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Volume 82, No. 5 December 2019

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Volume 82, No. 5 December 2019

ABOUT THE COVER

There is no uniform nationwide method for organizing and delivering governmental environmental health services to residents of the U.S. and its territories, as illustrated by the mosaic of tiles on this month's issue. The December cover article, "Environmental Health Systems and Delivery of Services in the United States and Its Territories," investigated environmental health organization and delivery methods among states and territories. The study aimed to provide a synthesized understanding of environmental health system delivery to assist in efforts to target and deliver workforce capacity building and professional development support.

See page 22.

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- Water Quality Trading Mechanism Enhances Willingness to Upgrade Rural Household Septic Systems in the Western Lake Erie Basin, Northwest Ohio

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PRESIDENT'S MESSAGE

Priscilla Oliver, PhD

Awards and Honors: Why Are They Important?

As youth, we are introduced to awards and honors early. Perfect attendance, the honor roll, the spelling bee, athletics, May Day, the science fair, music recitals, the bands, art displays, etc. get us ready for expressing our talents, excellence, competition, and obtaining rewards. Please get the youth to get involved and continue with this busy work for it builds character and helps us on our way to become productive adults. The socialization is important and it is the beginning of good working relationships in school, work, the profession, church, family, and in our communities. I thank my mother and teachers for making sure that I was involved in all of these activities as I grew up and developed. I also thank my coworkers and colleagues for continually working with and supporting me over the years.

All professions have some system of awards and honors that reward its members. "It is a poor dog that does not wag its own tail," said Little Richard. We, too, in environmental health have to wag our tail. Thus, there is a need for awards and they are important. It was Peter Drucker, "the founder of modern management," who wrote that the following motivates people: achievement, responsibility, and recognition. I submit that one feeds the other and keeps the cycle of work going. People need to have work, to achieve, be responsible, and be recognized in order to thrive and be pleased with work.

Nationally, the National Environmental Health Association (NEHA) is no different. We have a system of awards that are presented at our Annual Educational Conference (AEC) & Exhibition and at the annual affiliate meetings. It has been a pleasure to travel to affiliate meetings, speak and assist with recognizing award winners, and learn about the works and the honors that exist among our professionals. The list of awards and scholarships are expansive and growing. Thanks to all of the leaders, contributors, awardees, and supporters for the inspiration that you provide in this process. Yes, may it never end.

> *We need the awards and honors in our profession to motivate and inspire others.*

We need the awards and honors in our profession to motivate and inspire others. Awards help us to grow and improve the field of environmental health. It is good that we make these announcements in large meetings so others can see what is being achieved. Our individual self-worth is improved and we feel good about our work and the work of others. Individuals become very proud and passionate about the marketing in the field of environmental health. Awards and honors are history making activities. They allow us to be remembered through the perils of time and from generation to generation. The plaques and scrolls of winners are popular. Role models are made and mentoring and networking begin among award winners and the want to be award winners. A road map to success is provided in the lives and accomplishments of award winners. Good and long-lasting professional relationships may continue through time. Such activities can perk up the workday, boost confidences, provide sparks for the career, and lead to greater works and greatness.

The benefits of obtaining an award or honor are that you get the publicity from winning. Written announcements with photos and a tangible plaque, certificate, statue, or check may be presented for all to see. Family, friends, coworkers, and competitors get to witness or find out about the award. You have a chance to thank the selection committee and others that attend the recognition ceremony. You have an audience and people that are listening to hear about you and what you have to say. People will want to hear your story and reaction. Good speaking abilities are developed.

Award winners and honorees create organizational improvements and new positions, inspire innovation and creativity, and can improve teamwork. There are many team awards. Awards also provide a good pool of applicants for other positions such as experts and leaders. Yes, the way to a new or better job may be through an award or honor. There are limitless possibilities.

Many of us have much to say and do but we are holding back for whatever reason. Perhaps applying for an award will help you express yourself. I want to encourage you now to join NEHA and apply now for or nominate qualified applicants for the environmental health awards. Membership matters for this reason.

The many NEHA awards are listed on the website at www.neha.org/about-neha/awards. They are, to name a few: A. Harry Bliss Editor's Award, Walter F. Snyder Award from NSF International and NEHA, U.S. Department of Housing and Urban Development Secretary's Award for Healthy Homes, Samuel J. Crumbine Consumer Protection Award, Walter S. Mangold Award, Joe Beck Educational Contribution Award, NEHA Past Presidents Award, Davis Calvin Wagner Sanitarian Award from the American Academy of Sanitarians, NEHA Affiliate Certificates of Merit, etc.

Please see the NEHA website for a description, criteria, and list of previous winners. Take time to be recognized and to recognize others. Please join and check with your affiliates for a list of awards and apply for or nominate qualified applicants for environmental health awards. It is time to celebrate each other and our profession.

Finally, check around and apply for any other appropriate awards, scholarships, honors, and nominate qualified applicants. Now, do not get discouraged if you fail to win an award. Everyone cannot win the same award, honor, or scholarship at the same time. Just keep applying until your turn comes around and is reached. We need you as a state, office, group, city, county, and individual to apply for awards in NEHA, the affiliates, and the profession. We need your talents and progress.

Continue to do the very fine work you are doing for our planet. The award-winning work contributes to the campaign: **Make America Green Again**. Let us wag our own tail, celebrate, market ourselves, and become the best that we can be in environmental health. A special thank you is extended to our sponsors and donors of awards, honors, and scholarships in environmental health.

Priscilla President@neha.org

Did You Know?

NEHA's membership structure includes five different membership categories—Professional, Emerging Professional, Retired Professional, International, and Life. Members within these categories receive the electronic version of the *Journal*. Members based in the U.S. also have the option to purchase a print subscription of the *Journal* for $35. Learn more at www.neha.org/membership-communities/join.

SUPPORT THE NEHA ENDOWMENT FOUNDATION

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

Individuals who have contributed to the foundation are listed below by club category. These listings are based on what people have actually donated to the foundation—not what they have pledged. Names will be published under the appropriate category for 1 year; additional contributions will move individuals to a different category in the following year(s). For each of the categories, there are a number of ways NEHA recognizes and thanks contributors to the foundation. If you are interested in contributing to the Endowment Foundation, please call NEHA at (303) 756-9090. You can also donate online at www.neha.org/about-neha/donate.

Thank you.

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Editor's Note: A supplemental file was submitted along with this peer-reviewed article and has been posted online due to space limitations. The Journal *did not copy edit this file; the authors have provided it as an extra resource if the reader wants more information. The supplemental information can be accessed at www.neha.org/jeh/supplemental.*

Comparison of Use, Storage, and Cleaning Practices for Personal Protective Equipment Between Career and Volunteer Firefighters in Northwestern Kenkucky in the United States

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Abstract **Most occupational research on firefighter exposure in the U.S. has been conducted in large urban cities with career firefighters. Over 70% of U.S. firefighters, however, are volunteers, a population overrepresented in small rural fire departments and thus under studied. We conducted three focus groups with individuals from eight fire departments in the Green River Firefighters Association fire protection district in northwestern Kentucky. Based on these focus groups, we developed a survey and administered it to 43 career and 187 volunteer firefighters at their annual fire training school. Based on their responses, we identified significant variables related to existing personal protective equipment (PPE) use, storage, and cleaning practices of firefighters. Except for storage, work practices related to the use of turnout gear (coats and pants) showed no significant difference between the two groups of firefighters. A majority of both career firefighters (85%, *n* = 16) and volunteer firefighters (59%, *n* = 57) stored their gear at the fire department (*p* < .05). Although turnout gear is the core component of PPE, 11% of the volunteer firefighters did not own turnout gear. Both firefighter groups have a substantial challenge with respect to PPE practices. Career firefighters deal with more frequent exposures to fire-related contaminants during training and while on duty. In contrast, volunteer firefighters lack the resources needed to properly maintain, clean, and store their PPE, concerns that are not addressed by National Fire Protection Association recommendations.**

Introduction

Research interest in the health of firefighters in the U.S. increased in the 1980s. Over the following decades, a series of investigations in the U.S. has examined the adverse acute and chronic health effects related to firefighter occupational exposures (Fent et al., 2018; Gold, Burgess, & Clougherty, 1978). Most of the studies on firefighter occupational exposures have focused on career firefighters in densely populated urban cities (Dahm, Bertke, Allee, & Daniels, 2015; Daniels et al., 2014, 2015; Fent et al., 2018; Sparer et al., 2017). In particular, there are few, if any, studies on occupational exposures that focus on firefighters in small rural fire departments in the U.S.

Most firefighters in small rural fire departments are volunteers (Easterling & Prince, 2007) and are more likely to be vulnerable to carcinogenic exposures (Hwang, Taylor, Cann, Golla, & Gilbert, 2019; Hwang, Taylor, Cann, Norris, & Golla, 2019). Some of the heightened vulnerability of volunteer firefighters to occupational exposures can be attributed to a lack of respiratory protection standards, as volunteer fighters are not subject to Occupational Safety and Health Administration (2011) standards that are in place for career firefighters. The carcinogenic toxin benzo[a]pyrene, for example, is associated with lung, bladder, and kidney cancers; diesel exhaust is associated with rectal cancer, lung cancer, and leukemia (International Agency for Research on Cancer, 2010, 2013).

In the U.S., 85.2% (*N* = 25,604) of all fire departments employ mostly or all volunteers, and 69.0% (*N* = 788,250) of all firefighters are volunteers (Haynes & Stein, 2017). In Kentucky specifically, 75.7% of firefighters across nearly 700 fire departments are volunteers. The national average is 70.9% (U.S. Fire Administration, 2018). This pattern of

predominantly volunteer firefighters is commonly observed in the smaller rural communities in northwestern Kentucky.

Small rural fire departments do not have as high of a call volume as large urban fire departments or as large of a budget for employing career firefighters. Thus, volunteer firefighters are likely to be residents of the community who have committed to serve in an emergency, as needed in a part-time capacity or for a single shift, in addition to their separate primary job. Furthermore, volunteer firefighters in Kentucky do not receive direct financial benefits, although they can claim a $1,000 refundable income tax credit.

By contrast, career firefighters are full-time responders who are compensated accordingly. In terms of tasks, volunteer firefighters mainly perform response, training, and maintenance activities, whereas career firefighters do these tasks plus perform administrative and medical fitness activities, such as medical evaluation and respiratory protection programs (Easterling & Prince, 2007).

The occupational health risks faced by firefighters are exceptional. To manage these risks, firefighters depend heavily on personal protective equipment (PPE), including turnout gear (coats and pants), hoods, gloves, helmets, eye protection, masks, footwear, and self-contained breathing apparatuses (SCBA). Therefore, identifying existing PPE practices for maintaining, cleaning, and storing firefighter gear is essential.

In a recent study of firefighters in Kentucky, Lesniak (2017) examined how the use of some PPEs can affect their performance. The firefighters participating in that study, however, were from a large urban fire department staffed by career firefighters, a scenario that precludes a comparison of volunteer and career firefighters, which is the scope of this study. Essential to that comparison is an understanding of the use, storage, and cleaning of the PPE worn by career versus volunteer firefighters. We used a survey instrument to obtain a wider perspective of and additional insights into existing PPE practices in small rural fire departments in northwestern Kentucky (survey can be found at www.neha.org/jeh/supplemental). The survey is the first step in a larger occupational exposure assessment study examining the effects of contaminants on the health of firefighters in this region.

Methods

Study Design

Our study design used both qualitative and quantitative methods and was approved by the institutional review board (IRB) of Western Kentucky University (IRB code number: 16-446). Specifically, we developed and tested the survey instrument through focus group interviews, and then we administered the survey instrument to firefighters at the fire training school, each of whom signed an informed consent form. We followed this two-phase approach for three reasons: 1) our goal was to develop a systematic survey instrument, 2) we wanted to identify the PPE concerns of different groups of firefighters, and 3) we needed to build a sustainable relationship with the firefighters for the purpose of the larger study.

Focus Groups

We conducted three focus groups for fire departments in the local Green River Firefighters Association (GRFA) fire protection district to develop the survey instrument. The district staffs 70 municipal fire departments in 8 counties in northwestern Kentucky, which represents 10% of the fire departments in the state. The participants in the first and second focus groups were leaders, such as fire chiefs and directors. The participants in the third focus group were frontline individuals, such as firefighters and instructors. For all three focus groups, we held meetings for approximately 90 min. We kept all discussions strictly confidential and did not collect or record any personal information.

In the first focus group, eight firefighter leaders discussed questions relating to occupational exposures in their working environments, including PPE practices. Based on that discussion, we developed a survey instrument that emphasized the use, storage, and cleaning practices for PPE. In the second focus group, the same eight leaders provided feedback on the resultant survey instrument and discussed logistics for administering the survey. We then revised the survey instrument based on their feedback.

For the third focus group, the leaders from the first two focus groups sent an invitation by e-mail to firefighters in the local district. From the respondents, 11 volunteer firefighters were randomly selected to comprise the third focus group. We held a discussion about the revised survey instrument with the third focus group and solicited the perceptions of frontline individuals concerning work practices, obstacles, and support on the job. After this discussion, the third version of the survey instrument was finalized for distribution.

Survey Instrument Distribution

We distributed the paper format survey to 230 firefighters at the annual fire training school, which grants continuing education hours for certification and covers a range of topics from basic firefighting skills to traffic incident management. A raffle was conducted for a chance to win a $25 gift card in return for voluntary survey participation. From the survey results, we extracted 31 questions related to a variety of firefighter PPE work practices for data analysis. For seven participants who indicated they were both a career and a volunteer firefighter, we incorporated their employment status and job titles for classification. If the participant was a full-time firefighter (e.g., an assistant chief), then he or she was classified as a career firefighter ($n = 4$). If the participant was working part-time (e.g., retired), then he or she was classified as a volunteer firefighter ($n = 3$).

We recorded all completed survey instruments using survey software and compared PPE practices between career and volunteer firefighters with chi-squared tests using SAS version 9.4 with significance levels determined by $p \leq .05$.

Results

Demographic Information

The response rate for the survey instrument was 53% (121 of 230 firefighters). The respondents represented 24 counties in northwestern Kentucky, only one of which was an urban city, as defined by a population ≥ 50,000 (U.S. Census Bureau, 2018). A total of 19 career and 102 volunteer firefighters participated in the study (Table 1).

The demographics of the career and volunteer firefighters were similar ($p > .05$) but the participating career firefighters tended to be younger and more experienced. Two of the survey questions asked the total number of years as a firefighter and the number of years at the current fire department. The difference between those two numbers was 3 times higher for career firefighters than volunteers (3.3 years for the career firefighters versus 1.1

years for the volunteer firefighters), indicating that career firefighters have a faster turnover rate from one fire department to another.

Personal Protective Equipment Gear

Due to the unique environmental conditions of fire suppression operations, firefighters depend on PPE. Thus, respondents were asked to identify the types of PPE worn (Table 2). The firefighters relied heavily on all types of PPE except for hearing protection at a fire scene (range 78–100%). Additionally, we found that 100% of career firefighters were issued turnout gear, compared with 89% of the volunteer firefighters. Overall, 17% of the firefighters had more than one set of turnout gear; career firefighters had an average of 1.5 sets of gear, whereas volunteer firefighters had only one set.

Although the fire departments participating in this study provided full monetary support to purchase new turnout gear for 78% of career firefighters and 67% of volunteer firefighters, our study found that 22% of the career firefighters and 41% of the volunteer firefighters replaced their gear longer than every 10 years. The maximum age of the newest and oldest sets of turnout gear ranged from 12–15 years and 20–37 years, respectively. Both the oldest and newest sets of turnout gear owned by volunteer firefighters were at least 1.6 times older than those of the career firefighters; however, there was no statistically significant difference between the career and volunteer firefighters ($p > .05$, Table 3).

Personal Protective Equipment Storage Practices

The PPE storage practices of career firefighters differed significantly from volunteer firefighters ($p < .05$, Table 4). Most career firefighters (85%, $n = 16$) stored gear at the fire department (e.g., in a locker or fire truck) versus 59% ($n = 57$) of the volunteer firefighters. Only 21% ($n = 4$) of the career firefighters stored their gear in personal vehicles compared with 53% ($n = 51$) of the volunteer firefighters.

The firefighters were also asked about container usage or portable storage practices. Most volunteer firefighters (63%, $n = 58$) stored their turnout gear in a container such as a zipper bag or airtight container. Only 13 volunteer firefighters (14%) stored their gear in a mesh container as recommended by the National Fire Protection Association (NFPA, 2014).

TABLE **1**

Demographic Characteristics by Firefighter Group

Characteristic	Career ($n = 19$)		Volunteer ($n = 102$)		p-Value
	#	%	#	%	
Age (years)					
<30	4	5.5	19	26.0	.632
30–39	4	5.5	14	19.2	
40–49	2	2.7	16	21.9	
≥50	1	1.4	13	17.8	
Total years served					
<5	3	2.7	42	37.8	.504
5–9	5	4.5	17	15.3	
10–14	5	4.5	10	9.0	
15–19	0	0	5	4.5	
≥20	4	3.6	20	18.0	
Years served at current fire department					
<5	9	7.4	54	44.6	.084
5–9	3	2.5	18	14.9	
10–14	4	3.3	8	6.6	
15–19	1	0.8	5	4.1	
≥20	2	1.7	17	14.1	

TABLE **2**

Personal Protective Equipment (PPE) Used at a Fire Scene by Firefighter Group

PPE Type	Career ($n = 19$)		Volunteer ($n = 102$)	
	#	%	#	%
Gloves	19	100	94	100
Coats and pants (i.e., turnout gear)	18	95	94	100
Helmet	18	95	94	100
Hoods	18	95	92	98
Footwear	18	95	90	96
Self-contained breathing apparatus	17	89	89	95
Eye protection	17	89	74	79
Masks	17	89	73	78
Hearing protection	7	37	11	12

Personal Protective Equipment Cleaning Practices

We also evaluated cleaning practices of the firefighters, including cleaning determination, frequency of cleaning, and type of washer used for cleaning. Overall, the two groups had similar cleaning practices ($p > .05$, Table 5) but volunteer firefighters tended to wash gear less frequently than career firefighters. Most firefighters had not performed advanced cleaning of their turnout gear. An extractor, which is a high-performance

TABLE **3**

Age in Years of the Newest and Oldest Sets of Turnout Gear Owned by Firefighter Group

Turnout Gear Set	Career				Volunteer				*p*-Value
	Mean	*SD*	Minimum	Maximum	Mean	*SD*	Minimum	Maximum	
Newest set	3.3	3.8	0.1	12.0	5.3	4.2	0.1	20.0	.08
Oldest set	6.1	3.5	1.5	15.3	10.0	8.1	0.3	37.0	.07

TABLE **4**

Turnout Gear Storage Practices by Firefighter Group

Storage Practices*	Career		Volunteer		*p*-Value
	%	# of Responses/ # of Participants	%	# of Responses/ # of Participants	
Location					
Locker at fire department	74	14/19	50	48/96	.027
Fire truck	11	2/19	9	9/96	
Personal vehicle	21	4/19	53	51/96	
Home	0	0/19	9	9/96	
Container type					
Zipper bag	44	8/18	58	53/91	.206
Mesh container	11	2/18	14	13/91	
Airtight container	0	0/18	5	5/91	

*Based on multiple answers (more than one answer).

industrial washer, was more accessible to the career firefighters (42%, n = 8) than to the volunteers (12%, n = 11) because it is usually located in the fire department.

Discussion and Conclusion

Personal Protective Equipment Gear Replacement

Career and volunteer firefighters in small rural communities in northwestern Kentucky face different challenges with respect to PPE use, storage, and cleaning practices. Volunteer firefighters find it challenging to meet PPE requirements due to fewer resources. In particular, turnout gear loses protective functions, such as fire and chemical resistance, as it ages and has a maximum life span of 10 years from the date of manufacture (NFPA, 2014). Yet we found that volunteer firefighters tended to have older turnout gear that was less frequently replaced (>10 years) than career firefighters. Additionally, one of the volunteer firefighters in our survey did not possess turnout gear at all. Although most small rural fire departments provide monetary support for the purchase of turnout gear, and in our survey 67% of volunteer firefighters had full monetary support for turnout gear, a full set of gear on a limited budget still might not be affordable for all firefighters (Green River Firefighters Association [GRFA], 2016).

Training and Personal Protective Equipment Gear

Career firefighters in Kentucky must complete a minimum of 100 training hours annually, while volunteer firefighters need only 20 hours (Kentucky Fire Commission, 2017). Training covers subjects such as fire behavior, first aid, and communication. Specific fire-related training operations can cause exposure to residual smoke off-gassing from PPE and occupational air contaminants on PPE. For example, career firefighters routinely train for aircraft emergencies in which the primary threat is petroleum. Typically, volunteer firefighters only encounter petroleum when they fight crude oil tank fires at a fire scene. Thus, the chance of being exposed to smoke and air contaminants from burnt petroleum likely is higher for career firefighters because they are exposed not only at fire scenes but also during required training.

Another difference between career and volunteer firefighters relates to the training requirements for PPE. Specific PPE criteria are established by NFPA's *Standard 1851: Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting* (NFPA, 2014). The basic section on PPE is part of the required training for both career and volunteer firefighters; however, career firefighters undergo more hours of training. This difference in training hours could explain our finding that nearly twice as many career firefighters were familiar with the NFPA standards as were volunteers.

Personal Protective Equipment Gear Storage

Except for storage location, we did not identify any differences between career and volunteer firefighters in the use, storage, and cleaning of turnout gear (p > .05). In a previous study, nearly half (47%) of the firefighters reported storing their turnout gear in personal vehicles (Fent et al., 2013). In this study, the volunteer firefighters were more likely than the career firefighters (53% and 21%, respectively) to store their turnout gear in a personal vehicle, a tendency that might be due to the size and dispersal of the response area for small rural fire departments. Given the large area covered by rural departments and the high likelihood that vol-

TABLE **5**

Turnout Gear Cleaning Practices by Firefighter Group

Cleaning Practice*	Career		Volunteer		*p*-Value
	%	# of Responses/ # of Participants	%	# of Responses/ # of Participants	
Cleaning determination					
After fire	53	10/19	39	37/94	.347
Visibly dirty	37	7/19	54	51/94	
Following SOP	42	8/19	22	21/94	
Frequency of routine cleaning					
None	11	2/19	4	4/95	.295
After each use	37	7/19	31	29/95	
≤ Every 6 months	37	7/19	24	23/95	
> Every 6 months	5	1/19	23	22/95	
Frequency of advanced cleaning					
None	83	15/18	71	65/92	.152
After each use	6	1/18	0	0/92	
≤ Every 6 months	6	1/18	7	6/92	
> Every 6 months	6	1/18	14	13/92	
Washer type**					
Hose or hose with brush	31	6/19	40	36/89	.095
Top- or front-load washing machine	21	4/19	51	45/89	
Extractor	42	8/19	12	11/89	

SOP = standard operating procedure.
*Based on multiple answers (more than one answer).
**Types of dryer and cleaning solutions are not shown.

unteer firefighters have other jobs, they often respond to calls by driving their personal vehicles to the scene of an emergency (GRFA, 2016). Therefore, volunteer firefighters tend to store their turnout gear in their vehicles. Storing PPE in vehicles and moving contaminated gear in and out of personal vehicles can increase the risk of residual exposure to contaminants, such as polycyclic aromatic hydrocarbons (Baris et al., 2001; Dahm et al., 2015; Fabian et al., 2014), polychlorinated dibenzo-p-dioxins and dibenzofurans, and polybrominated dibenzo-p-dioxins and dibenzofurans (Shaw et al., 2013).

Whether firefighters are exposed to accumulated contaminants in their vehicles is a relevant question and the possibility of take-home contamination from previous fires should not be ignored (Du Plessis et al., 2010; Hwang, Taylor, Cann, Norris, & Golla, 2019). In terms of container type, the NFPA (2014), recommends that turnout gear be stored in breathable mesh unless the gear is new. We observed, however, that firefighters more often than not stored unlaundered gear in an airtight container in a personal vehicle or at the fire department.

Personal Protective Equipment Gear Cleaning

NFPA discusses two processes for cleaning PPE: routine cleaning and advanced cleaning. Routine, light cleaning is often performed by a firefighter and consists of brushing off dry debris, rinsing with a water hose, and spot cleaning. Advanced gear cleaning refers to thorough cleaning by hand or machine, with cleaning agents, and often by contracted companies. NFPA mandates advanced cleaning of all personal turnout gear at least once every 6 months or whenever routine inspections indicate a problem with the gear. We found that the advanced cleaning practice, however, is not followed in small rural fire departments, which are mainly staffed by volunteers and have budget constraints.

The volunteer firefighters surveyed in this study had limited access to cleaning equipment, including extractors for routine gear cleaning. An extractor is a high-functioning washer that controls water temperature, chemical injection, and extract speed. Most of the firefighters we surveyed air-dried turnout gear in direct sunlight, which is not recommended by NFPA, and a few firefighters used clothes dryers. Furthermore, firefighters reported washing gear with mild detergents, regular laundry detergents, and turnout gear cleaners. The type of washer, dryer, and detergent can affect how quickly turnout gear degrades.

Personal Protective Equipment Gear as Control

Industrial hygiene lists protection methods from most to least effective in a standard hierarchy of control: hazard elimination, substitution, engineering control, administrative control, and PPE. The standard hierarchy does not apply to firefighters, however, due to a unique working environment, namely intermittent risk, on-call work, and responses outside the workplace. Consequently, firefighters must rely on PPE, the least effective method of control.

We found that firefighters depend heavily on all PPE at a fire scene, except for hearing protection, which interfered with vital communication with fellow firefighters, dispatchers, and other emergency response workers. Firefighters, then, are not protected from the other noise sources that are present such as sirens, ventilation fans, extraction equipment, operating equipment for fire suppression, and SCBA equipment. Although these other noise sources are intermittent and usually short, accumulated exposure can lead to hearing loss (Hong, Samo, Hulea, & Eakin, 2008).

Limitations

This study has several limitations. The ratio of career to volunteer firefighters in our study was unbalanced, reflecting the composition of the surveyed fire district, in which 81% of firefighters were volunteers (GRFA, 2017). The selection of volunteer firefighters could be more discriminating, thereby limiting participation to those with less experience. Volunteer firefighters with less than 3 years of experience cannot contribute to focus groups because they have not completed the required NFPA training hours. We found that many volunteer firefighters had less than 3 years of experience. We further compared the types of firefighters enrolled in the fire school (N = 230) with the survey participants (N = 121). Approximately 19% of the students and 16% of our participants were career firefighters, illustrating the imbalance between career and volunteer firefighters in this region.

Other limitations are due to nonresponses, sample composition, participant bias (self-selection and recall), and investigator bias. Due to the moderate 53% response rate in this study, nonresponse bias was unavoidable. To increase response rate, a monetary incentive was randomly offered to the participants.

The unique format of the fire school, however, was not fully explored prior to distributing the survey. During fire school training, firefighters participate in multiple activities on the ground or in the field rather than lectures in a classroom; therefore, potential respondents had insufficient time to respond to the entire survey. To better understand the firefighter cohort in this region, we plan to conduct a follow-up survey at the fire school over an extended period of time using a multimodal approach, such as a combined paper- and Internet-based format.

All respondents voluntarily agreed to participate in the survey. Voluntary responses imply there is possible self-selection bias due to purposive participants, in contrast to a randomized sample (Murray et al., 2014). Additionally, the information provided by the survey participants might have been influenced by recall bias from the focus group. Although focus group discussion data were useful for placing study findings into context, all statements by the focus group participants should have been recorded and fully transcribed to enable a more transparent process. Finally, there could be bias from the investigators who guided the discussion.

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INTERNATIONAL PERSPECTIVES

Is Cleanliness Really a Reason for Consumers to Revisit a Hotel?

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Abstract **The importance of the sanitary conditions of a hotel has been recognized but its importance to travelers might be underestimated. The purpose of this study is to measure the effect of cleanliness on consumer risk perceptions and its influence on attitudes and behavioral intentions. This study used experimental scenario questionnaires (two sanitary conditions: clean versus unclean) and found that health risk perceptions of consumers were affected by cleanliness. The risk perceptions also affected consumer attitudes, which then influenced behavioral intentions.**

Introduction

Recent pandemic outbreaks, such as severe acute respiratory syndrome (SARS), influenza A (H1N1), and the Middle East respiratory syndrome coronavirus (MERS-CoV) have affected consumer behavior globally. During the SARS outbreak, 8,588 individuals were affected and 724 died worldwide (Tse, So, & Sin, 2006). Wu and coauthors (2010) investigated the impact of infectious diseases on hotel room occupancy rates in Hong Kong and found steep declines in room occupancy rates during outbreaks of diseases such as H5N1 bird influenza (avian flu) and SARS. Restaurants also saw business losses as high as 90% during the SARS outbreak (Fowler & Prystay, 2003).

During the MERS-CoV outbreak between 2012 and July 2015, 26 countries were affected and 1,368 laboratory-confirmed cases were reported (World Health Organization [WHO], 2015a). The recent incidence of MERS in South Korea was the largest outbreak outside the Middle East and caused more than 10,000 people to be quarantined or isolated in government facilities (WHO, 2015b), greatly affecting the country's tourism and economy. Domestic consumption declined and tourist numbers fell by more than 40% ("Mers outbreak," 2015).

Previous studies have found that cleanliness can be a critical issue and consumers are influenced by cleanliness when they purchase products in a service environment (d'Astous, 2000; Hecht & Martin, 2006; Hoffman, Kelley, & Chung, 2003; Lucas 2003; Vilnai-Yavetz & Gilboa, 2010; Wakefield & Blodgett, 1996; Zemke, Neal, Shoemaker, & Kirsch, 2015). Cleanliness issues have been seriously considered in the outbreaks of pandemic diseases as a vector for delivering germs that cause diseases. According to the Centers for Disease Control and Prevention (2011), hands transmit almost 80% of all infections. The service industry took note of such transmission, as consumer behavior was influenced by pandemic outbreaks and human contact was avoided to prevent disease (WHO, 2004; 2015a; 2015b). The hospitality industry adopted recommendations from the World Health Organization and has been trying to maintain sanitized conditions, as well as strongly urging employees to maintain good personal hygiene.

Public health laws in Korea state that businesses related to public health (hotels and motels, hair salons, public bathhouses, etc.) have a duty toward public health and specify that 1) rooms, bedding, and bathrooms should be clean and water quality standards maintained and 2) ventilation and lighting should be sufficient (Korean Public Health Code, 2019). Stains on bedding or bad smells in bathrooms are potential violations of the public health code. In general, Korean consumers expect pleasant air quality and clean rooms without stains on the materials that they are going to use, including towels, beddings, couches, tables, and drinking glasses.

Consumer perceptions of hotel cleanliness can vary by individual and cultural background, but a study comparing the hotel selection criteria of Korean and U.S. travelers found that people from both countries chose cleanliness as the most important factor (Mccleary, Choi, & Weaver, 1998). Common knowledge of hygiene standards has been established across different cultures as the result of several pandemic disease outbreaks.

Consumers change their behavior to avoid risks, which can be perceived based on several factors that influence individuals. Along with pandemic outbreaks, unexpected natural events and man-made disasters have a negative effect on the economy, especially tourism. The Fukushima disaster in Japan in 2011 influenced traveler intentions to visit Japan and the number of visits declined that year (Handler, 2016). In a study conducted 2 years after the incident, Taiwanese people were still

TABLE **1**

Demographic Characteristics (*N* = 224)

Characteristic	#	%
Sex		
Male	101	45.5
Female	121	54.5
Marital status		
Married	103	46.4
Single	119	53.6
Age (years)		
<20	11	4.9
20–29	63	28.1
30–39	59	26.3
40–49	54	24.1
50–59	26	11.6
60–69	9	4.0
≥70	2	0.9
Education level		
High school or less	34	15.2
Associate degree or student	66	29.5
Bachelor's degree or student	112	50.0
Master's degree or student	12	5.4
Monthly household income (won)*		
<2,000,000	37	16.5
≥2,000,000–<4,000,000	80	35.7
≥4,000,000–<6,000,000	62	27.7
≥6,000,000–<8,000,000	27	12.1
≥8,000,000	18	8.0
Preferred price for a hotel room (won)*		
<100,000	39	17.5
≥100,000–<200,000	130	58.3
≥200,000–<300,000	48	21.5
≥300,000	6	2.7
Preferred type of accommodation		
Hotel	119	54.3
Motel	9	4.1
Pension (guest or boarding house)	47	21.5
Airbnb	38	17.4
Other	6	2.8
Health condition		
Not very good	1	0.4
Not good	7	3.1
Normal	80	35.7
Good	101	45.1
Very good	35	15.6

*1 U.S. dollar equals 1,169.24 won (as of October 31, 2019).

willing to travel to Japan, but with conscious behavioral changes such as searching for more information on food origins and avoiding certain areas of the country (Handler, 2016).

The risk perceptions of consumers, therefore, need to be studied so that countries can respond proactively to consumer behavioral changes. Risk can be defined in many ways depending on the discipline; this study defines risk as a concern for one's own health (a risk type categorized as physical risk).

When it comes to research on the attributes that influence consumer behavior in hospitality marketing, cleanliness has been secondary to other factors. Previous studies have investigated factors that influence hotel selection, of which cleanliness was one (Callan 1998; Lockyer, 2005; Sohrabi, Vanani, Tahmasebipur, & Fazli, 2012; Taylan Dortyol, Varinli, & Kitapci, 2014). Lockyer (2005) found that cleanliness was the most important factor for hotel selection, but many other factors have been considered for marketing purposes, and cleanliness has rarely been seen as an important factor influencing hotel selection or consumer behavior in previous studies. In a summary of attribute categories in hotel selection from 1984–2010, cleanliness rarely appeared as a single attribute (Tanford, Raab, & Kim, 2011). Vilnai-Yavetz and Gilboa (2010) mentioned that cleanliness has been considered a less important factor in the service environment, although cleanliness has a potential impact on consumer revisit intentions because it gives a first impression of service to consumers (Harris & Sachau, 2005).

Studies have objectively examined the current conditions of cleanliness in hotels using scientific measurements such as adenosine triphosphate (ATP) testing. Hotel rooms have been recognized as a potential source of community-acquired infections such as methicillin-resistant *Staphylococcus aureus* and *Clostridium difficile* (Xu, Weese, Namvar, & Warriner, 2015) and studies using ATP testing have shown unsanitary conditions in hotel rooms (Almanza et al., 2015a, 2015b; Xu et al., 2015). TV remotes, telephones, bathroom faucets, countertops, and toilet seats were places where oxacillin-resistant bacteria was often found (Xu et al., 2015). One important finding was that sampled surfaces did not differ between different hotel classes in terms of ATP levels. Xu and coauthors (2015) concluded that regardless of

hotel class, housekeeping did not adequately practice sanitation of rooms and risk reduction based on the expected value of hotel class did not apply to cleanliness. One study showed that there were consumer segments willing to pay extra for UV disinfection of a hotel room (Zemke et al., 2015).

Certain unsanitary conditions in a hotel can cause unpleasantness for consumers and might influence their perception of physical risk. A study using means-end chain analysis found that consumers made a mental link between the attributes of retail stores and the motivations that link four risk dimensions, including physical risk (Mitchell & Harris, 2005). Mitchell and Harris' (2005) hierarchical value map showed a sequence of relationships among attributes, consequences, motivations, and risks; as a result of an unclean store, consumers perceived an unhygienic environment, which gave them a perception of unhealthiness and, eventually, physical risk. The study focused on four risk dimensions (physical, financial, time and convenience, and psychosocial), but did not extend to consumer revisit intentions or satisfaction. The study did identify, however, strategic positions for each risk dimension and gave clearer strategies for retailers to understand the store choice process of consumers.

The purpose of our study was two-fold. The first was to investigate the impact of risk perception developed from perceptions of hotel cleanliness on consumer attitudes. Cleanliness previously has been considered as one of the attributes in hotel selection and we wanted to determine if it is essential to consumers in attaining trust in the sanitary conditions of a hotel in relation to purchase behaviors. The second purpose of this study was to investigate the impact of consumer attitudes toward a hotel on their future behavioral intentions. This study offers the hospitality industry precautionary principles for consumer health risk perceptions. Consumers should be able to be confident that they are visiting establishments with sanitary conditions in the physical environment.

TABLE **2**

Respondent Cleanliness and Health Involvement (*n* = 223)

	Mean	*SD*
I pay attention to cleanliness and health	5.28	1.225
I believe cleanliness has correlations to health	5.48	1.297
I do not stay at a place that is not clean	5.31	1.298
I pay attention to sanitation of hotels while traveling	5.65	1.179
I consider sanitation issues when selecting a hotel	5.76	1.132

Note. 1 = strongly disagree, 7 = strongly agree.

TABLE **3**

Results of *t*-Test Between Clean and Unclean Conditions of a Hotel

Risk Perception	Clean (*n* = 117) (Mean ± *SD*)	Unclean (*n* = 107) (Mean ± *SD*)	*t*-Test Value
Likely to contract diseases	1.88 ± 1.203	4.89 ± 1.828	-14.417*
Likely to be sick	1.88 ± 1.249	4.67 ± 1.776	-13.472*
Great chance to contract pandemic outbreaks	1.79 ± 1.227	5.09 ± 1.838	-15.651*
Not safe for health to stay	1.87 ± 1.289	5.47 ± 1.806	-17.257*

*$p < .001$.
Note. 1 = strongly disagree, 7 = strongly agree.

TABLE **4**

Effect of Hotel Sanitary Conditions on Health Risk Perception

Predictor	ß	*SE*	*t*-Test Value
Constant	5.026	0.137	36.723*
Sanitary condition	-3.171	0.198	-16.048*

*$F = 257.540$, $R^2 = .538$, Adjusted $R^2 = .536$, $p < .001$.

Methods

Design and Stimulus Selection

A common-language definition of cleanliness is used in this study, rather than a measurement of purity or a germ-free condition. This study employs a scenario-type survey to allow respondents to precisely imagine the sanitary conditions of a hotel. Participants were randomly assigned to answer one of two scenario questionnaires (clean versus unclean). The sanitary conditions of hotels were described using hotel ranking descriptions in South Korea (Korea Tourism Organization, 2017).

Measurement Variables

The health risk measure used four items on a 7-point Likert-scale (Prentice-Dunn, McMath, & Cramer, 2009; Rogers, 1983) to measure the levels of health risk perception resulting from the unsanitary conditions of a hotel (e.g., I am likely to contract diseases: 1 = strongly disagree, 7 = strongly agree). Attitude was measured by four items excerpted from previous studies (Gao & Mattila, 2014) (e.g., my attitude toward this hotel is positive: 1 = strongly disagree, 7 = strongly agree). Behavioral intention was assessed using four items developed by Wirtz and Mattila (2004) (e.g., I will stay in this hotel

TABLE **5**

Regression Results of Effectiveness of Health Risk Perception on Attitudes

Predictor	ß	*SE*	*t*-Test Value
Constant	5.212	0.194	26.898*
Health risk	-0.575	0.047	-12.205*

*$F = 148.972$, $R^2 = .403$, Adjusted $R^2 = .400$, $p < .001$.

TABLE **6**

Regression Results of Behavioral Intentions

Predictor	ß	*SE*	*t*-Test Value
Constant	-0.160	0.090	-1.787
Attitude	0.984	0.024	41.045*

*$F = 1,684.698$, $R^2 = .884$, Adjusted $R^2 = .883$, $p < .001$.

next time: 1 = strongly disagree, 7 = strongly agree). Cronbach's α for the measured items was satisfactory (health risk = .978, attitude = .945, behavioral intention = .968), representing high reliability. Health risk, attitude, and behavioral intention were correlated and showed sufficient validity: health risk and attitude [$r(223) = -.635$, $p = .01$], health risk and behavioral intention [$r(223) = -.634$, $p = .01$], and attitude and behavioral intention [$r(224) = .870$, $p = .01$]. To control for the effects of individual differences in the health involvement, five questions were asked (e.g., I always pay attention to health and cleanliness: 1 = strongly disagree, 7 = strongly agree; Cronbach's α = .911).

Study Design and Process

This study used a survey method to collect the data. The survey was conducted with residents of South Korea over 3 weeks. We distributed a total of 280 questionnaires, of which 253 were returned. After screening the responses, unusable responses were excluded, leaving 224 for analysis. The data were analyzed using IBM SPSS version 24.0 for descriptive statistics, *t*-tests, reliability analysis, correlation analysis, and regression analysis. The different conditions of cleanliness (clean versus unclean) were coded using a dummy variable—the clean condition was coded as 1, the unclean as 0. Regression analyses were performed to investigate the relationships among the dependent variables.

Results

The results of an independent samples *t*-test showed that those respondents who read the scenario describing clean conditions in the hotel answered that the hotel was clean ($t = 24.955$, $p < .001$, mean = 5.97, $SD = 1.411$), while those who read the scenario describing unsanitary conditions in the hotel answered that the hotel was unclean (mean = 1.70, $SD = 1.147$). The questionnaire, therefore, appears to have been appropriately designed for the study.

The study sample consisted of 54.5% female and 45.5% male respondents (Table 1). Approximately half of the respondents were single (53.6%) and the rest were married (46.4%). The age ranges of the respondents were 20–29 years (28.0%), 30–39 years (26.3%), and 50–59 years (24.1%). Most had a bachelor's degree or were students pursuing a bachelor's degree. About 36% of the respondents had a monthly income of >2,000,000 won and <4,000,000 won. The majority of the respondents preferred a hotel room price ranging from 100,000–200,000 won and hotels were the preferred type of accommodation. In addition, most of the respondents answered that their health condition was good (45.1%) or normal (35.7%).

We examined engagement with cleanliness and health issues (Table 2). On a 7-point Likert scale, most of the responses were higher than 5, showing that respondents were greatly engaged with cleanliness and health. A simple regression was performed to measure the effect of health involvement on health risk perception as a control variable in the model before conducting the main regression analysis. The results showed that health involvement did not influence health risk perception (ß = -0.034, $SE = 0.138$, $p > .05$). Hence, health involvement did not show any impact on the dependent variables and it was excluded from further analysis.

An independent samples *t*-test was performed on the risk perceptions in clean and unclean conditions (Table 3). The unclean condition triggered higher risk perceptions; most of the respondents answered that unclean conditions in a hotel were likely to affect their health and concluded it was not safe to stay at such a hotel for health reasons.

The sanitary condition of the hotel was regressed on health risk perception (Table 4). Regression analysis showed that sanitary conditions significantly negatively affected individuals' perceived health risk (ß = -3.171, $SE = 0.198$, $p < .000$). Hence, a sanitary condition was associated with health risk perception. In other words, a cleaner condition leads to lower health risk perception. Therefore, sanitary conditions had an influence on health risk perception.

In the next step, a regression was performed to investigate the effect of health risks on attitudes (Table 5). The results showed that consumer attitudes were significantly affected by health risk perception (ß = -0.575, $SE = 0.047$, $p < .001$). Lastly, attitudes were regressed on behavioral intentions (Table 6); attitudes were found to significantly affect behavioral intentions (ß = 0.984, $SE = 0.024$, $p < .001$).

Discussion

This study has several implications. First, the results showed that health risk perceptions were highly affected by the sanitary conditions of a hotel. Individuals are concerned

about hygiene conditions of any location at any time because pandemic disease outbreaks can occur without warning. Hotels for travelers worldwide should maintain hygiene standards for both health reasons and customer satisfaction. Establishments in the service industry are dependent on interactions with consumers, with various effects, including physical and psychological ones. Cultural differences can influence consumer behaviors but cleanliness of hotels remains the most important factor, regardless of nationality (Mccleary et al., 1998).

As previously found, an unsanitary environment affects physical risk perception (Mitchell & Harris, 2005) and maintaining cleanliness standards for consumers is the top priority for hotels at all times. This study also found that health risk perceptions affected attitude. Therefore, health risk perceptions should not be underestimated, especially when people need to stay outside of their homes. To reduce the perception of health risk, hotels should control the sanitary environment at all times. Furthermore, health risk perceptions are hard to ameliorate, so both housekeeping and other staff should be well trained regarding sanitation, especially when the public has been warned about specific health issues. In Korea, staff working for public health-related businesses must complete a 3-hr mandatory sanitary education program every 2 years. Many experts, however, have suggested that the minimum education curriculum needs to be updated to reflect the characteristics of each business. The curriculum needs updating because the program is nonspecific, delivering the same education to the staff of large hotels with multiple restaurants and event facilities as to the staff of small motels that only rent rooms (Jung, 2019).

This study has some limitations. First, this study limited the hotel environment to only one condition: cleanliness. There might be other conditions that affect the health risk perceptions of consumers, as well as other factors that affect attitudes different from health risk perceptions. In future studies, more factors should be included to investigate risk perceptions. Second, this study had geographical limitations because the survey was conducted only in South Korea, so generalizability might be limited. Similar studies need to be conducted in other nations with different cultures, which might result in different outcomes.

Conclusion

This study investigated whether the environment of a hotel affects health risk perceptions of consumers, thereby affecting their attitudes and behavioral intentions. Our findings suggest that the sanitary conditions of hotels are crucial for business because health risk perceptions influence both attitudes and behavioral intentions. Consumers have become more sensitive to health risk perceptions when staying at a hotel, so the sanitary environment should meet or exceed the public health code at all times. Furthermore, providing appropriate education to employees in the industry is needed, with supervision from management. The hospitality industry needs to consider the importance of sanitation practices without underestimating health risk.

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Environmental Health Systems and Delivery of Services in the United States and Its Territories

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Abstract **There is no single, uniform nationwide method for organizing and delivering governmental environmental health (EH) services to residents of the U.S. and its territories. A comprehensive effort to describe existing EH service delivery models has not been conducted. To address this gap in knowledge, the authors investigated EH organization and delivery methods among states and territories in fall 2017. The aim was to provide a synthesized understanding of EH system delivery to assist in efforts to target and deliver workforce capacity building and professional development support. We contacted EH directors of every state and territory through an informational survey to 1) describe how services are delivered, 2) quantify service delivery jurisdictions, and 3) determine the administrative home of core EH programs. We achieved a 98% survey rate response. Service delivery administrative models were heterogeneous and fell into three categories: centralized, decentralized, and mixed/shared organization. The number of jurisdictions within states and territories ranged from 1–351 jurisdictions. The administrative agency home of EH varied widely. With this research, we hope to better understand the structure of each regional agency and the efficacy of each agency's performance as it relates to its structure and distribution.**

Introduction

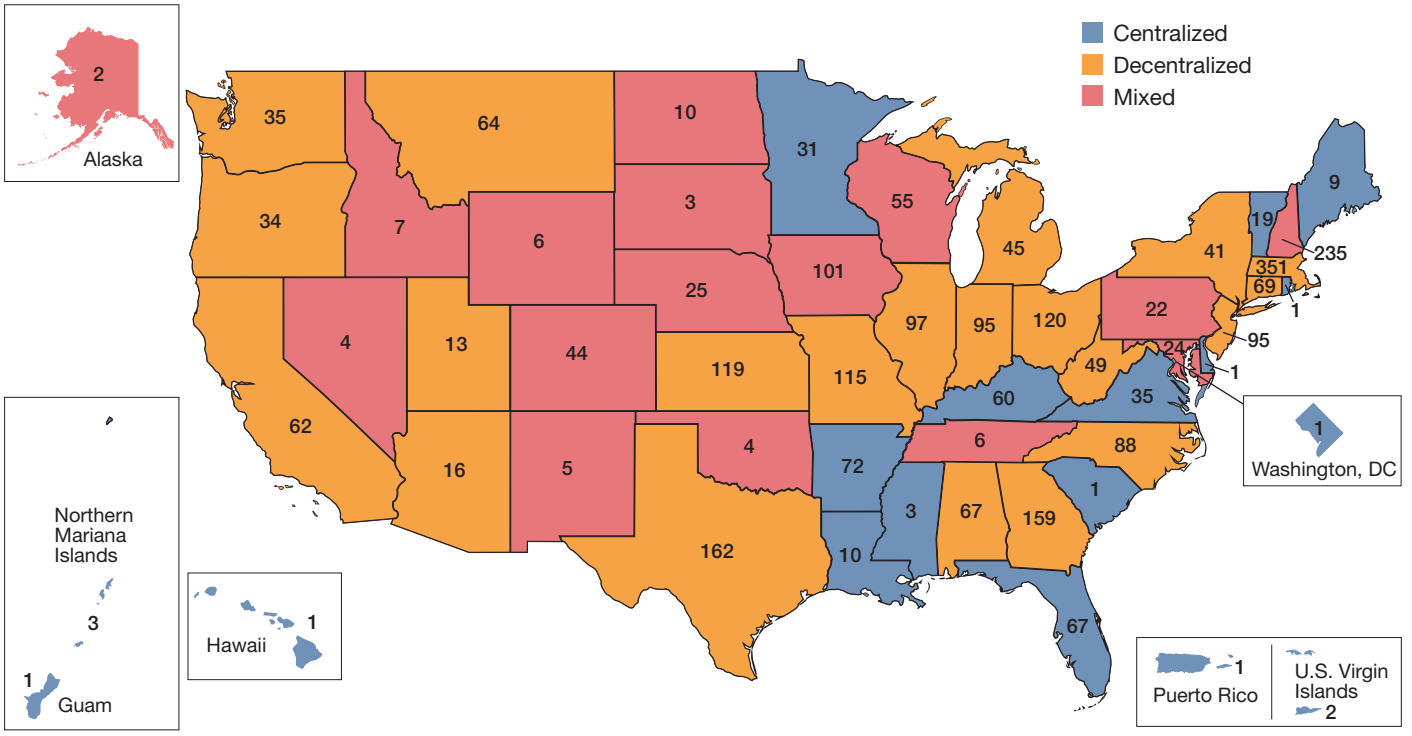
One of the greatest challenges facing U.S. policy makers today is that of the impending reformation of systems and entities that protect the nation's health (Mays, Scutchfield, Bhandari, & Smith, 2010). To be effective, such a reform needs to reassess the delivery of the foundational public health services to ensure that quality services are being made available to the population (Halverson et al., 1996; Sarisky & Gerding, 2011). Such an assessment requires an understanding of how public health systems are organized and delivered to the population.

In the U.S., there is no single uniform nationwide method for organizing and delivering governmental public health services to residents (Mays et al., 2006). The different organizational patterns tend to represent the varying functional and administrative relationship between state and local health departments (LHD) (Meit et al., 2012). The most frequently observed organizational patterns of public health agencies are centralized, decentralized, and mixed/shared (referred to here simply as mixed). Centralized systems are defined as public health systems where the state/territory agency retains much of the power and authority to issue public health orders, make budgetary decisions, and recruit personnel (Association of State and Territorial Health Officials [ASTHO], 2012). In decentralized systems, the converse is true in that local governments retain much of the authoritative power, often referred to as "home rule." In the context of environmental health (EH) services, mixed models are those in which EH units are organized and led centrally, yet at the same time some programs and services in some areas are managed and delivered through local governance (ASTHO, 2011).

Many studies have examined the governance, administration, and delivery of public health services, but no study, to the best of our knowledge, has exclusively surveyed the governance and administration of EH services across the U.S. and its territories (ASHTO, 2012; Mays, Halverson, Baker, Stevens, & Vann, 2004; Meit et al., 2012). EH services are a critical component of the foundational public health services that work toward protecting and promoting a healthful environment for all (Banerjee, Gerding, & Sarisky, 2018).

FIGURE **1**

Governance Structure of Environmental Health Services for the United States and Its Territories



Note. Numerals represent the number of environmental health jurisdictions within that state/territory.

The Centers for Disease Control and Prevention (2003) issued a document titled *A National Strategy to Revitalize Environmental Health Services* that argued for a renewal of EH services predicated on the following: 1) several diseases that are influenced by environmental factors are increasingly affecting the lives of people in the U.S. at a significant cost, 2) emerging threats to environmental public health require innovative interventions and solutions, 3) the role of EH professionals is extremely relevant in emergency and disaster preparedness, and 4) EH service issues are becoming more complex. These reasons continue to be relevant. Such a revitalization calls for a need to understand the structure and organization of EH services. Likewise, investigating environmental public health systems across the nation from a systems approach is critical to ascertain the effectiveness and efficiency of EH programs (Mays et al., 2004). To carry out such a comprehensive investigation, however, it is necessary to understand how EH services are administered and delivered nationwide.

Researchers who have studied the delivery of EH services have observed that EH is dominated by profoundly local challenges and frequently shaped by local politics. Furthermore, EH services are somewhat unique in that they generate revenue through permitting, licensing, and other fees (Dyjack, Case, Marlow, Soret, & Montgomery, 2007). Furthermore, the distinction in delivery patterns is also reflective of the state's governance structure and the administrative relationship between state and local levels (Meit et al., 2012). EH services are often grouped with other public health services depending on multiple factors such as administrative structure, governance, workforce, and size and area of the jurisdiction (Banerjee et al., 2018). Local EH practitioners constitute one of the largest professional fractions of the U.S. professional governmental public health workforce, second only to nursing (Murphy & Neistadt, 2009). Given this information, it is useful to compare the difference in delivery patterns between public health services and EH services.

Public health services and EH services are provided through an effective partnership and collaboration of several governmental agencies and private organizations (Mays et al., 2006). Despite their distinct missions, resources, and operations, these organizations work together to create a complex public health system that is orchestrated through the collaborative actions of many independent institutions (Mays et al., 2006). Within the EH sector, it is important to identify which government agencies and private organizations play a defining role in the delivery of services that collectively influence availability and effectiveness of EH programs across the nation.

This study was conducted to gain a preliminary understanding of the organization and delivery methods of EH services for each individual state and territory to provide a synthesized understanding of EH systems in the U.S. We hope that by describing and comparing the range of health agencies in the U.S., this study will provide the groundwork for answering questions about how U.S. public health agencies can better provide environmental public health services for their communities and residents.

Methods

The study aimed to investigate the organization and delivery methods of EH services among each individual state and territory to provide a synthesized understanding of EH systems in the U.S. The study was performed by collecting qualitative and quantitative data from EH directors of every state and territory in the form of an information survey that inquired about the methods of delivery, distribution of jurisdictions, and administrative agency home of each state and territory.

Data were collected by the National Environmental Health Association (NEHA) in September–December 2017. A short survey/questionnaire was designed to gather input that focused on the 1) categorization of the administration of EH services, 2) number of EH jurisdictions within a state or territory, and 3) major administrative home for the core EH services within a state or territory. With regards to the first query, the respondents were given three options to categorize the EH services within their state, which were decentralized, centralized, and mixed. The survey grouped mixed and shared models together, and the directors and affiliates were not asked to make a distinction between the two models. The remaining questions were open-ended.

This self-administered questionnaire was sent via an e-mail to 56 individuals representing all states and territories, which included 38 NEHA affiliates, 17 EH directors, and 1 EH representative from American Samoa. Electronic messages and phone reminders were provided to EH directors and affiliate presidents until feedback was received from a majority of states and territories. We then aggregated and analyzed the collective feedback from the respondents.

Results

Of the contacted individuals, 98% (n = 55) responded to the questionnaire. Responses were not received from one U.S. territory (American Samoa). All health service delivery methods are described here with comments on individual and overall patterns.

TABLE **1**

States That Have Adopted Different Models of Governance for Public Health and Environmental Health Services

State	Organization of Environmental Health Services[a]	Organization of Public Health Services[b]
Alabama	Decentralized	Centralized
Colorado	Mixed	Decentralized
Florida	Centralized	Mixed
Georgia	Decentralized	Mixed
Idaho	Mixed	Decentralized
Iowa	Mixed	Decentralized
Kentucky	Centralized	Mixed
Minnesota	Centralized	Decentralized
Nebraska	Mixed	Decentralized
Nevada	Mixed	Decentralized
New Hampshire	Mixed	Centralized
New Mexico	Mixed	Centralized
North Dakota	Mixed	Decentralized
South Dakota	Mixed	Centralized
Wyoming	Mixed	Decentralized

[a]Results from the National Environmental Health Association survey.
[b]Results from the Association of State and Territorial Health Officials report (2012).

Governance Structure and Typology

States and territories differ in organizational structure by centralized, decentralized and mixed organizational methods. Figure 1 presents which states and territories have a governance structure of centralized, decentralized, and mixed with regard to the delivery of EH services within the state/territory. We found that 12 states and 5 territories have centralized governance structure, 21 states have a decentralized governance structure, and 17 states operate under a mixed model of governance.

Furthermore, the characterization of the governance and administration of EH services were compared with that of public health services. Under the guidance of the Association of State and Territorial Health Officials (ASTHO) and the National Association of County and City Health Officers (NACCHO), the National Opinion Research Center (NORC) at the University of Chicago conducted a comprehensive study that characterized the governance and administration of public health services in the U.S. (ASTHO, 2011). The results of our study were compared with the data from the ASTHO (2012) study. Upon comparing the characterization of EH and public health services, we found that 15 out of 50 states were characterized differently in terms of the model of governance. Table 1 lists the states that have adopted different models of governance for public health and EH services.

Environmental Health Jurisdictions

Figure 1 presents how many EH jurisdictions are reported in each state and territory. In sum, the number of jurisdictions within all state agencies ranged from 1–351. We found Massachusetts to have the largest number of EH jurisdictions. Besides Massachusetts, the following states were identified as having >100 EH jurisdictions: Georgia, Iowa, Kansas, Missouri, Ohio, New Hampshire, and Texas. On the other hand, the states and territories with the few-

TABLE **2**

Major Administrative Agencies of Core Environmental Health Services in Each State and Territory

State/Territory	Major Administrative Agency of Core Environmental Health Services
Alabama	Alabama Department of Public Health, Bureau of Environmental Services
Alaska	Alaska Department of Environmental Health, Division of Air Quality, Division of Environmental Health, Division of Water
Arizona	Arizona Department of Health Services Arizona Department of Environmental Quality
Arkansas	Arkansas Department of Health
California	California Department of Public Health California Environmental Protection Agency
Colorado	Colorado Department of Public Health and Environment Local public health agencies
Connecticut	Connecticut State Department of Public Health
Delaware	Delaware Department of Health and Social Services, Division of Public Health, Health Systems Protection
District of Columbia	DC Department of Health DC Department of Energy and Environment
Florida	Florida Department of Health
Georgia	Georgia Department of Public Health
Guam	Guam Department of Public Health and Social Services
Hawaii	Hawaii State Department of Health
Idaho	Idaho Department of Health and Welfare Idaho Department of Environmental Quality Idaho's seven health districts
Illinois	Illinois Department of Public Health
Indiana	Indiana State Department of Health Indiana Department of Environmental Management
Iowa	Iowa Department of Public Health Iowa Department of Natural Resources Iowa Department of Inspections and Appeals
Kansas	Kansas Department of Health and Environment
Kentucky	Kentucky Department for Public Health Kentucky Department for Environmental Protection
Louisiana	Louisiana Department of Health
Maine	Maine Department of Health and Human Services
Maryland	Maryland Department of Health Maryland Department of the Environment
Massachusetts	Massachusetts Department of Public Health
Michigan	Michigan Department of Health and Human Services
Minnesota	Minnesota Department of Health
Mississippi	Mississippi Department of Health
Missouri	Missouri Department of Health and Senior Services

continued on page 26

est EH jurisdictions were Delaware, District of Columbia, Guam, Hawaii, Rhode Island, and South Carolina. Each of these states/territories has only one EH jurisdiction that administers EH services. We categorized the number of EH jurisdictions in Pennsylvania as uncertain based on the EH director's response.

The survey also asked for the major administrative agency home of core EH services in each state (Table 2). In some cases, respondents identified more than one major administrative home of core EH services. Examples of more than one administrative home include Kentucky, Maryland, Montana, and Nebraska. Most often the administrative hubs of EH services were identified as the state's department of health/public health/health and human services, followed by the department of environmental quality or department of agriculture.

Discussion

This study was conducted to better understand how EH services are constructed and delivered throughout the U.S. and its territories based on their governance typology, administrative dominance, and quantitative extent of EH jurisdictions and independent programs. The outcome is an enriched strategy in support of workforce capacity building, improved situational awareness in times of disease outbreak, and enhanced approaches to national information dissemination.

Governance Structure and Typology

This survey found that 12 states and 5 territories have a centralized governance structure, 21 states have a decentralized governance structure, and 17 states operate under a mixed model of governance. The authors did not, however, attempt to describe intracategory variation in the centralized, decentralized, and mixed models. The e-mail with the survey link did encourage respondents to ask questions in case of typological confusion. Otherwise, it was up to the respondent to interpret these terms to classify the governance structure and typology within their respective states. It is evident that there is little common understanding of the classifications, which can lead to ambiguity (ASTHO, 2011, 2012; Meit et al., 2012). There is ample evidence of this ambiguity in the 2012 ASTHO study, which performed a literature review to compare the typological classification of states regarding the governance of public health services. Of the seven peer-

reviewed articles that were reviewed in that study, only eight states had the same typological classification (ASTHO, 2012). Additional research is required to develop an effective survey instrument that minimizes ambiguity to aid in the appropriate classification of governance typology with regard to EH systems and delivery.

It should be noted that some of the responses indicated that several states were considering altering the governance structure of EH services. For instance, Connecticut currently operates under a decentralized model; however, the State Commissioner of Public Health has initiated an attempt to regionalize EH services to adopt a mixed model. In some instances, the leadership described in detail how the governance within a state or territory was categorized as mixed. One such example is Colorado, where food safety services based on state food regulations are administered at the local level in most counties; however, water program services are administered entirely by the state. While child care and onsite wastewater have state-issued regulations, the services are administered locally in Colorado.

While the issue of effectiveness is an important one, the scope of this study did not include the exploration of how the effectiveness of EH programs vary across the various governance structures. The authors recommend conducting a follow-up study to learn more about the benefits of each structure through qualitative insights gathered from focus groups with representatives of their respective constituencies. The goal of the focus groups would be to broach questions that would provide more clarity on which structures are more effective than others for protecting and promoting the health of the nation.

Quantitative Extent of Jurisdictions

The number of EH jurisdictions in the states and territories ranged from 1–351. EH services provided at the local level can vary greatly depending on their administrative coverage such as cities, counties, municipalities, and districts. Operating under a decentralized governance model, Massachusetts was found to have the largest number of EH jurisdictions. Massachusetts has 351 cities and towns that administer EH services within their municipal or regional jurisdictions. The Massachusetts Department of Public Health and Department of Environmental Protec-

TABLE **2** *continued from page 25*

Major Administrative Agencies of Core Environmental Health Services in Each State and Territory

State/Territory	Major Administrative Agency of Core Environmental Health Services
Montana	Montana Department of Public Health and Human Services Montana Department of Environmental Quality
Nebraska	Nebraska Department of Health and Human Services Nebraska Department of Agriculture Nebraska Department of Environmental Quality Three local public health agencies
Nevada	Southern Nevada Health District (Board of Health)
New Hampshire	New Hampshire Department of Environmental Services
New Jersey	New Jersey Department of Health
New Mexico	New Mexico Department of Environmental Health, Consumer Health Protection Division
New York	New York Department of Health
North Carolina	North Carolina Department of Health and Human Services Local public health agencies
North Dakota	North Dakota State Health Department
Northern Mariana Islands	Northern Mariana Islands Commonwealth Healthcare Corporation, Bureau of Environmental Health, Bureau of Environmental & Coastal Quality Commonwealth Utility Corporation Division of Agriculture
Ohio	Ohio Department of Health
Oklahoma	Oklahoma State Department of Health Oklahoma Department of Environmental Quality
Oregon	Oregon Health Authority
Pennsylvania	Pennsylvania Department of Health Pennsylvania Department of Environmental Protection Pennsylvania Department of Agriculture
Puerto Rico	Puerto Rico Department of Health
Rhode Island	Rhode Island Department of Health
South Carolina	South Carolina Department of Health and Environmental Control
South Dakota	South Dakota Department of Environment and Natural Resources South Dakota Department of Health
Tennessee	Tennessee Department of Health Tennessee Department of Agriculture Tennessee Department of Environment and Conservation
Texas	Texas Department of State Health Services
U.S. Virgin Islands	Virgin Islands Department of Health
Utah	Utah Department of Environmental Health
Vermont	Vermont Department of Environmental Conservation Vermont Department of Health Vermont Agency of Agriculture
Virginia	Virginia Department of Health Virginia Department of Agriculture and Consumer Services
Washington	Washington State Department of Health
West Virginia	West Virginia Department of Health and Human Resources
Wisconsin	Wisconsin Department of Agriculture, Trade, and Consumer Protection
Wyoming	Wyoming Department of Agriculture

tion, however, also administer environmental services for the state and write regulations that are administered at the local level.

It is important to note that there is variation in terms of what constitutes an EH jurisdiction. For instance, New Hampshire reportedly has 234 cities and towns, with each having a local health officer who provides some type of environmental service. Hence, the number of EH jurisdictions suggested was 235, which includes cities, towns, and the state health department. This interpretation is different from Vermont—the respondent assessed the number of EH jurisdictions based on the number of offices within the Vermont Department of Health (12 offices), Vermont Department of Environmental Conservation (5 offices), and Vermont Agency of Agriculture (2 offices). Hence, a total of 19 EH jurisdictions were reported from Vermont. This finding implies that a more structured understanding of what constitutes an EH jurisdiction needs to be established across the states and territories.

Administrative Dominance

The survey also asked respondents to identify the major administrative agency home of the core EH services in each state. Several states identified more than one major administrative hub of the core EH services. While in most states and territories the department of health/public health served as the most dominant administrative agency for the delivery of EH services, there were some exceptions. The Vermont Department of Environmental Conservation was identified as more dominant than the Vermont Department of Health and the Vermont Agency of Agriculture. This finding reflects the differences of governance patterns within the states, which further highlights the lack of a unified system in terms of governance typology.

Conclusions

Despite some limitations, this study provides a preliminary understanding of the organization and delivery methods of EH services. In order to gather a synthesized understanding of governance of EH systems in the U.S., however, additional research is required to develop an effective survey instrument that provides operational definitions to aid in the appropriate classification of governance typology with regard to EH systems and delivery. Also, a more structured understanding of what constitutes an EH jurisdiction needs to be established across the states and territories. This study focused on the foundational groundwork for answering questions about how public health agencies can better provide EH services for their communities and residents. Further research will help us better understand the structure of each regional agency and the efficacy of each agency's performance as it relates to its structure and distribution.

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DIRECT FROM AAS

Work, School, and Training in the Environmental Health Field: A Lifelong Relationship

Jennifer Dobson, MPH, REHS, HHS, DAAS
Jill M. Shugart, MSPH, REHS, CP-FS, DAAS
Katie L. Bante, MPH, REHS/RS

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 two 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 expects 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.

Jennifer Dobson is the environmental health services manager at the Yukon-Kuskokwim Health Corporation in Bethel, Alaska. She became a diplomate of AAS in 2019. Jill Shugart is a senior environmental health specialist and program coordinator for the Emergency Responder Health Monitoring and Surveillance Program at the Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health in Atlanta, Georgia. She became a diplomate of AAS in 2019. Katie Bante is an environmental health officer currently transitioning from the U.S. Coast Guard to the U.S. Department of Health and Human Services in Washington, DC. She recently applied to become a diplomate of AAS.

Introduction

Whether responding to foodborne outbreaks, conducting high risk facility inspections, or providing technical assistance to municipal water supplies, environmental health (EH) professionals must be ready to protect public health with the appropriate knowledge and skills. The term "jack of all trades" underscores the career of a true EH professional, with field skills spanning across subject matter specialties. The EH profession is often divided into subdisciplines such as industrial hygiene, food safety, vector control, and radiological health. What do these disciplines have in common? They share a solid foundation in hard sciences and require technical skills usually learned by conducting specialized work experience by way of internships or shadowing opportunities.

As the field of EH constantly evolves, practitioners are required to address topics of greater complexity (Centers for Disease Control and Prevention [CDC], 2003; Harrison & Coussens, 2007; National Environmental Health Association, 2013). Emerging topics, such as impacts of climate resilience or occupational health and safety for developing technologies, were not well recognized within the profession until recently (National Institute of Environmental Health Sciences, n.d.). Practitioners entering the field now are required to have even more diverse knowledge and skills than ever before.

You might find yourself wondering what education and skills are required to be a modern day EH professional. Much like the definition of EH, the answer is surprisingly complex. Most EH professionals working at health departments hold a bachelor's degree, but are likely to be in a field other than EH, and much of the workforce functions in the role of a generalist spanning multiple subject areas (Gerding et al., 2019). Within the environmental health officer category of the U.S. Public Health Service (USPHS), there has been a shift among applicants in recent years. For example, the number of individuals coming in to USPHS with traditional

EH undergraduate degrees is steadily being replaced with master's and doctoral degrees. Even among those with graduate degrees, the need for practical field skills within the many diverse subdisciplines exists. These findings reinforce the need for development and training among EH professionals in all sectors (CDC, 2003; Gerding et al., 2019).

The gold standard of full-time students pursing education at a brick-and-mortar school is changing; traditional students are now vastly outnumbered by working leaners (Carnevale, Smith, Melton, & Price, 2015). Today's working learners are more likely to be mature students (30 years or older) and many work in jobs related to their studies (Carnevale et al., 2015). Numerous advanced training and graduate programs have developed options that cater to working professionals, from part-time course work to distance delivery and independent study opportunities. These changing trends might be of benefit to working EH professionals.

At some point in your career, you may find yourself contemplating the need for advanced training or wondering how to integrate graduate school with full-time work. How does one work and dedicate substantial time to studies? How does one simultaneously practice and study our profession? We are here to assure you that it can be done. Here are our stories of working professionals' pursuits of training and education.

Jill M. Shugart

I was very fortunate to learn about the EH field early on. I toured Ohio University's EH department and Dr. Franklin Carver showed me a video of what you can do with an EH degree. Getting to learn about the environment and help people at the same time? I was immediately sold. I had no idea where this degree was going to take me or how many twists and turns it would hold but I knew it was for me.

I completed a Commissioned Officer Student Training and Extern Program (COSTEP) assignment with the Indian Health Service (IHS) and learned how to apply what I learned in the classroom to the field. The experience, however, showed me how much I still didn't know. I found myself going back to school. I thought, "That's it, I'll take more classes in EH." I learned more about EH but it was not even close to being enough. Having used the Centers for Disease Control and Prevention's website and resources as one of my mainstays in graduate school, I thought it would be a great idea to try to work there and really learn EH. While fulfilling a fellowship at the National Center for Environmental Health, I received some of the best advice of my career. The message from my esteemed colleagues was clear, "You've got this cushy job in Atlanta but you are not practicing EH. You need to get in the field."

I drove my car across I-40 West and had fleeting moments of doubt. I wondered if my brilliant trailblazing EH mentors had led me astray. When I arrived on the Hopi Indian Reservation, the oldest continuously occupied settlement in North America, to fill the sanitarian position that had been vacant for more than 4 months, the staff greeted me quite cheerily and said, "Thank goodness you are here, we have been waiting for you." I had arrived.

This assignment would prove to be one of the most instrumental jobs of my life and helped me grow tremendously as an EH professional. It helped shape my career track as a generalist and aid in my love of learning. As a result, I have been able to tackle EH problems or the bug du jour (as I like to call it) across the U.S. and even overseas. Never did I think I would conduct ship sanitation and construction inspections or be able to write health and safety guidance or provide recommendations to protect emergency responders before, during, and after a response. Taking challenging assignments, setting aside time for training courses, shadowing subject matter experts to close knowledge gaps, conducting outbreak investigations and field deployments, and obtaining multiple credentials have allowed me to find my passion in this field.

I challenge, however, that even if you have the combined technical field expertise and necessary knowledge to be the best EH practitioner you can be, it is still not enough. What are you doing with all of your knowledge and experience? Are you a mentor? Are you sharing your subject matter expertise with your peers and colleagues? Are you sponsoring interns and fellows and providing shadowing opportunities? I hope so because we need EH leaders. We need you! This need has been well documented (CDC, 2003; Gerding et al., 2019) but it cannot be overstated. We all have what we need to succeed but how much more can we do by getting that small steady prod of encouragement? Someone to tell you to "keep grabbing the brass ring" as one of my mentors told me. How are you making sure that you and those that will come after you are ready for that next EH challenge?

Katie L. Bante

Like so many others, I sort of fell into EH. Through an undergraduate introductory class, I learned about all the subdisciplines of EH. It was the variety of work that piqued my interest. I was also studying behavior change and how we might better adapt EH work to connect the human component with the science. I double majored in health education and promotion and EH to bridge these two bodies of knowledge.

Early in my career I leaned heavily on my health promotion expertise and it served me well in opportunities to contribute to EH interventions. Through an internship and two assignments with IHS, I gained valuable field experience in EH. In particular, I increased my technical skills in drinking water, occupational health, children's EH, vector/pest control, and emergency management. Gaining this experience came in part from the agencies and geographic regions I served, which were areas of greatest need when I was in those positions.

The other part of gaining experience came from seeking additional opportunities to expand my skills. Attending advanced training was helpful. It was also useful to be well connected with colleagues to collaborate on solutions to address some of the more challenging issues. For example, bed bugs in rural Alaska had become a widespread problem that many tribal EH programs were working to address. I partnered with colleagues from another agency to receive funding for a pilot project. Because we were the project leads, we became the subject matter experts in this area. This project provided the chance to learn even more about the topic through exposure

to international experts and allowed us to present our work at national and statewide conferences. Accepting a leadership position on a project can be a great way to enhance your technical expertise.

I completed my Master of Public Health (MPH) 10 years after I completed my undergraduate degrees. This approach was the best for me as it gave me time to develop my professional acumen before pursuing graduate-level study. I focused my MPH in disaster management. Unexpectedly through my coursework, however, I developed an interest in industrial hygiene. Having no prior experience in industrial hygiene, I knew the only way I could garner those skills would be to seek an industrial hygiene-centric position. Fortunately, that interest lined up with a U.S. Coast Guard vacancy. I opted to complete a graduate certificate in industrial hygiene to round out my educational background in preparation for this position. Like before, I had the chance to work as a project lead but this time I worked on an industrial hygiene project. This experience provided many occasions for me to learn and practice industrial hygiene in the field.

My education is ongoing. Attending training or taking classes is not the culmination of acquiring expertise. Even hands-on training is limited to the constraints of the classroom or scenario. Applying skills in the field is a necessary component to grow as an EH practitioner but it need not be limited to early on in your career. Seek occasions to be a subject matter expert. Take advantage of openings that are outside of your comfort zone and tailor your educational pursuits accordingly.

Jennifer Dobson

After developing an early interest in ecology, my true introduction to the EH field began during my undergraduate studies. Years later, I still recall my excitement after attending formative water and wastewater lectures. Although grateful that I had found my academic passion, I was always quite the pragmatist and became consumed with answering the question, "What kind of job/career is this degree preparing me for?" In an effort to answer that question, I took it upon myself to complete four internships. This opportunity allowed me to work up close and personal in diverse subdisciplines such as vector control, food safety, occupational health, and institutional health. I relied strongly on the process of elimination and eventually found my professional calling after completing a COSTEP assignment within IHS. The opportunity provided everything I could have hoped for—community-based field work with underserved populations. Check!

After graduation, I entered the full-time workforce as an EH professional within the tribal health system in Alaska. I was working as a true generalist with a focus on water and sanitation in one of the most remote regions in the country. I loved the breadth of requests for services that we received, from water sampling and safety surveys to infectious disease investigations. In order to get up-to-speed as a new professional, I benefited from both on-the-job and specific skill-based trainings.

I began my graduate education (via distance) 3 years later. Looking back, it's hard to say exactly why I began graduate school at that very moment. At first, it didn't even translate directly to the work I was doing at that time. Rather, I wanted to learn. As I continued working, changed positions, and received additional skills training, I slowly plodded ahead with course work each semester. I found more and more opportunities to integrate work and school, and I still use some of the outputs today. Despite taking far too long (in my own opinion) to complete my practicum, I earned an MPH after 5 years. After developing an interest in global health initiatives, I completed a global health graduate certificate. The vast majority of my time within the profession has been spent juggling work and school. I fully expect to be a lifelong learner.

A few of my hard earned lessons are as follows.

- Identify opportunities that fit your needs, schedule, and interests. The world of graduate education is now more accessible than ever to EH working learners.
- Find ways to merge the worlds of training and work. I've often been advised to try to adapt class topics to make them applicable to work. Better yet, my advice is to bring your work into the classroom. Find a real-world data set to analyze for a class or an actual research question from your position.
- Take it slow, if needed. Remember the adage about the tortoise winning the race.
- Actively seek mentoring. Mentors have played a profound role in my life and career. Put simply, go find someone that does what you want to do and find out how they got there. I like to call this guerilla mentoring. I cannot think of a more highly esteemed organization in which to seek mentoring than within the American Academy of Sanitarians, an organization in which I am a proud new diplomate.

In Closing

There is always going to be an environment in which we live in and there will always be people we can help. That is the beauty of EH. Sometimes you get to pick what area of EH you get to work in and sometimes it picks you. No matter if you are working at the local, state, tribal, territorial, or federal levels, or in the private sector, it is critical to build the knowledge and skills to excel at the EH work you are doing and to share your passion and successes with others. So, what about you? How are you doing EH? We invite you to share your stories, tips, and training resources to show how you do EH.

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DAVIS CALVIN WAGNER SANITARIAN AWARD

The American Academy of Sanitarians (AAS) announces the annual Davis Calvin Wagner Sanitarian Award. The award will be presented by AAS during the National Environmental Health Association's (NEHA) 2020 Annual Educational Conference & Exhibition. The award consists of an individual plaque and a perpetual plaque that is displayed in NEHA's office lobby.

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

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

NOMINATIONS MUST BE RECEIVED BY APRIL 15, 2020.

Nomination packages should be e-mailed to Gary P. Noonan at gnoonan@charter.net.

Files should be in Word or PDF format.

For more information about the award nomination, eligibility, and the evaluation process, as well as previous recipients of the award, please visit sanitarians.org/awards.

DIRECT FROM CDC ENVIRONMENTAL HEALTH SERVICES

Kelsey McDavid, MPH

Miguel Cruz, MPH, PhD

Environmental Health Shelter Assessments: Using Tools to Protect Occupants After Disasters

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

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

Kelsey McDavid is an associate service fellow and Miguel Cruz is a senior emergency operations officer. Both are part of the Emergency Management Section of CDC's National Center for Environmental Health/Agency for Toxic Substances and Disease Registry.

Every year, disasters affect jurisdictions across the U.S. and its territories. These disasters, whether natural or human-made, often result in displaced people—either ahead of the event to protect people or following the event because of damage and destruction to homes.

Many of these displaced individuals will be housed in a disaster shelter. Public health and environmental health teams have a key role in protecting the health of people in shelters. Meeting the basic human needs of people for safe shelter, food, water, and space are high priorities for any disaster response and recovery operation.

The types of facilities used as shelters can vary from open or congregate shelters that house a few individuals to large megashelter facilities that hold thousands. Noncongregate shelter arrangements can include vessels, hotels, and dormitories. Other types of shelters include medical shelters and Federal Medical Stations, tent cities, flotation barges, and impromptu shelters.

While disaster shelters protect people from the direct effects of the natural environment, a number of public health issues can arise in the living environment. Postdisaster environmental conditions can result in outbreaks of diseases and exacerbate other health conditions. Some of the reported outbreaks occurring in shelters used in emergencies have been respiratory, gastrointestinal, and skin infections.

Environmental health teams need simple tools that are easy to implement across various disaster types to evaluate and document potential health threats in shelters. The 2005 hurricane season, which included hurricanes Wilma, Katrina, and Rita, was a wake-up call for how we need to care for large numbers of displaced people after a major disaster. These events demonstrated the importance of having standard systems for monitoring shelters, locally and nationwide. For example, at the peak of the event, more than 1,200 shelters were in operation in over 20 states. Existing systems, such as the National Shelter Systems operated by the American Red Cross, maintain information about registered facilities—locations, size, capacity, and occupant census—but do not provide information about hygiene, sanitation, and other important public health issues. As part of the preventive efforts by public health agencies, on-site shelter assessment can be conducted to evaluate any health and safety risks to occupants.

Following the 2005 hurricane season, The Centers for Disease Control and Prevention's (CDC) National Center for Environmental Health (NCEH) reviewed existing guidance and standards for disaster shelter assessments, working with experts from local, state, and federal government agency representatives; academia; and nongovernmental organizations. To address the findings of the review, CDC released in 2008 its first shelter assessment tool. The assessment tool and tool instructions included 98 safety areas or variables in 10 categories. Over the next 10 years, the tool or modified versions of the tool became the official shelter assessment in many state and local preparedness programs and has since been used in a number of domestic and international disaster events. This form became the adjunct tool for teaching environmental health professionals how to assess disaster shelters in CDC's Environmental Health Training in Emergency Response (EHTER). Since EHTER launched, thousands of environmental health

professionals have been trained on how to use this assessment tool.

In light of the evolving and increasingly complex nature of emergencies, CDC and its partners saw the need to update the 2008 version of the Environmental Health Assessment Form for Disaster Shelters. In 2018, the revision process began by convening partners from local, state, and federal government agencies and nongovernmental organizations within environmental health and emergency management professions. Through a series of interactive web conferences, more than 100 suggested changes were received. NCEH subject matter experts evaluated all suggestions and shared the draft document for approval by the partners. The new version of the form adds safety areas to be assessed such as prepared food, potable water, hygiene routines, hazardous material handling, medical waste disposal, child care areas, and companion animals.

People will continue to be at risk during disasters as the dynamic complexity and range of public health issues evolves. These interagency workgroup efforts serve as a model of collaboration among disaster partners for improving an existing disaster assessment tool. Although no one can predict the next disaster, environmental health professionals need to be equipped with the appropriate tools and resources to assist in ensuring that disaster shelter facilities remain safe, clean, and monitored for potential environmental hazards.

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Quick Links

- Download the Centers for Disease Control and Prevention's updated Shelter Assessment Tool: https://emergency.cdc.gov/shelterassessment/
- Learn more about Environmental Health Training in Emergency Response (EHTER): www.cdc.gov/nceh/ehs/elearn/ehter.htm

Did You Know?

Work is underway to update the Model Aquatic Health Code. Change requests can be submitted to the Council for the Model Aquatic Health Code by January 6, 2020. The new edition will be released in 2021. To submit a change request, visit www.cmahc.org/enter-change-request.php.

INTEGRATING PUBLIC HEALTH IN LAND REUSE AND REDEVELOPMENT

Editor's Note: The National Environmental Health Association is publishing a three-part series that highlights collaboration and partnerships with the Agency for Toxic Substances and Disease Registry (ATSDR) and redevelopment stakeholders to promote environmental health and land reuse as environmental and public health practices. This series will serve as a guide for identifying new and existing resources that can be adopted at the local environmental health level to safely reuse environmentally impacted land to improve community health outcomes. The conclusions in this series are those of the author(s) and do not necessarily represent the official position of the Centers for Disease Control and Prevention and ATSDR.

Part 3: Public Health Indicators Associated With Land Reuse and Redevelopment: Results of a 40-Community Analysis

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Background

This final series installment highlights the development of a set of community-derived public health indicators associated with land reuse and redevelopment created using the Agency for Toxic Substances and Disease Registry's (ATSDR) Action Model (ATSDR, 2019). We designed the Action Model to engage communities in land reuse and redevelopment plans with a goal to measure changes in overall community health status. To track these changes, the Action Model promotes the development of community-derived health measures across a broad range of public health categories, from physical and mental health to environmental and economic health.

ATSDR introduced the first three Action Model pilot communities in a publication in the July/August 2013 issue of the *Journal of Environmental Health* (Berman & Forrester, 2013). By 2018, over 45 different communities across the U.S. have used the Action Model in redevelopment planning. Our objective was to create a data set of types of community-derived public health indicators associated with land reuse and redevelopment. Our secondary objective for creating the set of indicators was to provide a resource to accompany the Action Model that communities can use for measuring outcomes of land reuse and redevelopment activities that can lead to improved overall community health status.

Methods

Communities who used the Action Model were community partnership pilot communities (i.e., communities in which we provided technical assistance on land reuse) or grantees from a past funding program (i.e., ATSDR community health projects related to contamination at brownfield/land reuse sites). Collaborative relations with over 45 Action Model communities provided us access to these Action Models and an opportunity to consolidate the models with the intention of developing a set of community-derived public health indicators associated with land reuse and redevelopment. We ultimately consolidated 40 Action Models to a set of 69 public health indicators through an iterative process of data consolidation and assessment:

1. **Abstraction**: We abstracted all indicators from the Actions Models into Microsoft Excel, resulting in several hundred different community-derived indicators. We categorized indicators by various community-selected health categories in one spreadsheet. Categories were not modified at this time.
2. **Consolidation**: We combined or separated multiple duplications of public health categories and multiple duplications of indicators. This work required multiple iterations. For example, the indicator of access to green space appeared under categories of Environment, Built Environment, and Economy. We eliminated these duplicates and moved this indicator under Environmental Improvement as it appeared there more frequently. We then grouped the indicators related to access to green space and recreation into one category (e.g., trails, parks, and playgrounds, to name a few). An indicator related to partnership and funding for environmental improvement efforts appeared under both Environment and Economy but more frequently under Environment. As such, we grouped these indicators under a new category called Environmental Resources. We did not include indicators that were specific to only one community, such as odor issues.
3. **Recategorization**: With the exclusion of indicators specific to only one community, anywhere from a minimum of 4% to a maximum of 58% of communities derived common indicators. The average percentage of communities that derived similar indicators was 18% and the median percentage that derived similar indicators was 13%. We rounded the average value of communities that derived common indicators to 20% and selected that as the cutoff value for inclusion in the data set. We then grouped indicators that were commonly derived among the 40 communities under 9 community health categories. The regrouping of indicators in the consolidation process made some community-selected category names irrelevant and warranted the renaming categories. Additionally, it justified providing a standardized defini-

TABLE **1**

Community Involvement Indicators

Indicator	Definition	Data Source
Number of city/community events and meetings	Count/number of events and meetings related to redevelopment	• Event/meeting flyers or agendas • Internal county/city/town or nonprofit data
Participation rates in city/community events and meetings	Number of people participating in events and meetings related to redevelopment	• Sign-in sheets • Internal county/city/town or nonprofit data
Number of public/outreach documents (e.g., publications, flyers, and readership statistics)	Count/number of public/outreach documents created related to redevelopment	• Number of publications, flyers, and/or infographics that are distributed or counted by web hits • Internal county/city/town or nonprofit data
Type of public/outreach documents (e.g., publications, flyers, and readership statistics)	The description of public/outreach documents created related to redevelopment	• Examples of publications, flyers, and/or infographics that are distributed or counted by web hits • Internal county/city/town or nonprofit data

Note. These indicators measure the implementation of community outreach and involvement activities to populations of interest associated with land reuse and redevelopment activities.

TABLE **2**

Environmental Improvement Indicators

Indicator	Definition	Data Source
Inventory to characterize land reuse sites (e.g., brownfields, cleanup sites, and under-used or polluted sites) through a public health lens (e.g., size, sensitive populations, frequency of access, etc.)	The description of land reuse sites in a community from a public health/exposure perspective	• Agency for Toxic Substances and Disease Control Site Screening Tool: www.atsdr.cdc.gov/sites/brownfields/site_inventory.html • Internally generated inventory, such as a spreadsheet maintained by a city
Pre- and post-redevelopment list of contaminants at sites	The list of contaminants suspected or confirmed to be at sites before and after redevelopment	• Internal county/city/town or nonprofit data
Pre- and post-redevelopment media impacts (e.g., air, soil, water, etc.)	The environmental media, such as soil, air, water, or sediment, that is suspected or confirmed to be impacted by chemical contamination before and after redevelopment	• Internal county/city/town or nonprofit data
Pre- and post-redevelopment levels of contamination	The quantitative levels of contamination measured in environmental media before and after redevelopment (e.g., soil lead levels in ppm)	• Internal county/city/town or nonprofit data
Number of lead abatements/remediations	Number of lead abatements or remediations that occur during redevelopment, such as the removal of lead-based paint from a structure slated for reuse	• Internal county/city/town or nonprofit data
Number of asbestos abatements/remediations	Number of asbestos abatements or remediations that occur during redevelopment, such as the removal of asbestos-containing material from a structure slated for reuse	• Internal county/city/town or nonprofit data

Note. Environmental improvement indicators measure the implementation of activities and achievement of outcomes related to hazardous chemical reduction.

tion for each category to accurately reflect its group of indicators.

4. **Clarification**: We added details and guidance to indicators related to changes in environment and community health outputs or outcomes associated with redevelopment to aid in measurement. To do so, we included the following factors:

- **Data availability/ease of collection**: Action Model communities typically relied on publicly available or community-collected data, such as property value assessments,

U.S. Census data, state vital statistics data, visual surveillance, and community-led surveys. They shared these data sources with ATSDR. When creating community-derived indicators, it is important to select indicators for which there are available data or for which data can be collected, such as by surveys or direct observation. In the resulting data set of indicators, we provided suggested data sources for all indicators.

- **Definition**: Overall, there was some ambiguity in the measures, which could result in data quality issues if communities interpret indicators differently. We added some additional clarity to indicators to provide at least a one-sentence definition. For example, under the topic of Housing, an indicator might have been listed as "census data," so we added typical census housing data for clarification (e.g., number of rentals, number of owned houses, occupancy, single-family owner occupied). In addition, some indicators, such as third grade reading comprehension, might not seem related to land reuse and redevelopment, so we added the explanation, "Important in areas with multiple older buildings that may be vacant and painted with lead-based paint or in areas of high disinvestment, which can impact school quality."

TABLE **3**

Baraboo, Wisconsin, Land Reuse and Redevelopment Indicators

Issue	Measure
Environment	
Pollution of the river	Water quality
River preservation	Site inventory, stormwater ordinances, pollution prevention practices, sewer system parameters
Sites	Site inventory, status of sites, health consultations/technical assists
Landscape and vegetation	Vegetation survey
Odor and rodents	Odor survey, rodent control data
Habitat concerns	Wildlife survey, environmentally-friendly lighting, habitat preservation
Land use/reuse	
Neighborhood design	Sidewalks survey, trails survey, green/open spaces, businesses/services, design techniques/standards, housing types, pre-1978 housing and commercial units, lead and asbestos remediation, demographics, community pride and satisfaction
Incompatible land uses	Description of incompatible land uses
Community-wide employment, business, and economic issues	Young families, births, college educated residents, tenants, businesses, people shopping/dining, economic statistics, school district and real estate data, people using parks (young people in the area)
Riverfront access and linkages to complement and connect the downtown square development	River access, trails survey, recreational activities, river walk and linkages
Safety/security/health	
Security of worksite during redevelopment	Site access, extra patrol
Poor condition of sidewalks	Sidewalks survey
Security of river trails	Surveillance and accident log
Communication/risk communication	
Continued partnership between city, public health, state, and residents	Partnership activities, city and health department education and outreach activities
Communication of hazards	Partnership activities, number of lead-poisoned children

Results

After the final consolidation, we had a set of 69 public health indicators associated with land reuse and redevelopment that are commonly being tracked by at least 20% of the 40 Action Model communities. The final grouping of indicators selected by communities fell under 9 community health categories:

- Built Environment: 17 indicators
- Community Involvement: 4 indicators
- Economy: 16 indicators
- Education: 4 indicators
- Environmental Improvement: 6 indicators
- Environmental Resources: 5 indicators
- Housing: 11 indicators
- Physical Health: 4 indicators
- Safety and Security: 2 indicators

For communities considering ways to track implementation of activities and changes over the course of revitalization, the indicators provide a variety of measures to contemplate. Ideally, communities may wish to select a handful of indicators from categories that best resonate with their particular community concerns, redevelopment activities, intended outcomes, and stakeholders.

The 69 indicators are provided, organized by health categories, under the ATSDR Build Your Own Community Health and Land Reuse Scorecard Toolkit at www.atsdr.cdc.gov/sites/brownfields/model.html. An example highlighting environmental improvement and community involvement indicators is provided in Tables 1 and 2.

Discussion

We created the Action Model to help communities measure overall changes in community health over the course of redevelopment. By consolidating the indicators derived by 40 communities to track such changes, we aim to provide additional guidance to assist communities in selecting indicators that might help them address redevelopment concerns and improve health outcomes. While we limited our 69 indicators to those collected by at least 20% of 40 different communities, we recognize that communities may be interested in indicators that are not part of ATSDR's community-derived set of indicators.

Our indicators can be used for guidance but communities can also consider measurement and evaluation in the context of their own stakeholders and intervention design. Com-

munities may wish to create their own indicators that demonstrate their unique concerns. For example, one community was concerned about how odor from a waste transfer facility affected residents' quality of life. This indicator was very specific to one community but it was still very important to that community and its intervention design. One resident ultimately conducted a survey of residents and businesses near the waste transfer facility and quantified quality of life impacts from waste odor, which helped move forward the eventual relocation of that facility to a more compatible area.

To provide additional Action Model indicator development guidance from a real community, we provide an example from Baraboo, Wisconsin, a community highlighted in Berman and Forrester (2013). Table 3 highlights the various measures the Baraboo Development Community derived and tracked over time. The full set of Baraboo's indicators is available and described in the report, *Community Health Monitoring: The Baraboo Ringling Riverfront Redevelopment* (www.atsdr.cdc.gov/sites/brownfields/docs/Final_Baraboo_032911.pdf). Ultimately, within a few short years, Baraboo began to measure positive outcomes by tracking their indicators, including a 40% reduction in potentially hazardous sites and exposures to contaminants (indicators related to pollution of the river and sites) and increases in new jobs and contribution to the tax base (indicators related to community-wide employment, business, and economic issues). Highlights are provided in the sidebar above.

Action Model Indicators Example

Baraboo, Wisconsin, an Action Model community, tracked environmental, health, housing, and other community-focused indicators over the course of a riverfront redevelopment. Baraboo tracked several outcomes within a few years of redevelopment plan implementation. These outcomes included the removal, remediation, or redevelopment of 4 of 10 (40%) land reuse sites, which reduced and removed potentially harmful contaminant exposures for more than 500 nearby residents. Redevelopment of land reuse sites also added 15 new jobs and increased the tax base by $3 million. The Baraboo case story is available in the Agency for Toxic Substances and Disease Registry's Land Reuse Toolkits for municipal agencies at www.atsdr.cdc.gov/sites/brownfields/land_reuse_toolkits.html.

Conclusion

The community-derived public health indicators associated with land reuse and redevelopment provide a useful accompaniment to the Action Model and serve as a promising tool for communities to track the delivery of activities and changes in overall health status over the course of redevelopment. Indicators mark progress and can support performance measurement and evaluation, increasing the opportunities for continuous program improvement and measuring change in environmental and general health outcomes. ATSDR's compilation of public health indicators will provide a helpful resource for communities to track their progress.

Acknowledgements: We thank and acknowledge the many communities who shared their community-derived indicators to help us create the data set of 69 public health indicators associated with land reuse and redevelopment. In addition, we thank Vidya Surakanda Nataraj Mohanam, who tirelessly created the prototype version of the data set of indicators while obtaining her Master of Public Health at the University of Illinois School of Public Health.

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Agency for Toxic Substances and Disease Registry. (2019). *ATSDR Action Model*. Retrieved from https://www.atsdr.cdc.gov/sites/brownfields/model.html

Berman, L., & Forrester, T. (2013). An indicator framework to measure the effects of brownfields redevelopment on public health. *Journal of Environmental Health*, *76*(1), 50–55.

CAREER **OPPORTUNITIES**

Food Safety Inspector

UL Everclean is a leader in retail inspections. We offer opportunities across the country. We currently have openings for trained professionals to conduct audits in restaurants and grocery stores. Past or current food safety inspection experience is required.

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In addition to food safety inspectors, we are also looking for GMP auditors for OTC, dietary supplement, and medical device applications. If interested, contact Diane Elliott at Diane.Elliott@ul.com to apply or receive further information.

EH **CALENDAR**

UPCOMING NEHA CONFERENCES

July 13–16, 2020: NEHA 2020 Annual Educational Conference & Exhibition, New York City, NY. For more information, visit www.neha.org/aec.

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

NEHA AFFILIATE AND REGIONAL LISTINGS

Georgia
May 27–29, 2020: Annual Education Conference, hosted by the Georgia Environmental Health Association, Lake Lanier Islands, GA. For more information, visit www.geha-online.org.

Michigan
March 18–20, 2020: Annual Education Conference, hosted by the Michigan Environmental Health Association, Traverse City, MI. For more information, visit www.meha.net/AEC.

Missouri
April 7–10, 2020: Annual Education Conference, hosted by the Missouri Environmental Health Association, Springfield, MO. For more information, visit https://meha mo.org.

Nevada
April 28–29, 2020: NFSTF & NVEHA Joint Conference, hosted by the Nevada Food Safety Task Force (NFSTF) and the Nevada Environmental Health Association (NVEHA), Las Vegas, NV. For more information, visit www.nveha.org.

New Jersey
March 1–3, 2020: Educational Conference & Exhibition, hosted by the New Jersey Environmental Health Association, Atlantic City, NJ. For more information, visit www.njeha.org.

Utah
May 6–8, 2020: Spring Conference, hosted by the Utah Environmental Health Association, Kanab, UT. For more information, visit www.ueha.org.

Washington
April 27–29, 2020: 68th Annual Educational Conference, hosted by the Washington State Environmental Health Association, Tacoma, WA. For more information, visit www.wseha.org.

TOPICAL LISTINGS

Emergency Response
January 26–31, 2020: Environmental Health Training in Emergency Response (EHTER) Operations, held by the Federal Emergency Management Agency's Center for Domestic Preparedness, Anniston, AL. For more information, visit https://cdp.dhs.gov/find-training/course/PER-309.

Food Safety
March 9–12, 2020: Integrated Foodborne Outbreak Response and Management (InFORM) 2020 Conference, Atlanta, GA. For more information, visit www.aphl.org/conferences/InformConf/Pages/default.aspx.

Public Health
April 7–8, 2020: Iowa Governor's Conference of Public Health, Des Moines, IA. For more information, visit www.ieha.net/IGCPH.

Is There a Silent Danger in Your Water System?

In recent years, there has been an increase in cases of Legionnaires' disease worldwide, with reported incidences of Legionnaires' disease growing at an alarming rate. In the USA alone, cases of Legionnaires' disease have increased by over 500% since 2000. Similarly, between 2000 and 2015 cases of infection in Europe have risen by 347% and 2017 saw the largest ever number of reported cases (9,238) and deaths (574).

Scientists suggest that this increase could be linked to several factors such as climate change, ageing populations, degrading infrastructure and better diagnostics and reporting but *Legionella* specialists at Hydrosense believe there may be more to the story. Experts at Hydrosense believe that shock treatments, when coupled with outdated frameworks for *Legionella* testing, could be plaguing water systems all over the world with a silent danger – Viable-but-non-Culturable (VBNC) *Legionella*.

What is Viable-but-non-culturable bacteria?

VBNC is a state of survival which was first recognised by Rita Colwell and her collaborators in 1982. *Legionella* bacteria enter this state when exposed to stressful conditions such as heat shock and superchlorination and will start to shut down functions like reproduction until conditions improve. In this state, *Legionella* bacteria cannot grow on conventional culture plates in a laboratory and are therefore, undetectable via the widely accepted laboratory culture testing method.

Nevertheless, VBNC bacteria are still very dangerous and can lead to outbreaks of Legionnaires' disease, fatalities, shut-downs, fines, litigation and bad press. Despite restricted metabolic rates, VBNC cells have been shown to retain pathogenic properties. Research has demonstrated that VBNC bacteria recover their culturability after passage through human lung cells and as a result have the potential to cause infection in the same way as culturable bacteria.

How to test for VBNC bacteria?

VBNC cells are characterized by a loss of culturability on routine agar, which impairs

their detection by conventional plate count techniques. This is a major limitation of culture-based detection methods and can result in false negatives or significant underestimations of total viable cells in environmental and clinical samples.

Recent research has shown that heat shock of an entire water system at 158°F for an hour does not kill all the *Legionella* bacteria within it. In fact, a significant number of bacteria in this study (and specifically the most dangerous and virulent, *Legionella pneumophila* serogroup 1) entered a viable but non-culturable state. This phenomenon is also true for superchlorination and other biocide shock methods. Consequently, cleaning events in hospitals and other high-risk areas could appear to be effective when tested with the lab culture method but in reality, there could be high levels of VBNC *Legionella* still present in the system.

As a result, alternative methods like Hydrosense and PCR, which can detect VBNC *Legionella* bacteria, are becoming critical tools for water engineers. These rapid methods can be used in addition to the lab culture method to protect businesses and support better public health. They are faster too, with results from Hydrosense in only 25 minutes duty holders can implement immediate remedial action if they find a positive.

Application of Hydrosense technology by Trusted Water

Companies all over the USA are now incorporating on-site testing methods to protect clients and the general public from potentially deadly VBNC bacteria.

Trusted Water, who specialize in water management programs, certification and monitoring for healthcare, educational, residential, and business clients, is one such company. By utilizing on-site and remote water quality testing they assess their clients' water and their risk of creating or delivering contaminated water to their customers. The company performs facility risk assessments and develops water management programs to meet Center for Medicare and Medicaid Services (CMS) certification requirements for *Legionella* risk reduction.

Trusted Water started using Hydrosense rapid testing technology alongside a combination of other general water quality parameters such as 2-factor ATP testing, HPC, and *Pseudomonas*. Their engineers use Hydrosense as a crucial part of their escalation-based sampling protocol, meaning that the breadth of testing done is escalated based on the results of other general water tests. Thus, if general testing suggests that there is a possible risk of *Legionella* in the system, Hydrosense is used. Other complimentary *Legionella* testing methods may also be used if the Hydrosense test comes back positive.

Benefits gained from the implementation of Hydrosense technology

Adopting the Hydrosense test has given Trusted Water a clear competitive advantage. Not only has the test allowed them to improve their *Legionella* testing offering by facilitating more testing at a lower cost, but it has also allowed them to provide reliable results that account for VBNC bacteria while still on-site – thus enabling immediate action if a problem is found. This has been valuable for offering clients peace of mind and for avoiding lengthy shutdowns.

To find out more about the Hydrosense test kit range enquire at hydrosense@albagaia.com or visit http://bit.ly/NEHA-HYdrosense.

RESOURCE CORNER

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

NEHA BOOKSTORE
www.neha.org/store

Certified Professional–Food Safety Manual (3rd Edition)

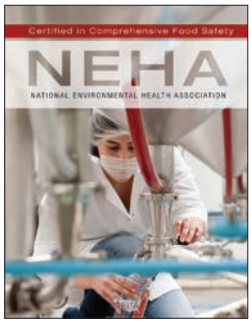
National Environmental Health Association (2014)

The Certified Professional–Food Safety (CP-FS) credential is well respected throughout the environmental health and food safety field. This manual has been developed by experts from across the various food safety disciplines to help candidates prepare for NEHA's CP-FS exam. This book contains science-based, in-depth information about causes and prevention of foodborne illness, HACCP plans and active managerial control, cleaning and sanitizing, conducting facility plan reviews, pest control, risk-based inspections, sampling food for laboratory analysis, food defense, responding to food emergencies and foodborne illness outbreaks, and legal aspects of food safety.

358 pages / Spiral-bound paperback
Member: $179 / Nonmember: $209

Certified in Comprehensive Food Safety Manual

National Environmental Health Association (2014)



The Food Safety Modernization Act has recast the food safety landscape, including the role of the food safety professional. To position this field for the future, NEHA is proud to offer the Certified in Comprehensive Food Safety (CCFS) credential. CCFS is a mid-level credential for food safety professionals that demonstrates expertise in how to ensure food is safe for consumers throughout the manufacturing and processing environment. It can be utilized by anyone wanting to continue a growth path in the food safety sector, whether in a regulatory/oversight role or in a food safety management or compliance position within the private sector. This manual has been carefully developed to help prepare candidates for the CCFS credential exam and deals with the information required to perform effectively as a CCFS.

356 pages / Spiral-bound paperback
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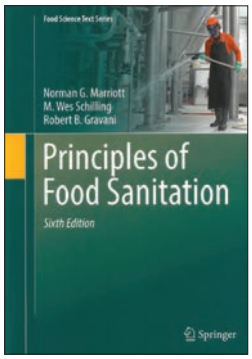
Principles of Food Sanitation (6th Edition)

Norman G. Marriott, M. Wes Schilling, and Robert B. Gravani (2018)



Now in its 6th edition, this highly acclaimed textbook provides sanitation information needed to ensure hygienic practices and safe food for food industry professionals and students. It addresses the principles related to contamination, cleaning compounds, sanitizers, and cleaning equipment. It also presents specific directions for applying these concepts to attain hygienic conditions in food processing or preparation operations. The new edition includes updated chapters on the fundamentals of food sanitation, as well as new information on contamination sources and hygiene, HACCP, waste handling disposal, biosecurity, allergens, quality assurance, pest control, and sanitation management principles. Study reference for NEHA's Registered Environmental Health Specialist/Registered Sanitarian and Certified Professional–Food Safety credential exams.

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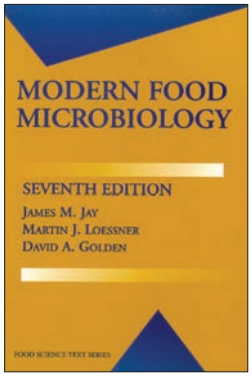
Modern Food Microbiology (7th Edition)

James M. Jay, Martin J. Loessner, and David A. Golden (2005)



This text explores the fundamental elements affecting the presence, activity, and control of microorganisms in food. It includes an overview of microorganisms in food and what allows them to grow; specific microorganisms in fresh, fermented, and processed meats, poultry, seafood, dairy products, fruits, vegetables, and other products; methods for finding and measuring microorganisms and their products in foods; methods for preserving foods; food safety and quality controls; and foodborne diseases. Other section topics include biosensors, biocontrol, bottled water, *Enterobacter sakazakii*, food sanitizers, milk, probiotics, proteobacteria, quorum sensing, and sigma factors. Study reference for NEHA's Certified Professional–Food Safety credential exam.

790 pages / Hardback
Member: $84 / Nonmember: $89

AEHAP
ASSOCIATION OF ENVIRONMENTAL HEALTH ACADEMIC PROGRAMS
announces

THE 2020 AEHAP STUDENT RESEARCH COMPETITION

for undergraduate and graduate students enrolled in a National Environmental Health Science & Protection Accreditation Council (EHAC)-accredited program or an environmental health program that is an institutional member of AEHAP.

Win a $1,000 Award

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Students will be selected to present a 20-minute platform presentation and poster at the National Environmental Health Association's Annual Educational Conference & Exhibition in New York City, New York, July 13–16, 2020.

Entries must be submitted by Friday, February 28, 2020, to
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For additional information and research submission guidelines, please visit www.aehap.org/aehap-src-scholarship-and-nsf-internships.html.

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

Opportunity for Students

From EHAC-Accredited Environmental Health Degree Programs to Win a $3,500 PAID INTERNSHIP

The Association of Environmental Health Academic Programs (AEHAP), in partnership with NSF International, is offering a paid internship project to students from National Environmental Health Science & Protection Accreditation Council (EHAC)-accredited programs. The NSF International Scholarship Program is a great opportunity for an undergraduate student to gain valuable experience in the environmental health field. The NSF Scholar will be selected by AEHAP and will spend 8–10 weeks (February–June 2020) working on a research project identified by NSF International.

Project Description
The applicant shall work with a professor from their degree program who will serve as a mentor/supervisor and locate a local hosting health department with which they will complete the research. Research will focus on evaluating the use and value of NSF standards for lead in school plumbing.

Application deadline: December 13, 2019

For more details and information on how to apply please go to www.aehap.org/aehap-src-scholarship-and-nsf-internships.html.

For more information, contact info@aehap.org or call (859) 622-6330.

NSF

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JEH QUIZ

FEATURED ARTICLE QUIZ #3

Comparison of Use, Storage, and Cleaning Practices for Personal Protective Equipment Between Career and Volunteer Firefighters in Northwestern Kentucky in the United States

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

1. Read the featured article carefully.
2. Select the correct answer to each *JEH* Quiz question.
3. a) Complete the online quiz found at www.neha.org/publications/journal-environmental-health,
   b) Fax the quiz to (303) 691-9490, or
   c) Mail the completed quiz to
   JEH Quiz, NEHA
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   Be sure to include your name and member number!
4. One CE hour will be applied to your account with an effective date of December 1, 2019 (first day of issue).
5. Check your continuing education account online at www.neha.org.
6. You're on your way to earning CE hours!

Quiz Registration

Name

NEHA Member Number

E-mail

Quiz deadline: March 1, 2020

1. In the U.S., __ of all firefighters are volunteers.
   a. 69.0%
   b. 70.9%
   c. 75.7%
   d. 85.2%

2. In Kentucky, __ of firefighters across nearly 700 fire departments are volunteers.
   a. 69.0%
   b. 70.9%
   c. 75.7%
   d. 85.2%

3. This study used a survey instrument to obtain a wider perspective of and additional insights into existing personal protective equipment (PPE) practices in small rural fire departments in northwestern Kentucky.
   a. True.
   b. False.

4. A total of __ career and __ volunteer firefighters participated in the study.
   a. 19; 102
   b. 102; 19
   c. 121; 230
   d. 230; 121

5. The surveyed firefighters relied heavily on all types of PPE except for
   a. masks.
   b. footwear.
   c. eye protection.
   d. hearing protection.

6. The fire departments participating in this study provided full monetary support to purchase new turnout gear for __ of volunteer firefighters.
   a. 54%
   b. 67%
   c. 78%
   d. 89%

7. Both the oldest and newest sets of turnout gear owned by volunteer firefighters were at least __ times older than those of career firefighters.
   a. 1.4
   b. 1.5
   c. 1.6
   d. 1.7

8. Only __ of volunteer firefighters stored their gear in a mesh container as recommended by the National Fire Protection Association.
   a. 8%
   b. 10%
   c. 12%
   d. 14%

9. Of volunteer firefighters, __ stored their gear in personal vehicles.
   a. 21%
   b. 53%
   c. 59%
   d. 85%

10. Overall, career and volunteer firefighters had dissimilar cleaning practices.
    a. True.
    b. False.

11. Compared with volunteer firefighters, a/an __ percentage of career firefighters cleaned their gear after each use.
    a. lower
    b. equal
    c. greater

12. Compared with career firefighters, a/an __ percentage of volunteer firefighters had never performed advanced cleaning of their gear.
    a. lower
    b. equal
    c. greater

JEH Quiz #1 Answers
July/August 2019

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

THANK YOU for Supporting the NEHA/AAS Scholarship Fund

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2020

ACCEPTING NOMINATIONS NOW

Walter S. Mangold Award

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

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

Nomination deadline is March 15, 2020.

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

2020 Joe Beck Educational Contribution Award

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

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

Nomination deadline is March 15, 2020.

For application instructions, visit www.neha.org/about-neha/awards/joe-beck-educational-contribution-award.

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NEHA **NEWS**

NEHA Releases Updated Body Art Model Code

Body art is defined as body piercing, tattooing, branding, scarification, subdermal implants, tongue splitting, transdermal implants, or the application of permanent cosmetics. Environmental health professionals play an important role in inspecting and regulating body art establishments where the practices of body art are performed.

The National Environmental Health Association (NEHA) advocates for national standards, best practices, and resources that enhance the abilities of environmental health professionals to ensure safe body art practices and protect public health. In 1999, NEHA, along with environmental health professionals and industry experts, developed the Body Art Model Code to identify best practices and body art inspection standards. In the time since the original code was released, body art has become much more accepted, diverse, and popular.

As such, NEHA began working in Spring 2016 with subject matter experts and national partners to update the code. The updated code was released on October 22, 2019. It was created with input from environmental health and industry professionals and addresses the ways body art impacts public health. The code is available for local and state agencies and other organizations to use as a resource to update their own body art codes.

The updated Body Art Model Code is divided into 22 sections:

1. Definitions
2. Body Art Operator Requirements and Professional Standards
3. Specific Considerations for Piercing
4. Jewelry Standards
5. Public Notification Requirements
6. Facility Recordkeeping Requirements
7. Informed Consent and Release Form
8. Records Retention
9. Disinfection and Sterilization Procedures
10. Preparation and Care of the Procedure Site
11. Requirements for Single-Use Items
12. Biomedical Waste
13. Requirements for Premises
14. License Requirements
15. Prohibitions
16. Enforcement
17. Inspection
18. Suspension
19. Revocation
20. Citations
21. Department Personnel Competency Requirements
22. Interpretation and Severability

The updated code also includes a section dedicated to specific considerations for tattooing, cosmetic tattooing, branding, and scarification. To view the updated Body Art Model Code, please visit www.neha.org/bamc. We thank the NEHA Body Art Model Code Committee Members for lending their time, expertise, and knowledge.

Application Period Open for the National Environmental Public Health Internship Program

NEHA is pleased to announce that the Centers for Disease Control and Prevention (CDC) is funding the National Environmental Public Health Internship Program (NEPHIP) to support 20 environmental health student internships during summer 2020. NEPHIP is supported through a cooperative agreement with CDC (CDC-RFA-OT18-1802). The purpose of NEPHIP is to encourage environmental health students to consider careers at local, state, or tribal environmental public health departments following graduation. Through this internship program, students will be exposed to the exciting career opportunities, benefits, and challenges of working with environmental public health agencies throughout the U.S.

NEHA's roll in NEPHIP is to:

- solicit applications from eligible environmental health departments and select locations based on established application criteria;
- solicit application from eligible environmental health students and select interns based on established application criteria; and
- match the selected interns with the environmental health departments based on geolocation preferences, interests, and professional goals that align with opportunities at the health department.

The application period for health departments and students is now open and will close on **January 15, 2020**.

Students who apply must be from National Environmental Health Science & Protection Accreditation Council (EHAC)-accredited environmental health academic programs. Selected students will receive a base stipend of $6,000 ($600/week) for undergraduate and $8,000 ($800/week) for graduate students to complete a 10-week internship. Information regarding student eligibility and additional considerations, as well as the application and application checklist, can be found at www.neha.org/professional-development/students/internships/student-eligibility.

Local, state, and tribal health departments interested in hosting an environmental health student intern can find information about eligibility and other considerations, as well as the application, at www.neha.org/professional-development/students/internships/health-department-eligibility.

Please visit NEHA's Internship web page (www.neha.org/professional-development/students/internships) for the following NEPHIP information:

- 2020 program guidelines,
- health department application,
- student internship application,
- past intern success stories, and
- 2019 NEPHIP program map.

NEHA Staff Profile

As part of tradition, NEHA features new staff members in the *Journal* around the time of their 1-year anniversary. These profiles give you an opportunity to get to know the NEHA staff better and to learn more about the great programs and activities going on in your association. This month we are pleased to introduce you to one NEHA staff member. Contact information for all NEHA staff can be found on page 44.

Ayana Jones

I joined NEHA's Program and Partnership Development department as a project coordinator in December 2018. My primary role at NEHA is to develop and execute project deliverables on a variety of environmental health content areas such as the Model Aquatic Health Code, open data, vector control, and water. I am one of five employees here in the Washington, DC, office, where we engage strategically with our public health and environmental health partners. Over the past year, I helped contribute to, facilitate, and monitor the work of several federally-funded environmental health projects.

I was born and raised in Maple Heights, a small suburb of Cleveland, Ohio. I attended Slippery Rock University for my bachelor of science in public health and more recently graduated from the University of Maryland in 2018. Before my transition to graduate school at the University of Maryland, where I studied health equity, I worked as an environmental health fellow and at the American Public Health Association. The foundation of my environmental health work began as a sanitarian at the Cuyahoga County Board of Health.

My personal and professional passions lie with the betterment of environmental health, specifically for the most vulnerable groups of people. One of my goals here at NEHA is to continue to promote environmental justice and health equity within my project areas and incorporate the roles of environmental justice and health equity in the environmental health workforce. My first year here at NEHA has been both challenging and exciting. I look forward to doing greater things at NEHA in the years to come. When I am not working, I enjoy doing hot yoga, working on audio editing projects, or going to jazz and soul concerts in the DMV (Washington, DC, Maryland, Virginia) area.

DirecTalk

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it must be cultivated. The Aroles recognized that certain influencers within their catchment played an outsized role in regional development decisions. Investing in those relationships and ensuring buy-in and support from these individuals would lead to better health outcomes for everyone. The farmers clubs were an excellent example of Arole ingenuity. They created clubs where farmers with wealth had something in common with subsistence farmers—everyone farmed—and these clubs were essential in creating cooperatives where everything from financing, infrastructure, pricing, and health centers could be discussed and worked on together. A common purpose bonded all the players, regardless of what caste they were born into.

The farmers clubs also played another more interesting and productive purpose. The Aroles understood that while the women were the change agents they needed to work with, the men were easily threatened and would likely prohibit their spouses from interacting with the Aroles, even if it benefitted their family's health. Hence, the farmers clubs. The village men's status was collectively improved by associating with the clubs. They came to trust the Aroles over time and eventually ceded permission for the women to become involved in many community health improvement initiatives. Brilliant.

Dr. David Dyjack addresses a gathering of Delhi community leaders in 1997. Photo courtesy of David Dyjack.

I'm struck by the notion that the greatest contribution we will likely make during our careers will not fall within the four walls of the environmental health profession. Alternatively, it will be what we achieve in collaboration with other disciplines: engineering, medicine, nursing, health education, architecture. To effectively gain access to these professions, we will, like the Aroles, need to cultivate trust with the gate keepers. In our case, these gate keepers include university deans, medical center directors, company presidents, governmental health officials, and nursing supervisors, among others. Let's meet them on their turf, create and deliver value as defined by them, and when they claim credit for our ideas, let our satisfaction lie with the fact that we achieved our aim.

The great rupee exchange of 1997 was the opening scene on a 5-week adventure that brought me to Delhi, Mumbai, Manipal, Bangalore, Chennai, and Hyderabad. I learned the importance of community participation and was introduced to the outsized role of women in the health of their and our communities. It's time to dust off the lessons from India and bring them on home.

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DirecTalk MUSINGS FROM THE 10TH FLOOR

Jamkhed

David Dyjack, DrPH, CIH

George, Allan, and I fingered the stacks of rupees, 350,000 to be exact. The year was 1997 and I had in a moment of insanity agreed to exchange our U.S. dollars on the black market in Mumbai, India. Any discomfort I felt was ameliorated by the calming presence of the church pastor for whom I was doing this favor, he savored the foreign currency and we needed the rupees. We felt considerable relief when the ledgers balanced. We dropped our cash in a brown paper grocery bag and proceeded into the street, making our way in the twilight on foot toward the YMCA. Imagine the absurdity of the scene—three young foreigners walking through the slums of a megacity with a literal bag of cash balanced on our heads. It would be the first in a series of mind-bending circumstances that would come to define our 5-week educational visit to India. What happened next, however, remains to this day a key milestone in my career.

I had arranged for our public health students to spend a few days with Drs. Raj and Mabelle Arole at their compound in a rural community named Jamkhed, which is about 320 km east of Mumbai. The Aroles were famous in international development circles for their commitment to community health in a time when they, both being physicians, could have easily practiced medicine and led comfortable lives. They forfeited a potential life of prestige and abundance to assist in rural development and help the poorest of the poor.

I ventured out after sunset on my first night at Jamkhed to escape the heat and insect infestation in the dormitory. I had one of those little miner headlamp flashlights as I looked out for potholes and things that go bump in the night. I had just been diagnosed with near-sightedness and was getting familiar with wearing glasses but what I saw next was bewildering. On the dark lane leading out of the compound were a considerable number of men and boys defecating in the street. I was embarrassed and taken aback at the sight and promptly snuffed out my headlamp. What the heck?

The greatest contribution we will likely make during our careers will not fall within the four walls of the environmental health profession.

While intrepid travelers are renowned for returning home with tales of adventure, I was less interested in conveying this experience to people back home and more interested in how one of the most famous development projects in the planet had failed in something as fundamental as providing latrines to its community. At the next opportunity I peppered Raj with my observation and he smiled with a knowing smile. He walked with me and with some pride and amusement, he pointed out ventilated improved pit (VIP) latrines that had been built adjacent to many homes in the community. I took some time to inspect a few and they oddly appeared unused. What was going on? He calmly explained that toilet building had been a priority and that the resources were secured to build VIP latrines. Regretfully, he demurred, he hadn't considered the social context of latrine use.

Life in Jamkhed is difficult and much of that difficulty is borne by the women and girls. The one time of day the ladies had to themselves to socialize and enjoy each other's company was first thing in the morning when they gathered and walked into the fields to engage in a communal bathroom break. It was their time to be together. Why would they elect to use a single toilet in the dark? They didn't. Furthermore, because they didn't, their children didn't either, which leads me back to my first night at Jamkhed. The men I saw that night didn't use the toilets because the women didn't. Herein lies an important lesson that has stayed with me for the last 20 years: women are the world's change agents. They ensure the children get immunized. They are essential players in small enterprise development. They are first to adopt techniques that use less energy for cooking. And yes, if they use the latrine, the children and men will likely follow suit.

I learned other important lessons during my time with Raj and Mabelle. Community participation in any endeavor is not a given,

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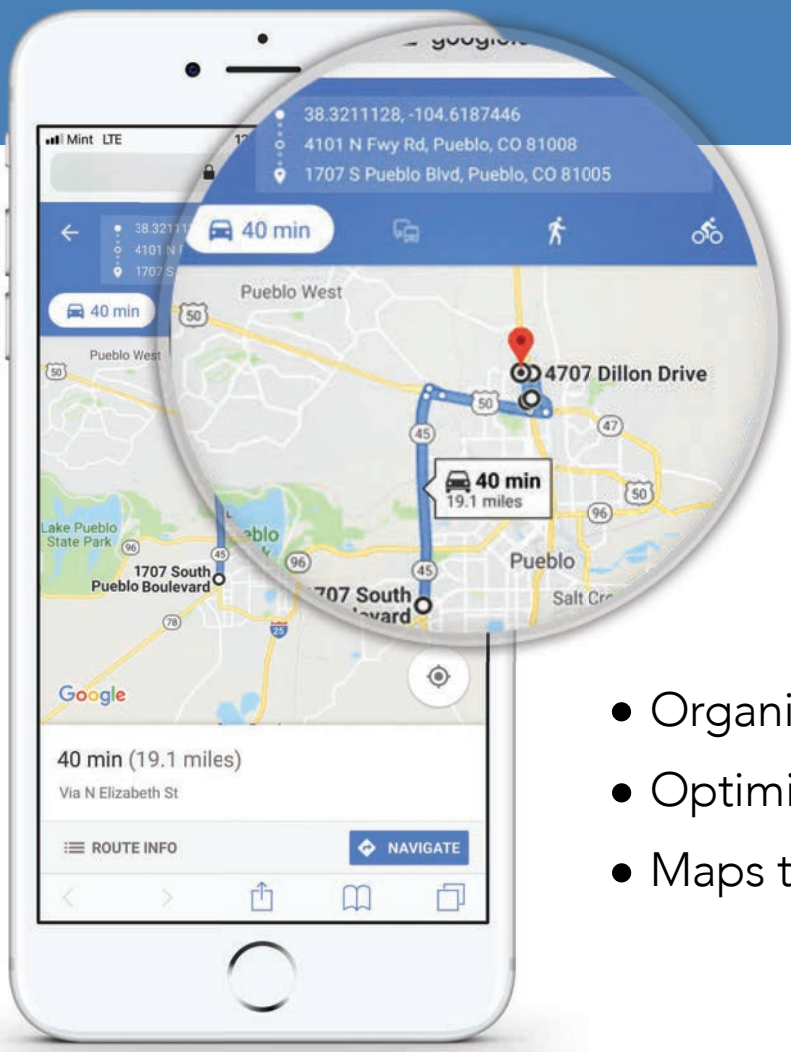

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