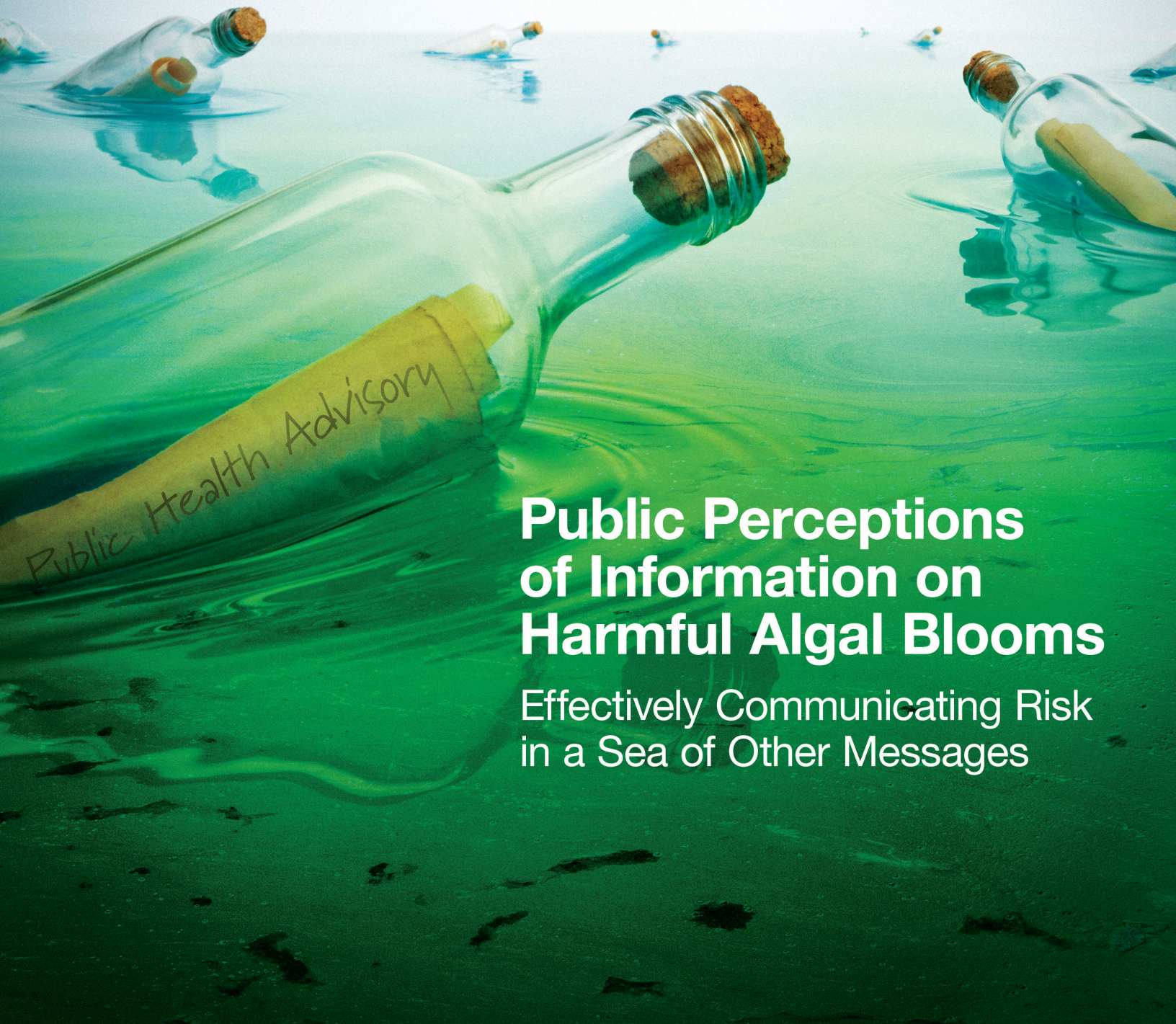
JOURNAL OF

Environmental Health

fifteen dollars

Dedicated to the advancement of the environmental health professional

Volume 85, No. 7 March 2023



Public Perceptions of Information on Harmful Algal Blooms

Effectively Communicating Risk in a Sea of Other Messages

Published by the National Environmental Health Association

www.neha.org

Fast, Easy, and Effective

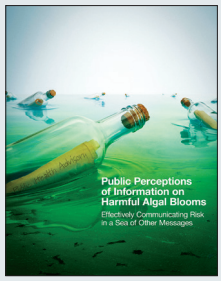
It's simple for staff to get sanitizing right every time with these powerful, ready-to-use products that quickly kill 99.9% of viruses and bacteria. Plus, the **one-step sanitizing and disinfecting formula** is made to use on food-contact surfaces without rinsing so **it's even easier to help prevent cross-contamination**. Available in spray and wipes.

Finally, There's a Better Way to Wipe Out Germs

See how PURELL® Surface Sanitizers do it.
Visit **Surfaces.GOJO.com/learn-more**.

JOURNAL OF
Environmental Health
Dedicated to the advancement of the environmental health professional
Volume 85, No. 7 March 2023

ABOUT THE COVER



Accurate, understandable, and reliable information is crucial during and after a harmful algal bloom (HAB) event. This month's cover article, "Identifying Public Perceptions of Information on Harmful Algal Blooms to Guide Effective Risk Communication," examined perceptions of residents near Lake Erie's western basin about where they received HAB information, what information was most important, and which sources they found most credible. Results from the study highlight that effective risk communication should provide information about severe events in an understandable and timely manner, convey unbiased facts, deliver information from sources seen as trustworthy, and use existing opportunities in the community to provide education.

See page 26.

Cover image © iStockphoto: ansonsaw, wichatsurin

ADVERTISERS INDEX

ADVANCEMENT OF THE SCIENCE

ADVANCEMENT OF THE PRACTICE

ADVANCEMENT OF THE PRACTITIONER

YOUR ASSOCIATION

don't miss

in the next *Journal of Environmental Health*

- Bacterial Contamination in Long Island Sound: Using Preemptive Beach Closure to Protect Public Health
- Decreased Moderate to Vigorous Physical Activity Levels Are Associated With Increased Traffic-Related Air Pollutants in Children With Asthma
- Effectively Communicating Results of Drinking Water Tests From Private Wells

Official Publication

neha National Environmental Health Association

Journal of Environmental Health
(ISSN 0022-0892)

Kristen Ruby-Cisneros, Managing Editor

Ellen Kuwana, MS, Copy Editor

Hughes design|communications, Design/Production

Cognition Studio, Cover Artwork

Soni Fink, Advertising
For advertising call (303) 802-2139

Published monthly (except bimonthly in January/February and July/August) by the National Environmental Health Association, 720 S. Colorado Blvd., Suite 105A, Denver, CO 80246-1910. Phone: (303) 802-2200; Fax: (303) 691-9490; Internet: www.neha.org. E-mail: kruby@neha.org. Volume 85, Number 7. Yearly subscription rates in U.S.: $150 (electronic), $160 (print), and $185 (electronic and print). Yearly international subscription rates: $150 (electronic), $200 (print), and $225 (electronic and print). Single copies: $15, if available. Reprint and advertising rates available at www.neha.org/jeh.

The *Journal of Environmental Health* is indexed by Clarivate, EBSCO (Applied Science & Technology Index), Elsevier (Current Awareness in Biological Sciences), Gale Cengage, and ProQuest. The *Journal of Environmental Health* is archived by JSTOR (www.jstor.org/journal/jenviheal).

All technical manuscripts submitted for publication are subject to peer review. Contact the managing editor for Instructions for Authors, or visit www.neha.org/jeh.

To submit a manuscript, visit http://jeh.msubmit.net. Direct all questions to Kristen Ruby-Cisneros, managing editor, kruby@neha.org.

Periodicals postage paid at Denver, Colorado, and additional mailing offices. POSTMASTER: Send address changes to *Journal of Environmental Health*, 720 S. Colorado Blvd., Suite 105A, Denver, CO 80246-1910.

Printed on recycled paper.

PRINTED WITH SOY INK

PRESIDENT'S MESSAGE

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

Join the Fliers Who Soar to Great Heights

The quote by Marty Rubin, "The deep roots never doubt spring will come," is a reminder even in the season of renewal that the current season of bloom for the National Environmental Health Association (NEHA) is from the environmental health trail blazers who sowed the initial seeds. In this column I want to highlight two groups—the American Academy of Sanitarians (AAS) and the NEHA History Project Task Force—that many associate with the foundation or roots of environmental health. Being around these amazing people reminds me of what Pelé said, "Success is no accident. It is hard work, perseverance, learning, studying, sacrifice, and most of all, love of what you are doing or learning to do." I cannot begin to express my gratitude for all the work done by these distinguished groups whose energy is infectious.

I have the pleasure and honor of being a member of both organizations where I have gained knowledge, fellowship, friendship, and joy. As Michelangelo said, "I am still learning." Furthermore, Antoine de Saint-Exupéry stated, "The tree is more than first a seed, then a stem, then a living trunk, and then dead timber. The tree is a slow, enduring force straining to win the sky." If our environmental health pioneers are the roots of the tree, mid-career professionals are the trunk and early career professionals are the leaves. A tree (e.g., NEHA) does not flourish unless all parts of the tree are working together. The bursting petals of the new NEHA logo represent a new era and excitement for what is possible for NEHA and our profession. NEHA shares the idea stated by Eleanor Roosevelt: "The future belongs to those who believe in the beauty of their dreams."

The current season of bloom for NEHA is from the environmental health trail blazers who sowed the initial seeds.

AAS is an organization that elevates standards, improves the practice, advances professional proficiency, and promotes the highest levels of ethical conduct in every field of environmental health. Many environmental health professionals do not realize that AAS sponsors the Davis Calvin Wagner Sanitarian Award, which is conferred for exceptional leadership ability, professional commitment, outstanding resourcefulness, dedication, and accomplishments in advancing the sanitarian profession and public health programs. In addition, AAS is one of the many cosponsors of the Samuel J. Crumbine Consumer Protection Award (https://crumbineaward.com). The Crumbine Award is a prestigious national award given annually to local environmental health jurisdictions that demonstrate excellence and continual improvement in a comprehensive food protection program. The purpose of the Crumbine Award is to encourage improvement and stimulate public interest in food service sanitation.

AAS has supported early career and student members since its inception. Through a partnership between NEHA and AAS, annual educational scholarships are awarded to exceptional undergraduate and graduate students pursuing a career in environmental health. AAS also helps to enhance student experiences at the NEHA Annual Educational Conference (AEC) & Exhibition.

Becoming a diplomate in AAS denotes a high standard of professionalism with marked distinction and a record of accomplishment in environmental health. It denotes professional status and gives prestige to the holders of the diplomate certification. AAS invites and encourages professionally credentialed environmental health practitioners with qualities of outstanding competence and leadership to become certified as diplomates.

Currently, there are thousands of registered environmental health specialist/registered sanitarian (REHS/RS) professionals, but since the inception of AAS in 1966, only 611 environmental health professionals have been awarded diplomate status. Becoming a diplomate helps you stand out from the crowd, enhancing your career while promoting the profession. Join the difference makers! As Jane Goodall stated, "What you do makes a difference and you have to decide what kind of difference you want to make."

To become a member of this prestigious group you must hold an REHS or RS credential, have three reference letters, have at least one published paper, and demonstrate to the

satisfaction of the AAS board your good moral character and high ethical and professional standing. For further information, please visit the AAS website at https://aaosi.wildapricot.org.

In 2020, NEHA President Dr. Priscilla Oliver, the founder of the One NEHA theme, started the NEHA History Project Task Force, which is composed of a group of illustrious NEHA professionals who have made numerous contributions to our field. I have had the privilege and honor of being an ex-officio member of this task force.

The NEHA History Project Task Force accomplishments include launching a webpage in 2021, led by Kristen Ruby-Cisneros, managing editor of the *Journal of Environmental Health*, to showcase its work and NEHA's history (www.neha.org/history). The NEHA History Project webpage provides an overview of the project and a list of task force members and how to get involved. Other highlights from the NEHA History Project webpage include:

- An electronic version of the NEHA Green Book: E*nvironmental Health 1937–1987, Fifty Years of Professional Development With the National Association of Sanitarians/ National Environmental Health Association* was published in 1987 by NEHA and provides a brief history of the first 50 years of the association. The task force, led by Dr. Hermen Koren, is developing a new and updated publication on the history of NEHA and the profession.
- NEHA Virtual Museum: We have posted images and descriptions of artifacts, instrumentation and tools, publications, and miscellaneous items related to environmental health and NEHA from the personal collection of Dr. Robert Powitz.
- A listing of past NEHA AECs: You can learn about where our past AECs have been held and peruse links to the reports published in the *Journal of Environmental Health* about each conference.

Dr. Leon Vinci has been a great chairperson keeping us on target. The task force has included distinguished individuals from academia such as Dr. Jack Hatlen and Dr. Herman Koren. Several NEHA past presidents have served on the task force, including Bob Custard, Diane Eastman, Dr. Amer El-Ahraf, Harry Grenawitzke, Dr. Priscilla Oliver, Dick Pantages, Vince Radke, Dr. Welford Roberts, and Dr. Chris Wiant. Retired RADM Webb Young represents the uniformed services and Drs. Robert Powitz and Leon Vinci represent the private sector. Rounding out the committee in an ex-officio capacity (along with me) are NEHA Executive Director Dr. David Dyjack and Kristen Ruby-Cisneros.

The NEHA History Project Task Force states it best: "All forms of input, ideas, and history are welcomed, and we invite you to share that with the task force. The task force also encourages individuals to reach out if interested in joining our work in preserving and presenting the history of NEHA and our profession."

Please become involved with NEHA on a local, state, or national level by spreading the word that environmental health is public health. In doing so, it can be as Dr. Seuss said, "You'll be on your way up! You'll be seeing great sights! You'll join the high fliers who soar to high heights."

gary.brown@eku.edu

Assessment of Chemical Exposures Investigation After Fire at an Industrial Chemical Facility in Winnebago County, Illinois

Jasmine Y. Nakayama, PhD
Krishna Surasi, MD
Epidemic Intelligence Service, Centers for Disease Control and Prevention

Lance R. Owen, PhD
Office of Innovation and Analytics, Agency for Toxic Substances and Disease Registry

Mark Johnson, PhD
Office of Community Health Hazard Assessment, Agency for Toxic Substances and Disease Registry

Sandra Martell, DNP
Abigail Kittler
Peter Lopatin, MBA
Winnebago County Health Department

Sarah Patrick, PhD
Illinois Department of Public Health

Caitlin Mertzlufft, PhD
Office of Community Health Hazard Assessment, Agency for Toxic Substances and Disease Registry

D. Kevin Horton, DrPH
Maureen Orr, MS
Office of Innovation and Analytics, Agency for Toxic Substances and Disease Registry

Abstract **After a chemical fire, an investigation assessed health effects by using syndromic surveillance to monitor emergency department (ED) visits, a general health survey to assess the general public, and a first responders health survey to assess first responders. A total of four separate multivariable logistic regression models were developed to examine associations between reported exposure to smoke, dust, debris, or odor with any reported symptom in the general public. Syndromic surveillance identified areas with increased ED visits. Among general health survey respondents, 45.1% (911 out of 2,020) reported at least one symptom. Respondents reporting exposure to smoke, dust, debris, or odor had 4.5 (95% confidence interval (CI) [3.7, 5.5]), 4.6 (95% CI [3.6, 5.8]), 2.0 (95% CI [1.7, 2.5]), or 5.8 (95% CI [4.7, 7.3]) times the odds of reporting any symptom compared with respondents not reporting exposure to smoke, dust, debris, or odor, respectively. First responders commonly reported contact with material and being within 1 mi of the fire ≥5 hr; 10 out of 31 of first responders reported at least one symptom. There was high symptom burden reported after the fire. Results from our investigation might assist the directing of public health resources to effectively address immediate community needs and prepare for future incidents.**

Introduction

On the morning of June 14, 2021, a fire ignited and spread rapidly through an industrial chemical facility owned by the largest industrial grease manufacturer in the U.S. and located on the Beloit Corporation Superfund site (U.S. Environmental Protection Agency [U.S. EPA], 2022a) in Winnebago County, Illinois (2020 population: 285,350; U.S. Census Bureau, n.d.). The fire created a dark plume of smoke visible by satellite imagery; required specialized firefighting services; and released smoke, dust, and debris for 4 days. Local authorities issued a 1-mi evacuation order and a 3-mi masking advisory during this time to assist mitigation of potential negative health outcomes in the nearby communities.

The available air sampling data from the U.S. Environmental Protection Agency demonstrated several 2.5 micron ($PM_{2.5}$) and 10 micron (PM_{10}) measurements above the World Health Organization public health screening levels (World Health Organization and Environmental Health Team, 2006); the Illinois Department of Public Health and the Agency for Toxic Substances and Disease Registry (ATSDR) determined that no measurements above the public health screening levels were found for other analytes monitored, including volatile organic compounds, carbon monoxide, oxygen, and hydrogen sulfide (Illinois Environmental Protection Agency, 2022; U.S. EPA, n.d.). Because additional chemical exposures, such as exposures to heavy metals, were unknown, public health authorities considered how to determine the health effects of the chemicals released from the fire in nearby communities and among first responders, who could have had different exposure experiences than the general population.

After a chemical exposure incident, ATSDR evaluates the need to conduct an Assessment of Chemical Exposures (ACE) investigation, which is an epidemiological assessment that can provide information to assess the health effects of the incident on individuals and communities, direct the public health response, focus outreach to prevent similar incidents, assess the need for modification of emergency response procedures, and identify groups of people who might need long-term follow-up (Agency

TABLE **1**

Characteristics of General Health Survey Respondents by Symptom Status and Overall and Characteristics of the General Population From 11 ZIP Codes, Winnebago County, Illinois, July 2021

Characteristic	Asymptomatic Respondents (*n* = 1,109) # (%)	Symptomatic Respondents (*n* = 911) # (%)	Respondents Overall (*N* = 2,020) # (%)	General Population From 11 ZIP Codes (*N* = 240,043) # (%)
Age (years)				
0–19	17 (1.5)	11 (1.2)	28 (1.4)	61,626 (25.7)
20–44	370 (33.4)	363 (39.8)	733 (36.3)	72,678 (30.3)
45–64	492 (44.4)	400 (43.9)	892 (44.2)	64,305 (26.8)
≥65	225 (20.3)	135 (14.8)	360 (17.8)	41,434 (17.3)
Missing	5 (0.5)	2 (0.2)	7 (0.3)	–
Gender or Sex [a]				
Female	664 (59.9)	613 (67.3)	1,277 (63.2)	123,580 (51.5)
Male	431 (38.9)	272 (29.9)	703 (34.8)	116,463 (48.5)
Transgender	1 (0.1)	5 (0.5)	6 (0.3)	–
Other	1 (0.1)	5 (0.5)	6 (0.3)	–
Prefer not to answer	12 (1.1)	16 (1.8)	28 (1.4)	–
Race				
White	967 (87.2)	777 (85.3)	1,744 (86.3)	188,983 (78.7)
Black or African American	25 (2.3)	40 (4.4)	65 (3.2)	30,516 (12.7)
Other	21 (1.9)	21 (2.3)	42 (2.1)	4,396 (1.8)
Asian	31 (2.8)	9 (1.0)	40 (2.0)	7,291 (3.0)
Multiracial	15 (1.4)	12 (1.3)	27 (1.3)	8,075 (3.4)
American Indian or Alaska Native	2 (0.2)	6 (0.7)	8 (0.4)	757 (0.3)
Native Hawaiian or Pacific Islander	0 (0)	0 (0)	0 (0)	25 (<0.1)
Prefer not to answer	48 (4.3)	46 (5.0)	94 (4.7)	–
Hispanic or Latino				
No	1,064 (95.9)	855 (93.9)	1,919 (95.0)	209,996 [b] (87.5)
Yes	45 (4.1)	56 (6.1)	101 (5.0)	30,047 (12.5)

continued on page 10

for Toxic Substances and Disease Registry [ATSDR], 2016; Duncan, 2014). On June 25, 2021, the Illinois Department of Public Health invited ATSDR to conduct an ACE investigation (Surasi et al., 2021).

This article presents findings from the ACE investigation of a chemical fire in Winnebago County, Illinois. The investigation included several public health tools to examine the magnitude, geography, and nature of the health effects of the fire in nearby communities and assessed exposures and health outcomes among first responders.

Methods

This ACE investigation used syndromic surveillance to monitor emergency department (ED) visits, a general health survey to assess the general public, and a first responders health survey to assess first responders.

Syndromic Surveillance

State health departments have access to the Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE), a syndromic surveillance program that monitors counts of reasons for ED visits (i.e., chief complaints) (Burkom et al., 2021; Centers for Disease Control and Prevention, 2022). The ESSENCE program incorporates statistical methods to detect anomalies in data and provides alerts and warnings that can guide efforts to determine if the trends require further attention or intervention. ESSENCE was used to monitor trends in ED visits during the month after the incident, map ZIP Code areas with the largest numbers of ED visits, and specify which chief complaints (e.g., respiratory, mental health) increased in these areas. As the facility was near the Wisconsin border, the Wisconsin Department of Health Services also queried ESSENCE using the same criteria for ED visits related to the fire during June 14–July 1, 2021.

General Health Survey

Using a general health survey to assess the general public, the investigation team examined the association of residents' reported contact with material (i.e., smoke, dust, debris) or report of smelling an odor with any reported new or worsening symptom within the 2 weeks prior to survey completion. The investigation team designed an electronic survey that was adapted from survey forms available from ATSDR's ACE Toolkit (ATSDR, 2014; Duncan & Orr, 2016) and Epi Contact Assessment Symptom Exposure (Epi CASE) Toolkit (ATSDR, 2020) to evaluate the human health effects of the fire in the nearby population. The survey asked about demographic characteristics, residential distance from the facility, contact with material, smelling an odor, healthcare use, and new or worsening symptoms within the 2 weeks prior to survey completion.

Demographic characteristics included age, gender, race, and ethnicity. Age was calculated from date of birth and categorized as 0–19, 20–44, 45–64, and ≥65. Respondents selected one option for gender: female, male, transgender, or other. Respondents self-reported race from a list of options (White, Black or African American, Asian, American Indian or Alaska Native, Native Hawaiian or Pacific Islander, Other) and were considered "Multiracial" if they selected more than one

race. Respondents indicated whether they were Hispanic or Latino. The distribution of age, gender or sex, race, and ethnicity was compared between survey respondents and the entire population of the 11 ZIP Codes of interest using estimates from the American Community Survey 5-Year Data 2019 (U.S. Census Bureau, 2021).

Residential addresses of survey respondents were geocoded at the census tract level. Their residential distance from the facility was calculated using Esri's ArcGIS Pro desktop application, and respondents were categorized as living <1, 1 to <3, 3 to <5, 5 to <10, 10 to <15, or ≥15 mi from the facility. Geospatial analyses used data from the Social Vulnerability Index (SVI), in which a higher quartile indicates higher social vulnerability (i.e., a community's susceptibility to negative effects from disasters) than a lower quartile (ATSDR, 2022).

The survey asked about contact with material and respondents chose all that applied: smoke, dust, debris, other, none, or unsure. Respondents also indicated if they smelled an odor. The survey then asked about the highest level of healthcare received because of the incident: formal healthcare services (i.e., hospitalization; visit to an ED, urgent care center, or outpatient clinic; or telehealth consult), self-treatment, or no healthcare needed.

The survey asked, "Over the past 2 weeks since the event have you experienced worsening of a preexisting or a new onset of any of the following symptoms?" and allowed respondents to select all that applied from a list of symptoms organized by category: ears, nose, and throat (ENT); neurological; ophthalmic; cardiopulmonary; psychiatric; and skin. Respondents reporting a new or worsening symptom within the 2 weeks prior to survey completion were categorized as symptomatic and all others as asymptomatic. Among symptomatic respondents, it was determined which symptoms were reported, how many symptoms were reported, and how many symptom categories were involved.

The survey was administered by leveraging the Qualtrics XM Platform client engagement system, which is an existing system that was used for COVID-19 vaccination registration. The survey was publicly available July 1–15, 2021, and residents could access it through a link shared via news outlets, social media, and the local health department website. Additionally, on July 5, the Qualtrics system was used to send the survey link to 40,217 email addresses of registered residents from 11 ZIP Codes of interest (5 identified through surveillance data and 6 nearby ones) and it was noted whether a respondent accessed the survey through the email link. On July 12, the survey link was emailed to registered residents of a neighboring Wisconsin county.

Survey data were analyzed in R software (version 4.1.0) and a response was excluded if it was a duplicate entry, the residential addresses did not geocode, it was missing symptom data, or it was from a first responder. Duplicate entries were determined by identifying duplicate unique identifiers created by the Qualtrics system; the earliest entry was included and subsequent entries with the same unique identifier were excluded. Additionally, geospatial analysis was conducted to visualize the distribution of respondents reporting any symptom. Frequencies were calculated for reported demographic characteristics, residential distance from the facility, healthcare use, contact with material, smelling an odor, and symptoms for residents from the general public responding to the general health survey. Multivariable logistic regres-

TABLE **1** continued from page 9

Characteristics of General Health Survey Respondents by Symptom Status and Overall and Characteristics of the General Population From 11 ZIP Codes, Winnebago County, Illinois, July 2021

Characteristic	Asymptomatic Respondents (*n* = 1,109) # (%)	Symptomatic Respondents (*n* = 911) # (%)	Respondents Overall (*N* = 2,020) # (%)	General Population From 11 ZIP Codes (*N* = 240,043) # (%)
Residential distance from the facility				
<1 mi	26 (2.3)	92 (10.1)	118 (5.8)	–
1–<3 mi	140 (12.6)	175 (19.2)	315 (15.6)	–
3–<5 mi	86 (7.8)	90 (9.9)	176 (8.7)	–
5–<10 mi	233 (21.0)	177 (19.4)	410 (20.3)	–
10–<15 mi	438 (39.5)	280 (30.7)	718 (35.5)	–
≥15 mi	186 (16.8)	97 (10.6)	283 (14.0)	–
Healthcare use				
No healthcare needed	1,096 (98.8)	451 (49.5)	1,547 (76.6)	–
Self-treated	8 (0.7)	347 (38.1)	355 (17.6)	–
Consulted a healthcare professional via phone or video conferencing	3 (0.3)	45 (4.9)	48 (2.4)	–
Visited an emergency department, urgent care, or outpatient clinic	0 (0)	57 (6.3)	57 (2.8)	–
Hospitalized	0 (0)	4 (0.4)	4 (0.2)	–
Missing	2 (0.2)	7 (0.8)	9 (0.4)	–

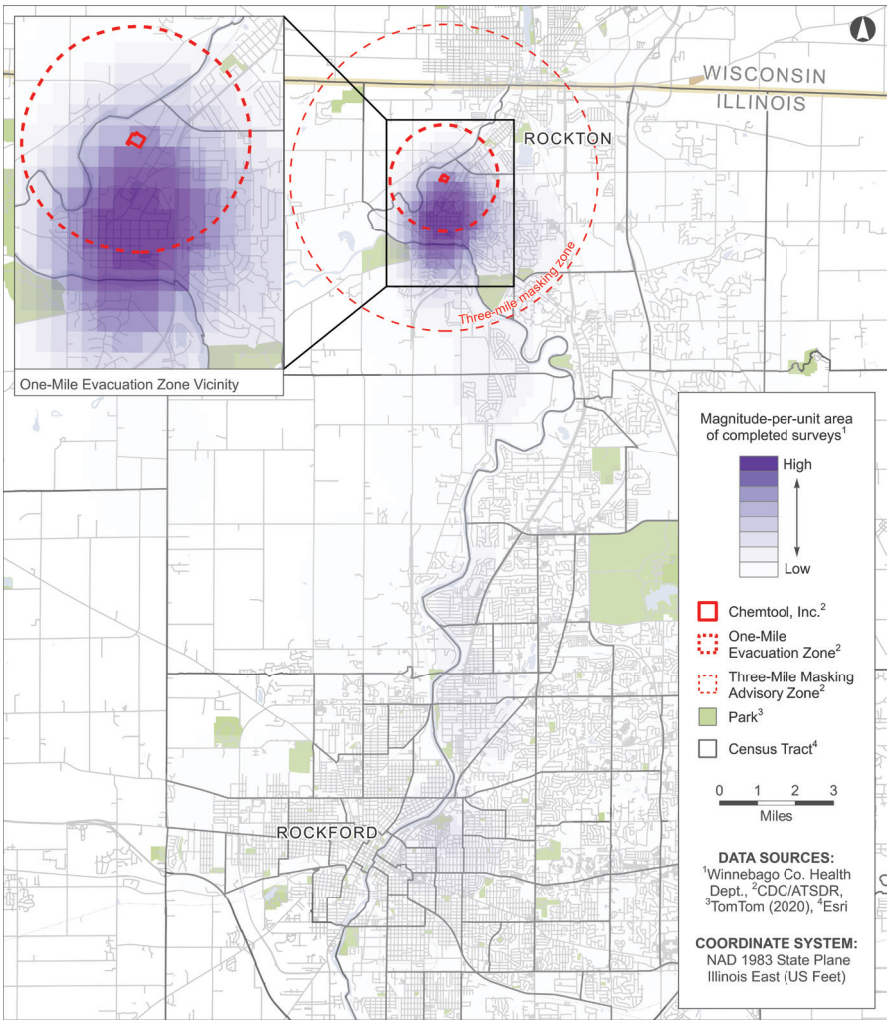
Note. Data include survey respondents of the general health survey and exclude first responders. General population data were obtained from the American Community Survey 5-Year Data 2019.

[a] Survey respondents self-identified their gender. The American Community Survey 5-Year Data 2019 presents proportions for sex.

[b] The non-Hispanic or Latino proportion of the general population was calculated by subtracting the number of Hispanic or Latino proportion from the total population.

FIGURE **1**

Kernel Density Map of General Health Survey Respondents Reporting a New or Worsening Symptom Within the 2 Weeks Prior to Survey Completion, Winnebago County, Illinois, July 2021



Note. Data include survey respondents of the general health survey and exclude first responders. CDC/ATSDR = Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry.

sion was applied to assess the association of contact with material or smelling an odor with the outcome of symptom status (symptomatic versus asymptomatic) among residents from the general public. Four separate models were developed with symptom status as the dependent variable and contact with smoke, contact with dust, contact with debris, or smelling an odor as the main exposure variable—and were adjusted for age, gender, race, ethnicity, and residential distance from the facility.

First Responders Health Survey

Although the general health survey was available to the general public, a separate health survey was later developed specifically for first responders that had nearly identical questions. Because it was suspected that first responders did not want to be identified on the general health survey because of fear of professional consequences, the first responders survey did not require them to enter identifying information to complete it. Local police and fire chiefs shared the survey link through internal professional communication channels.

First responders who completed the first responders health survey and respondents who completed the general health survey (e.g., before the first responders health survey was available) and self-identified as first responders were grouped together. Frequencies were calculated for reported demographic characteristics, use of personal protective equipment (PPE), contact with material, smelling an odor, symptoms, and healthcare use for first responders. No inferential statistical tests for first responders were performed because of small sample size.

This activity was reviewed by the Centers for Disease Control and Prevention (CDC) and was conducted consistent with applicable federal law and CDC policy.

Results

Syndromic Surveillance

ESSENCE syndromic surveillance data identified 15% more ED visits than baseline on the day of the incident in the county, and the number declined within the week. Mapping the area around the facility, the team identified 6 ZIP Code areas downwind of the facility with the largest number of ED visits. Among residents in those 6 ZIP Code areas, ESSENCE data showed alerts and warnings for specific chief complaints compared with the previous 90-day baseline. Chief complaints for respiratory symptoms increased on June 14, and chief complaints for asthma increased on June 17. Chief complaints for disaster-related mental health increased on June 15, and chief complaints related to self-harm increased on multiple days. Continued trends in ESSENCE 1 month after the incident were not identified.

The ESSENCE query conducted by the Wisconsin Department of Health Services resulted in 17 unique results for individuals visiting the ED from June 15–24; further, 6 of the results had a direct reference to the chemical fire for the chief complaint. None of the individuals was admitted for a higher level of care.

General Health Survey

From an initial 2,053 responses, 2 duplicate entries, 17 responses with residential

addresses that did not geocode, 4 responses that were missing symptom data, and 10 responses from first responders were excluded, resulting in an analytic sample of 2,020. Overall, 911 (45.1%) of respondents reported experiencing at least one new or worsening symptom within the 2 weeks prior to survey completion. Characteristics of respondents by symptom status and respondents overall, along with demographic characteristics of the general population from 11 ZIP Codes, are shown in Table 1. Figure 1 presents a map of the distribution of symptomatic respondents using a magnitude-per-unit-area visualization. Only 91 responses were completed between July 1–5; on July 6 and 7, an additional 860 and 630 responses were completed, respectively. Among symptomatic respondents, 80.6% (734 out of 911) accessed the survey through the email link, and among asymptomatic respondents, 96.1% (1,066 out of 1,109) used the email link to access the survey. Analysis indicated fewer survey responses and fewer reports of using formal healthcare services in census tracts with the highest SVI quartile compared with census tracts with lower SVI quartiles in a nearby city.

A total of 1,225 (60.6%) respondents reported contact with any material, with 965 (78.8%), 498 (40.7%), 690 (56.3%), and 47 (3.8%) of them reporting contact with smoke, dust, debris, and other material, respectively. A total of 1,047 (51.8%) respondents reported smelling an odor. Table 2 presents adjusted odds ratios for four separate models with reported symptom status as the outcome variable and different exposure variables (i.e., contact with smoke, contact with dust, contact with debris, or smelling an odor), adjusting for age, gender, race, ethnicity, and residential distance from the facility.

Among the 911 symptomatic respondents, 635 (69.7%) reported any ENT symptom, 477 (52.4%) reported any neurological symptom, 380 (41.7%) reported any ophthalmic symptom, 302 (33.2%) reported any cardiopulmonary symptom, 237 (26.0%) reported any psychiatric symptom, and 99 (10.9%) reported any skin symptom. Among symptomatic respondents, the median number of symptoms was 4 (interquartile range: 2–6) and the median number of symptom cat-

TABLE **2**

Adjusted Odds Ratio Associated With General Health Survey Respondents Reporting a New or Worsening Symptom Within the 2 Weeks Prior to Survey Completion for Four Separate Models With Different Exposure Variables, Winnebago County, Illinois, July 2021

Exposure Group	Adjusted *OR*	95% CI
Contact with smoke versus no contact with smoke	4.5	[3.7, 5.5]
Contact with dust versus no contact with dust	4.6	[3.6, 5.8]
Contact with debris versus no contact with debris	2.0	[1.7, 2.5]
Smelling an odor versus not smelling an odor	5.8	[4.7, 7.3]

Note. Data include survey respondents of the general health survey and exclude first responders. The four separate models are adjusted for age, gender, race, ethnicity, and residential distance from the facility. A total of six respondents with missing age data were removed from all four models. Furthermore, a total of 252 respondents were unsure about smelling an odor and were removed from the model with smelling an odor as the exposure variable. CI = confidence interval.

TABLE **3**

General Health Survey Respondents Reporting a New or Worsening Symptom Within the 2 Weeks Prior to Survey Completion for Commonly Reported Symptoms, Winnebago County, Illinois, July 2021

Symptom	Symptom Category	Respondents Reporting Symptom (*N* = 2,020) # (%)
Headache	Neurological	449 (22.2)
Stuffy nose or sinus congestion	ENT	384 (19.0)
Increased congestion or phlegm (mucus)	ENT	309 (15.3)
Irritation, pain, or burning in eyes	Ophthalmic	280 (13.9)
Burning nose or throat	ENT	267 (13.2)
Runny nose	ENT	250 (12.4)
Anxiety	Psychiatric	208 (10.3)
Coughing	Cardiopulmonary	207 (10.2)
Increased watering or tearing	Ophthalmic	199 (9.9)
Hoarseness	ENT	198 (9.8)
Dizziness or lightheadedness	Neurological	181 (9.0)
Difficulty breathing or feeling out-of-breath	Cardiopulmonary	139 (6.9)
Tension or nervousness	Psychiatric	129 (6.4)
Asthma	Cardiopulmonary	105 (5.2)
Fatigue or tiredness	Psychiatric	104 (5.1)
Difficulty sleeping (e.g., falling asleep, staying asleep)	Psychiatric	100 (5.0)

Note. Data include survey respondents of the general health survey and exclude first responders. The table includes only symptoms reported by ≥100 respondents. Respondents were able to report more than one symptom. ENT = ears, nose, and throat.

TABLE **4**

First Responders Reporting a New or Worsening Symptom Within the 2 Weeks Prior to Survey Completion, Winnebago County, Illinois, July 2021

Symptom	Symptom Category	First Responders Reporting (*N* = 31) # (%)
Headache	Neurological	4 (12.9)
Irritation, pain, or burning in eyes	Ophthalmic	3 (9.7)
Coughing	Cardiopulmonary	3 (9.7)
Hoarseness	ENT	2 (6.5)
Stuffy nose or sinus congestion	ENT	2 (6.5)
Increased congestion or phlegm (mucus)	ENT	2 (6.5)
Asthma	Cardiopulmonary	2 (6.5)
Runny nose	ENT	1 (3.2)
Burning nose or throat	ENT	1 (3.2)
Odor on breath	ENT	1 (3.2)
Sensation in throat	ENT	1 (3.2)
Dizziness or lightheadedness	Neurological	1 (3.2)
Blurred or double vision	Ophthalmic	1 (3.2)
Difficulty breathing or feeling out-of-breath	Cardiopulmonary	1 (3.2)
Wheezing in chest	Cardiopulmonary	1 (3.2)

Note. Data include respondents of the first responders health survey and respondents of the general health survey who self-identified as first responders. Data exclude respondents of the general health survey who did not self-identify as first responders. Respondents were able to report more than one symptom. ENT = ears, nose, and throat.

egories involved was 2 (interquartile range: 1–3). Symptoms reported by ≥100 respondents are listed in Table 3. Among symptomatic respondents, 106 (11.6%) used formal healthcare services and 347 (38.1%) self-treated. Four respondents who used formal healthcare services were hospitalized and the reported indications for admission were asthma (*n* = 2), epistaxis (*n* = 1), and one unknown indication.

First Responders Health Survey

Representing 14 different organizations, 31 first responders completed the surveys (10 from the general health survey and 21 from the first responders health survey). One first responder self-identified as female and the rest self-identified as male. Further, 28 first responders self-identified as White, 1 self-identified as Black or African American, 1 self-identified as Other for race, and 1 first responder was missing race data. Furthermore, 2 first responders self-identified as Hispanic or Latino, 1 was missing ethnicity data, and the remaining self-identified as non-Hispanic or Latino.

Moreover, 19 first responders reported wearing standard fire protection gear (i.e., fire helmet, turnout pants and jacket, leather gloves, and boots); 3 first responders reported wearing a mask; and 7 first responders reported not wearing a mask, gloves, goggles, hazmat suit coveralls, or standard fire protection gear. Further, 7 first responders reported spending ≤4 hr, 17 reported spending 5–23 hr, 5 reported spending ≥24 hr, and 2 were missing data on time spent within 1 mi of the facility. Only 2 first responders reported not contacting any material; 26, 19, 19, and 5 reported contact with smoke, dust, debris, and other material, respectively. And lastly, 26 first responders reported smelling an odor, 4 were unsure whether they smelled an odor, and 1 reported not smelling an odor.

Of the 10 symptomatic first responders, 6 reported ENT symptoms, 4 reported neurologic symptoms, 3 reported ophthalmic symptoms, and 5 reported cardiopulmonary symptoms (Table 4). Furthermore, 1 of the 10 symptomatic first responders sought care in an ED, urgent care, or outpatient clinic; 2 first responders self-treated; and the remaining 28 did not need healthcare.

Discussion

Nearly one half of the general health survey respondents reported a new or worsening symptom within the 2 weeks prior to survey completion. Moreover, reported contact with smoke, dust, or debris or report of smelling an odor was strongly associated with being symptomatic. This association suggests that the increase in reported symptoms could be related to reported exposure to the fire and its resulting material. Reported symptoms are consistent with previous reports of exposure to elevated $PM_{2.5}$ and PM_{10} (An Han et al., 2020; Bazyar et al., 2019). While the long-term health effects of this incident are unknown, other reports have identified adverse health outcomes reported many years after acute exposure to a chemical fire (Degher & Harding, 2004; Granslo et al., 2017; Greven et al., 2009). Given the high level of reported symptom burden in this sample, support for the community's access to appropriate healthcare resources and ongoing monitoring for changes in health, such as via syndromic surveillance, should be prioritized.

Findings from this investigation can also inform leaders to prepare for future emergency responses. Industrial companies can consider discussions to prevent and mitigate incidents with chemical exposures by having safety measures and emergency response resources to limit impact on the surrounding population and environment. Robust participation in Local Emergency Planning Committees can contribute to emergency response planning (U.S. EPA, 2022b). Careful attention to first responders' working conditions and PPE, especially during chemical exposures, is important in protecting the health of this group (Melnikova et al., 2018). More attention to gender, racial, and ethnic minority groups and residents from areas with higher social vulnerability—who might be at higher risk for negative effects from disasters—could contribute to a better understanding of if and how specific groups are disproportionately

affected by chemical exposures. Additionally, future investigations and survey methods (e.g., oversampling) could be beneficial in addressing this issue.

Our findings are subject to limitations of the survey that was rapidly modified from an in-person, interviewer-administrated survey to an electronic, self-administrated survey with limited time for validation. The general health survey might not be representative of the entire exposed cohort because it used a convenience sample. Further, the general health survey was primarily accessed through a direct link emailed to registrants who signed up for COVID-19 vaccine updates and required respondents to provide contact information and demographic information. This sampled population might be more comfortable with electronic communications, interested in public health activities, and agreeable to providing identifying information in surveys than the general public (Tripepi et al., 2010). The general health survey used an adapted Epi CASE survey—a brief survey designed to capture information soon after a disaster—but it did not capture detailed information on behaviors that might have increased or decreased exposure, factors affecting health status, or the nature of contact with material. Moreover, the general health survey did not collect detailed information, such as duration or intensity, about the characteristics of symptoms. Furthermore, the survey question about use of healthcare did not provide an option for respondents to indicate that they needed healthcare but lacked access, which could potentially mask the needs and experiences of different groups of people. Additionally, the 1-mi evacuation order and 3-mi masking advisory might have affected respondents' exposure, perception of risks, and responses to survey questions.

Conclusion

An epidemiological assessment was performed after a large chemical fire at a facility to identify potentially affected areas and assess the health effects of the fire in nearby communities and among first responders. This investigation was successful in using several public health tools after a fire at an industrial chemical facility in Winnebago County, Illinois. High levels of reported symptom burden were identified among surveyed residents. There were associations between respondents' reported contact with material or report of smelling an odor with any reported new or worsening symptom. Results from this investigation might assist the directing of public health resources to effectively address immediate community needs and prepare for future incidents.

Disclaimer: The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of CDC or ATSDR.

Corresponding Author: Jasmine Y. Nakayama, Centers for Disease Control and Prevention, 4770 Buford Highway NE, Mailstop S107-5, Chamblee, GA 30341. Email: qdt2@cdc.gov.

References

Agency for Toxic Substances and Disease Registry. (2014). *ACE ToolKit*. https://www.atsdr.cdc.gov/ntsip/ace_toolkit.html

Agency for Toxic Substances and Disease Registry. (2016). *Assessment of Chemical Exposures (ACE) Program*. https://www.atsdr.cdc.gov/ntsip/ACE_ToolKit/docs/ACE_Fact%20Sheet_053014.pdf

Agency for Toxic Substances and Disease Registry. (2020). *Epi CASE Toolkit*. https://www.atsdr.cdc.gov/epitoolkit/index.html

Agency for Toxic Substances and Disease Registry. (2022). *CDC/ATSDR Social Vulnerability Index*. https://www.atsdr.cdc.gov/placeandhealth/svi/index.html

An Han, H., Han, I., McCurdy, S., Whitworth, K., Delclos, G., Rammah, A., & Symanski, E. (2020). The Intercontinental Terminals Chemical Fire Study: A rapid response to an industrial disaster to address resident concerns in Deer Park, Texas. *International Journal of Environmental Research and Public Health*, *17*(3), Article 986. https://doi.org/10.3390/ijerph17030986

Bazyar, J., Pourvakhshoori, N., Khankeh, H., Farrokhi, M., Delshad, V., & Rajabi, E. (2019). A comprehensive evaluation of the association between ambient air pollution and adverse health outcomes of major organ systems: A systematic review with a worldwide approach. *Environmental Science and Pollution Research*, *26*(13), 12648–12661. https://doi.org/10.1007/s11356-019-04874-z

Burkom, H., Loschen, W., Wojcik, R., Holtry, R., Punjabi, M., Siwek, M., & Lewis, S. (2021). Electronic Surveillance System for the Early Notification of Community-Based Epidemics (ESSENCE): Overview, components, and public health applications. *JMIR Public Health and Surveillance*, 7(6), e26303. https://doi.org/10.2196/26303

Centers for Disease Control and Prevention. (2022). *National Syndromic Surveillance Program (NSSP)*. https://www.cdc.gov/nssp/index.html

Degher, A., & Harding, A.K. (2004). Case study of a chemical fire in an urban neighborhood: A wakeup call for the emergency response system. *Journal of Emergency Management*, *2*(3), 33–42. https://doi.org/10.5055/jem.2004.0031

Duncan, M.A. (2014). Assessment of chemical exposures: Epidemiologic investigations after large-scale chemical releases. *Journal of Environmental Health*, 77(2), 36–38.

Duncan, M.A., & Orr, M.F. (2016). Toolkit for epidemiologic response to an acute chemical release. *Disaster Medicine and Public Health Preparedness*, *10*(4), 631–632. https://doi.org/10.1017/dmp.2015.187

Granslo, J.T., Bråtveit, M., Hollund, B.E., Lygre, S.H., Svanes, C., & Moen, B.E. (2017). A follow-up study of airway symptoms and lung function among residents and workers 5.5 years after an oil tank explosion. *BMC Pulmonary Medicine, 17*(1), Article 18. https://doi.org/10.1186/s12890-016-0357-3

References

Greven, F., Kerstjens, H.A.M., Duijm, F., Eppinga, P., de Meer, G., & Heederik, D. (2009). Respiratory effects in the aftermath of a major fire in a chemical waste depot. *Scandinavian Journal of Work, Environment & Health*, *35*(5), 368–375. https://doi.org/10.5271/sjweh.1328

Illinois Environmental Protection Agency. (2022). *Chemtool Inc.* https://www2.illinois.gov/epa/topics/community-relations/sites/Chemtool/Pages/default.aspx

Melnikova, N., Wu, J., Yang, A., & Orr, M. (2018). Acute chemical incidents with injured first responders, 2002–2012. *Disaster Medicine and Public Health Preparedness*, *12*(2), 211–221. https://doi.org/10.1017/dmp.2017.50

Surasi, K., Nakayama, J.Y., Johnson, M., Martell, S., Patrick, S., Owen, L.R., Horton, D.K., & Orr, M. (2021). Notes from the field: Deployment of an electronic self-administered survey to assess human health effects of an industrial chemical facility fire—Winnebago County, Illinois, June–July 2021. *Morbidity and Mortality Weekly Report*, *70*(49), 1715–1716. https://doi.org/10.15585/mmwr.mm7049a4

Tripepi, G., Jager, K.J., Dekker, F.W., & Zoccali, C. (2010). Selection bias and information bias in clinical research. *Nephron Clinical Practice*, *115*(2), c94–c99. https://doi.org/10.1159/000312871

U.S. Census Bureau. (2021). *American Community Survey 5-Year Data 2019*. https://www.census.gov/data/developers/data-sets/acs-5year/2019.html

U.S. Census Bureau. (n.d.). *Census—Geography profile. Winnebago County, Illinois*. https://data.census.gov/cedsci/profile?g=0500000US17201

U.S. Environmental Protection Agency. (2022a). *Superfund site: BELOIT CORP., Rockton, IL*. https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0500272

U.S. Environmental Protection Agency. (2022b). *Local Emergency Planning Committees*. https://www.epa.gov/epcra/local-emergency-planning-committees

U.S. Environmental Protection Agency. (n.d.). *Chemtool fire*. https://response.epa.gov/site/site_profile.aspx?site_id=15241

World Health Organization and Environmental Health Team. (2006). *WHO air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide: Global update 2005: Summary of risk assessment*. https://apps.who.int/iris/handle/10665/69477

The COVID-19 Pandemic, Fukushima Nuclear Disaster, and Commonalities and Public Health Threat Complexities: A Public Health, Healthcare, and Emergency Management Command and Support Supersystem Model

Christopher Eddy, MPH, REHS, CP-FS
School of Science, Engineering, and Technology, College of Nursing and Health Care Professions, Grand Canyon University
Emergency Preparedness and Response, Fairfax County Health Department

Eriko Sase, PhD
Graduate School of Medicine, University of Tokyo Global Health Research Center of Japan, University of Nagasaki Saitama Prefectural University

Abstract **This article is a 12-year retrospective of the Fukushima nuclear disaster with a 7-year revisitation of our publication, "Implications of the Fukushima Nuclear Disaster: Man-Made Hazards, Vulnerability Factors, and Risk to Environmental Health" (Eddy & Sase, 2015). We shed light on early and erroneous assumptions made about the global environmental health impact, as well as follow up on prolonged site remediation difficulties and controversial scheduled discharges of containerized wastewater. As we developed a refreshed vision of the triple nuclear reactor meltdown, we incorporated lessons learned from the COVID-19 pandemic that resulted in a novel and universally applicable Public Health, Healthcare, and Emergency Management Command and Support Supersystem Model.**

The model addresses all-hazards readiness needs, which is a core component of U.S. Department of Health and Human Services/Administration for Strategic Preparedness and Response, U.S. Department of Homeland Security/Federal Emergency Management Agency, and U.S. Centers for Medicare & Medicaid Services (CMS) guidelines and law. The model and associated narrative is intended to guide future global and international public health threat planning and response and provide a decision support tool for state and local public health, emergency management, and homeland security practitioners. The model integrates core aspects of U.S. emergency preparedness and response federal doctrine and CMS regulations—representing multiple agencies, professions, and healthcare facility guidelines—with an integrated foundation of practical concepts from One Health, public health, and all-hazards approaches. Although internationally coordinated public health threat prevention and containment is the primary point of emphasis, our model can be applied at all jurisdictional levels.

Double Natural Disaster

On March 11, 2011, after the magnitude 9.0 Great East Japan Earthquake (also called the Tohoku earthquake and tsunami)—the strongest *earthquake* in Japan's recorded history—a 133-ft tsunami triggered a cascading sequence of power loss events that caused three nuclear reactor cores to melt completely, culminating in a massive release of radiation (Eddy & Sase, 2015; World Nuclear Association, 2022). The Fukushima nuclear disaster was designated an International Nuclear Event Scale (INES) Level 7 major accident, which is the highest level of severity and a level reached previously only with the 1986 Chernobyl disaster (The National Diet of Japan, 2012). The effects of the Fukushima nuclear disaster continue today, without the shielding sarcophagus that entombed the immediate and acute radiation threat in the Chernobyl disaster. Japan has, however, reversed its movement away from reliance on nuclear energy post-disaster in policies that align with a growing global nuclear power renaissance. These policies are aimed specifically at aggressively building new nuclear reactors and extending the lifespan of existing reactors by 20 years, even in the continuing global absence of nuclear waste disposal capacity (Noriyuki, 2022).

Early disaster reports contained assumptions that most of the radionuclides were discharged directly into the Pacific Ocean and thus justified threat assumptions gauged in comparison to the Chernobyl disaster. These threat assumptions included expediency of food safety precautions, securement of the relative area of impacted ecosystems, efficiency of evacuations, and an absence of immediate human deaths from radiation exposure (Steinhauser et al., 2014). Accounts of the disaster in print frequently relegated the Fukushima nuclear disaster to the title of the "second worst nuclear accident in history" (Bendix, 2019; Encyclopædia Britannica, 2022).

In the U.S., news media reported that traces of the fallout from the Fukushima nuclear disaster were detected by monitors throughout the U.S. at thresholds below levels that could possibly be of public health concerns (Guarino, 2012; Toro, 2011). The reporting echoed the message in an announcement from the U.S. Environmental Protection

What Is Already Known About This Topic?

Following the first-ever recorded triple nuclear reactor meltdown in 2011, the high-impact global environmental health threat was not communicated adequately to the public at local and international levels, while mitigation challenges increased dramatically through a series of failed engineering systems. The opportunity for containment and primary public health prevention was lost due to inadequate planning and vulnerability analysis. As a result, the stored radiological inventories escaped into the environment without barriers.

Efforts toward site cleanup now occur parallel to the COVID-19 pandemic. The primary public health prevention barriers to SARS-CoV-2 infection (i.e., distance, masks, vaccines) were available but not completely utilized by many nations, in part due to the lack of a unified and accepted Common Operating Picture of the pandemic life cycle and pathogen transmission pathways, adequate personal protective equipment, social distancing, and infection and health risks. Moreover, both incidents—the Fukushima nuclear disaster and the COVID-19 pandemic—are in a global crisis stage at 12- and 3-years of duration, respectively. In the U.S., emergency management doctrine speaks to prevention exclusively in terms of counterterrorism, cybersecurity, and other intentional attacks.

What Does This Article Add?

We update and clarify early nuclear incident misinformation, emphasize present threats and cleanup challenges, and recognize the need to update the traditional emergency management cycle rubric. We present a universally applicable model, the Public Health, Healthcare, and Emergency Management Command and Support Supersystem Model, which is based on our analysis of lessons learned from the Fukushima nuclear disaster and parallels presented by the ongoing COVID-19 pandemic. In our model, we integrate One Health and public health approaches with an all-hazards approach to public health threat prevention through health systems protection, which emphasizes population health and health equity that can adjust to asymmetrical, nonlinear, and protracted incident progression.

The model definitively recognizes the unique aspects of public health primary prevention; integrates the emergency management concept of mitigation; and merges preparedness, containment, and mitigation within the public health threat prevention phase, a FEMA Mission Area that is presently not well-defined. Containment, a construct of prevention, is the principal goal and tool to prevent radiological and biological incident transnational expansion. The model unifies often siloed public health, healthcare, and emergency management sectors while focusing on the protection of community hospitals and other healthcare facilities against exceeding medical care capacity, and preventing the activation of mitigation systems such as crisis standards of care and other service rationing systems.

What Are the Environmental Public Health Implications?

Over a decade after the Fukushima nuclear disaster, while facing a nearly insurmountable radiologically contaminated waste disposal incapacity, Japan made a controversial decision to intentionally discharge 1 million tons of processed wastewater containing radionuclides into the Pacific Ocean. Presently, large volumes of radioactive debris and damaged nuclear fuel are vulnerable to natural, accidental, and intentional trigger events that could reinitiate devastating nuclear reactions.

Separately, but similarly, the failure to implement in a timely manner the International Public Health Regulations to contain the novel coronavirus within Chinese borders resulted in the expansion of a national epidemic into a pandemic and a long-term and presently evolving global health crisis. Hence, while our novel model differentiates specifically avoidable human-caused hazards from natural disaster and utilizes examples from the existential pandemic and ongoing nuclear crisis, we focus on the shifting sense of urgency through the crisis aspect of the incident timeline (i.e., the acute phase of an incident) regardless of its official or legal designation (i.e., emergency, disaster) or magnitude. Moreover, we focus on the constant situational awareness evaluation and appropriate and immediate operational adjustment—based on the constant situational awareness of incident complexity triggers—that is needed to enable the prevention, containment, and mitigation of future incidents. Further, considering both the COVID-19 pandemic and the Fukushima nuclear disaster from a global health perspective, international coordination did not occur immediately, devastating consequences arose and are ongoing, and nation-specific policies continue to vary significantly around the world at the time of writing this article. Global public health incidents require globally coordinated solutions. Although internationally coordinated incident prevention and hazard containment is the primary point of emphasis, we posit that our Public Health, Healthcare, and Emergency Management Command and Support Supersystem Model can be applied at all levels of jurisdiction.

Agency (U.S. EPA, 2012). A U.S. EPA Office of Inspector General audit published more than 1 year after the incident, however, noted that many monitors were broken or had filters that were not maintained according to procedure, thus impairing the reliability of the monitoring and critical reporting infrastructure (U.S. EPA, 2012).

Globally, 14 months after the disaster, the World Health Organization (WHO, 2012) released its preliminary dose assessment that reported "probable partial" reactor core meltdowns at the Fukushima Daiichi Nuclear Power Plant. The report contained no discussion about the highly toxic mixed oxide (MOX) fuel in reactor Unit 3 that contained up to 6% plutonium (Union of Concerned Scientists, 2011). The prime minister of Japan stated, "Some may have concerns about Fukushima. Let me assure you, the situation is under control. It has never done and will never do any damage to Tokyo" (Prime Minister of Japan and His Cabinet, 2013).

Human-Caused Disaster

The chair of the Fukushima Nuclear Accident Independent Investigation Commission concluded, "It was a profoundly man-made disaster that could and should have been fore-

seen and prevented. And its effects could have been mitigated by a more effective human response" (The National Diet of Japan, 2012). Unlike Chernobyl, all three in-service reactor cores melted 100% within the first week of the Fukushima nuclear disaster due to the coolant loss event, lack of backup power sources, and poor planning (Eddy & Sase, 2015; World Nuclear Association, 2022).

Almost 5 years later, officials at Tokyo Electric Power Company (TEPCO) in a June 21, 2016, interview with the media apologized for not admitting the reactor meltdowns, referring to the omission as a premeditated cover-up (Yamaguchi, 2016). Radiation continued to be released as concerns rose that Japan downplayed the severity of the threat to global health and was not transparent in communications (Grossman, 2011; James et al., 2011; Organisation for Economic Co-operation and Development, 2019). Approximately 1,800 km^2 of land in Fukushima Prefecture was contaminated by radiation (The National Diet of Japan, 2012). Foods containing radiation above regulatory thresholds were restricted in Japan by the government and some foods (e.g., raw milk, mushrooms) were restricted from international export from Japan. The Food and Drug Administration (2021) in the U.S. provided import alerts in coordination with Japan. More than 150,000 people were displaced from their homes at the peak point and some might never be able to return (The National Diet of Japan, 2012).

Bags of Contaminated Soil and Debris

Excavated radioactive soils and debris—including those accumulated from mitigation processes during 2011 through approximately 2019—are bagged and stored outdoors, and thus are vulnerable to extreme weather. On October 10, 2019, Super Typhoon Hagibis peaked as a Category 5 storm with 160 mph winds and made landfall on October 12, 2019, as a Category 2 storm (Masters, 2020). Shortly after the storm, media and individuals via social networks began to post pictures of the broken bags. Each bag is designed to hold 1 ton of radiologically contaminated soil. Some bags were floating down local streams. One source stated that 91 bags of contaminated soil had been washed away during the typhoon (SimplyInfo.org, 2019). Officials in Japan verified that of the dozens of bags reported lost, 11 were retrieved and found empty (Ministry of the Environment, 2019). The bags are not watertight, according to the International Atomic Energy Agency (2015).

Contaminated Groundwater

The Fukushima Daiichi Nuclear Power Plant was built in between a mountain range and the Pacific Ocean, on top of a shallow groundwater table that is continuously replenished from mountain runoff. Groundwater that infiltrated damaged reactor building units and groundwater in direct and indirect contact with highly radioactive reactor corium (i.e., molten reactor core material) was mixed with stored cooling waters used to control the reactor vessels. The resulting mixture was stored in mammoth containers.

Approximately 1,000 storage tanks were set up progressively, including initially 350 steel tanks with rubber seams, each holding 1,200 m^3. A few of these storage tanks developed leaks in 2013 (World Nuclear Association, 2022). It was originally estimated that storage would be exhausted by 2020 and Japan now plans to discharge the tanks into the Pacific Ocean, involving 1 million tons of wastewater containing tritium (Greenpeace International, 2019). On April 13, 2021, the prime minister of Japan stated, "This is an unavoidable issue in proceeding with decommissioning. We will ensure the safety of treated water and take all measures to dispel rumors" ("Decision to Release Treated Water," 2021). Greenpeace Germany has condemned the discharges—that have been approved and are to be overseen by International Atomic Energy Agency—by stating that the employed treatment system cannot remove tritium, carbon-14, and strontium-90 (Burnie, 2020).

Compound Natural and Human-Caused Disaster

Technologies required to perform never-before-achieved mitigation and decommissioning processes at the Fukushima Nuclear Power Plant elevate the threat of the radiological hazards and prolong the threat into the future. Reactor corium might release radiation through uncontrolled fission reactions resulting from criticality or recriticality, which is the main hazard when handling nuclear fuel residues in damaged units ("The Long Road Ahead," 2021; Smirnov et al., 2020).

On January 27, 2021, approximately 10 years after the disaster, a Japanese newspaper reported high levels of radiation in reactor Unit 1, 20–40 petaBq (PBq) in Unit 2, and approximately 30 PBq in Unit 3 (the prefix peta indicates 1,000 trillion). The newspaper also stated that the dose could be fatal to a human standing near the area over a 2-hr period ("High Radiation Facilities," 2021). Decommissioning processes are projected to end between 2051 and 2061 (Ministry of Economy, Trade, and Industry, 2022).

On February 13, 2021, a magnitude 7.3 earthquake caused further damage of coolant tanks at the Fukushima Daiichi Nuclear Power Plant, necessitating the generation of even higher volumes of contaminated water as makeup coolant was required to be added (Associated Press, 2021; Tokyo Electric Power Company, 2021). Another magnitude 5.3 aftershock occurred the same day, demonstrating vulnerabilities of a fragile nuclear power system to the disaster-prone climate of Japan (Keane, 2021).

On March 16, 2022, a magnitude 7.4 earthquake impacted the Fukushima Daiichi Nuclear Power Plant, causing an automatic reactor Unit 5 coolant pump power shutdown, fire alarm activation, and coolant tank spillage. Although the alarm for radioactive liquid leakage sounded as a result of the earthquake, a TEPCO (2022) report stated that coolant waters did not drop.

Damaged, spent nuclear fuel rods and continuing reactor core instability increased the potential for future fuel meltdowns (Eddy & Sase, 2015; Smirnov et al., 2020). These factors extend the vulnerabilities of the power plant to extreme weather worsened by climate change, the constant possibility of technological disturbance through mitigation and remediation processes, and attacks through terrorism or acts of war.

A long-term perspective of the Fukushima nuclear disaster requires an appreciation for the placement of Japan at the intersection of four major geological tectonic plates within the infamous Ring of Fire (Israel, 2022). As one of the highest-risk areas in the world seismically (Wang & Nasseri, 2021), decades of remediation likely will be problematic. Some have estimated a 70–80% probability of an earthquake with a magnitude of 8 to 9 occurring over the next 30 years (JiJi Press, 2021).

Similarities Between a Nuclear Disaster and a Pandemic

In both incidents, uncertainty (a key risk assessment confounder) was pervasive. Both incidents were expected but neither were predicted precisely, nor were initial response actions made rapidly enough to gain meaningful prevention momentum. The characterization of the threat to human health from radiation and COVID-19 is also incomplete, which contributes to the consideration of widely available inexpert information and misinformation by the public. The evidence about the health effects of radiation—at small and large doses to environmental health, and including flora, fauna, agriculture, and wildlife—is equivocal in the literature and influenced by political and energy industry-driven economic interests.

The uncertainties of a novel pandemic pathogen, even though almost 3 years after the WHO declaration of a pandemic, may be deepening rather than clarifying as SARS COV-2 Omicron variants continue to arise and the severity of infection varies. Further, more variants likely will present in the future. Many other factors influenced uncertainty and unpredicted outcomes: the efficacy and use of personal protective equipment (PPE) and social distancing practices; multisystem inflammatory syndrome; neurological and other acute and chronic medical sequelae, including long COVID (Cutler, 2022; Huang et al., 2022); vulnerabilities and susceptibilities of immunocompromised individuals; coinfected and comorbid populations; and the efficacy and durability of vaccines challenged with potential evasion by new variants and subvariants.

International Health Regulations: Global Health Security

The striking similarity between the two crises is clarified further in terms of emergency management prevention and mitigation strategy performance. The breach of containment resulted from the global community's failure to adequately expect and prevent the release of hazards presented by rapidly expanding threats, as well as its poor adjustment to the escalating crisis. The Fukushima nuclear disaster was characterized by the loss of coolant event that resulted in the melting of nuclear fuel and the failure of radiation containment. The fuel inventory should have been the primary point of preparedness emphasis but was inadequately addressed in a disaster planning process that emphasized the probability and magnitude of natural disaster trigger events. The COVID-19 pandemic can be characterized as the loss of international epidemic containment, which potentially could have been preventable due to reporting obligations required by the International Health Regulations (IHR) under a Public Health Emergency of International Concern declaration (WHO, 2022).

The state of Missouri sued the People's Republic of China for loss of life, human suffering, and economic turmoil resulting from the COVID-19 pandemic. The court case states that the Chinese government had a duty to report "all events which may constitute a public health emergency of international concern within its territory within 24 hr under Article 6.1 of the International Health Regulations, yet it failed to do so" (*State of Missouri v. People's Republic of China*, 2020). Estimated costs for the resulting consequences of the two disasters are staggering: in U.S. dollars, $13.8 trillion for the COVID-19 pandemic and $700–800 billion for the Fukushima nuclear disaster, although the Fukushima cost is likely to increase due to the decade-spanning length of the projected mitigation schedule (Agarwal et al., 2022; NPR, 2021).

The IHR is the primary global public health security framework and the U.S. Department of Health and Human Services (HHS) National Health Security Strategy is the primary driver of U.S. national public health security. Both organizations address all-hazards readiness, public health emergencies, and radiological and infectious disease threat containment irrespective of natural, accidental, or intentional causes (U.S. Department of Health and Human Services [HHS], 2019a; WHO, 2022). Additionally, the HHS National Health Security Strategy and the IHR follow a multisectoral, One Health approach (Nuttall et al., 2014; Sinclair, 2019).

Updated in 2005, the IHR was based on lessons learned from the 2003 severe acute respiratory syndrome (SARS) global outbreak and was designed specifically to prevent the expansion of a novel epidemic across jurisdictional and national borders (WHO, 2022). The hazards associated with the Fukushima nuclear disaster and the COVID-19 pandemic are both specifically targeted by the IHR. Furthermore, the IHR demarcates both radiation and epidemic disease as requiring immediate and combined international attention by member states.

Although the necessity to bridge One Health and all-hazards preparedness is established in the literature, the Fukushima nuclear disaster and the COVID-19 pandemic reveal practical reasons for its establishment on the ground at local, state, federal, and territorial levels. For example, the 2004 SARS-CoV-1 and 2019 SARS-CoV-2, regardless of lacking definitive source confirmation (e.g., natural, accidental, or intentional), cause zoonotic diseases and are linked directly or indirectly to animals in the wild, at markets for human consumption, or used in research activities. Future surveillance and emergency preparedness response solutions require cross-sectoral collaboration among animal and veterinary, medical, and environmental health professionals. Additionally, the acute threat to human health by radiological accidents or attacks must be addressed by the immediate availability and accessibility of medical countermeasures. Long-term environmental health contamination caused by nuclear accidents requires cross-sectoral and integrated prevention strategies that consider the potentially irreversible nature of environmental contamination in animals, plants, and humans.

Redesigning the Emergency Management Cycle

It is essential to clarify terminologies used during emergency management planning processes. The terms disaster, emergency, and crisis have been addressed in the literature. It is accepted that crises are acute and difficult to manage, and disasters have already occurred (e.g., extreme weather events). As such, modern U.S. federal doctrine is invested in all-hazards emergency preparedness guidance that effectively bypasses the need to make categorical distinguishments between terms, aside from legal proclamation. The term crisis, however, is used in the healthcare industry, specifically in association with emergency management, including the utilization of various forms of the National Incident Management System (NIMS)-based, unified incident command system (ICS) to protect hospital surge capacity and assure quality of service when resources are scarce (Sase & Eddy, 2021).

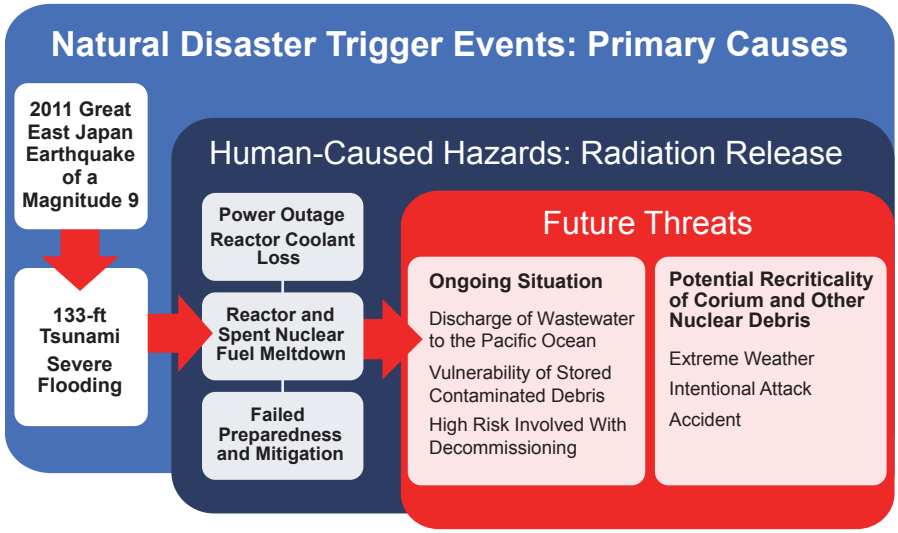
Crisis standards of care (CSC) is a system based on medical rationing, patient triage, and liability protection for the medical industry. Timbie et al. (2012) describes the initiation of CSC in that a "hospital must alter care delivery, and shift from the individual approach to healthcare, which is intended to deliver optimum care to each and every patient, to one that seeks to do the most good for the most people with the resources at hand." Emergency management contingencies should be arranged to avoid exceeding established threshold triggers and other indicator metrics to avoid the initiation of CSC (Sase & Eddy, 2021; Timbie et al., 2012).

Additionally, the term mitigation is not equivalent to prevention and main points of focus are divided between traditional emergency management and public health mandates. For example, the Federal Emergency Management Agency (FEMA, 2013) uses the term mitigation for sustained, long-range efforts to minimize the impact of future hazards, specifically those efforts traditionally associated with natural disaster or extreme weather. The term prevention is exclusive to counterterrorism and cybersecurity efforts (FEMA, 2013).

A voluminous suite of federal emergency management doctrine springs from the National Preparedness System, driven by the National Preparedness Goal, associated frameworks, and presidential directives, that in combination support the five mission areas of FEMA under the umbrella of the all-hazards-based NIMS. Emergency Support Functions (ESFs) provide federal assistance systems for public health and medical systems, primarily ESF-9 (HHS, 2019b). First responders, emergency managers, and homeland security experts are trained to follow a FEMA mission area-defined emergency management cycle, also referred to as a disaster lifecycle. The emergency management cycle has not changed significantly for decades, and its theoretical origin is traceable to a 1932 report (Carr, 1932; Neal, 1997; Rose et al., 2017). Extensive research exists on this topic except for the prevention mission area that is focused primarily on terrorism and intentional attacks. We added to the literature with the insertion of the public health approach to all-hazards readiness that emphasizes prevention through health systems protection, a population health focus, and the establishment of equity in agency performance through the effective and efficient utilization of NIMS/ICS training and exercise readiness systems (Sase & Eddy, 2016, 2021).

FIGURE **1**

Fukushima Natural Disaster Trigger Events



Our previous findings that the terms risk and hazard should not be used interchangeably led to a fundamental lesson learned from the Fukushima nuclear disaster: by focusing on the likelihood (probability) of a natural disaster occurring, the emphasis on planning for potential and actual hazards (e.g., accidental or human-caused) associated with radiological inventories was overlooked (Eddy & Sase, 2015). FEMA also uses the terms hazard and threat essentially interchangeably and they are routinely presented together (e.g., threats and hazard), such as in the FEMA National Preparedness Goal that drives the National Response Framework and associated ESFs (FEMA, 2019, 2020).

We clarify that risk is a probabilistic notion, only measurable in part and random in nature. We now reconsider the more than 1 decade-old Fukushima nuclear disaster, the resulting ecological crisis that is ongoing, and the numerous protracted mitigation challenges. This clarification is especially true in light of the likelihood of a trigger event initiating cascading hazards, such as the events that occurred at the Fukushima Daiichi Nuclear Power Plant. Threat is more descriptive for planning, operational, and response considerations, and is specifically tied to the severity of consequences, or loss and harm. Described in kind, a hazard is an event or substance, many of which are human-caused, accidental, and associated with industry and technology, though attacks are intentional and deliberate. Hazards are modifiable, manageable, and mitigatable.

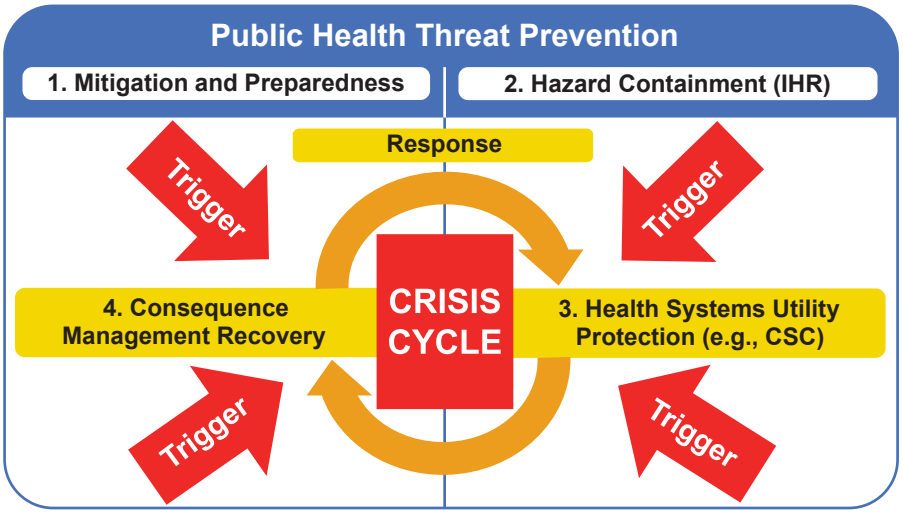
Through the process of clarifying emergency response terminology, we have developed an updated situational picture of ongoing threats separating natural disaster trigger events from the continuing and potential new global health consequences caused by the release of human-caused hazards in Figure 1.

In recording the continuous environmental hazards presented by the Fukushima nuclear disaster from the first days of the disaster—while the world became concurrently embraced by the uncertainty of a changing COVID-19 pandemic threat horizon—we were compelled to reconsider traditional disaster and emergency management doctrine and the traditional emergency management cycles. Our intention was to develop a template for preparedness that dually serves as an active barometer to track incident progression and escalation and serves as a guide for evolving response adjustment.

Our Public Health, Healthcare, and Emergency Management Command and Support Supersystem Model (Figure 2) that follows the one-picture disaster cycle heuristic tra-

FIGURE **2**

Public Health, Healthcare, and Emergency Management Command and Support Supersystem Model



Note. Red arrows represent potential incident complexity triggers, including:

- No advance warning scenario(s)
- Cascading or concurrent events
- Escalating incidents
- Heightened hazard severity (e.g., viral mutations)
- Continued hazard exposure or release
- Immovable vulnerabilities and populations with access and functional needs
- Sheltering and evacuation factors
- Multiple operational phases
- Evolving or devolving environmental health risks
- Secondary attacks on first responders
- Loss of essential public health and security infrastructure
- Extreme weather

CSC = crisis standards of care; IHR = International Health Regulations.

dition is focused on assuring health security broadly. We condense and decomplicate NIMS federal doctrine and CMS regulations related to the traditional disaster cycle by including an action-oriented instrument for crisis adaption.

The disaster cycle is patterned in concept and in part by our submitted manuscript (Sase et al., 2022). Furthermore, the cycle:

1. Integrates public health, emergency management, and healthcare for the purpose of aligning presently underregulated assisted-living facilities with other long-term care facilities currently mandated to follow CMS emergency management regulation.
2. Emphasizes the expanding and contracting incident complexity triggers (represented by arrows in Figure 2) that represent ongoing, potentially increasing and decreasing incident situational pressures that shape continuous incident operational stance adjustment and alignment with the Common Operating Picture.
3. Follows the IHR and HHS National Health Security Strategy and advocates for a One Health approach to collecting situational awareness data across human, animal, plant, and environmental health realms by focusing on surveillance and intelligence systems to early detect counterterrorism, global epidemics, and pandemics, as well as assure food defense and security (Eddy & Sase, 2021; Eddy et al., 2013, HHS, 2019a; Sase et al., 2022).

The model in Figure 2 expands to include One Health, public health, and all-hazards approaches in recognition of multiple stakeholders, agencies, regulations and guidelines, and the need for interoperability, surveillance, and exchange of oversight, expertise, and functional resources under the NIMS/ICS system.

We provide possible solutions for prevention and preparedness initiatives by unifying approaches to disaster planning and management that are traditionally separated and variously identified as planning, management, response, and even recovery cycles. We emphasize the necessity to expand situational awareness, which we describe as the continual analysis of incoming data and adjustment to changes based on the acquisition and assimilation of new knowledge. The Fukushima nuclear disaster revealed the imperative to take informed and correct action to shifting vulnerabilities over time toward the separation of natural from technological influences, including ongoing mitigation attempts and their outcomes. The inclusion of active surveillance and appropriate response adjustment, as needed, mirrors the philosophy of the classic Planning "P" concept (FEMA, n.d.).

Following traditional four-phase (does not include prevention) and five-phase disaster management cycles, we retain the five-phase elements that correspond directly to the National Preparedness Goal 5 FEMA Mission Areas (FEMA, 2018; University of Central Florida, 2022). Significantly, we merge the combined preparedness and prevention aspect as well as ongoing planning, training, and community hazard communication processes, with special focus on functional needs and at-risk and underserved populations. Importantly, we clearly separate response and prevention processes and emphasize mitigation as a construct of prevention paired with preparedness. Effective Japanese medical countermeasures made by various local governments (e.g., the administration of thyroid-protecting potassium iodide to people potentially exposed to the Fukushima Daiichi Nuclear Power Plant fallout) is an appropriate example of a critically timed mitigation strategy at the very early onset of a disaster (Sase et al., 2021).

Key to our Public Health, Healthcare, and Emergency Management Command and Support Supersystem Model (Figure 2) is the establishment and protection of effective health systems such as continuity of operations, supply chain and essential infrastructure, continuous surveillance and intelligence gathering, hazard communications delivered to the community, and ultimately the protec-

tion of healthcare systems (e.g., community hospitals, skilled nursing facilities, assisted-living facilities, and other long-term care entities)—including the elimination of pressures potentially causing the activation of CSC. The integrated systems are reliant on a range of associated planning strategies and tools: the Common Operating Picture, the preemptive hazard vulnerability analysis and tabletop exercise, and functional real-time crisis simulation required by CMS, the Joint Commission, and the National Fire Protection Association, among others (Sase et al., 2022).

Our point of primary response emphasis is the public health-oriented crisis cycle, a system within a system, at the center of our revised disaster and emergency management cycle, which is a heuristic cue that facilitates amplified operational stance adjustment and enhanced situational awareness via the constantly evolving Common Operating Picture (a standardized breakdown of incident operational information shared with all partners and stakeholders and focusing especially on healthcare coalitions). This supersystem model promotes heightened attention to steps necessary to respond to the waning and waxing phases of fluxional crises in accordance with appropriate and applicable statutory requirements and in harmony with the aforementioned federal doctrine.

Regarding both the Fukushima nuclear disaster and COVID-19 pandemic, examples of relaxing focus on known threats and predictable consequences can be noted repeatedly, with severe consequences resulting. Additionally, during the incident response, observed incident complexity triggers should be recorded for not only hotwash discussion but also the insertion into annually updated hazard vulnerability analysis to retain memory of incident unknowns, challenges, and successful and unsuccessful actions with accuracy for planning updates and enhancement.

Following the operational standards of NIMS and ICS, we consciously distinguish between steady-state prevention activity and active response and recovery modalities in our model by emphasizing hazard detection, containment, and immediate threat characterization throughout the crisis evolution as the primary operational emphasis, which is applicable to chemical, biological, radiological, nuclear, and explosive (CBRNE) hazards.

Conclusion

Our retrospective of the Fukushima nuclear disaster allows for a full spectrum concept of emergency preparedness and response, including the condensation of FEMA, HHS, CMS, and NIMS doctrine, to be integrated into practical diagrams that portray the multifactorial nature of crisis threats. This work enables a clear consideration of the threats to environmental health (Figures 1 and 2) that are the responsibility of state and local officials who might not have deep exposure to federal doctrine, significant CMS healthcare preparedness requirements, and cross-training between multiple disciplines (U.S. Centers for Medicare & Medicaid Services, 2021). By integrating the themes of each body of guidance, we present a practical all-hazards preparedness road map focused on the continuous analysis of environmental public health consequences. Furthermore, the road map focuses on the recognition of incident complexity trigger changes for state and local practitioners who will be the first responder. Most crises require an environmental public health response and/or solution.

The core of our Public Health, Healthcare, and Emergency Management Command and Support Supersystem Model (Figure 2) is a continuously adaptive Common Operating Picture that informs partners and other key stakeholders of evolving operational objective development and ICS posture adjustment based on the awareness of situational incident complexity triggers. While maintaining NIMS consistency, our model reinforces the sense of urgency for disaster planners and risk assessment experts necessary to prevent harm and loss caused by hazards and vulnerabilities.

Our work provides a decision support tool for all-hazards emergency planning and response, which contributes to national and global health security from local up to state, federal, and international levels. The overarching goal of our supersystem model is to support coordinated public health threat prevention and initial hazard containment at local, national, and international levels.

Disclaimer: The conclusions in this article are those of the authors and do not necessarily represent the official policy of any particular agency, university, or other entity.

Corresponding Author: Christopher Eddy, School of Science, Engineering, and Technology, College of Nursing and Health Care Professions, Grand Canyon University, 3300 West Camelback Road, Phoenix, AZ 85017. Email: chris.eddy@my.gcu.edu.

References

Agarwal, R., Gopinath, G., Farrar, J., Hatchett, R., & Sands, P. (2022). *A global strategy to manage the long-term risks of COVID-19* (Working Paper No. 2022/068). International Monetary Fund. https://www.imf.org/en/Publications/WP/Issues/2022/04/04/A-Global-Strategy-to-Manage-the-Long-Term-Risks-of-COVID-19-516079

Associated Press. (2021, February 19). Water leaks indicate new damage at Fukushima nuclear plant. *U.S. News & World Report*. https://www.usnews.com/news/world/articles/2021-02-19/water-leaks-indicate-new-damage-at-fukushima-nuclear-plant

Bendix, A. (2019, June 17). Chernobyl was the world's worst nuclear-power-plant accident. Here's how it compares with Fukushima and Three Mile Island. *Insider*. https://www.businessinsider.com/chernobyl-fukushima-three-mile-island-nuclear-disasters-2019-6

Burnie, S. (2020). *Stemming the tide 2020: The reality of the Fukushima radioactive water crisis*. Greenpeace Germany. https://www.greenpeace.org/static/planet4-japan-stateless/2020/10/5e303093-greenpeace_stemmingthetide2020_fukushima_radioactive_water_crisis_en_final.pdf

Carr, L.J. (1932). Disaster and the sequence-pattern concept of social change. *American Journal of Sociology*, *38*(2), 207–218. https://doi.org/10.1086/216030

References

Cutler, D.M. (2022). The costs of long COVID. *JAMA Forum*, *3*(5), e221809. https://doi.org/10.1001/jamahealthforum.2022.1809

Decision to release treated water from nuclear power plants into the ocean: Dilute more than 100 times in two year [Article in Japanese]. (2021, April 13). *Nikkei Asia*. https://www.nikkei.com/article/DGXZQOUA12CGP0S1A410C2000000/

Eddy, C., & Sase, E. (2015). Implications of the Fukushima nuclear disaster: Man-made hazards, vulnerability factors, and risk to environmental health. *Journal of Environmental Health*, *78*(1), 26–32.

Eddy, C., & Sase, E. (2021). Part 1: The Zika virus threat and prevention challenges: An all-hazards and One Health approach to pandemic and global epidemic prevention and mitigation. *Journal of Environmental Health*, *84*(2), 8–18.

Eddy, C., Stull, P.A., & Balster, E. (2013). Environmental health—Champions of One Health. *Journal of Environmental Health*, *76*(1), 46–48.

Encyclopædia Britannica. (2022). *Fukushima accident*. https://www.britannica.com/event/Fukushima-accident

Federal Emergency Mangement Agency. (2013). *Local mitigation planning handbook*. https://www.fema.gov/sites/default/files/2020-06/fema-local-mitigation-planning-handbook_03-2013.pdf

Federal Emergency Management Agency. (2018). *Threat and hazard identification and risk assessment (THIRA) and stakeholder preparedness review (SPR) guide: Comprehensive preparedness guide (CPG) 201* (3rd ed.). https://www.fema.gov/sites/default/files/2020-07/threat-hazard-identification-risk-assessment-stakeholder-preparedness-review-guide.pdf

Federal Emergency Management Agency. (2019). *2019 national threat and hazard identification and risk assessment (THIRA): Overview and methodology*. https://www.fema.gov/sites/default/files/2020-06/fema_national-thira-overview-methodology_2019_0.pdf

Federal Emergency Management Agency. (2020). *National preparedness goal*. https://www.fema.gov/emergency-managers/national-preparedness/goal

Federal Emergency Management Agency. (n.d.). *IS-201: Forms used for the development of the Incident Action Plan* [Lesson summary]. https://emilms.fema.gov/IS201/ICS0102summary.html

Food and Drug Administration. (2021). *FDA response to the Fukushima Daiichi nuclear power facility incident*. https://www.fda.gov/news-events/public-health-focus/fda-response-fukushima-dai-ichi-nuclear-power-facility-incident

Greenpeace International. (2019, December 23). *Greenpeace condemns Japanese government panel's draft proposal to discharge radioactive water* [Press release]. https://www.greenpeace.org/international/press-release/28080/greenpeace-condemns-japanese-government-panels-draft-proposal-to-discharge-radioactive-water/

Grossman, K. (2011, May 1). After Fukushima, media still buying nuclear spin. *Fairness & Accuracy in Reporting*. https://fair.org/extra/after-fukushima-media-still-buying-nuclear-spin/

Guarino, D.P. (2012, April 23). Audit confirms EPA radiation monitors broken during Fukushima crisis. *Global Security Newswire*. https://web.archive.org/web/20120427133105/https://www.nti.org/gsn/article/audit-confirms-epa-radiation-monitors-broken-during-fukushima-crisis/

High radiation facilities inside Fukushima No. 1 nuclear power plant may delay decommissioning process. (2021, January 26). *The Japan News/Yomiuri Shimbun*.

Huang, L., Li, X., Gu, X., Zhang, H., Ren, L., Guo, L., Liu, M., Wang, Y., Cui, D., Wang, Y., Zhang, X., Shang, L., Zhong, J., Wang, X., Wang, J., & Cao, B. (2022). Health outcomes in people 2 years after surviving hospitalisation with COVID-19: A longitudinal cohort study. *The Lancet Respiratory Medicine*, *10*(9), 863–876. https://doi.org/10.1016/S2213-2600(22)00126-6

International Atomic Energy Agency. (2015). *The Fukushima Daiichi accident* (Technical Vol. 5, Post-accident recovery). https://www-pub.iaea.org/MTCD/Publications/PDF/AdditionalVolumes/P1710/Pub1710-TV5-Web.pdf

Israel, B. (2022, September 15). Japan's explosive geology explained. *Live Science*. https://www.livescience.com/30226-japan-tectonics-explosive-geology-ring-of-fire-110314.html

James, M.S., Arnall, D., Vlasto, C., & Mosk, M. (2011, March 11). Radiation dangers heightened at Japanese nuclear plant. *ABC News*. https://abcnews.go.com/International/japan-fukushima-nuclear-power-plant-explosion-workers-injured-radiation/story?id=13120888

JiJi Press, Ltd. (2021, March 26). Risk of huge quake stays high on Japan's Pacific side. *nippon.com*. https://www.nippon.com/en/news/yjj2021032601019/

Keane, S. (2021, February 15). Magnitude 5.3 aftershock registered in Japan. *EuroWeekly News*. https://www.euroweeklynews.com/2021/02/15/magnitude-5-3-aftershock-registered-in-japan/

The long road ahead for Fukushima cleanup. (2021, January 8). *Fukushima Minpo News*. http://www.fukushimaminponews.com/news.html?id=1040

Masters, J. (2020, January 9). A rogues' gallery of the five Category 5 storms of 2019. *Scientific American*. https://blogs.scientificamerican.com/eye-of-the-storm/a-rogues-gallery-of-the-five-category-5-storms-of-2019/

Ministry of Economy, Trade and Industry, Japan. (2022). *Status update of Fukushima Daiichi decommissioning*. https://www.meti.go.jp/english/earthquake/nuclear/decommissioning/pdf/1f_status_20220307.pdf

Ministry of the Environment, Japan. (2019, October 21). *The current situation of large container bags in temporary storage sites (TSS) after heavy rain by Typhoon Hagibis*. http://josen.env.go.jp/en/pdf/report_191023.pdf

The National Diet of Japan. (2012). *The official report of the Fukushima Nuclear Accident Independent Investigation Commission: Executive summary*. http://www.nirs.org/fukushima/naiic_report.pdf

continued on page 24

References *continued from page 23*

Neal, D.M. (1997). Reconsidering the phases of disaster. *International Journal of Mass Emergencies and Disasters*, *15*(2), 239–264. https://digital.library.unt.edu/ark:/67531/metadc993379/

Noriyuki, I. (2022, December 27). *Japanese government council puts forth basic policy clearly stating nuclear power use*. Japan Atomic Industrial Forum, Inc. https://www.jaif.or.jp/en/news/6252

NPR. (2021, April 29). *Fukushima Daiichi nuclear disaster: 10 years later*. https://www.npr.org/transcripts/991668971

Nuttall, I., Miyagishima, K., Roth, C., & de La Rocque, S. (2014). The United Nations and One Health: The International Health Regulations (2005) and global health security. *Scientific and Technical Review*, *33*(2), 659–668. https://doi.org/10.20506/rst.33.2.2303

Organisation for Economic Co-operation and Development. (2019). *OECD reviews of public health: Japan*. https://doi.org/10.1787/9789264311602-en

Prime Minister of Japan and His Cabinet. (2013, September 7). *Presentation by Prime Minister Shinzo Abe at the 125th Session of the International Olympic Committee (IOC)*. https://japan.kantei.go.jp/96_abe/statement/201309/07ioc_presentation_e.html

Rose, D.A., Murthy, S., Brooks, J., & Bryant, J. (2017). The evolution of public health emergency management as a field of practice. *American Journal of Public Health*, *107*(Suppl. 2), S126–S133. https://doi.org/10.2105/AJPH.2017.303947

Sase, E., & Eddy, C. (2016). Millennials in an aging society: Improving end-of-life care by public health policy. *Georgetown Public Policy Review*, 2016 Spring Edition. http://www.gpprspringedition.com/end-of-life-care

Sase, E., & Eddy, C. (2021). Crisis standards of care: On justice and the public health approach to the COVID-19 pandemic. *Georgetown Public Policy Review*, 2021 Spring Edition. http://www.gpprspringedition.com/crisis-standards-of-care

Sase, E., Eddy, C., & Polivka, B.J. (2021). Lessons from Fukushima: Potassium iodide after a nuclear disaster. *American Journal of Nursing*, *121*(2), 63–67. https://doi.org/10.1097/01.NAJ.0000734144.20889.b0

Sase, E., Eddy, C., & Schuster, R. (2022). *A reform for supersystem of health: Lessons from crisis standards of care during a COVID-19 pandemic in the U.S.* [Manuscript submitted for publication].

SimplyInfo.org. (2019, November 3). *91 bags of contaminated Fukushima soil washed away in typhoon*. https://simplyinfo.org/2019/11/91-bags-of-contaminated-fukushima-soil-washed-away-in-typhoon/

Sinclair, J.R. (2019). Importance of a One Health approach in advancing global health security and the Sustainable Development Goals. *Scientific and Technical Review*, *38*(1), 145–154. https://doi.org/10.20506/rst.38.1.2949

Smirnov, A.D., Bogdanova, E.V., Pugachev, P.A., Saldikov, I.S., Ternovykh, M.Yu., Tikhomirov, G.V., Takezawa, H., Muramoto, T., Nishiyama J., & Obara, T. (2020). Neutronic modeling of a subcritical system with corium particles and water (from international benchmark). *Nuclear Energy and Technology*, *6*(3), 155–160. https://doi.org/10.3897/nucet.6.57742

State of Missouri v. People's Republic of China, 1:20-cv-00099 (E.D. Missouri 2000). https://www.courtlistener.com/docket/17085710/state-of-missouri-v-peoples-republic-of-china/

Steinhauser, G., Brandl, A., & Johnson, T.E. (2014). Comparison of the Chernobyl and Fukushima nuclear accidents: A review of the environmental impacts. *Science of the Total Environment*, *470–471*, 800–817. https://doi.org/10.1016/j.scitotenv.2013.10.029

Timbie, J.W., Ringel, J.S., Fox, D.S., Waxman, D.A., Pillemer, F., Carey, C., Moore, M., Karir, V., Johnson, T.J., Iyer, N., Hu, J., Shanman, R., Larkin, J.W., Timmer, M., Motala, A., Perry, T.R., Newberry, S., & Kellermann, A.L. (2012). *Allocation of scarce resources during mass casualty events* (Report No. 12-E006-EF). Agency for Healthcare Research and Quality. https://www.ncbi.nlm.nih.gov/books/NBK98854/

Tokyo Electric Power Company. (2021, February 14). *Status of the Fukushima Daiichi and Fukushima Daini Nuclear Power Stations after the earthquake that occurred on February 13, 2021 (as of 2:00 p.m., February 14)* [Announcement]. https://www.tepco.co.jp/en/hd/newsroom/announcements/archives/2021/20210214_01.html

Tokyo Electric Power Company. (2022). *Conditions at the Fukushima Daiichi Nuclear Power Station after the earthquake of March 16 (update)*. https://www.tepco.co.jp/en/hd/decommission/information/newsrelease/reference/pdf/2022/reference_20220318_01-e.pdf

Toro, R. (2011, March 31). Japan nuclear radiation showing up in U.S (infographic). *Live Science*. https://www.livescience.com/13507-infographic-japan-radiation-levels.html

Union of Concerned Scientists. (2011). *Fukushima FAQs*. https://www.ucsusa.org/resources/fukushima-faqs

University of Central Florida. (2022). *The disaster management cycle: 5 key stages & how leaders can help prepare*. https://www.ucf.edu/online/leadership-management/news/the-disaster-management-cycle/

U.S. Centers for Medicare & Medicaid Services. (2021). *State operations manual: Appendix Z–Emergency preparedness for all provider and certified supplier types: Interpretive guidance* (Rev. 204). https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/Downloads/som107ap_z_emergprep.pdf

U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response. (2019a). *National health security strategy, 2019–2022*. https://www.jcs.mil/Portals/36/Documents/Doctrine/Interorganizational_Documents/nhss_strat2019_2022.pdf

U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response. (2019b). *Emergency Support Functions*. https://www.phe.gov/preparedness/support/esf8/Pages/default.aspx

U.S. Environmental Protection Agency, Office of Inspector General. (2012). *Weaknesses in EPA's management of the radia-*

References

tion network system demand attention (Report No. 12-P-0417). https://19january2017snapshot.epa.gov/sites/production/files/2015-10/documents/20120419-12-p-0417.pdf

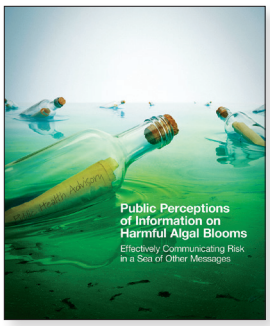
Wang, F., & Nasseri, A. (2021, February 17). After Tohoku, AIR's view of hazard from megathrust earthquakes and insights into vulnerability to tsunami. *Verisk*. https://www.air-worldwide.com/publications/air-currents/2021/after-tohoku-airs-view-of-hazard-from-megathrust-earthquakes-and-insights-into-vulnerability-to-tsunami/

World Health Organization. (2012). *Preliminary dose estimation from the nuclear accident after the 2011 Great East Japan earthquake and tsunami*. https://www.who.int/ionizing_radiation/pub_meet/fukushima_dose_assessment/en/

World Health Organization. (2022). *International Health Regulations*. https://www.who.int/health-topics/international-health-regulations

World Nuclear Association. (2022). *Fukushima Daiichi accident*. https://www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/fukushima-daiichi-accident.aspx

Yamaguchi, M. (2016, June 21). Japan utility: Delay in declaring 'meltdown' was cover-up. *AP News*. https://apnews.com/article/c62c84e4940f49a6a1faaccfa957d2f2



Identifying Public Perceptions of Information on Harmful Algal Blooms to Guide Effective Risk Communication

April Ames, PhD, CIH
University of Toledo College of Health and Human Services

Victoria Steiner, PhD
University of Toledo College of Health and Human Services

Ashleigh Konopka, MPH, MSOH-IH
University of Toledo College of Health and Human Services

Mary Ward, MSOH-IH
University of Toledo College of Health and Human Services

Eric J. Zgodzinski, MPH, DrPH, RS, CPH
Toledo–Lucas County Health Department

Abstract **Accurate, understandable, and reliable information is crucial during and after a harmful algal bloom (HAB) event. This qualitative descriptive study examined perceptions of residents near Lake Erie's western basin about where they received HAB information, what information was most important, and which sources they found most credible. A total of nine focus groups with Lucas County, Ohio, residents were videotaped, and the content was transcribed. We applied Colaizzi's rigorous method of content analysis to make sense of the data. The majority of 93 participants self-identified as White females between the ages of 40 and 59 years. From the focus groups, four themes emerged: 1) seeking prompt and clear notification about severe HABs, 2) realizing opportunities to learn about HABs, 3) pushing an agenda instead of relaying the facts, and 4) desiring credible information from trustworthy sources. Effective risk communication should provide information about severe events in an understandable and timely manner, convey unbiased facts, deliver information from sources seen as trustworthy, and use existing opportunities in the community to provide education. Although every HAB event is unique, these findings can inform other regions at risk for HABs.**

Introduction

Harmful algal blooms (HABs) are becoming more common in the U.S. and around the world. HABs occur when algae grow out of control in freshwater or saltwater and produces toxins that can make people or animals ill (Centers for Disease Control and Prevention, 2022). For over 10 years, knowledge and perceptions associated with HABs on the East Coast and West Coast of the U.S. have been examined (Ekstrom et al., 2020; Kirkpatrick et al., 2014; Kuhar, et al., 2009; Moore et al., 2020; Nierenberg et al., 2010). Individuals in communities affected by HAB events need accurate and reliable information to understand the potential impacts to the environment and public health. There are significant differences, however, in how individuals access, process and interpret, and react to the information they receive (Savoia et al., 2017) that affect their perceptions of risk and associated behaviors.

Residents (n = 92) and tourists (n = 100), increasingly affected by red tide events along the west coast of Florida (Alcock, 2007; Brand & Compton, 2007; Kirkpatrick et al., 2004), reported that the internet, television, and Mote Marine Laboratory were the sources they would seek out to learn more about red tide (Nierenberg et al., 2010). Residents in Washington (n = 71) and Oregon (n = 47)—who were surveyed after a massive marine HAB on the West Coast that was associated with the 2014–2016 Northeast Pacific marine heat wave—reported that they most often obtained information from newspapers and their state fish and wildlife agencies (Moore et al., 2020). Residents in California (n = 55) in the same study stated that they used newspapers and local television news most commonly for information.

An evaluation of multiple HAB education and notification strategies conducted in Washington and the Puget Sound region determined that messages sometimes provide information for scientists and not the public (Hardy et al., 2016). Similarly, information on red tide blooms can be difficult for the public to access or understand because the information is provided on the websites of federal and state agencies, as well as academic and research institutions, and directed toward specific commercial or government audiences (Hoagland et al., 2020). Nierenberg et al. (2010) concluded that "evaluation of Florida red tide informational tools is needed on a regular basis, as there are changes over time to both the informational content needed . . . and which informational resources are used by the public" (p. 605).

TABLE **1**

Focus Group Content Guide Related to Information Sources

Question	Follow-Up Probe
Where do you hear or learn about environmental issues in Lucas County?	Internet, news, TV, radio, newspapers, social media, health department, healthcare professionals, library, billboards, other community organizations?
What sources of information are the most credible?	–
Would you like to learn more? Where? How?	Internet, news, public meetings, TV, radio, newspapers, social media, health department, healthcare professionals, library, billboards, other community organizations?
What information is the most important to receive?	What the problem is? How to recognize the problem? Measures to take?

When information is communicated to the public by the news media, they might frame an environmental issue in a way that highlights some aspects of reality to strategically influence the public to support a particular agenda (Bolsen & Shapiro, 2017). Communication experts need to be aware of how the public relies on the framing of news stories about HAB information and how this framing impacts trust and perceptions of risk (Li et al., 2015). Among West Coast residents, levels of trust regarding information sources were reported to be highest for state government, followed by professional colleagues and academic institutions (Ekstrom et al., 2020).

Residents in Lucas County, Ohio (n = 93), who participated in focus groups 1 year after a drinking water advisory, reported a lack of trust toward the actions and decisions of authorities. In August 2014, more than 400,000 residents in Northwest Ohio and southeast Michigan were affected by the issuance of a do-not-drink advisory due to an HAB on the western basin of Lake Erie resulting from elevated microcystin toxin levels (McCarty et al., 2016). The distrust of authorities was intensified by the ongoing media coverage and sensationalizing of the event and the potential for subsequent algal blooms. To be part of the solution, residents felt that more information was needed on the primary cause of algal blooms (Ames et al., 2019).

The purpose of our qualitative descriptive study was to examine participant answers from these same focus groups to find out:

- Where did they get information?
- What information is most important to receive?
- What various sources of information did they find most credible?

A qualitative descriptive approach seeks to discover and understand a phenomenon, a process, or the perspectives and worldviews of the people involved (Bradshaw et al., 2017). Building on knowledge about where the public obtains information on HABs, our study enhances the understanding of a complex phenomenon and has implications for effectively communicating risk.

Methods

Design

Following approval by the institutional review board of the University of Toledo, we conducted a secondary analysis of data on residents' perceptions of information on HABs, using a qualitative descriptive study design.

Setting and Sample

Residents in Lucas County, Ohio, participated in nine focus groups, broken into geographic area by ZIP Code. Each focus group consisted of 10–12 English-speaking adults, ages 21–75 years. Exclusion criteria included: 1) individuals or members of their household who worked or had ever worked in media or journalism; environmental sciences; or city, state, or local government positions directly working with environmental issues and 2) individuals who had participated in a research study in the past 6 months.

Procedure

Individuals from a database of over 8,000 contacts maintained by a local marketing research firm were randomly called and asked to complete a brief telephone screener. These individuals were previously solicited by the firm via advertisements, mailers, and shopping center kiosks and were demographically representative of the region. Interested individuals who met the selection criteria were placed into the appropriate focus group by ZIP Code until enough participants were recruited.

Focus groups were conducted on-site at the firm after informed consent and lasted approximately 90 min. To reduce bias, discussions were facilitated by a trained focus group moderator who was not part of the research team. Participants received compensation of $75, per the standard practices of the marketing research firm. Focus groups were videotaped, and the content was transcribed verbatim into Microsoft Word to facilitate data analysis.

Measures

We developed a content guide with open-ended questions and follow-up prompts on environmental concerns and health for the focus groups with the Lucas County residents. Responses to the questions pertaining to perceptions of information on HABs were examined in this secondary data analysis (Table 1).

Data Analysis

We applied the rigorous method of content analysis from Colaizzi (1978), including deductive, inductive, and integrative phases, to make sense of the participants' information needs and sources. In the deductive phase, the data were converted from a narrative form to more manageable units. All original content transcripts of the data were read by the first two authors, which enabled the authors to acquire a sense of participant descriptions of their information needs and sources. The data were re-read by each author and then sorted and coded by extracting significant statements to determine category schemes.

The inductive phase entailed individually labeling themes that emerged from these category schemes. Discussion of themes among the authors occurred until a consensus was reached. This collaborative process helped to establish the credibility of the findings. The relationships between and within

themes were identified and woven together into an integrated whole in the final integration phase. Themes were compared and contrasted with findings from prior research studies and subsequently integrated into a thorough description of the phenomenon.

Results

The majority of the participants (N = 93) self-identified as White females between the ages of 40 and 59 years (Table 2). Four themes emerged: 1) seeking prompt and clear notification about severe HABs, 2) realizing opportunities to learn about HABs, 3) pushing an agenda instead of relaying the facts, and 4) desiring credible information from trustworthy sources.

Seeking Prompt and Clear Notification About Severe Harmful Algal Blooms

Some individuals pay attention to the news only when there is the potential for emergency alerts, such as the do-not-drink advisory that occurred in Lucas County. Because the possibility of another severe HAB event remained prominent in the news media, participants were still discussing information sources related to an emergent situation.

One participant stated, "I'll look up mainly just the Blade [newspaper] for local stuff. And usually only around the time that there would be a scare . . . it will let you know if the water is safe to drink at that time or not." Another participant described that she looked at Facebook a few times a day and stated, "That's where I see the news because I subscribe to all the news stations and the Blade [newspaper], city water department, police department, and fire department. That's where I see all those things. I don't read the paper every morning with my coffee, I Facebook every morning with my coffee because that is where I get all my information from." In emergent situations, personal contacts were also considered reliable information sources. One participant stated, "If I know someone that has a connection with that [environmental issue] . . . I messaged them and asked if they were drinking the water. If they write back and say absolutely, then I say okay, I'll continue to drink it."

Participants wanted a clear notification process during a severe HAB event that also relays the necessary action to take. After the do-not-drink advisory, information was conveyed to the community by an online dashboard of city water quality with a meter that indicated the status of current drinking water conditions, from clear to do-not-drink. Participants appreciated the daily communication, but the information being conveyed and what to do about it was not clear.

One participant described questioning the meaning of the water meter scale: "Is there a degree to the watch we should be watching? Or just go, 'Oh, it's a watch today?' It's like what does 'watch' mean? Is it close?" The meter was often in the watch position and the public became fatigued. "We're not paying attention to it anymore. I don't know that the way that the news is handling, or the media is doing it that it's like anything else, you become complacent." Another participant elaborated on the importance of notifying everyone and felt like they needed a better means of achieving that in the community: "There needs to be a better system."

TABLE **2**

Demographics for Focus Group Participants (N = 93)

Demographic	# (%)
Gender	
Male	33 (35.5)
Female	60 (64.5)
Race or ethnicity	
White	75 (80.6)
Black/African American	15 (16.1)
Hispanic	2 (2.2)
Other	1 (1.1)
Age (mean years)	
21–39	20 (21.5)
40–59	44 (47.3)
≥60	29 (31.2)
Highest education level	
Less than high school	4 (4.3)
High school graduate	31 (33.3)
Some college	21 (22.6)
Associate, technical, or vocational	17 (18.3)
College graduate	14 (15.1)
Postgraduate	6 (6.5)
Work status	
Retired	17 (18.3)
Disabled	16 (17.2)
Full-time	38 (40.9)
Part-time	14 (15.1)
Homemaker	5 (5.4)
Unemployed	3 (3.2)

Realizing Opportunities to Learn About Harmful Algal Blooms

Education about ongoing environmental issues, such as HABs, is also available to us in our daily lives and sought after by the public. One participant became aware of issues through social connections and said, "The mayor owns a gas station and is a personal friend of mine and I go there 2 or 3 days a week. Police chief, fire chief, all the council [members] come in every morning and drink coffee and I listen to them talk." Many learning opportunities simply arise, such as the participant who was at the state park and indicated, "I have been there a couple times where they talk about the marshes and the environment in the area. Well, I was just there, and they happened to be there taking a walk through the trails and they were talking to a group of people, and we just stopped and listened."

Participants also felt they could self-educate on issues due to the availability of information. "You know, if you truly care about something, you can read an article in the [newspaper] and go do additional research of more credible sources on the internet or any of those types. I mean we have access to so much information." Participants wanted to be able to make educated decisions to help themselves and the community. "Tell us everything. So, then you're more informed and you can make a decision. You don't need to worry as much, because it might not be as bad as what the media hypes it up to be." This sentiment was further expressed by another individual: "If there were a show on that, if it were educational, not necessarily we had an algae bloom scare. An educational show that dealt with health concerns."

Pushing an Agenda Instead of Relaying the Facts

The media also sensationalizes the news to meet their agenda of increasing readers and viewers. Participants provided examples of how the media draws attention to themselves.

One participant thought the media used the city water quality dashboard with a meter to exaggerate the situation and said, "So when the water meter was in the watch position, the [news station] banner on their Facebook page was a picture of the water meter. I mean that is sensationalizing anything to get you to go look. What's the meter doing today?"

Another example was related to a news reporter scooping water out of the lake during the HAB event. A participant expressed, "I think that news kind of portrays things worse than they really are anyways. Right along the shoreline they're going to find the greenest section of algae they can find and say, 'Look at this water.' So, I don't know, I don't trust." Another participant stated that when she sees something on the news media, she gets on her computer and "starts researching for more credible information." One quote that summarizes this theme is that "a lot of it is media driven to where nobody knows what to believe." Another participant stated, "The media is competing against each other . . . . You learned everything, and people were more trustworthy back then [when he was a kid]. Because they weren't trying to make it a story, a non-story a story."

Residents also wanted to hear positive news from the media, which was expressed by one participant as, "I think we all would want information on things that are going to harm us, but also updates on things that have been improved."

Desiring Credible Information From Trustworthy Sources

Because individuals and organizations seem to be agenda driven, the public can be unsure of who to trust. One participant shared, "Independent researchers or investigative reporters, stuff like that—it's probably what I would trust the most if I was looking it up. I would probably trust something that a politician says personally or TV news the least." Another agreed, "When we elect somebody, it doesn't matter what party, they represent all the people. Well, no, they represent who pads their pocket, and they don't think about us." Another participant stated, "I like an outside source . . . someone who is not involved in it. Someone who can be analytical without a personal motive."

Concern was expressed by participants about determining who was credible, especially when different information came from different sources. "The health department has their stats, they know what's going on according to everything, but you don't have a plumber do your electric for you. You need to go to somebody who actually knows what they're talking about, does this for a living." Another participant stated, "I'm so easily swayed if I watch one channel and then listen to an opinion on another. So, I tend to not believe either of them. You know, if I really want to validate something, I think I might be afraid of or might be concerned about, I try to gather information from numerous sources to see if any of them match up more than the others."

Even when information was obtained from credible sources, the participants felt the information could be conflicting. "And the scientists with degrees coming out their ears, alright I trust them, they're using their training, using their knowledge. But if you've got four of them, you might even have four different opinions." One participant stated, "You know, sometimes I would rather hear, 'I don't know,' than hear you make something up because you feel compelled to give me an answer."

Discussion

Our study expands the body of knowledge by identifying themes related to residents' perceptions of information about HABs that can guide effective risk communication. Similar to other studies, our study found that newspapers and television continue to be a source of information for many people, although the internet and social media was the primary source (Ekstrom et al., 2020; Hardy et al., 2016; Nierenberg et al., 2010). It is anticipated that the internet and social media will continue to be the prominent mechanism for the exchange of information despite trends in the specific platform (e.g., Twitter, Instagram). Regardless of the mechanism, it is crucial to convey accurate, understandable, and reliable information about HABs.

Residents should be notified about severe HABs or emergent situations and presented with understandable and accurate messages in a timely manner. A prior study found that alerts via email and social media were useful during initial HAB events; press releases were found most beneficial for severe blooms or blooms in "large lakes with diverse recreational use" (Hardy et al., 2016). Residents should also be offered opportunities to learn more about HABs in general. Individuals in our study wanted to know more about the causes of HABs to potentially change behaviors that could impact water quality and also indicated that education could enable them to take measures to protect themselves from future HABs.

Moreover, information is seen as credible if it is provided by individuals who do not have an agenda, who are not protecting their job, or who are not politically motivated. The residents in our study thought the news media lost credibility when they did not provide balanced reporting and sensationalized information, perhaps in an effort to captivate and retain viewers. Framing the information in a manner that emphasized the most negative aspects might have created fear in the community at the time of the do-not-drink advisory and subsequent year—and increased the public's perception of risk (Li et al., 2015).

Residents felt there was a gap in the availability of local information on HABs from trustworthy sources. Contrary to our study's findings, a study by Ekstrom et al. (2020) found trust of information sources was highest for state government, followed by professional colleagues and academic institutions. A lack of consistency within or between sources has been found to cause challenges with communication (Nierenberg et al., 2010). We found that the perception of disagreement among sources amplified distrust among community members. Understanding which information sources are trusted by the public is beneficial to communication about HABs to elicit appropriate behaviors based on the current conditions.

There are several factors that limit the transferability of these findings to other populations. The participants consisted of a large percentage who self-identified as female (65%). Additionally, the participants' perceptions of HABs were differentially influenced by the do-not-drink advisory. Some people in the focus groups were from a nearby city that was not directly affected by the advisory, although they were still concerned about their drinking water. They were, though, potentially impacted by the HAB event when going to a restaurant or business affected by the advisory or using the lake for recreational purposes. Other regions can have severe HABs that impact the community differently,

so it is ultimately up to the reader to infer whether the findings of this study could be transferred to their specific context. Regardless, our study provides insight into the perceptions of residents after a severe HAB event and has implications related to information needs and risk communication.

Communities affected by HABs can benefit from targeted outreach, including notification strategies and education, as well as methods to build trust to address information needs and effectively communicate risk (Ekstrom et al., 2020; Nierenberg et al., 2010). Taking steps to minimize risks and exposure to toxins for people and their animals is the fundamental goal of an effective HAB outreach program (Hardy et al., 2016). Although every HAB event is different, our study could be used to inform other regions that are at risk for HABs in the U.S. and worldwide.

Conclusion

HAB events are unique because they are an ongoing environmental issue; however, they can also cause severe events such as do-not-drink water advisories or fish consumption warnings. Residents want prompt information to deal with severe events but also education about HABs in general. Information, however, is not always viewed as trustworthy and might be framed to meet a particular agenda or be manipulated to sensationalize HAB events. Confusion and mixed messages can further intensify distrust and affect residents' perceptions about if there is a clear notification strategy or alert system in place. The public can only protect themselves and respond appropriately if risk communication about HABs is understandable and accurate, and—most essentially—trusted.

Acknowledgements: Focus groups were conducted as part of an environmental health assessment with the Toledo–Lucas County Health Department with Sheryl Milz, PhD, CIH, serving as the principal investigator. We would like to thank Jordan Murray for her thoughtful review of this manuscript.

Corresponding Author: April Ames, University of Toledo College of Health and Human Services, 3000 Arlington Avenue, Mailstop 1027, Toledo, OH 43614.
Email: april.ames@utoledo.edu.

References

Alcock, F. (2007). *An assessment of Florida red tide: Causes, consequences and management strategies* (Technical Report #1190). Marine Policy Institute at Mote Marine Laboratory. https://chnep.wateratlas.usf.edu/upload/documents/Mote%20Marine%20An%20Assessment%20of%20Red%20Tide.pdf

Ames, A., Steiner, V., Liebold, E., Milz, S.A., & Eitniear, S. (2019). Perceptions of water-related environmental concerns in Northwest Ohio one year after a Lake Erie harmful algal bloom. *Environmental Management*, *64*(6), 689–700. https://doi.org/10.1007/s00267-019-01217-z

Bolsen, T., & Shapiro, M.A. (2017). *Strategic framing and persuasive messaging to influence climate change perceptions and decisions*. Oxford Research Encyclopedia of Climate Science. https://doi.org/10.1093/acrefore/9780190228620.013.385

Bradshaw, C., Atkinson, S., & Doody, O. (2017). Employing a qualitative description approach in health care research. *Global Qualitative Nursing Research*, *4*. https://doi.org/10.1177/2333393617742282

Brand, L.E., & Compton, A. (2007). Long-term increase in *Karenia brevis* abundance along the Southwest Florida Coast. *Harmful Algae*, *6*(2), 232–252. https://doi.org/10.1016/j.hal.2006.08.005

Centers for Disease Control and Prevention. (2022). *Harmful algal bloom (HAB)-associated illness*. https://www.cdc.gov/habs/index.html

Colaizzi, P.F. (1978). Psychological research as the phenomenologist views it. In R.S. Valle & M. King (Eds.), *Existential-phenomenological alternatives for psychology* (pp. 48–71). Oxford University Press.

Ekstrom, J.A., Moore, S.K., & Klinger, T. (2020). Examining harmful algal blooms through a disaster risk management lens: A case study of the 2015 U.S. West Coast domoic acid event. *Harmful Algae*, *94*, Article 101740. https://doi.org/10.1016/j.hal.2020.101740

Hardy, F.J., Bouchard, D., Burghdoff, M., Hanowell, R., LeDoux, B., Preece, E., Tuttle, L., & Williams, G. (2016). Education and notification approaches for harmful algal blooms (HABs), Washington State, USA. *Harmful Algae*, *60*, 70–80. https://doi.org/10.1016/j.hal.2016.10.004

Hoagland, P., Kirkpatrick, B., Jin, D., Kirkpatrick, G., Fleming, L.E., Ullmann, S.G., Beet, A., Hitchcock, G., Harrison, K.K., Li, Z.C., Garrison, B., Diaz, R.E., & Lovko, V. (2020). Lessening the hazards of Florida red tides: A common sense approach. *Frontiers in Marine Science*, *7*, Article 538. https://doi.org/10.3389/fmars.2020.00538

Kirkpatrick, B., Fleming, L.E., Squicciarini, D., Backer, L.C., Clark, R., Abraham, W., Benson, J., Cheng, Y.S., Johnson, D., Pierce, R., Zaias, J., Bossart, G.D., & Baden, D.G. (2004). Literature review of Florida red tide: Implications for human health effects. *Harmful Algae*, *3*(2), 99–115. https://doi.org/10.1016/j.hal.2003.08.005

Kirkpatrick, B., Kohler, K., Byrne, M.M., & Studts, J. (2014). Florida red tide knowledge and risk perception: Is there a need for tailored messaging. *Harmful Algae*, *32*, 27–32. https://doi.org/10.1016/j.hal.2013.09.008

Kuhar, S.E., Nierenberg, K., Kirkpatrick, B., & Tobin, G.A. (2009). Public perceptions of Florida red tide risks. *Risk Analysis*, *29*(7), 963–969. https://doi.org/10.1111/j.1539-6924.2009.01228.x

Li, Z., Garrison, B., Ullmann, S.G., Kirkpatrick, B., Fleming, L.E., & Hoagland, P. (2015). Risk in daily newspaper coverage of red tide blooms in Southwest Florida. *Applied Environmental Education & Communication*, *14*(3), 167–177. https://doi.org/10.1080/1533015x.2015.1067579

McCarty, C.L., Nelson, L., Eitniear, S., Zgodzinski, E., Zabala, A., Billing, L., & DiOrio, M. (2016). Community needs assessment after microcystin toxin contamination of a municipal water

References

supply—Lucas County, Ohio, September 2014. *MMWR Morbidity and Mortality Weekly Report*, *65*(35), 925–929. https://doi.org/10.15585/mmwr.mm6535a1

Moore, S.K., Dreyer, S.J., Ekstrom, J.A., Moore, K., Norman, K., Klinger, T., Allison, E.H., & Jardine, S.L. (2020). Harmful algal blooms and coastal communities: Socioeconomic impacts and actions taken to cope with the 2015 U.S. West Coast domoic acid event. *Harmful Algae*, *96*, Article 101799. https://doi.org/10.1016/j.hal.2020.101799

Nierenberg, K., Byrne, M.M., Fleming, L.E., Stephan, W., Reich, A., Backer, L.C., Tanga, E., Dalpra, D.R., & Kirkpatrick, B. (2010). Florida red tide perception: Residents versus tourists. *Harmful Algae*, *9*(6), 600–606. https://doi.org/10.1016/j.hal.2010.04.010

Savoia, E., Lin, L., & Viswanath, K. (2017). Sources of information during the 2014 West Virginia water crisis: A cross-sectional survey. *Disaster Medicine and Public Health Preparedness*, *11*(2), 196–206. https://doi.org/10.1017/dmp.2016.98

DIRECT FROM AEHAP

From Assessment to Action: A Road Map to Becoming an Environmental Health Science Professional

Kim M. Lichtveld, MSPH, PhD
The University of Findlay

Maureen Y. Lichtveld, MPH, MD
University of Pittsburgh

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

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

Dr. Kim Lichtveld is the president of AEHAP and chair of the Department of Environmental, Safety, and Occupational Health Management at The University of Findlay. Dr. Maureen Lichtveld is dean of the School of Public Health at the University of Pittsburgh.

Introduction

Is the air safe to breathe? Is the water safe to drink? Can I feed my child the apple I bought at the grocery store? Is my house safe from toxic substances? How will climate change-related flooding and drought impact food security? These are some of the questions environmental health science professionals are trained to counter. From the time John Snow removed the pump handle and Rachel Carson described the origin of a *Silent Spring*, environmental health professionals consistently provided the evidence that the health of the environment is inextricably linked to that of people.

Never before has the profession been in such need of bolstering its workforce. Over the last few decades many communities have taken for granted the ability to control disease outbreaks and have access to safe food, clean water, healthy homes, and reliable sanitation (Brooks & Ryan, 2021). This trend has been combined with a realization that the traditional definition of environment is no longer relevant. For example, when Saharan dust increases the risk of childhood asthma in Puerto Rico, it is clear that geographical boundaries to assess the impact of environmental insults on human health are obsolete. Similarly, exposures to nonchemical stressors often related to social determinants of health, such as financial distress and poor housing, can result in stress and other adverse health consequences, and can potentially synergistically exacerbate contaminant exposures resulting in worse health and well-being (Gokoel et al., 2021; Lichtveld et al., 2018; Nilsen et al., 2020; Tulve et al., 2016). This indirect relationship has contributed to reduced investments in environmental health services, resulting in system weaknesses and vulnerabilities, which were highlighted by the COVID-19 pandemic (Brooks & Ryan, 2021).

Attributes of the Environmental Health Professional

There are many attributes that make the environmental health profession unique. Key among those attributes are the following three: 1) the profession is by design transdisciplinary in nature; 2) to be effective, an environmental health professional must engage a wide-ranging set of stakeholders from corporations to communities; and 3) career opportunities are multisectoral—from local to global and from worker health to water quality—making environmental health science professionals highly in demand. Our job now is to let the communities we serve understand how important this discipline is to ensure they can thrive every day of their lives. Future professionals also need to know the myriad of environmental health needs and career options within this degree. This awareness needs to be done early in their

FIGURE **1**

Complete Environmental Exposure Pathway

Note. The infographic was designed by the European Environment Agency and depicts the pathway from source of contamination—through environmental media—to the points of exposure, their routes, and subsequently those individuals who are exposed and affected (European Environment Agency, 2019).

career decision-making process (i.e., middle and high school years) to ensure the growth and continued impact environmental health science has on this ever-changing landscape.

Transdisciplinary by Design

Knowledge of each step of the environmental exposure pathway is pivotal (Figure 1). This understanding is vital to master the characterization of the contamination source(s) and human health risks—how chemicals move through the exposure media (e.g., water, soil, air); where exposure can occur (e.g., playground, water tap); how chemicals enter into the body and how metabolism occurs (e.g., exposure routes, inhalation, ingestion, dermal contact, breast milk); and most importantly, who is exposed, especially those individuals most vulnerable.

Expertise in environmental sciences and those disciplines targeting human health and social services have been artificially separated in many educational systems, yet both are pivotal to achieve community protection. Environmental health science programs need to focus on a pedagogical approach to integrate these disciplinary approaches. Illustrative examples of the benefit of this approach are evident in addressing airflow requirements to mitigate transmission of infectious agents in indoor environments (e.g., the SARS-CoV-2 pandemic) (Mbow et al., 2019), and the impact on food security related to biodiversity loss resulting from climate change (Lichtveld, 2022).

Wide-Ranging Stakeholder Portfolio

From communities to companies—the public and private sectors—successful environmental health science professionals engage with a diverse set of stakeholders. Similarly, they are active in many different professional organizations. Among those are the environmental and occupational health sections of the American Public Health Association, Society of Toxicology, Association of Schools and Programs in Public Health, National Environmental Health Association, and Association of Environmental Health Academic Programs (EHAC). Stakeholders also include both academic unit-wide and discipline-specific accrediting bodies such as the Council on Education for Public Health, National Environmental Health Science and Protection Accreditation Council, and Board for Global EHS Credentialing. Together, these stakeholders represent a nurturing environment for emerging and senior environmental health professionals alike.

Career Opportunities

So, who are we? The list is limitless: environmental health specialists, public health practitioners, academicians and scientists, disease control professionals, disaster management officials, occupational health and safety specialists, industrial hygienists, food safety specialists, chief resilience officers, water quality specialists, climate and human health scientists, and environmental health policy experts. Employment opportunities are equally diverse: health and environmental protection; academia; federal, state, and local health and environmental agencies; manufacturing companies; worker protection; and disaster preparedness and management. Noteworthy is the versatility of our profession. Given the heightened attention to the COVID-19 pandemic and climate-related risks to communities, we are now more visible as experts in infectious disease control, mitigating toxic exposures, and allowing communities to thrive in the safest possible way.

Helpful Resources

Professional Organizations

- American Public Health Association (www.apha.org)
- Association of Environmental Health Academic Programs (www.aehap.org)
- Association of Schools and Programs of Public Health (https://aspph.org)
- Association of State and Territorial Health Officials (www.astho.org)
- National Association of County and City Health Officials (www.naccho.org)
- National Environmental Health Association (www.neha.org)
- National Environmental Health Science and Protection Accreditation Council (www.nehspac.org)
- Society of Toxicology (www.toxicology.org)

Employment Organizations

- Academia, foundations, not-for-profit organizations, advocacy organizations, nongovernmental organizations
- Private sector: energy, industry, pharmaceuticals, environmental consulting, insurance, health and safety
- Public sector: Centers for Disease Control and Prevention, U.S. Environmental Protection Agency, Occupational Safety and Health Administration, National Institute for Occupational Safety and Health, state and local health departments

Pathways to Becoming an Environmental Health Professional

The road map towards environmental health science can start in primary school by consciously cultivating an awareness how the health of the environment is inextricably linked to that of people. Environmental health educators can play an important role in exposing high school science teachers and their students to environmental health. Examples include the Emerging Scholars Environmental Health Sciences Academy, Environmental Health Science Education, and Teen Research and Education in Environmental Science for High School Students (Covert et al., 2019; National Insitute of Environmental Health Sciences, 2019; Rocha et al., 2023; University of Pennsylvania, n.d.). These programs target disadvantaged juniors and rising seniors in public schools and are designed to promote college attendance in general and environmental health disciplines specifically.

The portfolio of environmental health degrees spans the undergraduate and graduate levels. Bachelor of science (BS) degrees are offered through many programs that often also offer specialty tracks such as health and safety management. At the graduate level, master of science (MS) and master of science in public health (MSPH) degrees provide opportunities to specialize in a wide variety of environmental health subspecialties as described in the career opportunities. A key aspect of this education are the mechanisms provided by programs accredited by EHAC, which provides the foundations required to translate science into practice to protect human health across multiple settings. Also, graduates are able to join the ranks of the registered environmental health specialists or registered sanitarians.

The doctor of philosophy degree (PhD) in environmental health sciences often focuses on in-depth assessments of the impact on exposures to contaminants throughout the research continuum. This research can range from basic mechanistic inquiries to organ system damage and environmental epidemiologic cohort studies. The PhD can also offer specialization in several toxicological subspecialities including ecotoxicology, genetic toxicology, and organ-specific endpoint (e.g., reproductive, pulmonary, and renal toxicology). Within medicine, specialization and board certification in environmental and occupational medicine focus on the clinical aspects such as organ system damage and function. Depending on prerequisite coursework, graduates with environmental health science degrees can also pursue certification in industrial hygiene, a coveted professional certification. Several academic institutions offer some of these specialty tracks online, creating greater access for those already practicing who want to augment their practical skills into a formal degree.

Career Advancement

Career advancement is both degree and employment sector specific. At the BS and MS professional levels, employment often follows successful internships or co-ops. A benefit for the employer is that the newly hired environmental health professional can "hit the ground running," decreasing the onboarding time and learning curve. Another advantage is that graduates of EHAC programs, who have often received support from the Association of Environmental Health Academic Programs, will be trained in the benchmark qualification for government and military sectors (Ryan & Hall, 2022). Graduates have the ability to capitalize on their education and effectively protect the health and well-being of others.

The newly employed professional starts a career in a familiar setting without having to go through an extensive job search. This scenario is often the case in industry where hiring systems are more flexible than the public sector. Private sector career opportunities include pharmaceutical, oil, and mining industries; health and safety companies; manufacturing; engineering; healthcare; and a range of other industries. In the public sector, many opportunities exist within federal, state, tribal, local, and city governments and communities. Most career opportunities are in public health or environmental agencies. For those pursuing an academic career, the trajectory traditionally involves obtaining a postdoctoral fellowship, followed by a faculty position and the opportunity to ascend in rank from assistant to full professor and over time in higher administrative positions. Given the plethora of options, environmental health science professionals can pursue multiple careers across different subspecialty areas and employment sectors.

Corresponding Author: Kim M. Lichtveld, President, Association of Environmental Health Academic Programs; Chair, Department of Environmental, Safety, and Occupational Health Management, The University of Findlay, 1000 North Main Street, Findlay, OH 45840. Email: lichtveld@findlay.edu.

References

Brooks, B.W., & Ryan, B.J. (2021). Building environmental public health back better. *Environmental Science & Technology Letters*, *8*(6), 443–444. https://doi.org/10.1021/acs.estlett.1c00391

Covert, H., Ilunga Tshiswaka, D., Ramkissoon, I., Sisskin, E., Lichtveld, M., & Wickliffe, J. (2019). Assessing science motivation among high school students participating in a supplemental science programme: The Emerging Scholars Environmental Health Sciences Academy. *International Journal of Science Education*, *41*(17), 2508–2523. https://doi.org/10.1080/09500693.2019.1689308

European Environment Agency. (2019). *The European environment—State and outlook 2020: Knowledge for transition to a sustainable Europe*. Luxembourg Publications Office of the European Union. https://www.eea.europa.eu/publications/soer-2020

Gokoel, A.R., Shankar, A., Abdoel Wahid, F., Hindori-Mohangoo, A.D., Covert, H.H., Wickliffe, J.K., Harville, E.W., Zijlmans, W.C.W.R., & Lichtveld, M.Y. (2021). The cumulative risk of prenatal exposures to chemical and non-chemical stressors on birth outcomes in Suriname. *International Journal of Environmental Research and Public Health*, *18*(14), Article 7683. https://doi.org/10.3390/ijerph18147683

Lichtveld, K., Thomas, K., & Tulve, N.S. (2018). Chemical and non-chemical stressors affecting childhood obesity: A systematic scoping review. *Journal of Exposure Science & Environmental Epidemiology*, *28*, 1–12. https://doi.org/10.1038/jes.2017.18

Lichtveld, M. (2022, November 10). 8 billion people: Four ways climate change and population growth combine to threaten public health, with global consequences. *The Conversation*. https://theconversation.com/8-billion-people-four-ways-climate-change-and-population-growth-combine-to-threaten-public-health-with-global-consequences-193077

Mbow, C., Rosenzweig, C., Barioni, L.G., Benton, T.G., Herrero, M., Krishnapillai, M., Liwenga, E., Pradhan, P., Rivera-Ferre, M.G., & Sapkota, T. (2019). Food security. In N. Benkeblia, A. Challinor, A. Khan, & J.R. Porter (Eds.), *IPCC special report: Climate change and land*. Intergovernmental Panel on Climate Change. https://www.ipcc.ch/srccl

National Insitute of Environmental Health Sciences. (2019). *Environmental health science education*. https://www.niehs.nih.gov/research/supported/translational/ehsic/index.cfm

Nilsen, F.M., Ruiz, J.D.C., & Tulve, N.S. (2020). A meta-analysis of stressors from the total environment associated with children's general cognitive ability. *International Journal of Environmental Research and Public Health*, *17*(15), Article 5451. https://doi.org/10.3390/ijerph17155451

Rocha, J., Cabral, B., Chen, E., Rodriguez, C., & Yancy, C.W. (2023). Integrative supports, resources, and opportunities—Exploring and expanding urban high school students' science identity: A longitudinal qualitative study. *Gifted Child Quarterly*, *67*(1), 44–63. https://doi.org/10.1177/00169862221119209

Ryan, B.J., & Hall, K. (2022). Strengthening the environmental health professional pipeline from education into practice. *Journal of Environmental Health*, *84*(7), 28–30. https://www.neha.org/Images/resources/JEH3.22-Column-Direct-From-AEHAP.pdf

Tulve, N.S., Ruiz, J.D.C., Lichtveld, K., Darney, S.P., & Quackenboss, J.J. (2016). Development of a conceptual framework depicting a child's total (built, natural, social) environment in order to optimize health and well-being. *Journal of Environment and Health Sciences*, 2(2), 1–8. https://doi.org/10.15436/2378-6841.16.1121

University of Pennsylvania. (n.d.). *Environmental health education programs*. https://ceet.upenn.edu/community-outreach-engagement/coec-environmental-health-education-programs/

Did You Know?

The NEHA History Project Task Force endeavors to preserve our rich history and share our stories. You can view our virtual museum full of artifacts and tools, as well as our logo history, past AEC dates and reports, and much more at www.neha.org/history.

DIRECT FROM CDC ENVIRONMENTAL HEALTH SERVICES

Brian Hubbard, MPH

Raquel Sabogal, MPH

Max Zarate-Bermudez, MSc, MPH, PhD

Community Resources for Contaminants of Concern in Private Wells

Editor's Note: The National Environmental Health Association 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 tools, resources, and guidance for environmental health practitioners. The conclusions in these columns are those of the author(s) and do not necessarily represent the official position of CDC.

Brian Hubbard is a health scientist and the Safe Water Section lead. Raquel Sabogal is an epidemiologist and environmental health scientist and is a subject matter expert in water quality. Max Zarate-Bermudez is an environmental epidemiologist and a subject matter expert in water quality. All work at the National Center for Environmental Health in the Water, Food, and Environmental Health Services Branch within CDC.

Public Health Programs Can Help Private Well Owners Understand Water Quality Results

In the U.S., approximately one in five water samples collected from private wells were found to be contaminated with at least one chemical at levels high enough to harm health (DeSimone et al., 2009). Given that about one in eight U.S. residents obtain their water from a private well, access to safe drinking water is vital (Centers for Disease Control and Prevention, 2022). Many private wells are not routinely tested for contaminants, which can be microbiological, chemical, or radiological. Environmental health practitioners serve as a valuable resource, helping their communities to increase well testing, identify contaminants of concern, and understand well water testing results.

CDC Worked to Improve Drinking Water in Private Wells

During 2015–2020, the National Center for Environmental Health (NCEH) within the Centers for Disease Control and Prevention (CDC) funded 19 state and local public health agencies to improve drinking water programs as part of Safe Water for Community Health. These recipients used the Environmental Public Health Performance Standards (www.cdc.gov/nceh/ehs/envphps/default.htm) to identify and address program gaps.

Based on their findings, funding recipients increased access to services for private well users by hosting outreach activities such as well owner workshops and partner meetings. They provided information on testing of well water, interpreting test results, and exploring ways to improve wells and choose treatment options. By closing program gaps, recipients were better able to help reduce private well user exposure to harmful contaminants in their drinking water. For example, recipients collected and tested 26,427 well water samples. They found that 4,346 wells serving approximately 11,000 people had high levels of contaminants. Work to reduce exposures to contaminants included repairing wells, installing new treatment systems, and in some cases, changing source water.

NCEH also supported recipient efforts to monitor water quality, improve the organization of data, develop targeted interventions, and expand tool kits. As recipients improved water quality monitoring, they enhanced their understanding of contaminants of concern and routes of exposure in the communities they served.

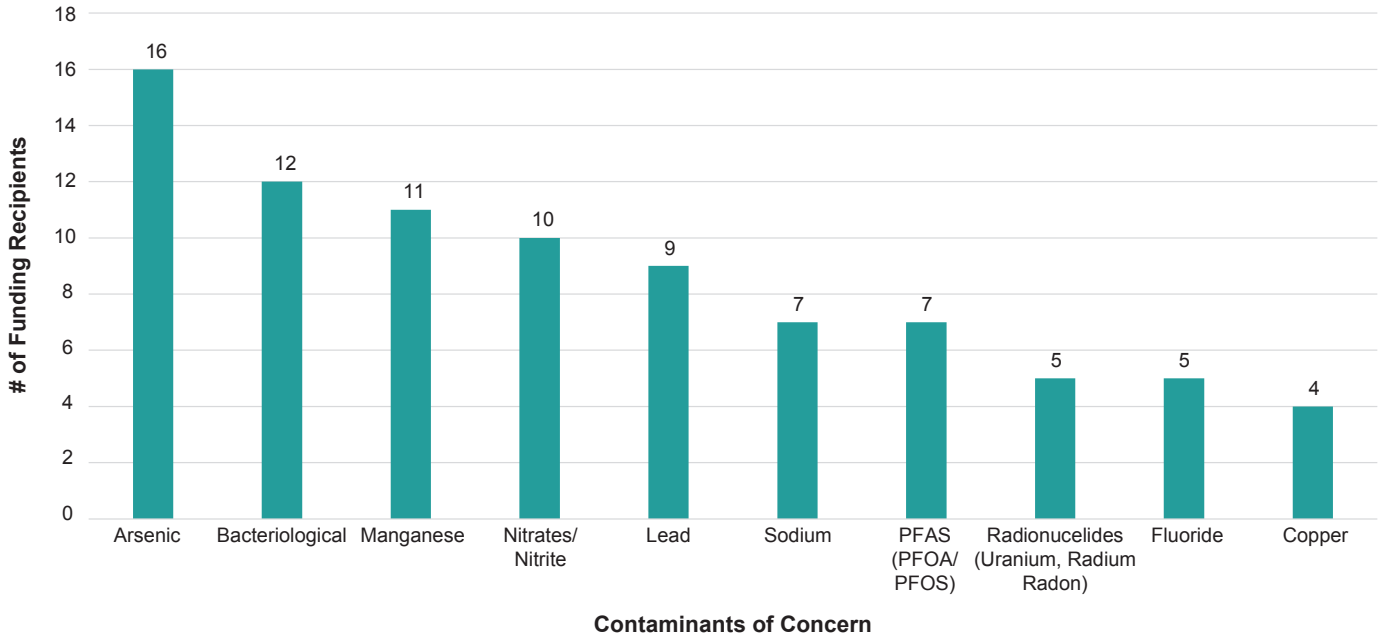
CDC Organized Information About Top Contaminants of Concern in Wells

At the close of the funding program, NCEH conducted exit interviews with recipients to learn which well contaminants were of greatest concern in their jurisdictions. Recipients provided their insights based on their improved water quality monitoring efforts. Among the top 10 mentioned (Figure 1), their top 5 contaminants of concern were:

1. arsenic,
2. bacteriological agents (*E. coli* and total coliform),

FIGURE **1**

Top 10 Contaminants of Concern Reported by Funding Recipients (*N* = 19)



Note. PFAS = per- and polyfluoroalkyl substances; PFOS = perfluorooctanoic acid; PFOS = perfluorooctanesulfonic acid.

TABLE **1**

Fact Sheets Developed by Funding Recipients to Inform Well Owners About Contaminants of Concern in Their Communities

Topic	Link
Arsenic	www.azdhs.gov/documents/preparedness/epidemiology-disease-control/environmental-toxicology/well-water/arsenic.pdf
Coliform bacteria	www.michigan.gov/documents/deq/deq-wd-gws-wcu-coliformbactiwellwatersampling_270604_7.pdf
Lead	www.oregon.gov/oha/PH/HealthyEnvironments/DrinkingWater/Monitoring/Documents/health/lead.pdf
Manganese	https://portal.ct.gov/-/media/Departments-and-Agencies/DPH/dph/environmental_health/eoha/pdf/24ResidentialDrinkingWaterWellTestingpdf.pdf?la=en
Nitrates	www.michigan.gov/documents/deq/deq-wd-gws-ciu-nitratebrochure_270430_7.pdf

3. manganese,
4. nitrates, and
5. lead.

These exit interviews also detailed how funding recipients handled challenges to providing water treatment recommendations to private well owners. Recipients said they did not always have the expertise to answer technical questions from well owners about treatment options and whether their wells could be improved. In these situations, recipients referred well owners to consult with external partners (e.g., private businesses, universities, cooperative extensions) to address treatment options. These partnerships were vital to improving access to safe water in these jurisdictions.

Fact Sheets and App Helped Well Owners Understand Water Quality Test Results

During their 5 years of private well activities, many funding recipients developed fact sheets on the contaminants affecting their communities. The fact sheets were used to inform and enable well owners to make their drinking water safer (Table 1). They provided these fact sheets at well owner workshops, during outreach events such as state fairs, and on their websites.

Many funding recipients also applied to partner with Be Well Informed (www.bewellinformed.info/about). This free tool, designed by the Environmental Council of the States, is an open-access web application that helps private well owners understand their water qual-

TABLE **2**

Funding Recipients That Use the Be Well Informed Tool

Jurisdiction	Link
Arizona	www.azdhs.gov/preparedness/epidemiology-disease-control/environmental-toxicology/well-water/index.php#be-well-informed
Massachusetts	www.mass.gov/service-details/understanding-my-laboratory-results
Michigan	www.michigan.gov/egle/Maps-Data/Be-Well-Informed
Virginia	www.wellwater.bse.vt.edu/well-informed-virginia.php
Wake County, North Carolina	www.wakegov.com/departments-government/water-quality-programs/groundwater-protection-and-wells/well-water-testing/understanding-test-results
West Virginia	https://bewellinformed.info/workbench
Wyoming	https://deq.wyoming.gov/water-quality/groundwater/know-your-well/

ity test results. When well owners from participating jurisdictions enter their water quality test results into the online application, they get easy to understand information regarding health concerns and available water treatment options. They can also learn where to obtain more information in their local area.

Many states are using the Be Well Informed tool (Table 2). Jurisdictions can customize it to suit their needs. Users report that there has been a significant reduction in the number of staff hours dedicated to answering questions about private well water testing. States interested in joining Be Well Informed can visit www.bewellinformed.info/for-partners to get started. Take a look at the Onboarding Kit first for step-by-step instructions and helpful FAQs with answers to common questions.

You can find additional resources for environmental health practitioners on private wells at www.cdc.gov/nceh/ehs/water/private-wells/index.html.

Corresponding Author: Brian Hubbard, Safe Water Section Lead, National Center for Environmental Health, Centers for Disease Control and Prevention, 4770 Buford Highway NE, Atlanta, GA 30341.
Email: bnh5@cdc.gov.

References

Centers for Disease Control and Prevention. (2022). *Private drinking water and public health*. https://www.cdc.gov/nceh/ehs/water/private-wells/private-drinking-water-public-health.html

DeSimone, L.A., Hamilton, P.A., & Gilliom, R.J. (2009). *Quality of water from domestic wells in principal aquifers of the United States, 1991–2004: Overview of major findings* [Circular 1332]. U.S. Geologic Survey. https://pubs.usgs.gov/circ/circ1332/includes/circ1332.pdf

Looking to Start or Improve Your Well Program?

Use our resources to find and address gaps in your program to protect people in your community whose water comes from private wells. Learn more at www.cdc.gov/nceh/ehs/water/private-wells/starting-a-private-well-program.html.

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 (NEHA) 2023 Annual Educational Conference & Exhibition. The award consists of an individual plaque and a perpetual plaque that is displayed in the NEHA office.

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, 2023.

Nomination packages should be emailed to Eric Bradley, AAS Executive Secretary/Treasurer, at ericbradley30252@gmail.com. Files should be in Word or PDF format.

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

DIRECT FROM ecoAmerica

Ben Fulgencio-Turner, MPP, CPH

Nicole Hill, MPH

The Climate World Is Changing, So Can We

Editor's Note: The National Environmental Health Association (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 from ecoAmerica whose mission is to build public support and political resolve for climate solutions. NEHA is an official partner of ecoAmerica and works closely with their Climate for Health Program, a coalition of health leaders committed to caring for our climate to care for our health. The conclusions in this column are those of the author(s) and do not necessarily represent the official position of NEHA.

Ben Fulgencio-Turner is the director of Climate for Health within ecoAmerica. Nicole Hill is the research and marketing manager for ecoAmerica.

Over the past century, the world has experienced a dramatic increase in emissions from burning fossil fuels, resulting in changes to the climate across the globe (Lindsey, 2022). We know that the outcome of these changes on human health is far-reaching, with every child around the world at risk from at least one climate change impact such as heat and air pollution (UNICEF, 2021). The 2022 Global Report of the *Lancet* Countdown (2022) confirms that life-threatening extreme weather events are becoming more frequent. These risks and health impacts are changing attitudes of people in the U.S. A 2022 ecoAmerica survey revealed that nearly 7 in 10 people in the U.S. agree that climate change is a serious problem (Hill, 2022).

As public consensus to take climate action grows, leaders and organizations at the local, national, and international levels are responding. A total of 196 parties signed the Paris Agreement at the 21st session of the Conference of the Parties (COP 21), agreeing to limit global warming to below 2 °C. In 2021 the U.S. formed the National Climate Task Force alongside additional executive actions from President Joe Biden prioritizing climate change. And just last year, the Inflation Reduction Act was passed—a historic bill estimated to bring economic growth, clean energy expansion, and emission reductions. People in the U.S. support these actions: over 4 in 5 say addressing climate change should be a priority for the U.S. (Hill, 2022).

The new resources and billions of dollars of investments and direct grants included in the Inflation Reduction Act will lower the price for renewable energy and help to address climate-related environmental hazards. Tax credits for individuals and organizations will significantly lower the up-front cost to transition to clean energy and resilient facilities and communities. Rewiring America (n.d.) has prepared a tool kit to estimate your benefits and plan how to access them. The federal government is also releasing regular updates on the Inflation Reduction Act (The White House, n.d.).

These advances owe a great deal to the engagement, advocacy, and strong voice of leaders in the health sector. Individual and community health is a strong motivator for action on climate change; people from all walks of life care deeply about clean air, safe water, and the risks of severe weather (Hill, 2021). The National Environmental Health Association (NEHA) is leading the way. The association's commitment to climate action is outlined in their policy statement on climate change (NEHA, 2020) and their declaration on 100% clean energy by 2030 (NEHA, 2018). NEHA was one of the first organizations to offer the Climate for Health Climate Ambassador Training at their 2019 Annual Educational Conference & Exhibition. As of January 2023, 46 national associations representing hundreds of thousands of healthcare professionals have joined ecoAmerica's Climate for Heath coalition and are committed to climate action to prevent future health harms.

You can make a difference in your workplace, local community, and home. In the workplace, advocate for a climate position statement or include it in your organization's mission. Review the climate statements from national climate leaders like NEHA for ambitious language to use. Stay in touch with Inflation Reduction Act implementation as specific credits and programs for transportation, buildings, and energy are defined. In your community, your role as an environmental health professional gives you an opportu-

nity to highlight the links between climate action and community health. Your voice can make a difference, spurring action to reduce children's exposure to exhaust by transitioning buses from fossil fuels to electric, reducing heat island effects through gardens and green spaces, and shifting energy sources to renewable energy that will reduce the health harms of climate change.

Finally, there are many options for action within your own home. The typical household and vehicle use of people in the U.S. make up two thirds of their carbon emissions (Song et al., 2019). You can reduce these emissions while saving money. Some options include:

- Prioritize insulation. The U.S. Environmental Protection Agency estimates that improving your insulation alone can reduce utility bills by over 10% (Energy Star, n.d.).
- Reduce harmful exposures in your home. Replacing appliances that burn methane with cleaner and more efficient ones, such as heat pumps and electric or induction ranges, saves money and improves the health of your family.
- Switch your gas burning car for an electric one.

The thousands of dollars of federal tax credits to make these improvements mean that the up-front investment for safer and cheaper energy is in reach for many more of us than we may realize. While we look at the scope of the overlapping impact of climate change and environmental degradation on individual health, it can feel overwhelming and hard to process. Recognizing that the situation is changing—and that tools are available to take meaningful action—is empowering and can help break through that paralysis. Taking action as an environmental health professional, as a community leader, and as an individual will help us all to secure safety and health.

> *"A health-centred, low-carbon response offers a renewed opportunity to deliver a future in which world populations can not only survive, but thrive."*
>
> *Lancet* Countdown, 2022

Corresponding Author: Nicole Hill, Research and Marketing Manager, ecoAmerica, 1730 Rhode Island Avenue NW, Suite 200, Washington, DC 20036.
Email: nicoleh@ecoamerica.org.

References

Energy Star. (n.d.). *Methodology for estimated energy savings from cost-effective air sealing and insulating*. https://www.energystar.gov/campaign/seal_insulate/methodology

Hill, N. (2021, May 26). *American Climate Perspectives Survey 2021, vol. III: The rural–urban divide on climate change. Where's the polarization?* ecoAmerica. https://ecoamerica.org/american-climate-perspectives-survey-2021-vol-iii/

Hill, N. (2022, November 22). *American Climate Perspectives Survey 2022, vol. V: Bi-partisan American attitudes: It's time for urgent climate action*. ecoAmerica. https://ecoamerica.org/american-climate-perspectives-survey-2022-vol-v-blog/

Lancet Countdown. (2022). *The 2022 Global Report of the* Lancet *Countdown*. https://www.lancetcountdown.org/2022-report/

Lindsey, R. (2022, June 23). Climate change: Atmospheric carbon dioxide. *Climate.gov*. https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide

National Environmental Health Association. (2018). *Declaration on 100% clean energy by 2030*. https://www.neha.org/clean-energy

National Environmental Health Association. (2020). *Policy statement on climate change*. https://www.neha.org/Images/resources/NEHA-Policy-Statement-Climate-Change-Oct2020.pdf

Rewiring America. (n.d.). *Your guide to the Inflation Reduction Act*. https://www.rewiringamerica.org/IRAguide

Song, K., Qu, S., Taiebat, M., Liang, S., & Xu, M. (2019). Scale, distribution and variations of global greenhouse gas emissions driven by U.S. households. *Environment International*, *133*(Part A), Article 105137. https://doi.org/10.1016/j.envint.2019.105137

UNICEF. (2021, August 19). *The impacts of climate change put almost every child at risk*. https://www.unicef.org/stories/impacts-climate-change-put-almost-every-child-risk

The White House. (n.d.). *Clean energy for all*. https://www.whitehouse.gov/cleanenergy/

Did You Know?

Jurisdictions can review our Climate Health Adaptation and Mitigation Partnership (CHAMP) and strategic framework at www.neha.org/climate-change. CHAMP can be used to identify climate-related health risks, develop climate adaptation plans, and implement targeted adaptation actions to protect communities. The program provides an opportunity to share lessons learned, stories of impact, and resources. The program also helps communities make progress toward meeting Healthy People 2030 objectives, raises awareness about how climate change disproportionately impacts health, and incorporates the Building Resilience Against Climate Effects (BRACE) framework from the Centers for Disease Control and Prevention.

ENVIRONMENTAL HEALTH ACROSS THE GLOBE

Benjamin J. Ryan, MPH, PhD, REHS
Baylor University

James Williams, MPH, FEH
Disaster Speak

How an Australian Centre for Disease Control Can Reinforce Environmental Health Systems and Services

Editor's Note: We are familiar with the phrase, "Environmental health is extremely local." While environmental health affects most of us on the local level, we also understand that environmental health is universal and does not know borders. The location, geography, people, and conditions can differ but the science and principles of environmental health do not. In this new column, the National Environmental Health Association (NEHA) will present environmental health issues and topics from a global perspective. Understanding environmental health on a global scale can help us recognize how that influences our local spheres and provides learning opportunities to broaden our perspectives.

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

Dr. Benjamin Ryan is a clinical associate professor at Baylor University and the past-president of the Association of Environmental Health Academic Programs. James Williams is the managing director of Disaster Speak, a boutique consultancy specializing in public health risk management and advisory services in all areas of public health, environmental health, sanitation, climate change, and disaster risk reduction.

The Australian government is working to establish a Centre for Disease Control (CDC). The goal is to ensure pandemic preparedness, lead the federal response to future disease outbreaks, and prevent noncommunicable and communicable diseases (Australian Government, 2022a). This news is welcomed as Australia is the only country in the Organisation for Economic Co-operation and Development (OECD) without a CDC or similar national organization (Australian Government, 2022b). The nation is uniquely placed to build on lessons from other countries to create a "world-class" Australian CDC by reinforcing environmental health systems and becoming the champion for evidence-based policy.

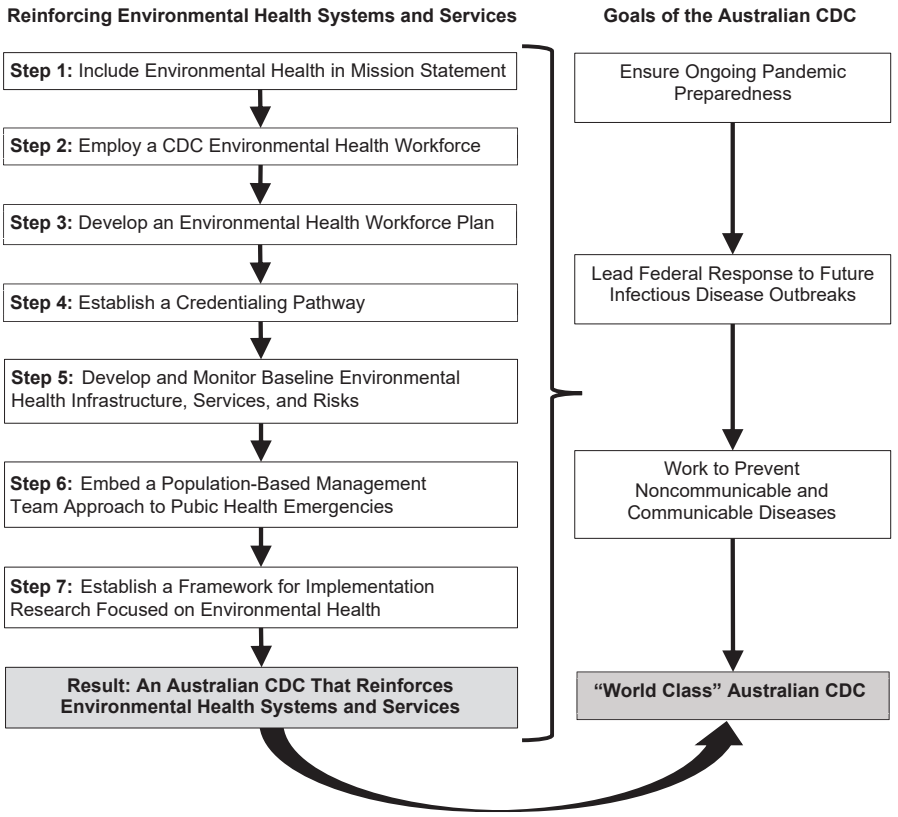
In Australia, local authorities along with state and territory governments manage and address environmental health risks (Australian Government, 2022c). These risks include air pollution, food safety, water quality, waste management, sanitation, infection control, animal and pest management, occupational health, hazardous materials (e.g., asbestos, lead), risk assessment, and education (Environmental Health Australia, n.d.). The majority of environmental health professionals in Australia are employed in local governments (Whiley et al., 2019). More broadly, the profession works across disciplines to ensure the safety of essential public health services.

The management of environmental health risks in Australia over recent decades has been distributed across government and many nonhealth agencies (Dwyer, 2022). This distribution has included shifting the management of risks to town planning, water management, and occupational health, and public health issues becoming dominated by clinical perspectives (Dwyer, 2022; Whiley et al., 2019). For example, strongyloidiasis, an issue primarily in Indigenous Australian communities, is largely due to failing wastewater systems, inadequate waste collection and disposal, overcrowding in houses, and inadequate veterinary care; however, these risks are often overlooked in favor of clinical treatment with ivermectin (Hays et al., 2017; Whiley et al., 2019). The success of this treatment has reduced environmental health advocacy without preventing reinfection, which demonstrates that clinical intervention alone cannot solve public health challenges (Ross et al., 2017; Taylor et al., 2014; Whiley et al., 2019).

There is an urgent need to reinforce environmental health at a national policy level

FIGURE **1**

Steps to Reinforce Environmental Health Systems and Services and Goals of the Australian Centre for Disease Control (CDC)



in Australia. For example, environmental health has a secondary role in the Australian CDC consultation paper and is not included in the *Senate Select Committee on COVID-19: Final Report*; *Fault Lines: An Independent Review Into Australia's Response to COVID-19*; *Australian Government Crisis Management Framework*; or *Australian COVID-19 Response Management Arrangements: A Quick Guide*. Funding has also struggled to cover needs in workforce development, practitioner training, and research. Additionally, there is no job code for environmental health listed by the Australian Taxation Office, but there are over 20 types of inspectors and more than 55 different types of nurses (Australian Taxation Office, 2022; Whiley et al., 2019).

Many nations have environmental health (i.e., science and workforce) integrated within their national public health agency model (Dwyer, 2022). The OECD (2020) recognizes how enhancing environmental health systems can reduce the vulnerability of communities to disease outbreaks, epidemics, and pandemics while improving overall societal well-being and resilience. Also, following an environmental health approach supported by optimal practitioner performance significantly reduces the impact of diseases on both communities and health systems (Kelley & Anderson, 2012). In the U.S., the Centers for Disease Control and Prevention, National Environmental Health Association, and Baylor University developed an initiative to support the environmental health workforce—Understanding the Needs, Challenges, Opportunities, Vision, and Emerging Roles in Environmental Health (UNCOVER EH)—and the profession is listed in the Pandemic and All-Hazards Preparedness and Advancing Innovation Act of 2019. To build on these lessons, we recommended that the steps outlined in Figure 1 be implemented.

The first step is to include environmental health in the mission statement. This inclusion would recognize that environmental health is a backbone of the public health system, which is beyond the scope of most doctors, nurses, and allied health professionals (Brooks & Ryan, 2021; Whiley et al., 2019). For example, communicable disease control specialists tend to take a narrower approach to managing risks as their expertise lies in the disease control itself, not the systems that generate risk (Dwyer, 2022). This step would also reflect that environmental health risks will continue to emerge, especially as Australia is now one of the more urbanized countries in the world (The World Bank, 2021). For example, per- and polyfluoroalkyl substances (PFAS) emerged as an issue in the early 2000s and are found in disposable food packaging, cookware, furniture, carpet, and manufacturing plants (Sunderland et al., 2019). The role of environmental health science is to understand the human health risks from PFAS and then, if necessary, implement interventions.

Steps two, three, and four would require employment of credentialed environmental health professionals coupled with a workforce development plan. Credentialed professionals would ensure that interdisciplinary thinking from a whole-of-society perspective is ingrained into the Australian CDC. Also, the Australian CDC would need to work with Environmental Health Australia to establish a credentialing framework to ensure alignment with other professions and colleagues in the UK and U.S. An environmental health workforce plan would bring all these components together. A template could be the Environmental Health Workforce Act (2021), which was introduced to the U.S. Congress to prioritize the needs of new and existing environmental health professionals.

The fifth step would be for the Australian CDC to work with local, state, and territorial governments to track and monitor environmental health infrastructure, services, and risks. This work could be in the form of an index or registrar, which would allow the Australian CDC to create a baseline, understand areas of need, and guide invest-

ment into public health system architecture. Once a baseline is established it would become a routine process to monitor progress. Also, this approach would reflect historical trends that public health interventions with the greatest impact on populations have addressed environmental factors (Whiley et al., 2019). In a pandemic situation, this approach would rapidly shorten the time needed to build public health capacity to drive a whole-of-society response.

Finally, the Australian CDC should embed a population-based management team (PBMT) approach along with a framework for implementation research focused on environmental health science (Burkle et al., 2021). A useful research template would be the Consolidated Framework for Implementation Research (Damschroder et al., 2022). This framework combined with PBMTs would ensure a range of disciplines with no profession taking priority over another, as well as fully explore and understand intervention measures and their impact on all aspects of society (Burkle et al., 2021). The benefit of this approach was demonstrated during the COVID-19 pandemic when Baylor University identified the need to safely reopen in person to support the Waco community and students, staff, and faculty (Ryan et al., 2022). By combining environmental health with a PBMT approach to mitigate risk, Baylor University was one of a few universities in the U.S. to open in fall 2020 and sustain operations throughout the pandemic.

As the backbone of the public health system, the Australian CDC should work to reinforce environmental health systems and services. Professionals in this field are based in communities, their training is interdisciplinary, and they focus on mitigating risk across all aspects of society. Further, the profession demonstrates its integral role through the balance of tension that can arise between community viability and protecting lives. The steps outlined provide a foundation to unleash the capabilities of environmental health in Australia. Ultimately, the steps provide a clear pathway toward a "world-class" Australian CDC that drives better health outcomes for all Australians.

Corresponding Author: Benjamin J. Ryan, Clinical Associate Professor, Department of Environmental Science and Department of Public Health, Environmental Health Science Program, Baylor University, Waco, TX.
Email: benjamin_ryan@baylor.edu.

References

Australian Government, Department of Health and Aged Care. (2022a). *Australian Centre for Disease Control*. https://www.health.gov.au/our-work/Australian-CDC

Australian Government, Department of Health and Aged Care. (2022b). *Role and functions of an Australian Centre for Disease Control: Prevention-promotion-protection*. https://www.health.gov.au/sites/default/files/documents/2022/11/role-and-functions-of-an-australian-centre-for-disease-control_0.pdf

Australian Government, Department of Health and Aged Care. (2022c). *About environmental health in Australia*. https://www.health.gov.au/topics/environmental-health/about

Australian Tax Office. (2022). *Salary and wage occupation codes*. https://www.ato.gov.au/Individuals/Tax-return/2022/In-detail/Publications/Salary-and-wage-occupation-codes-2022/?page=2#E

Brooks, B.W., & Ryan, B.J. (2021). Building environmental public health back better. *Environmental Science & Technology Letters*, *8*(6), 443–444. https://doi.org/10.1021/acs.estlett.1c00391

Burkle, F.M., Bradt, D.A., & Ryan, B.J. (2021). Global public health database support to population-based management of pandemics and global public health crises, part I: The concept. *Prehospital and Disaster Medicine*, *36*(1), 95–104. https://doi.org/10.1017/S1049023X20001351

Damschroder, L.J., Reardon, C.M., Widerquist, M.A.O., & Lowery, J. (2022). The updated Consolidated Framework for Implementation Research based on user feedback. *Implementation Science*, *17*, Article 75. https://doi.org/10.1186/s13012-022-01245-0

Dwyer, S. (2022, July 20). Environmental health essential in an Australian CDC. *Intouch Public Health*. https://intouchpublichealth.net.au/environmental-health-essential-in-an-australian-cdc-sophie-dwyer-psm/

Environmental Health Australia. (n.d.). *Knowledge centre*. https://www.eh.org.au/resources/knowledge-centre

Environmental Health Workforce Act of 2021, H.R. 2661, 117th Cong. (2021). https://www.congress.gov/bill/117th-congress/house-bill/2661/text

Hays, R., Esterman, A., & McDermott, R. (2017). Control of chronic *Strongyloides stercoralis* infection in an endemic community may be possible by pharmacological means alone: Results of a three-year cohort study. *PLOS Neglected Tropical Diseases*, *11*(7), e0005825. https://doi.org/10.1371/journal.pntd.0005825

Kelley, T.R., & Anderson, A. (2012). Environmental health funding challenges during difficult budget times. *Environmental Health Insights*, *6*, 13–15. https://doi.org/10.4137/ehi.s8827

Organisation for Economic Co-operation and Development. (2020, April 21). *OECD policy responses to coronavirus (COVID-19): Environmental health and strengthening resilience to pandemics*. https://www.oecd.org/coronavirus/policy-responses/environmental-health-and-strengthening-resilience-to-pandemics-73784e04/

Ross, K.E., Bradbury, R.S., Garrard, T.A., O'Donahoo, F.J., Shield, J.M., Page, W., Miller, A., Robertson, G., Judd, J.A., & Speare, R. (2017). The National Strongyloides Working Group in Australia 10 workshops on: Commendations and recommendations. *Australian and New Zealand Journal of Public Health*, *41*(3), 221–223. https://doi.org/10.1111/1753-6405.12611

Ryan, B.J., Muehlenbein, M.P., Allen, J., Been, J., Boyd, K., Brickhouse, M., Brooks, B.W., Burchett, M., Chambliss, C.K., Cook, J.D., Ecklund, A., Fogleman, L., Granick, P., Hynes, S., Hudson, T., Huse, M., Lamb, M., Lowe, T., Marsh, J., . . . Brickhous, N. (2022). Sustaining university operations during the COVID-19 pandemic. *Disaster Medicine and Public Health Preparedness*, *16*(5), 1901–1909. https://doi.org/10.1017/dmp.2021.69

Sunderland, E.M., Hu, X.C., Dassuncao, C., Tokranov, A.K., Wagner, C.C., & Allen, J.G. (2019). A review of the pathways of human exposure to poly- and perfluoroalkyl substances (PFASs) and present understanding of health effects. *Journal of Exposure Science & Environmental Epidemiology*, *29*(2), 131–147. https://doi.org/10.1038/s41370-018-0094-1

Taylor, M.J., Garrard, T.A., O'Donahoo, F.J., & Ross, K.E. (2014). Human strongyloidiasis: Identifying knowledge gaps, with emphasis on environmental control. *Research and Reports in Tropical Medicine*, *5*, 55–63. https://doi.org/10.2147/RRTM.S63138

Whiley, H., Willis, E., Smith, J., & Ross, K. (2019). Environmental health in Australia: Overlooked and underrated. *Journal of Public Health*, *41*(3), 470–475. https://doi.org/10.1093/pubmed/fdy156

The World Bank. (2021). *Urban population (% of total population)*. https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS

PROGRAMS ACCREDITED BY THE NATIONAL ENVIRONMENTAL HEALTH SCIENCE AND PROTECTION ACCREDITATION COUNCIL

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

Baylor University†
Waco, TX
Bryan W. Brooks, MS, PhD (UG)
bryan_brooks@baylor.edu
Benjamin Ryan, PhD (G)
benjamin_ryan@baylor.edu

Benedict College
Columbia, SC
Milton A. Morris, MPH, PhD
morrism@benedict.edu

Boise State University
Boise, ID
Kimberly Rauscher, MA, ScD
kimberlyrauscher@boisestate.edu

California State University at Northridge†
Northridge, CA
Nola Kennedy, PhD
nola.kennedy@csun.edu

California State University at San Bernardino
San Bernardino, CA
Mahmood Nikbakhtzadeh, PhD
mahmood.nikbakhtzadeh@csub.edu

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

Colorado State University
Fort Collins, CO
Joshua Schaeffer, PhD, CIH
joshua.schaeffer@colostate.edu

East Carolina University†
Greenville, NC
William Hill (UG)
hillw@ecu.edu
Stephanie Richards, PhD (G)
richardss@ecu.edu

East Central University
Ada, OK
Michael Bay, PhD
mbay@ecok.edu

East Tennessee State University
Johnson City, TN
Phillip Scheuerman, MS, PhD
philsche@etsu.edu

Eastern Kentucky University†
Richmond, KY
Vonia Grabeel, MPH, RS (UG)
vonia.grabeel@eku.edu
D. Gary Brown, DrPH, CIH, RS, DAAS (G)
gary.brown@eku.edu

Fort Valley State University††
Fort Valley, GA
Oreta Samples, PhD
sampleso@fvsu.edu

Illinois State University
Normal, IL
Guang Jin, PhD, PE
gjin@ilstu.edu

Indiana University–Purdue University Indianapolis
Indianapolis, IN
Mark Wood, MEM, PhD
woodmw@iu.edu

Mississippi Valley State University†
Itta Bena, MS
Ntombekhaya Jennifer Laifa, PhD
nj.laifa@mvsu.edu

Missouri Southern State University
Joplin, MO
Teresa Boman, PhD
boman-t@mssu.edu

Montana State University
Bozeman, MT
Seth Walk, PhD
seth.walk@montana.edu
Mari Eggers, PhD
mari.eggers@montana.edu

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

Old Dominion University
Norfolk, VA
Anna Jeng, ScD
hjeng@odu.edu

State University of New York, College of Environmental Science and Forestry
Syracuse, NY
Lee Newman, PhD
lanewman@esf.edu

Texas Southern University
Houston, TX
Zivar Yousefipour, PhD
zivar.yousefipour@tsu.edu

The University of Findlay†
Findlay, OH
Kim Lichtveld, PhD
lichveld@findlay.edu

University of Georgia, Athens
Athens, GA
Anne Marie Zimeri, PhD
zimeri@uga.edu

University of Illinois Springfield††
Springfield, IL
Lenore Killam, DPA
lkill2@uis.edu

University of Washington
Seattle, WA
Tania Busch-Isaksen, MPH, PhD, REHS
tania@uw.edu

University of Wisconsin Eau Claire
Eau Claire, WI
Crispin Pierce, PhD
piercech@uwec.edu

University of Wisconsin Oshkosh
Oshkosh, WI
Sabrina Mueller-Spitz, DVM, PhD
muellesr@uwosh.edu

West Chester University
West Chester, PA
Lorenzo Cena, PhD
lcena@wcupa.edu

Western Carolina University
Cullowhee, NC
Bryan Byrd, MSPH, PhD
bdbyrd@email.wcu.edu

Western Kentucky University†
Bowling Green, KY
Jacqueline Basham, MPH (UG)
jacqueline.basham@wku.edu
Edrisa Sanyang, PhD (G)
edrisa.sanyang@wku.edu

†*University also has an accredited graduate program.*
††*Accredited graduate program only.*
Note. G = graduate; UG = undergraduate.

ENVIRONMENTAL HEALTH **CALENDAR**

UPCOMING NATIONAL ENVIRONMENTAL HEALTH ASSOCIATION (NEHA) CONFERENCE

July 31–August 3, 2023: NEHA 2023 Annual Educational Conference & Exhibition, Hilton New Orleans Riverside, New Orleans, LA, https://www.neha.org/aec

NEHA AFFILIATE AND REGIONAL LISTINGS

Arizona
March 8–9, 2023: 2023 AZEHA Spring Conference (in person and virtual), Arizona Environmental Health Association (AZEHA), Phoenix, AZ, https://www.azeha.org

California
June 19–22, 2023: 2023 Annual Educational Symposium (AES), hosted by the Superior Chapter of the California Environmental Health Association, Sacramento, CA, https://www.ceha.org

Colorado
October 11–13, 2023: 67th Annual Education Conference, Colorado Environmental Health Association, Estes Park, CO, https://ceha49.wildapricot.org

Illinois
November 8–9, 2023: IEHA Annual Educational Conference, Illinois Environmental Health Association (IEHA), Oglesby, IL, https://www.iehaonline.org

Iowa
March 28–29, 2023: 2023 Public Health Conference of Iowa, Iowa Environmental Health Association, Ames, IA, https://www.ieha.net

Michigan
March 15–17, 2023: 2023 Annual Education Conference, Michigan Environmental Health Association, Port Huron, MI, https://www.meha.net

Montana
April 3–5, 2023: Confluence 2023: Learn, Lead, and Speak for Health, Montana Environmental Health and Public Health Associations, Billings, MT, https://mehaweb.wildapricot.org

New Jersey
March 5–7, 2023: 2023 NJEHA Educational Conference & Exhibition, New Jersey Environmental Health Association (NJEHA), Atlantic City, NJ, https://www.njeha.org

North Carolina
March 16–17, 2023: 2023 Public Health Leaders' Conference, North Carolina Public Health Association (NCPHA), Raleigh, NC, https://ncpha.memberclicks.net

September 27–29, 2023: 2023 NCPHA Fall Educational Conference, NCPHA, Concord, NC, https://ncpha.memberclicks.net

North Dakota
October 17–19, 2023: NEHA Region 4 Environmental Health Conference, hosted by the North Dakota Environmental Health Association, West Fargo, ND, https://ndeha.org

Ohio
April 13–14, 2023: 2023 Annual Educational Conference, Ohio Environmental Health Association, Dublin, OH, http://www.ohioeha.org

Utah
May 10–12, 2023: UEHA Spring Conference, Utah Environmental Health Association (UEHA), Richfield, UT, https://sites.google.com/ueha.org/ueha/home

Washington
May 8–10, 2023: Annual Educational Conference, Washington State Environmental Health Association, Tacoma, WA, https://www.wseha.org

TOPICAL LISTINGS

Environmental and Occupational Health
March 26–29, 2023: 40th National Conference & Exhibition, Environmental Information Association, Nashville, TN, https://www.eia-usa.org

Food Safety
April 24–28, 2023: 2023 Biennial Meeting, Conference for Food Protection, Houston, TX, http://www.foodprotect.org

May 8–11, 2023: Food Safety Summit, produced by *Food Safety Magazine*, Rosemont, IL, https://www.food-safety.com/food-safety-summit

July 16–19, 2023: IAFP 2023 Annual Meeting, International Association for Food Protection (IAFP), Toronto, ON, https://www.foodprotection.org/annualmeeting

Preparedness
April 24–27, 2023: 2023 Preparedness Summit, hosted by the National Association of County and City Health Officials, Atlanta, GA, https://www.preparednesssummit.org

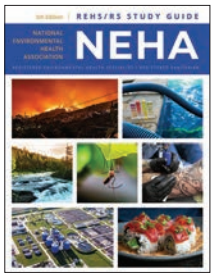
May 21–27, 2023: Environmental Health Training in Emergency Response (EHTER) Operations, Center for Domestic Preparedness, Federal Emergency Management Agency, Anniston, AL, https://cdp.dhs.gov/training/course/PER-309

RESOURCE CORNER

Resource Corner highlights different resources the National Environmental Health Association (NEHA) has available to meet your education and training needs. These resources provide you with information and knowledge to advance your professional development. Visit our online bookstore at www.neha.org/store for additional information about these and many other pertinent resources!

REHS/RS Study Guide (5th Edition)

National Environmental Health Association (2021)



The Registered Environmental Health Specialist/Registered Sanitarian (REHS/RS) credential is the premier credential of the National Environmental Health Association (NEHA). This edition reflects the most recent changes and advancements in environmental health technologies and theories. Incorporating the insights of 29 subject matter experts from across academia, industry, and the regulatory community, paired with references from over 30 scholarly resources, this essential reference is intended to help those seeking to obtain the NEHA REHS/RS credential. Chapters include general environmental health; statutes and regulations; food protection; potable water; wastewater; solid and hazardous waste; hazardous materials; zoonoses, vectors, pests, and poisonous plants; radiation protection; occupational safety and health; air quality and environmental noise; housing sanitation and safety; institutions and licensed establishments; swimming pools and recreational facilities; and emergency preparedness.

261 pages, spiral-bound paperback
Member: $169/Nonmember: $199

Disaster Field Manual for Environmental Health Specialists

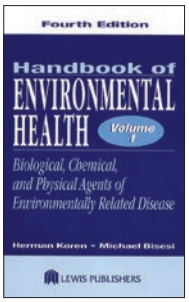
California Association of Environmental Health Administrators (2012)

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

224 pages, spiral-bound hardback
Member: $37/Nonmember: $45

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

Herman Koren and Michael Bisesi (2003)

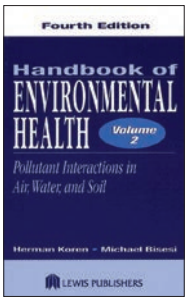


A must for the reference library of anyone in the environmental health profession, this book focuses on factors that are generally associated with the internal environment. It was written by experts in the field and copublished with NEHA. A variety of environmental issues are covered such as food safety,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

790 pages, hardback
Member: $215/Nonmember: $245

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

Herman Koren and Michael Bisesi (2003)



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

876 pages, hardback
Member: $215/Nonmember: $245

JEH QUIZ

FEATURED ARTICLE QUIZ #5

Assessment of Chemical Exposures Investigation After Fire at an Industrial Chemical Facility in Winnebago County, Illinois

Available to those with an active National Environmental Health Association (NEHA) membership, the *JEH* Quiz is offered six times per calendar year and is an easily accessible way to earn continuing education (CE) contact hours toward maintaining a NEHA credential. Each quiz is worth 1.0 CE.

Completing quizzes is now based on the honor system and should be self-reported by the credential holder. Quizzes published only during your current credential cycle are eligible for CE credit. Please keep a copy of each completed quiz for your records. CE credit will post to your account within three business days.

Paper or electronic quiz submissions will no longer be collected by NEHA staff.

INSTRUCTIONS TO SELF-REPORT A *JEH* QUIZ FOR CE CREDIT

1. Read the featured article and select the correct answer to each *JEH* Quiz question.
2. Log in to your MyNEHA account at https://neha.users.membersuite.com/home.
3. Click on Credentials located at the top of the page.
4. Select Report CEs from the drop-down menu.
5. Enter the date you finished the quiz in the Date Attended field.
6. Enter 1.0 in the Length of Course in Hours field.
7. In the Description field, enter the activity as "*JEH* Quiz #, Month Year" (e.g., *JEH* Quiz 5, March 2023).
8. Click the Create button.

JEH Quiz #3 Answers

December 2022

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

➔ Quiz effective date: March 1, 2023 | Quiz deadline: June 1, 2023

1. After the fire at an industrial chemical facility, local authorities issued a __ evacuation order to assist mitigation of potential negative health outcomes in the nearby communities.
   a. 1-mi
   b. 2-mi
   c. 3-mi
   d. 4-mi
2. The available air sampling data from the U.S. Environmental Protection Agency demonstrated several measurements for __ above the World Health Organization public health screening levels.
   a. volatile organic compounds
   b. carbon monoxide
   c. hydrogen sulfide
   d. $PM_{2.5}$ and PM_{10}
3. Using a general health survey to assess the general public, the investigation team examined the association of reported contact with material or report of smelling an odor with any reported new or worsening symptom within the 2 weeks prior to survey completion.
   a. True.
   b. False.
4. Syndromic surveillance data identified __ more emergency department visits than baseline on the day of the incident in the county.
   a. 5%
   b. 10%
   c. 15%
   d. 20%
5. The general health survey received an initial __ responses.
   a. 2,020
   b. 2,023
   c. 2,050
   d. 2,053
6. In total, __ respondents of the general health survey reported smelling an odor.
   a. 51.8%
   b. 56.3%
   c. 60.6%
   d. 78.8%
7. Among the 911 symptomatic respondents of the general health survey, 33.2% reported any __ symptom.
   a. ears, nose, and throat
   b. cardiopulmonary
   c. neurological
   d. psychiatric
8. The median number of symptoms reported by symptomatic respondents of the general health survey was
   a. 2.
   b. 3.
   c. 4.
   d. 5.
9. Among symptomatic respondents of the general health survey, __ used formal healthcare services.
   a. 11.6%
   b. 17.7%
   c. 21.4%
   d. 38.1%
10. Representing 14 different organizations, __ first responders completed the general health and first responders surveys.
    a. 10
    b. 16
    c. 21
    d. 31
11. Of the 10 symptomatic first responders, __ reported cardiopulmonary symptoms.
    a. 3
    b. 4
    c. 5
    d. 6
12. Reported contact with smoke, dust, or debris or report of smelling an odor was __ associated with being symptomatic.
    a. not
    b. weakly
    c. strongly

NEHA SECOND VICE-PRESIDENTIAL CANDIDATE PROFILE

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

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

Scott Holmes

Scott E. Holmes, REHS, MS, is passionate about protecting public health and the environment upon which all life depends, coaching and mentoring young environmental health professionals, and building resilience against health impacts from climate change. He has managed the Environmental Public Health Division with the Lincoln-Lancaster County Health Department in Nebraska since 1991. The Division has a broad range of environmental health programs including Air Quality, Children's Environmental Health (including Lead Safe Lincoln), Climate and Health Resilience, Environmental Health Education, Food Safety, HazMat Response, Land Use Plan Review, Waste Management, and Water Quality. The Division has 45 staff and a $5 million budget. Scott served as the Department's Epidemiologist (3 years) and worked as a sanitarian for the North Dakota Department of Health (3 years). Scott earned a B.S. in Microbiology - Environmental Health from Montana State University (1981) and an M.S. in Environmental Health from the University of Minnesota School of Public Health (1988).

Scott is an active member of NEHA. He currently serves as a mentor for NEHA's Environmental Health Leadership Academy and previously served as a Technical Advisor (Food Safety and Air Quality). Scott has presented numerous times at the Annual Education Conference and reviewed NEHA position papers. Scott was honored to receive the NEHA Past Presidents Award in 2017 for his work behind the scenes promoting environmental health. He is an active member and past president of the Nebraska Environmental Health Association. Scott currently serves as co-chair for the multi-Federal agency, multi-association Council for Improving Foodborne Outbreak Response (CIFOR). While on CIFOR, he has reviewed and edited the CIFOR Guidelines, Toolkit, and Industry Guidelines. Scott served on the Nebraska Board of Environmental Health Specialists for ten years - six as its chair. He also served on the State Emergency Response Commission. Scott served on the National Center for Environmental Health Board of Scientific Counselors and helped develop National Environmental Health Performance Standards. He served on UL's Environmental and Public Health Council for 15 years. Scott has lectured at the University of Nebraska-Lincoln and College of Public Health on topics including health impacts of climate change; environmental health; emergency response to outbreaks and disasters; land use planning and public health; and air quality impacts on health. Scott has presented at numerous state, regional and national conferences.

SPECIAL **LISTING**

The National Environmental Health Association (NEHA) Board of Directors includes nationally elected officers and regional vice-presidents. Affiliate presidents (or appointed representatives) comprise the Affiliate Presidents Council. Technical advisors, the executive director, and all past presidents of the association are ex-officio council members. This list is current as of press time.

Rachelle Blackham, MPH, REHS
Region 3
Vice-President

Kim Carlton, MPH, REHS/RS
Region 4
Vice-President

National Officers

www.neha.org/governance

President—D. Gary Brown, DrPH, CIH, RS, DAAS
President@neha.org

President-Elect—Tom Butts, MSc, REHS
PresidentElect@neha.org

First Vice-President—CDR Anna Khan, MA, REHS/RS
FirstVicePresident@neha.org

Second Vice-President—Larry Ramdin, MPH, MA, REHS/RS, CP-FS, HHS, CHO
SecondVicePresident@neha.org

Immediate Past-President—Roy Kroeger, REHS
ImmediatePastPresident@neha.org

Regional Vice-Presidents

www.neha.org/governance

Region 1—William B. Emminger, Jr., REHS, CPM
Region1RVP@neha.org
Alaska, Idaho, Oregon, and Washington. Term expires 2023.

Region 2—Michele DiMaggio, REHS
Region2RVP@neha.org
Arizona, California, Hawaii, and Nevada. Term expires 2024.

Region 3—Rachelle Blackham, MPH, REHS
Region3RVP@neha.org
Colorado, Montana, Utah, Wyoming, and members residing outside of the U.S (except members of the U.S. armed services). Term expires 2024.

Region 4—Kim Carlton, MPH, REHS/RS
Region4RVP@neha.org
Iowa, Minnesota, Nebraska, North Dakota, South Dakota, and Wisconsin. Term expires 2025.

Region 5—Traci (Slowinski) Michelson, MS, REHS, CP-FS
Region5RVP@neha.org
Arkansas, Kansas, Louisiana, Missouri, New Mexico, Oklahoma, and Texas. Term expires 2023.

Region 6—Nichole Lemin, MEP, RS/REHS
Region6RVP@neha.org
Illinois, Indiana, Kentucky, Michigan, and Ohio.
Term expires 2025.

Region 7—Tim Hatch, MPA, REHS
Region7RVP@neha.org
Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, and Tennessee. Term expires 2023.

Region 8—CDR James Speckhart, MS, REHS, USPHS
Region8RVP@neha.org
Delaware, Maryland, Pennsylvania, Virginia, Washington, DC, West Virginia, and members of the U.S. armed services residing outside of the U.S. Term expires 2024.

Region 9—Robert Uhrik
Region9RVP@neha.org
Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. Term expires 2025.

NEHA Staff

www.neha.org/staff

Seth Arends, Senior Graphic Designer, NEHA EZ, sarends@neha.org

Rance Baker, Director, NEHA EZ, rbaker@neha.org

Gina Bare, RN, Associate Director, PPD, gbare@neha.org

Kate Beasley, Digital Communications Specialist, kbeasley@neha.org

Jesse Bliss, MPH, Director, PPD, jbliss@neha.org

Faye Blumberg, Instructional Designer, NEHA EZ, fblumberg@neha.org

Nick Bohnenkamp, Senior Program and Operations Manager, PPD, nbohnenkamp@neha.org

Trisha Bramwell, Sales and Training Support, NEHA EZ, tbramwell@neha.org

Amy Chang, Senior Program Analyst, Environmental Health, PPD, achang@neha.org

Renee Clark, Director, Finance, rclark@neha.org

Holly Cypress, Administrative Support, PPD, hcypress@neha.org

Joetta DeFrancesco, Retail Program Standards Coordinator, NEHA-FDA RFFM, jdefrancesco@neha.org

Kristie Denbrock, MPA, Chief Learning Officer, kdenbrock@neha.org

Rosie DeVito, MPH, Program and Operations Manager, rdevito@neha.org

David Dyjack, DrPH, CIH, Executive Director, ddyjack@neha.org

Doug Farquhar, JD, Director, Government Affairs, dfarquhar@neha.org

Soni Fink, Sales Manager, sfink@neha.org

Anna Floyd, PhD, Senior Instructional Designer, EZ, afloyd@neha.org

Heather Folker, Director, Member Services and Credentialing, hfolker@neha.org

Nathan Galanos, Contracts Administrator, ngalanos@neha.org

Adrienne Gothard, Senior Program Coordinator, PPD, agothard@neha.org

Chana Goussetis, MA, Marketing and Communications Director, cgoussetis@neha.org

Elizabeth Grenier, Senior Project Coordinator, egrenier@neha.org

Thyra Kimbell, Project Coordinator, tkimbell@neha.org

Nicole Kinash, Administrative and Logistical Support, NEHA EZ, nkinash@neha.org

Becky Labbo, MA, Senior Evaluation Coordinator, PPD, rlabbo@neha.org

Terryn Laird, Public Health Communications Specialist, tlaird@neha.org

Melodie Lake, Editor/Copy Writer, NEHA EZ, mlake@neha.org

Angelica Ledezma, AEC Manager, aledezma@neha.org

Stephanie Lenhart, MBA, Senior Accountant, slenhart@neha.org

Matt Lieber, Database Administrator, mlieber@neha.org

Dillon Loaiza, Accounts Payable Specialist, dloaiza@neha.org

Julianne Manchester, PhD, Senior Research and Evaluation Specialist, NEHA EZ, jmanchester@neha.org

Laura Manes, HR Manager, lmanes@neha.org

Bobby Medina, Credentialing Specialist, bmedina@neha.org

Somara Mentley, Project Coordinator, PPD, smentley@neha.org

Eileen Neison, Credentialing Manager, eneison@neha.org

Nick Ogg, Media Production Specialist, NEHA EZ, nogg@neha.org

Shahzad Perez, IT Manager, sperez@neha.org

Kavya Raju, Public Health Associate, kraju@neha.org

Kristen Ruby-Cisneros, Managing Editor, *JEH,* kruby@neha.org

Michéle Samarya-Timm, MA, HO, REHS, MCHES, DLAAS, Membership and Affiliate Engagement Manager, msamaryatimm@neha.org

Katherine Sheppard, Executive Assistant, ksheppard@neha.org

Sadie Shervheim, Public Health Associate, sshervheim@neha.org

Chintan Somaiya, MBA, MS, Senior Project Coordinator, NEHA-FDA RFFM, csomaiya@neha.org

Jordan Strahle, Marketing and Communications Manager, jstrahle@neha.org

Reem Tariq, MSEH, Senior Project Coordinator, PPD, rtariq@neha.org

Christl Tate, Associate Director, Programs, NEHA EZ, ctate@neha.org

Amber Thompson, REHS, CP-FS, Senior Project Coordinator, PPD, athompson@neha.org

Sharon Unkart, PhD, Associate Director, Education, NEHA EZ, sdunkart@neha.org

Gail Vail, CPA, CGMA, Associate Executive Director, gvail@neha.org

Alfonso Valadez, Membership Services Representative, avaladez@neha.org

Christopher Walker, MSEH, REHS, Senior Program Analyst, Environmental Health, PPD, cwalker@neha.org

Laura Wildey, CP-FS, Senior Program Analyst, Food Safety, PPD, lwildey@neha.org

Cole Wilson, Operations Manager, NEHA-FDA RFFM, nwilson@neha.org

2022–2023 Technical Advisors

www.neha.org/governance

CLIMATE & HEALTH

David Gilkey, PhD
dgilkey@mtech.edu

Steven Konkel, PhD
steve.konkel@gmail.com

DATA & TECHNOLOGY

Chirag Bhatt, RS, CCFS
chirag.bhatt@hscloudsuite.com

Timothy Callahan, MPH
tim.callahan@dph.ga.gov

John Dodson-Will
johndodson@hedgerowsoftware.com

Michael Hicks
mhicks@relaventsystems.com

EMERGENCY PREPAREDNESS

Krista Ferry
krista.ferry@fda.hhs.gov

Luis Rodriguez, MS, REHS/RS, CP-FS, CPO, DAAS
ved8@cdc.gov

Jill Shugart
ahe8@cdc.gov

FOCUSED POPULATIONS

Welford Roberts, MS, PhD, REHS/RS, DAAS
welford@erols.com

Amir Tibbs
tibbsa@stlouis-mo.gov

FOOD SAFETY

Eric Bradley, MPH, REHS, CP-FS, DAAS
ericbradley30252@gmail.com

Tracynda Davis, MPH
tracynda.davis@fda.hhs.gov

Zachary Ehrlich, MPA, REHS
zachary.ehrlich@doh.nj.gov

Adam Kramer, MPH, ScD, MPH, RS
akramer2@cdc.gov

Cindy Rice, MSPH, RS, CP-FS, CEHT
cindy@easternfoodsafety.com

Christine Sylvis, REHS
sylvis@snhd.org

Andrew Todd
andrew.todd@fda.hhs.gov

GENERAL ENVIRONMENTAL HEALTH

Michael Crea, MS
crea@zedgepiercing.com

Tara Gurge, MS, RS, CEHT, MS
tgurge@needhamma.gov

Summer Jennings
jennings.s@sno-nsn.gov

Evan La Plant
evan.laplant@co.waupaca.wi.us

Greg Kearney, MPH, DrPH, REHS
kearneyg@ecu.edu

Adam Mannarino
adam.mannarino@gmail.com

Clint Pinion, Jr., DrPH, RS, CIT
clint.pinion@sw.edu

HEALTHY COMMUNITIES

Claudia Meister
cmeister@city.cleveland.oh.us

M.L. Tanner
tannerml@dhec.sc.gov

Robert Washam, MPH, RS, DAAS
b_washam@hotmail.com

INFECTIOUS & VECTORBORNE DISEASES

Broox Boze, PhD
bboze@vdci.net

Frank Meek
fmeek@rollins.com

WATER QUALITY

Ivars Jaunakais
ivars@sensafe.com

Sarah Mack
sarah.mack@enthalpy.com

Jason Ravenscroft, MPH, REHS, CPO
jravensc@marionhealth.org

Besty Seals
sealskj@dhec.sc.gov

Andrew Whelton, MPH
awhelton@purdue.edu

Steve Wilson
sdwilson@illinois.edu

WORKFORCE & LEADERSHIP

Bob Custard, REHS, CP-FS
bobcustard@comcast.net

Carly Hegarty
chegar@milwaukee.gov

Affiliate Presidents

www.neha.org/affiliates

Alabama—Russell Harry
russell.harry@adph.state.al.us

Alaska—Joy Britt
jdbritt@anthc.org

Arizona—Andres Martin
andres.martin@maricopa.gov

Arkansas—Richard McMullen
richard.mcmullan@arkansas.gov

Business and Industry—Michael Crea
nehabia@outlook.com

California—Linda Launer
president@ceha.org

Colorado—Conner Gerken
connerg@nchd.org

Connecticut—Thomas Stansfield, MPH, RS
tstansfield@tahd.org

Florida—Edward Bettinger
ed.bettinger@flhealth.gov

Georgia—Melinda Knight
gehaonline@gmail.com

Idaho—Carolee Cooper
carolee.cooper@dhw.idaho.gov

Illinois—Justin Dwyer
jadwyer84@gmail.com

Indiana—Holley M. Rose
hrose@ripleycounty.com

Iowa—Eric Heinen
eheinen@blackhawkcounty.iowa.gov

Jamaica (International Partner Organization)—Michael Myles
info@japhi.org.jm

Kansas—Perry Piper
ppiper@rileycountyks.gov

Kentucky—Brittany Wells, RS
kentuckyeha@gmail.com

Louisiana—Carolyn Bombet
carolyn.bombet@la.gov

Massachusetts—William (Bill) Murphy, MS, RS, CHO
murphyb@sudbury.ma.us

Michigan—Paul Hauck
board@meha.net

Minnesota—Sophia Walsh, REHS
president@mehaonline.org

Missouri—Leah Ferris
lferris@clayhealth.com

Montana—Sarah Robbin
sarahrobbin1@gmail.com

National Capital Area—Julia Balsley, REHS
NCAEHA.President@gmail.com

Nebraska—Harry Heafer, REHS
hheafer@lincoln.ne.gov

Nevada—Tara Edwards
edwards@snhd.org

New Jersey—Virginia Wheatley
info@njeha.org

New Mexico—Kellison Platero
kplatero@bernco.gov

New York State Conference of Environmental Health—Isaiah Sutton
isaiahs@co.chenango.ny.us

North Carolina—Angela Sowers
angela9247@me.com

North Dakota—Julie Wagendorf, MS, REHS/RS, CP-FS
admin@ndeha.org

Northern New England Environmental Health Association—Brian Lockard
blockard@ci.salem.nh.us

Ohio—Steve Ruckman, MPH, RS
mphosu@gmail.com

Oklahoma—Aaron Greenquist
agreenquist@tulsa-health.org

Oregon—Sarah Puls
sarah.puls@co.lane.or.us

Past Presidents—Priscilla Oliver, PhD
polivermsm@aol.com

Rhode Island—Dottie LeBeau, CP-FS
deejaylebeau@verizon.net

South Carolina—M.L. Tanner, HHS
tannerml@dhec.sc.gov

Tennessee—Kimberly Davidson
kimberly.davidson@tn.gov

Texas—Kacey Roman
kroman@freeport.tx.us

Uniformed Services—MAJ Nathaniel Sheehan
nathaniel.sheehan@outlook.com

Utah—Abby Weymouth
aweymouth@co.weber.ut.us

Virginia—Jessica Stewart
jessica.stewart@virginiaeha.org

Washington—Nancy Bernard
nancy.bernard@doh.wa.gov

West Virginia—Keith Allison
wvaos@outlook.com

Wisconsin—Carrie Pohjola
carrie.pohjola@wisconsin.gov

Wyoming—Derek Hensley
derek.hensley@wyo.gov

NEHA REGIONAL VICE-PRESIDENTIAL CANDIDATE PROFILES

The National Environmental Health Association (NEHA) is governed by a corporate Board of Directors who oversee the affairs of the association. The board is made up of two groups: national officers and regional vice-presidents (RVPs). NEHA has nine different regions. See page 50 for a listing of the regions and the states and groups each region represents. RVPs are elected by NEHA active and life members in their respective regions. RVPs serve 3-year terms.

Election policy specifies that candidate profiles for RVPs be limited to 400 words in total length. If a candidate's profile exceeds that limit, the policy requires that the profile is terminated at the last sentence before the 400-word limit is exceeded. In addition, the submitted profiles have not been grammatically edited, but presented as submitted and within the 400-word limitation. Three regions are up for election this year—Region 1, Region 5, and Region 7. The candidates are listed alphabetically by region.

Region 1

Bill Emminger

I have over 42 years of experience working with state and local environmental health programs in Indiana, Utah, and Oregon. I have had the honor to serve as Presidents of both the Oregon and Indiana Environmental Health Associations and as Vice-President/President Elect of the Utah Environmental Health Association. During my career I have been a guest lecturer at various state and national environmental health conferences, colleges, and universities. I helped both the states of Oregon and Utah to adopt the FDA Food Code and in helping Utah to adopt the Food Safety Manager Certification Act and rules. After working twenty years as the Environmental Health Director in Benton County Oregon, I retired on July 1, 2022. As Region 1 Vice-President I am looking forward to using my experience to promote and advocate for the environmental health profession.

Dr. Steve Konkel

Dr. Steve Konkel, PhD, Candidate for NEHA Region 1 RVP serving Alaska, Washington, Oregon and Idaho, is running on the theme "Competence, Vision, & Environmental Health Solutions." A NEHA member since 1999, he has served in various positions, such as Technical Section Head/Technical Advisor. A frequent presenter and planner for NEHA's AECs, Dr. Konkel has presented findings and lessons learned at every AEC on EH topics such as drinking water and sanitation, hazardous waste, sustainable development, and climate and health. He is currently working with colleagues drafting NEHA's Climate Change Policy Statement. He has presented ideas on environmental health workforce development to the NEHA Board of Directors, and participated in the International Faculty Forum on Environmental Health (IFFEH) internationally at World Congresses.

Dr. Konkel has published numerous academic articles and chapters in books, dating back to his pathbreaking MIT doctoral research. Based in Anchorage, Alaska, he has consulted on scientific and technical aspects of Environmental Health (EH) policy, programs, and projects, plus regulatory matters, since 2012.

His program and policy evaluations in Alaska include the State's first inventory and economic analysis of wind generation, program development for piped drinking water and sanitation services in rural Alaska, and policy analysis of Alaska's climate adaptation and mitigation options. He teaches courses on Arctic Policy as well as Principled Negotiation. He has worked at two Department of Energy (DOE) laboratories and in Alaska's 29th State Legislature. He served in the Office of the Governor as a Strategic Planner and Policy Analyst during Hon. Gov. Jay S. Hammond's 2nd Administration. He is a national subject matter expert on Climate and Health, focusing his efforts on the wide range of impacts affecting Alaska's biodiversity, ecosystem services and their impacts on human health and sustainability.

Dr. Konkel and Prof. Joe Beck founded the Masters in Environmental Health Science (MEHS) at Eastern Kentucky University in Richmond, KY. The program grew to 45 graduate students in its first 5 years. The program achieved CEPH (Council on Education in Public Health) accreditation in 2004; its status has been successfully renewed every 5 years. He also served 5 years as an Associate Professor in the University of Kentucky's College of Public Health (CPH). Subsequently he was awarded a Fulbright Professorship in Dublin, Ireland, where he created a new EH research institute. He combines innovative academic program and course development with applied environmental public health practice.

Region 5

Jaime Estes, MS, CP-FS, PCQI

Jaime Estes is currently Director of Food Safety with Albertsons Companies Corporate Offices based out of Plano, Texas. Jaime has spent 20+ years in the environmental and public health fields, the last 10 years with Albertsons Companies. Jaime's current role with Albertsons focuses on driving and implementing standardization within Division retail store food safety and sanitation programs, pest control programs, and ensuring regulatory compliance. Prior to joining Albertsons Companies, she worked for National Everclean Services in Agoura Hills, California and the Department of Defense in Fort Hood, Texas. Jaime is an active member of the Texas Environmental Health Association (TEHA), recently completing her 3-year State Governing Council Member term and continues to serve as Chair for the Committee on Constitution, Bylaws and Policies. She is an active member of the Conference for Food Protection and National Environmental Health Association. Jaime holds a Bachelor of Science degree in Entomology from Texas A&M University and a Master of Science degree in Food Safety from Michigan State University.

NEHA REGIONAL VICE-PRESIDENTIAL CANDIDATE PROFILES

Region 7

M.L. Tanner

A native of Mississippi, M.L. Tanner holds a BS in biology from the University of the South, Sewanee, TN. She got her start in environmental health at the Halifax County Health Department in North Carolina, then moved to NC Department of Environment and Natural Resources in the Children's Environmental Health Branch. Since coming to the South Carolina Department of Health and Environmental Control, she has worked in preparedness, rabies, and childhood lead poisoning prevention. She is Program Manager for the SC Childhood Lead Poisoning Prevention Program.

An active NEHA member since 2003, M.L. received the Sabbatical Exchange award and served as Technical Advisor for the Children's Environmental Health Section. M.L. was a member of the first cohort of NEHA's Environmental Health Leadership Academy and serves as a reviewer for the Journal of Environmental Health. M.L. is currently serving as a Technical Advisor for Healthy Communities.

Did You Know?

More than 44% of the U.S. population depends on groundwater as a primary water source. According to the U.S. Geological Survey, the U.S. uses 82.3 billion gallons of fresh groundwater per day for public and private supply, irrigation, livestock, manufacturing, mining, and other purposes. National Groundwater Awareness Week, taking place on March 5–11, was established to highlight the responsible development, management, and use of groundwater. The event is also a platform to encourage yearly water well testing and well maintenance, along with the promotion of policies that impact groundwater quality and supply. Learn more at www.ngwa.org/get-involved/groundwater-awareness-week.

NEHA **NEWS**

Newly Revised National Environmental Health Internship Program Provides More Opportunities to Prepare Future Environmental Health Workforce

By Adrienne Gothard (agothard@neha.org) and Jesse C. Bliss (jbliss@neha.org)

The environmental public health workforce is critical to ensure the health and safety of our nation. Local health departments employ approximately 14,500 full-time environmental public health workers across the nation, which is the second largest segment of the public health workforce after nursing and excluding administrative support. Environmental public health professionals are critical to public health as they strive daily to deliver essential services to ensure the safety of the water we drink, the food we eat, the air we breathe, and the neighborhoods we work and play in, to name a few. Maintaining a pipeline of empowered, educated, and prepared individuals for this workforce is vital to the provision of essential services and protects our communities from the health risks associated with environmental hazards, threats, and diseases (National Association of County and City Health Officials, 2020).

The National Environmental Public Health Internship Program (NEPHIP) is the National Environmental Health Association's (NEHA) premier development program for the environmental public health workforce. The program offers 400-hr paid internship opportunities for undergraduate and graduate environmental health students with qualified state, tribal, local, and territorial (STLT) environmental public health agencies. Through the program, interns can meet internship or practicum degree requirements, earn credit hours for required coursework, bolster their academic scholarship, and strengthen their work experience. Host health departments are provided dedicated intern support to start, pilot, and/or reinvigorate projects or programs and offer fresh and diverse perspectives.

This workforce initiative supports our goals to develop qualified applicant pipelines to help meet current and future workforce needs for environmental health professionals across the nation. The program also encourages students to consider careers in governmental environmental public health following graduation. According to a 2019 study, approximately one quarter of the environmental health professionals surveyed plan to retire within the next 5 years (Gerding et al., 2019). This finding shows the need to prepare environmental health students with real-world skills and experiences to help fill this gap.

NEHA originally developed the NEPHIP internship in 2015, with funding support from the Centers for Disease Control and Prevention (CDC). To date, the program has supported more than 195 internships in 110 health departments across 38 states and territories. In 2022, we significantly expanded and revised the program to include new fall and spring cohorts, which now provide year-round student internship opportunities. The enhanced program now supports more environmental health students than ever, with up to 50 internship placements available per year. We recognize the importance of diversity, equity, and inclusion within the environmental health workforce. These principles guide our marketing considerations and the intern selection criteria for the program, which work to promote equity, diversity, and broad geographic representation among our cohorts.

A National Environmental Public Health Internship Program (NEPHIP) intern placed traps for mosquito surveillance. Although the summer 2022 NEPHIP internship was virtual, the internship host mentor was able to send traps to the intern for mosquito surveillance in the intern's town of residence for the internship. Photo courtesy of the NEPHIP intern.

The summer 2022 session supported 41 internships, nearly double the size of any previous cohort. Although internships for this session remained primarily virtual due to the ongoing pandemic, interns and host health departments made the most of their experiences and successfully completed projects in a variety of areas such as mosquito surveillance, food safety, lead exposure prevention, and recreational and drinking water safety.

In addition to exploring the many environmental health programmatic areas, interns were encouraged to explore how climate change, health equity, and environmental justice concerns were associated with the environmental health hazard or issue being addressed by their projects. For example, one summer 2022 project sought to understand and identify potential food safety burdens or disparities experienced across different neighborhoods by comparing food safety violations and enteric disease cases with socioeconomic variables like race and education using ArcGIS. In reflecting on the experience, the intern stated, "I feel like I have learned a lot and I'm really excited that the work I completed [during the internship] can be used even after I'm long gone."

As the summer came to a close, we recruited our first-ever fall cohort with the participation of 10 students and environmental public health departments from across the country. Within this cohort, two interns were able to participate in fully in-person experiences—our first since the program went virtual in 2020. In 2022 we enhanced many offerings for the interns, including the opportunity to participate in the NEHA Annual Educational Conference & Exhibition, a professional development workshop hosted by us, and career mentorship sessions with experienced environmental health professionals working at STLT health departments.

As we further develop the program, we will continue to bring together dedicated environmental health students and health departments. More information about the program is available at www.neha.org/nephip. NEPHIP is supported through a cooperative agreement with CDC (CDC-RFA-OT18-1802).

References

Gerding, J.A., Landeen, E., Kelly, K., Whitehead, S., Dyjack, D.T., Sarisky, J., & Brooks, B. (2019). Uncovering environmental health: An initial assessment of the profession's health department workforce and practice. *Journal of Environmental Health*, *81*(10), 24–33. https://www.neha.org/Images/resources/JEH6.19-Feature-Uncovering-EH.pdf

National Association of County and City Health Officials. (2020). *2019 national profile of local health departments*. https://www.naccho.org/uploads/downloadable-resources/Programs/Public-Health-Infrastructure/NACCHO_2019_Profile_final.pdf

NEHA Government Affairs Updates

By Doug Farquhar (dfarquhar@neha.org)

The NEHA Government Affairs program works to represent and advocate for environmental health professionals and to inform policy makers on the importance of a well-supported and well-funded workforce. We highlight our recent activities in this update. Visit the Government Affairs webpage at www.neha.org/advocacy to access all our blogs and webinars, legislative actions, letters and sign-ons, and policy and position statements.

Blogs

In November 2022 we posted two blogs that explored specific state ballot measures related to environmental health and the results of the U.S. midterm elections on environmental health. On November 8, 2022, voters in the U.S. decided on 133 state ballot measures. Of these measures, several related to the environment and health, including measures on water, climate change, environmental projects, healthcare, and cannabis. The first November blog highlights a few of these measures. The second blog discusses the 2022 midterm election results with an emphasis on what the results mean for environmental health.

In December 2022 we posted two blogs that focused on the fiscal year 2023 appropriations bills for federal government agencies including the Centers for Disease Control and Prevention (CDC), Agency for Toxic Substances and Disease Registry (ATSDR), Food and Drug Administration (FDA), U.S. Department of Housing and Urban Development (HUD), and U.S. Environmental Protection Agency (U.S. EPA). The 12 appropriations bills released by the U.S. Congress included $800 billion in nondefense funding, a $68 billion increase over 2022. This funding is the highest level ever requested for nondefense programs.

You can explore these blogs and others at www.neha.org/government-affairs-blog.

Webinars

You can find an archive of past Government Affairs webinars at www.neha.org/advocacy-webinars. The following webinars were offered in September and November 2022.

- **Food Safety Legislation Policy and Trends:** During the 2022 legislative session, policy makers made substantive changes in the manner food is prepared and sold in the U.S., and Congress oversaw and funded the food safety efforts at CDC, FDA, and the U.S. Department of Agriculture (USDA). This webinar reviewed the laws passed and appropriations funded regarding food safety at state and federal levels.
- **2022 Midterm Election Impact:** This webinar broke down the results of the 2022 midterm election. In total, one third of the U.S. Senate, all of the U.S. House of Representatives, 6,279 state legislative seats, and 36 state governor positions were up for election in 2022. The webinar explored how these election results will change Congress and the states, and how that could impact environmental health.

Finally, our Government Affairs program participated in a food safety sharing session on microenterprise home kitchen operations hosted by the National Association of County and City Health Officials and CDC in December 2022. A microenterprise home kitchen operation is a type of food facility that is operated by the resident of a private home. Food can be stored, prepared, and served to customers at these operations, similar to a restaurant. This webinar focused on the various laws nationwide that permit microenterprise home kitchen operations and similar cottage food operations, as well as discussed the challenges these operations pose for local retail food regulatory programs. A recording of the webinar can be accessed at https://bit.ly/3iQpa6z.

Support Letters

We submitted support letters to the U.S. House of Representatives Appropriations Subcommittee on Labor, Health and Human Services, Education, and Related Agencies in November 2022. The letters supported an increase in funding for 1) the National Center for Environmental Health within CDC to $311.85 million and 2) the Office of Lead Hazard Control and Healthy Homes within HUD to $400 million. You can view all our letters and sign-ons at www.neha.org/letters.

NEHA **NEWS**

Preconference Offerings at the 2023 AEC

The NEHA 2023 Annual Educational Conference (AEC) & Exhibition—to be held on July 31–August 3 in New Orleans, Louisiana—will include a full preconference schedule offering attendees the opportunity to take a credential review course or attend a workshop or training on a variety of topics. More details, updates, and registration information can be found at www.neha.org/aec-preconference.

Certified Professional–Food Safety (CP-FS) Credential Review Course (July 29–30)

This 2-day refresher course is designed to enhance your preparation for the NEHA CP-FS credential exam and will cover exam content areas. Participants are expected to have prior food safety knowledge and training equal to the eligibility requirements to sit for the exam. The instructor will be available during and after the course for questions. There will be the opportunity to take the paper exam on-site at the AEC. An additional application and fee are required to take the exam and candidates must apply online. Please allow 6 weeks to process applications. *Fee: $449 for NEHA members and $549 for nonmembers. Registration includes the CP-FS Study Package* (CP-FS Study Guide *(4th edition) and CP-FS flash cards)*.

Registered Environmental Health Specialist/Registered Sanitarian (REHS/RS) Credential Review Course (July 29–31)

This 2.5-day refresher course is designed to enhance your preparation for the NEHA REHS/RS credential exam and will cover exam content areas. Participants are expected to have a solid foundation of environmental health knowledge and training equal to the eligibility requirements to sit for the exam. There will be the opportunity to take the paper exam on-site at the AEC. An additional application and fee are required to take the exam and candidates must apply online. Please allow 6 weeks to process applications. *Fee: $549 for NEHA members and $649 for nonmembers. Registration includes the* REHS/RS Study Guide *(5th edition)*.

Affiliate Leadership Workshop (July 31)

This one half-day workshop is designed just for NEHA affiliate leaders to collaborate, learn, and network. The session will explore environmental health legislation, leadership with a shared purpose, enhancing partnerships and linkages with NEHA, and much more. *Fee: No cost but preregistration is required.*

Communication: Influencing Inspection Outcomes (July 31)

When you walk away from an inspection or audit, do you have assurances owners, operators, and employees have a greater understanding of environmental health and how to partner in protection of their communities? This session will examine why communication in environmental health is important to positive inspection outcomes. *Fee: No cost but preregistration is required.*

Council for the Model Aquatic Health Code: Certified Pool Operator (CPO) Fusion Course (July 30)

This 1-day CPO Fusion Course prepares attendees to be certified or recertified as a CPO. Attendees will complete one half of the course online at their own pace and then will attend the 1-day course at the AEC for certification. Registration is due by July 10 to provide attendees with ample time to complete the online portion of the course. *Fee: $350.*

Council for the Model Aquatic Health Code: Certified Public Health Pool Inspector Course (July 31)

This new, 1-day certification course from the Council for the Model Aquatic Health Code is designed just for public health officials. Based on the Model Aquatic Health Code from the Centers for Disease Control and Prevention, the course provides the information needed to confidently inspect commercial pools. This course is a pilot offering and attendees will be able to provide input to guide finalization of the course. *Fee: $200.*

Environmental Health and Land Reuse (EHLR) Immersion Training (July 29–31)

This interactive 2.5-day training aims to increase the skills of the environmental health workforce to engage in land reuse and redevelopment. The training takes a deeper dive into the first three modules of our original EHLR Basic Training, which focus on community engagement, evaluation, and risk communication. Participants will earn 20 continuing education contact hours after completion of the training.

Prior to this training, attendees must complete modules 1, 2, and 3 of the EHLR Certificate Training at www.neha.org/ehlr. *Fee: $25 for NEHA members and $50 for nonmembers.*

NEHA and FDA National Retail Food Regulatory Program Standards Self-Assessment and Verification Audit Workshop (July 29–31)

This workshop is designed to provide participants with an overview of the National Retail Food Regulatory Program Standards criteria and an in-depth understanding of the self-assessment and verification audit processes, worksheets, and forms. Participants should be program managers or directly responsible for conducting program self-assessments and preparing for verification audits. *Fee: $140.*

Tools for Working Better, Smarter, Cheaper as You Utilize Data and Planning to Ensure Environmental Health Program Success: A Workshop for Current and Aspiring Environmental Health Leaders (July 31)

Does your environmental health program have all the funding, resources, and support needed to meet the needs of your community? Are you and other staff able to work to your full potential? Do you possess the data or evidence that indicate your programs are effective and efficient? If not, this one half-day workshop can offer tools helpful in achieving program and personal goals. *Fee: No cost but preregistration is required.*

Available Scholarships to Support Environmental Health Students

We are now accepting applications from environmental health students for the 2023 National Environmental Health Association (NEHA)/American Academy of Sanitarians (AAS) Scholarships. We hope to positively contribute to the future of environmental health and encourage an early commitment by students to pursue careers in environmental health through these scholarships. We believe that structured education at the undergraduate and graduate levels is necessary to foster a growing workforce and to promote successful professional development.

We established a scholarship fund in 1984 that began with a gift of $1,000 from Dr. A. Harry Bliss, former NEHA president, along with personal donations from other board members. Because of their strong belief in scholarship programs, AAS also made a financial donation to the program, which allowed us to increase the number of undergraduate scholarships awarded. In 1996, NEHA and AAS decided to jointly fund the scholarships and called them the NEHA/AAS Scholarships. In 2020, the boards of both organizations voted to name one of the undergraduate scholarships in honor of Dr. Sheila Davidson Pressley. In 2021, the second undergraduate scholarship was named in honor of Dr. Carolyn Hester Harvey. These esteemed individuals served as champions for students and academic excellence throughout their impressive careers.

Recently, the NEHA Board of Directors approved an increase in the amount of scholarship funding awarded. Funding for the scholarships is continually obtained from donations, proceeds from association fundraisers, and NEHA and AAS budget commitments. We encourage you to donate to the scholarship to help us achieve our goal to increase the scholarship amounts awarded next year. You can learn more and donate at www.neha.org/donate.

There are three scholarships available:

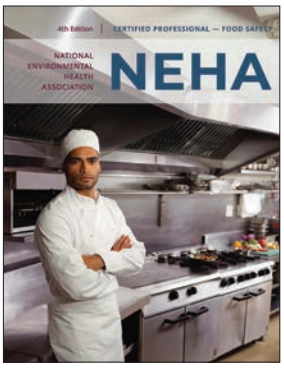
1. Dr. Sheila Davidson Pressley Undergraduate Scholarship ($2,650)
2. Dr. Carolyn Hester Harvey Undergraduate Scholarship ($2,650)
3. Graduate Scholarship ($3,750)

Beyond helping students to pay for tuition, fees, or the rent, the scholarships can ease up the pressure to enable students to enjoy their last semesters of school, bring focus back to classes rather than bank accounts, and allow students to pursue an unpaid internship or volunteer opportunity.

Applications are due April 15, 2023. Students will be notified of their application status by June 1, 2023. Learn more and apply at www.neha.org/scholarships.

NEHA **NEWS**

NEHA CP-FS Study Materials Now Available in Print and Electronic Versions



The NEHA *Certified Professional–Food Safety (CP-FS) Study Guide* (4th ed.) was updated in 2022 to the current FDA *Food Code* and includes information and requirements from the Food Safety Modernization Act. It was developed by retail professionals to help prepare candidates for the NEHA CP-FS credential exam with in-depth content, an examination blueprint, practice test, and many helpful appendices. The study guide is the go-to resource for students of food safety and food safety professionals in both regulatory agencies and industry.

A CP-FS is an individual who possesses the knowledge and skills necessary to ensure safe food in any retail environment as a quality assurance or quality control manager, facility manager, food-safe chemical supplier, or regulatory inspector/investigator. The CP-FS credential is well respected throughout the industry and is highly valued by employers when hiring food safety professionals.

We are excited to announce that the *CP-FS Study Guide* is now available in paperback and electronic versions. The e-book can be purchased via Google Play Books at $199 for members and $229 for nonmembers. NEHA members can access the discounted rate by adding the *CP-FS Study Guide* e-book to their cart in our bookstore and checking out to receive a promo code via email that allows them to purchase the book via Google Play at the members-only price.

We also offer over 195 flash cards to quiz you on the information presented in the CP-FS credential exam. Flash cards are strategically designed to enhance and encourage active recall and we have updated our flash cards to include pictures to help jog your memory as you study. You can now purchase the flash cards from our bookstore in either print or electronic versions. Both are available for $24.99.

Learn more about the CP-FS credential and our study resources at www.neha.org/cpfs-credential.

Nearly 2,500 Food Safety Experts Shared Their Needs

In early 2022 we launched a one-of-a-kind comprehensive national census—the Retail Food Safety Regulatory Training Needs Assessment—to identify strengths and knowledge gaps in the retail food safety regulatory community to better direct scarce training and education resources and identify where training should be developed or modified. Specifically, we aimed to:

- Determine the degree of exposure retail food regulatory professionals have to key content knowledge areas.
- Discover strengths and gaps between exposure to content and the working needs of the regulatory community.

We are pleased to report that we had an excellent response rate and received 2,443 qualified survey responses representing the regulatory workforce from across the regulatory community, as well as at different jurisdiction levels (Table 1).

TABLE **1**

Jurisdictions of Survey Respondents From the Retail Food Safety Regulatory Training Needs Assessment (*N* = 2,443)

Jurisdiction	Respondents # (%)
Federal	54 (2.2)
State	473 (19.4)
Local	1,862 (76.2)
Tribal	37 (1.5)
U.S. Territory	9 (0.4)

The complete survey findings will be shared this summer and will be used to help bolster educational resources, reduce knowledge gaps in the profession, and improve overall workforce capabilities.

Thank you to every retail food safety professional who participated. The honest and thorough feedback we received showcases the commitment of our workforce to the future of regulatory retail food safety.

To learn more about the assessment and to check back for findings this summer, visit our needs assessment webpage at www.neha.org/retail-grants-needs-assessment.

NEHA Staff Profile

As part of tradition, we feature new staff members in the *Journal* around the time of their 1-year anniversary. These profiles give you an opportunity to get to know our 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 pages 50 and 51.

Chintan Somaiya

I joined NEHA in March 2022 as a senior project coordinator to manage and support the NEHA-FDA Retail Flexible Funding Model (RFFM) Grant Program. The FDA Voluntary Retail Food Regulatory Program Standards apply to the operation and management of a retail food regulatory program that is focused on the reduction of risk factors known to cause or contribute to foodborne illness and to the promotion of active managerial control of these risk factors. My

goal is to support the vision of leadership to deliver a comprehensive data-driven program that enhances jurisdiction participation in the Retail Program Standards across the U.S. In addition to the NEHA-FDA RFFM Grant Program, I also support grants management, data management, research, and dashboard development projects at NEHA to demonstrate the impact of our work on communities.

I graduated with a master of business administration in healthcare administration from Loma Linda University in 2013. Along with that degree I also earned a master of science degree in food science and nutrition from Montclair State University in 2010 and an undergraduate degree in biotechnology in 2007 from the Birla Institute of Technology, Mesra.

I have had the great fortune of working with some of the finest industry experts who have mentored me through various academic and professional endeavors. At Montclair State University, I was able to work on research studies assessing the safety of ready-to-eat deli meats served in older adult care facilities in New Jersey. My second research study was to test the microbial safety of raw milk samples collected from farms across Pennsylvania.

At Loma Linda University Health (LLUH), I was able to work on the San Bernardino County Medi-Cal Outreach, Renewal, and Enrollment (SBC-MORE) initiative, a county-sponsored grant program that extended Medi-Cal to high-risk populations in San Bernardino County, California. At the Institute for Community Partnerships at LLUH, I led the development and enhancement of its Community Benefit program and investments for LLUH's four licensed hospitals. Our work in training and development of the Community Health Worker program was nationally recognized and adopted. While at LLUH, I also had the opportunity to work and support multiple short film projects including *A Certain Kind of Light*, a story about the work and contributions of Dr. Wil Alexander, and *Community Health Worker "Saw Me as a Human,"* a video that highlights how a community health worker helped an individual navigate the complexities of our healthcare system.

My wife and I were blessed with a baby boy in 2022. Interestingly, my wife and son share the same birthday. I enjoy filmmaking, reading (*Ikigai* and *When Breath Becomes Air* are always on my reread list), long walks, and playing or watching the game of cricket. I consider myself an avid learner. I feel very fortunate to be part of NEHA, where we are surrounded by inspiring leaders and talented individuals willing to support the growth of aspiring healthcare and public health leaders.

86th Annual Educational Conference & Exhibition

AEC 2023

neha National Environmental Health Association presents

July 31 – August 3 | New Orleans, LA

Raising the Voice of the Environmental Health Workforce

Keynote Speakers

Maureen Lichtveld, MPH, MD
Dean, School of Public Health
Professor, Environmental and Occupational Health
Jonas Salk Chair in Population Health
Communities and Climate Through the Lens of Environmental Health Practice

Lt. General Russel L. Honoré, U.S. Army (Ret.)
Commander of Joint Task Force Katrina
Leadership, Safety, and Global Preparedness Authority
Leader of U.S. Capitol Complex Security Review
Leadership: Getting the Difficult Job Done

neha National Environmental Health Association

Featured Sessions

A Rodent Symposium: Effective Communications, Control Practices, and Utilizing Resources

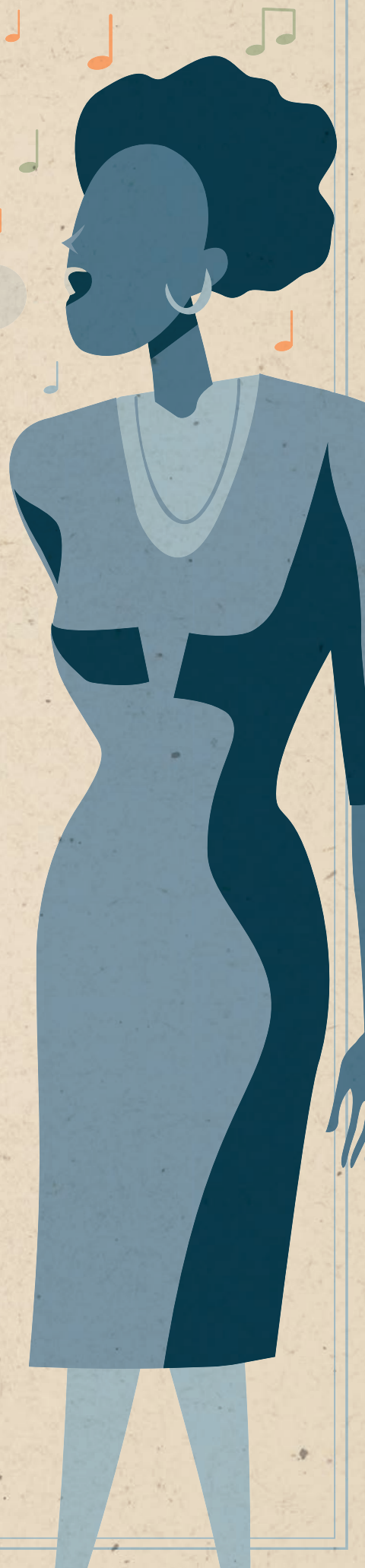
Tuesday, August 1

This expert panel will discuss the importance of breaking down silos for effective communications, rodent control practices, and knowledge among residents and local government workers while utilizing resources to further educate employees and clients.

The Conundrum of Food Safety Culture: Breaking Through Barriers to Drive Improvement

Wednesday, August 2

Join national and global food industry leaders as they share common challenges of rising inflation rates, workforce shortages, extreme weather events, pandemic recovery, and food defense. Executive leadership from the nation's top retail and food service industries will share their perspectives and leadership work to ensure food safety is incorporated into their overall business goals and corporate values.



The 2023 NEHA AEC is a hybrid event. Join us in person or virtually!

Early bird registration ends April 21.

Learn more about our featured speakers, view the draft educational agenda, and register today at **neha.org/aec.**

NEHA MEMBER SPOTLIGHT

Kavita Dorai, MS, REHS
California Department of Public Health

The National Environmental Health Association (NEHA) is shining a spotlight on the people within our membership through this new feature in the *Journal*. This month we are pleased to introduce you to Kavita Dorai, an investigator at the California Department of Public Health for 12 years. She investigates complaints and reports of abuse, neglect, misappropriation, and other types of unprofessional conduct against certified healthcare professionals. Dorai has been in the environmental health profession for 16 years.

Why did you join NEHA and what aspects of membership have you found most valuable to your career?
As an environmental health practitioner, NEHA was a logical choice to learn, network, and stay current. I heard NEHA's workshops were terrific and attended a preconference workshop on foodborne illness investigations in Albuquerque, New Mexico. It was put to good use right away in a foodborne illness investigation that involved a group of nine environmental lawyers who got food poisoning.

Over the years, I have returned to NEHA for its continuing education credits. The online education portal is amazing. It allows you to quickly access the latest information or take in a series of lessons on a particular topic.

Why did you choose the environmental health field?
I have always been a nature lover and after starting school, I volunteered with various nonprofit and nongovernmental organizations for environmental and social justice causes. I started writing a book that I researched for over 3 years, but I got sidetracked. Even then I made time for meaningful assignments such as being a docent at the Stebbins Cold Canyon Preserve and a volunteer at the Pine Hill Preserve. My volunteer work and the training I received were foundational in understanding how our built structure impacts the environment at many levels. During this journey, however, I realized I was still missing a good grasp of the interplay between environmental factors and human health. Preparation for the Registered Environmental Health Specialist (REHS) examination addressed the problem. The courses, workshops, independent study, and on-the-job training gave me the solid foundation I sought.

If you were not an environmental health professional, what other profession would you like to work in?
Writing about environmental health to various audiences. My current focus is on taking the conversation on environmental health to the public. I believe that empowering the public to make better choices will be transformative.

Describe any hobbies, activities, or causes you are passionate about.
I am passionate about environmental health, compassionate toward animals, and love nature. I write, paint, garden, and travel. Before coming to the U.S., I worked for Indian Union Cabinet Minister Maneka Gandhi. She has a nonprofit organization called People For Animals and my work there instilled a deep commitment toward animal welfare and habitat protection.

What is the one thing most people do not know about you that you are willing to share.
I have written a book called *Keshu: Climate Change and a Brave Little Fish*. The story is about a little fish's adventure, survival, and coming of age with a focus on surviving adversity. It is uplifting and introduces concepts of environmental health and collective social responsibility. The book is available through Google Play and Amazon.

Whom do you look up to and why?
My mother Savita Sharma. She was a teacher by profession. Everyone fondly called her Painting Aunty and she ran an art school from home for over 40 years. I have seen her teach all types of students and nurture them unconditionally. She was awarded the prestigious Kala Ratna for her lifetime of service to art and for developing a new way of drawing using the English alphabet. She taught me to be resourceful, resilient, and compassionate, and how to grow a child's imagination.

Is there a resource you use frequently for your work that you would recommend for other environmental health professionals?
I have had to use multiple resources for my work to research and verify information quickly.

- Environmental health fundamentals: Salvato's *Environmental Engineering*
- Energy and climate change: Websites from the U.S. Department of Energy and California Energy Commission
- Environment: Websites from the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Services, and California Department of Fish and Wildlife
- Childhood lead poisoning prevention, remediation, and statute interpretation: Website from the U.S. Department of Housing and Urban Development

We thank Kavita Dorai for sharing with us! You can read a full version of this spotlight at www.neha.org/membership/spotlights.

Walter S. Mangold Award

Walter S. Mangold dedicated his life to the practice of environmental health in an extraordinary and exemplary way. In doing so, he became a beacon of excellence and inspiration for all environmental health professionals who followed after him.

Do you have a colleague who fits the definition of doing extraordinary environmental health work? Consider taking the time to nominate them for the Walter S. Mangold Award, our most prestigious award.

Nomination Deadline: May 15, 2023

neha.org/mangold-award

neha National Environmental Health Association

extraordinary *adjective*

ex·traor·di·nary | ikˈstrôrd(ə)nˌerē

1. Going beyond what is usual, regular, or customary
2. Exceptional to a marked extent

Walter F. Snyder Award

Honoring a history of advancing environmental health.

Walter F. Snyder was a pioneer in our field and was the cofounder and first executive director of NSF. He embodied outstanding accomplishments, notable contributions, demonstrated capacity, and leadership within environmental health. Do you know someone like that?

Nominate them for the Walter F. Snyder Award for outstanding contributions to the advancement of environmental health. This award is cosponsored by NSF and NEHA.

Nomination Deadline: May 1, 2023

neha.org/awards
nsf.org/about-nsf/annual-awards

neha National Environmental Health Association

NSF

HS GOVTECH™
Beyond Data Management

Maximize your Efficiency with our Fully Integrated Virtual Inspection Solution

HS GOVCALL™

Virtual inspections are here to stay and GovCall™ allows restaurant workers to perform virtual inspections with EH professionals to streamline workflows.

GovCall™ is fully integrated with our HS CloudSuite™ platform; conference calls can be scheduled, or instantly initiated in conjunction with any regulatory activity in the system. This allows inspectors to mark violations and corrections with comments and even take and attach photos, all within the same conference call.

When needed, GovCall™ also produces a full, real-time, transcript of the entire inspection and can also include the HD video and audio recording (where allowed by statute).

Contact us today to schedule a demo and find out how HS GovTech™ can transform your agency with our versatile software.

Get in Touch

980.375.6060
info@hscloudsuite.com
hsgovtech.com

HSGovTech