp.

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, 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.aplh.org/conferences/Pages/InFORM.aspx. 

Did You Know?

You can follow NEHA on Twitter to get all the latest information and news from your association. Follow us at @nehaorg and join in the conversation. Also, check out NEHA's Facebook and LinkedIn pages to stay in sync with the organization and environmental health profession.

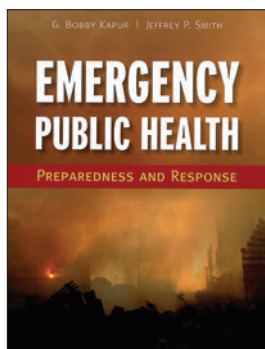
RESOURCE CORNER

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!



Emergency Public Health: Preparedness and Response

G. Bobby Kapur and Jeffrey P. Smith (2011)



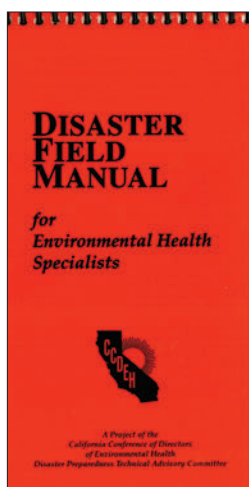
Emergency Public Health provides a unique and practical framework for disaster response planning at local, state, and national levels. This is the first book of its kind to systematically address the issues in a range of environmental public health emergencies brought on by natural calamity, terrorism, industrial accident, or infectious disease. It features historical perspectives on a public health crisis, an analysis of preparedness,

and a practical, relevant case study on the emergency response. Study reference for NEHA's REHS/RS exam.

568 pages / Paperback / Catalog #1121
Member: \$96 / Nonmember: \$101

Disaster Field Manual for Environmental Health Specialists

California Association of Environmental Health Administrators (2012)



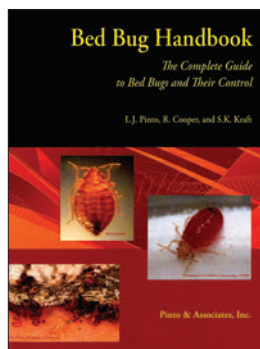
This manual serves as a useful field guide for environmental health professionals following a major disaster. It provides an excellent overview of key response and recovery options to be considered as prompt and informed decisions are made to protect the public's health and safety. Some of the topics covered as they relate to disasters include water, food, liquid waste/sewage, solid waste disposal, housing/mass care shelters, vector control, hazardous materials, medical waste, and responding to a radiological incident. The manual is made of water-resistant paper and is small enough to fit in

your pocket, making it useful in the field. Study reference for NEHA's REHS/RS exam.

224 pages / Spiral-Bound Hardback / Catalog #535
Member: \$37 / Nonmember: \$45

Bed Bug Handbook: The Complete Guide to Bed Bugs and Their Control

L.J. Pinto, R. Cooper, and S.K. Kraft (2007)



The *Bed Bug Handbook* is a complete guide to bed bugs and their control. It includes sections on the history and impacts of bed bugs, their biology and habits, how bed bugs spread, and medical and social considerations of bed bug infestations. The largest portion of the book consists of practical step-by-step guidance for preventing bed bug infestations and for dealing with bed bug outbreaks. There is an

extensive section on bed bug inspections. The book includes checklists for preventing and controlling bed bugs in specific kinds of facilities, such as apartments, hotels, medical facilities, and furniture rental warehouses.

266 pages / Paperback / Catalog #1037
Member: \$66 / Nonmember: \$69

Prevention of Bug Bites, Stings, and Disease

Daniel Strickman, Stephan P. Frances, and Mustapha Debboun (2009)



Here is all the information you will ever need—no matter where you are—to identify, avoid, and protect yourself against all manner of blood-sucking or venomous arthropods. Topics covered range from scorpions, spiders, ants, and bees to mites, ticks, lice, bed bugs, sand flies, biting midgies, mosquitoes, and horseflies. Attractive line drawings and color photographs help identify bugs accurately, and information on each bug's particular habits and habitats allows readers to minimize potentially

annoying, painful, and even lethal encounters. This book is packed with helpful tips on using barriers and on choosing the right repellent for the right bug in the right place. Based upon the best available science, this well-illustrated, crystal-clear guide is a useful reference for public health professionals and the public.

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

FEATURED ARTICLE QUIZ #1

Prevalence, Knowledge, and Concern About Bed Bugs

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

1. Read the featured article carefully.
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3. a) Complete the online quiz at www.neha.org (click on "Continuing Education"),
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c) Mail the completed quiz to
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Be sure to include your name and membership number!
4. One CE credit will be applied to your account with an effective date of July 1, 2015 (first day of issue).
5. Check your continuing education account online at www.neha.org.
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Quiz Registration

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JEH Quiz #5 Answers March 2015

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

→ Quiz deadline: October 1, 2015

1. The 2010 Comprehensive Global Bed Bug Study found that about ___ of surveyed pest management companies reported that they had been called to address a bed bug infestation in the last 12 months.
 - a. 65%
 - b. 75%
 - c. 85%
 - d. 95%
2. In the same study, approximately ___ of the surveyed pest management companies reported coming into contact with a bed bug infestation before 2000.
 - a. 15%
 - b. 25%
 - c. 35%
 - d. 45%
3. In 2010, the Centers for Disease Control and Prevention and the U.S. Environmental Protection Agency declared bed bugs a public health pest of concern.
 - a. True.
 - b. False.
4. Of those surveyed in this study, ___ reported that they knew someone who had bed bugs.
 - a. 3%
 - b. 6%
 - c. 18%
 - d. 21%
5. In regard to level of concern, the highest percentage of survey respondents indicated that they were
 - a. not at all concerned.
 - b. somewhat concerned.
 - c. very concerned.
6. ___ of survey respondents reported that they had changed their behavior because of bed bugs.
 - a. Ten percent
 - b. Twenty-six percent
 - c. Forty percent
 - d. Forty-six percent
7. Which behavior was the highest among the survey respondents that indicated a change?
 - a. Checking the bed and sleeping areas when away from home.
 - b. Inspecting items before purchase.
 - c. Washing clothing after travel.
 - d. Canceling travel arrangements.
8. Of those surveyed, the majority indicated that they
 - a. rented the residence they lived in.
 - b. owned the residence they lived in.
9. When asked about their knowledge related to bed bugs, approximately ___ of those surveyed responded they knew a lot or a moderate amount.
 - a. 3%
 - b. 8%
 - c. 35%
 - d. 43%
10. The study survey had several limitations including
 - a. small sample size.
 - b. utilization of a self-reporting survey tool.
 - c. income status of the village surveyed.
 - d. all of the above.
11. The "Bed Bugs in America" study showed that respondents were more concerned about encountering bed bugs where?
 - a. At hotels.
 - b. In the workplace.
 - c. In public transportation.
 - d. In movie theaters.
12. The "Bed Bugs in America" study found that " ___ out of ___ Americans has had an infestation in their home or they know someone who has encountered bed bugs at home or in a hotel."
 - a. one; three
 - b. one; four
 - c. one; five
 - d. one; ten

Corresponding Author and Subject Index

Code	Corresponding Author/Title	Volume/Issue	Keyword 1	Keyword 2	Keyword 3	Keyword 4	Keyword 5
1	Issam A. Al-Khatib et al. Hand Washing Among Palestinians in the West Bank and Gaza Strip: Attitudes and Practices	77.6 Jan/Feb 2015 Pages: 50–56	Children's Environmental Health	International	Public Health/Safety		
2	Keith S. Allen, MPA, REHS/RS, et al. A Community Outbreak of <i>Salmonella enterica</i> Serotype Typhimurium Associated With an Asymptomatic Food Handler in Two Local Restaurants	77.2 Sept 2014 Pages: 18–20	Epidemiology	Food	Microbiology		
3	Scott A. Bernhardt et al. Sensor Drift and Predicted Calibration Intervals of Handheld Temperature and Relative Humidity Meters Under Residential Field-Use Conditions	77.3 Oct 2014 Pages: 22–28	Ambient Air	Indoor Air	Occupational Health/Safety	Research Methods	
4	James D. Blando, MHS, PhD, et al. Hot Yoga Establishments in Local Communities Serving Pregnant Women: A Pilot Study on the Health Implications of its Practice and Environmental Conditions	77.3 Oct 2014 Pages: 8–12	Indoor Air	Occupational Health/Safety	Public Health/Safety	Recreational Environmental Health	
5	Carla L. Britton, MS, PhD, et al. Norovirus Outbreak at a Wildland Fire Base Camp Ignites Investigation of Restaurant Inspection Policies	77.1 Jul/Aug 2014 Pages: 8–14	Disaster/Emergency Response	Epidemiology	Food	Occupational Health/Safety	Public Health/Safety
6	Sheryl C. Cates et al. Sanitation in Classroom and Food Preparation Areas in Child-Care Facilities in North Carolina and South Carolina	77.4 Nov 2014 Pages: 20–27	Children's Environmental Health	Food	Institutions and Schools		
7	Francesca Clementi et al. Evaluation of HACCP System Implementation on the Quality of Mixed Fresh-Cut Salad Prepared in a University Canteen: A Case Study	77.6 Jan/Feb 2015 Pages: 78–84	Food	Institutions and Schools	International		
8	Ebru Husniye Colak et al. Geostatistical Analysis of the Relationship Between Heavy Metals in Drinking Water and Cancer Incidence in Residential Areas in the Black Sea Region of Turkey	77.6 Jan/Feb 2015 Pages: 86–93	Drinking Water	Hazardous Materials/Toxic Substances	International	Risk Assessment	Water Pollution Control/Water Quality
9	F.S. Conti et al. Application of the Pearl Model to Analyze Fecal Coliform Data From Conditionally Approved Shellfish Harvest Areas in Seven Texas Bays	77.2 Sept 2014 Pages: 22–29	Management/Policy	Public Health/Safety	Risk Assessment	Water Pollution Control/Water Quality	
10	Carol Cox, PhD, MCHES, et al. An Exploratory Analysis to Determine Priority Areas for Lead Poisoning Prevention Education Programs in Missouri	77.7 March 2015 Pages: 12–14	Children's Environmental Health	Education/Training	Lead	Management/Policy	
11	Jonathan Drewry, MPH, DrPH, RS, et al. The Role of Health Impact Assessment in Advancing Sustainable Development in Latin America and the Caribbean	77.8 April 2015 Pages: 16–20	International	Management/Policy	Sustainability		
12	Robyn Gilden, PhD, RN, et al. Evaluation of the Children's Environmental Health Network's Environmental Stewardship Checklist Responses	77.7 March 2015 Pages: 22–28	Children's Environmental Health				
13	Julia M. Gohlke, MS, PhD, et al. Incorporating Occupational Risk in Heat Stress Vulnerability Mapping	77.1 Jul/Aug 2014 Pages: 16–22	Meteorology/Weather/Climate	Occupational Health/Safety	Public Health/Safety	Risk Assessment	
14	LTJG Eric J. Green, MS, REHS, et al. Food Safety Knowledge and Practices of Young Adults	77.10 June 2015 Pages: 18–24	Education/Training	Food	Institutions and Schools	Risk Assessment	

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Code	Corresponding Author/Title	Volume/Issue	Keyword 1	Keyword 2	Keyword 3	Keyword 4	Keyword 5
15	Charles Hart, PhD, CIH, CSP, RS 2013 NEHA/UL Sabbatical Exchange Award to Canada: Comparing Undergraduate Environmental Health Education in Canada and the United States	77.7 March 2015 Pages: 30–33	Education/ Training	International	Workforce Development		
16	Vincent R. Hill, PhD, PE, et al. Fate and Transport of Enteric Microbes From Septic Systems in a Coastal Watershed	77.9 May 2015 Pages: 22–30	Wastewater	Water Pollution Control/Water Quality			
17	MAJ Joseph J. Hout, MSPH, PhD, REHS, CPH, et al. O-Chlorobenzylidene Malononitrile (CS Riot Control Agent) Exposure in a U.S. Army Basic Combat Training Cohort	77.3 Oct 2014 Pages: 14–21	Hazardous Materials/Toxic Substances	Indoor Air	Occupational Health/Safety	Public Health/ Safety	Risk Assessment
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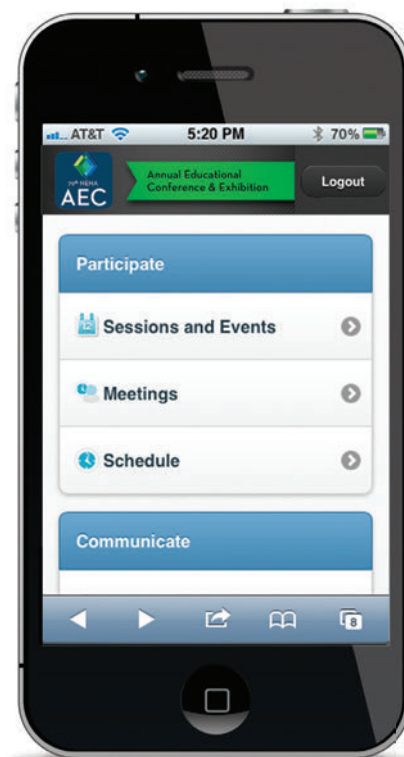
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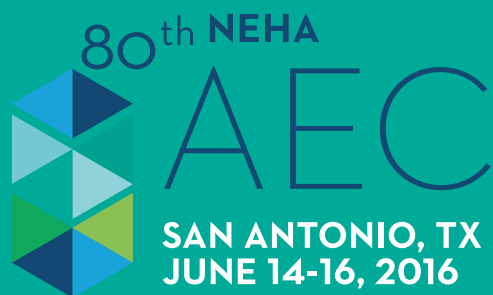
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DirectTalk

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approach to population health, both domestically and abroad, is necessary in an era where millions of people move across porous borders each day, driven in some cases by poor or changing environmental quality at home. Regretfully, some of these migrants (human, animal, and insect) will carry and transmit organisms with antibiotic-resistant properties, adding to the existing soup of superbugs we already have inside our borders.

Assertive and influential environmental health leadership is essential if Ebola, *Listeria*, and lead issues are to be responsibly managed. Our association is obligated to advocate for a public health system and workforce that is maintained and supported to provide an effective baseline of environmental health services for all Americans. To that end, the simplest and most cost-effective approach is to ensure environmental health is treated as a foundational public health service, aligned with the goal of optimal population health.

I'm optimistic. And I think you should be too.

The bedrock of life as we know it is anchored in a safe and healthy environment.

The public inherently knows this—a glance at your favorite newsfeed proves my point. Today's youth are active and supportive. In illustration, the de Beaumont Foundation recently reported that the ninth most popular degree in the U.S. is public health. NEHA conducted its first-ever Reddit "Ask Me Anything" session in May and received over 160 questions from a primarily very young audience. Many of the inquiries were thoughtful and thought provoking.

I recognize and thank the Nixon-era environmental health professionals for the many contributions they made to our quality of life. The Clean Water Act, Clean Air Act, the Occupational Safety and Health Administration Act, and the regulatory functions associated with them help make this a great country in which to live. These modern pioneers created the conditions that make today's innovations possible, giving rise to endless possibilities.

I am also optimistic that you and the thousands of environmental health professionals in local/state/federal government, military service, and private industry are either leaders or are prepared to ascend to leadership. Approximately 20% of all local health officials in the U.S. possess Registered Environ-

mental Health Specialist/Registered Sanitarian (REHS/RS) designations. Who is more familiar with local businesses, recreational communities, and local cultures/practices than us? We are the fulcrum around which the public health enterprise hinges.

Environmental health is profoundly local and profoundly personal. Just ask anyone who lives in Liberia or has suffered from lead or *Listeria* exposure. I'm convinced that as long as we are technically competent and forward thinking, collaborate, and execute our work as people first, and scientists second, our finest moments are just ahead.



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P.S. I recognize you may have been expecting an "I'm the New Executive Director" introduction. I'm privileged to work with, and for, you and hope our time together is rewarding for you, your career, and the health of people, no matter where they live. I commit to making every moment count, and ask that you join me in advancing the state of our profession. 🐼

NEHA NEWS

Achievements in Sustainability Webinar

The Security & Sustainability Forum (www.securityandsustainabilityforum.org), in cooperation with NEHA, held a webinar on June 3, "Achievements in Sustainability: A Look at Local Environmental Health Program Success." The webinar was an opportunity to learn how local environmental health programs achieved integration between sustainability and environmental health.

Participants heard from two past winners of NEHA's Excellence in Sustainability Award. The award was created in 2007 to recognize organizations, businesses, associations, and individuals who are using innovative and environmentally sustainable practices. More information about NEHA's Excellence in Sustainability Award can be found at www.neha.org/sustainability.

First to present were the representatives from the Johnson County Wastewater Department (Kansas), winners of the 2013 Excellence in Sustainability Award. Their wastewater cogeneration project is one of the largest wastewater cogeneration projects in the state's history and has been recognized for demonstrating sustainability and energy efficiency in wastewater treatment. The benefits of the project included expanding the capacity of a local

wastewater treatment plant, local power generation, carbon footprint reduction, and reduced travel from waste and sludge haulers.

The 2014 Excellence in Sustainability Award winners, Energy Smart Colorado, also presented. Energy Smart Colorado is a multi-jurisdictional, comprehensive, energy-efficiency retrofit program that provides health, safety, and energy efficiency services to rural mountain communities in Colorado. From 2010 to 2013, the program completed 3,085 energy assessments and 2,099 energy retrofits and has now transitioned as its own nonprofit entity, providing energy efficiency services to utilities, residents, and businesses in 30 counties across Colorado.

The webinar concluded with a preview of some of the sustainability sessions that are being offered at NEHA's 2015 Annual Educational Conference & Exhibition in Orlando, Florida, taking place this July, and with a question and answer session. NEHA's technical advisors in sustainability, Tom Gonzales and Dr. Timothy Murphy, assisted in facilitating the webinar.

NEHA was pleased to participate in the webinar and is excited to offer future webinars like this to its membership. The webinar is available online for viewing. Please visit www.neha.org for the link. 🐼

► **DirectTalk** MUSINGS FROM THE 10TH FLOOR



David Dyjack, DrPH, CIH

Outraged, Obligated, & Optimistic

I'm outraged. And you should be too. Lead, Liberia, and *Listeria*—in the news. What do they have in common? Unnecessary loss of life, squandered human potential, and expensive fixes. Each represents a basic environmental health challenge that suggests those of us in the risk reduction and health promotion business failed miserably. This is no time for finger pointing, though I am sorely tempted. Conversely, I do want to harness my disappointment and frustration and direct it toward solutions. Let's start with the tragic story of Freddie Gray.

Mr. Gray's arrest and death recently gave rise to civil disturbance in Baltimore, Maryland. Over 200 adults and 30 juveniles were arrested while 20 police officers were injured during just one night's violence. The Baltimore mayor's office reported the city's fire department responded to fires in 144 vehicles and 15 buildings. If this chaos and human tragedy were not enough, an article in the *Washington Post* reported that during his youth Mr. Gray suffered from residential environmental lead exposures leading to blood lead levels of 37 µg/dL. As a point of reference, blood lead levels above 5 µg/dL are believed to lead to diminished cognitive function, among other poor life outcomes. We may never know if this elevated dose at a young age predisposed him to behavior that led to his incarceration. Nonetheless the deck was stacked against him. Why wasn't this well-known environmental hazard abated long ago?

Liberia's Ebola epidemic was as predictable as it was tragic. Since its discovery in the 1970s, this zoonotic disease has been waiting

*The bedrock
of life as we know
it is anchored in a
safe and healthy
environment.*

for an opportunity to surge in countries such as Liberia, which had roughly 50 medical doctors for its population of 4.3 million people at the time of the outbreak. In December 2014 the World Bank estimated that the cost of the current Ebola response was approximately \$32 billion. Almost 5,000 Liberian lives were lost while we in public health tried to figure it out. Surveillance, monitoring, and preventive services could have been implemented to detect and respond to this long before the most recent epidemic exploded.

Listeria is in the news. Really? Sadly yes, with multiple deaths and illnesses in the U.S. associated with the consumption of contaminated ice cream. While the human health calamity is awful, to make matters worse approximately 1,450 full-time and part-time employees have been laid off, and about 1,400 others will be furloughed while the issue is remediated. How did environmental surveillance, detection, and mitigation systems in the greatest country on earth fail the victims and their families?

I'm outraged at needless suffering and squandered resources.

I'm obligated to speak out. And you should too.

Each of us needs to take a long look in the mirror and ask ourselves how on our watch these avoidable and painful environmentally mediated conditions led to such horrific end points. The environmental health profession writ large possesses the intellectual resources and tactical skills to have called out and reduced the risks before they got ugly. The truth is, efforts have been made. Baltimore has made significant progress to reduce lead exposure in its high-risk communities, though these efforts failed Freddie Gray. The U.S. Agency for International Development invests significant sums of money into developing country health systems, though a public health failure was evident in West Africa. The Food Safety Modernization Act demonstrates our federal government is serious about food safety. The system failed to protect the consumers of everyone's (including me) perennial favorite, ice cream.

I'm a supporter of the Patient Protection and Affordable Care Act (i.e., ACA), and its three main objectives of better care, reduced cost, and improved access to services. Regrettably, the law is obsessed with care while largely ignoring the social, economic, and environmental conditions that give rise to the vast majority of poor health. While I recognize many in the Federal Centers for Medicare and Medicaid Services and others will bristle at my contention, I'm right. An integrated systems

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