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THE ZIKA VIRUS THREAT

A Two-Part Series on Prevention, Preparedness, and Public Health Perspectives

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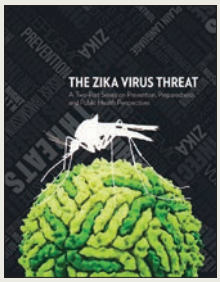

This month's issue features a two-part series on the Zika virus. The first part, "The Zika Virus Threat and Prevention Challenges" explores an all-hazards and One Health approach to pandemic and global epidemic prevention and mitigation. The second part, "Public Health Professional Perspectives on Zika Virus Preparedness" provides responses of environmental health professionals from a survey on the Zika virus and infectious diseases. The cover for this issue uses a word cloud to highlight the topics of the two-part series as the background for the primary mosquito reservoir of the Zika virus (*Aedes* mosquitoes) and a detailed image of the Zika virus.

See pages 8 and 20.

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PRESIDENT'S MESSAGE

Roy Kroeger, REHS

Great Opportunities for Environmental Health

As I sit down to write my second column, I am trying to find topics that will be relevant when you read them. September is National Food Safety Education Month and food safety is where the majority of our members work, so I feel this topic will be relevant. I am sure each of us can recall an incident when an establishment or maybe even a person disregarded food safety rules and made someone else sick.

In my case, I recall a lawsuit in which I had to testify when a restaurant allegedly made a person ill with *Salmonella* in October 2010. My testimony did not occur until summer 2014. The victim, who had doctor bills totaling more than $650,000, was awarded $11.37 million. A few days before the victim ate at the restaurant, my office marked the establishment with 18 violations. How many of you can think of a similar tragedy in your jurisdiction? This foodborne illness case is but one that describes the importance of food safety to our profession.

As I mentioned earlier, with each September comes Food Safety Education Month. I am confident it will be the busiest Food Safety Education Month ever for the National Environmental Health Association (NEHA). In my last column, I briefly mentioned that NEHA received a large grant from the Food and Drug Administration (FDA) to improve food safety. I wanted to expand on that a little more in this month's column.

In May 2021, NEHA received a cooperative agreement award from FDA to provide pass-through funding to state, local, tribal, and territorial retail food regulatory agencies to advance conformance with the Voluntary National Retail Food Regulatory Program Standards (Retail Program Standards).

In May 2021, NEHA received a cooperative agreement award to provide funding to retail food regulatory agencies to advance conformance with the Voluntary National Retail Food Regulatory Program Standards.

To facilitate this grant, NEHA has assembled a cadre of subject matter experts who will be assisting jurisdictions in their efforts to reduce the occurrence of foodborne illness through the implementation of the Retail Program Standards. Many of you might be familiar with the previous grants offered, but the NEHA approach will be different. We are managing the grants with you, the professional, in mind. We will collaborate with FDA and other experienced retail food safety subject matter experts to ensure participating jurisdictions meet their program goals. NEHA plans to offer enhanced technical support, subject matter expert assistance, and guidance to ensure applicant success throughout the grant cycle.

NEHA will also collaborate with the National Association of County and City Health Officials to implement the NEHA-FDA Retail Flexible Funding Model (RFFM) Grant Program, similar to the previous program. We will also work with the Conference for Food Protection to offer a dedicated educational program to address advancement and conformance with the Retail Program Standards. NEHA will open the grant application portal in September, the month that we observe food safety.

I hope that by now, many of you have seen the new grant categories and qualifications and are ready to request as much as $100,000 to support your food safety programs. NEHA Executive Director Dr. David Dyjack and several of my predecessors have espoused how environmental health is profoundly local and how we need to mold our programs to meet local needs. The Retail Program Standards allow you to achieve this endeavor while maintaining a consistent regulatory structure. If you are not aware of the new opportunities, please visit www.neha.org/retailgrants for more information.

If you have additional inquiries, please do not hesitate to contact our NEHA-FDA RFFM Grant Program Support Team via email at retailgrants@neha.org or toll-free at (833) 575-2404. Our team is waiting to help you!

With the RFFM Grant Program, FDA is asking NEHA to be intimately involved with the pass-through funding. NEHA will assist jurisdictions in both the application process and throughout the 1- or 3-year life cycle of the grants. Our assistance will help food safety programs meet their goals so that these jurisdictions are prepared to reduce the incidence of foodborne illness more effectively. If food safety programs take advantage of this funding to improve food safety, everyone benefits—inspectors, industry, and consumers. Together

we can prevent foodborne illness and future lawsuits like the one I mentioned at the start of this column.

The NEHA-FDA RFMM Grant Program is a significant project for our association and it will take a considerable amount of staff time and resources to implement successfully. Still, we cannot ignore other important projects that benefit our members and the profession. One of these projects is our student internship program, the National Environmental Public Health Internship Program (NEPHIP). NEHA has worked with the Centers for Disease Control and Prevention to secure funding to provide paid internships through NEPHIP for more than 60 student interns for each of the next 2 years. NEHA was pleased to learn this news as we had heard previously that the federal funding had been eliminated.

As an environmental health major from the National Environmental Health Science and Protection Accreditation Council (EHAC)-accredited program at Colorado State University (CSU), I am elated to hear this news. It has been nearly three decades since I received my bachelor of science degree, but as I recall, one of the most stressful times in my program was during my senior year when I was looking for an internship. Most places I applied to were willing to mentor an intern but none of them had funding to pay for it. I ended up taking an internship with no compensation in Cheyenne, Wyoming, which was a 1-hour drive from CSU. Internship grants would have made the experience so much easier for both the department and my student budget.

As many of the seasoned environmental health professionals are retiring from public health careers, the need for new professionals is more critical than ever before. NEPHIP encourages students attending EHAC-accredited programs to intern at a public health department as I did so many years ago. My 3-month internship led to a wonderful 28-year (and counting) career.

President@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/donate.

Thank you.

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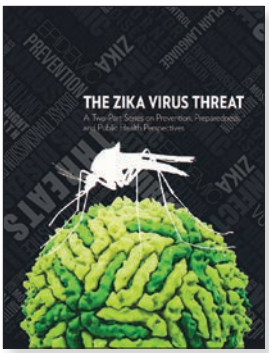

Part 1: The Zika Virus Threat and Prevention Challenges: An All-Hazards and One Health Approach to Pandemic and Global Epidemic Prevention and Mitigation

Christopher Eddy, MPH, REHS, CP-FS
College of Nursing and Health Care Professions, Grand Canyon University

Eriko Sase, PhD
Kennedy Institute of Ethics, Georgetown University
The School of Medicine, University of Tokyo
Department of Social Work and Child Science, Saitama Prefectural University

Abstract

To characterize the severity of the Zika virus (ZIKV) threat from an all-hazards perspective, we used the 2002 West Nile virus epidemic and epizootic as a comparator. Comparing these two threats allowed us to consider existing vulnerabilities and expected and uncertain consequences: infants born into disability, neurological symptoms across age groups, disease transmission pathways, national surveillance and control systems, and vaccine availability. We found that 1) human sexual ZIKV disease transmission, specifically the complexities of asymptomatic transmission and 2) verification that humans are the primary disease amplification reservoir are significant indicators of ZIKV threat severity. Novel public health messaging that describes disease transmission pathways in plain language must be developed to assure the health of all populations, not only those covered by protective legislation and defined as at-risk. Surveillance and mosquito control systems must be reestablished nationally and globally to enable a One Health approach to pandemic and global epidemic prevention and mitigation in a time of increasing climate change.

Introduction

The Zika virus (ZIKV) is a novel vector-borne zoonotic, congenital, sexually transmitted, and potentially pandemic pathogen that threatens a mostly ZIKV-naive human population in the U.S. (Bardina et al., 2017; Lucey & Gostin, 2016; Wiley & Chimelli, 2017). There is no vaccine for ZIKV, nor is there a treatment for the incompletely characterized human neurological and arthralgic conditions that it can cause (Lucey & Gostin, 2016; Russo & Beltrão-Braga, 2017). One in seven babies born to ZIKV-infected individuals in U.S. territories developed neurological anomalies (Centers for Disease Control and Prevention [CDC], 2018a; Rice et al., 2018). As the evidence of a ZIKV non-vectorborne transmission pathway grows, the proportion of vector to non-vectorborne ZIKV infection is still unknown (Gregory et al., 2017). Additionally, the U.S. has contributed to a consistently inadequate global pandemic/epidemic disease threat response due to the lack of coordinated public health prevention systems (National Academies of Sciences, Engineering, and Medicine [NASEM], 2017).

ZIKV and West Nile virus (WNV) share the same genus, common mosquito vector species, incompletely characterized neurological disease symptoms in humans, and a relatively recent introduction into the U.S. as novel emerging infectious diseases (Musso & Gubler, 2016). Our ZIKV comparator, WNV, was first recognized in the U.S. in 1999 when American crows died in New York City by the hundreds amid a human encephalitis epidemic. The zoonotic link between human and avian cases was not realized early enough to gain prevention benefits (Ludwig et al., 2002). Named the 2002 WNV epidemic and epizootic, WNV cycled through significant waves in 1999–2007 and 2012–2015 (Ostroff, 2013), resulting in 43,937 cumulative human disease cases and 911 human deaths (CDC, 2020a). Corvidae and horses were found to be early sentinel indicators that accurately telegraph the potential for human danger in a region, allowing for a heightened level of attention to vector surveillance and control.

Based on current knowledge of disaster planning and public health emergency response, while also focusing on commonality and severity of hazard consequences, we posit this research question: What can an all-hazards and One Health approach to the ZIKV threat add to informed prevention strategies?

Methods

We hypothesized that the 2002 WNV epidemic and epizootic and subsequent WNV epidemics as a comparator can establish enhanced understandings of the ZIKV threat by characterizing explanatory variables to inform accurate and evidence-based planning as well as prevention, mitigation, and response strategies.

We performed advanced Medical Subject Headings (MeSH) and keyword searches in MEDLINE/PubMed to locate studies that relate to the following: environmental health, mosquito, vector, all-hazards, disaster planning, public health emergency, zoonotic disease surveillance, at-risk or vulnerable populations, and environmental justice. Considering broader terms than at-risk, our literature search strategy yielded zero articles after combining environmental health, public health, social justice, and human rights search terms with our initial search strategy.

Our rigorous literature search strategy and subsequent reference evaluation included an analysis of all-hazards approaches to disaster planning and emergency response. We reviewed applicable, relevant, appropriate, and required regulations and guidelines, with an emphasis on U.S. federal agency publications and reports. Using a hybridized approach to vulnerability assessment, we evaluated the following factors: disease reservoirs, disease transmission pathways, biosurveillance, vector control, medical considerations and clinical symptoms, and economic loss by comparing WNV to ZIKV.

Results

ZIKV health consequences are unprecedented (Table 1) when considering severity as a primary factor of risk. ZIKV is also characterized by uncertain neurological disease symptoms, vaccine unavailability, poorly characterized disease transmission pathways, inconsistent and nationally unstandardized vector surveillance and control systems, and a scarcity of disaster and emergency-based literature.

Disaster planning and emergency response in the U.S. is defined in part by laws and guidelines such as the:

- National Response Framework and associated documents (Federal Emergency Management Agency [FEMA], 2020a);
- Stafford Disaster Relief and Emergency Assistance Act (Gable, 2012);
- National Incident Management System (FEMA, 2017);
- Pandemic and All-Hazards Preparedness Reauthorization Act (2019);
- Post-Katrina Emergency Management Reform Act (2006); and
- National Health Security Strategy (U.S. Department of Health and Human Services [HHS], 2019).

Although disaster management and mitigation and public health emergency prevention and response are split between the Federal Emergency Management Agency and the U.S. Department of Health and Human Services, a shared theme is an all-hazards approach that classifies events generally by natural, accidental, technological, or intentionally caused disaster or emergency. The acronym CBRN (chemical, biological, radiological, and nuclear) further guides the description of adverse events characterized by type, similarity of consequence, toxicity, persistence, latency, and transmissibility (HHS, 2019; International Committee of the Red Cross, 2020; National Research Council, 2010). A hazard vulnerability analysis (HVA) emphasizes hazard event probability and severity of location-specific threats in terms of identified vulnerabilities and anticipated consequences that are the emphasis for prevention and/or mitigation strategies (Centers for Medicare & Medicaid Services, 2017; Kaiser Permanente, 2021; National Research Council, 2010).

The 2002 WNV epidemic and epizootic were declared an emergency under the Robert T. Stafford Disaster Relief and Emergency Assistance Act in New York City and New Jersey in 2000 (FEMA, 2020b). In 2006, ZIKV was declared a public health emergency by Brazil and a public health emergency of international concern through implementation of the International Health Regulations by the World Health Organization (WHO), primarily due to the threat of microcephaly to babies born to ZIKV-infected individuals (Pan American Health Organization [PAHO] & WHO, 2016; WHO, 2016a). ZIKV epidemics have followed natural disasters due to loss of public health infrastructure and human behavior (Pacheco Barzallo et al., 2018; Reina Ortiz et al., 2017). All-hazards readiness (including biological threats that are natural, potentially pandemic, or intentional) and the HVA process have been described in application to CBRN events (Eddy & Sase, 2015a, 2015b; Eddy et al., 2010).

Disease Reservoirs

A key ZIKV disease transmission distinction is that humans are the amplification reservoir, which is in contrast with WNV epidemics and epizootics, where humans are dead-end hosts (CDC, 2018b; Marano et al., 2016; Moreno-Madriñán & Turell, 2018; Musso & Gubler, 2016). Birds were both the primary reservoirs of WNV and the amplifier of the 2002 WNV epidemic and epizootic (Moreno-Madriñán & Turell, 2018; Rosenberg et al., 2018).

Disease Transmission Pathways

An unexpected aspect of ZIKV is that the mode of infection transmission shifted from insects to humans as a sexually transmitted disease. ZIKV can be transmitted asymptomatically by a human host or reservoir who has little to no symptoms (CDC, 2003; Foy et al., 2011; Unemo et al., 2017; Webster et al., 2017). ZIKV is epidemically driven by human behavior, personal choices, and determinants of health (Table 1). In comparison, although evidence shows that WNV can be transmitted by urine and that asymptomatic transmission between humans is possible, those occurrences are scantly recorded. Unlike WNV, ZIKV is easily detectable in human semen, urine, organs, blood, transplacental fluids, and tears, with shedding and infectivity possible for weeks to months (Musso & Gubler, 2016; Paz-Bailey et al., 2018).

ZIKV can be transmitted person-to-person through the fecal–oral pathway. ZIKV has been successfully retrieved from fecal samples from laboratory mice and humans, leading to further evidence surrounding confirmed human sexual transmission and implications for immune-compromised individuals (Bôtto-Menezes et al., Chiu et al., 2017; Li et al., 2018). Furthermore, vehicles such as contaminated environmental surfaces and other fomites, including food contaminated with feces, are viable ZIKV transmission pathways (Francois Watkins & Appiah, 2020; Vorou, 2016). The Centers for Disease Control and Prevention (CDC, 2019) verifies that ZIKV can be directly transmitted by feces. Research has confirmed the presence of viable ZIKV in human rectal swab sampling, indicating localized viral amplification (Bôtto-Menezes et al., 2019).

ZIKV, *Shigella* bacteria, and the Ebola virus are all classified as newly recognized emerging (or reemerging for *Shigella*) sexually transmitted diseases from environmental, human, and zoonotic reservoirs, respectively (Bernstein et al., 2017). Although Ebola and *Shigella* are both well-documented as fecal–oral transmissible pathogens, all three pathogens presently are known to be hosted primarily by humans and nonhuman primates.

TABLE **1**

Comparison of Vulnerability Factors and Consequences for Zika Virus and West Nile Virus

	Zika Virus	West Nile Virus	Reference
Virus type	Anthroponotic	Zoonotic	Moreno-Madriñán & Turell, 2018; Rosenberg et al., 2018; Unemo et al., 2017
Virus genus/family	Flavivirus/flaviviridae	Flavivirus/flaviviridae	Musso & Gubler, 2016
Reservoir			
Primary reservoir: Bird		X	Moreno-Madriñán & Turell, 2018
Primary reservoir: Human, infectious to vector (anthroponotic)	X		Musso & Gubler, 2016; Rosenberg et al., 2018
Primary mosquito vector: Initial event	*Aedes* species	*Culex* species	Marano et al., 2016; Wiley & Chimelli, 2017
Biting habits: Daytime	X		World Health Organization (WHO), 2016b
Favorable vector environment	Drought-resistant eggs; dumps and human-made containers	Stagnant water and sewage; human-made containers	Rasanathan et al., 2017; Vazquez-Prokopec et al., 2010; WHO, 2016b
Vectorborne transmission			
Mosquito bite	X	X	
Non-vectorborne transmission			
Sexually transmitted infection (human)	X		Paz-Bailey et al., 2018; Russo & Beltrão-Braga, 2017; Unemo et al., 2017; Wiley & Chimelli, 2017
Urine and saliva	X	X	Paz-Bailey et al., 2018; Wiley & Chimelli, 2017
Semen	X		Musso & Gubler, 2016; Paz-Bailey et al., 2018
Breast milk			Musso & Gubler, 2016
Organs, bloodborne, or person-to-person	X	X	Krow-Lucal et al., 2017; Wiley & Chimelli, 2017
Transplacental	X	X	Wiley & Chimelli, 2017
Asymptomatic excretion	X	X	Paz-Bailey et al., 2018
Feces (primate studies)	X		Chiu et al., 2017
Feces (human)	X		Bôtto-Menezes et al., 2019; Centers for Disease Control and Prevention (CDC), 2019
Biosurveillance/vector control			
Mild symptoms in many human cases	X	X	Rosenberg et al., 2018
Human case underreporting: misclassification, misdiagnosis	X	X	de Brito et al., 2016; de Oliveira et al., 2017; Martinez et al., 2017; Rosenberg et al., 2018
Sexual and vector source hard to differentiate	X		Bernstein et al., 2017
Human surveillance data lag	X	X	Ostroff, 2013
Zoonotic early detection capacity: animal		X	Ragan et al., 2017
Vector control capacity: agency	U.S. unprepared	U.S. unprepared	National Academies of Sciences, Engineering, and Medicine (NASEM), 2017; National Association of County and City Health Officials, 2017; Ostroff, 2013
Date reportable to public health authority	2004	2004	Rosenberg et al., 2018
First-year data presented in reported time range	2016	2004	Rosenberg et al., 2018
At-risk populations			
Virus exposure: Naive human populations	X	X	Bardina, 2017
Vaccine or treatment available			Russo & Beltrão-Braga, 2017
Highly susceptible populations	Pregnant individuals, fetuses, all ages	Older adults, immune-compromised individuals	Russo & Beltrão-Braga, 2017; Wiley & Chimelli, 2017

continued ▸

TABLE **1** continued

Comparison of Vulnerability Factors and Consequences for Zika Virus and West Nile Virus

	Zika Virus	West Nile Virus	Reference
At-risk populations (continued)			
Occupational vulnerability	Outdoor workers, healthcare/laboratory personnel, mosquito control workers	Outdoor workers, healthcare/laboratory personnel, mosquito control workers	Occupational Safety and Health Administration & National Institute for Occupational Safety and Health, 2016
Social determinants	Poverty, public health intervention, stagnant water, mosquito nets, personal and environmental mosquito repellants or insecticides, lack of air conditioning or window screens	Income, race, age, population density, elevation, bird populations, housing, mosquito abatement districts, urbanization	CDC, 2017; Harrigan et al., 2010; Morano & Holt, 2017; Rasanathan et al., 2017; Ruiz et al., 2004
Executive Order 12,898	X		Exec. Order No. 12,898, 1994
Pandemic and All-Hazards Preparedness Act	X		Pandemic and All-Hazards Preparedness Reauthorization Act, 2019
International Health Regulation	X		WHO, 2021
Stafford Act: Emergency declaration		X	Federal Emergency Management Agency, 2020a
Medical considerations and clinical symptoms			
Vaccine or treatment available			Russo & Beltrão-Braga, 2017
Rapid diagnostics: Human, clinical			Rasanathan et al., 2017
Clinical conditions and sequelae	Miscarriage/stillbirth, microcephaly in fetus, multiple neurological disorders, eye and musculoskeletal abnormalities	Adult encephalitis, neurological disorders, new research shows uncertain fetal malformation	Chiu et al., 2017; de Araújo et al., 2018; Russo & Beltrão-Braga, 2017; Wiley & Chimelli, 2017
Guillain-Barré syndrome complications	Fatal in 3–5% of human cases	Infrequently reported	Hayes et al., 2005; Watrin et al., 2016; WHO, 2016b
Acute flaccid myelitis/paralysis	N/A	X	Al-Fifi et al., 2018; CDC, 2020b
Economic loss			
Estimated loss to productivity, medical and Medicare costs, other: U.S.	2% attack rate; $2 billion/year	$56 million/year; patients hospitalized with West Nile virus	Barrett, 2014; Lee et al., 2017
Estimated loss to productivity, medical costs: Houston, Texas (2012 and 2014 West Nile virus outbreaks)	N/A	2012: $47.6 million 2014: $6–8 million	Martinez et al., 2017; Murray et al., 2013; Ostroff, 2013
Aerial spraying for West Nile virus: Houston, Texas (2012)	N/A	$1.6 million	Ostroff, 2013
Suspected Zika microcephaly cases: Brazil	4,000 cases	N/A	Mittal et al., 2017
Confirmed Zika microcephaly cases or other brain malformations: U.S.	51 cases	N/A	Reynolds et al., 2017
Estimated cost: microcephaly case per child	$4 million	N/A	CDC, 2017
Estimated cost: microcephaly case per child who survives to adulthood	$10 million	N/A	CDC, 2017
Estimated GDP loss: Latin America and the Caribbean (2015–2017)	$7–18 billion	N/A	Daryani, 2018; NASEM, 2017

Note. All currency is reported in U.S. dollars. GDP = gross domestic product; N/A = not applicable.

Fecal transmission is common in sexual disease transmission and involves person-to-person and/or fomite-based infection pathways, which might explain the increase of human ZIKV epidemics even after increases in mosquito control (Chiu et al., 2017; Krow-Lucal et al., 2017; Webster et al., 2017; Whitlow, 2004). CDC reports 29 confirmed cases of local, multiperson ZIKV transmission in Florida, Texas, Puerto Rico, American Samoa, Federated States of Micronesia, Marshall Islands, and U.S. Virgin Islands (Murthy et al., 2018). WHO has embarked on a prospective, longitudinal cohort study to develop "rational measures to prevent the transmission of the virus" and National Institute of Health-sponsored research seeks to discover new ZIKV disease transmission pathway evidence (Shah et al., 2017; WHO, 2017).

Biosurveillance

Biosurveillance of mosquito vectors and animal and human diseases provides early detection data that can allow efficient mitigation and early-event risk communication to the community. Early-event detection, however, is doubtful for ZIKV, as the WNV comparator indicates repeated historical biosurveillance and vector control failures (Table 1). Overall, U.S. public health biosurveillance and situational awareness capacity are insufficient despite the legal requirement by the Pandemic and All-Hazards Preparedness and Advancing Innovation Act of 2019; furthermore, specific One Health integrated biosurveillance capacity is limited (Eddy & Sase, 2015b; Eddy et al., 2013; Gates, 2015; Ostroff, 2013; U.S. Government Accountability Office, 2017).

Although the WNV advance warning system was supported by a successful national public health outreach message campaign that created active involvement by the public with incentive to report dead birds, the same methodology is not possible for ZIKV due to the lack of an identified sentinel zoonotic reservoir or host (Hall, 2003; Ludwig et al., 2002; Ragan et al., 2017). Human ZIKV further challenges biosurveillance capacity because most adult human cases are mild in symptoms and many cases are underreported, misclassified, or misdiagnosed (de Araújo et al., 2018; de Brito et al., 2016; de Oliveira et al., 2017; Reynolds et al., 2017). Human ZIKV surveillance data provide too short a time period for effective vector response, and mosquito-borne and non-mosquito-borne ZIKV cases cannot be differentiated accurately (Bernstein et al., 2017; Ostroff, 2013).

Vector Control

The global and U.S. mosquito control infrastructure nearly disappeared with the perceived loss of risk immediacy, markedly deteriorating from the emergence of WNV to the emergence of ZIKV in the U.S. (Rodgers, 2017, WHO, 2016b). Advocated by WHO as the first line of defense, mosquito control waned globally in the mid-20th century due to "public health complacency" after the main ZIKV vector, *Aedes aegypti*, was eradicated in 18 countries by 1962 (Musso & Gubler, 2016; NASEM, 2017). Likewise, WNV lessons were not well-learned in the U.S. Relaxed vector control and surveillance programs contributed to the second WNV epidemic in Texas in 2012, resulting in 225 human cases and 19 deaths. Racial minorities and low-income populations were affected disproportionately (Murray et al., 2013; Ostroff, 2013). A third WNV epidemic occurred in Texas in 2014, with 139 human disease cases and 2 deaths. Of those cases, 76% were classified as severe neuroinvasive disease, which indicates an underreporting of West Nile fever (Martinez et al., 2017). In 2020, 664 total human cases and 52 deaths were attributed to WNV in the U.S. (CDC, 2021).

Local health agencies and associated mosquito control entities were underfunded and unprepared for the ZIKV threat, with only 8% of local mosquito control programs reported as fully capable (National Association of County and City Health Officials [NACCHO], 2017; Rodgers, 2017). While vector control traditionally is performed as a core service, only 50% of public health and environmental health programs fund a vector control program (Ruiz et al., 2018). Additionally, only 28 states in the U.S. require environmental health practitioners to be credentialed (London, 2017), indicating a continuing erosion of service quality by a public health workforce that is essential to assure health security. Since 2018, the National Association of County and City Health Officials has funded 28 mosquito control programs across 11 states to support and build capacity (Chatelain, 2021).

Future environments that are mosquito supportive will be associated with climate change and poverty, especially the aftermath from natural disasters that result in severe flooding and loss of public health infrastructure (Pacheco Barzallo et al., 2018; Reina Ortiz et al., 2017). From an all-hazards perspective, the U.S. could expect an increase in the severity of the ZIKV threat not only in impoverished areas but also among economically stable populations stressed by loss of public health infrastructure during emergency, disaster, or catastrophe (Moreno-Madriñán & Turell, 2018). Even during times of normalcy, public health budgets and workforce sizes have been decreasing. For example, state and local health departments in California reported a 24% decrease in budget funding and a 20% reduction in workforce staff over the past decade (Delaney, 2020).

In addition, it is estimated that international travel and trade, immigration, globalization, and urbanization will create an increasing influence over future mosquito-vectored disease emergence (Centre for Research on the Epidemiology of Disasters & United Nations Office for Disaster Risk Reduction, 2015; Leaning & Guha-Sapir, 2013; Loconsole et al., 2018; NASEM, 2017; Tambo et al., 2017).

At-Risk Populations

The Pandemic and All-Hazards Preparedness Reauthorization Act of 2019 reauthorized and included the enforcement basis for the protection of at-risk populations: the act specifically lists ZIKV as a priority emerging virus and defines at-risk populations as children, pregnant individuals, older adults, and individuals who have functional needs in the event of a public health emergency.

Due to the link between ZIKV and microcephaly/congenital Zika syndrome in newborns (PAHO & WHO, 2016; WHO, 2016a), Brazil declared ZIKV a national public health emergency on November 11, 2015, and WHO declared ZIKV a public health emergency of international concern by activating the International Health Regulations on February 1, 2016. Previously the 2002 WNV epidemic and epizootic, as well as subsequent epidemics, were considered to have affected immunecompromised and older human populations; therefore, public health agencies addressed them as specifically at-risk for the disease (CDC, 2003; Wiley & Chimelli, 2017).

Research from the 2002–2012 Texas WNV epidemics shows unexpected human morbidity and mortality in a broad range of ages (Philpott et al., 2019). Evidence also links poverty to environmental degradation and mosquito-supportive environments (Alirol et al., 2011; de Araújo et al., 2018; NASEM, 2017). Furthermore, there is evidence that social injustice causes a disproportionate burden of vectorborne disease (NACCHO, 2017).

Additionally, at-risk populations protected by order of the U.S. president issued in 1994 to address environmental justice are narrowly defined as racial and ethnic minorities and low-income populations (Exec. Order No. 12,898, 1994). In 2015, the authority of Executive Order 12,898 was applied directly to research involving mosquito-breeding habitat and disease vector management in Puerto Rico and Brownsville, Texas, due to the threat of ZIKV to unborn children (U.S. Environmental Protection Agency, 2016). Social and occupational health determinants also impact vectorborne disease incidence (Table 1) (Harrigan et al., 2010; Morano & Holt, 2017; Occupational Safety and Health Administration [OSHA] & National Institute for Occupational Safety and Health [NIOSH], 2016; Rasanathan et al., 2017; Ruiz et al., 2004). The U.S. provides worker exposure protection from vectorborne disease by mandated prevention guidelines (OSHA & NIOSH, 2016).

Medical Considerations and Clinical Symptoms

Guillain-Barré syndrome is strongly associated with ZIKV or WNV infection, with a human fatality rate of 3–5% (Hayes et al., 2005; Watrin et al., 2016; WHO, 2016c). The increase in cases of acute flaccid myelitis, also referred to as acute flaccid paralysis, is an emerging neurological and paralytic threat to humans that is associated with WNV (Al-Fifi et al., 2018; CDC, 2020b; Philpott et al., 2019). Future research could show ZIKV to be a significant acute flaccid myelitis threat. Some clinical experts involved in the treatment of ZIKV, however, have yet to acknowledge the many uncertainties of ZIKV that we present in this article (Becker-Dreps et al., 2020).

Economic Loss

Economic loss to historic WNV epidemics has been substantial (Table 1). The staggering projected losses from ZIKV deserve consideration in an HVA (Barrett, 2014; CDC, 2017; Daryani, 2018; Lee et al., 2017; Martinez et al., 2017; Mittal et al., 2017; NASEM, 2017; Ostroff, 2013; Reynolds et al., 2017).

Discussion

ZIKV presents a severe threat to pregnant individuals and babies born into lifelong disability and this knowledge should inform surveillance and control programs. Future research will better characterize the infective dose and zoonotic potential of ZIKV. Acute flaccid myelitis is unassociated with ZIKV at present but known to be caused by WNV, which adds to the uncertainty and therefore the severity of the threat posed by ZIKV. Research compels us to consider an expanded definition of at-risk populations (Philpott et al., 2019).

Although this study used a WNV comparator, we recognized the significance also of chikungunya and dengue viruses, which are both classic causes of chronic neurological as well as arthralgia and arthritic conditions in humans globally. Dengue viruses, like ZIKV and WNV, are flaviviruses. Chikungunya, similar to ZIKV, WNV, and dengue, is primarily vectored by *Aedes* mosquitoes; as such, differentiating mosquito-borne viral epidemic sources can result in uncertainty (International Association for Medical Assistance to Travellers, 2020). As previously stated, neither WNV- nor ZIKV-caused disease can be treated or prevented by a vaccine (Chiu et al., 2017; de Araújo et al., 2018; Rasanathan et al., 2017; Russo & Beltrão-Braga, 2017; Wiley & Chimelli, 2017). Pharmaceutical companies are discontinuing research and development processes due to perceived lack of demand, and hence profit (NASEM, 2016; "Vaccine against Zika," 2017).

Limitations

During the development of our literature review search strategy, we found a variety of disease transmission pathway descriptors (e.g., fecal–oral, person-to-person, human-to-human, and bodily contact) that potentially could have resulted in nomenclature inconsistencies across the published material.

Recommendations

The human sexual transmission pathways associated with ZIKV, unlike WNV, require a novel approach to population health outreach by addressing topics that might be taboo for some people. We found multiple terms in the literature used to describe infectious disease transmission pathways between people. The terms person-to-person, human-to-human, multiperson, close-contact, sexual, body fluid, stool, and other descriptors should be clarified to include discussion about fecal–oral pathways and fomites in plain language. Future research should attempt to seek opportunities to consolidate the broad language presently used to describe biological disease transmission and move public health, medical, and veterinary professionals toward a more specific and actionable discussion of pathways.

Additionally, in the absence of a vaccine, activities such as vector control, biosurveillance, and health education must be emphasized (Philpott et al., 2019). We advocate a two-pronged perspective that targets at-risk populations:

1. An all-species approach to mosquito-borne disease that emphasizes nonpharmaceutical interventions such as the establishment of nationally standardized mosquito surveillance and mosquito control systems.
2. An all-populations approach that includes appropriate legal protection and considers all people at risk to vectorborne infectious diseases.

The two-pronged approach should target education and human behavior modification because new vaccine research and development hinges on doubtful profit (NASEM, 2016; Philpott et al., 2019; "Vaccine against Zika," 2017). An emphasis on One Health-integrated early detection and prevention systems thinking is imperative to prevention and risk communication development strategies. Leveraging integrated knowledge bases across veterinary, environmental public health, and medical disciplines could assure that all people are protected from ZIKV and other mosquito-borne diseases (Eddy et al., 2013).

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

References on page 14

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continued on page 18

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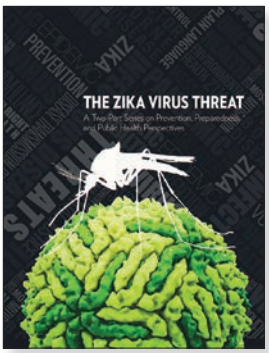

Part 2: Public Health Professional Perspectives on Justice and Zika Virus Preparedness: The Human Right to Health

Christopher Eddy, MPH, REHS, CP-FS
College of Nursing and Health Care Professions, Grand Canyon University

Eriko Sase, PhD
Kennedy Institute of Ethics, Georgetown University
The School of Medicine, University of Tokyo
Department of Social Work and Child Science, Saitama Prefectural University

Abstract **Expanding our all-hazards analysis of the Zika virus (ZIKV) by utilizing the human right to health as an experimental survey target, 88% of the environmental health professionals we surveyed (*N* = 24) expect government to fulfill that objective. Inconsistency in disease outbreak terminology and transmission, however, was also observed among those surveyed. Of the respondents, 79% perceived that Executive Order 12,898 (1994) applies to all people and 71% agreed that at-risk populations include environmental justice populations. To target at-risk populations most in need of intervention, we developed our All-Hazards and One Health Vulnerability and Consequence Analysis by integrating all-hazards theory and law, Executive Order 12,898, our survey findings, and the human right to health.**

Public health messaging should contain plain language guidance that keys in on human sexual transmission, contaminated environmental surfaces, and fomite pathways. We advocate for a One Health education approach for public health experts in infectious disease transmission science, especially in the absence of availability and accessibility to ZIKV preventive medicine.

Introduction

This article is paired with our preceding article (Eddy & Sase, 2021) in which we compared the known aspects of the 2002 West Nile virus (WNV) epidemic and epizootic (Centers for Disease Control and Prevention [CDC], 2003) with subsequent WNV human epidemics in the U.S. to the Zika virus (ZIKV). Our all-hazards and One Health approach to the estimation of hazard threat severity indicated that ZIKV presents a greater risk to the U.S. compared with WNV while acknowledging new evidence about WNV neurological disease incidence, the age of populations affected, and complications caused by acute flaccid myelitis, which is also called acute flaccid paralysis. Clinical experts continue, however, to communicate overly optimistic ZIKV threat characterizations (Becker-Dreps et al., 2020).

Although ZIKV consequences, including teratogenic birth defects and debilitating neurological conditions in adults, will require hyperpreventive vigilance by public health agencies, we showed that the U.S. historically has been unprepared for emerging infectious diseases, as demonstrated by WNV in the past and ZIKV in 2017–2019. Evidence mounts in practice and in the literature that the steady trend might not change. For example, in 2019, Eastern equine encephalitis caused human deaths in Massachusetts, Michigan, and Rhode Island. Massachusetts declared a "critical risk" threat within specifically identified geographic locations (Glutting, 2019).

We posit, however, that the ZIKV threat is not only unprecedented but also extends beyond the experience of population health systems due to the severity of the hazard and complications of known and unknown disease transmission pathways (Eddy & Sase, 2021). In Part 1, we found that public health messaging about the threat of WNV described the at-risk population as older adults and immunocompromised individuals during the 2002 WNV epidemic and epizootic (and subsequent human epidemics). Updated information repeats this population emphasis, some also include infants (Montgomery, 2015). Taking into consideration our Part 1 finding that the age spectrum affected by WNV is far broader than previously expected (although based on best available information at the time), community outreach and targeted at-risk population identification might not have been optimum in retrospection.

The role of the mosquito and human as ZIKV vector and nonvector infection sources is distinct from WNV. The human is the ZIKV amplifier and reservoir by causing infection of uninfected mosquitoes, as opposed to the WNV bird reservoir (see Table 1, Part 1). The individual now shoulders a responsibility to understand and prevent a disease that is a sexually transmitted disease (STD) and similar to an STD/enteric pathogen such as *Shigella*. Therefore, the individual that allows personal exposure to ZIKV participates indirectly in the exposure of others, potentially causing risk of irreversible harm to others.

Part 1 of this article series also exhibited a changing WNV at-risk population spectrum: unexpected deaths and chronic disease cases spread across broad age groups (Philpott et al., 2019), which expands the population of those at-risk to ZIKV and WNV beyond the protec-

TABLE **1**

Summary of Respondent Answers From a Survey on Zika Virus (ZIKV) and Infectious Diseases Conducted at the National Environmental Health Association 2018 Annual Educational Conference & Exhibition (*N* = 24)

Survey Question	Respondent Answers	
	Yes # (%)	No # (%)
Is ZIKV a zoonotic disease?	**19 (79)**	5 (21)
Can ZIKV be spread by the fecal–oral transmission pathway?	**3 (13)**	21 (88)
Was the WHO International Health Regulation activated for ZIKV?	**13 (54)**	11 (46)
Was the 2002 WNV event a pandemic?	14 (58)	**10 (42)**
Are WNV and ZIKV anthroponotic diseases?	**12 (50)**	12 (50)
Was SARS a pandemic?	16 (67)	**8 (33)**
Was the H1N1 2009 virus the last pandemic (as of 2018)?	**14 (58)**	10 (42)
Does your state require sanitarian registration?	15 (63)	9 (38)
Is environmental justice an enforceable law in the U.S.?	**9 (38)**	15 (63)
Does environmental justice apply to all people, including at-risk populations?	19 (79)	**5 (21)**
Does the definition of at-risk populations include environmental justice populations?	17 (71)	**7 (30)**
Are human rights guaranteed by law?	14 (58)	**10 (42)**
Are unavailable healthcare goods human rights issues?	**20 (83)**	4 (17)
Government must respect, protect, and fulfill (allocate budget/ personnel) human rights?	21 (88)	**3 (13)**

Note. The bolded numbers indicate the correct answer to the question. H1N1 = novel influenza A; SARS = severe acute respiratory syndrome; WHO = World Health Organization; WNV = West Nile virus.

tion of present laws (Eddy & Sase, 2021). These important revelations, coupled with our literature search review (including disparate biosurveillance/situational awareness and mosquito control services by agencies in the U.S., and profit-stymied vaccine research and development), compelled us to survey environmental health professionals about environmental justice and human rights. We selected the human right to health as a focus to understand the opinions of environmental health professionals.

Methods

We designed a survey based upon the findings in the Part 1 of this article series. We obtained permission from staff at the National Environmental Health Association (NEHA) to conduct a brief convenience survey at the 2018 NEHA Annual Educational Conference (AEC) & Exhibition that was held in Anaheim, California, on June 28, 2018. We examined opinions of experts in the practice of environmental health on nomenclature and legal constructs, disease transmission pathways, reservoirs and amplifiers, at-risk populations, and policies regarding environmental justice and human rights.

Of the estimated 45 persons attending a presentation we gave at the 2018 AEC, 24 responded to the survey. NEHA staff distributed hard-copy surveys before the presentation and planned to collect them before the presentation started. In addition, we strove to develop a better understanding of the threat presented by ZIKV by developing a retrospective threat analysis tool that was based upon our previous comparison of WNV with ZIKV findings merged with the survey data. Designating "ZIKV threat" as the response variable, we considered vulnerability factors and event consequences through the comparison of the known aspects of the WNV comparator to the known and unknown aspects of the ZIKV explanatory variables (Eddy & Sase, 2021).

We obtained permission to conduct a survey and administered informed consent to the audience by explaining the research aims and hypothesis (Eddy & Sase, 2021) and our intent to share their input in a publication. We explained that the publication might provide valuable insight for future disaster planning and epizootic, pandemic, or epidemic prevention initiatives that could have global implications. We explained to the attendees that they could decide to decline to participate in the estimated 10-min survey process. We also stated that participation was completely voluntary with no risk of harm to them and that their anonymous status would be kept confidential. Audience members were welcomed to request the results of the survey in the future.

Results and Discussion

Transmission Pathways

Among the respondents (*N* = 24), 79% recognized that ZIKV is a zoonotic disease (Table 1). Only 50% correctly identified WNV and ZIKV as anthroponotic (Table 1), showing inconsistency in understanding the relationships with the human-influenced environment and among the human reservoir/host, mosquito, and other humans. This finding indicates a need to emphasize that ZIKV is an STD and therefore social responsibility is an additional and critical aspect of both traditional mosquito control programs and community outreach and public health messaging. The Centers for Disease Control and Prevention has provided outreach guidance regarding the prevention of ZIVK via sexual transmission (www.cdc.gov/zika/prevention/sexual-transmission-prevention.html).

A small percentage of respondents (13%) considered ZIKV as potentially transmissible by fecal–oral pathways (person-to-person and indirect), indicating a limitation of professional knowledge regarding the nature of STD transmission pathways and the lack of the application of that knowledge toward a novel viral disease threat. This potentially significant disease transmission pathway further necessitates sophisticated community outreach and public health messaging strategies that are perhaps the first of their kind in U.S. public health history (Eddy & Sase, 2021). Disease pathogen transmission pathways are not well identified due to host-pathogen-res-

ervoir-environment complexities and limited available research (Lello & Fenton, 2017). In the case of emerging infectious diseases, such as the Ebola virus and ZIKV, the importance of the shift to sexual transmission pathways might increase due to future biological emergence dynamics (Antonovics et al., 2017).

Global Epidemics and Pandemics

Lack of agreement among respondents was observed regarding global and domestic epidemics: 58% identified 2009 H1N1 as the last pandemic at the time of the survey; 67% identified severe acute respiratory syndrome (SARS) as a pandemic, although it was not officially proclaimed a pandemic by the World Health Organization (WHO); and 58% identified the 2002 WNV event as a pandemic (Table 1). Only 54% of the respondents acknowledged that WHO initiated the International Health Regulations and declared a public health emergency of international concern due to ZIKV and the threat of microcephaly and congenital Zika syndrome to unborn babies (Table 1). These findings indicate that global disease control initiatives have not been consistently well explained and that the U.S. should communicate hazard nomenclature more clearly to state and local public health officials.

Environmental Justice

Respondents demonstrated a lack of certainty about Executive Order 12,898 (1994), which defines environmental justice: 79% perceived that Executive Order 12,898 applies to all people including at-risk populations and 71% perceived that at-risk populations include environmental justice populations, although only 38% agreed that Executive Order 12,898 is an enforceable tool in the U.S. (Table 1). In fact, Executive Order 12,898 was implemented specifically in Puerto Rico and Brownsville, Texas, to assist in combating ZIKV. The presenting author did describe to the attendees the implementation of Executive Order 12,898 for ZIKV control in Texas after the survey was conducted. The scope is limited, however, to exclusively protect racial-ethnic minority and low-income populations, and the term "at-risk" is not included (Eddy & Sase, 2021). The contradictory replies of the respondents to this section of questions provides further evidence in support of the first part of this article series that detailed recommendations for a revisitation of at-risk (vulnerable) population descriptors presently split between Executive Order 12,898 and other health-protected populations by a consolidation of U.S. laws, guidelines, and policies.

The Human Right to Health

A human rights-based approach protects all human beings—including at-risk populations—by increasing availability, accessibility, acceptability, and quality of healthcare services, programs, and goods (United Nations Economic and Social Council, 2000; United Nations General Assembly, 1966; United Nations Office of the High Commissioner for Human Rights, 2021). A majority of our respondents (88%) stated that the government has a responsibility to respect, protect, and fulfill human rights. Furthermore, a majority of the respondents (83%) recognized that unavailable healthcare goods and services are human rights issues and over one half (58%) agreed that human rights are protected by law in the U.S. (Table 1).

In terms of the availability of healthcare goods for ZIKV prevention, preventive medicine is unavailable partially because pharmaceutical companies are unwilling to pursue research and development for an unprofitable drug, as has happened historically with Lyme disease vaccines (CDC, 2020a; National Academies of Sciences, Engineering, and Medicine, 2016; "Vaccine Against Zika," 2017). The United Nations has set a standard for the provision of health-related services that could apply to both vaccination and public agency services in the International Covenant of Economic, Social, and Cultural Rights (United Nations General Assembly, 1966), although the U.S. has not ratified it. Currently, the Centers for Disease Control and Prevention (CDC, 2019) recommends a Zika prevention kit consisting of nonmedical items such as a bed net, standing water treatment tabs, insect repellent, permethrin spray, and condoms.

The Zika Virus Threat: An All-Hazards and One Health Vulnerability and Consequence Analysis

A retrospective analysis (Figure 1) shows the relational dynamics of data presented in Part 1 of this article series (Eddy & Sase, 2021) that follows our previous all-hazards research: we have designated "ZIKV threat" as the response variable, driven primarily by uncertainty, severity, vulnerability, and consequence-based explanatory variables (Eddy & Sase, 2015). Threat uncertainty is clarified in the threat analysis to include individual human perception that significantly factors into the prevention and readiness responsibilities shared by individuals, communities, and agencies. Figure 1 depicts that the ZIKV threat encompasses the entire population, with a special emphasis on the vulnerabilities of at-risk populations. Potential consequences can be mitigated before and during an event by various combinations of public health outreach, including targeted public health messaging designed to encourage preventive actions. Existing community-level vulnerabilities (e.g., stagnant bodies of water) at national, state, and local levels might be known hazards requiring prevention and mitigation in advance of an event.

Based upon our existing research and survey results, we integrated all-hazards theory and law, the U.S. environmental justice Executive Order 12,898 (1994), and a human rights-based approach. The threat analysis presented in Figure 1 serves to reduce the ZIKV threat. This analysis is translational to other vectorborne diseases, including those potentially causing other neurovirulent paralytic diseases such as acute flaccid myelitis, which can enable an all-species and all-populations approach for planners.

Although One Health has been firmly established as an approach to integrating human, animal, and environmental health disease prevention, ZIKV as a viable zoonotic disease and sentinel/early indicator of human disease is not well understood (Eddy et al., 2013). Nonetheless, we support advocacy by CDC (2020b) for a One Health approach to ZIKV, both as a concern for animal health and as support for a continuing surveillance and prevention stance for all vectorborne diseases as more scientific evidence is developed.

Limitations

Confidence intervals cannot be computed because we collected nonprobabilistic data in the convenience survey. No personal identifiers were collected from those surveyed and the data on sanitarian registration was limited by a lack of geographic location information for the respondents. Although we requested the surveys be collected before the resumption of the presentation, some surveys were collected after the presentation, causing a potential bias by presentation content (e.g.,

FIGURE **1**

The Zika Virus (ZIKV) Threat: An All-Hazards and One Health Vulnerability and Consequence Analysis

$$\text{ZIKV Threat} = \left(\frac{\text{Perception of Risk and Hazard Uncertainty + Vulnerability Factors}}{\text{Level of Prevention and Preparedness}}\right) + \left(\frac{\text{Severity of Hazard Consequences to At–Risk Populations}}{\text{Protection of Human Right to Health}}\right)$$

vaccine availability was mentioned as a challenge to availability that was captured in one of the questions). This study could also have selection bias: the participants of this survey were attendees at the 2018 NEHA AEC, which might imply that they have a stronger interest in the study content than others who did not attend. Furthermore, the spectrum of professionals taking this survey might not represent the broad capacity and knowledge variances that exist among their peers in the nation.

Recommendations and Conclusion

Our survey results show a remarkable trend in respondent beliefs that ZIKV might present human rights issues. A majority of respondents regarded human rights and environmental justice as important while showing inconsistency regarding knowledge of historical disease events, associated epidemiologic terms, and disease transmission pathways. These findings indicate that the respondents share a strong commitment to public service, especially in the absence of a vaccine—perhaps even self-identifying as champions of human rights for the populations at-risk to ZIKV.

Human Behavior

The consideration of the human right to health in the context of human behavior and uncertain disease transmission pathways, including contaminated environmental surfaces, fomites and person-to-person, sexual, and fecal–oral pathways, places a new emphasis upon the separation of agency responsibility, human behavior, and the health systems necessary to prevent human ZIKV infection. Prevention relies largely on human behavior and agency service provision (Figure 1). Individuals must avoid mosquito bites to prevent the transmission of infection to others, especially bearing in mind the reality of asymptomatic transmission. Therefore, agencies must establish adequate and standardized mosquito biosurveillance and control systems.

Given that ZIKV is both anthropogenic and an STD, we emphasize human behavior as a key control factor for interventions to assure protection of at-risk populations. In the case of ZIKV, the nature of human behavior could result in life-saving or life-threatening consequences. Public health agencies, therefore, need to pay attention to not initiate or perpetuate social stigma or violate patient privacy when developing prevention guidance, reflecting an approach informed by the lessons learned from people living with HIV (Mann et al., 1994) and other communicable diseases (Sase & Gruskin, 2007).

Infrastructure and Public Health Messaging

Our analysis calls for actions to enhance public health community outreach content regarding disease transmission pathway descriptions; content needs to be clear, evidence-based (to include the specific disease transmission pathways), and able to modify the human decisions that initiate preventive and mitigative behavior (Al-Fifi et al., 2018; Eddy et al., 2010). ZIKV is yet another warning shot across the bow of the international public health system that signals the urgent need to redevelop and sustain essential public health infrastructure. Surveillance and integrated pest management systems that have been advocated by WHO for decades and enhanced public health community outreach content as discussed in Part 1 of this article series should be emphasized. In Part 2, we have outlined the need for the U.S. to commit to biosurveillance, the human right to health, protection of at-risk populations, and empowerment systems that should occur in partnership with local, state, federal, and global stakeholders.

The lessons that we are learning from ZIKV could be the most significant among the plethora of emerging and reemerging infectious diseases that have menaced the world since the global eradication of smallpox in 1980. The state of global health is a harbinger of the current condition of the U.S. public health system. This opportunity is a second chance for the U.S. to apply the knowledge acquired by lessons learned from WNV.

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

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continued on page 24

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Did You Know?

NEHA has developed an interactive and educational map of the U.S. that provides general vector and public health pest information. This resource provides comprehensive and reliable information about where vectors are known to be found throughout the country, surveillance and control methods, and vectorborne diseases. Learn more at www.neha.org/vector-map.

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GUEST COMMENTARY

Hepatitis A Vaccination of Food Service Workers in Genesee County, New York

Brenden A. Bedard, MPH
Genesee and Orleans County Health Departments
SUNY Brockport
Nazareth College

Paul Pettit, MSL
Genesee and Orleans County Health Departments
SUNY Brockport

Sarah Baldulf
Genesee and Orleans County Health Departments

Kristine Voos
Genesee County Health Department

Abstract **Hepatitis A is caused by the hepatitis A virus and can cause a gastrointestinal illness. This guest commentary describes the hepatitis A vaccination efforts by the Genesee County Health Department for food service workers. In 2019, the health department provided free hepatitis A vaccines to food service workers on a voluntary basis. In total, 83 retail food handlers received the vaccine. Education on hepatitis A and the vaccine was provided prior to vaccination to the retail food workers. Pretests and posttests were given to these retail food workers and results indicated a statistically significant change in knowledge. Based on our results, we would recommend providing the hepatitis A vaccine to restaurant food handlers.**

Introduction

The hepatitis A virus (HAV) is primarily transmitted by the fecal–oral route (Centers for Disease Control and Prevention [CDC], 2003). This transmission can occur by direct contact of an infected person or ingestion of contaminated food or water with HAV (Fiore, 2004). Once ingested, HAV causes illness in the gastrointestinal tract and replicates in the liver. People infected with HAV can develop diarrhea, fever, anorexia, nausea, vomiting, myalgia, malaise, jaundice, and dark-colored urine within 28 days (range = 15–50 days) after infection (Fiore, 2004; Heymann, 2015). Symptoms can last several weeks, with relapsing hepatitis up to one year (Fiore, 2004; Heymann, 2015). Fatalities are rare but can occur. Adults over 50 years have a higher case fatality rate (Heymann, 2015).

Foodborne outbreaks of hepatitis A have occurred from food that was not cooked after being handled by an infected food worker (CDC, 2003; Massoudi et al., 1999; Schmid et al., 2009). These outbreaks can have a significant economic impact on public health and businesses (Dalton et al., 1996; Massoudi et al., 1999). Several studies have analyzed vaccinating restaurant food handlers as a disease prevention public health strategy (Meltzer et al., 2001; Prato et al., 2006; Rebmann et al., 2016; Yu et al., 2000).

According to the Centers for Disease Control and Prevention (CDC), the first reported widespread person-to-person hepatitis A outbreaks in the U.S. were identified in 2016 (CDC, 2020a). The current opioid public health crisis and increased intravenous drug abuse could be a contributing factor to widespread outbreaks of hepatitis A throughout the country. CDC has indicated that "people who use injection or noninjection drugs (all those who use illegal drugs)" are at an increased risk for acquiring hepatitis A (CDC, 2020b). Schade & Komorwska (1988) and Sundkvist et al. (2003) investigated a continuing outbreak of hepatitis A where the cause was intravenous drug abuse. Furthermore, Wells et al. (2006) studied the prevalence of hepatitis A among injection drug users.

A national survey conducted by the Substance Abuse and Mental Health Services Administration reported that the highest rate of substance abuse and illicit drug use among adults ages 18–64 was found in the accommodations and food service industries (Bush & Lipari, 2015). Based on the national outbreaks of hepatitis A and the numerous media reports of restaurant food handlers infected, along with the ongoing opioid crisis, the Genesee County Health Department decided to investigate how to fund hepatitis A vaccines for retail food service workers.

Genesee County participates in the Food and Drug Administration's (FDA) Voluntary National Retail Food Regulatory Program Standards. In 2019, Genesee County Health Department was awarded a grant by FDA and the Association of Food and Drug Officials for a moderate project to vaccinate retail food handlers. The voluntary vaccination program was structured first by notifying any retail food

TABLE **1**

Paired Sample *t*-Test Results for Pretests and Posttests on Hepatitis A Education

Question #	Question	Question Type	Pearson's Correlation	*p*-Value
1	How is the hepatitis A virus (HAV) transmitted?	Multiple choice	-.08496	.054*
2	For long-lasting protection, you need 3 doses of the HAV vaccine.	True/false	.074427	.349
3	How can hepatitis A be prevented?	Multiple choice	.039515	.001*
4	Symptoms typically appear 2–6 weeks after exposure to HAV.	True/false	.211464	.0002*
5	Hepatitis A vaccine was first recommended in the U.S. in 2005.	True/false	-.0214	.003*

*Statistically significant.

establishments that had high-risk violations in the past. Due to the limited amount of vaccine (150 doses), retail food establishments were told that this program was a first come, first served opportunity. After the high-risk violation restaurants were given an opportunity for the free vaccine, all retail food establishments in the county had the opportunity to vaccinate their retail food handlers. The health department provided on-site education and vaccinations at the retail food establishments.

Methods

Pretests and posttests were used to evaluate the effectiveness of the hepatitis A education given on site to the retail food handlers. The pretest and posttest were developed from the CDC Vaccine Information Statement (VIS) for hepatitis A (CDC, 2020c). The community health nurse from the Genesee County Health Department used the VIS to educate the retail food handler prior to administering the hepatitis A vaccine. Prior to the education, a pretest was administered, and then the same test was administered again after the education.

The paper-based test consisted of five questions. The questions were related to the epidemiology of hepatitis A and prevention of the virus. The test consisted of two multiple choice questions and three true/false questions (Table 1). From the completed pretests and posttests, an analysis was performed using Microsoft Excel. A one-tail paired sample *t*-test was selected to determine *p*-values of the pretests and posttests.

Results

A total of 83 retail food handlers were vaccinated for hepatitis A from March to December 2019. Of the vaccinated food handlers, 66% were female participants and 34% were male participants. The median age of the retail food handlers was 42 years with a range of 19–80 years. Overall, 12 retail food establishments participated in the program and had employees vaccinated. Out of the 83 retail food handlers vaccinated, 82 took the pretest and posttest (99%). Results of the pretest and posttest identified 4 out of the 5 questions from the one-tailed paired sample *t*-test having a *p*-value < .05, which was statistically significant (Table 1). Question 2 was the only question with a *p*-value > .05.

Discussion and Conclusion

This vaccination initiative indicated that if the hepatitis A vaccine was provided for free to retail food establishments, their employees showed an interest in receiving the vaccine. Education provided to these employees based on the VIS for hepatitis A demonstrated a statistically significant change in food handler knowledge of the infection and vaccine.

With the overall rate of substance abuse among food service employees being the highest among full-time workers, along with the ongoing outbreaks of hepatitis A in the U.S., we would suggest that providing the hepatitis A vaccine to food handlers could provide increased immunity in the community and prevent transmission to restaurant patrons (Bush & Lipari, 2015; CDC, 2021; Sharapov et al., 2016). The Genesee County Health Department would like to expand this program to grocery store produce workers if funding is available. We would recommend for other health departments who might be interested in replicating this program to look for grants to help support providing education and the hepatitis A vaccine to food handlers.

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Corresponding Author: Brenden A. Bedard, 14016 Route 31 West, Albion, NY 14411.
Email: brenden.bedard@orleanscountyny.gov.

References on page 28

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Did You Know?

September is both National Preparedness Month and National Food Safety Education Month. Check out page 46 of this issue for a new column from the NEHA Preparedness Committee on individual preparedness and visit www.ready.gov/september for ways to participate in events across the country. Visit page 56 to see what NEHA has planned for National Food Safety Education Month, including a weekly webinar series and the return of our Food Safety Heroes blog.

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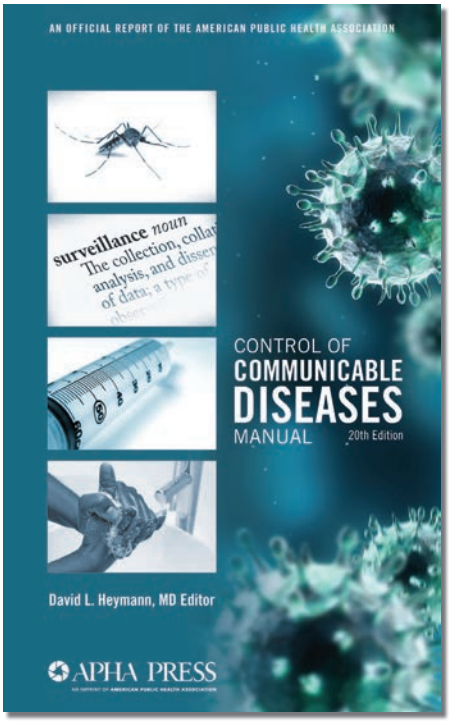

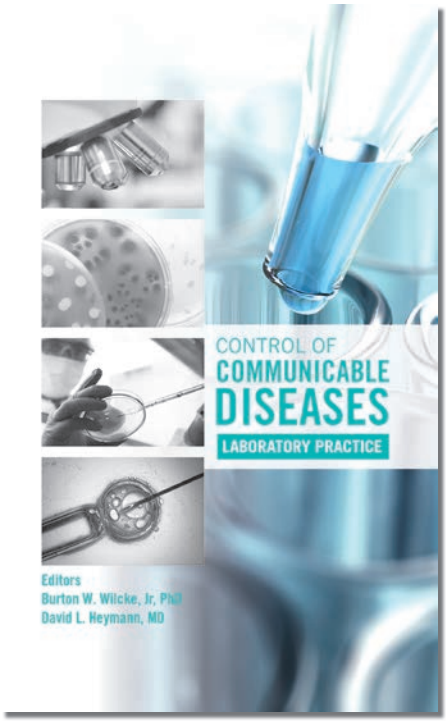

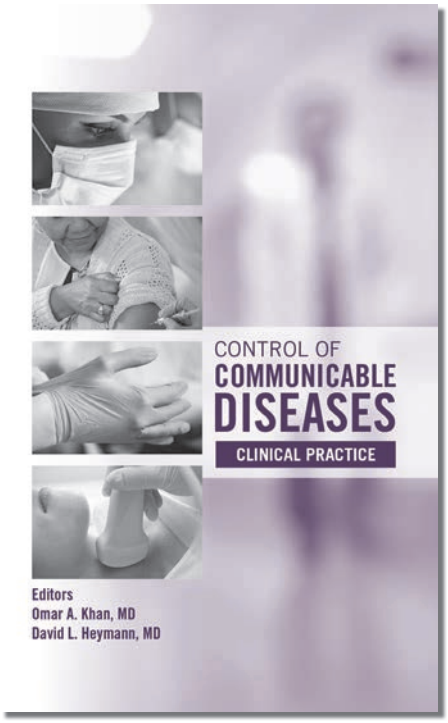

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Improving the Reliability of Food Safety Disclosure: Restaurant Grading in Seattle and King County, Washington

Zoe C. Ashwood, MS
Princeton University

Becky Elias, MBA
Food Protection Program, Environmental Health Services, Public Health—Seattle & King County (at time of study)

Daniel E. Ho, JD, PhD
Stanford University

Abstract **The reliability of food safety inspection disclosures has long been questioned. Providing meaningful disclosures to consumers based on public data is a core challenge for environmental health. We present new results, based on retrospective data and a novel randomized peer review trial, to improve the reliability of the restaurant food safety grading system that was implemented in Seattle and King County, Washington, in 2017. To address critiques of inspections as driven by inspector differences and merely "snapshots-in-time," we used data from multiple inspections and adjusted scores within each inspector area to isolate relative performance. We studied the geographic distribution, predictability, and reliability of this adjusted grading system.**

Our findings are threefold. First, critical violations are much more reliably cited than non-critical violations, providing much more reliable inputs for grading. Second, and contrary to common belief, little evidence exists that repeat violations or the time trend of scores are associated with increased risk, hence providing no useful information for grading. Third, the adjusted system, based on quantile rankings of average critical points in up to four inspections, is much more robust to widespread inspector differences in stringency. Compared with conventional systems, this system reduces unwarranted geographic and intertemporal differences and improves predictive power. We provide easy-to-use, open-source statistical software for jurisdictions to implement this approach.

Introduction

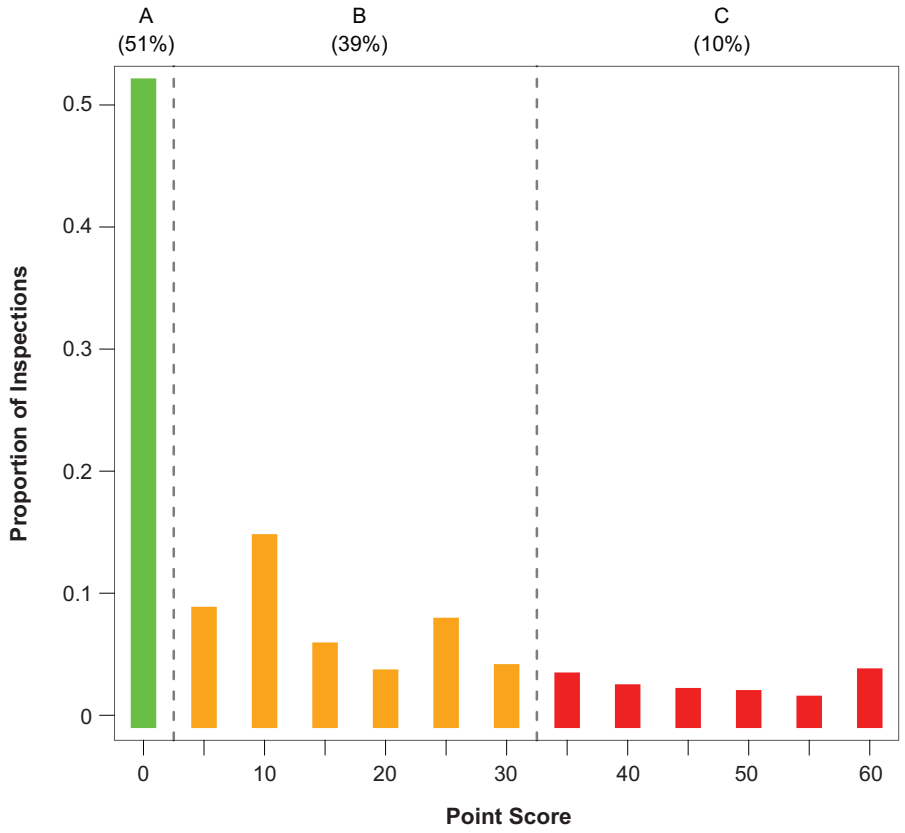
Foodborne diseases affect 1 in 6 individuals and account for roughly 3,000 deaths and 128,000 hospitalizations annually in the U.S. (Centers for Disease Control and Prevention [CDC], 2011). Roughly 60% of outbreaks are attributable to foods prepared in restaurants (CDC, 2015). Food safety inspections play an important role in reducing the public health risk of foodborne illnesses (Bekemeier et al., 2015), but local inspection systems can vary tremendously in design (Peacock, 2002). Over the past 20 years, many jurisdictions have adopted restaurant grading systems, which assign grades (e.g., A, B, C) that restaurants must publicly post to inform consumers (Ho, 2012). Conventional grading systems base a grade on the violation score, which is typically the sum of critical and non-critical violation points from a single routine inspection (Ho, 2012).

While popular among consumers, the public health community has harbored some concerns about these grading systems. The U.S. Public Health Service incorporated letter grading in the federal model food code in 1940, but the Food and Drug Administration (FDA) rescinded it in 1976 (U.S. Department of Health, Education, and Welfare, 1976) based in part on the fear that scores reflect a snapshot-in-time only (Comptroller General, 1975). Criticisms center around the validity and variability of inspection scores given rapidly changing conditions in establishments (Boehnke & Graham, 2000; Kovács et al., 2020; Wiant, 1999), the reliability of inspection scores when inspectors can vary considerably in stringency (Ho, 2012; Lee et al., 2010; Seiver & Hatfield, 2000), and consumer misperceptions of letter grades (Dundes & Rajapaksa, 2001; Seiver & Hatfield, 2000). Prior evidence is mixed as to whether inspection scores are correlated with foodborne illness outbreaks (Cruz et al., 2001; Irwin et al., 1989; Jones et al., 2004) or as to the effect of grading on illnesses, hospitalizations, or cited violations (Handan-Nader et al., 2020; Ho et al., 2019; Simon et al., 2005; Wong et al., 2015). With many jurisdictions adopting grading systems, designing grading systems to address these critiques is a challenge for public health officials.

In response to popular demand, Public Health–Seattle & King County, which is the local health jurisdiction serving King County, began in 2013 to explore the adoption of a grading system. The department met with stakeholders, studied existing grading systems, and developed criteria and hypotheses about how existing systems might be improved. For instance, stakeholders posited that the grade should be based on more than a single inspection and questioned whether

FIGURE **1**

Food Safety Inspection Score Distribution, King County, 2015



Note. Dashed lines represent how conventional systems might draw cutoffs for grade categories (e.g., A, B, C), with the second dashed line representing the return visit cutoff score (35 points). For visibility, scores are censored above 60 points.

a) non-critical violations should be included, b) repeat critical violations are a unique indicator of risk, and c) the time trend of inspection scores matters (Ho & Elias, 2019).

A particular challenge to designing a reliable grading system is that inspectors can differ widely in their stringency due to complexities of the health code and interpretation and application of risk assessment on the ground. To address this concern, the department designed a randomized controlled trial of peer review as a quality assurance system in 2014–2015 (Booth, 2016). During this intervention, inspectors jointly visited establishments but independently scored health code violations. The department found that the intervention improved interinspector reliability (Ho, 2017) and as a result adopted peer review, including more joint visits with supervisors as an ongoing quality assurance practice. Differences across inspectors in stringency remained, however, posing a challenge for designing the grading system (Ho, 2017).

We report here our analysis of data from the peer review intervention, matched sample analysis, and simulation evidence to design a more reliable, evidence-based grading system that addresses these concerns.

Methods

Grading Inputs

We used a) county inspection records for 6,392 establishments that had been subject to two routine inspections per year (so-called "risk level 3" permits in King County that are based on complexity and risk of food preparation) and b) results from peer-review inspections to determine the factors that should be used to grade an establishment. While our subsequent analyses focus on these "high-risk" facilities, a similar grading protocol was adopted for lower-risk establishments (see Supplemental Appendix at www.neha.org/jeh/supplemental). Several permit types, such as grocery stores and food trucks, were exempt from this grading process due to differences in permitting, operations, and inspections.

Critical Violations

When health inspectors visit an establishment, they report both critical and non-critical violations in the inspection report. Whereas critical violations are described as "improper practices or procedures identified as the most prevalent contributing factors of foodborne illness or injury," non-critical violations are "preventive measures to control the addition of pathogens, chemicals, and physical objects into foods" (Public Health–Seattle & King County, 2013). To assess predictive validity of critical violation points, we merged data from the 57 cases of instances of probable or laboratory-confirmed foodborne illnesses linked to establishments that triggered full investigations from 2012–2016 with data from 51,757 routine inspections.

We used logistic regression to assess the predictive power of critical and total inspection scores on the probability of outbreaks. To assess reliability of critical violations, we used data from 378 peer-review inspections, during which inspectors observed identical conditions and independently scored 52 health code violations. We used logistic regression to test whether the probability of agreement on a code item by two inspectors was associated with critical versus non-critical violations, controlling for the baseline citation rate and establishment identifiers (n = 19,656).

Repeat Violations

To test whether repeat violations had unique predictive power over subsequent performance, we used matched sample analysis (Imbens & Rubin, 2015; Rubin, 2006). In each year, we matched restaurants that received identical critical violation points in each of two rounds of inspections, but we defined the "treatment" group as establishments with at least one repeat violation of the same code item—which the control group did not have. We tested outcome differences in the subsequent routine inspec-

tion using subclassification for exact matching (Imbens & Rubin, 2015).

Time Trends

To test for whether time trends mattered, we again used matched sample analysis. We calculated all unique strictly increasing sequences of scores across two inspections (i.e., restaurants with worsening trends). We matched these with establishments with reverse sequences (i.e., restaurants with improving trends). We tested for outcome differences in the subsequent inspection again using subclassification for exact matching.

Time Period

To determine the number of inspection rounds to use as a grading input, we used regression analysis, sequentially adding historical rounds of inspections going back 20 inspection periods. We studied the marginal predictive power of the additional inspection round and compared that against the reduction in restaurants with requisite historical data.

Grading Systems

We used inspection records to determine the grade distribution under a conventional grading system and under our proposed quantile-adjusted system.

Conventional (Unadjusted) Grading

Figure 1 displays the distribution of critical violation points for a single inspection round in 2015 for 6,392 establishments, which is highly skewed. Conventional systems might classify roughly 50% of establishments with no critical violations as the top category (A). Such systems also often use thresholds for a return visit (e.g., >35 points in King County) to distinguish the middle and bottom categories (B and C, respectively). As Figure 1 shows, applying a conventional system to King County would result in roughly 50% of establishments receiving an A grade, 40% receiving a B grade, and 10% receiving a C grade.

Quantile-Adjusted Grading

Our proposed grading system leverages the fact that inspectors are principally assigned to inspect food establishments based on ZIP codes. Given the geographic dispersion of many jurisdictions, such area assignments are common, but our method could also be adapted to alternative inspector assignment schemes. In earlier work, we determined that ZIP code differences are substantially more likely to represent differences due to inspectors, rather than establishments (Ho, 2017).

Our solution was to use a quantile adjustment, which identifies the same quantiles within each inspector area on an annual basis. We set these quantiles based on the county-wide breakdown of 0-point inspections and return-eligible inspections so as to reflect absolute changes in compliance over time. In 2015, these cutoffs would correspond to the 0.5 and 0.9 quantiles distinguished by the green, orange, and red bars in Figure 1. Our Supplemental Appendix spells out statistical details, but Figure 2 provides the application of the adjustment in one area. The left panel presents inspection scores under a lenient inspector and the right panel presents inspection scores for a stringent inspector after an area rotation.

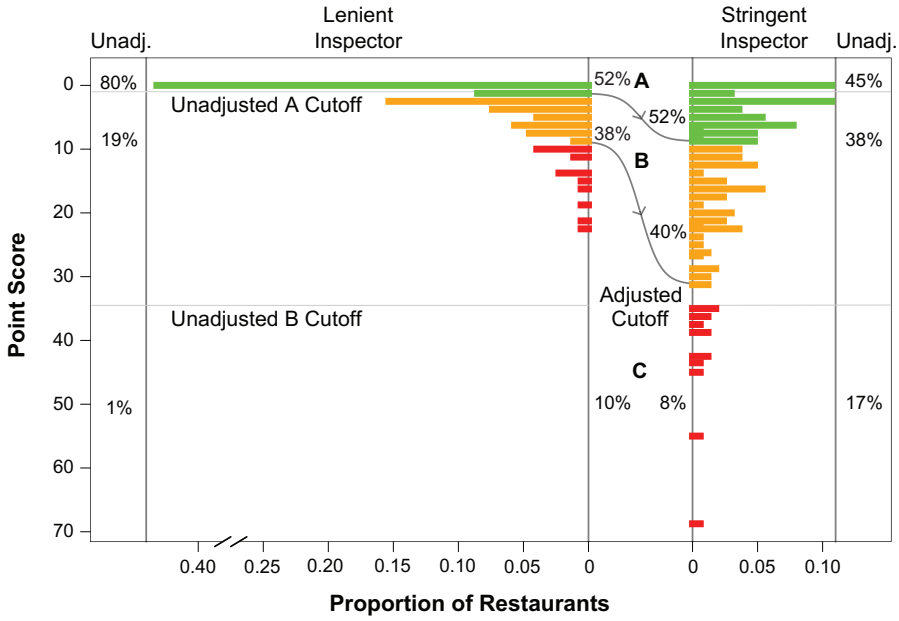
Using unadjusted cutoffs would shift the proportion of A, B, and C grades considerably after an area rotation. The quantile adjustment identifies cutoffs relative to each ZIP code, thereby reducing false negatives under the lenient inspector and false positives under the stringent inspector. While other jurisdictions have attempted a similar adjustment based on the normal distribution (Holmes, 2016), health inspection scores do not necessarily follow a normal distribution (Figure 1) and our approach provides a more flexible (nonparametric) way of identifying groups without strong distributional assumptions (Koenker, 2005).

Assessment

To assess the performance of the adjusted grading system, we used regression analysis with inspector-fixed effects to simulate how sensitive grades are to inspector differences under either grading system. We leveraged area rotations to examine how each system performs in terms of a) geographic distribution and reliability by comparing the proportion of grades assigned to each ZIP code and b) predictive reliability by comparing the assigned grades over area rotations of inspectors.

FIGURE **2**

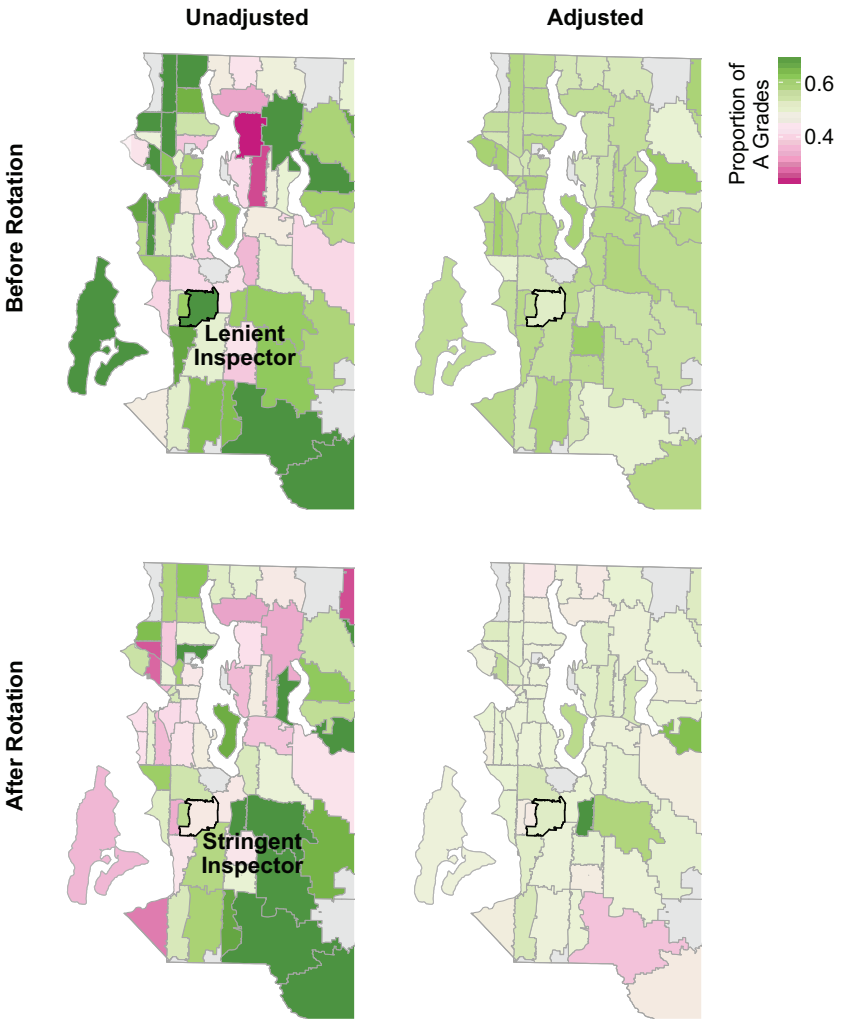
Adjusted Food Safety Inspection Grading Methodology for Score Distribution for the Same ZIP Code, King County, 2015



Note. Histograms represent scores for the establishments in the same ZIP code under a lenient inspector and a stringent inspector on the left and right (before and after an area rotation), respectively. Adjusted grading identifies area-specific cutoffs each year, indicated by the middle curved lines, that typically preserve the relative percentages for each grading category. Unadj. = unadjusted.

FIGURE **3**

Geographic Distribution of Food Safety Inspection Grades Across King County, 2015



Note. The left and right panels plot grades under the unadjusted and adjusted grading systems, respectively. The top and bottom rows plot grades before and after an area rotation, respectively.

Results

Grading Inputs

Critical Violations

Both the overall inspection score and critical violation score are statistically significant predictors of foodborne illness outbreaks (*p*-values <.05, see Supplemental Appendix, Section A). This finding confirms case-control results from King County in 1986–1987 that showed lower scores and critical violations were associated with outbreaks (Irwin et al., 1989). As outbreaks are rare events, however, sensitivity and specificity are low. Using receiver operating characteristic (ROC) curves, the area under the ROC curve (AUC) is only 0.58 using critical points and 0.63 using overall points (see Supplemental Appendix, Section B).

During peer review, inspectors disagreed on citing at least one code item in nearly 60% of inspections, even though they observed identical conditions. Logistic regression results showed that non-critical violations exhibit substantially lower interinspector reliability (*p*-value <.001), a finding robust to controls for baseline citation rates and restaurant fixed effects. This result is consistent with the focus of state and county training primarily toward critical violations.

As critical violations are both indicative of the highest risks for foodborne illness and more reliably inspected, we excluded non-critical violations as an input to grading.

Repeat Violations

We found little evidence that repeat violators perform worse on subsequent inspections from 2006–2012. In one year (2008), repeat violators even appear to perform statistically better on subsequent inspections. The only evidence that repeat violators perform worse comes from 2013–2014. As explained in the Supplemental Appendix, there are strong behavioral reasons to think that this finding is an artifact of internal reporting that flagged establishments likely due to repeat violations and changing citation behavior rather than a genuine test of repeat violations. Due to the lack of consistent evidence, we ruled out using the presence of repeat violations as input to grading.

Time Trends

Contrary to conventional wisdom, we similarly found little evidence that time trends predict subsequent outcomes and hence we do not consider forecasting grades based on time trends.

Time Period

Although most conventional grading systems use only a single routine inspection, we found that inspections beyond the last inspection add predictive power. A 1-point increase in the last inspection was associated with a 0.31-point increase in the next inspection. Coefficients for the second, third, fourth, and fifth last inspections are 0.21, 0.15, and 0.09, and 0.06, respectively (*p*-value <.01 for all). By the sixth last inspection, however, the coefficient was statistically insignificant. As only two routine inspections are conducted for high-risk restaurants per year, the number of restaurants with a full inspection history diminishes as we go back further. Given a relatively pronounced break in predictive power around 4 to 5 inspections, we decided to use

up to four inspections as inputs to grading. See the Supplemental Appendix for a description of how we handled grades for establishments with fewer than four inspections.

Comparison of Adjusted and Unadjusted Grading

We compared how quantile-adjusted grading differs from a conventional unadjusted system. Based on our results, the quantile adjustment takes as an input the average critical violation points over up to four inspections (we used an unweighted average for explainability purposes) and assigns grades based on ZIP-code specific cutoffs to approximate the 50%, 40%, and 10% breakdown of A, B, and C grades for 2015, respectively.

First, our simulation results showed that moving from the 10th to the 90th most stringent inspector in the county and controlling for establishment dummy variables would eliminate an A grade for over one half of King County establishments. This finding confirms how critical adjustments for interinspector differences are to designing a reliable disclosure system. By construction, these arbitrary differences due to inspector assignment disappear under the adjusted system.

Second, adjusted grading improves arbitrary geographic differences. The left panels of Figure 3 depict the distribution of A grades under conventional grading. Superficially, the top left panel would suggest that there are sharp differences across areas of King County. After an area rotation, however, the geographic concentration of A-grade restaurants would shift dramatically. For instance, the outlined area of Tukwila (12 miles south of Seattle) had a lenient inspector prior to the rotation, which would result in 80% of restaurants with an A grade, but after the more stringent inspector rotated in, only 45% of restaurants would earn A grades (Figure 3). The lenient inspector rotated to Kent, continuing to score restaurants leniently, which would in turn reduce C grades in Kent from 11% to 3%. Such sharp changes can cause tension between operators and inspectors, as well as among inspection staff.

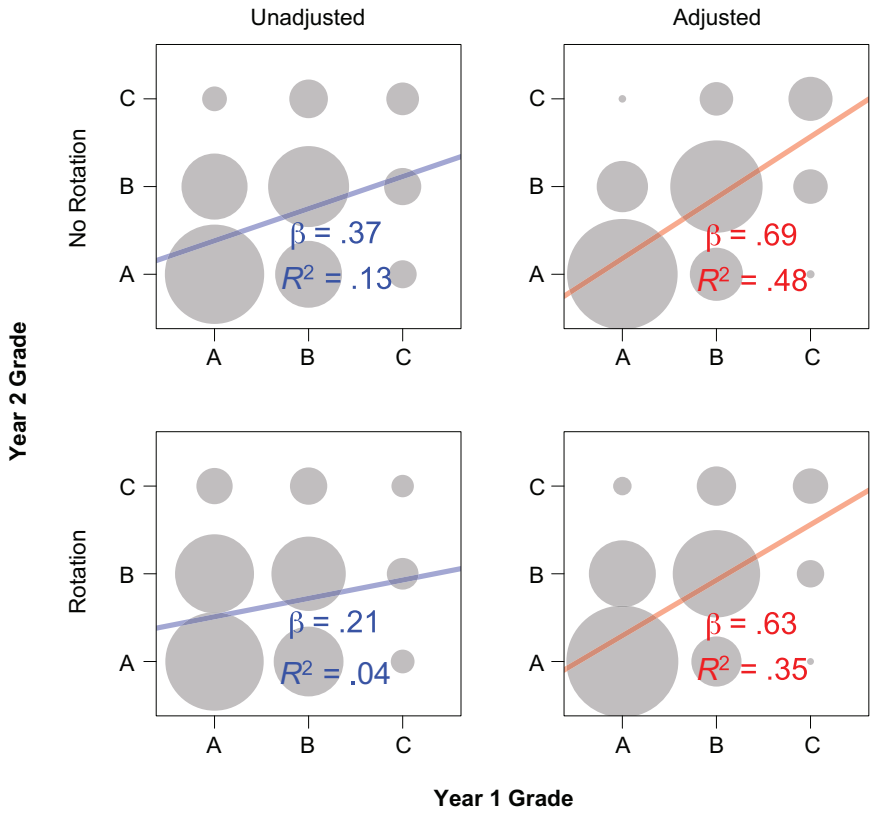
The right panels of Figure 3 show that adjusted grading smoothens out these arbitrary geographic differences. Within each area, the quantile-adjusted grading system can identify relative performance (e.g., top 50% for A grades, bottom 10% for C grades) regardless of inspection styles. Geographic location and convenience are known to be major factors in dining choices (Auty, 1992; Johns & Pine, 2002); as one researcher phrased it: "competitive rivalry in the restaurant sector is such that all competition is local" (Parsa et al., 2011). As King County covers a 2,307 mi^2 area, relative performance in an area might also be more meaningful for consumers and for providing establishments with an incentive to improve.

Third, we examined the predictive power and temporal consistency of grades under either system. The premise of grading is that the posted placard should inform consumers about prospective conditions. Figure 4 plots the grade distribution across years where there was no area rotation in the top row (2014–2015) and across years with an area rotation in the bottom row (2013–2014). Dots are weighted by the number of establishments with a particular grade combination, so that dots aligned on a 45-degree line indicate that prior grades are the same as subsequent grades. The left panels plot unadjusted grades and the right panels plot adjusted grades, with regression coefficient and R^2 values noted. Unadjusted grading performs particularly poorly when there is an area rotation (R^2 = .04). Adjusted grades have a much higher predictive power (R^2 = .35–.48) over subsequent grades. This improvement in predictive power holds even when adjusted grades do not use any inspections from the prior year.

Last, we examined the grade distribution of outbreaks under both systems. The propor-

FIGURE **4**

Predictive Reliability of Food Safety Inspection Grades



Note. Each panel plots the distribution of grades from one year to the next, with dots proportional to the number of establishments receiving that grade combination. The left and right columns plot grades under the unadjusted and adjusted systems, respectively. The top and bottom rows plot grades when inspectors remain in the same area and when inspectors are rotated across years, respectively.

tion of restaurants involved in outbreaks that received A grades was 40% in the unadjusted system and 37% in the adjusted system. While the direction of this shift is desirable, the distributional difference was not statistically significant (using a chi-squared test). This finding is perhaps not surprising given the small number of probable or confirmed outbreaks, and the high stochastic component to foodborne illness outbreaks (CDC, 2011).

Discussion and Conclusion

While many jurisdictions have rapidly adopted grading systems, our findings help to address the skepticism that led FDA to rescind grading in 1976. First, it is possible to reduce the effects of interinspector variability by quantile adjustment. This adjustment is akin to grading standards commonly deployed when a predominant concern is about differences in graders (i.e., inspectors) (Guskey, 1994; Levit & Downs, 1997). Second, such grading can reduce perverse incentives for inspectors, who might be reluctant to cite violations dispositive of a grade, leading potentially to grade inflation (Ho, 2012; Wikström, 2005). As cutoffs vary over time and the inspector has limited control over a grade, the system could also have the benefit of defusing tension with operators on site.

While quantile grading is a considerable improvement, it does not address all skepticisms of grading. First, the need to explain the system to both consumers and operators prohibits more advanced statistical adjustments that could distinguish area- versus inspector-specific effects (DeVellis, 2016). Second, the use of the system alone cannot ensure that consumers adequately understand the information, which led King County to engage in a series of usability studies to determine the design of placards. Third, the system does not fix the first-order issue of ensuring that food safety professionals accurately and consistently implement the health code based on risk principles, which is better addressed through quality assurance initiatives such as peer review or FDA standardization (Booth, 2016). Fourth, designing such a system on a firm evidence basis can be costly and shift public resources in unanticipated ways (Ben-Shahar & Schneider, 2014; Dranove et al., 2003). Last, a grading system can exist in some tension with the emerging focus on hazard analysis critical control point (HACCP) principles (Seiver & Hatfield, 2000).

Environmental Health Implications

Based on these results, which we presented in 2016, King County implemented a version of this grading system in 2017. This implementation, alone, has implications on a substantial population, as King County is the eighth largest jurisdiction in the country in terms of permitted establishments. Our findings, however, also have broader, concrete implications for how other public health departments should think about restaurant grading and food safety inspections. Given the core challenge of high variability in food inspection staff practices that we have documented in this study, existing inspection systems should a) consider improving inspection reliability with solutions such as peer review before adopting grading and b) design grading systems to adjust for interinspector differences (using the free, easy-to-use, open-source statistical software we provide) and to focus on critical violations over a longer period of time than a single inspection.

Adjusted grading is a considerable improvement to meet the consumer demand for information disclosure about food safety that is not only succinct but also more reliable. Disclosures of restaurant inspections are an important toolkit in public health regulation and grading, in particular, has been a critical case for our understanding of health and safety disclosures more generally (Fung et al., 2007). We hope that these results will promote other research to place health disclosures on a firmer evidence basis.

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Corresponding Author: Daniel E. Ho, Stanford University, Crown Quadrangle, 559 Nathan Abbott Way, Stanford, CA 94305-8610. Email: dho@law.stanford.edu.

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continued on page 36

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Did You Know?

The NEHA-FDA Retail Flexible Funding Model Grant Program application portal will open September 9! Awarding $6 million over a 3-year period, this new grant program serves to leverage and advance the food safety efforts of retail food regulatory agencies through conformance of the Voluntary National Retail Food Regulatory Program Standards. Learn about application requirements, important deadlines, and actions to take to prepare a successful application at www.neha.org/retailgrants.

BUILDING CAPACITY

Darryl Booth, MBA

Build Capacity by Automating the Boring Stuff

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, the National Environmental Health Association (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 over 20 years. He serves as technical advisor to the NEHA data and technology section.

I came across a book with a provocative title, *Automate the Boring Stuff With Python: Practical Programming for Total Beginners*, by Al Sweigart. Python is a programming language and this book serves as the entry-point for new programmers. But just ignore that for a moment.

It's the premise that I love: Automate the boring stuff.

I would never deride anybody's chosen craft or all the hard work that goes into its daily execution, so I'll pick apart my own job for a moment. There's the exciting stuff that gets my heart pumping and then there's the boring stuff:

- Finding time on others' calendars, especially outside of your organization.
- Spending time on expense reporting, time-tracking, mileage reports, and the like.
- Weeding through my inbox.
- Making simple, routine, and repetitive responses to emails.
- Maintaining my to-do list.

Alright, so what about environmental health professionals? What is the boring stuff that could be automated?

- Scheduling inspections.
- Coordinating with operators.
- Following up on inspection documentation.
- Writing out the details for common violations along with the corrective actions.
- Organizing photos.

Most data systems automatically schedule routine and follow-up inspections for you. Hopefully that's covered. Many systems also allow your department or bureau to create a library of standard comments and paragraphs that can be pasted and edited. But perhaps we could do better with automation.

Remember Machine Learning and Artificial Intelligence?

Worldwide businesses are leaning in on artificial intelligence (AI) and machine learning (ML). In short, these concepts mean that instead of hiring a programmer to code the behavior of a system based on a specification, we can train a system by feeding it millions of examples of historical desired behavior. Train, not code.

In the April 2020 Building Capacity column, *Experimenting With Artificial Intelligence to Build Capacity*, we investigated how ML and AI could be used to "score" or predict the likelihood of food safety violations and perhaps, by extension, the likelihood of foodborne illness (www.neha.org/sites/default/files/jeh/JEH4.20-Column-Building-Capacity.pdf). We explored training the model with years of inspection history, inspector commentary, and additional factors such as facility ownership and longevity in the program.

Automating Routine Communications

I'm warming up to the predictive text feature recently added by Google's Gmail (branded Smart Compose) and Microsoft Outlook 365

FIGURE **1**

Example of Predictive Text

Note. In the example above, the inspector began by typing "No irreversible temperature" and the system proposed the light grey text as a possible finish. To accept the completion, the inspector presses the tab key and moves on to compose the next sentence. The proposed language was learned by previously entered comments.

(branded Text Predictions). Maybe you've noticed it. The system predicts the rest of your sentence as you type (Figure 1). If you like the suggestion, you can press the tab key to accept the proposal and, voilà, you've added a computer-generated response right into your communications!

If you choose to ignore the suggest text, you can continue to type out what you had in mind. The system abandons its suggestion and learns just a little bit more about how you like to respond in different contexts.

In these and similar features, the machinery is trained in advance by feeding it millions, maybe billions, of common language phrases. Depending on the computing power, the system might offer only the next likely word. In more powerful applications, the system could propose the exact next sentence or even the next paragraph.

In one example I studied, the system was trained with the complete works of Shakespeare. This exercise yielded a very strange result, indeed. Or I should say, "This did yield a v'ry strange result, forsooth."

Automating Inspector Comments and Office Communications

To apply this concept to our space, we must begin with examples of well-formed communications. Guess what? Most health departments, having been computerized for 10–20 years, have years of inspector comments and other communications.

In fact, one large inspection database to which I have access includes over 250,000 inspector comments! When we train a model using an environmental health professional's distinct language, the system begins to make recommendations that are in line with the type of communications we need to express on our inspection reports.

You might ask, "What about variability?" or "What about the rogue inspector who didn't adhere to the department 'style guide' for inspector comments?" The answer is twofold. First, if those authors are known, they can be explicitly excluded. Second, the "poor practices" of the minority of authors is quickly overshadowed by the preponderance of good examples. Further, as inspectors decline poorly worded suggested text, the model learns that they (the poorly written communications) are out-of-favor, essentially downvoting them out of existence. So, it's not a one-time configuration—it's learning.

I have one more aspiration for this feature request: facility-specific comments. If I'm at a facility that lacks a walk-in cooler, then no proposed text should ever reference a walk-in cooler. If I just took five temperature readings, then the proposed narrative should insert those readings interstitially into the proposed comment.

Conclusion

The examples above are aspirational today, but they are not science fiction, It's a matter of applying the available tech to more and more precise job functions. In the coming months and years, you might be invited to train, evaluate, and influence automation that can reduce keystrokes and improve automation. Remember that improving the underlying systems has a multiplier effect on the output of all its operators.

Corresponding Author: Darryl Booth, General Manager, Environmental Health, Accela, 2633 Camino Ramon #500, San Ramon, CA 94583. E-mail: dbooth@accela.com.

DIRECT FROM AEHAP

Jamie D. Hisel, MPH
Eastern Kentucky University

Kim Hall, PhD
Western Carolina University

The Association of Environmental Health Academic Programs Takes Action

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

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

Jamie Hisel is the past president of AEHAP and a clinical faculty member at Eastern Kentucky University. Kim Hall is the president of AEHAP and an associate professor at Western Carolina University.

The last year has taken the world by storm and put a spotlight on the need for competent environmental health and public health professionals. Environmental health professionals across the nation and the world were and continue to be on the front lines fighting the pandemic and helping us get to the point we are today. Without their knowledge, training, and expertise, things would have likely turned out much worse with even more lives lost and a grim outlook for the future. It doesn't take a pandemic, however, for us in the environmental health field to know and realize the importance of environmental health. The Association of Environmental Health Academic Programs (AEHAP) was founded in 1999 to address a severe environmental health workforce shortage by promoting and supporting environmental health science degree programs accredited by the National Environmental Health Science and Protection Accreditation Council (EHAC). With the pandemic highlighting an even greater need, the AEHAP Board of Directors (BOD) decided it was time to take action.

Program Outreach

A roundtable discussion was hosted during the 2020 AEHAP Annual Meeting, giving environmental health program directors across the nation an opportunity to discuss the challenges and needs with their respective academic programs. While the discussion was enlightening and informative, it left a lot of questions on how AEHAP can help support these programs during this difficult time. The AEHAP BOD quickly developed a program outreach initiative in which each board member was responsible for personally reaching out to an assigned number of program directors to have in-depth conversations regarding the needs of their respective programs.

As the outreach efforts began, immediately there were some common themes that began to appear among all programs. Recruitment and student engagement was among the top need expressed by program directors. Higher education has taken significant financial hits in recent years requiring many environmental health programs to operate with fewer resources, which leaves little time, energy, and effort for recruitment.

The COVID-19 pandemic only exasperated the recruitment shortfalls by taking away many of the traditional recruitment methods. Many academic programs were left scrambling to fill in the gaps and recruitment often took a backseat to the sudden shift to online learning that was necessary last year. Several program directors noted challenges with engaging students in the online learning environment as it did not always allow for the hands-on instruction that is characteristic in environmental health programs. Instead of focusing on new student recruitment, programs

reported focusing on retention of current students who faced a myriad of challenges, including health and safety concerns, work and family responsibilities, and a preference for in-person instruction.

As higher education returns to normal operations and concerns of student engagement begin to alleviate, environmental health programs can begin to redirect efforts toward recruitment and engage students with in-person, hands-on education to help prepare them for environmental health practice. The AEHAP BOD understands the importance of recruitment and is committed to developing new, innovative, and effective recruitment materials to distribute to our programs this upcoming academic year. These materials will not only introduce the environmental health field and its career possibilities but also spark a passion for the profession and help students to visualize the contributions they can make as the next generation of environmental health professionals.

National Student Environmental Health Association

The National Student Environmental Health Association (SEHA) was developed by AEHAP during the 2019–2020 academic year. The purpose of the organization is to bring together people knowledgeable in and zealous for environmental health to promote the advancement of the science and practice. The organization also brings together members of the faculty and student body on a basis of mutual interest, understanding, and helpfulness. Student organizations have a longstanding history in higher education and have proven over the years to provide valuable leadership, networking, and service opportunities to students (Rosch & Collins, 2017). Student organizations can serve as a valuable tool for student engagement leading to student retention and higher graduation rates, overall academic and career success, greater leadership capacity, and even increased cognitive and social development (Mayhew et al, 2016; Reese, 2003). The AEHAP BOD understands the positive impact student organizations can have on academic programs and was committed to this initiative.

SEHA was officially rolled out during spring 2020 just ahead of the COVID-19 pandemic. While we had high hopes for a strong start to SEHA, the pandemic rightfully took center stage and we were able to add only a couple of chapters to our national student organization. After a few outreach efforts and information sessions, SEHA has been receiving some interest and we hope to add several more chapters to the organization with this next academic year. We are excited for the future of SEHA and hope this national student organization will play an important role in engaging the next generation of environmental health professionals early on and provide them with valuable leadership and networking opportunities.

First Annual Student Symposium

On May 11, 2021, AEHAP hosted its 1st Annual AEHAP Environmental Health Student Symposium. The symposium brought together students and faculty from all over the country in a virtual format to showcase the research of the 2021 winners of the Student Research Competition and NSF International Internship. We were also fortunate to have a special keynote address from NEHA Executive Director Dr. David Dyjack. The event was a success and is something we plan to continue each year as it is an excellent platform to bring together students, faculty, and environmental health professionals to share ideas and showcase some of the impressive student research projects.

Future Plans

AEHAP, in concert with the American Academy of Sanitarians and EHAC, has been working to develop a certificate program to recognize the achievements and competencies of students graduating from accredited programs of environmental health. With the recent introduction of the Environmental Health Workforce Act (H.R. 2661) by Representative Brenda Lawrence (D-Michigan), we feel it is imperative to help support this initiative by providing our programs with valuable resources to ensure they are able to provide quality education and training for future environmental health professionals.

Since the Great Recession in 2008, more than 50,000 state and local environmental health workforce jobs have been lost (Robin & Leep, 2017) and approximately 50% of the environmental health workforce will be eligible to retire by 2023 (Bogaert et al, 2019). Now, more than ever, the field of environmental health needs action. We need a more robust and diverse workforce and we will only achieve that by investing in our accredited environmental health academic programs. AEHAP is committed to continuing these efforts, but we will not be able to do it alone. It will take the collective efforts of all of us in environmental health to support our academic programs to recruit and retain the next generation of environmental health professionals. Our future depends on it.

Corresponding Author: Jamie D. Hisel, Past President, Association of Environmental Health Academic Programs; Clinical Faculty, Department of Environmental Health, College of Health Sciences, Eastern Kentucky University, 521 Lancaster Avenue, 220 Dizney Building, Richmond, KY 40475.
Email: jamie.hisel@eku.edu.

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DIRECT FROM CDC ENVIRONMENTAL HEALTH SERVICES

Beth Wittry, MPH, REHS

Jasen Kunz, MPH

Elaine Curtiss, MEd

Environmental Assessments: An Important Part of Outbreak Investigations

Editor's Note: The National Environmental Health Association (NEHA) strives to provide up-to-date and relevant information on environmental health and to build partnerships in the profession. In pursuit of these goals, NEHA features 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.

LCDR Beth Wittry and CDR Jasen Kunz are environmental health officers and Elaine Curtiss is a health communicator. All work in CDC's National Center for Environmental Health.

Environmental assessments (EAs) help ensure outbreaks are fully understood and addressed to protect health (Brown et al., 2017). Key information about the outbreak—how and why it happened and what interventions should be implemented—is not always obvious and can be challenging to determine. Conducting EAs during an outbreak investigation helps determine control measures to prevent future outbreaks.

Collaborative Efforts Guide Environmental Assessments

Collaboration between environmental, epidemiological, and laboratory investigators helps guide an outbreak response. During an investigation, epidemiologists focus on who got sick (host) and when and where the outbreak happened. Laboratorians analyze clinical specimens to determine what made people sick (agent). Environmental health specialists collect environmental samples and data to see how the agent was able to infect the host.

Sharing outbreak data can help determine the system failures (contributing factors) and root causes (environmental antecedents) of an outbreak. These data also help investigators recommend actions to stop the outbreak and prevent another one.

Environmental Assessments Help Investigators Learn How and Why an Outbreak Occurs

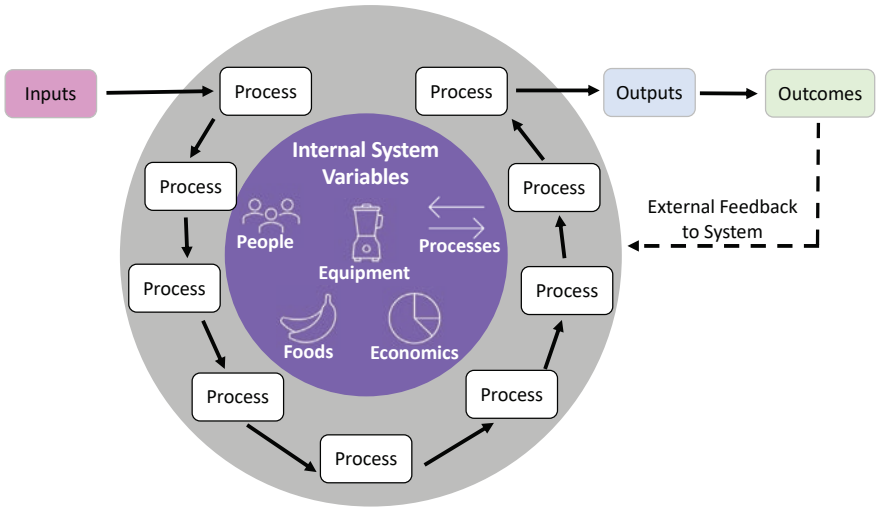
An EA helps investigators describe where the outbreak happened (outbreak environment). Investigators study the outbreak environment, like a system made up of many parts. They examine how parts of the system—inputs, processes, variables, outputs, and outcomes—influence one another (Figure 1) to determine how the outbreak occurred (contributing factors). They can then examine which variables, such as processes, people, economics, and equipment, are responsible for the outbreak (environmental antecedents).

For example, when recurring outbreaks of acute gastroenteritis occurred on two cruise ships in 2019 (Rispens et al., 2019), investigators suspected norovirus as the agent based on the symptoms experienced and duration of illness. They collected epidemiological data and based on prior knowledge, they focused on frozen berries and fruits most likely consumed in smoothies. The investigators sent suspected frozen fruit items to the laboratory for testing and norovirus was found in the samples. Investigators now knew exactly *what* was causing the illness; however, they did not know *how* and *why* it got into the environment.

During the EA, investigators created a flowchart to map out how the fruit items were prepared for smoothies, which helped determine whether any steps in food preparation on the ship contributed to the fruits being contaminated. The flowchart did not reveal any issues on the ship, so investigators moved their focus to the supplier. The investigators were able to trace the frozen berries back to a single supplier and determined that contamination most likely occurred from this source. As a result, the World Health Organization issued a recall notice for those berries. Without a traceback investigation to confirm a supplier-based outbreak due to contaminated food, people would have likely continued to get sick.

FIGURE **1**

Diagram of the Food Safety System



Data Collected During Environmental Assessments Can Help Inform Prevention Efforts

Illness outbreaks are common in food settings. Data from the Centers for Disease Control and Prevention (CDC) show that restaurants with certified kitchen managers had lower rates of foodborne norovirus outbreaks compared to those without certified kitchen managers (Hoover et al., 2020). In addition, EA data from 404 outbreaks showed key gaps in retail food safety practices and outbreak investigations, particularly around sick workers who were noted to be a common source of food contamination and outbreaks (Lipcsei et al., 2019).

EAs can also apply to other settings, like outbreaks related to water. For example, outbreak investigations of Legionnaires' disease require an EA to identify potential sources of exposure (Garrison et al., 2016) and such assessments have shown that water management programs are an effective control strategy for preventing *Legionella* outbreaks (Clopper, Kunz, Salandy, et al., 2021).

Environmental Assessments Are Different From Inspections and Require Different Training

Routine inspections look at regulations, operational violations, and sanitary conditions during normal operations when there is no outbreak. EAs look for clues to understand how factors in the environment led to an outbreak. Since outbreaks can be infrequent in a community, EAs might not be common for health department staff. Everyone needs to know their roles during an outbreak investigation. Training staff before the emergency means they will be ready when an outbreak occurs.

Centers for Disease Control and Prevention Tools to Help Conduct Environmental Assessments

CDC's National Environmental Assessment Reporting System helps food safety programs capture EA data from investigations of foodborne illness. Programs can join for free and use their data to help identify environmental causes of outbreaks and take follow-up actions to reduce or prevent future outbreaks. CDC's Environmental Assessment Training Series provides training on the role of EAs in the context of outbreak investigations and the food safety system.

The *Legionella* Environmental Assessment Form helps investigators assess a facility's water system, determine whether to conduct *Legionella* environmental sampling, and helps investigators design sampling plans. The CDC Toolkit for Controlling *Legionella* in Common Sources of Exposure can further support EAs during public health investiga-

Quick Links

- Read more about the National Environmental Assessment Reporting System findings from norovirus outbreaks in restaurants: www.cdc.gov/nceh/ehs/nears/norovirus-outbreaks-restaurant-practices.html
- Explore the *Legionella* Environmental Assessment Form, *Legionella* Control Toolkit, and training videos: www.cdc.gov/nceh/ehs/activities/legionella.html
- Find tools to help you conduct assessments after an emergency: www.cdc.gov/nceh/ehs/rra/conducting-assessments.html

Environmental Assessment Data

States, tribes, localities, and territories can adopt the Food and Drug Administration's *Food Code* for their own restaurant food safety rules. The Centers for Disease Control and Prevention's environmental assessment (EA) data show that states that have adopted the *Food Code* provision on certified kitchen managers have fewer norovirus outbreaks.

Data from the National Environmental Assessment Reporting System (NEARS) have also helped us understand the following:

- Why investigators did or did not conduct EAs for outbreaks.
- Practices linked to smaller and shorter norovirus outbreaks in restaurants.
- Traits to outbreaks that helped investigators identify their contributing factors.

Learn more about findings from NEARS at www.cdc.gov/nceh/ehs/nears/publications.htm.

Environmental Health Practitioners Fill Key Roles in Outbreak Investigations

- Assess a specific event that occurred in the past using critical thinking.
- Focus on how and why a pathogen got into the outbreak environment and spread.
- Collect data through interviews, observations, record reviews, and environmental sampling.
- Use data from their assessment, laboratory, and epidemiology findings to inform what should change to stop and prevent future outbreaks.
- Identify contributing factors and environmental antecedents to the outbreak.
- Implement interventions and make recommendations to help stop and prevent future outbreaks.

What Is the Difference Between Contributing Factors and Environmental Antecedents?

- Contributing factors: How an outbreak happened—behaviors, practices, and environmental conditions that led to the agent getting into, surviving, or growing in the environment. For example, an *E. coli* outbreak happened because the food worker did not cook a burger long enough or to a hot enough temperature to kill the *E. coli* in the beef.
- Environmental antecedents: Why an outbreak happened—conditions that led to the contributing factor(s). For example, it was lunch rush and the worker was in a hurry and did not check to make sure the burger was cooked to proper temperature. Ultimately, this antecedent might be due to a lack of food safety culture or a lack of active managerial control in the restaurant.

Photo 1. The Centers for Disease Control and Prevention's (CDC) Legionella *Environmental Assessment Form,* Legionella *Control Toolkit, and instructional videos can help investigators learn how to conduct assessments and collect samples. Photo courtesy of CDC.*

tions. The toolkit contains essential information regarding design, operation, maintenance, and controls specific to the source of exposure (Clopper, Kunz, & Hannapel, 2021). Investigators can watch educational videos (Photo 1) to learn tips for conducting these EAs and how to interpret results from the form.

Environmental Assessment Data Improve Public Health Outcomes

Outbreak investigations can be complex and difficult to solve. The goal of every investigation is to learn how and why the outbreak is occurring and fix the problem to help prevent more illness. Data collected from outbreaks can inform the most common contributing factors and environmental antecedents. What we learn from EA data can help identify risk factors and stop outbreaks before they occur. Ultimately, this evidence-based information strengthens the science behind the root causes of an outbreak to inform and influence public health practices and policies.

Corresponding Author: Beth Wittry, Environmental Health Officer, National Center for Environmental Health, Centers for Disease Control and Prevention, 4770 Buford Highway, Atlanta, GA 30341. Email: xks5@cdc.gov.

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

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

Baylor University
Waco, TX
Bryan W. Brooks, MS, PhD
bryan_brooks@baylor.edu

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

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

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

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

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

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

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

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

East Tennessee State University†
Johnson City, TN
Kurt Maier, MS, PhD
maier@etsu.edu

Eastern Kentucky University†
Richmond, KY
Vonia Grabeel, MPH, RS (undergraduate)
vonia.grabeel@eku.edu
Clint Pinion, Jr., MA, MPH, DrPH, CIT, RS
clint.pinion@eku.edu

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

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

Indiana University–Purdue University Indianapolis
Indianapolis, IN
Max Moreno, MEM, PhD
mmorenom@iu.edu

Mississippi Valley State University†
Itta Bena, MS
Swatantra Kethireddy, PhD
swatantra.kethireddy@mvsu.edu

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

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

North Carolina Central University
Durham, NC
John Bang, MD, PhD
jjbang@nccu.edu

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

Old Dominion University
Norfolk, VA
Sean Banaee, PhD, CIH
sbanaee@odu.edu

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

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

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

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

University of Illinois Springfield††
Springfield, IL
Egbe Egiebor, PhD
eegie2@uis.edu

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

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

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

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

Western Carolina University
Cullowhee, NC
Kim Hall, PhD
kkhall@email.wcu.edu

Western Kentucky University††
Bowling Green, KY
Ritchie Taylor, PhD
ritchie.taylor@wku.edu

†University also has an accredited graduate program.
††Accredited graduate program only.

DIRECT FROM THE NEHA PREPAREDNESS COMMITTEE

What Matters in Individual Health Preparedness

Jeff Rubin, PhD, CEM
Christopher Walker, MSEH, REHS
Latasha A. Allan, MSPH, MEDM
National Environmental Health Association Preparedness Committee

Editor's Note: The National Environmental Health Association (NEHA) strives to provide up-to-date and relevant information on environmental health and build partnerships in the profession. In pursuit of these goals, NEHA is pleased to feature a column from the NEHA Preparedness Committee. NEHA has several committees comprised of subject matter experts that focus on environmental health topics including body art, climate change, food safety, preparedness, vector control, and more. These committees provide guidance, input, and expertise to NEHA leadership and staff, environmental health professionals, and partner organizations.

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

Jeff Rubin is a semiretired emergency manager and geologist who teaches at the Emergency Medical Services program at the Oregon Institute of Technology. Christopher Walker is a senior program analyst in general environmental health and emergency preparedness for NEHA. Latasha Allen is a disaster epidemiologist and chair of the NEHA Preparedness Committee.

The National Environmental Health Association (NEHA) recognizes the important role of the environmental health workforce in public health preparedness, response, and recovery from emergencies and disaster-related events. NEHA established the Preparedness Committee to bring together subject matter experts to heighten the significance of environmental health within emergency preparedness. The committee comprises public and private sector environmental health and emergency management expertise. Committee activities include:

- providing guidance on NEHA preparedness programs and projects,
- identifying training gaps and emerging issues in environmental health preparedness,
- promoting and disseminating materials and resources developed by NEHA and the committee, and
- identifying environmental health preparedness funding and other opportunities to engage and support the workforce.

The mission of the NEHA Preparedness Committee is to serve as a resource for NEHA and all environmental health professionals in preparing for, responding to, and recovering from emergencies and disasters to create more resilient communities and to minimize death, illness, and injury. The committee champions the efforts of environmental health professionals who respond to emergencies and disaster related events. While September is National Preparedness Month (www.ready.gov/september), the essential services that environmental health professionals provide before, during, and after disasters and disruptions are a year-round responsibility.

Environmental health professionals have critical roles before, during, and after disasters and other disruptions, including participating in community assessments (Ferré et al., 2019; Kurkjian et al., 2016), emergency shelter and other mass care site planning and operational safety (Cruz et al., 2017; Schnall et al., 2019), air and water quality (Phillips, 2018; Ratnapradipa et al., 2018), and informing reentry decisions in evacuated areas. Understanding what is most likely to kill, injure, or sicken people after disasters offers insight into not only community hazards and vulnerabilities but also effective self-preparedness.

Most disasters produce consistent patterns of death and injury (Issa et al., 2018; Uscher-Pines, 2007). Primary causes are directly attributable to the event itself and thus vary by event type (e.g., drowning in tropical storms and floods, direct trauma in earthquakes and tornados). Secondary causes vary less by event type as they are driven by common effects: loss of electrical power and shelter, transportation disruption, loss of healthcare access, attempted repair and restoration, and other disruption of daily routine (De Rubeis et al., 2021; Issa et al., 2018). Primary and particularly secondary causes can be difficult to attribute, typically leading to undercounting (Santos-Burgoa et al., 2018). Secondary causes of death, illness, and injury

can be divided into four broad categories: preexisting medical conditions, environmental degradation and unmediated environmental exposure, secondary trauma, and psychological effects. All of these causes relate to not only postevent outcomes but also can affect primary event survival.

Preexisting medical conditions include common noncommunicable diseases that are typically controlled by medication (e.g., cardiorespiratory ailments, diabetes, psychological disorders), require recurring procedures (e.g., hemodialysis for end-stage renal disease), and/or rely on regular oxygen administration, powered life-support equipment, or other adjuncts (Kelman et al., 2015; Murakami et al., 2018; Ryan et al., 2017). The common link is dependence on maintenance care, the disruption of which turns a chronic, relatively stable condition into an acute one at the worst possible time.

Environmental causes include unmediated exposure to the ambient environment, degraded air and water quality (Phillips, 2018), otherwise controlled infectious diseases (Chow et al., 2019; Ghosh et al., 2021; Murthy & Christian, 2010), and introduced toxicants such as carbon monoxide (e.g., Iqbal et al., 2012). Rarer vectorborne diseases also become more common after floods and hurricanes, such as Zika virus (Ahmed & Memish, 2017; Murthy & Christian, 2010). Secondary trauma includes motor vehicle collisions, electrocution, and other injuries, particularly those related to repair and short-term recovery (Brackbill et al., 2014; Ghosh et al., 2021). Psychological causes beyond preexisting conditions include disrupted lifelines and routine and extended effects (e.g., personal loss or displacement, prolonged disruption, seismic aftershocks and other subsequent events, and personal trauma) (Ferré et al., 2019; Kino et al., 2020).

The threshold for generating secondary health effects is low—it doesn't take a disaster, just an extended disruption. As most of these effects are recurrent and thus predictable, they can be prevented or at least lessened by a combination of awareness and deliberate action by governments, institutions, support services, and individuals. Identifying vulnerable populations is a start, ideally accompanied by maintaining a continuity of prescription medications and basic primary care and outpatient services (Carameli et al., 2013; Desalvo et al., 2014; Dimentstein et al., 2020). Instead of focusing on generic emergency kits, encouraging and enabling individuals to identify their specific vulnerabilities to relevant hazards, establish a reserve of prescription medications (or suitable substitutes with clinician guidance), and become familiar with backup oxygen and power options for home life-support. Toxic and disease exposure—acute and long-term—associated with environmental degradation commonly relate to political and socioeconomic vulnerability well before and after specific incidents (Phillips, 2018).

Maintaining awareness of primary and secondary hazards, vulnerable populations, and the role of environmental health professional before, during, and after disasters and disruptions is an important component of community and individual resilience. As we consider our own self-care and vulnerabilities as environmental health professionals working in emergency response, we can continue to engage individuals at risk, look beyond short-term needs, and recognize individual perspectives and needs (Gowan et al., 2015; McColl & Burkle, 2012).

Corresponding Author: Jeff Rubin, Member, Preparedness Committee, National Environmental Health Association.
Email: jnrubin@aya.yale.edu.

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Useful Environmental Health Preparedness Resources

A range of preparedness resources and an expanded reference section for this column can be found on the NEHA Preparedness webpage at www.neha.org/preparedness.

General

- U.S. Department of Health and Human Services—Individual Resilience: www.phe.gov/Preparedness/planning/abc/Pages/resilience-factsheet-responders.aspx

Food and Water

- Centers for Disease Control and Prevention—Food, Water, Sanitation, and Hygiene Information for Use Before and After a Disaster or Emergency: www.cdc.gov/disasters/foodwater/index.html
- U.S. Environmental Protection Agency—Emergency Disinfection of Drinking Water: www.epa.gov/ground-water-and-drinking-water/emergency-disinfection-drinking-water

Medications

- *Consumer Reports*—When Disaster Strikes: What to Put in Your Medication Go Bag: www.consumerreports.org/drugs/must-haves-for-your-medication-go-bag

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EH CALENDAR

UPCOMING NATIONAL ENVIRONMENTAL HEALTH ASSOCIATION (NEHA) CONFERENCE

June 28–July 1, 2022: NEHA 2022 Annual Educational Conference & Exhibition, Spokane, WA, https://www.neha.org/aec

NEHA AFFILIATE AND REGIONAL LISTINGS

Colorado
September 14–17, 2021: 65th Annual Education Conference, Colorado Environmental Health Association, Pueblo, CO, http://www.cehaweb.com

Illinois
September 13–14, 2021: IEHA South Chapter Annual Educational Conference, Illinois Environmental Health Association South Chapter, Marion, IL, https://ieha.coffeecup.com/calendar.html

November 8–9, 2021: IEHA Annual Educational Conference, Illinois Environmental Health Association, Oglesby, IL, https://ieha.coffeecup.com/calendar.html

Indiana
September 20–22, 2021: 70th Annual Fall Educational Conference, Indiana Environmental Health Association, Lawrenceburg, IN, https://www.iehaind.org/Conference

Iowa
October 20, 2021: 2021 IEHA Fall Conference, Iowa Environmental Health Association, West Des Moines, IA, https://www.ieha.net

Michigan
March 22–25, 2022: 2022 Annual Education Conference, Michigan Environmental Health Association, Traverse City, MI, https://www.meha.net/AEC

North Carolina
October 6–8, 2021: NCPHA Fall Educational Conference, North Carolina Public Health Association, Asheville, NC, https://ncpha.memberclicks.net

Texas
October 6–8, 2021: 65th Annual Educational Conference, Texas Environmental Health Association, Round Rock, TX, https://www.myteha.org

Utah
September 29–October 1, 2021: UEHA Fall Conference, Utah Environmental Health Association, Tooele, UT, http://www.ueha.org/events.html

Virginia
October 28–29, 2021: VEHA Virtual Fall Conference & Interstate Environmental Health Seminar, Virginia Environmental Health Association, https://veha32.wildapricot.org/events

Wisconsin
September 22–24, 2021: WEHA Educational Conference, Wisconsin Environmental Health Association, Eau Claire, WI, https://weha.net/events

Wyoming
August 31–September 1, 2021: 2021 WEHA Annual Education Conference, Wyoming Environmental Health Association, Casper, WY, https://www.wehaonline.net

TOPICAL LISTINGS

Water Quality
Spring 2022: *Legionella* Conference: Prevention of Disease and Injury From Waterborne Pathogens in Health Care, NSF Health Sciences and NEHA, www.legionellaconference.org

IN MEMORIAM

Scott Meador

The National Environmental Health Association (NEHA) was saddened to learn that Scott Meador passed away on May 19, 2021, in Tulsa, Oklahoma. Meador started his public health career in 2003 at the health department in Mesquite, Texas. He worked as a sanitarian and in the mosquito control program. In 2007, he started at the Tulsa Health Department in the Environmental Health Division as an environmental specialist and eventually became the vector control program coordinator.

Meador did an excellent job improving the Mosquito Control Program at the Tulsa Health Department. He was instrumental in creating new standard operating procedures that reflected current changes in mosquito control. The new procedures made it easier to trap, collect, and test mosquitoes for West Nile virus. He worked with several municipalities to improve their mosquito programs in northeast Oklahoma. Meador was well known to the local media stations as the mosquito guy. He was interviewed many times a year to educate residents on how they could reduce the mosquito population to prevent the spread of disease. He was dedicated to improving the quality of life for the residents of Tulsa County and the improvements he made in the mosquito program benefited all people and stakeholders in northeast Oklahoma.

Meador worked on a couple of projects with the Public Health Foundation (PHF) and the Centers for Disease Control and Prevention (CDC). One example was the Vector Control Population Health Driver Diagram Project led by PHF and made possible through support from CDC's National Center for Environmental Health. The health driver diagram was used collaboratively by public health and healthcare partners to identify and address the primary and secondary drivers of a shared community health challenge. Meador used several quality improvement techniques to improve the efficiency and target areas of the community where mosquitoes were found to carry West Nile virus.

Although Meador had a great impact in the Tulsa community, his professional work reached far and wide across NEHA and beyond. He participated in the NEHA Vector Program Committee for many years. His accomplishments included the development and dissemination of the NEHA policy statement on comprehensive mosquito control (www.neha.org/government-affairs/neha-policy-statements) and support of the development of the integrated mosquito and tick management webinars. His work will continue to have an impact on the vector community for many years to come.

As a dedicated public health official, Meador spent the last year serving as the safety officer for the Tulsa Health Department during the COVID-19 pandemic response. He used his talents to help organize and coordinate both the testing and vaccine distribution sites. He tirelessly walked the route people would take while at the Tulsa Health Department's point of dispensing (POD) sites looking for safety hazards, chatting with people and assisting them where needed. As military history was a huge interest to Meador, he collected veteran stories along the way by striking up conversations as veterans would come in for vaccine appointments.

Meador loved being a dad and traveling with his wife, Shauna. He loved all things baseball, NASCAR, and U2. On the weekends, he could be found restoring military helmets for people all over the country. The Tulsa Health Department will miss Scott Meador and are forever grateful for his contributions to his community.

NEHA extends its deepest sympathies to the family, friends, and colleagues of Scott Meador. His passion and devotion to protecting the health and safety of the community he served, as well as our country, will not be forgotten.

Source: Text and photo courtesy of the Tulsa Health Department Environmental Services.

Editor's Note: If you would like to share information about the passing of an environmental health professional to be mentioned in a future In Memoriam, please contact Kristen Ruby-Cisneros at kruby@neha.org. The Journal will publish the In Memoriam section twice a year in the June and December issues, or in other issues as determined appropriate.

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 the NEHA 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)

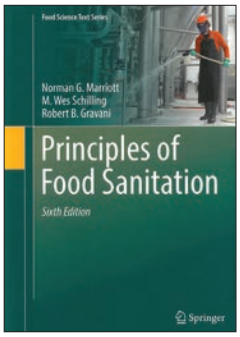
National Environmental Health Association (2014)

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

Principles of Food Sanitation (6th Edition)

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

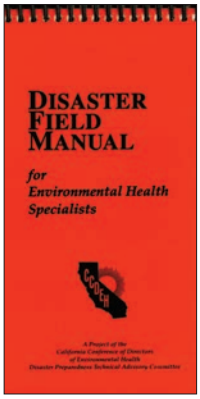


Now in its 6th edition, this highly acclaimed book provides sanitation information needed to ensure hygienic practices and safe food for food industry professionals and students. It addresses the principles related to contamination, cleaning compounds, sanitizers, and cleaning equipment. It also presents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

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

Disaster Field Manual for Environmental Health Specialists

California Association of Environmental Health Administrators (2012)



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

224 pages / Spiral-Bound Hardback
Member: $37 / Nonmember: $45

Control of Communicable Diseases Manual (20th Edition)

Edited by David L. Heymann, MD (2015)

The *Control of Communicable Diseases Manual (CCDM)* is revised and republished every several years to provide the most current information and recommendations for communicable disease prevention. The *CCDM* is designed to be an authoritative reference for public health workers in official and voluntary health agencies. The 20th edition sticks to the tried and tested structure of previous editions. Chapters have been updated by international experts. New disease variants have been included and some chapters have been fundamentally reworked. This edition is an update to a milestone reference work that ensures the relevance and usefulness to every public health professional around the world. The *CCDM* is a study reference for NEHA's Registered Environmental Health Specialist/Registered Sanitarian and Certified Professional–Food Safety credential exams.

729 pages / Paperback
Member: $59 / Nonmember: $68

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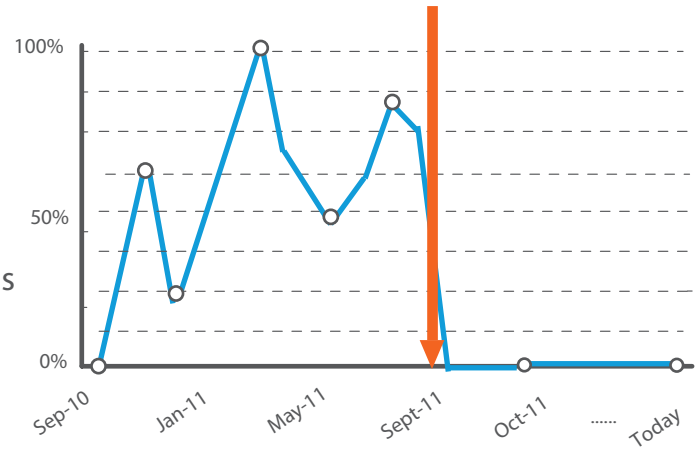

Reference: Duda et Al., 2014

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Region4RVP@neha.org
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Region7RVP@neha.org
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Region9RVP@neha.org
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NEHA Staff

www.neha.org/staff

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

Jonna Ashley, Association Membership Manager, jashley@neha.org

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

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

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

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

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

Renee Clark, Accounting Manager, rclark@neha.org

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

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

Roseann DeVito, MPH, Project Manager, rdevito@neha.org

Steven Dourdis, MA, Human Resources Business Partner, sdourdis@neha.org

Monica Drez, Web Developer, mdrez@neha.org

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

Santiago Ezcurra Mendaro, Media Producer/LMS Administrator, sezcurra@neha.org

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

Soni Fink, Sales Manager, sfink@neha.org

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

Madelyn Gustafson, Project Coordinator, PPD, mgustafson@neha.org

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

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

Angelica Ledezma, AEC Manager, aledezma@neha.org

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

Matt Lieber, Database Administrator, mlieber@neha.org

Tyler Linnebur, MAcc, CPA, Staff Accountant, tlinnebur@neha.org

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

Bobby Medina, Credentialing Department Customer Service Coordinator, bmedina@neha.org

Jaclyn Miller, Marketing and Communications Specialist, NEHA-FDA RFFM, jmiller@neha.org

Avery Moyler, Administrative Support, NEHA EZ, amoyler@neha.org

Alexus Nally, Member Services Representative, atnally@neha.org

Eileen Neison, Credentialing Specialist, eneison@neha.org

Michael Newman, A+, ACA, MCTS, IT Manager, mnewman@neha.org

Charles Powell, Media and Workforce Development Specialist, NEHA EZ, cpowell@neha.org

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

Michéle Samarya-Timm, MA, HO, REHS, MCHES, DLAAS, Senior Project Coordinator, Environmental Health, PPD, msamaryatimm@neha.org

QuiNita Spann, Executive Assistant, qspann@neha.org

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

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

Christl Tate, Training Operations and Logistics Manager, NEHA EZ, ctate@neha.org

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

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

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

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

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

Alyssa Wooden, MHS, Project Coordinator, PPD, awooden@neha.org

Brett Wyker, MS, Evaluation Coordinator, NEHA-FDA RFFM, bwyker@neha.org

2020–2021 Technical Advisors

www.neha.org/technical-advisors

CLIMATE AND HEALTH

David Gilkey, PhD
dgilkey@mtech.edu

Jennie McAdams
jenniecmcadams@franklincountyohio.gov

Richard Valentine
rvalentine@slco.org

Felix Zemel, MCP, MPH, CBO, RS, DAAS
felix@pracademicsolutions.com

DATA AND TECHNOLOGY

Darryl Booth, MBA
dbooth@accela.com

Timothy Callahan
tim.callahan@dph.ga.gov

EMERGENCY PREPAREDNESS

Martin Kalis
mkalis@cdc.gov

Christopher Sparks, MPH, MPA, RS
christopher.sparks@houstontx.gov

FOOD SAFETY

Eric Bradley, MPH, REHS, CP-FS, DAAS
eric.bradley@scottcountyiowa.com

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

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

GENERAL ENVIRONMENTAL HEALTH

Michael Crea, RS
crea@zedgepiercing.com

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

Crispin Pierce, PhD
piercech@uwec.edu

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

Sylvanus Thompson, PhD, CPHI(C)
sthomps@toronto.ca

HEALTHY COMMUNITIES

Stan Hazan, MPH
hazan@nsf.org

Robert Powitz, MPH, PhD, RS, CP-FS
powitz@sanitarian.com

Kari Sasportas, MSW, MPH, REHS/RS
ksasportas@lexingtonma.gov

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

INFECTIOUS AND VECTORBORNE DISEASES

Christine Vanover, MPH, REHS
npi8@cdc.gov

Tyler Zerwekh MPH, DrPH, REHS
tyler.zerwekh@dshs.texas.gov

SPECIAL POPULATIONS

Cynthia McOliver, MPH, PhD
mcoliver.cynthia@epa.gov

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

Jacqueline Taylor, MPA, REHS
bljacnam@aol.com

WATER

Andrew Pappas, MPH
apappas@isdh.in.gov

Maureen Pepper
maureen.pepper@deq.idaho.gov

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

Sara Simmonds, MPA, REHS
sara.simmonds@kentcountymi.gov

WORKFORCE AND LEADERSHIP

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

Affiliate Presidents

www.neha.org/affiliates

Alabama—Beverly M. Spivey
beverly.spivey@adph.state.al.us

Alaska—Joy Britt
jdbritt@anthc.org

Arizona—David Morales
david.morales@maricopa.gov

Arkansas—Richard Taffner, RS
richard.taffner@arkansas.gov

Business and Industry—Alicia Enriquez Collins, REHS
nehabia@outlook.com

California—Darryl Wong
president@ceha.org

Colorado—Keith Seimsen
KeithSeimsenCEHA@gmail.com

Connecticut—Kevin Elak, RS, REHS, CP-FS
kevin.elak@middletownct.gov

Florida—Eric Maday
eric.maday@flhealth.gov

Georgia—Jessica Badour
jessica.badour@agr.georgia.gov

Idaho—Jesse Anglesey
janglesey@siph.idaho.gov

Illinois—Justin Dwyer
jadwyer84@gmail.com

Indiana—Jammie Bane
jbane@co.deleware.in.us

Iowa—Matt Even
meven@bentoncountyia.gov

Jamaica (International Partner Organization)—Karen Brown
info@japhi.org.jm

Kansas—Tanner Langer
tdlanger@cowleycounty.org

Kentucky—Clint Pinion, Jr., MA, MPH, DrPH, CIT, RS
clint.pinion@eku.edu

Louisiana—Carolyn Bombet
carolyn.bombet@la.gov

Massachusetts—Diane Chalifoux-Judge, REHS/RS, CP-FS
diane.chalifoux@boston.gov

Michigan—Drew Salisbury, MPH, REHS
dsalisbury@meha.net

Minnesota—Lisa Schreifels, REHS
president@mehaonline.org

Missouri—Deb Sees
dsees@jacksongov.org

Montana—Jeff Havens
jeffphavens@hotmail.com

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

Nebraska—Elizabeth Rhodes
elizabeth.rhodes@douglascounty-ne.gov

Nevada—Brenda Welch, REHS
welch@snhd.org

New Jersey—Lynette Medeiros
president@njeha.org

New Mexico—John S. Rhoderick
john.rhoderick@state.mn.us

New York State Conference of Environmental Health Directors—Elizabeth Cameron
lcameron@tompkins-co.org

North Carolina—Josh Jordan
josh.jordan@dhhs.nc.gov

North Dakota—Marcie Bata
mabata@nd.gov

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

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

Oklahoma—Jordan Cox
coxmj12@gmail.com

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

Past Presidents—Vince Radke, MPH, RS, CP-FS, DLAAS, CPH
vradke@bellsouth.net

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

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

Tennessee—Kimberly Davidson
kimberly.davidson@tn.gov

Texas—Stevan Walker, REHS/RS
mswalker@mail.ci.lubbock.texas.us

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

Utah—Talisha Bacon
tbacon@utah.gov

Virginia—Jessica Stewart
jessica.stewart@virginiaeha.org

Washington—Tom Kunesh
tkunesh@co.whatcom.wa.us

West Virginia—Jennifer Hutson
wvaos@outlook.com

Wisconsin—Mitchell Lohr
mitchell.lohr@wisconsin.gov

Wyoming—Chelle Schwope
chelle.schwope@wyo.gov

NEHA **NEWS**

Note of Thanks to Departing Board Member

The National Environmental Health Association (NEHA) is fortunate to have members who are willing to volunteer their time and energy to NEHA through positions within its Board of Directors and on committees and work groups, as well as serve as subject matter experts, trainers, and peer reviewers. We would be remiss if we did not acknowledge the dedication, hard work, and efforts of one member of the NEHA Board of Directors on the occasion of her departure from the board: Immediate Past-President Dr. Priscilla Oliver.

Immediate Past-President Priscilla Oliver, PhD, leaves the NEHA Board of Directors after 5 years of faithful and dedicated service. She will be remembered for the coined phrase, "We Are One NEHA." She undertook an expanded recruitment approach of diverse and comprehensive technical advisors for NEHA who covered existing and developing areas of environmental health topics. These experts continue to make contributions to NEHA. She brought us together as "One NEHA" during tumultuous times and in a time of expanded growth within the organization. Dr. Oliver created the Dr. Bailus Walker, Jr. Diversity and Inclusion Awareness Award with the first recipient named this year.

Dr. Oliver guided NEHA through the beginning of the COVID-19 pandemic and the conflicts within our society that stemmed from incidents of injustice and inequity in 2020. The articles and statements in the *Journal of Environmental Health* on leadership, environmental health services, and conflict provided guidance to environmental health professionals, as well as to NEHA staff and board members. She strongly supported seeking government funding during the COVID-19 pandemic, which was most productive in helping NEHA survive and thrive.

As NEHA president, Dr. Oliver was a strong proponent of student activities and programs. She spoke on behalf of environmental health to practitioners, student groups, and administrators in Jamaica and across the country. She created in memoriam the Dr. Sheila Davidson Pressley Scholarship and the Dr. Carolyn Hester Harvey Scholarship for deserving environmental health students. Dr. Oliver also initiated the formation of the NEHA History Project Task Force and the NEHA Sick, Bereavement, and Memorial Committee to support all members and partners. She is active in both groups.

Dr. Oliver plans to continue in retirement her educational pursuits as an adjunct faculty member at the Morehouse School of Medicine. She is also the director and founder of the Physician and Undergraduate Student Educational (PAUSE) Foundation, Inc, a nonprofit organization created in 1995. The mission of PAUSE is to increase the number of racial-ethic minority and diverse students in medicine and dentistry. She will return to be a member of the National Environmental Health Science and Protection Accreditation Council.

Dr. Oliver stated, "I am supportive of 'We Are One NEHA' and will forever be supportive of 'One NEHA.' It has been my honor to serve you and NEHA."

NEHA Celebrates National Food Safety Education Month

By Terryn Laird (tlaird@neha.org)

This September, NEHA will be celebrating National Food Safety Education Month with a webinar series focused on emerging food safety trends and by highlighting the efforts of food safety heroes who are making impacts all over the country! We will be exploring some emerging trends and the role of changing technology in food safety. Starting on September 1, NEHA will host one webinar each week exploring different topics alongside experts who are at the forefronts of their fields.

Join us as we dive into topics such as food safety during third-party delivery and the impacts of emerging food technologies in smart kitchens and automated services. Learn about the ways our profession is using technology to advance food safety education and how to apply new education techniques in your organization. You can also explore the world of cannabis edibles and learn about the food safety considerations for this rapidly growing industry. Food safety regulatory programs interested in the Food and Drug Administration's (FDA) Voluntary National Retail Food Regulatory Program Standards can join a detailed session to understand how funding from the NEHA-FDA Retail Flexible Funding Model Grant Program can be used to further educate their teams and build a more robust food safety program.

We will be celebrating the work of food safety professionals whose passion, dedication, and contributions have had a significant impact on those around them with the return of our Food Safety Heroes campaign. Throughout the month of September we will be profiling these food safety heroes to celebrate and express gratitude for the work they do every day. If you would like to nominate a food safety hero, we would love to hear from you! Nominees are being accepted now through our online nomination form at bit.ly/NEHAFSH.

To view our past celebrations, take a look at the NEHA National Food Safety Education Month page at www.neha.org/neha-celebrates-national-food-safety-education-month.

We can't wait to celebrate National Food Safety Education Month 2021 with you!

5 Checks for Safe Food Delivery From the NEHA Food Safety Program Committee

By Terryn Laird (tlaird@neha.org)

In response to the rise in demand for dine-at-home service from retail food establishments, the NEHA Food Safety Program Committee has developed a new infographic, 5 Checks for Safe Food Delivery, to help build capacity and further enhance food safety training offered by third-party delivery services. Increased demand for food delivery has highlighted the importance of providing information and education aimed to address the specific food safety concerns and practices associated with food and food packaging handling during delivery service.

This resource supplies information on safe food handling for delivery persons who might not have prior experience in food service or who might have gaps in their knowledge related to delivery-specific best practices. The infographic is brief, easy-to-understand, and includes both text and images for each recommendation, allowing for increased accessibility by multilingual users. The five checks, or recommendations, are related to the health and hygiene of the delivery person, the cleanliness of the delivery vehicle, proper handling of food and beverage containers, maintaining safe temperature of foods during delivery, and being prepared for problems that might arise.

While the 5 Checks for Food Safety infographic is available in a traditional infographic format, it has also been specifically designed as a modular resource ready for digital integration, such as on existing phone or web apps. The content can be downloaded from the 5 Checks for Food Safety webpage (www.neha.org/5-checks) as individual sections or as text and images for easier integration.

The infographic was designed by the NEHA Food Safety Program Committee, which includes regulatory and industry professionals. To develop the five checks, the committee sought feedback and recommendations from third-party delivery companies, partner associations, and members of the Retail Food Safety Association Collaborative's Retail Food Safety Advisory Group. The content was directly informed by the Guidance Document for Direct-to-Consumer and Third-Party Delivery Service Food Delivery created by the Direct to Consumer Delivery Committee of the Conference for Food Protection.

As the prominence of third-party delivery services continues to rise, so does the importance of ensuring delivery drivers handle food safely from retail food establishments to the consumer. The 5 Checks for Safe Food Delivery infographic is a tool that can assist in filling critical educational gaps within rapidly emerging consumer trends. By providing clear and straightforward recommendations, NEHA aims to help retail food establishments and third-party delivery companies take action to better protect the health and safety of themselves and their customers.

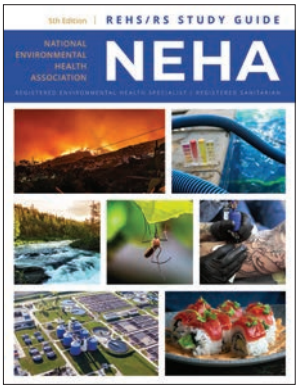
Updated Version of the REHS/RS Credential Exam to Release on September 1

By Sarah Hoover (credentialing@neha.org)

NEHA will release an updated version of its Registered Environmental Health Specialist/Registered Sanitarian (REHS/RS) credential exam on September 1, 2021. This release is a culmination of efforts that began in the last quarter of 2019. Subject matter experts (SMEs) were recruited to attend an in-person workshop in early February 2020. Little did the world know that we were about to experience a pandemic like most had never seen before. Due to the diligence and perseverance of these dedicated SMEs, virtual workshops were held over the course of 2020 through April 2021.

By adhering to the exam development process called Developing a Curriculum (DACUM), established by The Ohio State University over 40 years ago, NEHA continues to offer world-class credentials to environmental health professionals. Adherence to the DACUM process ensures that knowledge-based credentials, like those offered by NEHA, are relevant to professional practice and reliable in assessing minimum competency for credential designation. NEHA is next turning its focus on updating its Certified in Comprehensive Food Safety (CCFS) credential in the upcoming months.

Candidates interested in or currently eligible for the REHS/RS credential can visit the REHS/RS webpage at www.neha.org/rehs for the most up-to-date information regarding changes to the exam, along with an FAQ document detailing changes from the old exam to the new version.



New REHS/RS Study Guide Now Available

By Jaclyn Miller (jmiller@neha.org)

The NEHA *Registered Environmental Health Specialist/ Registered Sanitarian (REHS/RS) Study Guide* has been updated! The new fifth edition incorporates the insights of 29 subject matter experts and has been recreated in a fresh visual layout to enhance the reading and studying experience.

NEHA **NEWS**

This essential resource includes 15 chapters that provide an overview of each content area for the REHS/RS credential exam. Each chapter covers a different environmental domain and is broken down into standardized sections including Roles and Responsibilities, Recommended Reading, Test Mapping, and Sample Exam Questions.

Chapters include:

- General Environmental Health
- Statutes and Regulations
- Food Protection
- Potable Water
- Wastewater
- Solid and Hazardous Waste
- Hazardous Materials
- Zoonoses, Vectors, Pests, and Poisonous Plants
- Radiation Protection
- Occupational Safety and Health
- Air Quality and Environmental Noise
- Housing Sanitation and Safety
- Institutions and Licensed Establishments
- Swimming Pools and Recreational Facilities
- Emergency Preparedness

The REHS/RS guide is 261 pages and is now available for purchase in the NEHA bookstore, priced at $169 for NEHA members and $199 for nonmembers. Visit NEHA's Study Resources page at www.neha.org/rehs-study-references for additional information and purchase options.

NEHA Staff Profiles

As part of tradition, NEHA features new staff members in the *Journal* around the time of their 1-year anniversary. These profiles give you an opportunity to get to know the NEHA staff better and to learn more about the great programs and activities going on in your association. This month we are pleased to introduce you to three NEHA staff members. Contact information for all NEHA staff can be found on pages 54 and 55.

Avery Moyler

I work as administrative support in the Entrepreneurial Zone to help support various projects, including online course delivery and policy projects largely related to body art. I am passionate about research, writing, and policy, and am glad to be working with an awesome team and using my skills in those areas to help environmental health professionals keep the public safe and healthy.

I was lucky enough to spend 5 years at the University of Virginia earning a Master of Public Policy and a Bachelor of Arts. My education focused on agriculture, sustainability, and building healthy communities. After graduating, I moved to Denver and worked as a ski instructor in the winter and did conservation work in the warmer months. When I was ready and eager to work in an office, I joined NEHA and as luck would have it, immediately began working from home due to the COVID-19 pandemic.

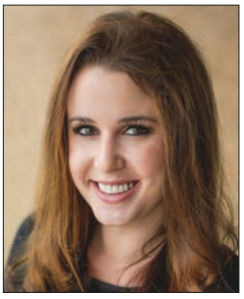
I love to travel, spend time outdoors, and cook (and eat). I've made it to about 25 countries so far and hope to get to many more! Some of my favorites include Cambodia, Indonesia, and Italy—basically anywhere scooters and mopeds are commonplace.

Charles Powell

I started at NEHA in September 2020 in the Entrepreneurial Zone as its new media and workforce development specialist. I primarily work on course development and producing video, audio, and photography on projects such as the upcoming Self-Assessment and Verification Audit online course and a Temporary Food Establishments course for Puerto Rico. I also work on other video projects across the organization, such as the introduction videos and animations that were shown at the NEHA 2021 Annual Educational Conference & Exhibition Three-Part Virtual Series.

Prior to joining NEHA, I worked at a variety of organizations across the country in video production, training, and education, such as Johnson & Johnson and the Denver Public Library. I also have an extensive career on the film festival circuit, producing festivals and screening my own work and films I've worked on at festivals around the world.

Outside of NEHA, I work on my own film projects and independent research focused on storytelling and science. My most recent animated film creatively reimagines handwashing as a Spaghetti Western and was featured in *The Human Touch*, a journal published by the University of Colorado Center for Bioethics and Humanities.



Jordan Strahle

I joined NEHA in September 2020 as the marketing and communications manager within the *Journal*, Education, and Marketing department. I am responsible for assisting all NEHA staff in the development and execution of marketing plans, email blasts, social media, and updating portions of the website. I am passionate about ensuring that our organization maintains a strong and consistent brand.

My first year with NEHA was interesting, to say the least, as I have been working from home due to the COVID-19 pandemic. It has been a worthwhile challenge to get to know the organization, as well as build relationships with coworkers I have only met

virtually. Despite this unusual start, I can honestly say that my favorite part of working at NEHA is the people I work with. Being the marketing and communications manager allows me to work with all departments within NEHA, which enables me to support their hard work and ensure that our membership takes advantage of everything we have to offer.

I graduated from the University of Colorado at Colorado Springs in 2009 with a Bachelor of Arts in communications with an emphasis in mixed media and broadcasting, as well as a Bachelor of Arts in political science with an emphasis in American political systems. Prior to joining NEHA, I was the director of communications with the Colorado Contracts Association for 5 years. Early in my career I worked with the Colorado House of Representatives and served as a communications and constituent engagement aide for the Denver City Council.

I grew up in the small town of Granby, Colorado, and moved to Denver after college. My husband and I own a home in Aurora and truly love the Denver metro area. My passions include traveling, music, interior decorating, hanging out with my husband and dogs, and spoiling my nephew. I am looking forward to growing with NEHA and meeting all of my wonderful coworkers in person.

Did You Know?

Assembled in 2020, the NEHA History Project Task Force was charged to study and review the rich history of NEHA and the environmental health field, as well as make that history available to all. The NEHA History Project webpage highlights and shares the work of the task force, including an online virtual museum of artifacts from environmental health's past, electronic access to the "NEHA Green Book" that presents the history of NEHA's first 50 years, and much more. Check it out at www.neha.org/neha-history-project.

DirecTalk
continued from page 62

sector. Like the soy industry, we should embed ourselves in everything, not as a survival mechanism but because we can speak to the issues those sectors value. Value creation and fee-for-service might ultimately prove to be incongruent models.

What I describe is a journey, not a destination. Funders generally do not desire to support community engagement and partnership development. The emphasis is on deliverables—numbers, dollars, impact. These deliverables are easily demonstrated by regulatory and conformance style inspection and illness data. All the while, like spadefoot toads, public health officials and their authority are being picked off one by one by disruptions in the political universe. Where do go from here?

Let's learn to sing in unison. We are exploring the potential opportunity to engage a consultant to develop communication tools and resources for both our public and private sector members. The aim of this endeavor would be for us to sing in unison, from Guam in the west to Puerto Rico in the east. We would be better equipped to consistently tell our story, convey our value, and be generally more understandable and accessible to the public at large. Let's see if we can translate our organizational success into something valuable—a universally embraced profession. A profession whose broad training and preparation in natural and social sciences will serve to advance the health, safety, and financial security of communities everywhere.

A view of the Pink Moon, a supermoon that occurred on April 26–27, 2021. Photo courtesy of David Dyjack.

I leave you with a photo I took of the April 2021 Pink Moon. The Cherokee Nation of the East Coast call it the "kawohni" or "flower moon," and the Creek Nation of the Southeast refer to it as "tasahcee-rakko" or "big spring moon." It symbolizes the arrival of spring rains and the promise of a bountiful summer. A vernal pool pregnant with possibilities.

Dave

ddyjack@neha.org
Twitter: @DTDyjack

NEHA Annual Financial Statement

plante moran

Plante & Moran, PLLC
Suite 600
8181 E. Tufts Avenue
Denver, CO 80237
Tel: 303.740.9400
Fax: 303.740.9009
plantemoran.com

Independent Auditor's Report

To the Board of Directors
National Environmental Health Association

Report on the Financial Statements

We have audited the accompanying financial statements of National Environmental Health Association (the "Association"), which comprise the statement of financial position as of September 30, 2020 and 2019 and the related statements of activities and changes in net assets, functional expenses, and cash flows for the years then ended, and the related notes to the financial statements.

Management's Responsibility for the Financial Statements

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

Auditor's Responsibility

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

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

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

Opinion

In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of National Environmental Health Association as of September 30, 2020 and 2019 and the changes in its net assets, functional expenses, and cash flows for the years then ended in accordance with accounting principles generally accepted in the United States of America.

Emphasis of Matter

As described in Note 2 to the financial statements, the COVID-19 pandemic has impacted business operations. Our opinion is not modified with respect to this matter.

plante moran

Plante & Moran, PLLC
Suite 600
8181 E. Tufts Avenue
Denver, CO 80237
Tel: 303.740.9400
Fax: 303.740.9009
plantemoran.com

To the Board of Directors
National Environmental Health Association

Other Reporting Required by *Government Auditing Standards*

In accordance with *Government Auditing Standards*, we have also issued our report dated February 4, 2021 on our consideration of National Environmental Health Association's internal control over financial reporting and on our tests of its compliance with certain provisions of laws, regulations, contracts, grant agreements, and other matters. The purpose of that report is to describe the scope of our testing of internal control over financial reporting and compliance and the results of that testing, and not to provide an opinion on the internal control over financial reporting or on compliance. That report is an integral part of an audit performed in accordance with *Government Auditing Standards* in considering National Environmental Health Association's internal control over financial reporting and compliance.

Plante & Moran, PLLC

February 4, 2021

National Environmental Health Association

Statement of Activities and Changes in Net Assets

Years Ended September 30, 2020 and 2019

	2020			2019		
	Without Donor Restrictions	With Donor Restrictions	Total	Without Donor Restrictions	With Donor Restrictions	Total
Revenue and Gains						
Program and partnership development	$ 1,892,395	$ -	$ 1,892,395	$ 2,148,242	$ -	$ 2,148,242
Annual Education Conference	50,200	-	50,200	941,288	-	941,288
Credentialing and education	745,390	-	745,390	768,780	-	768,780
Membership dues	530,173	-	530,173	500,565	-	500,565
Journal of Environmental Health	144,096	-	144,096	149,546	-	149,546
Contributions	19,844	8,193	28,037	19,614	7,191	26,805
Hurricane supplemental	2,147,201	-	2,147,201	2,396,756	-	2,396,756
Publications	29,590	-	29,590	40,474	-	40,474
PPP grant funds	616,763	-	616,763	-	-	-
Entrepreneurial Zone	1,372,830	-	1,372,830	1,706,298	-	1,706,298
Investment income - Net	96,073	11,726	107,799	57,613	460	58,073
Miscellaneous income	12,480	-	12,480	32,245	-	32,245
Net assets released from restrictions	7,000	(7,000)	-	-	-	-
Total revenue and gains	7,664,035	12,919	7,676,954	8,761,421	7,651	8,769,072
Expenses						
Program services:						
Grants, contracts, and subawards	4,799,601	-	4,799,601	4,682,035	-	4,682,035
Special projects	1,573,057	-	1,573,057	2,635,017	-	2,635,017
Total program services	6,372,658	-	6,372,658	7,317,052	-	7,317,052
Support services:						
Management and general	812,104	-	812,104	1,031,230	-	1,031,230
Fundraising	2,947	-	2,947	-	-	-
Total expenses	7,187,709	-	7,187,709	8,348,282	-	8,348,282
Increase in Net Assets	476,326	12,919	489,245	413,139	7,651	420,790
Net Assets - Beginning of year	2,558,371	98,874	2,657,245	2,145,232	91,223	2,236,455
Net Assets - End of year	**$ 3,034,697**	**$ 111,793**	**$ 3,146,490**	**$ 2,558,371**	**$ 98,874**	**$ 2,657,245**

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

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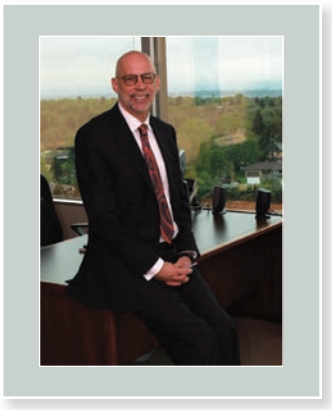
DirecTalk MUSINGS FROM THE 10TH FLOOR



Jolie Laide

David Dyjack, DrPH, CIH

Cynthia Ozick's *Riddle of the Ordinary* rings true. "We often take for granted the very things that most deserve our gratitude." Touché.

While I spend less time musing on the 10th floor of our offices in Colorado and more at my residence in Maryland, the internal tension I feel on raising our profession's profile is no less intense. Ozick elegantly captures the conundrum. "The extraordinary does not let you walk away and shrug your shoulders. But the ordinary is a much harder case." How do we lead the profession from ordinary to extraordinary? I increasingly believe the journey starts with us. Let me share a story from the research community that might strike you as irrelevant. I feel, however, it reveals a few million years of evolutionary wisdom. The story begins in the springtime in a California wetland somewhere east of the Sierra Nevada.

Each spring spadefoot toads amble out of their winter slumber to copulate in vernal pools. The cacophony of male toads calling out to potential mates would drown out the clumsy, amorous advances of their human counterparts in bars and nightclubs. But here is where the spadefoot toad strategy diverges from their human counterparts: the toads croak their romantic intentions in unison. The harmonious amphibious symphony serves to intimidate potential predators and makes the location of any one individual male toad virtually undetectable.

A few years ago, the U.S. Department of Defense decided to change the flight path of their aircraft training sorties. The new route brought the fighter jets directly over the wetlands where the toads were engaged in their annual reproductive jubilee. The sound of the aircraft disturbed the toads who ceased singing as the aircraft passed by. As the early adopter male toads attempted to restart the process, their lone croaks were easily identified and located by coyotes and owls who selectively consumed them. Each time the planes flew by, the process repeated itself. Amphibian populations plummeted.

Let's learn to sing in unison.

Community singing is a protective strategy for spadefoot toads. As I ponder the future of the profession, I feel there is a lesson to be learned here, bringing new meaning to the cliché of hanging together or hanging separately. I learned this week that in the late 1980s there were almost 40 states that required the Registered Environmental Health Specialist/Registered Sanitarian (REHS/RS) credential as a standard of practice. I understand that number has plummeted to 22 as of 2021. Each state, like a lone croaking toad, is potentially picked off by local predators committed to the fallacy that the health, safety, and security of their constituents is best served by less qualified professionals.

Likewise, the soy industry pondered its future in the 1950s as this new source of protein failed to achieve market penetration. Evidently no one had an appetite for vegetarian meat, soy yogurt, or soy milk. The industry pivoted. Instead of having a marquee product, they employed an alternate strategy: put soy in everything. Today you can find soy in infant formula, breadcrumbs, gravy, cooking spray, soup, chewing gum, crackers, frozen desserts, snack foods, etc. This strategy is counterintuitive to me as I have long held to the notion that if you attempt to be everything, you end up being nothing.

This part of the column is where I seek your ideas. Do we remain true to our marquee services, such as food and septic systems, or do we embrace the full spectrum of the environmental challenges that our communities have and will encounter? The rub is that many of the emerging issues will not be funded under a fee-for-service model. Who is going to pay for the management of harmful algal blooms? Will local governments start charging a climate change tax? Microplastics? Fire recovery? Drought management? Extreme heat? Next pandemic? Tire shreds? Vector management?

As the national advocate for the profession, we take our charge seriously. While we owe it to you to be successful, we must increasingly be an organization of value. We should aspire to be a connector among the allied health professions, schools and programs, healthcare, engineering, planning, and the private

continued on page 59

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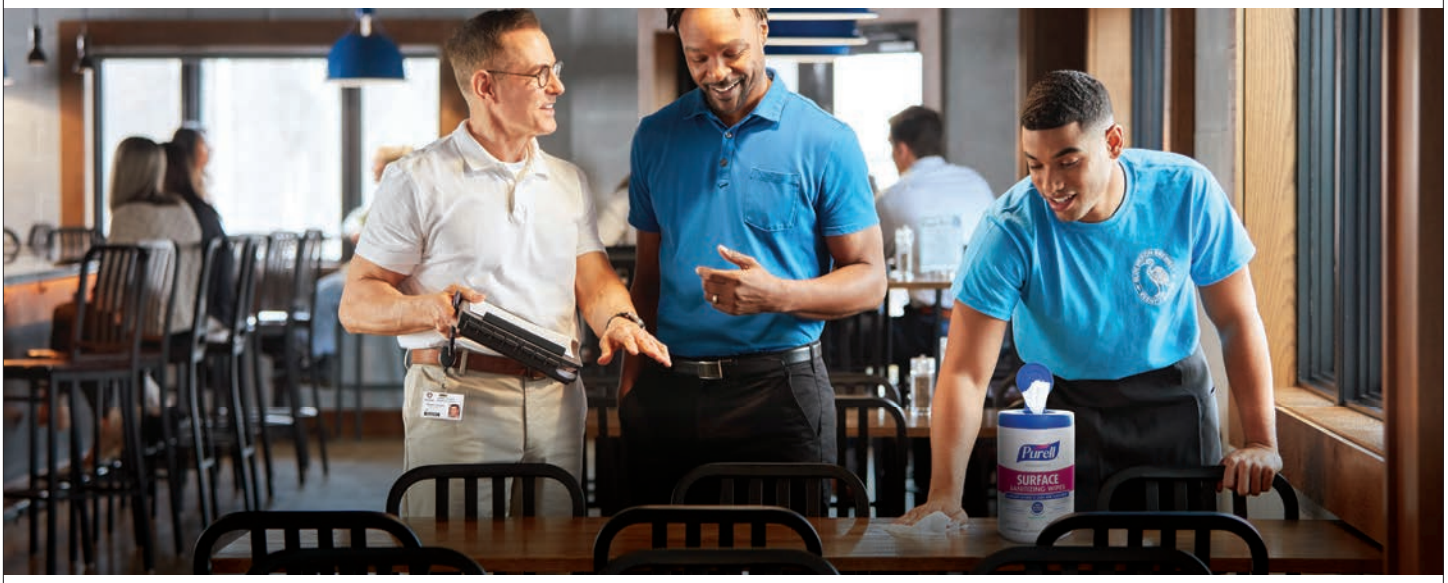

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