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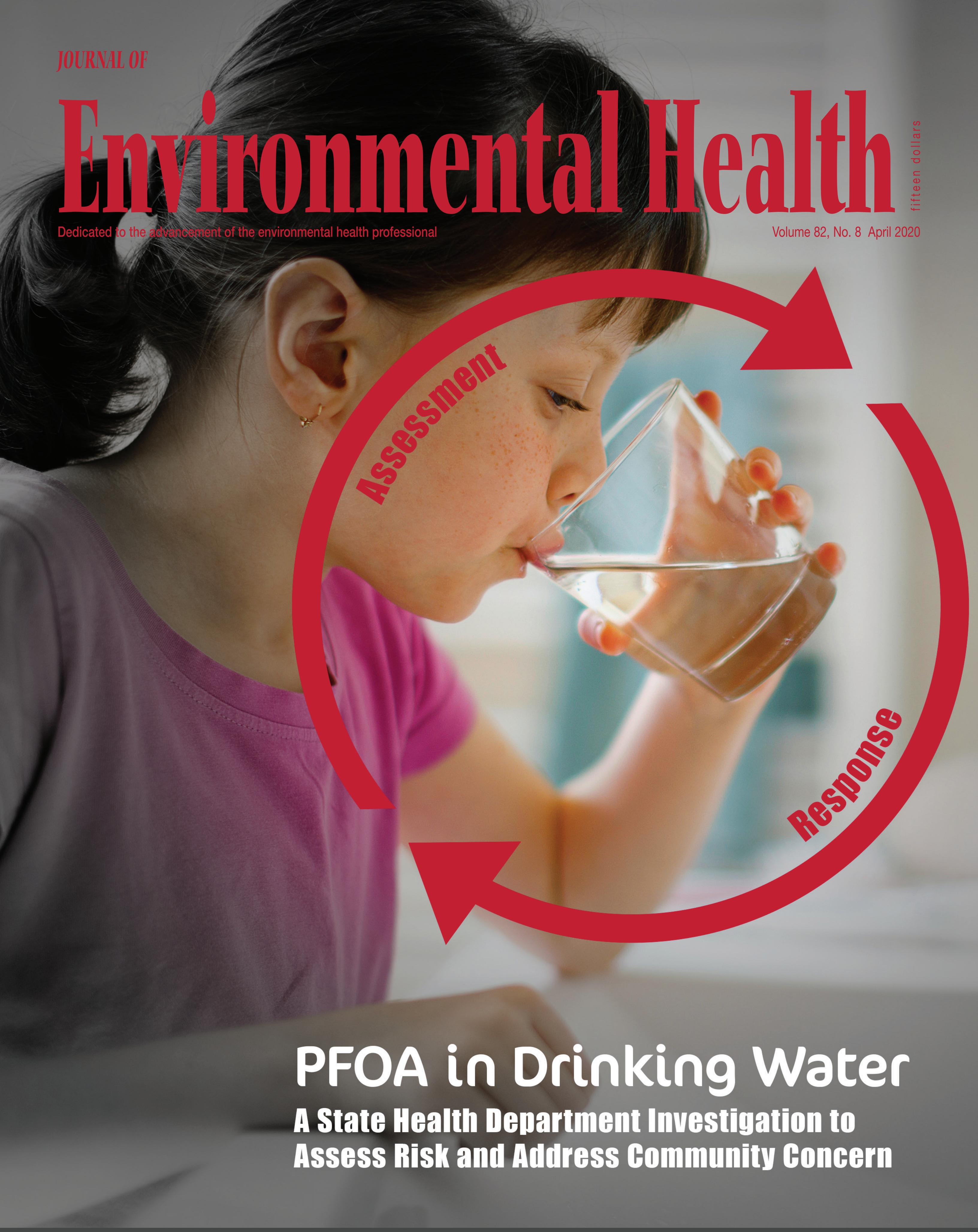

PFOA in Drinking Water

A State Health Department Investigation to Assess Risk and Address Community Concern

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Environmental Health

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ABOUT THE COVER

Perfluorooctanoic acid (PFOA) is a man-made chemical with a variety of uses, including coatings for nonstick cookware and food packaging, waterproof fabrics, and fire-fighting foam. Exposure to PFOA is so widespread that it is present in the blood of most people. The persistence of PFOA in the environment is a concern because exposure to PFOA has been associated with adverse health outcomes. This month's cover article, "Public Health Assessment of and Response to Perfluorooctanoic Acid in Drinking Water, Bennington, Vermont," highlights a state health department investigation to assess risk and address community concerns around PFOA contamination in a Vermont community. The findings provide insights for future public health responses to PFOA and other perfluoroalkyl substance contamination.

See page 8.

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2020 Walter F. Snyder Award

Call for Nominations

Nomination deadline is April 30, 2020

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

❖ ❖ ❖

Nominations for the 2020 Walter F. Snyder Award are being accepted for environmental health professionals achieving peer recognition for:

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

❖ ❖ ❖

Past recipients of the Walter F. Snyder Award include:

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The 2020 Walter F. Snyder Award will be presented during NEHA's 84th Annual Educational Conference & Exhibition to be held in New York City, New York, July 13–16, 2020.

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

DAVIS CALVIN WAGNER SANITARIAN AWARD

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

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

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

NOMINATIONS MUST BE RECEIVED BY APRIL 15, 2020.

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

Files should be in Word or PDF format.

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

PRESIDENT'S MESSAGE

Priscilla Oliver, PhD

A Call for Diversity in Environmental Health

In 2004, I received the U.S. Environmental Protection Agency (U.S. EPA) Atlanta Regional Diversity Award. It was and still is given annually to a deserving employee who has demonstrated a willingness to support, promote, and defend the selection and work of diverse students, employees, supervisors, clients, and customers in both work and the community. A prestigious list of recipients is hanging on a wall plaque in the U.S. EPA reception area near photos of the chain of command of top leaders, the president of the U.S., administrator of U.S. EPA, and the regional administrator. Matt Robbins, a former award recipient, quietly said to me, "Well now Priscilla, your name will be on the wall of U.S. EPA for others to see after you are gone." I have thought about that often and that has prompted me to write this column. Diversity has increasingly become an important part of organizational operations and health.

Diversity has increasingly become an important part of organizational operations and health.

Working with the National Council of Diversity of Environmental (N-CODE) Health, a Centers for Disease Control and Prevention (CDC) and Eastern Kentucky University (EKU) project really broadened my perspective and commitment to diversity. On day one of our meeting, I sat next to Sheila Davidson Pressley, who recently passed away. She went on to become a champion, Doctor of Public Health (DrPH), and dean at EKU. Here I worked on a task force with many prominent national leaders in environmental health to promote diversity of faculty and students in colleges, universities, the National Environmental Health Association (NEHA), and the workforce. These are some of the giants in environmental health and many were or became leaders in NEHA. Scholarly writers of diversity in environmental health and members of NEHA, Drs. Bailus Walker, Dan Harper, and Welford C. Roberts were part of the EKU/CDC task force. Please review the current list of NEHA technical advisors (see page 44 and 45) as they are a strong reflection of the promotion of diversity in NEHA. I encourage them to join in the fight for diversity and for you to call on them to assist with the important work in our communities. We thank all for serving.

Let me be clear, minorities are included in diversity but as defined it is now broader to include persons of various backgrounds, ethnicity, age, gender, and country of origin representation. All of us are needed in environmental health, medicine, dentistry, public health, law, education, etc. Why? We need to improve the health of all, which is stated in the NEHA mission to "advance the environmental health professional for the purpose of providing a healthful environment for all." We need to better understand all peoples, cultures, and living conditions to better serve human conditions. Role models are needed for others to emulate and to increase our self-worth. We need to serve all in environmental crises around the globe. We need to learn from others in far and near lands. There is a need to discover and share strategies throughout. The sky is the limit if we are inclusive. There have been some successes but we have more work to do.

In many areas, the demographics are changing. Our neighborhoods are becoming more diverse so our professions need to reflect this change in our fabric. Culture is important to reflect our needs and interests. People want to see and interact with diverse workers who understand and look like them. Environmental health is a service profession that performs inspections and conducts training. The aging workforce and early retirements are eminent and demand for us to be ready for more workers in replacement. Our environmental health workers should reflect the communities they support.

To achieve the goals of increasing diversity, it is important that we plan, recruit, train, and market the importance of the profession. We want and need good people that are inspired, well-trained, knowledgeable, technically competent, and reliable. The National Environmental Health Science and Protection Accreditation Council needs our full support. Reach out to them and market to young students and professionals. Visit the campuses and offer tours to middle school, high school, and college students. A call for federal, state, and nonprofit funding to support training and college expansion of the environmental health curriculum is requested. The other professions also need support to make sure that there is equity in all communities to improve overall health. Environmental health and medicine must work together. The underserved and socioeconomically deprived areas need help and should get help.

A call is issued here for all to join in this effort to develop and implement measures to improve diversity in environmental health. Create programs and projects to improve college preparation, work with recruiting faculty and students early and often. A call is made for multicultural and multigenerational efforts to enhance diversity in environmental health from middle school and K-12 to college and graduate school. Partnerships at all levels should join in on this effort. "One NEHA" that is diverse is now and our future.

Priscilla
President@neha.org

Did You Know?

To celebrate the 50th anniversary of Earth Day, NEHA will host an Earth Day Twitter Chat on Tuesday, April 21 from 2:00–3:00 p.m. EDT. The chat theme is "Climate Action." Environmental health professionals work closely with communities to ensure the safety of the resources used every day, from the air we breathe to the food we eat and the water we drink. These resources are being affected by climate impacts. Take this opportunity to initiate a conversation about how climate impacts health and what can we do to fight the effects of climate change and build resilience. Join us in leading the conversation by using #ClimateChangesHealth! and #EarthDayChat. Learn more at www.neha.org.

SUPPORT THE NEHA ENDOWMENT FOUNDATION

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

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

Thank you.

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Public Health Assessment of and Response to Perfluorooctanoic Acid in Drinking Water, Bennington, Vermont

Lauren Prinzing, MPH
Vermont Department of Health

Brianna Moore, PhD
Colorado School of Public Health

David Grass, PhD
Sarah Vose, PhD
Jenna Voigt, MPH
Harry Chen, MD
Lori Cragin, PhD
Vermont Department of Health

Abstract **A growing body of research links exposure to perfluorooctanoic acid (PFOA) and adverse health outcomes. PFOA was discovered in private drinking water wells in Bennington, Vermont, in 2016, prompting an investigation by the Vermont Departments of Health and Environmental Conservation. The objectives of the investigation were to assess potential exposure pathways in Bennington, to inform participants of their serum PFOA level, and to compare serum levels with U.S. background levels. Serum PFOA concentrations were strongly correlated with PFOA concentrations in well water (r_s = .65, p < .01) and cumulative exposure to PFOA in residential drinking water (r_s = .65; p < .01). Response to large-scale private drinking water contamination incidents in real time provides unique challenges. In Vermont, open communication with the public, proactively addressing community concerns, and the presence of an Environmental Contingency Fund allowed some of those challenges to be overcome. Our findings provide insights for future public health responses to PFOA and other perfluoroalkyl substance contamination.**

Introduction

Perfluorooctanoic acid (PFOA) is a manmade chemical with a variety of uses, including coatings for nonstick cookware and food packaging, waterproof fabrics, and fire-fighting foam (Agency for Toxic Substances and Disease Registry [ATSDR], 2018; Organisation for Economic Co-operation and Development, 2002; U.S. Environmental Protection Agency [U.S. EPA], 2009). PFOA is highly persistent in most environments, particularly in drinking water (ATSDR, 2018). Exposure to PFOA is so widespread that it is present in the blood of most people (ATSDR, 2018; Kannan et al., 2004; Perfluoroalkyl Sulfonates Significant New Use Rule, 2007). National Health and Nutrition Examination Survey data indicate that the geometric mean level of serum PFOA in people in the U.S. is 1.9 µg/L (Centers for Disease Control and Prevention [CDC], 2017).

The persistence of PFOA in the environment is a concern because exposure to PFOA has been associated with adverse health outcomes (Post, Cohn, & Cooper, 2012; Steenland, Fletcher, & Savitz, 2010). Among adults exposed to PFOA through ingestion of contaminated drinking water, higher serum PFOA concentrations are strongly associated with high cholesterol (Emmett et al., 2006; Steenland, Tinker, Frisbee, Ducatman, & Vaccarino, 2009; Winquist & Steenland, 2014), altered lipid profiles (Steenland, Fletcher, et al., 2010; Steenland, Tinker, et al., 2009), elevated uric acid levels (Steenland, Tinker, Shankar, & Ducatman, 2010), and pregnancy-induced hypertension (Darrow, Stein, & Steenland, 2013). Studies have shown associations between exposure to PFOA and ulcerative colitis (Steenland, Zhao, Winquist, & Parks, 2013), altered liver enzyme levels (Frisbee et al., 2009; Gallo et al., 2012), thyroid disease (Melzer, Rice, Depledge, Henley, & Galloway, 2010), and kidney and testicular cancer (Barry, Winquist, & Steenland, 2013; Vieira et al., 2013). While studies have demonstrated these relationships, further research might help to refine our understanding of the impact of PFOA on these outcomes.

Despite the voluntary phaseout of PFOA beginning in 2000, new discoveries of local PFOA contaminations continue to emerge (Hu et al., 2016). In 2014, PFOA was discovered in drinking water near a CHEMFAB manufacturing facility in Hoosick Falls, New York. Following this discovery, residents in nearby Bennington, Vermont, raised concerns about a former CHEMFAB/Saint-Gobain manufacturing facility in their community, which had applied nonstick coatings to fiberglass fabrics from 1969–2002.

In 2016, the Vermont Department of Environmental Conservation (DEC) began testing private drinking water wells for PFOA near the former manufacturing facility. At the time this exposure assessment was conducted, 304 of the 365 tested wells exceeded the advisory limit of 20 ppt for PFOA and perfluorooctanesulfonic acid (PFOS) combined, as set by the Vermont Department of Health (Health Department) in 2016. PFOA levels ranged from nondetectable to almost 3,000 ppt. This discovery prompted a public health investigation by the Health Department beginning in April 2016.

The goal of this investigation was to assess potential PFOA exposure pathways for people in the Bennington community, and to inform study participants of their PFOA blood concentrations and how those concentrations compared with background levels in the U.S. population. While it was not a primary goal of the investigation, information about health outcomes that have been associated with PFOA exposure was collected from study participants. This information was used to evaluate potential associations between exposure to PFOA in Bennington and health outcomes.

Methods

Study Population

Participants were considered for inclusion in the study if 1) DEC tested the well of their current home or their previous home (within the past 8 years) in Bennington or 2) they worked or previously or currently live at the former CHEMFAB/Saint-Gobain facility in Bennington. Each participant was asked to complete a questionnaire and to provide a blood sample. Water monitoring was conducted by DEC in private drinking water wells surrounding the former manufacturing facility. Water monitoring in the area continues (see supplemental map at www.neha.org/jeh/supplemental). Water monitoring data for 365 private drinking water wells were linked to participants based on their home address. Overall, 477 participants initially enrolled in the study, with 475 completing the questionnaire and having blood drawn. An additional 3 individuals were excluded due to missing exposure data, leaving a final analytic sample size of 472.

Prior to study participation, each adult participant provided written consent. For children, a parent provided consent. This exposure assessment study was deemed to be public health practice and was therefore exempt from Vermont Agency of Human Services Institutional Review Board approval.

All participants were asked to answer questions about sex, age (years), race (White, other), education level (<high school, high school degree or equivalent, any college), and annual household income (<\$40,000, \$40,001–\$90,000, or >\$90,001). Participants were asked about their occupational history (direct, indirect, or no work with PFOA), as well as their number of years at their current or previous residence that was tested for PFOA. Self-reported height and weight were used to calculate body mass index (kg/m^2). Additionally, adult participants were asked about their alcohol consumption (average drinks per week), physical activity levels (average hours of strenuous activity per week), and whether they had smoked at least 100 cigarettes in their lifetime (yes or no).

PFOA Sampling: Serum and Drinking Water

Serum samples were collected from participants and shipped on dry ice to the Centers for Disease Control and Prevention (CDC) for analysis. Given the ubiquity of PFOA in the environment, sample collection was conducted following CDC guidelines (2013–2014) to prevent potential contamination. Serum concentrations of linear PFOA (n-PFOA) and branched isomers of PFOA (Sb-PFOA) were quantified using a modification of the on-line solid-phase extraction coupled with isotope dilution high-performance liquid chromatography tandem mass spectrometry approach (Kato, Basden, Needham, & Calafat, 2011). Low and high concentration quality-control materials, prepared from a calf serum pool, were analyzed with the study samples, analytical standards, and with reagent and matrix blanks to ensure the accuracy and precision of the data as described in CDC Laboratory Method 6304.06 (CDC, 2013–2014). The limits of detection (LOD) for n-PFOA and Sb-PFOA were 0.1 ng/mL. We assessed PFOA as total concentrations (sum of n-PFOA and Sb-PFOA); for values <LOD we used the instrumental readings.

Drinking water samples were collected following a standard operating procedure for the laboratory analysis of PFOA as described in the U.S. Environmental Protection Agency (U.S. EPA) Laboratory Method 537 version 1.1 (Shoemaker, Grimmett, & Boutin, 2008). Briefly, sample containers were filled with water from the water supply at each site (generally, from the spigot at the bottom of the water supply pressure tank) after running the water for 10 min. A field blank was included for each site. Samples were stored in coolers filled with ice for shipment to Northern Lake Services in Wisconsin for analysis. Water samples were analyzed using a liquid chromatography linked to tandem mass spectrometry method. The detection limit for PFOA ranged from 2.1–6.7 ppt.

Exposure Assessment and Health Outcomes

Questionnaires were used to collect self-reported information about water consumption and dietary habits, as well as residential and occupational information related to the CHEMFAB/Saint-Gobain plant. Participants were asked to report the number of 8-ounce glasses of unfiltered, filtered, and bottled water consumed on a daily basis. Participants were asked to identify whether they consumed milk, meat, or eggs from animals raised in the sampling areas (yes or no) or consumed fish that were caught within the sampling area (yes or no). Participants were asked how often they ate fruits and vegetables that were grown in the sampling area (daily, weekly, monthly, or never). Finally, participants were asked to identify whether they had ever worked at the CHEMFAB/Saint-Gobain plant (yes or no) or lived at the plant after it closed in 2002 and was converted to residential, multiunit housing (yes or no).

The primary health outcomes of interest were based on previous associations identified by the C8 Panel and ATSDR (ATSDR, 2018; C8 Science Panel, 2012). Participants were asked to self-report if they had ever been diagnosed with high cholesterol, chronic kidney disease, increased uric acid levels, altered liver enzymes, ulcerative colitis, pregnancy-induced hypertension, or kidney or testicular cancer. Participants were also asked if they were taking medication for high cholesterol, high blood pressure, or for a thyroid condition.

Statistical Analysis

Due to the right-skewed distribution of the exposure data, nonparametric methods were used for the descriptive analyses. Spearman rank correlation was used to assess the association between exposure to PFOA via several different pathways and the concentration of PFOA in an individual's blood. Wilcoxon rank-sum and Kruskal–Wallis tests were used to assess differences in blood PFOA concentration across the various subgroups.

For our main effect analyses, serum PFOA concentrations were log_{10}-transformed to ensure that the assumption of normality was met. We used logistic regression models to examine the association between log_{10}-transformed serum PFOA concentrations and high cholesterol, chronic kidney disease, increased uric acid levels, altered liver enzymes, fatty liver disease, hypothyroidism, hyperthyroidism, ulcerative colitis, and pregnancy-induced hypertension as separate outcomes. Age and smoking were identified as relevant confounders based upon previous research (Darrow et al., 2013; Frisbee et al., 2009; Steenland, Tinker, et al., 2010); the addition or removal of these covariates also had a meaningful impact on the effect estimates (>10% change in estimate). We present the results in terms of crude and adjusted odds ratios (*OR*s) and 95% confidence intervals (*CI*s). An alpha level of .05 was used to determine statistical significance for all analyses. All analyses were completed using SAS version 9.4.

Results

Characteristics of the participants are displayed in Table 1. The majority of study participants were adult (87.3%), female (60.0%), and White (86.2%). The proportion of non-Whites enrolled in the study (13.2%) exceeds the proportion of non-Whites in Bennington county (0.4%), according to the U.S. Census. The majority of study participants (74.4%) were eligible to participate because they lived in homes served by private water supplies that were tested for PFOA. Relatively few of the study participants had worked directly (5.1%) or indirectly (8.7%) with PFOA.

Exposure to PFOA

We detected n-PFOA in all serum samples analyzed (range: 0.3–1,123.3 µg/L) and Sb-PFOA in 62% (range: <0.1–36.3 µg/L). Additionally, n-PFOA and Sb-PFOA serum concentrations had moderate to high corre-

TABLE **1**

Characteristics of Participants, Vermont, 2016

Characteristic	# (%)
Age group	
Child	60 (13)
Adult	412 (87)
Sex	
Male	189 (40)
Female	213 (60)
Race/ethnicity	
White	407 (86)
Other	65 (14)
Household income	
<$40,000	93 (20)
$40,001–$90,000	112 (24)
>$90,001	72 (15)
Don't know/refused	120 (41)
Highest level of education*	
<12 years	122 (30)
High school degree	86 (31)
College classes or college degree	170 (41)
Don't know/refused	34 (8)
Work/residential history	
Worked directly with PFOA	24 (5)
Worked indirectly with PFOA prior to 2003	41 (9)
Worked or lived at CHEMFAB/Saint-Gobain building after 2002	16 (3)
Currently live in a home that was tested	351 (74)
Formerly lived in a home that was tested	27 (6)
Other	13 (3)
Smoked 100 cigarettes in lifetime*	
Yes	169 (41)
No	222 (54)
Number of alcoholic drinks per week*	
None	184 (45)
1–3	122 (30)
≥4	89 (23)
Time spent doing exercise per week*	
<3 hr	174 (42)
≥3 hr	181 (44)
BMI category*	
Underweight/normal	144 (35)
Overweight	141 (32)
Obese	127 (31)

BMI = body mass index; PFOA = perfluorooctanoic acid.
*Question asked only of adult participants.

TABLE **2**

Perfluorooctanoic Acid (PFOA) Concentrations in Blood (µg/L) by Sex, Age, Occupational Exposure, Dietary Intake, and Medication Use, Vermont, 2016

Characteristic	#	Geometric Mean (µg/L)	*p*-Value
Sex			
Male	189	13.0	
Female	213	8.8	<.01
Males by age (years)[a]			
18–39	30	7.4	
40–59	75	14.4	
≥60	81	14.4	.10
Females by age (years)[a]			
18–39	39	4.0	
40–59	89	8.4	
≥60	83	13.0	<.001
Occupational exposure to PFOA			
Worked directly with PFOA	24	59.0	
Did not work directly with PFOA	388	9.6	<.001
Fruit/vegetable from a farm within sampling area[b]			
Daily/weekly	165	11.8	
Monthly/never	215	8.3	.04
Milk from animals raised within sampling area[b]			
Yes	19	16.7	
No	236	10.0	.15
Meat from animals raised within sampling area[b]			
Yes	42	7.4	
No	232	10.5	.11
Eggs from animals raised within sampling area[b]			
Yes	24	7.8	
No	284	10.3	.30
Fish caught within sampling area[b]			
Yes	105	12.2	
No	169	9.5	.22
Cholesterol medication			
Yes	90	18.1	
No	372	8.9	<.001
Blood pressure medication			
Yes	115	16.2	
No	350	8.9	<.001
Thyroid medication			
Yes	44	11.9	
No	416	9.9	.71

[a]Adults only.
[b]This subgroup analysis was performed only among those who had nonoccupational exposure to PFOA.

lations with potential sources of exposure to PFOA. Among current residents, serum PFOA concentrations were strongly correlated with PFOA concentrations in well water (r_s = .65; p < .01). Among current residents, cumulative exposure to PFOA in residential drinking water (calculated as the PFOA level in well water multiplied by the number of 8-ounce glasses of unfiltered water consumed daily multiplied by the years at current residence) was strongly and positively correlated with serum PFOA concentrations (r_s = .65; p < .01). There was no correlation between consumption of filtered or bottled water and serum PFOA.

Subgroup Analysis of Exposure to PFOA

In this study population, men had significantly higher geometric mean levels of serum PFOA concentrations than women (13.0 µg/L versus 8.8 µg/L, respectively; p < .01) (Table 2). Among adult women (18 years and older), the geometric mean serum PFOA concentrations increased with age (p < .01). Individuals who worked directly with PFOA had significantly higher serum PFOA concentrations than those who did not (59.0 µg/L versus 9.6 µg/L, respectively; p < .01). Among those who were not occupationally exposed to PFOA, frequent consumption (daily or weekly) of fruits and vegetables grown within the sampling area was associated with higher serum PFOA concentrations (p = .04). After stratifying by drinking water source with concentrations above or below Vermont's Health Advisory level (20 ppt), the association with fruit and vegetable consumption was no longer significant for those with water concentrations below 20 ppt. Compared with those who did not self-report taking any medications, individuals who self-reported taking blood pressure lowering medications (p < .01) or cholesterol lowering medications (p < .01) had significantly higher serum PFOA concentrations. There was no statistical difference in PFOA blood levels between those who did or did not report taking thyroid medication.

Serum PFOA Concentrations and Health Outcomes

Higher serum PFOA concentrations were associated with an increased prevalence of high cholesterol and pregnancy-induced hypertension (Table 3). Specifically, each 1-log_{10}-ng/mL increase in serum PFOA was associated with a 1.4 increase in odds of high cholesterol (95% *CI* [1.1, 2.1]). Among women who reported having at least one child, each 1-log_{10}-ng/mL increase in serum PFOA was associated with a 6.2 increase in odds of pregnancy-induced hypertension (95% *CI* [1.9, 20.3]). We did not detect an association between serum PFOA concentrations with chronic kidney disease, increased uric acid levels, altered liver enzymes, hypothyroidism, hyperthyroidism, or ulcerative colitis. Power calculations conducted prior to enrolling participants indicated that we were unlikely to detect a statistically significant association between PFOA exposure and the less common health outcomes—such as ulcerative colitis or chronic kidney disease—given the relatively small size of the exposed population. We were unable to evaluate the relationship between PFOA exposure and kidney or testicular cancer in this study population due to small sample size.

TABLE **3**

Associations Between Serum Perfluorooctanoic Acid (PFOA) Concentration and Health Outcomes Among Adults, Vermont, 2016

Outcome	# With Outcome	# Without Outcome	Serum PFOA (per 1-log_{10}-ng/mL increase) *OR*[a] (95% *CI*)
High cholesterol	112	269	1.4 (1.1, 2.1)
Chronic kidney disease	8	370	0.4 (0.1, 1.3)
Increased uric acid levels	19	361	1.1 (0.5, 2.2)
Altered liver enzyme levels	20	355	1.0 (0.4, 1.9)
Hypothyroidism	45	334	1.0 (0.6, 1.7)
Hyperthyroidism	7	370	0.5 (0.1, 1.8)
Ulcerative colitis	10	365	1.4 (0.5, 3.5)
Pregnancy-induced hypertension[b]	13	126	6.2 (1.9, 20.3)

CI = confidence interval; OR = odds ratio.
[a]Adjusted for age (continuous) and smoked 100 cigarettes in lifetime (yes, no).
[b]Analysis conducted only among women who reported having at least one child (*n* = 152).

Discussion

The primary goal of this study was to assess potential PFOA exposure pathways for people in the Bennington community, and to inform study participants of their PFOA blood concentrations and how those concentrations compared with background levels in the U.S. population. In evaluating the potential associations between exposure to PFOA in Bennington and various health outcomes, we observed strong associations between serum PFOA concentrations with some of the self-reported health outcomes. In a post hoc evaluation, we identified strengths and challenges of the Health Department's exposure assessment. Our findings could provide methodological insights for future responses to PFOA and other perfluoroalkyl substance contamination.

Consistent with previous studies (Emmett et al., 2006; Hoffman et al., 2011; Steenland, Jin, et al., 2009), serum PFOA concentrations in blood were strongly and consistently correlated with PFOA concentrations in well water. This finding provides evidence in support of the hypothesis that consumption of contaminated drinking water was the primary exposure pathway in Bennington.

We observed an association between more frequent (daily or weekly) consumption of fruits and vegetables grown within the sampling area and higher serum PFOA concentrations. Further analysis revealed that this association was present only among those who also consumed water with levels of PFOA above the Health Department's advisory level (20 ppt). Other studies have found similar associations between higher serum PFOA levels and consumption of fruits and vegetables grown in areas contaminated by PFOA. Researchers speculate that this association might be due to watering fruits and vegetables with PFOA-contaminated water (Emmett et al., 2006; Steenland, Jin, et al., 2009).

Prior studies have examined the relationship between exposure to PFOA and high cholesterol among occupationally exposed males (Costa, Sartori, & Caonsonni, 2009; Olsen et al., 2007) or those with higher serum concentrations of PFOA (Darrow et al., 2013; Steenland, Fletcher, et al., 2010; Steenland, Jin, et al., 2009; Winquist & Steenland, 2014). Our study adds to these previous studies by demonstrating that sustained exposure to PFOA is associated with high cholesterol, even at exposure concentrations lower than the C8 and occupational studies.

Our results also suggest that higher serum PFOA concentrations are associated with an increase in odds of pregnancy-induced hypertension in this community (geometric mean among women: 8.8 µg/L), which is consistent with previous work by Darrow and coauthors (2013) among a highly exposed community in the Mid-Ohio Valley (geometric mean: 16.2 µg/L). In contrast, Starling and coauthors (2014) reported limited to no evidence of an association between serum PFOA concentrations (median: 2.8 µg/L) and pregnancy-induced hypertension. This finding suggests that the association between exposure to PFOA and pregnancy-induced hypertension might be dose dependent, where these associations might not be detectable in communities with a lower level of exposure.

Previous studies have demonstrated a positive association between higher serum PFOA concentrations with elevated uric acid levels (Steenland, Tinker, et al., 2010), altered liver enzymes (Gallo et al., 2012), thyroid disease (Melzer et al., 2010), and ulcerative colitis (Steenland et al., 2013), among other health outcomes. Although we did not detect such associations, our null findings could be a result of the limited sample size. Our study was underpowered to detect these rarer health outcomes and latency might have played a role as well. The fact that no association was detected with some health outcomes in the study of the Bennington community does not rule out the possibility that an association exists.

These results should be interpreted with caution in light of several limitations. First, participant self-selection and recall bias could have impacted the results of this study. We speculate that individuals with higher concentrations of PFOA in well water and adverse health outcomes might have been more likely to participate, potentially resulting in a bias away from the null. Another limitation is the use of self-reported measures. Participants with higher exposure to PFOA might have been more likely to report adverse health outcomes, potentially resulting in a bias away from the null. Participants did not know their serum PFOA level, however, when completing the questionnaire, which we hope limited reporting bias.

Our study included participants who were exposed to PFOA occupationally as well as via consumption of contaminated drinking water. In order to avoid further decreases in statistical power, both of these exposure groups were included in the majority of our analyses (with the exception of fruit and vegetable consumption). Given a larger sample size, however, it would have been more methodologically sound to explore serum PFOA levels and health outcomes for each exposure group separately. Due to the cross-sectional nature of the study, the temporal relationship between PFOA exposure and the health outcomes could not be established because we cannot be certain that the exposure preceded each of the health outcomes.

An important strength of the study was the very small loss to follow-up. Of the 477 participants who met eligibility requirements and enrolled in our study, 472 (98%) participants completed surveys and had their blood drawn. Furthermore, water PFOA concentrations were known for all participants who currently or formerly lived in a home where the water had been tested (378 participants, 80%), which allowed for an objective measurement of exposure to PFOA via drinking water.

Conclusion

There is a need to better understand how to appropriately respond to large-scale private drinking water contamination incidents. Although CDC and the Council of State and Territorial Epidemiologists have established guidelines for investigating and responding to potential environmental clusters (CDC, 2013), there are unique challenges that arise when responding to such incidents, especially as situations are changing quickly in real time. Our investigation could provide insights for future rapid response studies conducted at the state or local level.

First, communication is key in such endeavors. Established guidelines emphasize the importance of open communication. In our rapid response study, the State of Vermont communicated early and often in a transparent manner with community members. State officials and staff members were open with residents about what was known and what was not known.

DEC staff went door-to-door in the community while collecting water samples to explain why sampling of water was being conducted. After the well water results became available, the Health Department's Central Office called more than 200 residents to provide guidance on next steps for those residents whose wells tested positive for PFOA. The Health Department's Bennington District Office staff members were an integral component of the response, as they were a trusted source of information embedded within the community. Following serum collection and analysis, Health Department staff explained the results to participants and addressed resident concerns as they arose.

There were several meetings held in Bennington with state officials and Health Department and DEC staff to explain the nature of the investigation, the progress made toward providing a permanent alternative source of water, and the potential impacts of contamination on the members of the community. It was especially important to explain to residents what their blood results did and did not mean: for example, that a particular serum PFOA concentration was not necessarily predictive of subsequent adverse health outcomes on an individual level, nor that a particular health condition was necessarily attributable to PFOA exposure. Fact sheets were developed to disseminate information to the public and to facilitate conversations between staff and residents.

The state used its Health Alert Network to share information with healthcare providers about potential interventions and health effects to relay to concerned residents. Health Department staff members also had direct contact with numerous healthcare providers in the Bennington area. Both the Health Department and DEC created web pages dedicated to the PFOA contamination response, as well as e-mail distribution lists to communicate with affected residents. Finally, a direct access phone line was established to make state employees readily available to residents. Together, these specific actions may be beneficial as an example for other agencies.

Second, agencies should strive to be proactive in addressing community concerns. DEC immediately began providing bottled water to households that were potentially affected before PFOA levels in drinking water were confirmed. The existence of an Environmental Contingency Fund, which is established from fees on the disposal of hazardous waste, enabled DEC to take this proactive approach in how it responded to the contamination prior to obtaining commitments from the responsible party to pay for those steps. Other states could consider creating such funds to enable a rapid response to environmental contamination.

After the discovery of contamination at the facility, DEC extended the testing of private water wells to a 1.5-mile radius of the former manufacturing facility. When samples near the edge of the 1.5-mile radius were found to have PFOA concentrations above 20 ppt, DEC further expanded the sampling area, and continues to implement its statewide per- and polyfluoroalkyl substances (PFAS) sampling plan to strategically investigate numerous sources of PFAS in the state.

There were also lessons learned as part of our response to the local PFOA contamination. Health Department staff indicated that having a better understanding of public and private water supply infrastructure in the Bennington area would have been helpful in the initial stages of the exposure assessment. The collaboration between state agencies could have benefited from the use of a single, shared database. It is recognized, however, that establishing such a database could be difficult during a time-sensitive response.

An additional factor in this rapid response was the evolving guidance on the allowable level of PFOA in drinking water. There is no federal maximum contaminant level for PFOA or any other PFAS. At the time of our investigation and response, the only national drinking water guidance for PFOA was U.S. EPA's short-term health advisory of 400 ppt. Since then, U.S. EPA has established a nonenforceable, nonregulatory health advisory level of 70 ppt for PFOA and perfluorooctane sulfonate (PFOS) combined.

Following review of the available science, the Health Department set a health advisory level of 20 ppt for PFOA and PFOS combined. The Health Department updated the Vermont health advisory in July 2018 to include three more PFAS in addition to PFOA and PFOS. Added together, the level of PFOA, PFOS, perfluorohexane sulfonic acid (PFHxS), perfluoroheptanoic acid (PFHpA), and perfluorononanoic acid (PFNA) may not exceed 20 ppt. Health advisory levels for PFOA and similar chemicals vary from state to state. For example, the maximum contaminant level for PFOA in New Jersey is 14 ppt, whereas New York adopted U.S. EPA's health advisory level of 70 ppt for PFOA and PFOS combined. State-specific variations in health advisory levels should be a factor to consider when contamination crosses state lines.

There is growing concern about exposure to PFOA and PFAS via contaminated drinking water and their associated adverse health outcomes. Our results build on previous studies by highlighting that sustained exposure to PFOA, even at relatively low concentrations in private residential drinking water, is associated with self-reported high cholesterol, pregnancy-induced hypertension, taking medication for high cholesterol, and taking medication for high blood pressure. As noted above, the results do not rule out associations with other adverse health outcomes as well.

Our results also lend support to the assertion that the relative contribution of exposure to PFOA via contaminated drinking water outweighs the relative contribution of other potential exposure pathways (Emmett et al., 2006; Hoffman et al., 2011; Post, Louis, Lippincott, & Procopio, 2013; Steenland, Jin, et al., 2009). Furthermore, our investigation and response can provide insights for other agencies responding to environmental contamination incidents.

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Food Safety Policies and Procedures for Student-Led Food Events at Colleges and Universities in the United States

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Abstract **The purpose of this study was to assess similarities and differences in food safety policies and procedures related to student-led food events at colleges and universities (CUs) in the U.S. The data were collected from public or land-grant CUs through a web-based questionnaire. Of the 231 CU personnel who were responsible for overseeing student-led food events receiving the questionnaire, 75 personnel provided information about current food safety policies and procedures at their institutions. The findings of this study could influence the development of a guidance document about food safety policies and procedures for student-led food events.**

Introduction

Foodborne illnesses are prevalent in the U.S., where 9.4 million foodborne illnesses caused by 31 identified pathogens annually result in 1,351 deaths and 55,961 hospitalizations (Scallan et al., 2011). Contaminated equipment, procuring food from unsafe sources, inadequate cooking, improper food handling, and poor personal hygiene are major risk factors that can cause foodborne illnesses (Food and Drug Administration, 2014). Unsafe practices by food handlers have continued to be reported despite the recognized importance of ensuring safe food handling practices and proper personal hygiene to mitigate the risks of foodborne illnesses (Angelo, Nisler, Hall, Brown, & Gould, 2017; Arendt, Ellis, Strohbehn, & Perez, 2011; Kwon, Roberts, Sauer, Cole, & Shanklin, 2014).

Risk Factors for Unsafe Food Handling Practices Among College and University Students

The risk of foodborne illness at colleges and universities (CUs) is inevitable because of dining in a communal manner, preparing large quantities of food, and serving food to a diverse demographic. According to the Centers for Disease Control and Prevention (CDC, 2018), 333 foodborne illness outbreaks caused 17,519 illnesses and 343 hospitalizations from 2000–2015 in U.S. K-12 schools and CUs. While food handling practices of college students have been studied to mitigate risks of food safety issues on campuses, specific risk factors of foodborne illnesses at CUs have not yet been identified.

Researchers have studied food handling practices of college students, and researchers have specifically identified the major risk factors associated with unsafe food handling practices of college students: lack of cooking experience (Morrone & Rathbun, 2003), poor personal hygiene (Byrd-Bredbenner et al., 2007), lack of self-confidence about food handling (Byrd-Bredbenner et al., 2007), and lack of food safety awareness (Abbot, Byrd-Bredbenner, Schaffner, Bruhn, & Blalock, 2009; Byrd-Bredbenner et al., 2007; Green & Knechtges, 2015; Lazou, Georgiadis, Pentieva, McKevitt, & Iossifidou, 2012; Sanlier & Konaklioglu, 2012).

Food Safety Policies and Procedures at Colleges and Universities

All CUs in the U.S. are mandated to comply with the requirements of the *Handbook for Campus Safety and Security Reporting* in addressing on-campus violence and safety issues (U.S. Department of Education, 2016). Each CU appoints an administrative entity to govern various aspects of campus safety to fulfill campus safety and security enforcement requirements (e.g., environmental health and safety, risk management, student health, safety). Food safety at student-led food events is handled by different departments depending on the CU. Unfortunately, policies and procedures associated with food safety tend to be limited and overshadowed by measures more focused on preventing on-campus crime and violence (U.S. Department of Education, 2017). Furthermore, there is no universal definition for a student-led food event. Authors in this study defined a student-led food event as "any event organized by a registered or recognized student organization where food will be prepared and/or provided to consumers either on- or off-campus."

Food handling by college students might involve more risks than foods handled by food handlers in commercial foodservice operations because, as many researchers have found, college students sometimes lack knowledge of food safety or food handling practices (Abbot, Policastro, Bruhn, Schaffner, & Byrd-Bredbenner, 2012; Lazou et al., 2012). Some CUs have implemented policies and procedures to address food safety issues during student-led food events on campus. For example, accord-

TABLE 1

Demographic Characteristics of Personnel Overseeing Student-Led Food Events (*n* = 68)

Characteristic	#	%
Sex/Gender		
Male	34	50.0
Female	31	45.6
Other	3	4.4
Age (years)		
≤30	11	16.7
31–40	13	19.7
41–50	15	22.7
51–60	17	25.8
>60	10	15.2
Highest education level		
High school	2	3.0
Bachelor's degree	27	40.3
Graduate degree	38	56.7
Number of years worked in current unit		
≤5	28	44.5
>5	35	55.5
Number of years worked in current role		
≤5	31	47.7
>5	34	52.3
Receiving food safety training		
Yes	53	77.9
No	15	22.1
College and university by U.S. Census Bureau region*		
Northeast	4	5.9
Midwest	16	23.5
South	14	20.6
West	33	48.5
Other	1	1.5
Student enrollment		
≤25,000	29	42.6
>25,000	39	57.4
Number of registered student organizations		
≤500 student organizations	34	50.7
>500	12	18.0
I don't know	21	31.3
Number of approved student-led food events (2016–2017 academic year)		
≤200	21	31.3
>200	19	28.4
I don't know	27	40.3

Note. Totals might not equal 100% due to unanswered questions.

*U.S. Census Bureau regions: Northwest = Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont; Midwest = Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin; South = Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia; West = Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming; Other = Guam, Micronesia, Northern Marianas, Puerto Rico, U.S. Virgin Islands.

ing to the University of Wisconsin, any food events hosted by a department, an organization, or another group either on or off property should follow approved food handling policies (University of Wisconsin-Superior, 2014). At Texas State University, all personnel planning a food event must complete a food handler course provided by the institution's Environmental Health, Safety & Risk Management Office (Texas State University Environmental Health, Safety & Risk Management, n.d.). The Department of Safety and Risk Management at the University of Rhode Island also enforces a Food Handling and Food Vendor Policy (#99-5-1) that requires college students to observe food safety practices during such events (University of Rhode Island Department of Safety and Risk Management, n.d.). The policy also describes procedures that address food safety issues and standard food safety regulations for student-led food events.

Iowa State University is another institution that has addressed this issue by establishing food safety policies and procedures for student-led food events and requiring its students involved in student-led food events to complete a yearly 1-hour online training on food safety basics called SafeFood 101 (Iowa State University Office of Risk Management, 2020). Food safety policies and procedures, enforced by that entity, are in accordance with the Iowa Code (Iowa Code 2020 Food Establishments and Food Processing Plants, 2019). The Iowa State University Office of Risk Management oversees the enforcement of these policies during student-led and other food-related events that must abide by its food safety guidelines. Student organizations hosting food events are required to obtain a temporary food handler permit and authorization to serve food at student-led events (Iowa State University Office of Risk Management, 2020).

There has been no known research study that has investigated presence/absence and types of food safety policies and procedures for student-led food events at CUs. Therefore, this study aimed to investigate current food safety policies and procedures at CUs to assess their similarities and differences. The specific research objectives of this study were to 1) assess current food safety policies and procedures for student-led food events at CU; 2) examine differences and similarities (e.g., varied sizes of CUs, distinct roles of risk management, and difference in the number of risk management professionals) in food safety policies and procedures; 3) identify commonly required or recommended food safety policies and procedures for these events; and 4) identify food safety personnel attitudes towards food safety policies and procedures for student-led food events at CUs.

Methods

The target population of this study comprised professionals in administrative entities responsible for overseeing student-led food events at CUs. This study examined public and land-grant CUs because a comparison of CUs located in different states with the same classification such as land-grant (U.S. Department of Agriculture National Institute of Food and Agriculture [USDA NIFA], n.d.) and public and land-grant (Association of Public and Land-grant Universities [APLU], n.d.) was convenient.

Sample Selection

The U.S. Department of Agriculture National Institute of Food and Agriculture (USDA NIFA) lists 120 land-grant CUs and the Association of Public and Land-grant Universities (APLU) lists 190 public and land-grant universities (APLU, n.d.; USDA NIFA, n.d.). Eliminating redundant CUs from the two lists (231 public and/or land-grant CUs) helped identify those that should receive a web-based questionnaire. Contact information for the sample population was obtained from institution websites by searching for appropriate contact persons through related keywords (e.g., food safety, risk management, environmental health and safety, campus food event).

Titles of administrative entities associated with food safety policies and procedures for student-led food events varied with each CU, so the first person listed for each qualifying school was considered the most likely individual to be overseeing CU food safety, and that was the person we contacted via e-mail. These individuals included safety and health program managers, safety officers, environmental health service officers, and health and safety professionals. A risk management director, environmental health and safety specialist, or event coordinator was contacted in cases for which no responsible professional was listed in the directory.

TABLE **2**

Food Safety Knowledge of Personnel Overseeing Student-Led Food Events (*n* = 74)

Knowledge Item*	#	%
1. When should hands be washed?		
a. After using the restroom	0	0
b. After taking out the garbage	0	0
c. After handling money	0	0
d. All of the above	**74**	**100**
2. What is the recommended method for checking the temperature of food?		
a. Using a calibrated thermometer	**73**	**98.6**
b. Tasting the food	0	0
c. Seeking customer feedback	0	0
d. Relying on the five senses (i.e., taste, sight, touch, smell, and sound)	1	1.4
3. What are some ways in which cross-contamination can occur?		
a. Scratching a sore and then touching food	0	0
b. Touching a refrigerator handle with a gloved hand and then touching food	0	0
c. Using an unclean cleaning cloth to wipe a food contact surface (e.g., chopping board)	0	0
d. All of the above	**74**	**100**
4. Cold foods such as salads should be kept below what temperature for food safety?		
a. 24 °F	3	4.1
b. 41 °F	**65**	**87.8**
c. 60 °F	6	8.1
d. 78 °F	0	0
5. Which of the following is a major food allergen?		
a. Chicken	1	1.4
b. Marshmallows	1	1.4
c. Eggs	**72**	**97.3**
d. Spinach	0	0
6. The greatest risk to food safety comes from which of the following?		
a. Food purchased from approved and reliable vendors	0	0
b. Poor personal hygiene and/or health of food handlers	**74**	**100**
c. Using older equipment for serving food	0	0
d. Using imported foods	0	0

continued ▸

An e-mail including the study's purpose, informed consent form, and a link to the web-based questionnaire was sent. In an effort to contact appropriate individuals, a request was included to forward the invitation to personnel responsible for overseeing student-led food events on campus. Approval was obtained from the university's institutional review board prior to conducting data collection.

Questionnaire Content

We modified the questionnaire developed and validated by Rajagopal and Strohbehn (2011) to align it with the purpose of this study. The resulting questionnaire comprised six sections. The first section contained 10 multiple-choice food safety items designed to assess food safety knowledge of participants. The second section contained four items related

TABLE **2** *continued*

Food Safety Knowledge of Personnel Overseeing Student-Led Food Events (*n* = 74)

Knowledge Item*	#	%
7. What should be done if a food stand serving food does not have a hand-washing sink?		
a. Nothing, most food stands just "make do"	0	0
b. Locate the food stand close to a building with restrooms and hand sinks	6	8.1
c. Prepare a temporary hand-washing station	**57**	**77.0**
d. Use hand sanitizer to clean hands	11	14.9
8. Which of the following is most likely to support the rapid growth of microorganisms and cause foodborne illness?		
a. Cut melons	1	1.4
b. Dairy products	13	17.6
c. Foods containing raw seed sprouts	8	10.8
d. All of the above	**52**	**70.3**
9. What is the key food safety concern when preparing and serving foods that will be sold to consumers?		
a. Location of food stand	1	1.4
b. Sale project of food items	1	1.4
c. Number of customers served	0	0
d. Employee personal hygiene	**72**	**97.3**
10. Which of the following is an effective sanitizer that can be used to sanitize food contact surfaces (such as chopping board, prep tables) and utensils (such as bowls, ladles)?		
a. Potassium	1	1.4
b. Chlorine	**72**	**97.3**
c. Nitrogen	0	0
d. Calcium	1	1.4

Note. Bolded numbers represent the correct response.
*α = .79.

to current procedures students must follow for hosting student-led food events at their institution. The third section contained three items concerning food safety policies and procedures currently implemented for student-led food events at their institution. The fourth section contained 12 items concerning food safety inspection and incidences of foodborne illnesses at their institution. The fifth section contained 18 items that examined participant perception of food safety policies and procedures at their institutions using a 5-point Likert-type scale (1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree). Its internal reliability was examined using Cronbach's α (Ary, Jacobs, & Sorensen, 2010). Finally, the sixth section contained 11 demographic items (Dillman, Smyth, & Christian, 2014). The questionnaire was posted on Qualtrics.

Pilot Study

We conducted the pilot study in two steps to ensure the content, construct, and face validity of the questionnaire (Dillman et al., 2014). In the first step, experts in food safety and food service (*n* = 3), event management (*n* = 1), research methods (*n* = 1), extension and outreach (*n* = 1), and risk management (*n* = 1) who oversee student-led events at a Midwestern land-grant university reviewed the questionnaire. In the second step, the questionnaire was forwarded to professionals (*n* = 5) responsible for overseeing food safety at student-led food events at a Midwestern university. The feedback obtained from these participants was used to modify the questionnaire and its administration procedures and data from the pilot study were excluded from the final analysis.

Questionnaire Distribution

The web questionnaire was distributed to personnel on the mailing list of entities associated with overseeing food safety policies and procedures at CUs. The questionnaire distribution process followed the guidelines for conducting online surveys outlined by Dillman and coauthors (2014). The initial contact list was constructed using the CUs directory. When we could not identify an individual responsible for overseeing food safety policies and procedures for a campus, we sent an e-mail to the director or manager asking that the e-mail be forwarded to the appropriate personnel. Reminder e-mails were sent for three consecutive weeks. Participants were assured their answers would remain confidential and they would receive a summary of the findings as compensation for their participation.

Data Analysis

Data obtained from Qualtrics were transferred into an Excel spreadsheet and then to SPSS version 23.0. The data were coded and entered in accordance with the guidelines outlined by Salant and Dillman (2008). Descriptive statistics such as mean, percentage, frequency, and standard deviation were computed to allow for data distribution analysis, and questionnaire scale reliability was assessed using Cronbach's α (Ary et al., 2010). A one-way analysis of variance (ANOVA) and an independent *t*-test were used to examine significant differences in the attitudes of food safety personnel toward food safety policies and procedures for student-led food events. A Welch *F*-test was also conducted for cases with unequal variances between groups. Finally, a post hoc test (the Scheffe test) was conducted to determine differences within specific groups. A .05 level of significance was used for analysis.

Results and Discussion

Demographic Characteristics

A total of 231 web questionnaires were distributed to personnel responsible for overseeing student-led food events (e.g., environmental health and safety, and risk management directors) at CUs. Of the 86 returned questionnaires, 75 (32.5%) were usable. The number of female and male participants was 31 (45.6%) and 34 (50.0%), respectively (Table 1), and 3 participants (4.4%) answered "other." The majority of participants were 51–60 years of age and had a bachelor's (40.3%, *n* = 27) or graduate (56.7%, *n* = 38) degree. Of the participants, 35 (55.5%) had worked at their current institution for >5 years and 28 (44.5%) had done so for ≤5 years. Furthermore, 34 participants (52.3%) had worked in their current position for >5 years, while 31 (47.7%) had worked in their current position for ≤5 years. Although some participants (77.9%, *n* = 53) had received formal food safety training (i.e., certified food protection manager certification, National Environmental Health Association training, registered environmental health specialist certification, state department of health standardization, good manufacturing practice, hazard analysis critical control point, ServSafe), 15 (22.1%) were untrained in food safety.

Participants from 27 (40.3%) CUs indicated they did not know the number of student-led food events held, an apparent concern in terms of monitoring and ensuring food safety. Of the CUs, 12 (18.0%) had >500 registered student organizations, while 34 (50.7%) had ≤500 and 21 participants (31.3%) said they were unaware of the number of registered student organizations at their institution.

Food Safety Knowledge of Participants

Table 2 shows the food safety knowledge scores of personnel responsible for overseeing food safety at student-led food events (*n* = 74). The mean knowledge score was 9.25 ± 0.29 out of 10 possible points and the Cronbach's alpha coefficient of reliability was .79. As this value is greater than .70, it is considered reliable (Nunnally, 1978). Table 2 shows that participants were knowledgeable about the majority of questions, although they had difficulty in answering questions about potentially hazardous food (29.7%) and the food stand requirement of a hand-washing sink (23.0%).

Food Safety Policies and Procedures for Student-Led Food Events

Of the 75 participating CUs, 55 (73.3%) CUs allowed food to be prepared and/or served to the public during student-led food events, while 20 (26.7%) CUs disallowed this practice (Table 3). Among the 55 CUs that allowed such activities, 44 (80.0%) CUs required preapproval, while 11 CUs (20.0%) did not. Commonly required food safety policies were equated with the existence of preapproval food safety policies shown as different types of authorization required for student-led food events. The list of different types of event approval methods to serve food to the public is presented in Table 3.

Overall, 73.6% (*n* = 39) of participating CUs implemented food safety policies and procedures for student-led food events at the institutional level and 26.4% of the participating institutions indicated they did not have food safety policies and procedures, with half of these (13.2%, *n* = 7) stating that they were not aware of the existence of such policies and procedures.

TABLE **3**

Current Food Safety Policies and Procedures for Student-Led Food Events at Colleges and Universities (*N* = 75)

Policy/Procedure	#	%
Permission to prepare and/or serve food to the public during student-led food events		
Yes	55	73.3
No	20	26.7
Existence of preapproval to serve food to the public during student-led food events		
Yes	44	80.0
No	11	20.0
Type of approval to serve food to the public (select all that apply)		
Apply for a temporary food handling permit	29	38.7
Submit an event authorization form	29	38.7
Obtain prior approval to hold the event	31	41.3
Complete online food safety training	13	17.3
Provide evidence of food safety certificate	8	10.7
Other	9	12.0
Permission to serve catered food (e.g., pizza vendor) at student-led food events		
Yes	28	66.7
No	14	33.3
Existence of food safety policies and procedures for student-led food events at the institutional level		
Yes	39	73.6
No	7	13.2
I don't know	7	13.2
Existence of food safety policies and procedures for student-led food events at the unit/college/department level		
Yes	40	75.5
No	7	13.2
I don't know	6	11.3
Food safety policies and procedures in accordance with state food safety requirements		
Yes	42	79.2
No	4	7.5
I don't know	7	13.2

Note. Totals might not equal 100% due to unanswered questions.

TABLE **4**

Food Safety Inspections, Foodborne Illness Incidents, and Food Safety Training at Participating Colleges and Universities (*n* = 52)

Food Safety Inspection, Incident, and Training	#	%
Administration of food safety inspections for student-led food events		
Yes	9	17.3
Sometimes	30	57.7
No	13	25.0
In charge of food safety inspection		
Personnel internal to the institution	30	76.9
Personnel external to the institution	6	15.4
I don't know	3	7.7
The criteria for conducting the food safety inspections (select all that apply)		
Size of event	10	19.2
Type of food served (e.g., high risk foods such as meat, dairy, etc.)	28	53.8
Extent of food preparation	26	50.0
If packaged foods are being sold	12	23.1
If catered food is being sold	12	23.1
Audience served (e.g., children, pregnant woman, elderly, and/or immunocompromised)	10	19.2
Other	6	11.5
Reasons for not conducting food safety inspections		
Lack of staff	6	28.6
Lack of time	3	14.3
Lack of resources	2	9.5
Lack of knowledge	0	0
No departmental or university policy requiring food safety inspections	3	14.3
Other	7	33.3
Occurrence of foodborne illness incidents associated with student-led food events		
Yes	2	3.8
No	35	67.4
I don't know	15	28.8
Action steps for suspected foodborne illness associated with student-led food events		
No action required	5	10.7
Submit an incident report to the appropriate entity who addresses food safety at student-led events	15	31.9
Work with the appropriate entity to identify the cause of the foodborne illness	16	34.0
Sign an agreement document prior to the event that releases the institution from any legal liability in case a foodborne illness originates from the student-led food event	3	6.4
Other	8	17.0

continued on page 22

Food Safety Inspections and Incidences of Foodborne Illness

Of the 55 CUs that allowed food to be prepared and/or served to the public during student-led food events, 39 (75.0%) indicated that they had conducted food safety inspections during student-led food events (Table 4), while 13 (25.0%) participants indicated they had not. Among those CUs that conducted food safety inspections, 30 (76.9%) reported that most of the inspections were conducted by internal personnel, while 6 (15.4%) indicated that inspections are the responsibility of external personnel (e.g., state agency personnel). Table 4 presents the criteria for conducting food safety inspections at participating CUs.

Students in registered student organizations that conduct student-led food events receive food safety education either from an entity (61.5%, *n* = 32) or academic department (36.5%, *n* = 19) on campus, from units external to the campus (26.9%, *n* = 14), and/or from the USDA Cooperative Extension System (5.8%, *n* = 3). Table 4 presents the delivery methods for food safety training for the participants of student-led food events. A total of 34 (65.4%) participants indicated they had staff members who oversaw food safety, while 16 (30.8%) indicated otherwise.

Attitudes Toward Food Safety Policies and Procedures

The mean score for food safety personnel attitudes toward food safety policies and procedures was 3.78 ± 0.50 on a 5-point Likert-type scale, with a Cronbach's α of .72. In terms of food safety personnel attitudes, student food safety compliance for ensuring public health had the highest mean rating of 4.85 ± 0.41, while the frequency of student safe food handling practices after completion of food safety training had the lowest mean of 2.81 ± 1.12 (Table 5).

The items that participants strongly agreed upon included:

- Food safety inspection of student-led food events is important to avoid foodborne illness incidents (4.38 ± 0.73).
- I am confident in my knowledge of food safety and sanitation (4.27 ± 0.98).
- My institution does not have food safety and sanitation policies and procedures for student-led food events because no foodborne illness incidents have occurred at student-led food events in my college/university (4.23 ± 1.17).
- My department should regularly provide the latest food safety and sanitation information to student organizations (4.15 ± 1.03).

Demographic Differences in Attitudes

Despite the small numbers in each group, independent sample *t*-tests were conducted to determine differences in the attitude scores of food safety personnel with varying demographic characteristics such as sex, age, total number of years working in the current unit, total number of years at the same job, food safety training completion, administration of food safety inspections, student enrollment at the current institution, number of registered student organizations, and number of approved student-led food events during the 2016–2017 academic year. A one-way ANOVA and *t*-tests were conducted to identify differences in student attitudes in various census regions (U.S. Census Bureau, n.d.), with the results summarized in Table 6.

Even though a statistically significant difference was identified between attitude scores of personnel who received food safety training (3.80 ± 0.45) and those who did not (3.70 ± 0.70), the effect size of the two groups was low (i.e., Cohen's $d = .17$), reflecting that while the effect size for practical significance represented no practical importance with respect to participation in food safety training, participants who had received food safety training might have more positive attitudes towards food safety policies and procedures associated with student-led food events than those who had not. There was also no statistical difference or practical importance found between the attitudes of those who conducted food safety inspections and those who did not.

Another item of statistical significance was participant attitudes toward food safety policies and procedures that depended on the number of registered student organizations and approved student-led food events. Participants from institutions with >500 registered student organizations (4.01 ± 0.24) yielded higher mean attitude scores than those from institutions with ≤500 (3.73 ± 0.57, $p < .05$). In terms of practical importance, the effect size between the two groups was calculated as slightly higher (Cohen's $d = .70$) than the categories of small (<.41) and moderate (<.70). According to Rosenthal and coauthors (2000), when both *p*-value ($p < .05$) is significant and effect size is large enough (Cohen's $d \geq .70$), no inferential problem exists. Thereby, this finding indicates that participants at institutions that had >500 registered student organizations might have more positive attitudes toward food safety policies and procedures than those with ≤500.

TABLE **4** *continued from page 21*

Food Safety Inspections, Foodborne Illness Incidents, and Food Safety Training at Participating Colleges and Universities (*n* = 52)

Food Safety Inspection, Incident, and Training	#	%
Food safety education provider for students in student-led food events (select all that apply)		
U.S. Department of Agriculture (USDA) Cooperative Extension System	3	5.8
Other units on campus	32	61.5
Academic departments on campus (e.g., food science)	19	36.5
Entities external to the campus	14	26.9
I don't know	34	65.4
Presence of staff who oversee food safety at student-led food events		
Yes	34	65.4
No	16	30.8
I don't know	2	3.8
Availability of food safety training for the staff who oversee food safety		
Yes	37	71.2
No	10	19.2
I don't know	5	9.6
Delivery method for food safety training (select all that apply)		
Online/web-based training	11	21.2
Face-to-face training	22	42.3
Hybrid online/web-based training and face-to-face training	4	7.7
Other	3	5.8
Sources for obtaining or updating food safety information (select all that apply)		
Federal websites	21	40.4
State agency websites	18	34.6
Local agency websites	14	26.9
Newsletters from federal agencies	4	7.7
Newsletters from state agencies	5	9.6
Newsletters from local agencies	4	7.7
Webinars	10	19.2
Attendance at local/regional/national conferences	13	25.0
USDA Cooperative Extension System	3	5.8
Other	8	15.4

Conclusion and Recommendations

Absence of Widely Accepted Food Safety Policies and Procedures at Colleges and Universities

The food safety policies and procedures for student-led food events were categorized as to whether or not institutions allow food to be prepared and/or served to the public during student-led food events. Institutions that allow such activities reported implementing specific food safety policies and procedures to address food safety issues during student-led food events. For example, while registered student organizations could be required to obtain preapproval to serve food to the public, the preapproval process for student-led events varied among CUs. The absence of a widely accepted and used preapproval

TABLE **5**

Attitudes Toward Food Safety Policies and Procedures of College and University Personnel Overseeing Student-Led Food Events (n = 48, α = .72)

Attitude	Mean[a]	*SD*	# (%)				
			Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Student compliance with food safety policies and procedures at a student-led food event is important for public health	4.85	0.41	0 (0)	0 (0)	1 (2.1)	5 (10.4)	42 (87.5)
Food safety inspection of student-led food events is important to avoid foodborne illness incidents	4.38	0.73	0 (0)	1 (2.1)	4 (8.3)	19 (39.6)	24 (50.0)
I am confident in my knowledge of food safety and sanitation	4.27	0.98	1 (2.1)	3 (6.3)	3 (6.3)	16 (33.3)	25 (52.1)
My institution does not have food safety and sanitation policies and procedures for student-led food events because no foodborne illness incidents have occurred at these events in my college/university[b]	4.23	1.17	2 (4.2)	3 (6.3)	7 (14.6)	6 (12.5)	30 (62.5)
My department should regularly provide the latest food safety and sanitation information to student organizations	4.15	1.03	2 (4.2)	2 (4.2)	4 (8.3)	19 (39.6)	21 (43.8)
My department should provide food safety training to students involved in student-led food events	3.94	1.28	5 (10.4)	1 (2.1)	7 (14.6)	14 (29.2)	21 (43.8)
My unit should provide contact information to consumers to report a suspected foodborne illness that results from a student-led food event	3.92	1.20	1 (4.2)	5 (10.4)	9 (18.8)	11 (22.9)	21 (43.8)
When food is catered for student-led food events, the college/university is not responsible to ensure food safety dining[b]	3.90	1.28	1 (2.1)	10 (20.8)	5 (10.4)	9 (18.8)	23 (47.9)
Not all student-led food events need to comply with food safety policies and procedures[b]	3.73	1.43	4 (8.3)	10 (20.8)	2 (4.2)	11 (22.9)	21 (43.8)
It is not the responsibility of my institution if a foodborne illness incident results from an unauthorized student-led food event[b]	3.71	1.29	4 (8.3)	5 (10.4)	9 (18.8)	13 (27.1)	17 (35.4)
I would be interested in attending conferences to stay informed about current food safety and sanitation requirements	3.69	1.36	5 (10.4)	5 (10.4)	8 (16.7)	12 (25.0)	18 (37.5)
It is important to me that all students belonging to registered student organizations receive food safety training	3.67	1.28	5 (10.4)	4 (8.3)	7 (14.6)	18 (37.5)	14 (29.2)
It is not the responsibility of my unit if a foodborne illness or outbreak results from an unauthorized student-led food event[b]	3.54	1.37	5 (10.4)	7 (14.6)	9 (18.8)	11 (22.9)	16 (33.3)
All members of my staff are knowledgeable about food safety and sanitation	3.50	1.35	5 (10.4)	7 (14.6)	10 (20.8)	11 (22.9)	15 (31.3)
All members of my staff know how to address suspected foodborne illness incidents	3.29	1.43	9 (18.8)	4 (8.3)	11 (22.9)	12 (25.0)	12 (25.0)
There is a need for developing policies and procedures that address food safety and sanitation practices for student-led food events at my institution	3.25	1.49	9 (18.8)	7 (14.6)	9 (18.8)	9 (18.8)	14 (29.2)
There is a need for developing policies and procedures that address food safety and sanitation practices for student-led food events in my unit	3.25	1.34	7 (14.6)	5 (10.4)	17 (35.4)	7 (14.6)	12 (25.0)
Student groups that receive food safety training always follow safe food handling practices during student-led food events	2.81	1.12	5 (10.4)	18 (37.5)	8 (16.7)	15 (31.3)	2 (4.2)

[a]Scale: 1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; 5 = strongly agree.
[b]Item was reverse coded due to negatively worded items.

process creates a research gap in food safety policies and procedures at CUs.

Lack of Food Safety Policies Due to the Perceived Low Level of Foodborne Illness Occurrence

This study also found that some institutions have no food safety policies and procedures in place even though they allowed food to be prepared and/or served to the public at student-led food events. The results show that these participants did not sense a strong necessity to develop food safety policies and procedures for student-led events at their institutions. While the gravity of a lack of food safety policies and procedures might be overlooked because of a low level of foodborne illness occurrence associated with student-led food events at CUs, the food safety culture in student-led food events enables food safety personnel to flexibly conduct regular food safety inspections during events. Although some institutions conduct food safety inspections at these events, widely accepted criteria were not identified for food safety inspections during student-led food events. Some factors leading to the lack of food safety inspections were identified as a lack of food safety policies as well as a shortage of staff, time, and resources, indicating that some institutions do not have staff to oversee food safety at student-led food events.

Inadequate Food Safety Knowledge Among Participants

While most participants in the present study achieved high scores (>9.00 out of 10 possible points) in their food safety knowledge assessment, nearly one quarter of the participants provided incorrect answers to specific food safety items associated with outdoor food events. The lack of food safety policies and procedures might have caused some participants to be unfamiliar with knowledge items associated with food events. This knowledge gap indicates that food safety training for personnel overseeing food safety at student-led food events should be required for food safety knowledge, refinement, or update.

Insufficient or No Food Safety Inspections at Student-Led Food Events

The lack of food safety inspections (if any) at these events does not reveal whether safe food handling practices are being followed post-training. Unsafe food handling practices

TABLE **6**

Food Safety Personnel Attitude Scores Toward Food Safety Policies and Procedures by Demographic Characteristics (n = 68)

Characteristic	Mean Attitude Score (*SD*)	*t*-Value
Sex		
Male	3.66 (0.59)	1.65[a]
Female	3.90 (0.08)	
Age (years)		
≤40	3.90 (0.41)	1.96[a]
>40	3.59 (0.58)	
Number of years worked in current unit		
≤5	3.80 (0.56)	0.18
>5	3.77 (0.45)	
Number of years worked in current role		
≤5	3.75 (0.55)	0.43
>5	3.81 (0.44)	
Receiving food safety training		
Yes	3.80 (0.45)	0.42[a] Cohen's d = .17
No	3.70 (0.70)	
Conducting food safety inspections		
Yes	3.90 (0.49)	3.05
No	3.45 (0.36)	
College and university by U.S. Census Bureau region[b]		
Northeast	4.44 (0)	F-value = 1.98
Midwest	3.99 (0.34)	
South	3.58 (0.52)	
West	3.72 (0.52)	
Student enrollment		
≤25,000	3.78 (0.53)	0.03
>25,000	3.78 (0.49)	
Number of registered student organizations		
≤500	3.73 (0.57)	1.97[a] Cohen's d = .70[c]
>500	4.01 (0.24)	
Number of approved student-led food events (2016–2017 academic year)		
≤200	3.80 (0.58)	1.19[a] Cohen's d = .41
>200	3.97 (0.26)	

[a] $p < .05$.

[b] U.S. Census Bureau regions: Northwest = Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont; Midwest = Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin; South = Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia; West = Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming; Other = Guam, Micronesia, Northern Marianas, Puerto Rico, U.S. Virgin Islands.

[c] Acceptable level of effect size (Cohen's $d \geq .7$).

of college students have been observed in numerous studies (Abbot et al., 2009; Booth, Hernandez, Baker, Grajales, & Pribis, 2013; Byrd-Bredbenner et al., 2007; Egan et al., 2007), although these studies were not specific to student-led food events. Therefore, to enhance student food safety compliance, rigorous and widely accepted food safety policies and procedures should be implemented and monitored to ensure food safety.

Establishing Criteria for Food Safety Policies Based on the Extent of Events

Statistical and practical significance were identified in participant attitudes with respect to the number of registered student organizations. As such, considering the extent of the number of registered student organizations would be beneficial when constructing criteria for food safety policies and procedures for student-led food events. For example, food safety entities could construct a plan for conducting food safety inspections and training programs based on the number of registered student organizations. Future studies could also explore differences in food safety policies and procedures by institutions with different numbers of registered student organizations. A method of benchmarking food safety policies and procedures could also be developed to provide practical suggestions for institutions that do not implement food safety policies and procedures.

Limitations

This study was limited by the number of outdated e-mail addresses in the sample population. In the process of collecting the data, a number of e-mails bounced back due to outdated e-mail accounts listed on institution websites. Although this study used an updated contact list, whether or not the e-mails actually reached appropriate recipients is unclear. Lack of information about the existence of food safety policies and procedures might have also limited this study because small land-grant colleges did not clearly present either food safety policies or food safety entities on their website. Finally, the sample used in this study represented only CUs listed in the USDA NIFA (n.d.) and APLU (n.d.) publications. Future efforts should be made to broaden the scope of CUs (e.g., include private CUs) and to update contact information of food safety entities at institutions to ensure external validity.

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continued on page 26

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Did You Know?

Check out NEHA's food safety resources at www.neha.org/eh-topics/food-safety-0. The web page provides links and information to NEHA's food safety credentials; food manager, handler, and HACCP certifications; food safety trainings; and more. You can also find NEHA's updated cannabis food safety resources on this web page. The food safety products and materials NEHA offers can be used by someone just beginning a career in the food industry or by a professional with many years of experience.

GUEST COMMENTARY

Supporting Students and Young Professionals in Environmental and Occupational Health, Safety, Science, and Policy-Related Graduate Programs

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Abstract **This 2017–2019 project started with a systematic assessment of three independent environmental and occupational health-related doctoral (PhD) programs, which are sponsored by different agencies, institutes, and schools within Rutgers Biomedical and Health Sciences at Rutgers, The State University of New Jersey: Exposure Science, Toxicology, and Environmental Health. In addition, we examined other graduate and undergraduate environment-related schools, departments, divisions, and institutes with degree programs (majors and minors) and certificate programs at Rutgers. Then, we conducted a survey of students. Data collected can result in enhancements to connections between entities, with multiple potential benefits. For example, for Rutgers School of Public Health, data can inform efforts to increase student applications to both master's and doctoral programs, as well as increase faculty participation in teaching and student advising. The project should result in more qualified student applications from students in their final year of master's programs. Subsequently, acceptances into and matriculations from PhD programs should also increase. Overall, this approach should provide more continuity of scholarship at schools, institutes and/or other environmental programs at Rutgers. In summary, this project's data can help support positive yet complex relationships across engaged entities at Rutgers and inform other U.S. environmental health programs.**

Introduction

In 2003, following publication and release of Healthy People 2010 public health objectives, which included aspects of environmental health (EH), a revitalization strategy for essential EH services was published by the Centers for Disease Control and Prevention (CDC), National Center for Environmental Health, Division of Emergency and Environmental Health Services (CDC, 2003). This 10-part framework included support of research and enhanced workforce development (i.e., training and continuing education). In addition, the Uniformed Services environmental health officers receive guidance for their transition out of the military and into civilian careers (CDC, n.d.). These documents, and many others since then (Heidari, Chapple-McGruder, Whitehead, Castrucci, & Dyjack, 2019; Resnick, Zablotsky, & Burke, 2009), have noted substantial challenges facing the EH profession. These challenges include recruitment and retention, including high turnover and movement between agencies or from public agencies to the private sector because of higher salaries.

In addition, there are many older practitioners retiring or approaching traditional retirement age. At the same time, jobs available in EH for specialists, sanitarians, and scientists (including various types of technicians) are predicted to grow about 11% between 2016 and 2026, which is faster than the national average across industries and sectors (U.S. Department of Labor, 2019). In other words, challenges and opportunities exist.

U.S. federal agencies, national laboratories, and research institutes provide funded opportunities for individuals with recently completed undergraduate, graduate, and doctoral-level degrees in environmental public health (PH) sciences as well as environmental engineering and related policy studies (CDC, 2019; Food and Drug Administration, 2018; USAJobs, 2019; U.S. Environmental Protection Agency, 2016; U.S. Department of the Interior, n.d.; U.S. Geological Survey, n.d.). Furthermore, U.S. federal agencies, some national-level nonprofit organizations, and research institutes provide information on EH careers and various scholarship opportunities for varying amounts of annual or one-time funding. Students can be in undergraduate and graduate programs involving EH and PH sciences, engineering, technology, statistics, and/or policy (Association of Environmental Health Academic Programs, n.d.; National Environmental Health Association, 2020a, 2020b; National Environmental Health Science and Protection Accreditation Council, 2019; National Science Foundation, n.d.; U.S. Department of Energy, Oak Ridge Institute for Science and Education, 2015, n.d.).

In summary, these EH workforce realities bring renewed attention to the need for engaging young people at the end of high school or early in their undergraduate careers in EH, as well as generally in PH and related allied health careers through their sciences, math, or statistics courses (Shendell, Gourdine, & Yuan, 2017). Students and young professionals need to know there are substantial entry-level employment opportunities with promotion potential in the science, technology, engineering, and mathematics (STEM) fields beyond traditional career pathways such as the health professions and laboratory-based research for EH professionals (Ahonen & Lacey, 2017; Resnick et al., 2009). Also, students and young professionals need to know environmental education and training for EH work, including in interpersonal soft skills, are related but separate (Knechtges & Kelly, 2015; Thomas, 2003).

Furthermore, there are employment opportunities in EH for students and young professionals who have earned a bachelor's degree and a certification in an area such as food safety/food sciences, industrial hygiene/worker safety, general EH, and emergency preparedness and response (Marion, Murphy, & Zimeri, 2017). Moreover, STEM and EH employments need more representation by students and young professionals from racial and ethnic minority groups, who have perceived barriers to EH and have been discouraged by perceived or relatively lower EH job salaries (Haynes & Jacobson, 2015; Quimby, Seyala, & Wolfson, 2007). Overall, EH needs improved marketing toward and visibility among students and young professionals in U.S. universities and colleges in support of urban, suburban, and rural EH. These modern communications efforts must be online for mobile-friendly platforms.

This commentary shares the key lessons learned from an EH project conducted as part of requirements of the lead author for the Rutgers Leadership Academy (RLA) 2017–2019 cohort. Data from anonymously surveyed undergraduate and graduate students in the 2018–2019 academic year can inform public and private universities and colleges with students in STEM and EH.

Methods

Initially, in winter to summer 2018, contents of Rutgers websites, informational brochures, and fact sheets produced were examined and summarized to better understand the breadth, depth, and geographic scope (across Rutgers campuses and across NJ) of the various schools, departments, and institutes with EH, science, engineering, policy, or sustainability programs (majors, minors, and/or certificates or continuing education courses) available at Rutgers. Students in PH (master's and certificate programs) are eligible to take courses throughout Rutgers (see supplemental figure at www.neha.org/jeh/supplemental).

In spring–summer 2018, an online, 12-question survey with single answer or "choose all that apply" responses was developed with input from Rutgers faculty and staff, a beta-tester (federal work study student), and a pilot tester (Master of Public Health core course assistant from 2017–2018) (Table 1). This survey was conducted anonymously in late November to late January 2018–2019 using PsychData. This project was exempt from institutional review board/human subjects approval because the survey was conducted as part of normal educational classroom-type assessment activities and practices.

Participation was voluntary and was done with consent without written documentation because it was an online activity. Students were invited via their Rutgers student e-mail address to complete the survey as part of an extra credit opportunity: for 5 points in a 1,000-point course with 10 bonus points per semester for the EH required core course at Rutgers School of Public Health (SPH). A screenshot of the final screen or automated e-mail sent to a student's Rutgers account (other part of bonus opportunity led by another part of Rutgers SPH) proved completion.

Results and Discussion

In December 2018 and late January 2019, 73/73 (100%) and 31/53 (58%), respectively, or 104/126 (83%) total Master of Public Health students and 12/40 (30%) undergraduate sustainability minor students completed the survey. Two undergraduate students were excluded because they did not finish the survey. The initial goal was survey completion in <10 min. The actual mean completion time for 116 students was about 6 min (364 s). Table 2 presents key results from the online survey conducted late fall 2018 to early winter 2019, including the sample population of responding students.

The key findings to inform recommendations from the RLA project to Rutgers administration regarding online/web-based promotion of EH and PH to students are:

- The majority of students (66%) wanted a new website and 49% stated this new website, as one website or a set of pages hosted by the Rutgers School of Graduate Studies or a Rutgers Institute, could be titled "Rutgers and Our Environment."
- Most participants (92%) stated faculty and professional staff should have their own focused web page and reported feeling similarly about undergraduate students and master's students (versus approximately 90% for PhD students and 81% for postdoctoral research fellows).
- For potential layout of matrixed web page design (slightly preferred over bullet points), which was proposed as 2–3 rows and 2–3 columns of cells where each cell would have an identifying word or phrase and visual/photo to be clicked on to lead to a page listing information and student/team profiles (see examples at www.njsafeschools.org currently hosted by Rutgers SPH), no option presented had a majority vote. Some participants provided text comments. The top three, with approximately 30% of students liking each of these orders, had EH/PH as first:
  - Human Health, Ecological Health, Safety, Sustainability
  - Human Health, Safety, Ecological Health, Sustainability
  - Human Health, Safety, Sustainability, Ecological Health
- For the potential options for a relative ranking for links to subpages, no option had a majority vote, but one was liked by 32%: undergraduate students, graduate (master's) students, doctoral students; faculty, staff, postdoctoral fellows.

TABLE **1**

Student Survey Questions and Response Options

Question Number	Response Options Provided
Question 1	
Do you think one Rutgers-hosted website unifying the various environmental and occupational health, safety, science, and policy-related programs here at Rutgers University–New Brunswick, including Rutgers Biomedical and Health Sciences (RBHS) schools, is a good idea?	• Yes • No • I would consider it after receiving more information • I do not know
Question 2	
For such a website unifying the various environmental and occupational health, safety, science, and policy-related programs here at Rutgers University–New Brunswick, including RBHS schools, which potential titles do you like?	• Rutgers and the Environment • Rutgers and Our Environment • Rutgers and Study of the Environment • Studying the Environment at Rutgers • Studying Impacts on the Environment at Rutgers • Studying Impacts on Our Environment at Rutgers
Questions 3–7	
Do you think separate pages on faculty/staff members (3), undergraduate students (4), master's level graduate students (5), doctoral students (6), and postdoctoral students (7) on the proposed website is a good idea?	• Yes • No • I would consider it after receiving more information • I do not know
Question 8	
For such a website unifying the various environmental and occupational health, safety, science, and policy-related programs here at Rutgers University–New Brunswick, including RBHS schools, the aforementioned stakeholder-level pages could each be organized into categories (as a bulleted list or a 2 x 2 matrix) of the primary areas of research and/or practice of the individuals. Which option(s) do you prefer?	• Human health, ecological health, safety, sustainability • Ecological health, sustainability, human health, safety • Human health, safety, ecological health, sustainability • Human health, safety, sustainability, ecological health • Sustainability, ecological health, human health, safety • Ecological health, sustainability, human health, safety
Question 9	
In your opinion, who should be the points of contact (e-mail and/or phone) present on the proposed website pages? Please note: Some Rutgers schools, departments/units, and programs may list contact information for prospective student applicants and/or currently enrolled students on a separate page or at the bottom of their main website.	• Administrative manager/assistants • Chair/director/program manager • Vice-chair/associate or assistant director • I believe each individual listed should also have his/her/their Rutgers e-mail address listed
Question 10	
For the proposed website's home page/primary page organization to secondary pages (category-level) and tertiary (individual-level) pages, would you prefer a modern matrix design (think two rows with three columns) or a bulleted list of the various groups previously noted?	• Matrix design • Bulleted list • Either design would be fine/I have no strong preference • I do not know
Question 11 and 12 (per question 10)	
Since you prefer the modern matrix design, which of these options do you most prefer (11)/least prefer (12)? At present, for illustrative purposes, each of the six potential stakeholder groups are included in this question's answer options. Note, the options below have two rows, separated by a semicolon, and within each row one would read from left-to-right across the screen on any mobile-friendly device (smartphone, tablet, laptop, desktop computer).	• Undergraduate students, graduate (master's) students, doctoral students; faculty, staff, postdoctoral fellows • Graduate (master's) students, doctoral students, undergraduate students; faculty, staff, postdoctoral fellows • Doctoral students, graduate (master's) students, undergraduate students; faculty, staff, postdoctoral fellows • Undergraduate students, graduate (master's) students, doctoral students; faculty, postdoctoral fellows, staff • Graduate (master's) students, doctoral students, undergraduate students; faculty, postdoctoral fellows, staff • Doctoral students, graduate (master's) students, undergraduate students; faculty, postdoctoral fellows, staff • Any of the options are fine/I do not have a preference • I do not know

Note. Survey participants had choice of "other" with a free text response for questions 2, 8, and 9.

TABLE **2**

Student Survey Results

Question	Master of Public Health (MPH) and Undergraduate Student Response (*n* = 114)		Undergraduate Student Response (*n* = 10)	
	#	%	#	%
Question 1	114	100	10	100
Yes	75	65.8	5	50.0
No	2	1.8	0	0
I would consider it after receiving more information	35	30.7	4	40.0
I do not know	2	1.8	1	10.0
Question 2[a]	114	100	10	100
Rutgers and the Environment	25	21.9	3	30.0
Rutgers and Our Environment	56	49.1	5	50.0
Rutgers and Study of the Environment	10	8.8	0	0
Studying the Environment at Rutgers	12	10.5	1	10.0
Studying Impacts on the Environment at Rutgers	19	16.7	1	10.0
Studying Impacts on Our Environment at Rutgers	18	15.8	3	30.0
Other	10	8.8	2	20.0
Question 3	112	98.2	9	90.0
Yes	103	90.4	8	80.0
No	1	0.9	0	0
I would consider it after receiving more information	4	3.5	0	0
I do not know	4	3.5	1	10.0
Question 4	112	98.2	9	90.0
Yes	103	90.4	8	80.0
No	3	2.6	0	0
I would consider it after receiving more information	6	5.3	1	10.0
Question 5	112	98.2	9	90.0
Yes	104	91.2	6	60.0
No	3	2.6	1	10.0
I would consider it after receiving more information	5	4.4	2	20.0
Question 6[b]	112	98.2	9	90.0
Yes	100	87.7	6	60.0
No	2	1.8	1	10.0
I would consider it after receiving more information	9	7.9	2	20.0
Question 7	112	98.2	9	90.0
Yes	93	81.6	6	60.0
No	5	4.4	1	10.0
I would consider it after receiving more information	11	9.6	1	10.0
I do not know	3	2.6	1	10.0

continued on page 32

TABLE **2** *continued from page 31*

Student Survey Results

Question	Master of Public Health (MPH) and Undergraduate Student Response (n = 114)		Undergraduate Student Response (n = 10)	
Question 8[ac]	112	98.2	9	90.0
Human health, ecological health, safety, sustainability	31	27.2	9	90.0
Ecological health, sustainability, human health, safety	9	7.9	1	10.0
Human health, safety, ecological health, sustainability	37	32.5	2	20.0
Human health, safety, sustainability, ecological health	34	29.8	1	10.0
Sustainability, ecological health, human health, safety	20	17.5	6	60.0
Ecological health, sustainability, human health, safety	13	11.4	3	30.0
Question 10	112	98.2	9	90.0
Matrix design	30	26.3	2	20.0
Bulleted list	33	28.9	2	20.0
Either design would be fine/I have no strong preference	41	36	4	40.0
I do not know	8	7	1	10.0
Question 11	71	62.3	6	60.0
Undergraduate students, graduate (master's) students, doctoral students; faculty, staff, postdoctoral fellows	36	31.6	3	30.0
Graduate (master's) students, doctoral students, undergraduate students; faculty, staff, postdoctoral fellows	2	1.8	0	0
Doctoral students, graduate (master's) students, undergraduate students; faculty, staff, postdoctoral fellows	3	2.6	0	0
Undergraduate students, graduate (master's) students, doctoral students; faculty, postdoctoral fellows, staff	14	12.3	2	20.0
Graduate (master's) students, doctoral students, undergraduate students; faculty, postdoctoral fellows, staff	2	1.8	0	0
Doctoral students, graduate (master's) students, undergraduate students; faculty, postdoctoral fellows, staff	1	0.9	0	0
Any of the options are fine/I do not have a preference	11	9.6	0	0
I do not know	2	1.8	1	10.0

Note. Mean time elapsed/students active in survey was 364 s.
[a]Multiple responses could be selected.
[b]One MPH student (0.9%) selected the "I do not know" response.
[c]Three MPH students (2.7%) selected the "other" response.

In summary, this project highlighted the complex relationships across entities engaged in EH. Furthermore, data on current student thinking can inform other EH programs in the U.S.

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Did You Know?

NEHA has gathered resources to help students through their college years and in the transition into the workforce. Visit www.neha.org/students to find information on NEHA memberships tailored to students and emerging professionals, internships, scholarships, and employment opportunities.

BUILDING CAPACITY

Darryl Booth, MBA

Experimenting With Artificial Intelligence to Build Capacity

Editor's Note: **A need exists within environmental health agencies to increase their capacity to perform in an environment of diminishing resources. With limited resources and increasing demands, we need to seek new approaches to the business of environmental health. Acutely aware of these challenges, NEHA has initiated a partnership with Accela called Building Capacity—a joint effort to educate, reinforce, and build upon successes within the profession using technology to improve efficiency and extend the impact of environmental health agencies.**

The *Journal* is pleased to publish this column from Accela that will provide readers with insight into the Building Capacity initiative, as well as be a conduit for fostering the capacity building of environmental health agencies across the country. The conclusions of this column are those of the author(s) and do not necessarily represent the views of NEHA.

Darryl Booth is the general manager of environmental health at Accela and has been monitoring regulatory and data tracking needs of agencies across the U.S. for almost 20 years. He serves as technical advisor to NEHA's informatics and technology section.

Google Maps rapidly recommends the fastest route, considering vast amounts of crowd-sourced traffic data. Facebook automatically suggests the names of friends in uploaded photos and proposes you "tag" them, thereby validating its assumptions and improving future results. Mobile phones and personal voice assistants rely on voice-to-text, filtering through background noises, languages, and accents. These are commonplace examples of machine learning and artificial intelligence (AI). Many other impactful stories emerge when applied to medicine (e.g., imaging and diagnosis), business transactions, complex climate models, autonomous vehicles, and more. The rapid growth is fueled by low-cost, large-scale computing power and ubiquitous connectivity. Yet, beyond the benefits we receive as consumers, what additional factors should we pursue as environmental health professionals and data managers?

Artificial Intelligence

The term AI covers a long list of disciplines that make machines smarter (or make machines *seem* smarter). AI incorporates concepts such as machine learning, deep learning, natural language processing, image processing, and automated speech recognition. It takes a data scientist to understand it all but we can learn.

Many AI applications begin by training the system to observe previous experiences, either in real time or by mining historical data. Consider how a game of chess can be broken-down into elemental first, second, and third moves. Moves and countermoves alter the outcome likelihoods and by observing many outcomes (i.e., wins and losses), the system draws conclusions about how those elemental decisions impacted the outcomes. The accumulation of data can be packaged and presented as intelligence and helps inform what chess moves are likely to result in a win.

While Google, Amazon Web Services, and others provide AI platforms on a low-cost or pay-as-you-go basis in the cloud, for our purposes in this column, we will experiment with the Microsoft Azure AI Platform and follow a simple tutorial to understand how machine learning could apply to environmental health.

Considering Our Data

To look at hand washing and find patterns spanning many years of routine inspections, we are invited to select features surrounding each observation (Figure 1). So, for each IN and OUT occurrence, what might help predict future violations? Inspection/violation history, facility type, type of ownership, and food handler certifications are examples.

Create a Model

The model is trained by classifying our data in the hope that it can accurately predict

FIGURE **1**

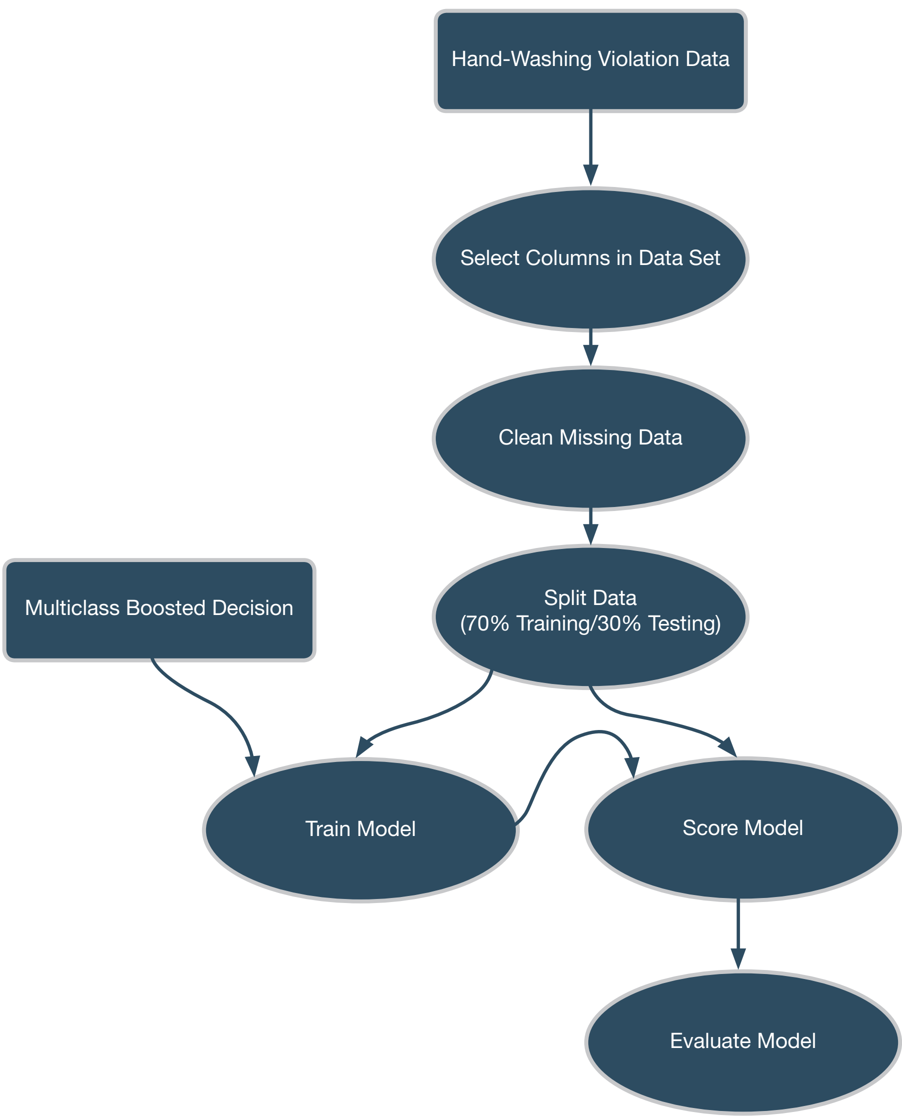
Example of a Hand-Washing Data Set

	A	B	C	D	E	F	G	H
1	Handwashing Observation	Assessed Risk	Facility Type	Ownership Type	Food Handler Cert	Prior Violation	Years in Related Business	Complaints
2	IN	Medium	Limited Prep	Corporate	Yes	No	12	No
3	IN	Medium	Full Service	Corporate	Yes	Yes	5	No
4	OUT	Medium	Full Service	Partnership	Yes	Yes	6	No
5	OUT	Medium	Full Service	Partnership	Yes	Yes	6	No

Note. Column A indicates an observed historical inspection result. Columns B–H are features intended to try to train a model.

FIGURE **2**

Artificial Intelligence Model



future outcomes. We've collected hundreds of thousands of observations related to hand washing. Can the model reliably predict future hand-washing issues using the features we selected?

Upon creating my free account and following a basic tutorial, I selected a feature that checks multiple machine learning methods. Since I don't know the method that fits our problem best, I let the system run them all—we'll see which is best.

Train and Test

I clicked "Run" to train the system. It took several minutes to run, train, and test the model (Figure 2). During this phase, the system consumed my data, split the streams, performed classification analyses, and tested the model.

I found the split data concept to be the most interesting. I learned that a common practice is to divide your data, retain a portion to train the model, and use the remaining to test the results. If the predictive model matches the test data, we gain confidence in our model. We used 70% of our data to train the model and 30% of our data to test the model.

When the process finished, I reviewed the results, which were a statistical analysis of our data and a score. The results and graphs indicated the degree to which our training data conclusions matched our sample data. With the portion of the data we fed into the system for training, could we predict outcomes in the sample of data we set aside for testing? If not, something went wrong and the model should be revised and rerun.

A primary learning point is that training models are an iterative process. A project might have many models and many experiments. After the model is selected, it should be refreshed and retrained over time.

Deploy and Utilize

Once satisfied that our model is valid, the model can be packaged and published in the cloud. A published model can be accessed in real time by other software systems such as websites or your own inspection system. So, in the same fashion an investor pulls up a stock price on the Internet or a family member pulls up weather forecasts, our simple model could be used to lookup (or predict) a routine inspection violation profile.

What would it mean to health department resourcing to predict likely violations as an understanding of facility risk? How would this information impact inspection frequencies, fees, and staffing?

Bias in the Model

It is easy to inject inappropriate biases into our models. Take a moment to be thoughtful about the features of the data set in the training exercise. To imply a gender, race, or economic standing into the model might be incorrectly emphasized or amplify related biases over time.

Conclusion and Next Steps

The model described above is simple and intended to be only thought-provoking. The computing resources and tutorials to repeat the basic example above are freely available to enthusiasts like me. That's a welcome democratization of cloud computing power.

A more meaningful and valid exploration of the capabilities should be executed by food safety experts and data scientists, pursing a consensus model that is sufficiently valid as to impact our day-to-day practices. A quick search of scholarly papers shows many promising projects and results published by highly qualified experts.

Resource

Microsoft Azure Artificial Intelligence Tutorial: https://docs.microsoft.com/en-us/azure/machine-learning/tutorial-designer-automobile-price-train-score

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Did You Know?

The 25th anniversary of National Public Health Week will be celebrated on April 6–12. Each day of the week will focus on a single public health topic—mental health, maternal and child health, violence prevention, environmental health, education, healthy housing, and economics. Learn more at www.nphw.org.

DIRECT FROM CDC ENVIRONMENTAL HEALTH SERVICES

Report Summary: The Role of Local Environmental Health Departments in Tick-Related Activities and Services

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

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

Kayleigh Hall is an Oak Ridge Institute for Science and Education (ORISE) fellow in the National Center for Environmental Health. Dr. Chelsea Gridley-Smith is a director of environmental health at the National Association of County and City Health Officials (NACCHO). Amy Chang is a senior program analyst at NACCHO. Dr. Amy Ullmann is a public health advisor in CDC's Division of Vector-Borne Diseases.

Cases of tickborne disease have more than doubled in the past 13 years and represent three quarters of all reported vectorborne disease cases in the U.S. Lyme disease alone accounted for over 80% of reported tickborne diseases (Rosenberg et al., 2018). Certain regions of the U.S. have been more greatly impacted than others. For example, reported cases of spotted fever rickettsiosis increased dramatically from 2016–2017, with New England, East North Central, and Middle Atlantic regions reporting a 215%, 78%, and 65% increase in cases, respectively. Similarly, reported cases of anaplasmosis increased by 39% (Heitman et al., 2019). Furthermore, tickborne diseases are emerging, including *Borrelia miyamotoi* disease, Bourbon virus disease, and Heartland virus disease (Rosenberg et al., 2018). Causing further alarm, the number of counties in the northeastern U.S. at high risk for Lyme disease has increased by more than 320% since the late 1990s (Kugeler. Farley, Forrester, & Mead, 2015).

The steadily increasing numbers of reported tickborne diseases in the U.S. have become a vexing public health issue, placing strain on state and local health departments (Rosenberg et al., 2018). Slightly more than half of all local health departments (LHDs) provide vector control services and a recent survey of the environmental health (EH) workforce shows that 38% of EH professionals reported working in vector control (Gerding et al., 2019; National Association of County and City Health Officials [NACCHO], 2016). In addition, a web-based review of vector control programs suggested that 39% of programs offering tick services were LHD EH vector control programs (Ruiz, Vanover, Parale, & Gerding, 2018).

While many LHDs perform vector surveillance and control activities, the number and types of tick-related activities performed is poorly understood. To this end, the Centers for Disease Control and Prevention (CDC) and the National Association of County and City Health Officials (NACCHO) partnered on an effort to gain a better understanding of current LHD EH department tick-related activities and services offered and their needs for strengthening and enhancing those services. From March to May 2019, key informant interviews were conducted with eight local EH departments and one tribal EH department (Figure 1) with varying geographic locations, population size served, population densities, and levels of sophistication of tick and vector control services and activities (NACCHO, 2019). The key informant interviews sought to identify the level of involvement of EH professionals in various tick activities, including their practices and resources they use, as well as their technical assistance and resource needs.

Among EH departments interviewed, EH professionals were commonly involved in passive tick surveillance and community education and outreach but they were less likely to be involved in tick control and management (Figure 2). EH professionals utilized resources from CDC's website, state health departments, and local universities to answer tick-related questions and they found it useful to partners both internally and externally for tick-related activities. Partner-

FIGURE **1**

Map of the Nine Key Informant Interview Participants

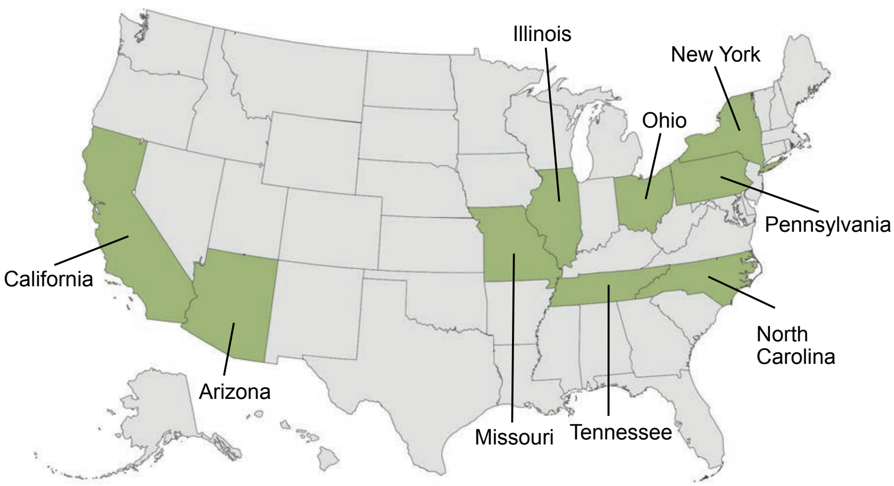
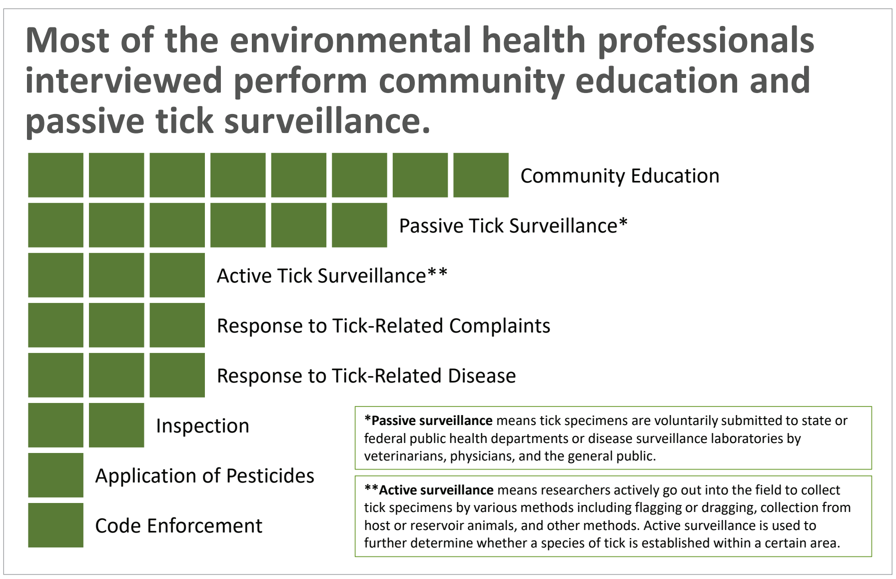


FIGURE **2**

Tick-Related Activities Performed by Key Informant Interview Participant



Source: The Role of Local Environmental Health Departments in Tick-Related Activities and Services (National Association of County and City Health Officials, 2019).

Example of a Challenge and Success in Securing Funding for Tick-Related Activities

Challenge: One respondent hoped to focus on tick-related activities after being hired full-time in their department's vector program but has been too overwhelmed with mosquito and rat issues.

Success: One respondent reported working with their state department of environmental protection to conduct active surveillance on select sites in their jurisdiction. They have also been successful in securing limited funding to post signs with Lyme disease education and warnings in community parks.

ships were leveraged for increased capacity to conduct tick-related activities such as public outreach, surveillance, control, and management. Additionally, EH professionals were aware of current and emerging tick issues in their jurisdiction and cited Lyme disease as a top concern. In contrast, some respondents cited that the public, upper-level management, including boards of health, and medical professionals were unaware that ticks are an issue in their communities.

EH professionals reported challenges that include a lack of direct funding and inadequate staffing for tick-related activities (see sidebar). While EH professionals face barriers to conducting tick-related activities, the respondents highlighted a few key opportunities for strengthening capacity or enhancing efforts:

- Conducting routine tick surveillance, even on a small scale, to establish baselines and provide insight into trends.
- Using a community health improvement plan to identify ticks as a priority for their communities and help justify resources for tick-related activities.
- Engaging constituents in the development of tick-related policy can provide understanding into community concerns and priorities.

The key informant interviews and subsequent report provide insight into the role of EH departments in tick activities and services, as well as the challenges they face. As tickborne diseases continue to grow and threaten the public's health, communities might look to their local EH departments to provide resources and solutions. EH professionals should seek opportunities to strengthen tick-related services in order to meet the needs of their communities and protect public health.

EH professionals are encouraged to use available resources to enhance their knowledge of vectors, especially ticks, as well as strengthen their vector control programs. CDC and partners including NACCHO continue to support EH programs and professionals through the development of vector control tools and resources. Vector control resources for EH professionals can be found at www.cdc.gov/nceh/ehs/activities/vector-control.html. Information on ticks and tickborne diseases can be found at www.cdc.gov/ticks. More information about the interview results and recommendations presented in this column can be found within the full report available at www.naccho.org/uploads/downloadable-resources/Local_EH_Department_Tick_Activities_Final.pdf.

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Did You Know?

A new article highlighting findings from the Understanding the Needs, Challenges, Opportunities, Vision, and Emerging Roles in Environmental Health (UNCOVER EH) initiative was recently published in the *American Journal of Public Health*. UNCOVER EH seeks to assess and improve the profession and practice of environmental health. Find the new article—as well as other published articles and resources—at www.neha.org/uncover-eh.

EH CALENDAR

UPCOMING NATIONAL ENVIRONMENTAL HEALTH ASSOCIATION (NEHA) CONFERENCES

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

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

NEHA AFFILIATE AND REGIONAL LISTINGS

Colorado
September 15–18, 2020: Annual Education Conference, Colorado Environmental Health Association, Pueblo, CO, www.cehaweb.com

Florida
August 2–8, 2020: 72nd Annual Education Meeting, Florida Environmental Health Association, Jensen Beach, FL, www.feha.org/2020AEM

Georgia
May 27–29, 2020: Annual Education Conference, Georgia Environmental Health Association, Lake Lanier Islands, GA, www.geha-online.org

Illinois
November 2–3, 2020: Annual Educational Conference, Illinois Environmental Health Association, Utica, IL, http://iehaonline.org

Indiana
April 16, 2020: Spring Conference, Nashville, IN

September 21–23, 2020: 70th Annual Fall Educational Conference, Lawrenceburg, IN

Indiana Environmental Health Association, www.iehaind.org/Conference

Iowa
October 14–15, 2020: Fall Conference, Iowa Environmental Health Association, Des Moines, IA, www.ieha.net/FallConference2020

Jamaica
October 25–30, 2020: One Health, One Global Environment Conference, Jamaica Association of Public Health Inspectors and the Americas Region of the International Federation of Environmental Health, Montego Bay, Jamaica, www.onehealthconference.com

Minnesota
May 14–15, 2020: Spring Conference, Minnesota Environmental Health Association, Walker, MN, www.mehaonline.org

Missouri
April 7–10, 2020: Annual Education Conference, Missouri Environmental Health Association, Springfield, MO, https://mehamo.org

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

Ohio
April 16–17, 2020: 74th Annual Educational Conference, Ohio Environmental Health Association, Dublin, OH, www.ohioeha.org

Oregon
March 31–April 2, 2020: Annual Education Conference, Oregon Environmental Health Association, Bend, OR, www.oregoneha.org/aec.htm

Texas
October 26–30, 2020: 65th Annual Education Conference, Texas Environmental Health Association, Austin, TX, www.myteha.org

Utah
May 6–8, 2020: Spring Conference, Utah Environmental Health Association, Kanab, UT, www.ueha.org/events.html

Virginia
April 24, 2020: Spring Onsite Workshop/Field Day, Virginia Environmental Health Association, Charlottesville, VA, https://veha32.wildapricot.org

Washington
April 27–29, 2020: 68th Annual Educational Conference, Washington State Environmental Health Association, Tacoma, WA, www.wseha.org/2020-aec

Wisconsin
September 23–25, 2020: Educational Conference, Wisconsin Environmental Health Association, Eau Claire, WI, https://weha.net

TOPICAL LISTINGS

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

Water Quality
August 19–21, 2020: *Legionella* Conference 2020, NSF Health Sciences and NEHA, Chicago, IL, www.legionellaconference.org

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 NEHA's online Bookstore for additional information about these and many other pertinent resources!

NEHA BOOKSTORE
www.neha.org/store

Certified Professional–Food Safety Manual (3rd Edition)

National Environmental Health Association (2014)

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

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

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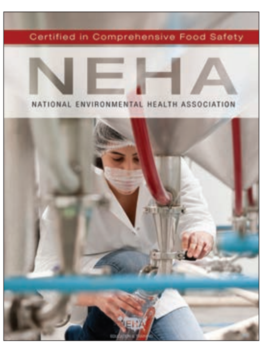
National Environmental Health Association (2014)

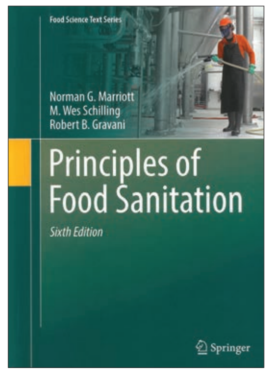


The Food Safety Modernization Act has recast the food safety landscape, including the role of the food safety professional. To position this field for the future, NEHA is proud to offer the Certified in Comprehensive Food Safety (CCFS) credential. CCFS is a mid-level credential for food safety professionals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

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

Principles of Food Sanitation (6th Edition)

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

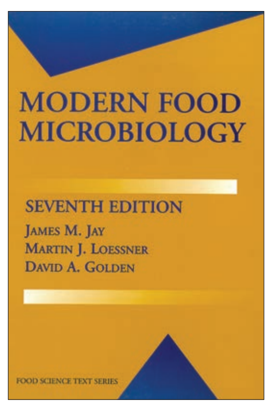


Now in its 6th edition, this highly acclaimed textbook provides sanitation information needed to ensure hygienic practices and safe food for food industry professionals and students. It addresses the principles related to contamination, cleaning compounds, sanitizers, and cleaning equipment. It also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

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

Modern Food Microbiology (7th Edition)

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



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

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

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Sunday, July 12

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National Environmental Health Association

NEHA NEWS

NEHA Celebrates the 50th Anniversary of Earth Day

By Maddie Gustafson (mgustafson@neha.org) and Kaylan Celestin (kcelestin@neha.org)

The National Environmental Health Association (NEHA) is excited to participate in the celebration of the 50th anniversary of Earth Day. On April 22, 1970, 20 million Americans took to the streets to support a healthy and sustainable environment in massive coast-to-coast rallies. 1970 was a pivotal year in environmental health as the U.S. Environmental Protection Agency was established, as well as the Clean Air and Clean Water Acts.

To celebrate this monumental anniversary, NEHA has partnered with community-based organizations to provide resources, activities, and opportunities to actively participate in Earth Day! In honor of the 50th anniversary of Earth Day, NEHA will coordinate a volunteer event to benefit the local community for all staff to participate in. We will also offer an association-wide telework day in support of reducing carbon emissions and conduct a survey with all staff members to determine our reduction in carbon emissions on Earth Day (see our NEHA News piece about the universal telework day for the 2019 World Environmental Health Day in the March 2020 *Journal of Environmental Health* at www.neha.org/publications/journal-environmental-health/jeh-issue-march-2020).

In addition to our association efforts, we wanted to come together to provide interactive events, resources, and leadership for the environmental health community through a Twitter chat, Earth Day 2020 web page, and toolkit of our Earth Day partners and activities.

2020 Beacon for NEHA Membership Campaign

By Jonna Ashley (jashley@neha.org)

NEHA is pleased to announce the launch of our second annual membership recruitment campaign. The 2020 Be a Beacon for NEHA Membership campaign builds upon the momentum of the 2019 campaign, which brought over 100 new members to the association. We are again asking members to reach into their professional networks to activate new members to join NEHA. In order to be the strongest voice on environmental health, we must have a robust and engaged membership base. By prioritizing individual membership, we prioritize the profession of environmental health.

The Beacon of NEHA lighthouse symbol is inspired by NEHA's original 1930s logo and represents that our members are a guiding light for the environmental health professional. NEHA will send every eligible person who successfully recruits a new member a stylish tote bag with this meaningful symbol, as well as recognize them on NEHA's website. The campaign will end on June 15. The top three recruiters will receive a ticket for themselves and one guest to the UL Event at the NEHA 2020 Annual Educational Conference & Exhibition in New York City (www.neha.org/aec). You can learn more about the campaign, including full details on how it works and recruitment tips, at www.neha.org/nehabeacon.

NEHA 2020 Membership Survey

By Jonna Ashley (jashley@neha.org)

Over the past 2 years, NEHA has enjoyed tremendous membership growth. To better understand the motivations and needs of these new members, NEHA conducted a survey of 3,600 members who joined or rejoined after a lapse in their membership between 2018 and 2019.

Survey results indicate the primary reason that members joined in the past 2 years was to pursue or maintain their environmental health credentials at both the national and state level (Table 1). Overwhelmingly, members conveyed that they find value in NEHA's online learning courses but would like to see improvements in both content and ease of access to these resources. Of the respondents, 60% cited NEHA's E-Learning as the benefit they would most like to see improved and expanded upon moving forward.

TABLE **1**

National Environmental Health Association (NEHA) Membership Survey Participant Answers to "Why Did You Join NEHA?" (*N* = 539)

Answer Choice	#	%
I need membership for discounts and resources related to my credential.	173	32.1
My employer or colleague recommended association membership to me.	91	16.9
For access to educational resources including E-Learning and the *Journal of Environmental Health*.	84	15.6
To stay up-to-date on news, events, and opportunities in the environmental health field.	63	11.7
To enhance my network and connect with other environmental health professionals around the country.	62	11.5
I attended a NEHA Annual Educational Conference & Exhibition and purchased membership along with my registration.	54	10.0
Other	12	2.2

NEHA NEWS

In response to the survey, NEHA Executive Director Dr. David Dyjack has charged a group of NEHA staff to "think radically about quality improvement around the NEHA customer experience and to construct e-learning that is simple and easy to access, simple and easy to understand, and arranged in a manner that makes sense to individual members."

NEHA would like to thank the new members who thoughtfully responded to the 2020 membership survey. We take your feedback seriously and we strive to be an association that continues to understand and address your professional needs.

Sheila Davidson Pressley Passes Away

NEHA was saddened to learn of the passing of Sheila Davidson Pressley, DrPH, CPH, DAAS, REHS, HHS, on January 24, 2020. Dr. Pressley was the dean of the College of Health Sciences at Eastern Kentucky University in Richmond, Kentucky. She was also an active member of NEHA and the American Academy of Sanitarians. NEHA expresses its deepest sympathies to her family, friends, and colleagues. An In Memoriam for Dr. Pressley highlighting her career and impact on the environmental health profession will be published in the May 2020 *Journal of Environmental Health*.

Did You Know?

You can access NEHA's policy statements at www.neha.org/publications/position-papers. NEHA's latest policy statement addresses the adoption and implementation of the current Food and Drug Administration's *Food Code*. Other recent policy statements cover cottage foods, clean energy, ear piercing guns and microblading, mosquito control, and cannabis-infused food products.

DirecTalk

continued from page 50

tosporidium outbreak at a water park in the Western U.S. The case was complicated, as it involved the accidental comingling of surface waters with traditional wading and swimming pools. Today, our professional network has resources that provide specific guidance on *Cryptosporidium* risk management and those resources are available at the CMAHC website.

CMAHC does a lot more than just manage updates to MAHC. They are involved in cutting-edge research on emerging public health issues related to public aquatic facilities and work to promote MAHC adoption nationwide. While there is insufficient space to cover all that in detail here, I would love to discuss it further with anyone who may be interested in learning more. Please reach out to me or the new CMAHC executive director, Kristie Riester (kristieriester@cmahc.org), and join us in our mission to ensure a healthier and safer swim experience for everyone.

The pool outside Taliesin West in Scottsdale, Arizona. Photo courtesy of David Dyjack.

This story started with a blurry-eyed, jet lagged David Dyjack, trying to make sense of a Friday morning appointment with the pool and spa industry. This saga ends with me accepting a MAHC board position, a role I have embraced since 2018. I envision nationwide adoption of the Food and Drug Administration's *Food Code*—everyone eats. I also envision nationwide adoption of MAHC—virtually everyone swims in pools, intermittently relaxes in a spa, or enjoys a salubrious moment in a float tank. The story ends with a steely-eyed David Dyjack who firmly believes MAHC can be the cornerstone of aquatic health and safety and an intellectual vehicle that drives us into the future.

Acknowledgement: Kristie Riester, executive director of CMAHC, was a contributor to this column.

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DirecTalk MUSINGS FROM THE 10TH FLOOR

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MAHC Truck Delivers Results

Sunrise. Was I in Colorado? Mental cobwebs courtesy of a late night arrival into Denver slowly dissolved as my morning espresso ritual achieved its intended results. Just where was I supposed to be? A quick scan of my schedule revealed that I was to meet in a couple hours with key influencers in the pool, spa, and hot tub industry at a hotel about 30 minutes north of the city. The occasion was the triennial conference of the Council for the Model Aquatic Health Code (CMAHC), a group that I recognized were the magicians behind efforts to maintain and improve the hospitality industry's recreational water health and safety. What I didn't anticipate was a subsequent invitation to join their board of directors. What was I getting myself into?

The Centers for Disease Control and Prevention's (CDC) Model Aquatic Health Code (MAHC) is the only all-inclusive model pool code in the U.S. Similar to restaurant owners and operators who reference food codes for guidance on how to keep food safe to eat, those who work in or with public aquatic facilities can reference MAHC to learn how to provide a safe swimming and aquatic environment. MAHC is comprised of a set of voluntary guidelines that are based on the latest science and best practices known to help make public pools healthy and safe for swimmers, visitors, and staff. If followed, the MAHC guidelines can help reduce the risk for disease outbreaks, drownings, chemical injuries, and other types of injuries at public pools.

What does this code mean for us? State and local government officials can use some or all the guidelines to develop and update their own pool codes. The last time I reviewed the adoption status, about half of the jurisdictions in the country had adopted or were considering adopting some or all of the code. Aquatics professionals can also use the code as a reference guide when they are designing and building new aquatic facilities or considering updates for their operation and maintenance policies. CDC releases an updated edition of MAHC every 3 years. The process to update MAHC is managed by CMAHC.

The Model Aquatic Health Code can be a cornerstone of aquatic health and safety.

So, what is CMAHC? CMAHC is a nonprofit organization that was created to partner with CDC on a few key measures related to MAHC. First and foremost, CMAHC works with CDC to keep the code up-to-date with the latest science and best practices. This endeavor is achieved by managing the MAHC update process that happens every 3 years. During that time, aquatics and public health experts can submit, comment on, and vote on proposed changes to MAHC. The voting takes place following CMAHC's triennial Vote on the Code Conference. The next major meeting of CMAHC will take place October 13–14, 2020, in Houston, Texas. Based on the results of the voting, CMAHC updates MAHC with the proposed changes and submits it to CDC for final consideration and publication.

The update process for the next MAHC edition is well underway as public health and aquatic experts have already started to submit proposed changes. I encourage you to add your voice to this process. As regulators, inspectors, and health and safety professionals, you have valuable insight to contribute reflecting what you have learned in your work that could make aquatics healthier and safer for everyone. You can register to become a CMAHC member, learn more about the MAHC update process, and submit proposed changes at www.cmahc.org.

For the National Environmental Health Association (NEHA), this conversation is not abstract. NEHA formally endorsed MAHC through a board-approved policy statement in July 2017. You can learn more at www.neha.org/node/59193. We also encourage every regulatory jurisdiction and relevant private industry sector to adopt the practices outlined in MAHC. In the court of law, attorneys might ask, "Did you know, or should you have known, that MAHC represented the best available science in protecting the swimming public's health and safety?" How would you or your jurisdiction respond?

I wish there had been a MAHC early in my career when I was retained to work on a *Cryp-*

continued on page 49