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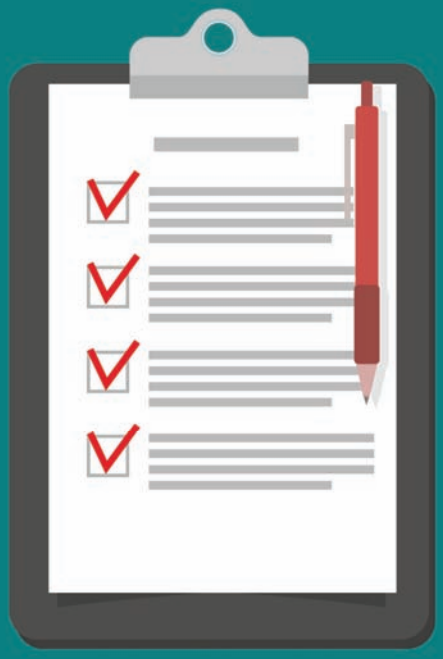

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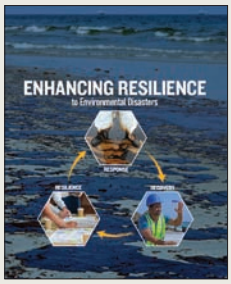


September is National Preparedness Month (www.ready.gov/September) and we thought it fitting to highlight this issue's article, "Response, Recovery, and Resilience to Oil Spills and Environmental Disasters: Exploration and Use of Novel Approaches to Enhance Community Resilience," on the cover. Researchers convened a workshop to examine events following environmental disasters. Focus groups examine three topics related to enhancing resilience to environmental disasters: response and exposure risk characterization, recovery and the role of the citizen scientist, and resilience and community participation. Recommendations from the workshop can improve future response and recovery efforts, as well as strengthen and support community resilience.

See page 8.

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## E-*JOURNAL* BONUS ARTICLE

### Erratum

In the July/August 2017 *Journal of Environmental Health* (volume 80, number 1), the abstract for *Incidence of Non-Hodgkin Lymphoma and Residential Proximity to Superfund Sites in Kentucky* by W.B. Webber and R. Stone was printed incorrectly. The first paragraph of the article's introduction was published as the abstract. We apologize for this error.

Below is the correct abstract for this article:

The rates of non-Hodgkin lymphoma (NHL) in Kentucky and the U.S. began to rise in the mid-20th century. Plausible mechanistic explanations exist for linkages between the development of NHL and exposures to specific chemicals. Several of these chemicals are present in sites within the U.S. Environmental Protection Agency's Superfund program. This study investigated a possible association between residential proximity to Superfund sites in Kentucky and incidence of NHL over a period of 18 years. Cumulative incidence rates per 100,000 persons were calculated at the census tract level, within 5 km–10 km and <5 km from Superfund sites. Geographically weighted regression was necessary to create best-fitting models due to spatial autocorrelation and nonstationarity. Residential proximity to Superfund sites in Kentucky was associated with higher incidence of NHL; the average cumulative incidence of NHL per 100,000 decreased as the distance to the hazardous sites increased. This study confirmed previous research findings of an association between residential proximity to environmentally hazardous sites and the cumulative incidence rates of NHL. Future research should take into account the chemical profile of each site to identify the most hazardous sites. Potential intervention strategies are presented based on the results of this study.

Official Publication

Journal of Environmental Health
(ISSN 0022-0892)

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**Hughes design|communications,** Design/Production
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Published monthly (except bimonthly in January/February and July/August) by the National Environmental Health Association, 720 S. Colorado Blvd., Suite 1000-N, Denver, CO 80246-1926. Phone: (303) 756-9090; Fax: (303) 691-9490; Internet: www.neha.org. E-mail: kruby@neha.org. Volume 80, Number 2. Yearly subscription rates in U.S.: $150 (electronic), $160 (print), and $185 (electronic and print). Yearly international subscription rates: $150 (electronic), $200 (print), and $225 (electronic and print). Single copies: $15, if available. Reprint and advertising rates available at www.neha.org/JEH. CPM Sales Agreement Number 40045946.

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Full text of this journal is available from ProQuest Information and Learning, (800) 521-0600, ext. 3781; (734) 973-7007; or www.proquest.com. The *Journal of Environmental Health* is indexed by Current Awareness in Biological Sciences, EBSCO, and Applied Science & Technology Index. It is abstracted by Wilson Applied Science & Technology Abstracts and EMBASE/Excerpta Medica.

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

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

Periodicals postage paid at Denver, Colorado, and additional mailing offices. POSTMASTER: Send address changes to *Journal of Environmental Health*, 720 S. Colorado Blvd., Suite 1000-N, Denver, CO 80246-1926.

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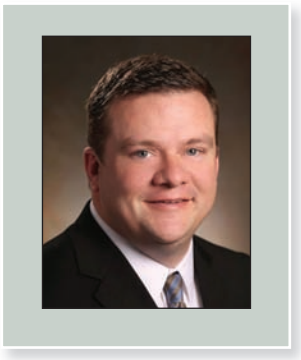

Adam London,
MPA, RS, DAAS

# Making Waves

I was five or six years old the first time I saw Lake Michigan. I was completely awestruck by the enormity of it, surrounded by towering dunes of golden sugar sand and the expanse of a seemingly endless crystal blue sea. That initial visit was the start of a lifelong relationship for this Michigan boy. The wonder of it all has hardly diminished in my mind these many years later. Stepping into that cold, clear water for the first time every year is a near spiritual experience. Stealing the simmer from the hottest of summer days and refreshing the soul, Lake Michigan is truly one of our nation's greatest treasures.

A few years later, I met her larger sister up in the land of Hiawatha, the lake the Ojibwe call Gitche Gumee—Lake Superior. This titanic and frosty beauty has a spirit all her own: dark, brooding royal blue and shrouded with mystery and power. Lakes Michigan and Superior, along with their sisters Erie, Huron, and Ontario, have their own unique characteristics. These are the daughters of glaciers that deeply scarred the Earth nearly 10,000 years ago and they literally define the region. My home state is one of the very few that is discernable from outer space due the lakes' embrace of our two peninsulas. I suspect that my affection for the Great Lakes is similar to how others feel about the Everglades, the Mississippi River, and other monumental bodies of freshwater.

Beyond my own sentimental attachment to the Great Lakes is the fact that this natural wonder is home to a diverse and delicate ecosystem. The Great Lakes biome is one of Earth's unique places. It is also essential for the economy and health of an enormous region that more than 50 million people call home. The Great Lakes basin contains over 20% of the world's supply of fresh surface water—approximately six quadrillion gallons, which is enough water to blanket the continents of North and South America under two feet of water.

*I ask you to take action this year for the sakes of our profession and the environmental health of our communities.*

This resource is of incalculable value to public health and to our economic sustainability, and yet we do not always seem to behave as if we understand the importance of this treasure. Sewage overflows, invasive species, water diversions, industrial contamination, agricultural runoff, oil pipelines of questionable integrity, and illicit dumping of garbage are just a few problems the lakes have faced in recent years. Many of you may recall the national news about blooms of toxin-producing algae that compromised the water supply systems of Toledo and other communities in the western basin of Lake Erie. In other news, Asian carp are poised to follow zebra and quagga mussels in the next of a series of biologic invasions threatening to decimate ecological balances, fisheries, and tourism. These are real threats not only to the quality of the environment but also to environmental health at large.

Amid these threats comes the disappointing news that the proposed federal budget seeks to eliminate funding for the Great Lakes Restoration Initiative (GLRI). These cuts, as part of a 31% cut to the overall budget of the U.S. Environmental Protection Agency (U.S. EPA), could significantly jeopardize the health of these majestic lakes and all North Americans. Since 2010, GLRI has funded over 3,000 quality improvement projects throughout the region and has been supported by Democrats and Republicans alike. GLRI is merely one of many projects that are proposed for reduction or elimination as part of deep funding cuts to the federal agencies that our profession works most closely with, such as U.S. EPA, the Food and Drug Administration, and the Centers for Disease Control and Prevention. These cuts are unfortunate and they underscore the importance of policy advocacy by organizations such as your National Environmental Health Association (NEHA).

The mission of our association is to advance the environmental health profession and to advocate for the cause of environmental health. I believe NEHA has done a tremendous job of providing resources for the growth and development of environmental health professionals. I also believe, however, that

we have failed to adequately apply our force to make waves politically. NEHA staff and national officers from the board of directors visited Capitol Hill earlier this year. This first NEHA Hill Day was made possible through the hiring of NEHA staff in the Washington, DC, area. During this gathering we had the opportunity to meet with the offices of many Representatives and Senators. The purpose of these meetings was to introduce them to our profession, offer our partnership, and ask for their support of the Environmental Health Workforce Act that was introduced by Representative Brenda L. Lawrence (D-Michigan). I was personally surprised by how interested these officials were in environmental health once they understood what it is. Framing our issues, such as the quality of our freshwater resources, in the paradigm of national security and public safety was a tactic that I believe was especially powerful when speaking with people who might not otherwise support public health initiatives.

NEHA's Hill Day and an intentional engagement with legislators is going to become part of an ongoing strategy of our association to engage in the contact sport of politics. As your president and colleague, I ask you to take action this year for the sakes of our profession and the environmental health of our communities. This month, I ask you to call and write your elected officials. Tell them who we are and that environmental health is a critical part of our national security. Tell them that America is great because of places like the Great Lakes.

I have a second request of you this month: take a child outside and introduce them to the natural wonders of your region. A nearby urban school district bussed a group of inner city children to Lake Michigan to celebrate the end of this past academic year. Many of these students had never seen the big lake before. They splashed and played with unbridled joy after their teachers convinced them that the waters were shark-free. I was touched to hear them talk about new dreams as future scientists and wanting to come back again and again. This field trip was as life changing for them as it was for me nearly four decades ago. Take a young person out into nature—this effort is one more way to make waves for better environmental health.

adamelondon@gmail.com

# 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 one year; additional contributions will move individuals to a different category in the following year(s). For each of the categories, there are a number of ways NEHA recognizes and thanks contributors to the foundation. If you are interested in contributing to the Endowment Foundation, please call NEHA at 303.756.9090. You can also donate online at www.neha.org/about-neha/donate.

*Thank you.*

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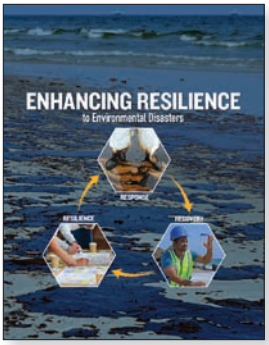



# Response, Recovery, and Resilience to Oil Spills and Environmental Disasters: Exploration and Use of Novel Approaches to Enhance Community Resilience

Margaret A. Reams, PhD
*Department of Environmental Sciences*
*Louisiana State University*

Anna K. Harding, PhD
*College of Public Health and Human Sciences*
*Oregon State University*

Wilma Subra, MS
*Subra Company, Inc.*

Nina S. N. Lam, PhD
*Department of Environmental Sciences*
*Louisiana State University*

Steven G. O'Connell, PhD
Lane Tidwell, PhD
Kim A. Anderson, PhD
*Department of Environmental and Molecular Toxicology*
*Oregon State University*

Abstract **Researchers from Oregon State and Louisiana State Universities convened a diverse gathering of leaders of Gulf Coast regional nongovernmental organizations, regulatory agencies, residents, and researchers to examine events following environmental disasters. The overall goals of the workshop were to develop unique findings from participant experiences that could be beneficial and to offer specific recommendations for the improvement of response, recovery, and resilience in future disasters. We examined three topics related to enhancing resilience to environmental disasters: rapid response for characterizing exposure; recovery and the role of the citizen scientist; and increased resilience with community participation. The participants shared their experiences and recommended solutions including increased training for citizen scientists, expanded use of innovative sampling technologies, and greater sharing of environmental conditions and information among stakeholders and agencies postevent. The recommendations will improve future response and recovery efforts, and should strengthen communities by supporting key theoretical attributes of resilience.**

## Introduction

Environmental disasters like the Gulf Coast hurricanes of 2005 and the BP oil spill of 2010 provide opportunities to examine response and recovery efforts and to derive useful lessons. Following these events, researchers, policy makers, and public interest organizations have weighed in with insights and recommendations designed to improve future planning and responses to large-scale environmental disturbances. For example, the Federal Emergency Management Agency has called for a more comprehensive "whole community" approach with greater interaction among stakeholders, public agencies, nongovernmental organizations (NGOs), and researchers to support improved pre-event planning, emergency response, and a range of recovery activities (Federal Emergency Management Agency, 2011).

Some observers point to the need for a new "community of practice" among researchers, service providers, planners, and residents to coordinate their efforts for better anticipation and response to future environmental disasters (Amaratunga, 2014; Cundill, Roux, & Parker, 2015; McNutt, 2015). Others encourage more participatory decision making and citizen input into pre-emergency planning and policy development to support recovery (Nelson, Adger, & Brown, 2007). Each of these involves some type of expanded and improved communication and information-sharing functions among the various entities with responsibilities for planning, emergency response, and recovery assistance following environmental disasters.

An examination of the response and recovery activities conducted by public agencies, NGOs, academic researchers, and community stakeholders following recent events along the Gulf Coast provides insights into how these efforts can be improved in the future. Researchers funded by the National Institute of Environmental Health Sciences (NIEHS) Superfund Research Programs at Oregon State University (OSU) and Louisiana State University (LSU) convened a diverse gathering of leaders of Louisiana and Gulf Coast regional NGOs, state regulatory agencies, community residents, and academic researchers to examine events following Hurricanes Katrina and Rita of 2005, the BP gulf oil spill of 2010, the Mississippi River floods of 2011, and Hurricane Isaac of 2012.

The workshop, Response, Recovery, and Resilience to Oil Spills and Environmental Disasters, was held on January 29, 2013, in Baton Rouge, Louisiana. Highlights and web-based information was disseminated

(http://superfund.oregonstate.edu/LSUSymposium). This event was held in a workshop format and provided a venue for a large cross section of individuals to share their experiences. Specifically, participants explored how improvements in pre-emergency planning, postevent monitoring of environmental conditions, and better communication of exposure risks might contribute to stronger recovery and enhance community resilience. The workshop topics encompassed a range of activities conducted in the Gulf Coast region by workshop participants in the aftermath of the recent disasters. For example, the Gulf Restoration Network encouraged residents to systematically document and share observations concerning the location and effects of the BP oil spill.

The objective of this article is to present the recommendations of the workshop participants to improve planning and response in three areas: 1) response and exposure risk characterization, 2) recovery and the role of the citizen science in monitoring postdisaster conditions, and 3) resilience and encouragement of community participation in predisaster planning. The findings and recommendations present new knowledge for building communities of practice for disaster planning, supporting citizen science activities, and enhancing the overall resilience of vulnerable communities to large-scale environmental disturbances.

## Study Design

We organized the workshop to examine response and recovery-related activities conducted after the Gulf Coast environmental disasters, and to develop specific recommendations to improve efforts in the future. Response and recovery planning as well as the subsequent implementation—due to different protective goals of various players in environmental disaster—often progress in parallel or have insufficient interactions. Therefore, the workshop was aimed at developing mutual understanding among workshop participants, generating awareness of monitoring technologies for characterizing exposure, exploring agile community resources, and identifying methods for better data and information sharing. Recommendations from workshop participants who have firsthand experiences are particularly useful because they identify points of linkage between response efforts and recovery, illuminating the process or critical path through which community resilience can be strengthened following environmental disasters.

We invited participants from organizations and public agencies with responsibilities and involvement in recent environmental disasters along the Gulf Coast to attend a one-day symposium and workshop held on the campus of LSU in Baton Rouge. The meeting was held on January 29, 2013, and was cohosted by researchers of the Superfund Research Programs at OSU and LSU. The attendees represented a diverse group of stakeholders and a broad range of expertise, including 15 individuals representing seven NGOs who work directly with residents of south Louisiana communities. These included the Louisiana Bucket Brigade, a citizen science and air monitoring group; the Louisiana Environmental Action Network, an association of activist citizens from around the state whose communities face environmental disturbances and pollution issues; and the Mary Queen of Vietnam Community Development Corporation in New Orleans, a group representing the environmental concerns of the Vietnamese residents of New Orleans East. Also, representatives of the Gulf Restoration Network, the Lake Pontchartrain Basin Foundation, the Baton Rouge Citizens to Save Our Drinking Water, and the Louisiana Wildlife Federation participated. These NGOs have years of experience working with residents and several were active in recovery assistance following the storms of 2005 and the 2010 oil spill. As a result, they were able to bring to the discussions real-world experience and insights into the needs of their constituents.

Other participants included 18 representatives of Louisiana state regulatory agencies, including the Department of Health and Hospitals, the Department of Environmental Quality, the Louisiana Department of Wildlife and Fisheries, the Louisiana Department of Natural Resources, and the Louisiana Oil Spill Coordinator's Office. Five participants represented the oil and gas industry, including the Shell Pipeline division and oil field service companies. Three participants from the federal government represented the U.S. Coast Guard and the U.S. Environmental Protection Agency (U.S. EPA) Dallas Region 6. In addition, 25 academic researchers and 15 graduate students from various academic disciplines including environmental and health sciences, chemistry, oceanography and coastal sciences, geography, economics, political science, and communication participated in the symposium. They represented OSU, LSU, University of New Orleans, and McNeese State University. Several experts from the groups listed above were included to provide information on newer monitoring technologies that could be deployed in environmental disasters. The morning portion of the symposium consisted of speakers and the afternoon session included three focus-group discussions. In all, 41 individuals participated in the focus groups.

We followed established methodology for focus-group discussions of specific questions and topics (Kitzinger, 2007). We selected several professionals in environmental fields to lead the focus groups. The leaders explained the objectives of each focus-group session and the guidelines for interaction, introduced the specific questions, moderated and guided the discussion, and encouraged all members of the group to speak freely, so as to increase interaction among participants. The key points of the discussions were recorded by at least one notetaker assigned to each group.

Focus groups worked in parallel on three topics: 1) response and exposure risk characterization, 2) recovery and the role of the citizen scientist, and 3) resilience and community participation. Citizen science refers to collaboration between scientists and volunteers to systematically observe and gather information about selected real-world issues. The interaction is increasingly recognized as a useful approach to raise the science literacy of nonexperts, to gather data to advance understanding of a range of environmental issues, and to identify research topics of concern to community residents (Bonney et al., 2009). The focus groups also examined the advantages and challenges to developing a new framework for response and recovery. Each group included representatives of regulatory agencies and NGOs who work closely with residents and academic researchers. At the end of the workshop, the participants reconvened and presented summaries of their discussions, points of consensus, and recommendations for improved disaster response and recovery planning.

## Results

The workshop was convened in Baton Rouge in late January 2013, with 81 in attendance for the symposium and 41 participating in the workshop, including participants from regulatory

TABLE **1**

**Focus-Group Discussion Findings for Improving Response to Environmental Disasters to Facilitate Resilience**

**Focus Group 1: Response and Exposure Risk Characterization**

1. **During emergency events, which contaminants should be assessed and where?**
   - Citizens were concerned with lack of transparency and uncertainty about regulated chemical locations before and after a disaster.
   - There was no consensus on what chemicals should be monitored.
   - Predisaster planning and sampling strategies should be shared with local communities.
2. **How to determine and employ monitoring approaches?**
   - It is critical to have the community engaged for site selection for chemical sampling to characterize postdisaster contamination.
   - Use techniques that do not require a priori knowledge about potential contaminants prior to sampling.
   - Employ passive sampling devices so that samples can be collected and archived in laboratory freezers for later use if needed.
   - It is unlikely that all chemicals that should be monitored will be known in order to fully characterize risk; therefore, it is important to maximize chemicals screened.
3. **What quality assessment/quality control standards are needed to ensure citizen scientist-collected data are useful?**
   - More people often are needed during and after environmental disasters to perform environmental monitoring.
   - Part of quality assurance would include standard operating procedures (SOPs) and applicable training processes for citizens and nongovernmental organizations (NGOs).
   - Employ newer technologies, such as photographs with GPS, as part of training and documentation.

**Focus Group 2: Recovery and the Role of the Citizen Scientist**

1. **What are the best practices for training citizen scientists?**
   - Citizen scientist training must be transparent while ensuring safety of participants.
   - Clear SOPs need to be developed specifically for citizen scientists.
2. **How can citizen scientists integrate effectively with exposure assessments?**
   - Citizen scientists must be actively engaged in predisaster planning.
   - Citizen science programs should include multiple partners, such as technology or engineering groups, advisors, community groups, government agencies, universities, and NGOs.
   - Use communication expertise that is community specific and valuable for information sharing amongst the interested parties.
   - Citizen scientists should engage in identification of sampling sites.
   - Data are easily accessible by all interested parties.

**Focus Group 3: Resilience and Community Participation**

1. **What are the best approaches for community participation in assessing local environmental conditions?**
   - Understanding the individual community is essential, and that there is no "one-size-fits-all" model.
   - Learn from history and tradition, and seek local ecological knowledge of the community.
2. **How can information be shared among groups?**
   - Identify community-specific concerns following environmental disasters.
   - Proactively work with communities to develop response and recovery plans.
   - Use social media tools to share results of environmental monitoring with interested individuals and groups within the communities.
   - Share accurate and timely information with applicable risk communicated.
3. **How can communities build resilience to environmental disasters?**
   - Communicate accurate risk reduction strategies.
   - Support redundancy of services so that key functions can be carried out in the aftermath of disasters.
   - Encourage NGOs, agencies, and academics to reach across cultural boundaries to better serve communities that have been hit by disaster.

agencies, NGOs, universities, and oil and gas companies. Presentations are available (http://superfund.oregonstate.edu/LSUSymposium).

The participants selected one of three focus-group discussions to join. Most of the participants did not know each other personally, and the focus groups created the opportunity for members of the various organizations to establish connections. Each group focused on one topic and included members of each organization represented. We were particularly interested in areas of consensus and nonconsensus, given the diversity of roles played by the participants. The participants shared and examined historical successes and failures and identified ways to improve response and recovery, leading to specific recommendations. The main points from each of the three focus group discussions are summarized in the following section and in Table 1.

### Theme 1: Response and Exposure Risk Characterization

A consensus could not be achieved to define a template for identifying chemicals that should be monitored. Certainly, the Emergency Planning and Community Right-to-Know Act of 1986 makes emergency planning easier by requiring regulated industries to report to state and federal authorities annually the amounts of listed chemicals that are used, treated, stored, transported, and/or disposed of by the firms, and this information is available to residents (U.S. EPA, 2017). So, while it is recognized that agencies have records of hazardous chemicals used and stored in commercial settings within a community, these records alone were considered insufficient as the sole basis for monitoring. It was acknowledged that some hazardous chemicals might not be disclosed in a timely or thorough fashion, especially if they change hands. In addition, during some environmental disasters, contaminants, and hazardous chemicals might be moved some distance from their original storage location.

For example, participants from the Louisiana Bucket Brigade reported that during the 2011 Mississippi River flooding, multiple chemical waste pits were affected, and some did not have responsible parties identified. Given that state agencies lack the resources and staff to assess all sites after a disaster and tend to respond to the worst ones, many sites were not evaluated. These concerns about the oversight of hazardous materials were coupled with the acknowledgement that many chemicals are not regulated. Also, the possible lack of transparency of chemical storage and use before, during, and after an environmental disaster was a reoccurring theme.

The concerns expressed reflect a sense of "undone science" wherein there might be knowledge gaps concerning exposure risks, due in part to when and where monitoring is conducted within communities (Hess, 2007). Such knowledge gaps have been characterized as "outcomes of undone science" (Frickel & Vincent, 2011). While there was general agreement that there should be transparent processes for both monitoring and for deciding which chemicals should be tracked after environmental disasters, no consensus could be achieved about the processes. Discussions faltered when the groups attempted to develop a protocol for monitoring specific chemicals.

*Monitoring Approaches*

It is highly unlikely that all chemicals that can pose a risk will be known after an environmental disaster. Even prior to an environmental disaster, it is often not possible to know which chemicals should be monitored to fully characterize risk. One approach to address these concerns is to utilize techniques that do not require an a priori knowledge about potential contaminants prior to sampling. Field sampling approaches that use technologies that can be subsequently analyzed back at the laboratory for many contaminants may be especially valuable. One example is passive sampling techniques. Various passive sampling devices (PSDs) are applicable to a broad range of chemicals. Several different types of PSDs could be used to further expand the range of chemicals that could be monitored.

Another important feature of employing passive samplers is that samples from the field could be collected and archived in laboratory freezers for later use if needed. Should contaminants of concern be discovered later, these archived samples could be analyzed and provide important feedback to the communities concerning the spatial and temporal extent of the contamination. The cost of this more robust approach to characterizing risk could be kept low, as not all archived passive samplers would be analyzed necessarily, which is typically the most expensive part of monitoring. The archived environmental disaster samples could become a valuable curated collection.

*Monitoring Quality Assurance*

Consensus was achieved that more person power often is needed during and after environmental disasters for environmental monitoring. Also, the participants agreed that citizen scientists could be useful in these types of circumstances when state agency personnel might have difficulty getting into affected communities to conduct assessments. Consensus was not achieved, however, that citizen scientists or NGOs could be useful and potentially trusted to collect samples that might hold up under legal scrutiny. While there was great enthusiasm by communities and NGOs to cooperate with agencies, there was reluctance to change the status quo, and concern that citizen scientists would need to have documented training and other safeguards—as yet undefined—to ensure sample integrity. There was significant interest in receiving training from existing agency-sponsored courses addressing proper methods of field sampling. Also, this training would have to be conducted prior to emergency events so that volunteers could be mobilized quickly. The participants also expressed interest in co-developing training materials (including training videos), courses, and other focused outreach resources that could be used specifically in preparation of environmental disasters. It was agreed that training materials should include a quality assurance plan for citizens and NGOs to promote sampling results that are trusted and useful.

### Theme 2: Recovery and the Role of the Citizen Scientist

*Training Citizen Scientists*

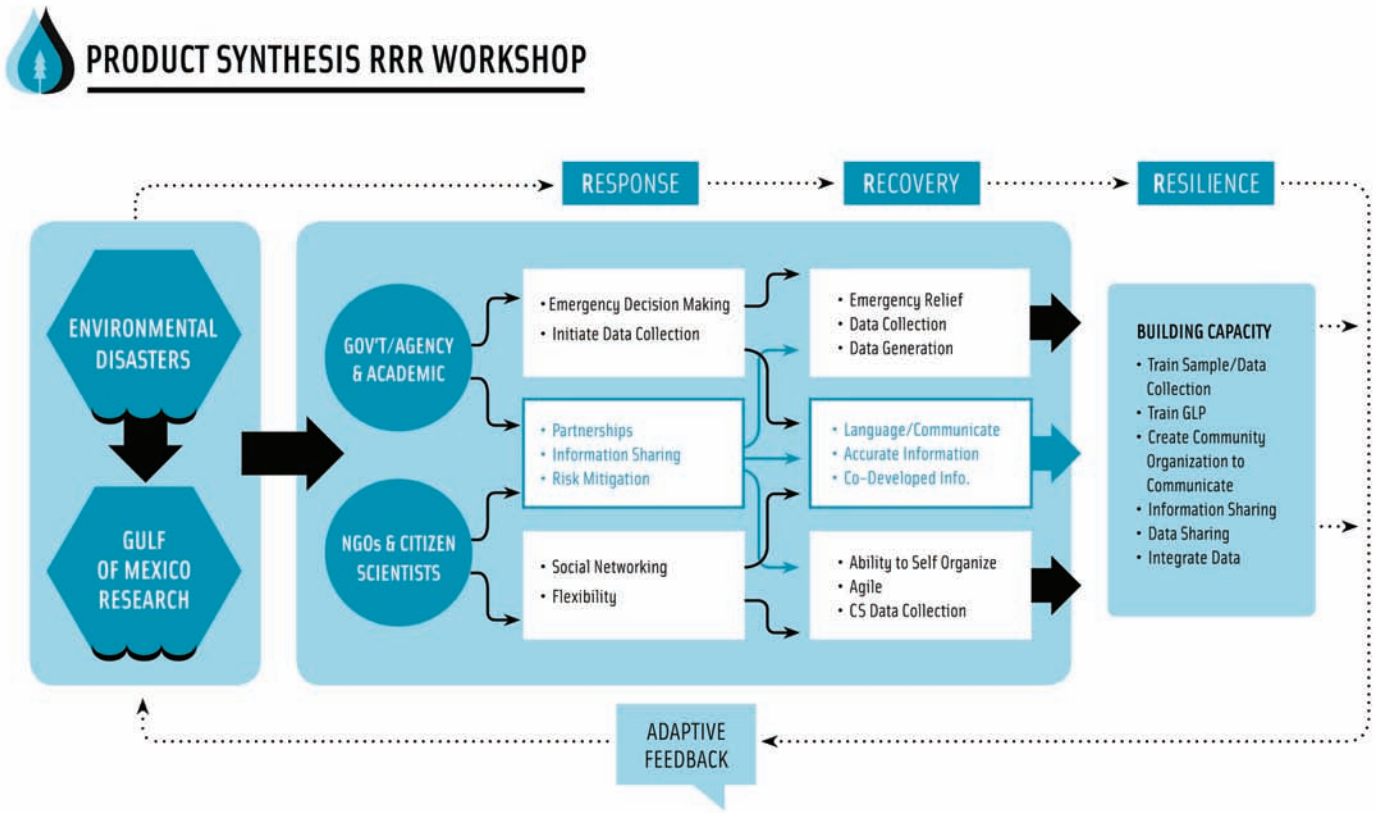
It was recognized that training of citizen scientists should occur prior to environmental disasters. While some focus-group participants still expressed a desire to protect the goals of their agencies and stressed the need to maintain the status quo of roles and responsibilities for environmental monitoring, training citizen scientists was considered an important use of an "agile" community resource. In addition to quality training discussed above, the development and use of standardized procedures was considered essential.

*Citizen Scientist Integration*

There was a consensus that the goals and objectives of citizen science programs should include multiple partners, such as technology or engi-

FIGURE **1**

**Synthesis of Workshop Results**




RRR = Response, recovery, and resilience; NGOs = nongovernmental organizations; CS = collaborative stage; GLP = good laboratory practice.

neering groups or advisors, community groups, government agencies, universities, and NGOs. Citizen scientist groups have the ability to self-organize and develop important community partnerships. Many have developed excellent lines of communication within the community. With the incorporation of citizen groups with agencies, universities, and NGOs, the nexus of integration could be powerful. Citizen scientist groups also often possess language and communication expertise that is community-specific and valuable for information sharing amongst interested parties.

### Theme 3: Resilience and Community Participation

*Community Participation in Assessing Local Environmental Conditions*

This group of discussants agreed on a fundamental need to understand the communities themselves and to take into account the socioeconomic and geographic diversity of communities, as there is no "one-size-fits-all" model for assessing local environmental conditions and exposure risks in the aftermath of environmental emergencies. The group stressed the need for broad-based, collaborative efforts that build trust among community members so that information can be provided that is relevant to the specific community.

The group agreed on the need for further investment in proactive response and recovery planning, requiring a plan that addresses community-specific needs and risks. Receiving timely and updated information about specific actions residents can take to reduce their exposure risks was determined to be critical to communities. Bidirectional lines of communication between regulatory agencies and communities were identified as being important to build trust and to identify community-specific concerns following environmental disasters. The group agreed it was important to learn from history and tradition, and to seek out those who could provide traditional ecological and historical knowledge of the community. One suggestion was to incorporate into school curricula or on websites information about the local environment, natural hazards, and strategies for risk mitigation that would make the knowledge more broadly known.

Finally, the discussants agreed that communities can be made more resilient through diversification of skill sets within communities. They stressed the importance of supporting redundancy of services so that key functions can be carried in the aftermath of disasters. For example, information sharing could be achieved through greater use of social media tools, to share results of environmental monitoring with interested indi-

viduals and groups within the communities. The group also suggested greater utilization of cloud-based, open-sourced technology both to communicate information about environmental conditions and to gather feedback from the public.

## Discussion

The workshop was created to gather information that could be used to improve planning and response to future environmental disasters. Figure 1 summarizes points of consensus and also depicts two important dimensions of the challenge.

The first dimension is the current set of functions and roles played by regulators, researchers, NGOs, and community residents as exhibited during the response and recovery phases of recent Gulf Coast disasters. The second dimension depicts key conceptual linkages between response and recovery efforts and longer-term resilience within a community. In the center section of the diagram, boxes outlined in blue summarize the prescriptive recommendations for new partnerships and shared functions to be carried out by the various groups during the response and recovery phases.

During the response phase, the functions provided by government agencies and academic researchers during recent disasters and those performed by nonexperts (e.g., citizens and NGOs) have tended to be distinct, with no overlapping duties or shared functions. For example, agency officials were responsible for emergency decision making, including assessing exposure risks, issuing warnings concerning air and water quality, and even ordering public evacuations of highly affected areas. By contrast, the functions performed by residents and NGOs involved passing on information through established social groups and communication networks.

The recommendations were clear from the workshop participants: the two types of entities should work together to form ongoing partnerships to support accurate information gathering and sharing, and to develop and disseminate risk mitigation strategies. This approach provides a clear mechanism or process for community members to self-organize to carry out necessary functions after disasters, one of the key theoretical attributes of more resilient communities (Adger, 2000; Holling, 1973, 1996; Norris, Stevens, Pfefferbaum, Wyche, & Pfefferbaum, 2008). Also, increased opportunities for residents to participate in environmental monitoring addresses one of the significant issues raised by the focus groups, a concern that agency representatives might not conduct environmental monitoring in specific areas most relevant to the environmental exposure risks of the residents. "Functional redundancy" is an attribute of more resilient communities both in the immediate aftermath and recovery periods, and could be increased by more individuals and groups recording their observations of environmental conditions following large-scale disturbances (Holling, 1973, 1996). Also, because residents conducting monitoring are probably highly motivated to share the results of their efforts, the monitoring should encourage more communication among residents and support the creation and maintenance of networks of interested individuals and groups.

During the recovery phase, functions performed by the experts and nonexperts also have tended to be distinct, with government agencies concerned with emergency relief and data collection to assess changes in environmental threat levels. Groups of residents and various NGOs, however, also performed important functions related to disaster relief and assistance. At this stage, the participants called for increased interaction to perform shared functions including co-developing of information about environmental conditions and residents' needs in the aftermath of the disaster. They stressed the need to work together to gather the most accurate data possible to assess the exposure conditions within the local community.

Through increased coordination of efforts and improved, ongoing, bidirectional communication between government agencies and communities, the participants envisioned community stakeholders being able to conduct more accurate assessments of exposure risks—furthering another key theoretical element of resilience, a holistic and scientific understanding of risk (Adger, 2006; Gunderson, 2000). Expanded citizen monitoring efforts and use of innovative technologies, such as passive sampling devices, should contribute to more accurate assessments of local conditions, especially because residents can place the information they compile in the context of the concerns and behavior patterns of their neighbors.

Lastly, the increased interaction should support the formulation and implementation of adaptive strategies, including postdisaster response plans that reflect more closely the concerns of residents regarding potential environmental exposure risks. Further, increased monitoring and communication among community stakeholders, researchers, and agency officials should lead, in time, to more thorough evaluations of response actions, thereby informing the adjustments and modifications necessary to improve postdisaster response and recovery efforts. This evaluation and improvement process is shown as a feedback mechanism in the diagram and enhances the third element of more resilient communities: the capacity to adapt to changing levels of risk (Adger, 2006; Lam, Arenas, Pace, LeSage, & Campanella, 2012; Lam, Reams, Li, Li, & Mata, 2016; LeSage, Pace, Campanella, Lam, & Liu, 2011; Nelson et al., 2007; Reams, Lam, & Baker, 2012; Reams, Lam, Cale, & Hinton, 2013).

## Recommendations and Conclusions

The results of the focused discussions of the three topics of interest indicate clearly that the topics are interrelated. The workshop participants recommended that improvements in the first topic—response and exposure risk characterization—could be achieved through better pre-event planning so that the likely contaminants that might be released into local environments can be identified. Also, participants emphasized the importance of environmental monitoring to be conducted in the specific places where residents have acute concerns. The participants were in agreement that because of the importance of this issue, residents and citizen scientists should be trained prior to emergencies and used to help address this gap in information about environmental conditions following environmental disasters. This type of pre-event planning could support new communities of practice among community stakeholders, including residents, NGOs, and public decision makers.

The second discussion topic—recovery and the role of the citizen scientist—led to a similar call for more information about local environmental conditions following disasters. The focus-group participants stated that residents often have questions about exposure risks in their own neighborhoods from

floodwaters and sediments, for example, and that these questions were not addressed by agency employees. As a result, residents worried about the safety of moving around their neighborhoods; their concerns were not allayed by either the environmental assessment activities or the postdisaster communication efforts of the state regulatory agencies.

To address this need for more information, the focus groups expressed enthusiasm for the wider use of new PSDs, which can be used by groups of residents to gather information from their own neighborhoods, thereby creating a new source of data that can be shared with environmental agencies. To realize these benefits, residents will need training and the participants recommended the development of new web-based training courses to promote best practices for those who would conduct the monitoring. Increased opportunities for environmental monitoring by nonexperts have the potential to raise residents' scientific understanding of local hazards, and to enhance their capacity to participate more substantively in environmental policy development and emergency planning.

The potential for citizen scientist-driven environmental projects are quickly developing. One such opportunity is where citizen scientists can receive training, develop their own projects, or join an existing network (http://citizen.science.oregonstate.edu). Certainly, the greater use of PSDs by citizen scientists could generate more information to be shared with agency officials, academic researchers, and others. The site enables citizen scientists to develop a profile, perform online training, request sampling sites, or join local events. The website also manages sample submissions and allows users to view their data, key features identified in the focus groups. Additional resources to support a greater role for nonexperts in disaster recovery can be found on the Citizen Science Association website (http://citizenscienceassociation.org).

The third discussion theme concerned how to encourage more public participation in decisions to support more resilient communities in the longer term. The group stressed a fundamental need for improved communication and trust among community residents, especially those identified as community leaders, NGOs, researchers, and public agencies. The foundation of social capital that is needed to support longer-term resilience needs to be established before the next disturbance (Gunderson, 2000).

The central communication challenge is how to get information about environmental conditions following disasters into the hands of community residents and other stakeholders. One lesson repeatedly noted by NGO and community presentations was that information concerning data and risk is more effectively received by communities through known community leaders rather than agency or academic researchers. The participants recommended the use of network-type organizations like the Louisiana Environmental Action Network, the Gulf Restoration Network, and the Louisiana Bucket Brigade, whose members monitor and observe local environmental conditions and share that information with the public through interactive websites. The participants also suggested public agencies, residents, and NGOs make wider use of social media strategies, including tweets and Facebook postings to share monitoring results, and create interactive online maps showing locations and information gathered from monitoring sites.

Finally, the participants agreed that the level of trust needs to be improved among residents, public agencies, and other groups following disasters. They recommended increased opportunities for public and NGO participation in emergency planning and response activities within the local community. The groups agreed that recovery of communities would be quicker if bidirectional communication is enhanced between residents and regulatory agencies. Also, the participants recommended the wider use of formal data-sharing agreements between researchers and community groups to build trust and enhance the capacity for collaboration among residents, NGOs, and academic researchers. Increased trust, more systematic interaction, and information gathering and sharing among these key groups should help enhance the long-term resilience of coastal and industrialized communities facing exposure risks from significant natural and technological hazards.

*Acknowledgements:* This project was supported in part by award number P42 ES016465 (KAA and AKH) and the associated Chemistry Facility Core; P42 ES013648 (MR); P30 ES000210 (KAA); and R21 ES020120 (KAA and AKH) from NIEHS and the OSU Food Safety and Environmental Stewardship Program. Steven O'Connell was supported in part by NIEHS Training Grant Fellowship T32ES007060-32 from the National Institutes of Health (NIH). Nina Lam was supported in part by a grant from the National Science Foundation, award number 1212112. The content is solely the responsibility of the authors and does not necessarily represent the official views of NIEHS or NIH.

*Corresponding Author:* Kim A. Anderson, Department of Environmental and Molecular Toxicology, Oregon State University, Agricultural Life Sciences Building, Room 1007, Corvallis, OR 97331.
E-mail: kim.anderson@oregonstate.edu.

## References

Adger, W.N. (2000). Social and ecological resilience: Are they related? *Progress in Human Geography, 24*(3), 347–364.

Adger, W.N. (2006). Vulnerability. *Global Environmental Change, 16*(3), 268–281.

Amaratunga, C.A. (2014). Building community disaster resilience through a virtual community of practice (VCOP). *International Journal of Disaster Resilience in the Built Environment, 5*(1), 66–78.

Bonney, R., Cooper, C.B., Dickinson, J., Kelling, S., Phillips, T., Rosenberg, K.V., & Shirk, J. (2009). Citizen science: A developing tool for expanding science knowledge and scientific literacy. *BioScience, 59*(11), 977–984.

Cundill, G., Roux, D.J., & Parker, J.N. (2015). Nurturing communities of practice for transdisciplinary research. *Ecology and Society, 20*(2), 22–28.

## References


Federal Emergency Management Agency. (2011). *A whole community approach to emergency management: Principles, themes, and pathways for action* (FDOC 104-008-1). Washington, DC: Department of Homeland Security. Retrieved from https://www.fema.gov/media-library/assets/documents/23781

Frickel, S., & Vincent, M.B. (2011). Katrina's contamination: Regulatory knowledge gaps in the making and unmaking of environmental contention. In R.A. Dowty & B.L. Allen (Eds.), *Dynamics of disaster: Lessons on risk, response and recovery* (pp. 11–28). London, England: Earthscan.

Gunderson, L.H. (2000). Ecological resilience—In theory and application. *Annual Review of Ecology and Systematics, 31*, 425–439.

Hess, D.J. (2007). *Alternative pathways in science and industry: Activism, innovation, and the environment in an era of globalization*. Cambridge, MA: The MIT Press.

Holling, C.S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics, 4*, 1–23.

Holling, C.S. (1996). Engineering resilience versus ecological resilience. In P. Schulze (Ed.), *Engineering within ecological constraints* (pp. 31–44). Washington, DC: The National Academies of Sciences.

Kitzinger, J. (2007). Focus groups. In C. Pope & N. Mays (Eds.), *Qualitative research in health care* (3rd ed., pp. 21–31). Oxford, United Kingdon: Blackwell Publishing, Ltd.

Lam, N.S.N., Arenas, H., Pace, K., LeSage, J., & Campanella, R. (2012). Predictors of business return in New Orleans after Hurricane Katrina. *PLoS One, 7*(10), e47935.

Lam, N.S.N., Reams, M., Li, K., Li, C, & Mata, L.P. (2016). Measuring community resilience to coastal hazards along the northern Gulf of Mexico. *Natural Hazards Review,* 17(1), 04015013.

LeSage, J., Pace, R.K., Campanella, R., Lam, N.S.N., & Liu, X. (2011). Do what the neighbors do: Reopening businesses after Hurricane Katrina. *Significance, 8*(4), 160–163.

McNutt, M. (2015). A community for disaster science. *Science, 348*(6230), 11.

Nelson, D.R., Adger, W.N., & Brown, K. (2007). Adaptation to environmental change: Contributions of a resilience framework. *Annual Review of Environment and Resources, 32,* 395–419.

Norris, F.H., Stevens, S.P., Pfefferbaum, B., Wyche, K.F., & Pfefferbaum, R.L. (2008). Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. *American Journal of Community Psychology, 41*(1–2), 127–150.

Reams, M.A., Lam, N.S.N., & Baker, A. (2012). Measuring capacity for resilience among coastal counties of the U.S. northern Gulf of Mexico region. *American Journal of Climate Change, 1*(4), 194–204.

Reams, M.A., Lam, N.S.N., Cale, T.M., & Hinton, C.M. (2013). Applying a community resilience framework to examine household emergency planning and exposure-reducing behavior among residents of Louisiana's industrial corridor. *Journal of Emergency Management, 11*(2), 107–120.

U.S. Environmental Protection Agency. (2017). *Emergency Planning and Community Right-to-Know Act (EPCRA)*. Retrieved from https://www.epa.gov/epcra


# Did You Know?

More than 900 environmental health professionals enjoyed over 200 educational sessions at NEHA's 2017 AEC in Grand Rapids, Michigan, this July. The conference received a variety of media attention—watch and listen to the interviews at www.neha.org/news-events/latest-news/neha-aec-2017-makes-history.

# Hotel Key Cards: How Clean Is the First Thing Guests Touch on Their Way to Their Rooms?

Haeik Park, PhD
*Indiana University–Purdue University Fort Wayne*

Jooho Kim, PhD
*James Madison University*

Mengyu Zhang
Barbara Almanza, PhD, RD
*Purdue University*

Jeffrey J. Fisher, PhD
*Central Michigan University*

Jing Ma, PhD
*University of Delaware*

Abstract **Many studies have found that the cleanliness of hotel rooms has a great impact on hotel guest satisfaction. Relatively little attention, however, has been given to the comprehensive guest experience related to cleanliness. This study focuses on the cleanliness of hotel room key cards as a source of contamination for guest hands and assesses the contamination of hotel key cards collected from 25 hotels using an adenosine triphosphate meter, a way to rapidly detect actively growing microorganisms. Results expand knowledge about hotel cleaning practices and appropriate handling of hotel room key cards. Implications and suggestions for practitioners are discussed.**

## Introduction

Even though hotel staff regularly clean most hotel rooms and public areas, research on the effectiveness of cleaning suggests that more cleaning might be needed. A recent study claimed that even though cleanliness based on observation provides for an aesthetic evaluation, it does not address issues related to microbial contamination and the possibility of acquiring an illness from contaminated surfaces (Almanza et al., 2015b). Hotel guests have become sick from hotel stays (Centers for Disease Control and Prevention, 2017). Examples include Legionnaires' disease outbreaks in a hotel on the Las Vegas Strip (Ritter, 2011) and a Marriott Hotel in Chicago (Smith, 2012). These infectious diseases might result from environmental contamination or person-to-person transmission in hotels (Love, Jiang, Barrett, Farkas, & Kelly, 2002). Hands are a critical source of disease transmission (Cannon & Davis, 2005) and proper hand washing with soap is thought to reduce diarrheal diseases by approximately 47% (Curtis & Cairncross, 2003).

Disease outbreaks in hotels have a substantial financial impact on the hotel industry. Chen and coauthors (2007) found that severe acute respiratory syndrome (SARS) resulted in one of the largest drops in hotel stock prices, approximately 29%, in one month alone in Taiwan. The World Health Organization, in fact, estimated $10 billion in costs to travel-related industries from this one crisis with SARS (Cooper, 2003).

Hotel guest rooms are assigned to housekeeping staff for daily cleaning based upon the record of the expected check in and check out of the guests. Although procedures differ with each company, general cleaning includes dumping trash, stripping and making beds, dusting and wiping down the bedroom, and finally, bathroom cleaning (Casado, 2012). Supervisors then inspect guest rooms (Casado, 2012; Nitschke & Frye, 2008). The cleaning of hotel rooms, however, is complicated by the need for rapid turnover of the rooms from one guest to another, even with daily housekeeping service provided by the hotel. Cleanliness of hotels is important to guest satisfaction and an attribute in hotel quality (Ananth, DeMicco, Moreo, & Howey, 1992; Atkinson, 1988; Knutson, 1988; Lockyer, 2003). Studies have suggested that cleanliness has a large impact on hotel guest behavior in switching to other hotels (Lewis & Nightingale, 1991; Lockyer, 2005). In these studies, most researchers have focused solely on the cleanliness of guest rooms (Dolnicar & Otter, 2003; Lockyer, 2003, 2005; Weaver & Oh, 1993). The cleanliness of a hotel guestroom is one of the most important attributes to "customer delight" (Magnini, Crotts, & Zehrer, 2011). According to Xie and coauthors (2014), cleanliness is significantly related to hotel performance in online consumer reviews.

In spite of the importance of hotel cleanliness to guests, relatively little attention has been given to the comprehensive guest experience related to cleanliness. Most studies have focused on visual assessments of cleanliness. At least one study using aerobic plate counts (APC) and coliform counts did find that some areas of the guest rooms, as well as the maid carts, had high levels of contamination (Almanza et al., 2015a). Visual assessment of hotel room cleaning does not appear to represent the level of microbial contamination that likely is present because almost all hotel room surfaces failed when microbiological standards set in other industries were used for the hotel rooms (Almanza et al., 2015b). Similarly, other areas of hotel cleanliness have not been well assessed. For example, a hotel key card is the first thing that guests touch on the way to their guest room and is likely to be touched frequently from the time they check in to the time they check out. Guests might take their key cards to the beach and drop

TABLE **1**

**Result of *t*-Test Comparing New and Used Hotel Key Cards**

| | *n* | Mean | *SD* | *df* | *t*-Test |
|---|---|---|---|---|---|
| New key cards | 25 | 36.45 | 35.30 | 35.49 | -8.845* |
| Used key cards | 25 | 175.03 | 69.93 | | |

*$p < .000$.

TABLE **2**

**Result of *t*-Test Comparing Used Hotel Key Cards by Hotel Price**

| | *n* | Mean | *SD* | *df* | *t*-Test |
|---|---|---|---|---|---|
| Economy | 11 | 189.75 | 76.47 | 23 | .930 |
| Mid-class | 14 | 163.47 | 64.83 | | |

them in the sand, or to the pool. Also, they might keep key cards in their pockets, wallets, smartphone cases, or simply hold them in their hands. As a result, hotel key cards might act as a contamination source of guest hands.

The adenosine triphosphate (ATP) test can been used to assess overall cleanliness by measuring presence of organic soil and microbiological organisms. It is widely used to detect contamination on surfaces (Cunningham, Rajagopal, Lauer, & Allwood, 2011; Sherlock, O'Connell, Creamer, & Humphreys, 2009) and is well accepted in research studies (Worsfold & Griffith, 1996). An ATP meter detects an enzymatic luciferin/luciferase reaction and quantifies it as bioluminescence. The ATP meter measures the light signal and reads the quantitative biomass in relative light units (RLUs) (Shaughnessy, Cole, Moschandreas, & Haverinen-Shaughnessy, 2013). The advantages of ATP meters are their easy use and handling, instant results, portability, and the fact that they require no laboratory for data analysis. Higher RLUs numbers indicate presence of more organic soil and microorganisms (all types).

This study addressed the following research questions: How contaminated are hotel key cards? Is the cleanliness of hotel key cards different among different hotel segments? And, what is the best cleaning practice for hotel key cards? Based on these research questions, the purpose of this study was to 1) assess the cleanliness of hotel key cards using an ATP meter, 2) compare the cleanliness of new and used key cards, and 3) assess possible cleaning methods for hotel key cards.

## Methods

In this study, the ATP test method was utilized using an ATP hygiene monitor device, manufactured by Hygiena, to detect the level of microbial contamination on the surface of hotel key cards. An UltraSnap testing swab with the unique liquid stable luciferase/luciferin reagent was used for each key card. Both sides of a hotel key card (3.375 x 2.125 in.) were swabbed in two directions while rotating the swab according to manufacturer directions. For more accurate interpretation of results, all readings were adjusted by multiplying by 1.1, because the manufacturer recommended area for swabbing is 4 x 4 in. for a typical flat surface. A new pair of rubber gloves was used to prevent cross-contamination of the hotel key cards before touching swab sticks and hotel key cards at each hotel.

In total, 149 hotel key cards were collected from 25 hotels in two Midwest cities. Key cards from these 25 hotels were divided into two market segments: economy and mid-class hotels. Five researchers were assigned to collect data in pairs when visiting the 25 hotels for data collection. Data were collected during a 3-week period in October 2014. Prior to data collection, the five researchers received training about how to use the ATP meter and swab. The researchers first read manufacturer directions, then watched an instructive video provided by the manufacturer, and then practiced the swabbing technique using the ATP meter and swabs on sample surfaces. Permissions for data collection were asked of the staff or manager at each hotel site accompanied by a letter stating the purpose of the study and confidentiality of the results. After agreeing to participate, each hotel was asked to provide five used and one new key card for testing.

After the ATP meter is turned on and calibrated, RLU measurements may be taken. According to manufacturer instructions, readings <10 indicate that the surface is considered as clean. Readings of 11–30 suggest a warning that the surface is not adequately clean. A reading >30 is considered dirty.

Three cleaning methods were tested that might be commonly available to hotels. They included the use of wipes (Lysol disinfecting wipes) that are sometimes used in office areas; a sanitizer (Ecolab Oasis 146 Multi-Quat Sanitizer) that might be used in surface cleaning in food services, schools, hospitals, and other areas; and a commercial dishwasher (Hobart CLPS66E), as found in many commercial kitchens. Three dirty key cards were used for each of the cleaning tests.

## Results

Data were analyzed by using the statistical software program SPSS 20. The result of the independent samples *t*-test comparing new and used hotel key cards is shown in Table 1. The ATP readings of new key cards (36.45, 35.30) were significantly lower in comparison with used key cards (175.03, 69.93), $t(35.49) = -8.845$, $p < .000$. The mean value of readings for the new key cards (mean = 36.45) was slightly higher than 30. This result indicates that used hotel key cards (mean = 175.03) were clearly interpreted as dirty. Surprisingly, only about 60% of the new cards (15/25) had <30 RLUs and 10 new hotel key cards were not considered clean, even though the mean was close to being below the recommended level of 30 RLUs. Among the new key cards, the cleanest key card had 2 RLUs and the dirtiest key card had 133 RLUs.

Another independent samples *t*-test was conducted to compare whether different hotel segments (price) had a significant effect on the cleanliness of hotel key cards (Table 2).

The results of the *t*-test found that there was no statistically significant difference between economy and mid-class hotels, $t(23) = .930$, $p > .05$. This result indicates that used hotel key cards were dirty regardless of hotel segment.

The results of the three different cleaning methods are shown in Table 3. Overall, RLUs dropped substantially with any of the three cleaning methods (use of disinfecting wipes, a sanitizer bucket, or a dishwashing machine). Averages for the three cleaning methods were all <30 RLUs and would be considered clean. Among the three cleaning methods, use of disinfecting wipes (Lysol) resulted in the lowest RLUs. The sanitizer bucket and dishwasher had similar cleaning effects. Unfortunately, all three cleaning methods also resulted in a malfunction of the hotel keycards. This result indicates that a proper cleaning method for hotel key cards still needs to be developed.

TABLE **3**

**Tests of Cleaning Standards for Hotel Key Cards**

| | Relative Light Units (RLUs) Mean (Range) |
|---|---|
| Before cleaning | 235.67 (113–446) |
| After cleaning | |
| Lysol wipes | 10.00 (7–12) |
| Sanitizer bucket | 28.67 (7–52) |
| Dishwasher | 29.00 (5–49) |

*Note.* RLUs were used to measure cleanliness of key cards.

## Discussion and Conclusion

This study tested the cleanliness of hotel key cards from 25 hotels. Hotel price ranges went from economy to mid-class and included budget, business, limited service, and extended-stay types; 22 of the hotels were from chains and three were nonchain hotels. As was expected, significantly different RLUs were shown between new and old key cards. Even though more than half of the new key cards showed <30 RLUs, the averaged RLUs for both new and used cards was >30. This finding indicates that even many new cards were not meeting recommended standards provided by ATP manufacturer instructions. We found that 40% of the hotels (10/25) had dirty new cards showing >30 RLUs. Only 36% of new key cards (8/25) were found to be clean with <10 RLUs. The results indicate that in many hotels, key cards are not handled in a sanitary manner. During data collection, it was noted that some of the hotels did not keep the new key cards separate from the used key cards. Furthermore, the reason that the new key cards are not meeting recommended standards could be attributed to the manufacturing stage.

As a limitation of this study, it is not possible to identify the specific microorganisms or even whether the contamination is bacterial on the key cards when using an ATP meter. It is clear, however, that hotel key cards were dirty enough that further study for possible microbial contamination would be recommended by using APC or coliform count methods.

This study also looked at the difference between hotel segments using price to differentiate economy and mid-class hotels. The price range for most of the economy hotels in this study was $50–$80. For mid-class hotels, the price range was $90–$140. As there were no luxury hotels in the cities where data were collected, this study was not able to compare the cleanliness of hotel key cards in this segment. Future study should include a wider range of hotel segments. Results demonstrated no significant differences between the two hotel segments by price. Used key cards in all hotels were dirty. This finding suggests hotels might not consider key cards to be objects that require cleaning. Only one hotel (out of 25) had hand sanitizer for guest use next to the front desk area. This hotel also had lower RLUs, indicating cleaner key cards.

In addition, it appears typical cleaning methods used for other surfaces are not recommended for hotel key cards, as they did damage the cards. This result might have also impacted the ability of hotels to clean key cards. Apparently, proper key card cleaning procedures have not yet been developed or implemented. On the other hand, keycard manufacturing companies do offer cleaning chemicals and pads for card readers for the doors of guest rooms, although these can be expensive. At this time, cleaning of key cards appears to be best done by wiping them with a clean dry cloth. Alternatively, more frequent turnover with the use of new, unused cards might also result in lower contamination levels.

The hotel key card is the first thing that guests touch upon arrival and on the way to their rooms. They carry it with them wherever they go during their stay. The results of this study demonstrated all used key cards and half of the new key cards would be defined within the parameters of this study as "dirty." Unfortunately, some commonly available methods for cleaning other areas in a hotel are not appropriate for cleaning key cards. Managers and practitioners should keep this finding in mind. If key cards appear dirty, hotels might consider disposing of them (particularly because chemical sanitization could affect the card reader function). Alternatively, the use of protective key card sleeves (which often include the room number for the convenience of the guest) might also limit possible contamination as guests carry the cards. Finally, more recent keyless access systems using smartphones might also potentially solve issues with contaminated key cards. Although they raise other issues regarding smartphone cleanliness, they are at least personally owned and not shared by other guests. Ultimately, the key card cleaning issue might be solved through technology. In the meantime, hotels should consider using key card sleeves, looking for innovative key card cleaning methods, storing new and used cards separately, and replacing cards more frequently.

*Corresponding Author:* Haeik Park, Assistant Professor, Department of Hospitality and Tourism Management, Indiana University–Purdue University Fort Wayne, Neff330c, 2101 East Coliseum Boulevard, Fort Wayne, IN 46805-1499. E-mail: parkh@ipfw.edu.

## References


Almanza, B.A., Kirsch, K., Kline, S.F., Sirsat, S., Stroia, O., Choi, J.K., & Neal, J. (2015a). How clean are hotel rooms? Part I: Visual observations vs. microbial contamination. *Journal of Environmental Health, 78*(1), 8–13.

Almanza, B.A., Kirsch, K., Kline, S.F., Sirsat, S., Stroia, O., Choi, J.K., & Neal, J. (2015b). How clean are hotel rooms? Part II: Examining the concept of cleanliness standards. *Journal of Environmental Health, 78*(1), 14–18.

Ananth, M., DeMicco, F.J., Moreo, P.J., & Howey, R.M. (1992). Marketplace lodging needs of mature travelers. *The Cornell Hotel and Restaurant Administration Quarterly, 33*(4), 12–24.

Atkinson, A. (1988). Answering the eternal question: What does the customer want? *The Cornell Hotel and Restaurant Administration Quarterly, 29*(2), 12–13.

Cannon, M.J., & Davis, K.F. (2005). Washing our hands of the congenital cytomegalovirus disease epidemic. *BMC Public Health, 5*(1), 70.

Casado, M.A. (2012). *Housekeeping management* (2nd ed.). Hoboken, NJ: John Wiley & Sons, Inc.

Centers for Disease Control and Prevention. (2017). Legionella (*Legionnaires' disease and Pontiac fever)*. Atlanta, GA: National Center for Immunization and Respiratory Diseases, Division of Bacterial Diseases. Retrieved from http://www.cdc.gov/legionella/qa-media.html

Chen, M.-H., Jang, S.S., & Kim, W.G. (2007). The impact of the SARS outbreak on Taiwanese hotel stock performance: An event-study approach. *International Journal of Hospitality Management, 26*(1), 200–212.

Cooper, S. (2003, July 7). What the SARS crisis has taught the travel industry? *Business Travel News*, *20*(12), 10.

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

Curtis, V., & Cairncross, S. (2003). Effect of washing hands with soap on diarrhoea risk in the community: A systematic review. *The Lancet Infectious Diseases, 3*(5), 275–281.

Dolnicar, S., & Otter, T. (2003). Which hotel attributes matter? A review of previous and a framework for future research. In T. Griffin & R. Harris (Eds.), *Proceedings of the 9th Annual Conference of the Asia Pacific Tourism Association (APTA)*, *University of Technology Sydney, 1*, 176–188.

Knutson, B.J. (1988). Frequent travelers: Making them happy and bringing them back. *The Cornell Hotel and Restaurant Administration Quarterly, 29*(1), 82–87.

Lewis, R.C., & Nightingale, M. (1991). Targeting service to your customer. *The Cornell Hotel and Restaurant Administration Quarterly, 32*(2), 18–27.

Lockyer, T. (2003). Hotel cleanliness—How do guests view it? Let us get specific. A New Zealand study. *International Journal of Hospitality Management, 22*(3), 297–305.

Lockyer, T. (2005). Understanding the dynamics of the hotel accommodation purchase decision. *International Journal of Contemporary Hospitality Management, 17*(6), 481–492.

Love, S.S., Jiang, X., Barrett, E., Farkas, T., & Kelly, S. (2002). A large hotel outbreak of Norwalk-like virus gastroenteritis among three groups of guests and hotel employees in Virginia. *Epidemiology and Infection, 129*(1), 127–132.

Magnini, V.P., Crotts, J.C., & Zehrer, A. (2011). Understanding customer delight: An application of travel blog analysis. *Journal of Travel Research, 50*(5), 535–545.

Nitschke, A.A., & Frye, W.D. (2008). *Managing housekeeping operations* (3rd ed.). Orlando, FL: American Hotel & Lodging Educational Institute.

Ritter, K. (2011, April 24). Guests slap Vegas resort with $337.5 million lawsuit over illness. *The Seattle Times*. Retrieved from http://www.seattletimes.com/nation-world/guests-slap-vegas-resort-with-3375-million-lawsuit-over-illness/

Shaughnessy, R.J., Cole, E.C., Moschandreas, D., & Haverinen-Shaughnessy, U. (2013). ATP as a marker for surface contamination of biological origin in schools and as a potential approach to the measurement of cleaning effectiveness. *Journal of Occupational and Environmental Hygiene, 10*(6), 336–346.

Sherlock, O., O'Connell, N., Creamer, E., & Humphreys, H. (2009). Is it really clean? An evaluation of the efficacy of four methods for determining hospital cleanliness. *The Journal of Hospital Infection, 72*(2), 140–146.

Smith, M. (2012, August 28). 2 dead in Legionnaires' outbreak tied to downtown hotel. *Chicago Tribune*. Retrieved from http://articles.chicagotribune.com/2012-08-28/news/chi-4-more-legionnaires-cases-tied-to-downtown-hotel-20120827_1_legionella-bacteria-legionnaires-downtown-hotel

Weaver, P.A., & Oh, H.C. (1993). Do American business travelers have different hotel service requirements? *International Journal of Contemporary Hospitality Management, 5*(3).

Worsfold, D., & Griffith, C.J. (1996). An assessment of cleanliness in domestic kitchens. *Hygiene and Nutrition in Foodservice and Catering, 1*(3), 163–173.

Xie, K.L., Zhang, Z., & Zhang, Z. (2014). The business value of online consumer reviews and management response to hotel performance. *International Journal of Hospitality Management, 43*, 1–12.

# How Under-Testing of Ethnic Meat Might Contribute to Antibiotic Environmental Pollution and Antibiotic Resistance: Tetracycline and Aminoglycoside Residues in Domestic Goats Slaughtered in Missouri

Lauren K. Landfried, MS, RD, LD, FAND
*Saint Louis University*

Patrick Pithua, MSc, PhD
*University of Missouri*

Brett Emo, MPH, PhD
Roger Lewis, PhD, CIH
Jonathan A. Jacoby, PhD, CIH, CSP, CHMM
Christopher King, PhD, CSP, CHMM
Carole R. Baskin, MSc, DVM, CPIA
*Saint Louis University*

Abstract **Over the past decade, there has been growing demand for goat meat in the U.S. due to an increase in ethnic immigrant populations and mainstream interest. Unfortunately, goat meat is tested for antibiotic residues much less systematically than other meats, and in particular, 5 times less frequently than beef. It is also not tested for resistant pathogens. Recent increases in testing of other species has led to disproportionally higher rates of samples found positive for antibiotics, so we hypothesized that positive rates currently reported in goat meat are suppressed. As a proof of concept, we screened a total of 277 kidneys representative of goats raised and sold for meat in Missouri and found a 3-fold difference in positive samples between our results and those reported nationally in 2014. Further testing revealed contamination with five different classes of antibiotics of importance to human medicine, raising concerns about goat meat pollution by antibiotics and how it might contribute to human exposure and the rise in antibiotic resistance.**

## Introduction

Antibiotic resistance results in over 2 million illnesses and 23,000 deaths yearly in the U.S. in addition to $20 billion a year in healthcare costs and $35 billion in lost productivity (Centers for Disease Control and Prevention [CDC], 2017; Marshall & Levy, 2011). Agriculture accounts for nearly 80% of antibiotic use (Food and Drug Administration [FDA], 2014a; The Pew Charitable Trusts, 2013) and has been well documented as a source of environmental and food pollution (Martinez, 2009), and a source of resistance genes in human pathogens, particularly enteric bacteria (Awad et al., 2015; Chang, Wang, Regev-Yochay, Lipsitch, & Hanage, 2015; Marshall & Levy, 2011).

Antibiotics for food animals can be purchased and administered without direct veterinary oversight, and there is still a widespread but erroneous perception that continuous administration at subtherapeutic levels helps animal growth (Aarestrup, 2012). The Food and Drug Administration (FDA) has issued multiple recommendations to cease this practice (FDA, 2012), but it has continued nevertheless. Resistant bacteria are not only a public health issue with multiple potential routes of exposure aside from handling and consuming contaminated meat, including through the water supply and crops (Senta, Terzic, & Ahel, 2013), and they also pose an occupational hazard to farm workers (Gilchrist et al., 2007).

Through the National Antimicrobial Resistance Monitoring System (NARMS) with the Centers for Disease Control and Prevention (CDC) and the U.S. Department of Agriculture (USDA), FDA monitors only retail chicken, turkey, beef, and pork for contamination with resistant enteric bacteria *Salmonella*, *Campylobacter*, *E. coli*, and *Enterococcus* (FDA, 2014b). In its 2014 report, FDA found that 9.1% of chicken, 5.5% of ground turkey, 0.8% of beef, and 1.3% of pork samples tested at retail outlets were positive for *Salmonella*, with 60% of chicken and 70% of turkey strains resistant to at least one antimicrobial. *Campylobacter,* which causes an estimated 1.3 million illnesses and 120 deaths each year, was found in 33% of retail chicken samples (FDA, 2014b). Macrolide- and fluoroquinolone-resistant strains of *Campylobacter jejuni,* which account for 90% of morbidity and mortality due to *Campylobacter*, were detected in less than 4% and 15% of positive samples, respectively; antibiotic-resistant strains for *Campylobacter coli* were detected in 11–20% of retail chicken samples tested (FDA, 2014b). Prevalence of *E. coli* ranged from 43% in retail ground beef and pork chops to 83% in ground turkey, with rates of antibiotic resistance being highest in retail ground turkey at 83% and lowest in retail ground beef at 23% (FDA, 2014b). *Enterococcus* bacteria prevalence was quite high, ranging from 86–98% across all meats, with resistance rates >79% (FDA, 2014b).

In 2011, goat meat had the highest percentage of drug residues compared with other meat carcasses according to USDA's Food Safety and Inspection Service (FSIS) meat inspection results (USDA, 2013). This finding suggests that withdrawal times set for drug use in goats are not always followed or are imprecise because use of antibiotics in goats is predominantly extra-label, which means that drug dosages are extrapolated from those of other species rather than specifically tested in goats (National Milk Producers Federation [NMPF], 2016; Ruegg, 2013). At the time, USDA FSIS used only a two-tier approach to targeted testing: testing of suspicious animals at slaughter and herd-specific testing because of prior violations. In total, 346 samples (0.05%) were collected from 651,783 slaughtered goats, and 0.58% of these were positive for antibiotic residues (USDA, 2013). This rate of violation was greater than that of cattle and swine, which had a 0.19% violation rate with a 0.025% screening rate and a 0.01% violation rate with a 0.005% screening rate, respectively (USDA, 2013).

In 2012, USDA FSIS opted for an additional testing approach consisting of systematic sampling at slaughter for species making up 95% of the meat market, thus excluding goats (USDA, 2014). This new method yielded a 17-fold increase in percentages of samples testing positive for antibiotics in these species, suggesting that adding systematic sampling to targeted sampling was likely to uncover more violations than targeted sampling alone.

Goat farming has increased significantly in recent years in response to consumer demand, but research on goat production in the U.S. is still relatively new. The National Agricultural Statistics Service (NASS, 2005) performed the first major survey of goat operations. Another study by USDA investigated the nation's goat industry in 2009 and focused on strategies for managing herds, such as seeking veterinary assistance, giving injections, knowledge of diseases, and sanitation after the birthing process (Animal and Plant Health Inspection Service, 2009).

These studies provided valuable insights on farming methods and farmer motivations, primarily that farmers who raised goats for meat had relatively little knowledge of antibiotics and withdrawal times, which is the FDA-mandated time between the last exposure to a specific medication and slaughter. The intent of withdrawal times is to avoid human exposure to antibiotics used to treat animals, either through meat handling or consumption.

Growing demand for goat meat in the U.S. over the past decade reflects an increase in ethnic immigrant populations and mainstream interest in the flavor and health benefits of goat products (Agricultural Marketing Resource Center, 2015; National Agricultural Statistics Service, 2015). In 2014, the immigrant population in the U.S. totaled 42.4 million with 30% coming from Asian and African countries, where 93.5% of the world goat production occurs (Anderson, 2017; Aziz, 2010; Food and Agriculture Organization of the United Nations, 2017; Migration Policy Institute [MPI], 2017; Zong & Batalova, 2017).

In Missouri, immigrants make up approximately 3.7% of the total population. Nearly half of those come from the high goat production areas of the world (MPI, 2017). From the public health standpoint, immigrants are considered a vulnerable population due to past lack of access to healthcare and lower socioeconomic status, which perpetuates some of these health inequities (Derose, Escarce, & Lurie, 2007). In 2014, 24% of U.S. immigrants lived below the federal poverty line compared with 15% of native-born U.S. citizens and fewer had health insurance than native-born U.S. citizens (53% compared with 68%) (Zong & Batalova, 2017).

The lack of precise drug dosages and withdrawal times for goats—combined with the inexperience of goat farmers in the U.S. regarding proper usage of these drugs, relative lack of attention from USDA on testing goat meat for antibiotic residues, exclusion of goat meat in the NARMS program, and rising goat meat demand by populations that often arrive in the U.S. with health vulnerabilities and have lower access to healthcare in this country—might amount to a brewing public health crisis in the form of unchecked human exposure to antibiotics and resistant pathogens secondary to goat farming and goat meat consumption.

In order to investigate the possibility that reported percentages of goat carcasses testing positive for antibiotics likely is an inaccurate representation of the true rate of goat meat contamination with these drugs, at least locally, we tested carcasses of goats slaughtered in the state of Missouri, irrespective of plans by the Missouri Department of Agriculture (MDA) to test these same samples through their two-tiered (focused testing) approach. The null hypothesis was that the rate of kidneys tested from slaughter facilities in the state of Missouri showing presence of antibiotics would be less than or equal to the USDA FSIS results of 0.58%. The alternate hypothesis was that the rate of kidneys tested from slaughter facilities in the state of Missouri showing presence of antibiotics would be greater than the USDA FSIS results of 0.58%.

## Materials and Methods

The project was submitted to the Institutional Biosafety Committee (IBC) at Saint Louis University for review and determined that it did not require IBC review.

The *Missouri's Official Plants Under Inspection* lists processing plants inspected by MDA, according to USDA FSIS standards. Only two such approved plants process goats consistently in the state of Missouri; the other plants slaughter goats only upon request (Missouri Department of Agriculture, 2015). One of the two slaughter plants receive the goats from suppliers who purchase goats at auctions that were born and raised around the State of Missouri, amounting to approximately 100–130 South African Boer and Kiko/Boer cross goats per week. The other approved slaughter plant processes only approximately 10 goats a month as requested from local farmers. For these reasons, we chose the first plant for our study. While goat is the main animal species slaughtered there, lamb and beef make up approximately 13% and 2%, respectively, of animals processed. When multiple animals are slaughtered on the same day, goats go first, followed by sheep and then beef. The plant is cleaned and sterilized after each species.

Our noninterventional, investigational study assessed whether or not there is a difference in the rate of kidneys that screen positive for antibiotic residues from slaughter facilities in the state of Missouri compared with the USDA FSIS results. Based on the null hypothesis that there would be no difference in the rate of positive screens between those in Missouri and USDA FSIS results for goat meat (0.58% positive samples reported in 2011), a sample of 277 kidneys should have yielded one positive screen (USDA, 2013). This number was determined using a binomial test with 80% power and an assumption that the rate of violations is 0.58%, making an effect size of

.0058. Any positive screens in excess of 1 per 277 would indicate that the frequency of goats with antimicrobial drug residues at slaughter is currently higher in Missouri than the national average previously reported by USDA FSIS. We coordinated with the slaughter plant to obtain a subset of the total Missouri population by collecting one kidney from either side of the 277 goats originating from the northeast, northwest, central, and southern areas of the state of Missouri. The slaughter plant owner provided no specific information about the age, gender, or breed of the goats.

Kidneys were chosen for analysis because the organ contains the highest concentrations of antimicrobial drug residues (Doyle, 2005) and as such is used by USDA FSIS for testing purposes. Kidneys were collected on six separate occasions over the span of 5 months with the following number of kidneys collected at each collection: 29, 47, 89, 8, 38, and 67 for a total of 278 kidneys purchased in case an additional kidney was needed for analysis. Dates were chosen for collection based on information provided by the slaughterhouse regarding varied provenance of goats both in terms of producers and geographical origin, ensuring that samples collected over these months came from a variety of farms. Therefore, while sampling was not systematically randomized and took into account the availability of the research team to travel to the slaughterhouse to pick samples up (sampling convenience), it clearly departed from the focused approach (based on perceived health status of animal at slaughter or history of a herd) used by MDA. Assuming 130 goats processed by the slaughter plant per week, or at most 2,860 goats over the 5 months of collection, our sampling rate of 9.7% was also well above that of the USDA national rate (0.05%).

Kidneys were screened for the presence of antimicrobial drugs using the Kidney Inhibition Swab (KIS) test (Hravnak et al., 2009). Each kidney was labeled numerically as it was screened, and then stored in a labeled container in the freezer for future identification. Screening was performed using the protocol in the operator's manual, *Charm Kidney Inhibition Swab Test for Antimicrobial Drug Detection in Kidney Tissue*. This process included taking the swab out of the KIS tube and inserting the exposed cookie cutter-like edge into each kidney to make a circular cut approximately one-half inch-deep in the kidney. The sterile cotton swab was then inserted into the cut and twirled around the cut for 30 seconds or until it became saturated with liquid from the kidney (at least 80 µL of sample). The swab was subsequently added back to the KIS tube, piercing an upper foil where it combined the kidney juice with a clear solution for 2 min, and then screwed down through the lower foil to combine the liquid with an agar containing thermophilic bacteria and placed on an incubator set at 64 + 2 °C for 175 min (Charm Sciences, 2009). A positive control (penicillin G) and negative control were run with each sample batch. The steps described above are illustrated in Figure 1.

FIGURE **1**

**Pictures of Testing Methods**


The limits of quantification for the residues screened using the KIS test were as follows: penicillin G (0.03–0.04 µg/mL), oxytetracycline (3.0 µg/mL), tylosin (0.4 µg/mL), gentamicin (0.75 µg/mL), sulfadimethoxine (0.25 µg/mL), sulfamethazine (0.5 µg/mL), neomycin (4.0 µg/mL), and tulathromycin (1.0 µg/mL). These values are set as such because of the following kidney clearance levels set in the U.S.: penicillin G (0.05 µg/mL), oxytetracycline (12.0 µg/mL), tylosin (0.2 µg/mL), gentamicin (0.4 µg/mL), sulfadimethoxine (0.1 µg/mL), sulfamethazine (0.1 µg/mL), neomycin (7.2 µg/mL), and tulathromycin (21.0 µg/mL) (Charm Sciences, 2009). Positive screens were rescreened twice for a total of three positive screens to be designated as positive for antibiotic residues before being sent for further analysis to determine the specific antibiotic.

Eurofins Analytical Laboratories, Inc. (a USDA FSIS-accredited laboratory) further analyzed positive screen samples using high performance liquid chromatography tandem mass spectrometry (HPLC-MS). This test is able to determine the specific chemical makeup of the drugs in the kidneys. The three classes of antibiotics tested were tetracyclines, aminoglycosides, and β-lactams because these three classes are routinely used off-label in goats, with the exception of neomycin, and were deemed by a focus group of goat experts as the groups of most concern for overuse (FDA, 2017). The parameters for positive results of the tetracycline antibiotics tested are: oxytetracycline (10 µg/kg), tetracycline (10 µg/kg), chlortetracycline (10 µg/kg), and doxycycline (20 µg/kg); the parameters for positive results of the aminoglycoside antibiotics tested are: dihydrostreptomycin (10 µg/kg), gentamicin (50 µg/kg), hygromycin (20 µg/kg), kanamycin (20 µg/kg), neomycin (20 µg/kg), paromomycin (25 µg/kg), spectinomycin (50 µg/kg), and streptomycin (20 µg/kg). The parameters for positive results of the β-lactams tested are: amoxicillin (2 µg/kg), ampicillin (1 µg/kg), cloxacillin (2 µg/kg), dicloxacillin (1 µg/kg), oxacillin (2 µg/kg), and penicillin G (1 µg/kg) (Eurofins, 2015).

Descriptive analysis for screening the goats using the KIS tests and the identification of the specific antibiotics using HPLC-MS were performed. A one-sample test of proportions was performed to compare the number of positive samples collected from a slaughter facility in the state of Missouri with the USDA FSIS results of 0.58% using a 95% confidence interval ($\alpha = .05$).

TABLE **1**

**Results From HPLC-MS Analysis of Antimicrobial Drugs That Exceeded the Threshold of Detection**

| | Aminoglycoside Antibiotics | | Tetracycline Antibiotics | | |
|---|---|---|---|---|---|
| | Gentamycin (µg/kg) (Parameter: 50 µg/kg) | Neomycin (µg/kg) (Parameter: 20 µg/kg) | Oxytetracycline (µg/kg) (Parameter: 10 µg/kg) | Tetracycline (µg/kg) (Parameter: 10 µg/kg) | Chlortetracycline (µg/kg) (Parameter: 10 µg/kg) |
| Kidney #90 | 2,900 | – | – | 83 | 1,100 |
| Kidney #105 | 3,500 | – | – | 80 | 1,200 |
| Kidney #212 | – | 3,700 | 22 | – | 12 |
| Kidney #217 | – | 780 | 18 | – | 14 |
| Kidney #244 | – | 2,800 | 11 | – | – |

HPLC-MS = high performance liquid chromatography tandem mass spectrometry.

## Results

Of the 277 kidneys screened using KIS tests, five (1.8%) were found to be positive for antimicrobial drug residues. Compared with the positive rate of 0.58% reported by USDA FSIS, we rejected the null hypothesis ($p$ = .024) using an $\alpha$ of .05 and accepted the alternate hypothesis that the proportion of kidneys positive for antibiotics was greater than the USDA FSIS results. The positive samples were sent for further analysis using HPLC-MS at Eurofins Analytical Laboratories, Inc., with the results included in Table 1. The kidneys analyzed using HPLC-MS were labeled using the number assigned during the screening process. The levels of antibiotics found above the parameters set by Eurofins Analytical Laboratories, Inc., were included for each of the five kidneys. There were no positive results found for the β-lactams, but all five samples had positive results for both aminoglycoside and tetracycline antibiotics. The highest levels were found for both gentamicin and neomycin of the aminoglycoside class of antibiotics and chlortetracycline of the tetracycline class of antibiotics, with over 100 times the amount compared with the parameters set by Eurofins Analytical Laboratory, Inc.

## Discussion

There are a number of ways for antibiotics used in agriculture to pollute the environment: spillover in the manufacturing process, atmospheric dispersal of treated feed, and unmetabolized antibiotics in animal waste used to fertilize crops. Antibiotics have been shown to persist long enough to make their way to humans and thus exert selection pressure on human pathogens, contributing to emergence of antibiotic-resistant organisms (Chee-Sanford, Krapac, Yannarell, & Mackie, 2012). Another contributor to human exposure to antibiotics or to resistant organisms is through handling and consumption of meat contaminated with either. Our small study was concerned with exposure to antibiotics from goat meat, a species difficult to dose accurately with antibiotics, raised by fairly inexpert farmers, and relatively neglected by the USDA FSIS meat inspection process.

Using the USDA protocol for detecting antimicrobial residues in meat, which identifies samples with illegal levels of antibiotics at slaughter (Ruegg 2013; NMPF 2016), we found positive samples at a rate 3-fold that expected based on reports by USDA FSIS. In addition, each of the positive carcasses was contaminated with at least two different classes of antibiotics. Neomycin was the only drug found in our kidney samples that is used in goats according to label. Other antibiotics found could only have been used legally with veterinary prescription according to the Animal Medicinal Drug Use Clarification Act (AMDUCA) (Fajt, 2011). Given the levels of neomycin in the kidney samples, the withdrawal times must not have been followed in the goats we tested; FDA requires that neomycin be discontinued 3 days prior to slaughter (FDA, 2016).

Regarding other antibiotics found in our samples, gentamicin is not recommended for food animals due to its risk of toxicity, its delayed metabolism, and veterinarians often prescribing inappropriate doses (Smith, Gehring, Craigmill, Webb, & Riviere, 2005; Tan, Jiang, Huang, & Hu, 2009; The United States Pharmacopeial Convention, 2007). While it has many contraindications, it is often used in cases of persistent mastitis infection, presumably when prescribed by a veterinarian (Nathawat, Bhati, Sharma, Mohammed, & Kataria, 2013). The entire tetracycline class of drugs is considered off-label but is routinely used in the treatment of Gram-positive and Gram-negative bacteria-causing illnesses such as pneumonia, scours, acute mastitis, and septicemia (Health, 2015). In food animals, the drug label for tetracycline hydrochloride water soluble powder indicates a withdrawal time of 22 days (Health, 2015). According to the label of chlortetracycline, the withdrawal time is 10 days for food animals (Kepro Veterinary Products, 2015). Oxytetracycline requires a withdrawal time of 29 days (Mobini, 2013). While there may be instances when these drugs are appropriate to use in goat production, AMDUCA requires that there be veterinary oversight in order to ensure that the drug is being used therapeutically and withdrawal times are adequate (Fajt, 2011).

The level of antibiotic residues in these samples highlights meat handling and consumption as a contributor to excessive exposure of the human microbiome to antibiotics and eventually to emergence of antibiotic-resistant organisms, in part through exchange of resistance genes among bacteria (Marti, Jofre, & Balcazar, 2013). As all but one of the drugs found were off-label drugs, a veterinarian should have been involved in the treatment of the animal (FDA, 2016). This finding suggests that veterinarians need to increase their efforts of educating farmers about proper withdrawal times and discourage intentional misuse of antibiotics, particularly in the light of negative publicity about the agriculture industry's role in promoting antibiotic resistance (CDC, 2015).

In response, FDA has tried to curb inappropriate practices through several actions

such as releasing warnings aimed at reducing the use of antimicrobial drugs in food animals for production purposes (FDA, 2017). Additionally, FDA released a proposed rule that would require approved or conditionally approved drug companies to report the sales and distribution of antimicrobial drugs to track the quantity going to animal production (Antimicrobial Animal Drug Sales and Distribution Reporting, 2016). Despite the regulatory and advisory efforts of CDC and FDA, our experiment suggests that these rulings and recommendations are not universally followed at the farm level and that USDA FSIS should be screening a higher proportion of goat carcasses than it currently does.

## Conclusion

While our findings were noteworthy, we acknowledge the limitations of this study. Although we tested a higher percentage of carcasses than USDA FSIS, our sample was not quite as large or as diverse potentially as that used by USDA FSIS. This limitation could introduce a location bias in our results, and it is therefore possible that the results obtained from this study are not generalizable to the whole country. The state of Missouri ranked ninth in the nation for number of farms and third in total number of goats in the 2012 NASS data (USDA, 2012). There is also the question of whether or not greatly increasing sampling rates, as we did, is justified to improve detection rates 3-fold. Goat meat represents an increasing share of the market and serves a relatively vulnerable population. Therefore, we believe that, at the very least, goat meat should be subjected to systematic testing (three-tier) and not solely focused testing (two-tier). We also believe that goat meat contamination with resistant pathogens should be monitored as part of FDA's NARMS.

***Corresponding Author:*** Carole R. Baskin, Institute for Biosecurity, Department of Environmental and Occupational Health, Saint Louis University, 3545 Lafayette, Room 464, Saint Louis, MO 63104.
E-mail: cbaskin2@slu.edu.

## References

Aarestrup, F. (2012). Sustainable farming: Get pigs off antibiotics. *Nature, 486*(7404), 465–466.

Agricultural Marketing Resource Center. (2015). *Meat goats*. Retrieved from http://www.agmrc.org/commodities__products/livestock/goats/meat-goats/

Anderson, M. (2017). *African immigrant population in U.S. steadily climbs*. Washington, DC: Pew Research Center. Retrieved from http://www.pewresearch.org/fact-tank/2015/11/02/african-immigrant-population-in-u-s-steadily-climbs/

Animal and Plant Health Inspection Service. (2009). *National animal health monitoring system (NAHMS) to study goat industry in 2009*. Riverdale, MD: U.S. Department of Agriculture, Animal and Plant Health Inspection Service. Retrieved from https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/monitoring-and-surveillance/nahms/nahms_goat_studies

Antimicrobial Animal Drug Sales and Distribution Reporting, 21 C.F.R. Part 514,80, DHHS FDA, Docket No. FDA–2012–N–0447; 0910–AG45 Stat. (2016). Retrieved from https://www.federalregister.gov/documents/2016/05/11/2016-11082/antimicrobial-animal-drug-sales-and-distribution-reporting

Awad, Y.M., Kim, K.R., Kim, S.-C., Kim, K., Lee, S.R., Lee, S.S., & Ok, Y.S. (2015). Monitoring antibiotic residues and corresponding antibiotic resistance genes in an agroecosystem. *Journal of Chemistry, 2015*. Retrieved from http://dx.doi.org/10.1155/2015/974843

Aziz, M.A. (2010). Present status of the world goat populations and their productivity. *Lohmann Information, 45*(2), 42. Retrieved from http://www.lohmann-information.com/content/l_i_45_artikel17.pdf

Centers for Disease Control and Prevention. (2017). *Antibiotic/antimicrobial resistance*. Retrieved from http://www.cdc.gov/drugresistance/about.html

Chang, Q., Wang, W., Regev-Yochay, G., Lipsitch, M., & Hanage, W.P. (2015). Antibiotics in agriculture and the risk to human health: How worried should we be? *Evolutionary Applications, 8*(3), 240–247.

Charm Sciences, Inc. (2009). *Operator's manual: Charm kidney inhibition swab (KIS) test for antimicrobial drug detection in kidney tissue*. Lawrence, MA: Author.

Chee-Sanford, J.C., Krapac, I.J., Yannarell, A.C., & Mackie, R.I. (2012). Environmental impacts of antibiotic use in the animal production industry. *Prevention of Infectious Diseases in Livestock and Wildlife, 29*, 228–239. Retrieved from http://www.diva-portal.org/smash/record.jsf?pid=diva2:603376

Derose, K.P., Escarce, J.J., & Lurie, N. (2007). Immigrants and health care: Sources of vulnerability. *Health Affairs, 26*(5), 1258–1268.

Doyle, M.E. (2005). *Veterinary drug residues in processed meats—Potential health risk: A review of the scientific literature*. Madison, WI: University of Wisconsin, Food Research Institute. Retrieved from http://fri.wisc.edu/files/Briefs_File/FRIBrief_VetDrgRes.pdf

Eurofins. (2015). *Analyses/packages* (Quotation No. UTVU-20140234-02). Retrieved from http://www.eurofinsus.com/downloads/SARF_ECAL.pdf

Fajt, V.R. (2011). Drug laws and regulations for sheep and goats. *Veterinary Clinics of North America: Food Animal Practice, 27(1)*, 1–21.

Food and Agriculture Organization of the United Nations. (2017). *Data*. Rome, Italy: Author. Retrieved from http://www.fao.org/faostat/en/#data

Food and Drug Administration. (2012). *FDA to protect important class of antimicrobial drugs for treating human illness* [Press release].

Food and Drug Administration. (2014a). *Summary report on antimicrobials sold or distributed for use in food-producing animals*. Retrieved from http://www.fda.gov/downloads/ForIndustry/UserFees/AnimalDrugUserFeeActADUFA/UCM231851.pdf

Food and Drug Administration. (2014b). *NARMS integrated report 2014: The National Antimicrobial Resistance Monitoring System:*

## References


*Enteric bacteria*. Retrieved from http://www.fda.gov/downloads/AnimalVeterinary/SafetyHealth/AntimicrobialResistance/NationalAntimicrobialResistanceMonitoringSystem/UCM528861.pdf

Food and Drug Administration. (2016). *Approved animal drug products (Green Book)*. Retrieved from http://www.fda.gov/AnimalVeterinary/Products/ApprovedAnimalDrugProducts/

Food and Drug Administration. (2017). *FDA's strategy on antimicrobial resistance—Questions and answers*. Retrieved from http://www.fda.gov/AnimalVeterinary/GuidanceComplianceEnforcement/GuidanceforIndustry/ucm216939.htm

Gilchrist, M.J., Greko, C., Wallinga, D.B., Beran, G.W., Riley, D.G., & Thorne, P.S. (2007). The potential role of concentrated animal feeding operations in infectious disease epidemics and antibiotic resistance. *Environmental Health Perspectives, 115*(2), 313–316.

Health, M.-A. (2015). *Tetracycline hydrochloride water soluble powder*. Retrieved from http://www.msd-animal-health.co.in/products/tetracycline/020_product_details.aspx

Hravnak, M., Frangiskakis, J.M., Crago, E.A., Chang, Y., Tanabe, M., Gorcsan, J., III, & Horowitz, M.B. (2009). Elevated cardiac troponin I and relationship to persistence of electrocardiographic and echocardiographic abnormalities after aneurysmal subarachnoid hemorrhage. *Stroke, 40*(11), 3478–3484.

Kepro Veterinary Products. (2015) *Chlortetracycline hydrochloride*.

Marshall, B.M., & Levy, S.B. (2011). Food animals and antimicrobials: Impacts on human health. *Clinical Microbiology Reviews, 24*(4), 718–733.

Marti, E., Jofre, J., & Balcazar, J.L. (2013). Prevalence of antibiotic resistance genes and bacterial community composition in a river influenced by a wastewater treatment plant. *PLosOne, 8*(10).

Martinez, J.L. (2009). Environmental pollution by antibiotics and by antibiotic resistance determinants. *Environmental Pollution, 157*(11), 2893–2902.

Migration Policy Institute. (2017). *Migration data hub*. Washington, DC: Author. Retrieved from http://www.migra tionpolicy.org/programs/migration-data-hub

Missouri Department of Agriculture (2015). *Missouri's official plants under inspection*. Retrieved from http://agriculture.mo.gov/animals/health/inspections/officialplants.php

Mobini, S. (2013). Medications commonly used in goats and approximate withdrawal times. Fort Valley, GA: Georgia Small Ruminant Research and Extension Center, Fort Valley State University.

Nathawat, P., Bhati, T., Sharma, S.K., Mohammed, N., & Kataria, A.K. (2013). Prevalence of *Staphylococcus aureus* in lactating goats with clinical mastitis and their antibiogram studies. *Animal Biology & Animal Husbandry: International Journal of the Bioflux Society, 5*(1), 32–37.

National Agricultural Statistics Service. (2005). *Dairy goat and sheep survey*. Albany, NY: New York State Department of Agriculture & Markets, Division of Milk Control & Dairy Services and the National Agricultural Statistics Service.

National Agricultural Statistics Service. (2015). *Sheep and goats*. Washington, DC: United States Department of Agriculture, Economics, Statistics and Market Information System. Retrieved from http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1145

National Milk Producers Federation. (2016). *Milk and dairy beef drug residue prevention: Producer manual of best management practices*. Retrieved from https://www.nationaldairyfarm.com/sites/default/files/2016-Residue-Manual.pdf

The Pew Charitable Trusts. (2013). *Record-high antibiotic sales for meat and poultry production: Campaign on human health and industrial farming*. Washington, DC: Author. Retrieved from http://www.pewtrusts.org/en/research-and-analysis/analysis/2013/02/06/recordhigh-antibiotic-sales-for-meat-and-poultry-production

Ruegg, P.L. (2013). *Antimicrobial residues and resistance: Understanding and managing drug usage on dairy farms*. Madison, WI: University of Wisconsin, Department of Dairy Science.

Senta, I., Terzic, S., & Ahel, M. (2013). Occurrence and fate of dissolved and particulate antimicrobials in municipal wastewater treatment. *Water Research, 47*(2), 705–714.

Smith, G.W., Gehring, R., Craigmill, A.L., Webb, A.I., & Riviere, J.E. (2005). Extralabel intramammary use of drugs in dairy cattle. *Journal of the American Veterinary Medical Association, 226*(12), 1994–1996.

Tan, X., Jiang, Y.-W., Huang, Y.-J., & Hu, S.-H. (2009). Persistence of gentamicin residues in milk after the intramammary treatment of lactating cows for mastitis. *Journal of Zhejiang University Science B, 10*(4), 280–284.

The United States Pharmacopeial Convention. (2007). *Aminoglycosides (veterinary—systemic)*. Retrieved from http://c.ymcdn.com/sites/www.aavpt.org/resource/resmgr/imported/aminoglycosides.pdf

U.S. Department of Agriculture. (2012). *2012 Census of agriculture—State data*. Retrieved from http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_US_State_Level/st99_2_014_014.pdf

U.S. Department of Agriculture. (2013). *United States national residue program for meat, poultry, and egg products: 2011 residue sample results*. Washington, DC: Food Safety and Inspection Service, Office of Public Health Science.

U.S. Department of Agriculture. (2014). *United States national residue program for meat, poultry, and egg products: 2014 residue sampling plans*. Washington, DC: Food Safety and Inspection Service, Office of Public Health Science. Retrieved from http://www.fsis.usda.gov/wps/wcm/connect/533beea8-1bcf-468e-a13b-531232b2af2f/2014-Blue-Book.pdf?MOD=AJPERES

Zong, J., & Batalova, J. (2017). *Frequently requested statistics on immigrants and immigration in the United States*. Washington, DC: Migration Policy Institute. Retrieved from http://www.migrationpolicy.org/article/frequently-requested-statistics-immigrants-and-immigration-united-states

GUEST COMMENTARY

# Zika Virus in the Americas: Is It Time to Revisit Mosquito Elimination?

Jennifer Ann Marie Calder, MPH, DVM, PhD
*City of Stamford Department of Health*
*Columbia University*

Abstract **Recent outbreaks of mosquito-borne diseases in the Americas indicate the need for the reinstatement of mosquito elimination efforts in the region. These efforts need to have buy-in from all governmental agencies within the region using a multidisciplinary effort with appropriate financial support.**

In recent years, the Americas have experienced several emerging mosquito-borne diseases. Dengue virus first appeared in the Caribbean and Latin America in the 1980s; in 1999, West Nile virus was first recognized in New York City and is now endemic throughout the hemisphere (Komar & Clark, 2006). Malaria was eliminated from North America and most of the Caribbean; however, as a result of increased international travel and/or commerce, there have been travel-associated cases in nonendemic countries with an outbreak in 2006 in Jamaica that was linked to a single source introduction of the Haitian isolate (Webster-Kerr et al., 2011).

Since 2004, there have been an increasing number of persons traveling to the Americas from countries where mosquito-borne diseases exist in which humans play a role in the transmission. Thus, the risk for intercountry and intercontinental transmission has increased. Prior to the outbreak of chikungunya in the Caribbean, between October and December 2012, 84% of travellers from chikungunya-endemic countries to the Caribbean arrived from South Africa, India, China, the Philippines, and the French territory of Réunion—and the U.S. was the top destination from chikungunya-endemic areas of the Caribbean (Khan et al., 2014). In May 2015, the Pan America Health Organization announced the first case of Zika virus on Easter Island (Chile) and since then it has spread throughout parts of South America, Latin America, and the entire Caribbean with the exception of Cuba.

The *Aedes aegypti* mosquito is the main vector involved in the transmission of dengue fever, yellow fever, chikungunya fever, and Zika fever. In the mid-1980s, *Aedes albopictus* was imported into the U.S. from Asia; it is also capable of transmitting the viruses associated with the diseases listed above. Unlike *A. aegypti, A. albopictus* has been able to adapt to temperate climates, has shown a higher affinity for human blood, and in some instances has undergone genetic adaptation that enhances its ability to transmit select pathogens. For these reasons, the potential for disease transmission from *A. albopictus* is great.

To date, yellow fever and Japanese encephalitis are the only mosquito-borne diseases for which a human vaccine exists, and chemoprophylaxis exists only for malaria. While research continues to pursue developing effective vaccines and treatment modalities, mosquito elimination seems to be the most viable option at this time. Attempts to eliminate *A. aegypti* in the Americas, despite early successes, were not sustained for several reasons. First, not all countries in the region were willing to participate in the elimination efforts. Second, there has been a significant population shift to urban areas that overburdened the fragile infrastructures. Third, economic factors limited expenditure on maintaining the vector-free status in areas where elimination occurred, and fourth, the response to reinfestation was slow ("The feasibility," 1997).

In light of the World Health Organization's declaration that Zika virus is a global health emergency, it is time to reevaluate mosquito elimination in the Americas. North America has the resources to quickly identify and control the spread of mosquito-borne diseases. This capacity was enhanced after the initial West Nile virus outbreak in 1999. The major concern in the Americas for rapid spread of mosquito-borne diseases is primarily related to resource-poor countries in the region. To counteract this concern will require countries to be unified in their efforts and utilize a multipronged, integrated approach.

Environmental concerns and mosquito resistance associated with the use of dichlorodiphenyltrichlorethane (DDT) have meant that many countries now use alternatives such as malathion or permethrin for mosquito control. While shown to be effective, these alternatives can be toxic to some nontarget species, including those essential for pollination (Oliver, Softley, Williamson, Stevenson, & Wright, 2015; Salvato, 2001). While decreasing the mosquito population is crucial, destroying essential pollinators would have long-term negative effects on agriculture and the food supply, and therefore the continued use of these agents should be reviewed to develop effective methods that reduce the development of mosquito resistance, spare nontarget species, and decrease residual environmental contamination.

Environmental controls such as reducing peridomestic breeding sites are often discussed. Infrequently discussed, however, are the vast volume of unprocessed solid waste sites that exist in many resource-poor countries and the large volume of untreated sewage that still empties into the waterways surrounding many metropolitan cities—these provide excellent breeding sites for mosquitoes. The challenge to the governments of these countries is to develop effective recycling programs that would reduce the solid waste volume and create treatment plants to address sewage discharge.

The use of larvicides has been shown to be effective, but may be costly for some resource-poor countries that may be unwilling and or unable to invest in this intervention and thus might select other options such as larvivorous fish. There isn't sufficient research, however, to support the use of larvivorous fish and their effect on native fish and nontarget species is not fully understood (Walshe, Garner, Abdel-Hameed Adeel, Pyke, & Burkot, 2013).

The use of sterile males has been successful in the eradication of screwworms (*Cochliomyia hominivorax)* from the U.S. and several Central American countries. The application of this technique to *A. aegypti*, however, indicated that this approach might not be a viable option. Therefore, it is time to consider utilizing modern techniques such as genetically modified mosquitoes. Currently, research is ongoing in this area; however, additional research is needed to determine the effect of genetically modified mosquitoes on the mosquito population and the effect on animals that consume these mosquitoes.

Education will be an essential complement to achieve successful mosquito elimination and reduce transmission. Education must engage the community to participate in peridomestic reduction of mosquito habitats either voluntarily or via legislation, and to encourage people to use personal protective measures. Too often there is an attitude of "I don't like to use chemicals," so individuals either do not use repellents or use ineffective homemade products. While some of these persons do not become clinically ill, they maintain disease transmission because some asymptomatically infected persons are viremic and infectious to mosquitoes. Therefore, increased efforts need to be invested in educating individuals about the use of approved insect repellents. The use of bed nets needs to be reemphasized in the region and local programs developed for the supply and replacement of insecticide-treated bed nets.

While there are recommendations given to persons traveling to or living in areas where mosquito-borne diseases are endemic, these recommendations oftentimes are either ignored or, at most, intermittently followed for several reasons. First, visitors to these areas often visit during the winter months with the desire to abandon the burden of bulky clothing, to sit outside and enjoy nature, or to go to the beach. Second, the architectural design of buildings in these areas often does not include the use of window and door screens, and most have unscreened verandas and balconies that are in year-round use, thus putting individuals at increased risk of exposure. Third, while many businesses, resorts, and some homes have air-conditioning, using air-conditioning would require sitting indoors, which many people prefer not to do. Finally, because of the climate, wearing long sleeves is done infrequently and outdoor activities continue into the late night.

Although it will be challenging to change the "outdoor" culture that exists in these countries, the architectural design of buildings easily can be addressed with minor legislative changes. There should be a requirement for newly constructed buildings and buildings that are being refurbished or remodeled to install window and door screens, and verandas and balconies should be enclosed with screens.

Mosquito elimination efforts clearly are needed, but must be implemented and evaluated based on scientific evidence. This effort will require a multidisciplinary One Health approach to integrated pest management that is supported by dedicated financial resources at local and international levels. All countries will need to build effective mosquito surveillance and control programs—and resource-poor governments likely will need to secure international funding to support and sustain these activities.

***Acknowledgement:*** This work received no specific grant from any funding agency, commercial, or not-for-profit sectors.

***Corresponding Author:*** Jennifer Ann Marie Calder, City of Stamford Department of Health, 880 Washington Boulevard, 8th Floor, Stamford, CT 06902.
E-mail: jcalder@stamfordct.gov.

## References

Khan, K., Bogoch, I., Brownstein, J.S., Miniota, J., Nicolucci, A., Hu, W., . . . Wilder-Smith, A. (2014). Assessing the origin of and potential for international spread of chikungunya virus from the Caribbean. *PLOS Currents Outbreaks, 1*, 1–11.

Komar, N., & Clark, G.G. (2006). West Nile virus activity in Latin America and the Caribbean. *Revista Panamericana de Salud Pública*, *19*(2), 112–117.

Oliver, C.J., Softley, S., Williamson, S.M., Stevenson, P.C., & Wright, G.A. (2015). Pyrethroids and nectar toxins have subtle effects on the motor function, grooming and wing fanning behaviour of honeybees (*Apis mellifera*). *PLoS ONE, 10*(8), e0133733.

Salvato, M.H. (2001). Influence of mosquito control chemicals on butterflies (Nymphalidae, Lycaenidae, Hesperiidae) of the lower Florida Keys. *Journal of the Lepidopterists Society, 55*(1), 8–14.

(1997). The feasibility of eradicating *Aedes aegypti* in the Americas. *Revista Panamericana de Salud Pública*, *1*(1), 68–72.

Walshe, D.P., Garner, P., Abdel-Hameed Adeel, A.A., Pyke, G.H., & Burkot, T. (2013). Larvivorous fish for preventing malaria transmission. *Cochrane Database of Systematic Reviews, 12*, CD008090.

Webster-Kerr, K., Figueroa, J.P., Weir, P.L., Lewis-Bell, K., Baker, E., Horner-Bryce, J., . . . Campbell-Forrester, S. (2011). Success in controlling a major outbreak of malaria because of *Plasmodium falciparum* in Jamaica. *Tropical Medicine and International Health, 16*(3), 298–306.

**BUILDING CAPACITY**

Darryl Booth, MBA

# Amplifying Environmental Health Visibility to Build Capacity

**Editor's Note: A need exists within environmental health agencies to increase their capacity to perform in an environment of diminishing resources. With limited resources and increasing demands, we need to seek new approaches to the business of environmental health.**

**Acutely aware of these challenges, NEHA has initiated a partnership with Accela called *Building Capacity*. *Building Capacity* is 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 bimonthly 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 senior vice president and general manager of environmental health at Accela and has been monitoring regulatory and data tracking needs of agencies across the U.S. for almost 20 years. He serves as technical advisor to NEHA's informatics and technology section.**

Take a measure of the public's health. In so doing, you've taken a corresponding measure of the relevant environmental health programs for that population. Yet, a healthful public (healthful thanks to decades of mindful public health interventions) will eventually, and subconsciously, decouple these results from the health program activities that helped establish that state. Just think about the antivaccine movement as an easy example of the cultural dissonance that occurs as time passes, despite easy access to the facts.

Health departments thus find themselves having to sustain not only their current levels of success but also the public's perceived value of environmental health programs if they are to ensure continued funding and support. It follows, then, that demonstrating the real value of public health programs can be difficult—how can one effectively measure the absence of illness or a hazard?

We put this question out to members of the National Environmental Health Association (NEHA). The passionate response showed that while this issue is a common challenge, many health departments are taking steps to address it. What follows are four activities health departments can undertake to measure and promote their impact.

## They Put a Number on It

You likely already appreciate how communicating successes and requests using measurable data points adds credibility to your message when reporting upwards. You might already have the basic information you need—number of facilities and program types in your inventory, inspections completed, complaints responded to, revenue collected, etc.

A powerful reporting system and qualified staff, on top of a robust data management application, will deliver less obvious insights that can tell a more persuasive story about your productivity (and potentially identify room to grow). By how much have you improved complaint response time? How many fewer return visits, on average, do you conduct now versus previous years? What's the average application processing time per program type? Is there a bottleneck, be it person or process, that can be improved? Can you count the transactions conducted online that eliminate those carbon-producing trips downtown?

The ability to quickly assess this data (and instantly deliver it, too) matters. If it requires several hours or days to hunt down and manually count folders and documents, or design and run virtual reports, you are missing an opportunity to be more responsive and agile (and have your staff stay focused on their day jobs). A regular cadence of data disclosure with limited or zero intervention on your part gets your work in front of the right eyes more often, and more easily (Figure 1).

## They Speak Their Audience's Language

A report delivered to your board will have different information and purpose compared to information shared at a public meeting or event.

FIGURE **1**

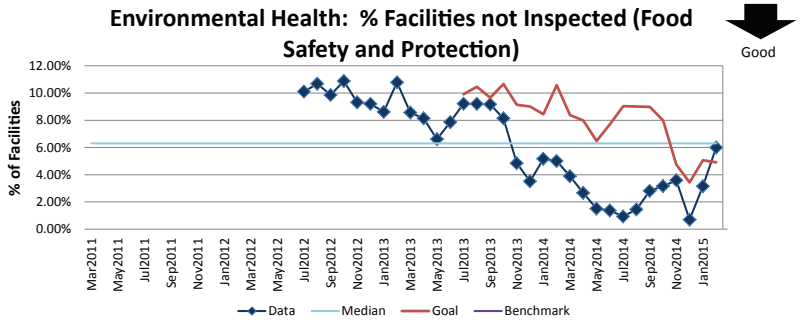
**Example of an Environmental Health Department Publishing Stats Through Both Numbers and Visuals**

**Environmental Health: % Facilities not Inspected (Food Safety and Protection)**
**Public Health & Wellness**
**Process: Enforce Laws**

| Baseline, Goal, & Benchmark | Source Summary | Continuous Improvement Summary |
|---|---|---|
| Baseline: FY13 9.22% facilities not inspected<br>Goal: In comparison to the same month of the prior year, reduce % of facilities not receiving required inspections by 2%.<br>Benchmark: TBD | Data Source: EHMIS<br>Goal Source: Executive Leadership<br>Benchmark Source: TBD | Plan-Do-Check-Act Step 8: Monitor and diagnose<br>Measurement Method: 12 month rolling count of inspections completed outside of federally mandated timeframe<br>Why Measure: To ensure public safety & comply with Fed and State Law<br>Next Improvement Step: Evaluate high risk facilities |

**How Are We Doing?**

| Mar2014-Feb2015 12 Month Goal | Mar2014-Feb2015 12 Month Actual | | Feb2015 Goal | Feb2015 Actual | |
|---|---|---|---|---|---|
| 6.98% | 2.60% |  | 4.91% | 6.00% |  |
| % of Facilities | % of Facilities | | % of Facilities | % of Facilities | |




I've previously covered effective ways to reach the public, such as social media; print, web, television, and radio advertising; community newsletters; and participating in local events. An especially effective method, when possible, is to embrace visual communication.

An estimated 65% of people are visual learners, and video and pictures can transcend language and other comprehension barriers. Riverside County Department of Environmental Health in southern California found great success in using public service announcement (PSA) videos to educate the public on human health and environmental topics, increasing web traffic by 15%.

Using the insights gleaned from your "numbering" effort previously mentioned, I encourage you to consider how data visualization can help you get vibrant, engaging images (charts, graphs, maps, etc.) in front of the public and your stakeholders.

## They Develop Citizens and Partners to Be Advocates for Them

"Today, we are facing a growing number of issues that we must educate the public about," said Drew Shaw, senior environmental health specialist at Ottawa County Department of Public Health in Michigan. "A few of these issues are a shrinking water supply, climate change, and deteriorating infrastructure. These issues will require input and action not only by environmental health professionals but also by the average citizen."

In other words, if we can't make the public into partners, we can't get the job done. This effort is more than simply telling people about the importance of environmental health department work. It's vital that your residents come away from interacting with the health department as an extension of you—warning family members at a picnic not to eat food that's been out for too long or reminding neighbors to get their septic systems pumped.

Message framing is a powerful tool that, when used with your data, can make environmental health personal. Frames are abstractions that give structure to a message; how information is presented to the audience (the frame) influences how people process that information. The FrameWorks Institute, an independent nonprofit, conducts and publishes multidisciplinary communications research to identify the most effective ways of reframing social and scientific topics. FrameWorks, the Centers for Disease Control and Prevention's National Center for Environmental Health, the American Public Health Association, the Association of State and Territorial Health Officials, and the Association of Public Health Laboratories partnered on a research project to develop toolkits for environmental health communication (www.frameworksinstitute.org/environmental-health.html). The toolkits are designed to help the environmental health sector increase public understanding of the relationship between environmental conditions and public health, environmental health challenges, and the importance of regulatory efforts (Figure 2). Using toolkits like these, and your own framing efforts, can enhance public engagement in your activities.

Similarly, look to your partners in local government. If you lose funding, how will that affect your capacity to share critical emergency response information with the fire department? If a local entrepreneur is trying to open a new restaurant and the local licensing entity needs you to review building plans before they issue a license, how long will it take if you recently had to absorb extra work due to loss of a full-time employee?

There is a strong trend in local government information technology right now to move toward enterprise systems, large-scale application software packages that support business processes, information flows, reporting, and data analytics in complex organizations that often touch the same data for different purposes. Consider how you can reduce duplicative data entry and break down silos among your departments by investing in an enterprise data management system, or at least an application programming interface (API) integration with your community and economic development departments. You will realize cost-savings and the new level of transparency and efficiency of transactions among your departments will make it much easier to demonstrate your value and develop advocates in your organization.

## They Empower Their People

A strong civic engagement effort requires internal engagement to be sustainable. Engag-

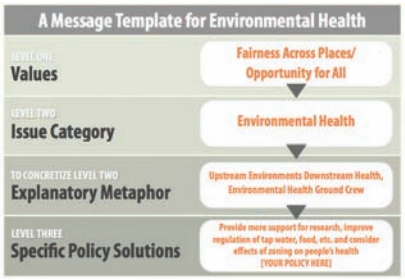
ing your staff, seeking their input, and making them feel like a part of the greater mission can give such an effort staying power. Many responses called for additional training for environmental health professionals to make sure they have advanced scientific knowledge, strong communication skills and are up-to-date on local, state, and federal laws and regulations. This strategy makes sense: if a health inspector cites a violation that a previous inspection missed, your department or the law may be perceived as inconsistent. Providing training can also help your team feel more confident and empowered.

## Final Thoughts

Health departments are among the pillars of a healthy community. As time passes and attention turns to other compelling matters, however, the potential exists for its value to feel diminished. It's a matter of vigilance to use the best tools at hand, and an appropriate budget, to maintain mindshare and, as an extension, capacity. To build capacity, the value must grow.

FIGURE **2**

**Template Messaging Framework From FrameWorks Institute's Environmental Health Communications Toolkit**




Available at www.frameworksinstitute.org/toolkits/environmentalhealth.

On this topic, I recall author, columnist, and speaker Harvey Mackay's 1997 best-selling book, *Dig Your Well Before You're Thirsty*. There's no time like the present!

## Join the Conversation

How is your organization taking ownership of your public image? Share your stories or opinions and access links to additional resources at the Building Capacity LinkedIn page: https://www.linkedin.com/groups/6945520.

*Acknowledgements:* The recommendations that surfaced in this column are credited to NEHA members through foundational NEHA Annual Educational Conference & Exhibition presentations, thought pieces, and scholarship applications, which are an ongoing testament to the acumen of the professionals among us. Thank you.

Kelly Delaney, product marketing associate for Accela, provided the research for this column.

*Corresponding Author:* Darryl Booth, Senior Vice President and General Manager of Environmental Health, Accela, 2633 Camino Ramon #500, San Ramon, CA 94583.
E-mail: dbooth@accela.com.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## DIRECT FROM AEHAP

Jason W. Marion, PhD
*Eastern Kentucky University*

Timothy J. Murphy, PhD, REHS/RS, DAAS
*The University of Findlay*

Anne Marie Zimeri, PhD
*University of Georgia*

# Trends in the Environmental Health Job Market for New Graduates

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

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

**Jason Marion is an associate professor in the Department of Environmental Health Science at Eastern Kentucky University. He is the current past-president of AEHAP. Timothy Murphy is an associate professor and chair of Environmental Safety and Occupational Health Management at The University of Findlay. He is the current past-president of EHAC. Anne Marie Zimeri is an assistant professor in Environmental Health Science at the University of Georgia. She is the current president of AEHAP.**

## Introduction

The question of whether the job market can support future graduates of environmental health programs remains an important and difficult question for environmental health programs, current and prospective students, parents, and other stakeholders. Our previous report using 2014 data from the U.S. Bureau of Labor Statistics demonstrated anticipated growth and higher than average pay in the profession through at least 2022 for baccalaureate degree holders (Marion & Sinde, 2015). Growth in the profession does not necessarily translate into job availability if the market is saturated with job candidates. In 2013, *U.S. News & World Report* indicated that public health is one of the 11 hottest choices as a major for current college students (Gandel & Haynie, 2013). Some of the graduates of these popular public health programs could potentially influence the environmental health market, particularly in the public sector, if they do not obtain adequate skills prior to graduation.

While university programs produce graduates, local health departments (LHDs) have suffered tremendous job losses nationally. From 2008–2012, LHDs eliminated 44,000 positions (National Association of County and City Health Officials, 2014). From 2012–2015, nearly 8,000 more positions were lost nationally in LHDs, totaling almost 52,000 fewer positions since 2008 (Newman, Ye, Leep, & Zometa, 2016). Although there was a net gain of 850 positions in LHDs in 2016 (Robin & Leep, 2017), the U.S. has 50,000 fewer LHD employees today than one decade ago.

In terms of job opportunities in the public workforce, the Public Health Workforce Interests and Needs Survey (PH WINS) indicated that despite these major job losses over the last decade, turnover and retirement are likely contributing to an increase in future position availability. Specifically, 18% of all PH WINS respondents indicated intentions to leave their agency during the survey year, while an additional 25% indicated plans to retire by 2020 (Pourshaban, Basurto-Dávila, & Shih 2015). Job satisfaction and pay were identified as the top two reasons why voluntary job departure was occurring in PH WINS. To fill positions, unless pay and job satisfaction issues are addressed by policy solutions, the quality of the incoming workforce might diminish and the demand for college graduates will decrease as communities with fewer financial resources cannot recruit highly qualified college graduates.

TABLE **1**

**Percentage of Recent Graduates Working in the Private Sector Among National Environmental Health Science and Protection Accreditation Council Undergraduate Programs, 2012–2017**

| Year | Responding Programs | Private Sector Average (%) | *SD* | Minimum | Maximum |
|---|---|---|---|---|---|
| 2012 | 24 | 49.6 | 0.23 | 20 | 80 |
| 2013 | 22 | 49.6 | 0.22 | 0 | 86 |
| 2014 | 24 | 52.8 | 0.22 | 0 | 88 |
| 2015 | 27 | 53.1 | 0.23 | 0 | 100 |
| 2016 | 25 | 52.1 | 0.26 | 14 | 100 |
| 2017 | 17 | 48.2 | 0.24 | 0 | 100 |

*SD* = standard deviation.

TABLE **2**

**Current Job Market Perceptions of National Environmental Health Science and Protection Accreditation Council Undergraduate Programs, 2012–2017**

| Year | *N* | Decreasing # (%) | No Change # (%) | Increasing # (%) |
|---|---|---|---|---|
| 2012 | 29 | 2 (6.9) | 17 (59) | 10 (34) |
| 2013 | 29 | 3 (10) | 13 (45) | 13 (45) |
| 2014 | 31 | 3 (3.2) | 11 (35) | 19 (61) |
| 2015 | 32 | 2 (6.3) | 7 (22) | 23 (72) |
| 2016 | 29 | 0 (0) | 8 (28) | 21 (72) |
| 2017 | 29 | 2 (6.9) | 12 (41) | 15 (52) |

## Methods

For monitoring potential changes in job availability, an annual survey is performed among the programs accredited by the National Environmental Health Science and Protection Accreditation Council (EHAC). The annual survey provides a holistic perspective of the health of environmental health programs nationally with data being obtained from all undergraduate and graduate programs. A variety of data points, including program enrollment, number of annual graduates, number of recent job placements, types of job placements, and more, are included in the annual survey. Using the data from these reports (2012–2017), we examined the annual responses of program leaders for approximately 30 undergraduate programs and eight graduate programs regarding whether they thought the job market for their graduates was increasing, decreasing, or not changing.

In addition, we examined where each of these programs were placing their students (public or private sector) to see if programs historically placing students in public sector positions were being adversely impacted by changes in the public sector. Private and public are the terms used in the annual surveys from 2012–2017. The annual surveys include questions ascertaining how many recent graduates over the past year were employed in the public and private sector. Within public and private categories, data are further collected annually for the public sector by obtaining employment data for recent graduates employed in local health departments, federal service, state service, educational institutions, nonprofits, and other as subcategories of the public sector categorization. For private sector work, consulting, manufacturing, resource extraction, and other were the subcategories. Using the responses to the overarching categories of public sector and private sector employment, a logistic regression model was generated to see if programs perceiving increasing job growth were oriented more toward having graduates placed in private sector positions.

## Results

During 2012–2017, the undergraduate institutions reported graduating 2,047 students. Graduate programs reported 553 new graduates. Among the undergraduate programs providing data on job placement during this timeframe, 950 graduates (48%) were described as being placed in the public sector and 1,013 graduates (52%) in the private sector. The ratio of placement (public versus private) among respondent undergraduate programs remained approximately 50% during the observation period (Table 1). Similar findings are true for the graduate programs, whereby 226 of 480 (47%) recent masters-level graduates were placed in the public sector from 2012–2017.

In regard to perspectives on the market, 179 undergraduate program responses and 48 graduate program responses were received from 2012–2017 as to whether the job market was increasing, decreasing, or not changing for their future graduates. From 2012–2017, a total of 10 (5.6%) of the undergraduate program responses suggested a decreasing market. The majority of respondents, 101 (56%), perceived the market increasing, with 68 (38%) indicating no change (Table 2). Among graduate program respondents from 2012–2017, only one (2.1%) program perceived a decreasing job market (response occurred in 2012). The graduate programs overwhelming perceived an increasing job market with 33 (69%) respondents reported an increasing job market and 14 (29%) perceived no change.

During 2012, the majority of undergraduate programs (59%) perceived a flat job market. In 2013, however, an equal amount perceived a flat and increasing job market (45%) (Table 2). Since 2014, over half of the undergradu-

ate programs have perceived an increasing job market although the rate of increase may be slowing towards prerecession levels (Figure 1). For the graduate programs, the frequency of program respondents perceiving an increasing job market has been 50% or higher since the observation period (Figure 1).

Beyond the numerical data obtained in the annual survey, programs provide qualitative feedback. Such open-response feedback on the job availability portion of the survey has consistently and frequently generated responses indicating that job opportunities are increasing in the private sector and declining in the public sector for their students. To investigate the impact of the private sector employment opportunities on undergraduate program expectations as related to increasing job opportunities, undergraduate programs expecting employment increases were coded as "1" and programs expecting otherwise were coded as "0". Then, using the numerical responses for how many of their recent graduates were placed in the public sector versus the private sector, we generated a new variable, "private." The new variable represents the proportion of graduates working in private industry. For example, a program with 5 of 10 graduates in a given year working in the private sector would be coded as 0.5. Using these data, a logistic regression model was generated to examine the likelihood of a program to perceive an increasing job market. The model was also adjusted for year effect, whereby 2012 was set as the reference group.

Upon performing the regression analysis, the year effect was significant, whereby the likelihood of expecting an increasing job market for undergraduates was significantly greater ($p < .05$) in 2015, 2016, and 2017 compared with 2012. The odds of an undergraduate program in 2017 perceiving an increasing job market were 3.9 times greater than the perceptions of 2012 (Table 3). Furthermore, the proportion of students for a given program entering the private sector was also a significant predictor of whether a program anticipated an increasing job market. Specifically, as the proportion of private sector employment increased, so did the odds of a program reporting a perception that job opportunities were increasing for their students (odds ratio = 6.0; 95% confidence interval [1.1, 32]).

FIGURE **1**

**Undergraduate and Graduate Program Perceptions of an Increasing Environmental Health Job Market by Year**

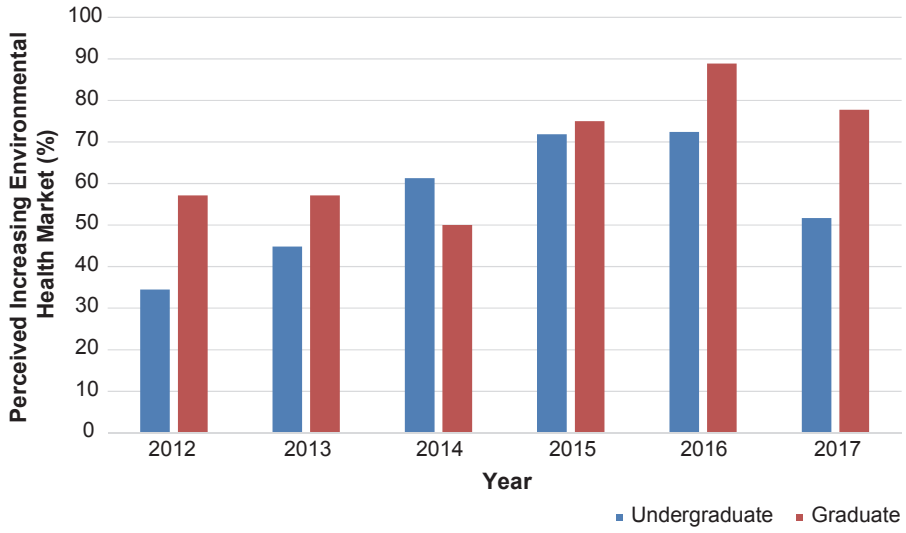



TABLE **3**

**Multivariable Logistic Regression Model for Predicting the Likelihood of a Perceived Increasing Environmental Health Job Market for National Environmental Health Science and Protection Accreditation Undergraduate Programs, 2012–2017**

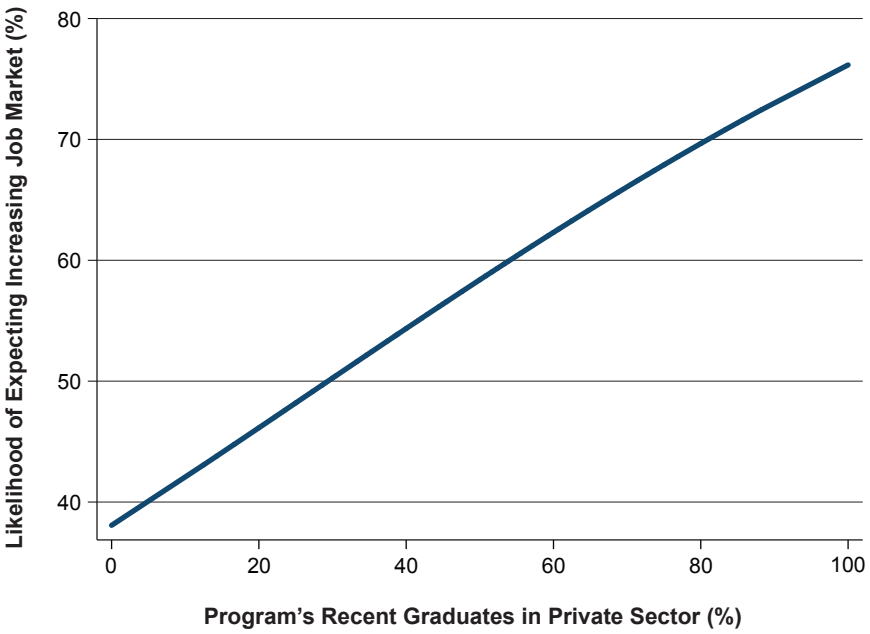
| Covariate | β | *SE* (β) | a*OR* (95% *CI*) | *p*-Value |
|---|---|---|---|---|
| Private* | 1.8 | 0.85 | **6.0 (1.1, 32)** | **.036** |
| 2012 | 1.0 | – | reference | – |
| 2013 | 0.61 | 0.62 | 1.8 (0.54, 6.2) | .331 |
| 2014 | 1.1 | 0.62 | 3.1 (0.92, 10) | .067 |
| 2015 | 1.5 | 0.61 | **4.7 (1.4, 16)** | **.012** |
| 2016 | 1.7 | 0.63 | **5.2 (1.5, 18)** | **.009** |
| 2017 | 1.4 | 0.68 | **3.9 (1.0, 15)** | **.044** |
| Constant | -1.6 | 0.62 | – | – |

*SE* = standard error; a*OR* = adjusted odds ratio; *CI* = confidence interval.
*Note.* Significant values are shown in bold.
*The proportion of recent graduates working in private industry.

In terms of percentages rather than proportions, for each 1% increase in private sector employment, the odds of a program perceiving increasing job opportunities for their students increase by 1.8%. The model, in terms of percentages, demonstrates in Figure 2 that even for programs with no private sector employment (0%), less than 40% of these programs anticipated an increasing job market. For programs with 100% private sector employment, approximately 75% of these programs perceived an increasing job market.

FIGURE **2**

**Modeled Environmental Health Job Market Perceptions by Program as a Function of Graduate Placement in Private Sector**




In terms of model quality, the model had adequate discrimination (area under the receiver operator characteristic curve = 70.5%). The model predicted results were not significantly different than the observed results ($p$ = .17), indicating adequate fit.

## Discussion

The overall perception among EHAC program respondents continues to indicate a favorable job market for current students and recent graduates. Among programs that indicated decreasing job opportunities or no change in the market, many of these programs provided supplemental comments referencing downturns in local/regional economies or lack of available jobs with traditional government employers. The programs reporting the largest enrollments and highest opinions about the job market are those most closely aligned to the private sector.

Nationally, low pay for environmental health professionals working in state and local government could be impacting perceptions about job availability for baccalaureate degree holders from EHAC programs. As we have previously described, EHAC graduates possess a strong science background and technical skills suitable for private and public sector work, as well as fields beyond environmental health (Marion & Murphy, 2016). The value of the EHAC degree, which was designed for the modern environmental public health workforce, is often not fully appreciated by government policies or budgeting that impacts local public health. Accordingly, many agencies do not recruit EHAC college graduates when more affordable high school graduates and college graduates of other disciplines are seeking employment. Circumstances, such as long-standing salary concerns as described in the North Carolina environmental health community in 2009, will need to be addressed if the most-qualified persons are to be recruited and retained in the environmental public health workforce (Zontek, DuVernois, & Ogle, 2009).

As public agencies develop budgets intending to be conscientious about their limited financial resources, by offering salaries not commensurate with the private sector, these agencies will struggle to recruit well-trained persons ready to "hit the ground running." By lowering the hiring requirements or not maintaining hiring requirements on par with the private sector, these agencies will need to invest additional staff time into education and training that would not be needed as extensively for EHAC program graduates (Neistadt & Murphy, 2009).

Retention issues from low pay will result in high turnover and a greater need to invest more resources into training the frequent new hires lacking basic environmental public health core competencies. Such education costs to be assumed by the employer for these under qualified persons were estimated in 2007 to be $9,500 (Murphy & Neistadt, 2007). Substantial increases in U.S. education costs have since occurred. The U.S. Department of Labor, Bureau of Labor Statistics (2017a) estimates that from 2006–2016, U.S. education costs increased by 63%. If the same holds true from 2007–2017, training and educating an under qualified environmental health professional could now likely cost a minimum of $15,000. Upon the employer making the education and training investment, the newly trained environmental health professional will then be more marketable and difficult to retain if pay is not on par with other public sector environmental health positions or the private sector.

Until there are more significant investments in state and local environmental health agencies and their workforces, graduating EHAC students examining compensation and career advancement will seek opportunities in the private sector. As graduates head to the private sector, alumni will encourage their peers to do better paying cooperative education and internship opportunities in the private sector. Such experiences are and will likely continue to result in graduates choosing private sector careers. The findings here are further supported by data from the Bureau of Labor Statistics, which indicates that environmental jobs requiring a baccalaureate degree will remain concentrated and stable in state and local levels of government; however, most growth will be occurring in the private sector, particularly among private consultants (U.S. Department of Labor, Bureau of Labor Statistics, 2017b).

Overall, even among the environmental health programs with the fewest number of recent graduates in the private sector, few foresee a declining job market. Most of the programs that are most closely aligned to

public sector employment opportunities perceive either no change or increasing opportunities in the job market. Future studies among recent graduates taking into consideration salary differences between public and private employers are encouraged. Such discrepancies, if any, between public versus private salaries among EHAC graduates could be useful in informing environmental public health budgets and policies.

## Conclusions

- Over half of accredited EHAC undergraduate and graduate programs perceive increasing job opportunities for their graduating students.
- The programs most closely aligned to the private sector reported more favorable job outlook scenarios for their graduates.
- Assessments of salary differences among recent EHAC graduates entering the private sector versus the public sector are warranted.

*Corresponding Author:* Jason W. Marion, Associate Professor, Department of Environmental Health, College of Health Sciences, Eastern Kentucky University, 521 Lancaster Avenue, 220 Dizney Building, Richmond, KY 40475. E-mail: jason.marion@eku.edu.

## References

Gandel, C., & Haynie, D. (2013, September 10). 11 hot college majors. *U.S. News & World Report*. Retrieved from http://www.usnews.com/education/best-colleges/slideshows/11-hot-college-majors

Marion, J.W., & Murphy, T.J. (2016). A fork in the road for environmental health workforce development and U.S. public health. *Journal of Environmental Health*, *79*(2), 40–43

Marion, J.W., & Sinde, Y. (2015). The need for environmental public health professionals and the role of EHAC-accredited programs in increasing the pool. *Journal of Environmental Health*, *78*(2), 36–41.

Murphy, T.J., & Neistadt, J.S. (2007, June). *Improving public health services and saving resources: Hiring graduates from accredited environmental health programs*. Presentation conducted at the National Environmental Health Association Annual Educational Conference & Exhibition, Atlantic City, NJ.

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

Neistadt, J.S., & Murphy, T.J. (2009). Are we really saving resources with current hiring practices at local health departments? *Journal of Environmental Health*, *71*(6), 12–14.

Newman, S.J., Ye, J., Leep, C.J., Hasbrouck, L., & Zometa, C. (2016). Assessment of staffing, services, and partnerships of local health departments—United States, 2015. *Morbidity and Mortality Weekly Report*, *65*(25), 646–649.

Pourshaban, D., Basurto-Dávila, R., & Shih, M. (2015). Building and sustaining strong public health agencies: Determinants of workforce turnover. *Journal of Public Health Management and Practice*, *21*(Suppl. 6), S80–S90.

Robin, N., & Leep, C.J. (2017). NACCHO's national profile of local health departments study: Looking at trends in local public health departments. *Journal of Public Health Management and Practice*, *23*(2), 198–201.

U.S. Department of Labor, Bureau of Labor Statistics. (2017a). *TED: The economics daily: College tuition and fees increase 63 percent since January 2006*. Retrieved from https://www.bls.gov/opub/ted/2016/college-tuition-and-fees-increase-63-percent-since-january-2006.htm

U.S. Department of Labor, Bureau of Labor Statistics. (2017b). *Occupational outlook handbook: Environmental scientists and specialists*. Retrieved from https://www.bls.gov/ooh/life-physical-and-social-science/environmental-scientists-and-specialists.htm

Zontek, T.L., DuVernois, C.C., & Ogle, B.R. (2009). Job satisfaction and issues related to the retention of environmental health professionals in North Carolina. *Journal of Environmental Health*, *72*(3), 10–15.

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## DIRECT FROM ATSDR

Lynn Wilder, PhD, CIH

Rachel Worley, PhD

Pat Breysse, PhD

# Community Exposures to Per- and Polyfluoroalkyl Substances in Drinking Water: A National Issue

**Editor's Note: As part of our continuing effort to highlight innovative approaches to improving the health and environment of communities, the *Journal* is pleased to publish a bimonthly column from the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is a federal public health agency of the U.S. Department of Health and Human Services (HHS) and shares a common office of the Director with the National Center for Environmental Health (NCEH) at the Centers for Disease Control and Prevention (CDC). ATSDR serves the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances.**

**The purpose of this column is to inform readers of ATSDR's activities and initiatives to better understand the relationship between exposure to hazardous substances in the environment and their impact on human health and how to protect public health. We believe that the column will provide a valuable resource to our readership by helping to make known the considerable resources and expertise that ATSDR has available to assist communities, states, and others to assure good environmental health practice for all is served.**

**The conclusions of this column are those of the author(s) and do not necessarily represent the official position of ATSDR, CDC, or HHS.**

**Lynn Wilder is a senior environmental health scientist at ATSDR. Rachel Worley is an environmental health scientist at ATSDR in the Division of Community Health Investigations. Pat Breysse is the director of NCEH/ATSDR and leads CDC's efforts to investigate the relationship between environmental factors and health.**

Per- and polyfluoroalkyl substances (PFAS) contamination is present in many municipal and private drinking water supplies throughout the U.S. Communities and other groups are concerned about possible health effects related to PFAS exposure. Current scientific knowledge gaps preclude definitive answers to questions about the magnitude and types of human health problems associated with these substances. The National Center for Environmental Health and Agency for Toxic Substances and Disease Registry (NCEH/ATSDR) are involved in PFAS work either directly or by helping local, territorial, tribal, state, and federal partners.

## Background

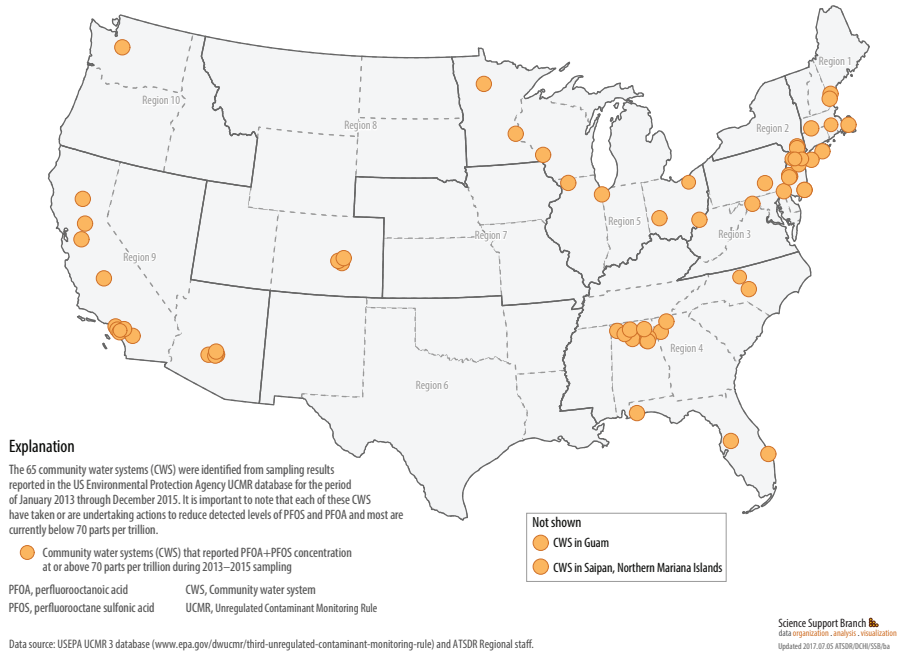
In May 2016, the U.S. Environmental Protection Agency (U.S. EPA) issued the following drinking water lifetime health advisory values for two PFAS compounds: 70 ng/L (or parts per trillion) for both perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS). The final health advisory concentration applies to either compound separately or, because U.S. EPA considers the effects to be additive, both compounds combined. These concentrations replaced U.S. EPA's provisional health advisory values of 400 ng/L (PFOA) and 200 ng/L (PFOS). Releasing these nonregulatory guidelines to states and municipal water treatment facilities lead to almost immediate concern in affected communities across the nation. Community concerns are heightened by the fact that the scientific understanding of possible health effects from exposure to these compounds is limited.

PFAS repel water and oil (hydrophobic and lipophobic), are heat tolerant, and are very persistent in the environment. PFOA and PFOS are members of a family of long-chain PFAS compounds that were used worldwide from the 1950s until recently for their unique chemical properties (DeWitt, 2015). These compounds were used in consumer products including nonstick cookware, carpet and clothing stain resistant coatings, and in grease-resistant food wrappers and packaging. Several other PFAS, including PFOA, PFOS, and perfluorohexane sulfonate (PFHxS) were components in aqueous film-forming foam used at airports and military bases for fire suppression.

Longer chain PFAS, including PFOA, PFOS, PFHxS, and perfluorononanoic acid (PFNA) bioaccumulate; their estimated half-

FIGURE **1**

**Community Water Systems Reporting Perfluorooctanic Acid and Perfluorooctane Sulfonic Acid Concentrations at or Above Health Advisory Values, 2013–2015**




lives range from about two to nine years in humans. Since the National Health and Nutrition Examination Survey (NHANES) began testing the general population for PFAS in 1999, they have found measurable PFOA, PFOS, and PFHxS in most of the serum samples. Since manufacturers phased out production of PFOA and PFOS, the levels in serum have been decreasing in the general population. From 1999–2014, blood PFOA and PFOS levels declined by more than 60% and 80%, respectively (Centers for Disease Control and Prevention [CDC], 2017).

## Scope of the Challenge

Currently, there are no federal regulations that require all drinking water systems to test for any PFAS. The public water systems that have undergone testing were part of U.S. EPA's Unregulated Contaminant Monitoring Rule (UCMR) program during 2013–2015. The majority of households (close to 70% of the population, or about 225 million people) in the U.S. get drinking water from one of the 4,600 systems found to have no reportable levels of PFOA or PFOS (U.S. Census Bureau, 2007; U.S. EPA, 2017). Some facility exceedances were based on pretreated or premixed water samples, not on point of distribution samples. Once blended or treated, PFOA and PFOS were below U.S. EPA health advisory values.

One or more PFAS species were present, however, in 194 public water systems. Another 65 systems had a PFOA/PFOS level above the U.S. EPA health advisory value (Figure 1). These 65 systems serve approximately 6 million people. It is important to note that each of these 65 systems have taken or are taking actions to reduce levels and most are now below the U.S. EPA health advisory level.

While the majority of the population (70%) is served by approximately 4,800 individual public systems that already have been tested, the remaining 30% of the population is served by a far greater number of individual systems. Approximately 47,000 individual water systems serve roughly 60 million people and over 13 million individual private wells serve 33–38 million people. If a drinking water source is located near a potential source of PFAS pollution, testing for these compounds is recommended.

### Major Exposure Pathways

- Drinking Water
  - Public water systems
  - Private residential wells
- Fish (in Contaminated Areas)
- Diet/Consumer Products
  - Grease-resistant wrappers and packaging
  - Clothing
  - Cookware
  - Nursing infants can be exposed through breast milk

## Health Effects

To date, some epidemiologic studies of PFOS and/or PFOA have shown statistically significant associations with PFOA or PFOS and several health indicator variables. Exposure to PFOA and/or PFOS might

- result in low birth weight (Chen et al., 2012; Darrow, Stein, & Steenland, 2013; Fei, McLaughlin, Tarone, & Olsen, 2007);
- affect growth, learning, and behavior of children (Bellinger, 2013; Fei & Olsen 2011; Forns et al., 2015; Stein & Savitz, 2011; Stein, Savitz, & Bellinger, 2013);
- lower a woman's chance of getting pregnant (Crawford et al., 2017; Fei, McLaughlin, Lipworth, & Olsen, 2009; Whitworth et al., 2012);
- interfere with the body's natural hormones (Jain, 2013; Joensen et al., 2013; Lopez-Espinosa, Mondal, Armstrong, Bloom, & Fletcher, 2012; Shrestha et al., 2017; Wang et al., 2014);
- increase cholesterol levels (Eriksen et al., 2013; Fitz-Simon et al., 2013; Fletcher et al., 2013; Frisbee et al., 2010; Nelson, Hatch, & Webster, 2010; Sakr et al., 2007; Steenland, Tinker, Frisbee, Ducatman, & Vaccarino, 2009);
- affect the immune system (Dalsager et al., 2016; Grandjean et al., 2012; Granum et al., 2013; Steenland, Zhao, Winquist, & Parks, 2013,); and
- increase the risk of cancer (kidney, bladder, testis, and prostate) (Alexander & Olsen 2007; Barry, Winquist, & Steenland, 2013; Mastrantonio et al., 2017; Vieira et al., 2013).

### Per- and Polyfluoroalkyl Substances (PFAS) Sources of Environmental Contamination

- Waste from manufacturing facilities (since the 1950s)
- Using certain aqueous film-forming foams at military installations (1970–1990) and airports
- Using PFAS-containing sludge from wastewater treatment plants as a soil amendment

Laboratory animals exposed to high amounts of PFAS (mostly PFOA or PFOS) have shown changes in liver, thyroid, and pancreas function and changes in hormone levels and developmental endpoints. Liver, testis, and pancreas cancers were seen in rats exposed to PFOA. Liver cancer was observed in rats exposed to PFOS (Butenhoff et al., 2002; Butenhoff, Chang, Olsen, & Thomford, 2012; Cui, Zhou, Liao, Fu, & Jiang, 2009; Iwai & Yamashita, 2006; Lau, Butenhoff, & Rogers, 2004; Lau et al., 2006; Luebker, York, Hansen, Moore, & Butenhoff, 2005; Seacat et al., 2002).

Although statistical associations add to the evidence base, causal associations have not been established between PFAS exposure and adverse human health effects. More epidemiologic and exposure study research is needed. The health effects of exposures to PFAS mixtures is currently not known.

## Our Perspective on Biomonitoring

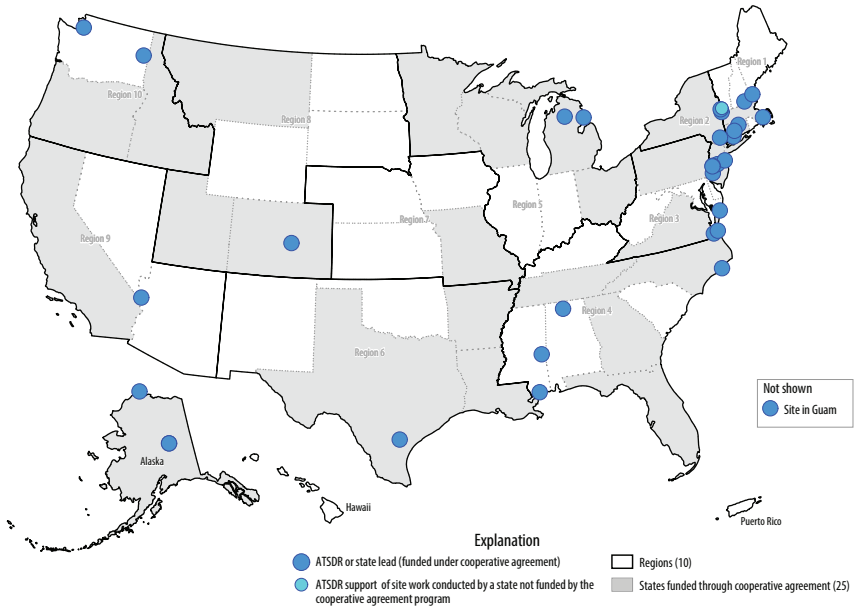
**National Monitoring:** Since 1999, the Centers for Disease Control and Prevention has measured several types of PFAS in the U.S. population as part of NHANES. With a decrease in production and use of PFOA and PFOS, the national levels have also gone down over time. From 1999–2014, serum PFOA and PFOS levels declined by more than 60% and 80%, respectively (CDC, 2017).

**Community Investigations:** Blood tests for PFAS are most useful when they are part of either a comprehensive and systematic investigation or a health study. Such an investigation can provide population estimates of the magnitude and range of exposures to PFAS within a community. For example, scientists can use the results to estimate the highest and lowest levels of PFAS levels in a specific community or PFAS levels in special groups, such as children. Additional information can show other factors that might affect exposure, like age and occupation, source of drinking water, and duration of residence in the area. This systematic approach will allow results to be compared to other communities, track trends in exposure over time, and use results to show the need for health studies or actions in the future.

**Individual Testing:** Community members want to know blood PFAS levels. Once tested, they want to know what the results mean to their current and future health, and the health of their children. We understand and acknowledge that some people may want to know the level of PFAS in their blood. There is currently no established PFAS level, however, at which a health effect is known nor is there a level that is clearly associated with past or future health problems. An individual's PFAS result can only be compared with national or community levels to determine if they are within the range or higher or lower than population values.

FIGURE **2**

**Location of Agency for Toxic Substances and Disease Registry (ATSDR) and State Partner Cooperative Agreements to Address Perfluorooctane Sulfonic Acid Drinking Water Contamination**




## NCEH/ATSDR Activities

We are involved in PFAS work either directly or by helping local, territorial, tribal, state, and federal partners. We offer technical assistance to help state and local health departments learn more about PFAS and how to investigate PFAS exposure in their communities. We tracked PFAS levels in drinking water from systems reporting to U.S. EPA UCMR3 to ensure efforts are underway to reduce levels below U.S. EPA's lifetime health advisory. We are also writing a Toxicological Profile that will summarize what is known about PFAS and how it might affect your health. And finally, we continue to monitor PFAS levels in blood in the U.S. population.

Figure 2 shows the locations of where ATSDR, our state partners, or both are involved in communities with PFAS-contaminated drinking water. As other contaminated water sources are discovered, this map will evolve.

## NCEH/ATSDR PFAS Exposure Assessment Technical Tools

To assist state health departments and others wanting to assess PFAS exposures in a community using a statistical approach, we created a set of tools that might be useful. The assessment tools are designed to help health departments conduct PFAS biomonitoring activities with the assumption that the primary source of PFAS exposure is from drinking water.

The PFAS Exposure Assessment Technical Tools include the following materials:

- approach for designing the exposure assessment,
- exposure and health effects questions,
- sample letters explaining individual blood test results,
- risk evaluation and communications materials, and
- blood sample collection and laboratory analysis protocols.

State and local health departments can request a copy of these materials and ask questions via e-mail to pfas@cdc.gov. Additionally, ATSDR's website (www.atsdr.cdc.gov/pfc/index.html) includes more information about PFAS and links to helpful resources.

*Acknowledgements:* We thank ATSDR's Barbara Anderson, PhD, and Susan Moore, MS, for their mapping and data analysis expertise.

*Corresponding Author:* Lynn Wilder, Senior Environmental Health Scientist, National Center for Environmental Health/Agency for Toxic Substances and Disease Registry, 4770 Buford Highway NE, Atlanta, GA 30341. E-mail: lwilder@cdc.gov.

References can be viewed at www.neha.org/jeh/supplemental.

## Did You Know?

Purdue University has released a new study that investigates chemical emissions and exposures caused by cured-in-place-pipe (CIPP) repair sites. CIPP is the most popular water pipe repair technology used in the U.S. that might pose health risks due to the chemicals emitted in the process. Learn more at www.neha.org/news-events/latest-news/purdue-announces-new-study-emissions-cured-place-pipe-repair.

**DIRECT FROM CDC** ENVIRONMENTAL HEALTH SERVICES BRANCH

Lauren Lipcsei, MPH

Taylor Radke, MPH

# Food Safety Innovations in Federal Guidelines

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

**In these columns, EHSB and guest authors share insights and information about environmental health programs, trends, issues, and resources. The conclusions in this column are those of the author(s) and do not necessarily represent the official position of CDC.**

**Lauren Lipcsei and Taylor Radke are both Oak Ridge Institute for Science and Education (ORISE) research fellows in EHSB's Division of Emergency and Environmental Health Services at the National Center for Environmental Health.**

In January 2017, the Department of Health and Human Services released an updated version of the *Food Service Guidelines for Federal Facilities* (Figure 1), previously known in 2011 as the *Health and Sustainability Guidelines for Federal Concessions and Vending Operations*. These guidelines apply to food service concession and vending operations at federal facilities (e.g., a full-service cafeteria in a federal building, a full-service restaurant in a national park, or a self-service food operation at a national monument), and will be used for developing contracts and permits. The Food Service Guidelines Federal Workgroup that developed the guidelines included more than 60 representatives from the following nine federal departments and agencies:

- U.S. Department of Agriculture,
- U.S. Department of Commerce,
- U.S. Department of Defense,
- U.S. Department of Education,
- U.S. Department of Health and Human Services,
- U.S. Department of the Interior,
- U.S. Department of Veterans Affairs,
- U.S. Environmental Protection Agency, and
- U.S. General Services Administration.

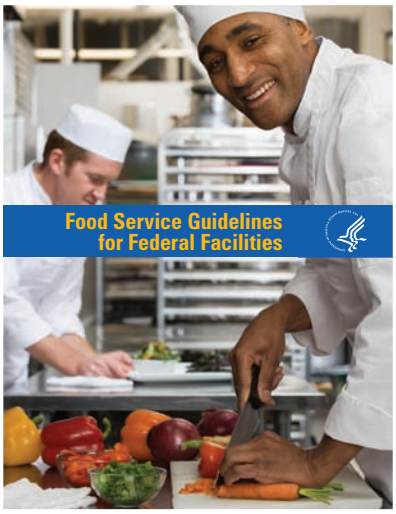
The updated guidelines include four sections: Food and Nutrition; Facility Efficiency, Environmental Support, and Community Development; Food Safety; and Behavioral Design. Each section identifies two levels of criteria implementation that are considered during the negotiation of contracts between federal facilities and food service contractors. The two levels of criteria are:

1. Standard Criteria
   a. Criteria that are considered to be widely achievable.
   b. Implementation at this level is expected.
2. Innovative Criteria
   a. Criteria that promote exceptional performance and are deemed more attractive by federal facilities during contract bidding.
   b. Implementation at this level is encouraged.

These two levels of implementation are supported by scientific findings and align with existing national policy or guidance.

FIGURE **1**

***Food Service Guidelines for Federal Facilities***




## Food Safety

September is National Food Safety Month and we would like to highlight the Food Safety section of the *Food Service Guidelines for Federal Facilities*, which was not included as its own section in the 2011 guidelines.

Each year in the U.S., foodborne illness causes approximately 48 million illnesses, 128,000 hospitalizations, and 3,000 deaths (Scallan et al., 2011). To reduce this burden, the Food and Drug Administration publishes the *Food Code*, which provides a scientifi-

TABLE **1**

**Food Safety Standard and Innovative Criteria Categories**

| Category | Standard Criteria<br>The contractor shall follow the recommendations in the most recently published *Food Code* regarding: | Innovative Criteria |
|---|---|---|
| Food safety management system/active managerial control | The development and implementation of food safety procedures. | The contractor shall establish a comprehensive written food safety plan that seeks to achieve active managerial control of foodborne illness risk factors, including but not limited to a) improper holding temperatures; b) inadequate cooking, such as undercooking raw shell eggs; c) contaminated equipment; d) food from unsafe sources; and e) poor personal hygiene.<br>The plan could describe the food safety procedures for the particular food service facility, including how employees are to be trained on those procedures and the methods by which proper implementation of those procedures are routinely monitored. |
| Undercooked meat, poultry, and egg products | Minimum cooking temperatures for raw animal food. | The contractor shall not serve raw or undercooked meat, poultry, or egg products, even upon request of the customer. |
| Practices to control *Listeria monocytogenes* in ready-to-eat products | The preparation, storage, and display of refrigerated, ready-to-eat foods. | The contractor shall develop and implement written sanitation and temperature control programs that target the control of *Listeria monocytogenes* in ready-to-eat products, including documentation of cleaning frequencies for equipment, utensils, and nonfood contact surfaces (e.g., walls, floors, ceilings) and temperature control in coolers, deli cases, and refrigerators. |
| Sick employees | Excluding and restricting ill workers from working with food. | The contractor shall develop and implement a written employee health policy that outlines how employees are trained on the reporting of symptoms, diagnoses, and activities that are associated with the transmission of foodborne illness from food workers and how such training is documented and the policies for excluding, restricting, and reinstating employees who have or report symptoms, diagnoses, or activities as described in the *Food Code*. |
| Food handler training | Food safety training for food employees. | The contractor shall develop and implement a written policy that addresses employee food safety training. |
| Certified food protection manager | The contractor shall have at least one management/supervisory employee who is a certified food protection manager present during all hours of operation. | |

cally sound basis for addressing food safety issues in retail food and food service establishments. The *Food Code* has served as the primary model for retail food regulation since its first edition in 1993.

The primary food safety standard criteria in the guidelines is that contractors operating in federal facilities are expected to adhere to the most recently published version of the *Food Code* and its Supplement. This standard applies to concessions where food is prepared and sold or served.

The food safety innovative criteria identify behaviors and practices that go beyond the *Food Code*. When implemented, these criteria could further reduce the risk of foodborne illness in federal foodservice operations. The Food Safety section has five categories that include the following innovative options (Table 1):

1. food safety management system/active managerial control;
2. undercooked meat, poultry, and egg products;
3. practices to control *Listeria monocytogenes* in ready-to-eat products;
4. sick employees; and
5. food handler training.

The guidelines also plan to offer innovative implementation criteria for the area of food protection manager certification. Since the topic is to be included as an update in the 2017 *Food Code*, it became standard criteria in the guidelines.

The inclusion of the new Food Safety section helps the guidelines meet one of its three goals: to "ensure that food safety practices are followed to minimize the risk of foodborne illness" (Food Service Guidelines Workgroup, 2017). We invite you to review the new *Food Service Guidelines for Federal Facilities* and to pay particular attention to the new Food Safety section. Learn more at www.cdc.gov/obesity/downloads/guidelines_for_federal_concessions_and_vending_operations.pdf.

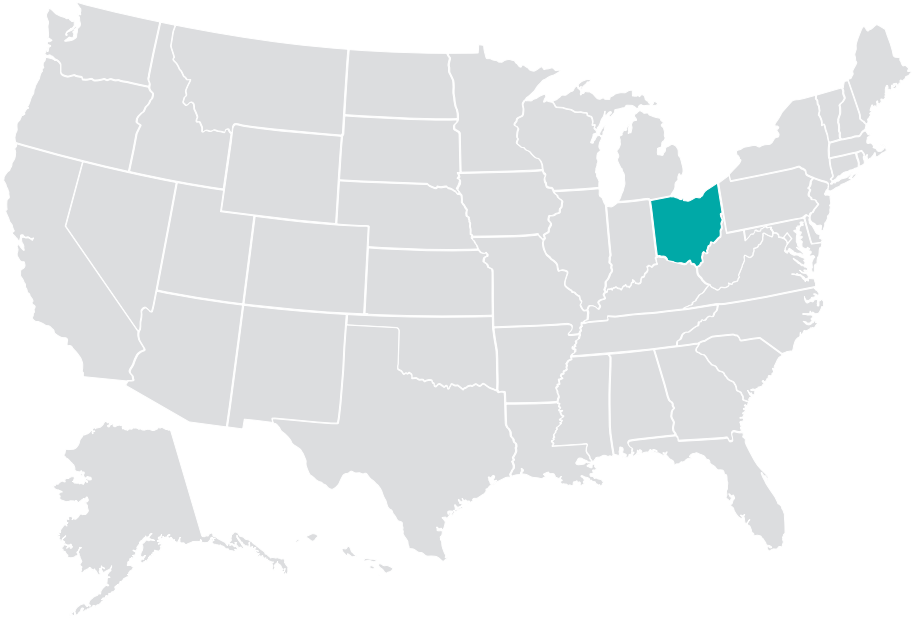
*Corresponding Author:* Lauren Lipcsei, Division of Emergency and Environmental Health Services, National Center for Environmental Health, Centers for Disease Control and Prevention, 4770 Buford Highway NE, MS F-58, Atlanta, GA 30341.
E-mail: yus0@cdc.gov.

## References

Food Service Guidelines Federal Workgroup. (2017). *Food service guidelines for federal facilities*. Washington, DC: U.S. Department of Health and Human Services.

Scallan, E., Hoekstra, R.M., Angulo, F.J., Tauxe, R.V., Widdowson, M.A., Roy, S.L., . . . Griffin, P.M. (2011). Foodborne illness acquired in the United States—Major pathogens. *Emerging Infectious Diseases*, *17*(1), 7–15.

## ACROSS THE COUNTRY WHAT'S HAPPENING IN ENVIRONMENTAL HEALTH



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

## OHIO

### Lawn Mower Exchange Effort a Success in Protecting Health and Improving the Environment

A lawn mower exchange program by Columbus Public Health's (CPH) Division of Environmental Health demonstrates that improved air quality can protect health and make economic sense. The initiative, coordinated by the division's Office of Environmental Protection and Sustainability, is a partnership with Lowe's Home Improvement. It offers city residents the opportunity to purchase a nonpolluting, battery-powered electric mower at a discount in exchange for their working gas mower. Part of the discount is a subsidy provided by CPH to Lowe's to offset the cost of the electric mowers. A local recycler scraps the exchanged gas mowers free of charge.

Gas powered lawn equipment is a significant contributor to outdoor air pollution, according to Richard Hicks, director of the Office of Environmental Protection and Sustainability. Outdoor air pollution is a health concern as exposure has been linked to a variety of serious health conditions, including asthma. The asthma prevalence rate for adults in Franklin County, which includes Columbus, is 13.9%. "The mower exchange is an effort to give our residents an easy and meaningful way to improve air quality and health," stated Hicks.

The exchange in April 2016 offered 45, 40-volt mowers to participants. Hicks said customers began lining up outside the store over 2 hours before the event began. The demand forced Lowe's to pull additional mowers from stock. In the end, 70 mowers were sold and store stock was exhausted.

Prior to the event, Hicks approached a colleague at The Ohio State University's John Glenn College of Public Affairs for information on the economic and health benefits that could be attributed to a mower exchange program. The request became a graduation project for one of the school's graduate students. Project findings included:

- gasoline-powered lawn equipment accounts for as much as 12% of U.S. carbon emissions;
- use of an inefficient gas mower for 1 hour can produce pollution that is equivalent to driving 200 miles in a car;
- use of a battery-powered mower for 5 years produces 507 g less pollution when compared with the use of an inefficient gas mower; and
- over the battery's projected 5-year life, this reduction results in a healthcare savings of $4.70 for each dollar of subsidy provided.

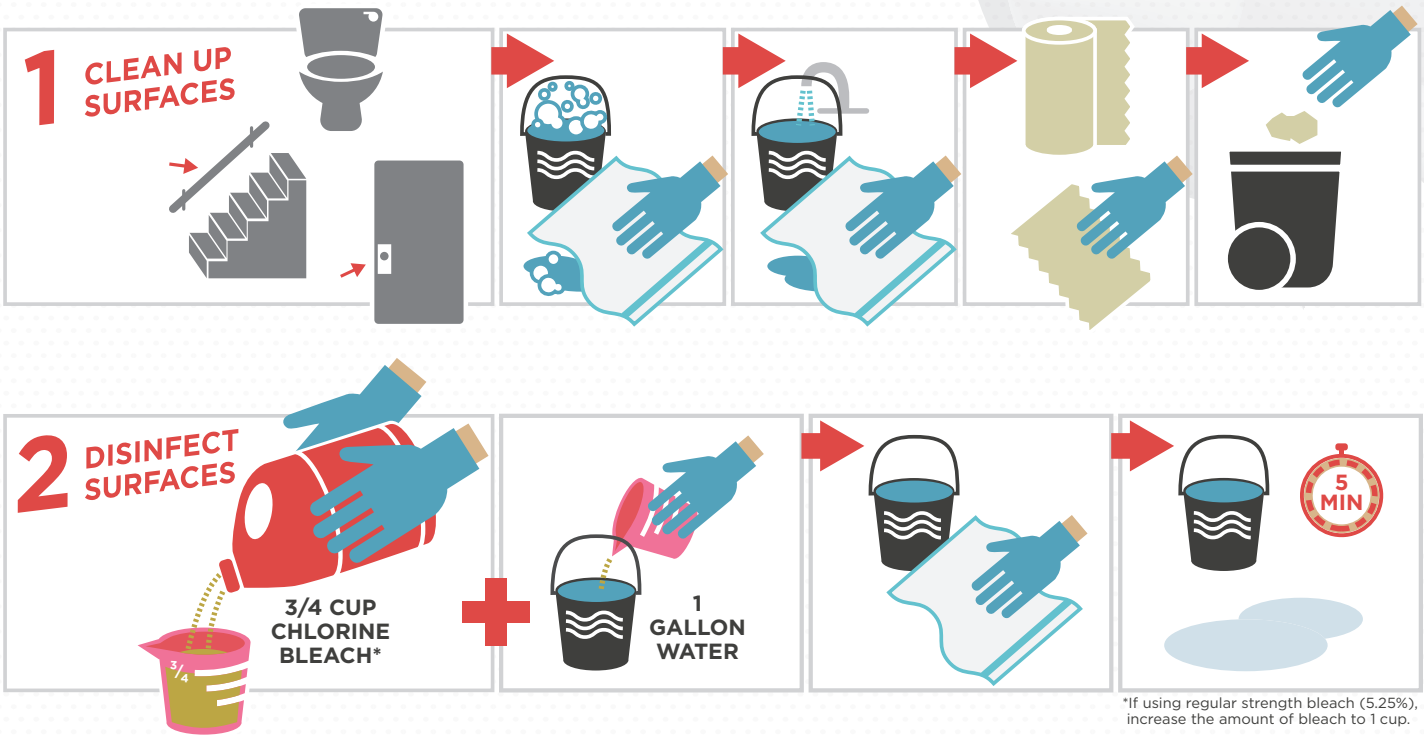
For CPH, these findings mean that providing Lowe's with a $4,500 subsidy resulted in a corresponding healthcare savings of $21,150. "These findings suggest that a decision by local health departments to help subsidize the switch to cleaner forms of energy can have very real health, environmental, and economic benefits," Hicks said.

The event's success has CPH and Lowe's thinking about growing the program next year. Lowe's has offered to expand the effort in 2018 beyond its single store pilot to include four new locations throughout Columbus.

*Source:* Columbus Public Health, Division of Environmental Health, https://www.columbus.gov/publichealth/programs/Environmental-Health.

# Help Prevent the Spread of NOROVIRUS A STOMACH BUG

## Stop norovirus! Clean surfaces that are touched a lot.




*If using regular strength bleach (5.25%), increase the amount of bleach to 1 cup.

**Norovirus spreads by contact with an infected person or by touching a contaminated surface or eating contaminated food or drinking contaminated water.**

**El norovirus se propaga por el contacto con una persona infectada o al tocar una superficie contaminada o comiendo alimentos contaminados o beber agua contaminada.**

**Le norovirus se propage par contact avec une personne infectée, en touchant une surface contaminée, en mangeant des aliments contaminés ou en buvant de l'eau contaminée.**

**诺如病毒的传播途径是与感染者接触或接触污染的表面或食用被污染的食物或饮用受污染的水。**

**Scientific experts from the U.S. Centers for Disease Control and Prevention (CDC) helped to develop this poster. For more information on norovirus prevention, please see http://www.cdc.gov/norovirus/preventing-infection.html.**

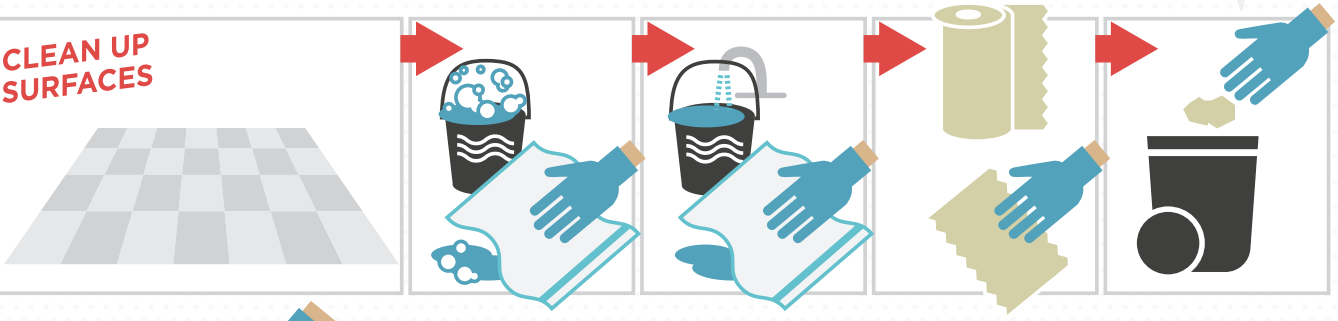
# Clean Up & Disinfect For NOROVIRUS A STOMACH BUG

**Act fast! Clean up any vomit or diarrhea immediately.**

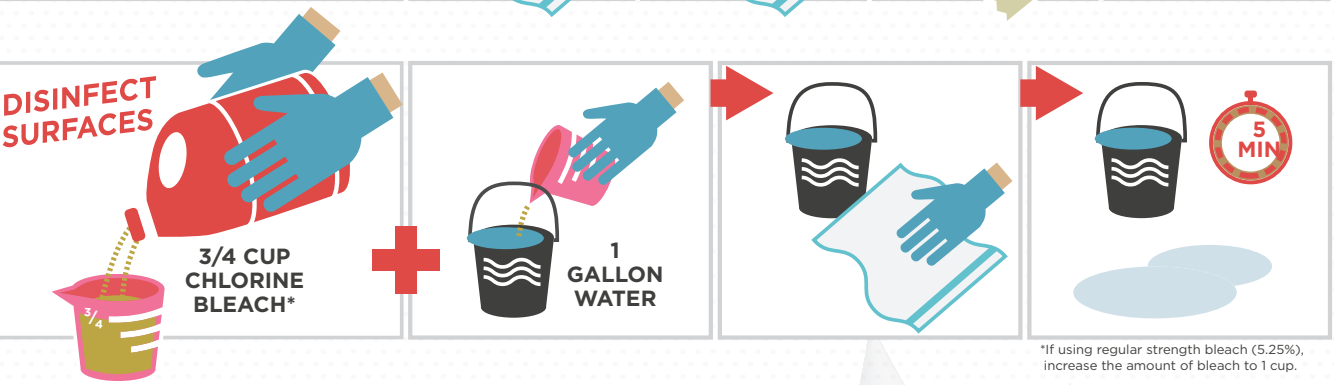
## 1 WIPE UP SURFACES

Only use hot water & bleach if fabric laundering directions permit

## 2 CLEAN UP SURFACES



## 3 DISINFECT SURFACES




*If using regular strength bleach (5.25%), increase the amount of bleach to 1 cup.

## 4 WASH YOUR HANDS


**Any vomit or diarrhea may contain norovirus and should be treated as though it does.**

**Cualquier vomito o diarrea puede contener norovirus y debe ser tratado como si lo hiciera.**

**Toute vomissure ou diarrhée peut contenir un norovirus et doit être traitée comme si elle en contenait.**

**任何呕吐或腹泻如都可能含有诺时应病毒，治疗如视为含有诺病处理。**

**Scientific experts from the U.S. Centers for Disease Control and Prevention (CDC) helped to develop this poster. For more information on norovirus prevention, please see http://www.cdc.gov/norovirus/preventing-infection.html.**

# CAREER **OPPORTUNITIES**

### Food Safety Inspector

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

**United States**
Amarillo, TX
Bakersfield, CA
Billings, MT
Boston, MA
Buffalo, NY
Cedar Rapids, IA
Chicago, IL
Cincinnati, OH
Coeur d'Alene, ID
Columbus, OH
Eureka, CA
Grand Junction, CO
Grand Rapids, MI
Honolulu, HI
Idaho Falls, ID
Kansas City, MO/KS
Lexington, KY
Little Rock, AR
Louisville, KY
Lubbock, TX
Midland, TX
Oakland, CA
Odessa, TX
Owatonna, MN
Philadelphia, PA
Portland, OR
Rapid City, SD
Richmond, VA
Rochester, NY
San Diego, CA
Shreveport, LA
Sioux Falls, SD
St. Louis, MO
Syracuse, NY
Tulsa, OK
Washington, DC
Wichita, KS
Yuma, AZ

**Canada**
British Columbia
Calgary
Montreal
Toronto
Vancouver
Winnipeg

If you are interested in an opportunity near you, please send your resume to ATTN: Sethany Dogra at LST.RAS.RESUMES@UL.COM or visit our website at www.evercleanservices.com.

## Did You Know?

NEHA Food Safety Instructors are listed on NEHA's Food Safety Training online trainer directory, and receive discounts on NEHA products and trainer packs. To register as a NEHA Food Safety Instructor, submit an application to demonstrate your skills and experience at www.neha.org/professional-development/certifications/become-food-safety-instructor.

## Find a Job
## Fill a Job

**Where the "best of the best" consult...**

**NEHA's Career Center**

First job listing **FREE** for city, county, and state health departments with a NEHA member, and for Educational and Sustaining members.

For more information, please visit neha.org/professional-development/careers

# EH CALENDAR

## UPCOMING NEHA CONFERENCES

**June 25–28, 2018: NEHA 2018 Annual Educational Conference & Exhibition**, Anaheim, CA. For more information, visit www.neha.org/aec.

**July 8–11, 2019: NEHA 2019 Annual Educational Conference & Exhibition**, Nashville, TN.

**July 13–16, 2020: NEHA 2020 Annual Educational Conference & Exhibition**, New York, NY.

## NEHA AFFILIATE AND REGIONAL LISTINGS

**Alabama**
**October 17–19, 2017: Annual Education Conference**, hosted by the Alabama Environmental Health Association, Mobile, AL. For more information, visit www.aeha-online.com.

**Colorado**
**September 20–22, 2017: 63rd Annual Education Conference**, hosted by the Colorado Environmental Health Association, Colorado Springs, CO. For more information, visit www.cehaweb.com.

**Illinois**
**October 19–20, 2017: Annual Educational Conference**, hosted by the Illinois Environmental Health Association, East Peoria, IL. For more information, visit http://iehaonline.org.

**Indiana**
**September 25–27, 2017: Fall Educational Conference**, hosted by the Indiana Environmental Health Association, Lawrenceburg, IN. For more information, visit www.iehaind.org.

**Jamaica**
**October 22–26, 2017: International Environmental Conference and IFEH Council Meeting**, hosted by the Jamaica Association of Public Health Inspectors in association with the IFEH Americas Region Group member countries, Montego Bay, Jamaica. For more information, contact japhi.ifeh.conference@gmail.com.

**Kansas**
**October 11–13, 2017: Joint Annual Conference and Trade Show**, hosted by the Kansas Environmental Health and Kansas Small Flows Associations, Wichita, KS. For more information, visit www.keha.us.

**Minnesota**
**September 19–21, 2017: FDA Central Region Retail Food Protection Seminar and NEHA Region 4 Biannual Educational Conference**, Minneapolis, MN. For more information, visit www.mehaonline.org.

**Nebraska**
**October 26, 2017: Annual Conference**, hosted by the Nebraska Environmental Health Association, Ashland, NE. For more information, visit www.nebraskaneha.com.

**New Jersey**
**September 21, 2017: Annual Symposium**, hosted by the New Jersey Environmental Health Association, Edison, NJ. For more information, visit www.njeha.org/events.

**North Dakota**
**October 17–19, 2017: Fall Education Conference**, hosted by the North Dakota Environmental Health Association. For more information, visit http://ndeha.org/wp/conferences.

**Rhode Island**
**October 4–5, 2017: 55th Annual Yankee Conference on Environmental Health**, hosted by the Rhode Island Environmental Health Association, Newport, RI. For more information, https://rieha.wildapricot.org.

**Tennessee**
**October 4–6, 2017: 71st Annual Interstate Environmental Health Seminar**, hosted by the Tennessee Environmental Health Association, Gatlinburg, TN. For more information, visit www.wvdhhr.org/wvas/IEHS/index.asp.

**Texas**
**October 9–13, 2017: Annual Educational Conference**, hosted by the Texas Environmental Health Association, Austin, TX. For more information, visit www.myteha.org.

**Virginia**
**October 23, 2017: Fall Educational Conference**, hosted by the Virginia Environmental Health Association, Richmond, VA. For more information, visit http://virginiaeha.org/educational-sessions.

**Wisconsin**
**October 18–20, 2017: Joint Educational Conference**, hosted by the Wisconsin Environmental Health Association, Sheboygan, WI. For more information, visit www.weha.net.

## Did You Know?

You can share your event with the environmental health community by posting it directly on our community calendar at www.neha.org/news-events/community-calendar. Posting is easy and it's a great way to bring attention to your event.

## Thank you for Supporting the NEHA/AAS Scholarship Fund

**American Academy of Sanitarians**
Lawrenceville, GA

**James J. Balsamo, Jr., MS, MPH, MHA, RS, CP-FS**
Metairie, LA

**LeGrande G. Beatson**
Farmville, VA

**Bruce Clabaugh**
Highlands Ranch, CO

**George A. Morris, RS**
Dousman, WI

**Richard L. Roberts**
Grover Beach, CA

**Leon Vinci, DHA, RS**
Roanoke, VA

## don't miss

**in the next *Journal of Environmental Health***

- Effectiveness of an Occupational Noise and Hearing Loss Intervention Among Landscaping and Groundskeeping Workers
- Household Radon Gas Occurrences and Geographic Distribution in Western Michigan
- Measuring Arsenic Exposure Among Residents of Hernando County, Florida
- Persistence of Bowl Water Contamination During Sequential Flushes of Contaminated Toilets
- E-*Journal* Article: Reducing Risk of Respiratory Illness Associated With Traditional Cookstoves in India



## Did You Know?

In a recent survey, 69% of Registered Environmental Health Specialist/Registered Sanitarian (REHS/RS) credential holders reported receiving a promotion or salary increase after they passed the REHS/RS credential exam. Find out more about the benefits of a credential at www.neha.org/credentials!

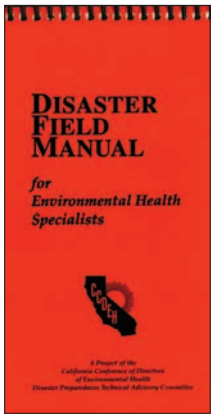
# RESOURCE CORNER

*Resource Corner highlights different resources that NEHA has available to meet your education and training needs. These timely resources provide you with information and knowledge to advance your professional development. Visit NEHA's online Bookstore for additional information about these, and many other, pertinent resources!*

NEHA BOOKSTORE
www.neha.org/store

## Disaster Field Manual for Environmental Health Specialists

*California Association of Environmental Health Administrators (2012)*

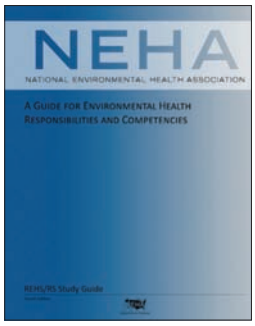



This manual serves as a useful field guide for environmental health professionals following a major disaster. It provides an excellent overview of key response and recovery options to be considered as prompt and informed decisions are made to protect the public's health and safety. Some of the topics 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*

## REHS/RS Study Guide (4th Edition)

*National Environmental Health Association (2014)*

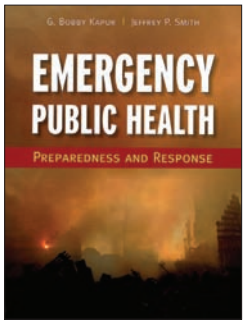



The Registered Environmental Health Specialist/Registered Sanitarian (REHS/RS) credential is NEHA's premier credential. This study guide provides a tool for individuals to prepare for the REHS/RS credential exam and has been revised and updated to reflect changes and advancements in technologies and theories in the environmental health and protection field. The study guide covers the following topic areas: general environmental health; statutes and regulations; food protection; potable water; wastewater; solid and hazardous waste; zoonoses, vectors, pests, and poisonous plants; radiation protection; occupational safety and health; air quality; environmental noise; housing sanitation; institutions and licensed establishments; swimming pools and recreational facilities; and disaster sanitation.

*308 pages / Paperback*
*Member: $149 / Nonmember: $179*

## Emergency Public Health: Preparedness and Response

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




*Emergency Public Health* provides a unique and practical framework for disaster response planning at local, state, and national levels. This book is the first of its kind to systematically address the issues in a range of environmental public health emergencies brought on by natural calamity, terrorism, industrial accident, or infectious disease. It features historical perspectives on a public health crisis, an analysis of preparedness, and a practical, relevant case study on the emergency response. Study reference for NEHA's Registered Environmental Health Specialist/Registered Sanitarian credential exam.

*568 pages / Paperback*
*Member: $114 / Nonmember: $124*

## 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 a timely 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: $64*

# NEHA's Annual Financial Statement

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F: 303.740.9009
www.EKSH.com

## INDEPENDENT AUDITORS' REPORT

To the Board of Directors
National Environmental Health Association
Denver, Colorado

### REPORT ON THE FINANCIAL STATEMENTS

We have audited the accompanying financial statements of National Environmental Health Association (the "Association"), which are comprised of the statements of financial position as of September 30, 2016 and 2015, and the related statements of activities 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.

### AUDITORS' 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 audit 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 auditors' 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 auditors consider 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, 2016 and 2015, and the changes in its net assets and its cash flows for the years then ended in accordance with accounting principles generally accepted in the United States of America.

### OTHER MATTERS

Our audits were conducted for the purpose of forming an opinion on the financial statements as a whole. The accompanying schedule of expenditures of federal awards, as required by Title 2 U.S. *Code of Federal Regulations* Part 200, *Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards*, is presented for purposes of additional analysis and is not a required part of the financial statements. Such information is the responsibility of management and was derived from and relates directly to the underlying accounting and other records used to prepare the financial statements. The information has been subjected to the auditing procedures applied in the audits of the financial statements and certain additional procedures, including comparing and reconciling such information directly to the underlying accounting and other records used to prepare the financial statements or to the financial statements themselves, and other additional procedures in accordance with auditing standards generally accepted in the United States of America. In our opinion, the information is fairly stated, in all material respects, in relation to the financial statements as a whole.

### OTHER REPORTING REQUIRED BY *GOVERNMENT AUDITING STANDARDS*

In accordance with *Government Auditing Standards*, we have also issued our report dated March 7, 2017, on our consideration of the 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 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 the Association's internal control over financial reporting and compliance.

EKS&H LLLP

EKS&H LLLP

March 7, 2017
Denver, Colorado

| | For the Years Ended | | | | | |
|---|---|---|---|---|---|---|
| | September 30, 2016 | | | September 30, 2015 | | |
| | Unrestricted | Temporarily Restricted | Total | Unrestricted | Temporarily Restricted | Total |
| Revenues and gains | | | | | | |
| Research and development | $ 1,514,445 | $ - | $ 1,514,445 | $ 2,696,218 | $ - | $ 2,696,218 |
| Annual Educational Conference | 878,217 | - | 878,217 | 540,516 | - | 540,516 |
| Credentialing and education | 774,868 | - | 774,868 | 734,832 | - | 734,832 |
| Membership dues | 394,391 | - | 394,391 | 385,528 | - | 385,528 |
| Journal of Environmental Health | 229,628 | - | 229,628 | 201,895 | - | 201,895 |
| Special projects | 3,183,029 | - | 3,183,029 | 1,964,700 | - | 1,964,700 |
| Contributions | 11,005 | - | 11,005 | 10,630 | - | 10,630 |
| Publications and module contracts | 56,435 | - | 56,435 | 48,906 | - | 48,906 |
| Miscellaneous income | 24,515 | - | 24,515 | 31,770 | - | 31,770 |
| Investment income | 30,756 | 1,130 | 31,886 | 4,934 | 192 | 5,126 |
| Total revenues and gains | 7,097,289 | 1,130 | 7,098,419 | 6,619,929 | 192 | 6,620,121 |
| Expenses | | | | | | |
| Research and development | 1,511,344 | - | 1,511,344 | 2,467,207 | - | 2,467,207 |
| Annual Educational Conference | 612,162 | - | 612,162 | 643,685 | - | 643,685 |
| Journal of Environmental Health | 270,100 | - | 270,100 | 353,312 | - | 353,312 |
| Credentialing and education | 501,050 | - | 501,050 | 633,296 | - | 633,296 |
| Membership | 59,670 | - | 59,670 | 246,578 | - | 246,578 |
| Publications and module contracts | 20,008 | - | 20,008 | 39,112 | - | 39,112 |
| Special projects | 3,258,083 | - | 3,258,083 | 1,615,244 | - | 1,615,244 |
| Administration and general | 290,765 | - | 290,765 | 583,994 | - | 583,994 |
| Total expenses | 6,523,182 | - | 6,523,182 | 6,582,428 | - | 6,582,428 |
| Change in net assets | 574,107 | 1,130 | 575,237 | 37,501 | 192 | 37,693 |
| Net assets at beginning of year | 1,040,632 | 80,705 | 1,121,337 | 1,003,131 | 80,513 | 1,083,644 |
| Net assets at end of year | $ 1,614,739 | $ 81,835 | $ 1,696,574 | $ 1,040,632 | $ 80,705 | $ 1,121,337 |

See notes to financial statements.

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

# NEHA ORGANIZATIONAL **MEMBERS**

## Sustaining Members

**Accela**
www.accela.com

**Advanced Fresh Concepts Corp.**
www.afcsushi.com

**Air Chek, Inc.**
www.radon.com

**Allegheny County Health Department**
www.achd.net

**American Chemistry Council**
www.americanchemistry.com

**Arlington County Public Health Division**
www.arlingtonva.us

**Association of Environmental Health Academic Programs**
www.aehap.org

**Baltimore City Health Department, Office of Chronic Disease Prevention**
http://health.baltimorecity.gov/programs/health-resources-topic

**Baltimore City Lead Hazard Reduction Program**
www.baltimorehousing.org/ghsh_lead

**Baltimore County Department of Planning**
www.baltimorecountymd.gov/Agencies/planning

**Black Hawk County Health Department**
www.co.black-hawk.ia.us/258/Health-Department

**Chemstar Corporation**
www.chemstarcorp.com

**Chester County Health Department**
www.chesco.org/health

**City of Milwaukee Health Department, CEH**
http://city.milwaukee.gov/health/environmental-health

**City of Racine Public Health Department**
http://cityofracine.org/Health

**City of St. Louis Department of Health**
www.stlouis-mo.gov/government/departments/health

**Colorado Department of Public Health and Environment, Division of Environmental Health and Sustainability, DPU**
www.colorado.gov/cdphe

**Digital Health Department, Inc.**
www.dhdinspections.com

**Diversey, Inc.**
www.diversey.com

**DuPage County Health Department**
www.dupagehealth.org

**Ecolab**
www.ecolab.com

**EcoSure**
adolfo.rosales@ecolab.com

**Eljen Corporation**
www.eljen.com

**Enviro-Decon Services**
www.enviro-decon.com

**Erie County Department of Health**
www.erie.gov/health

**Georgia Department of Public Health, Environmental Health Section**
http://dph.georgia.gov/environmental-health

**Gila River Indian Community: Environmental Health Service**
www.gilariver.org

**GLO GERM/Food Safety First**
www.glogerm.com

**GoJo Industries**
www.gojo.com

**Health Department of Northwest Michigan**
www.nwhealth.org

**HealthSpace USA Inc**
www.healthspace.com

**Hedgerow Software Ltd.**
www.hedgerowsoftware.com

**Industrial Test Systems, Inc.**
www.sensafe.com

**Jackson County Environmental Health**
www.jacksongov.org/442/Environmental-Health-Division

**Jefferson County Public Health (Colorado)**
http://jeffco.us/public-health

**Kanawha-Charleston Health Department**
http://kchdwv.org

**Kenosha County Division of Health**
www.co.kenosha.wi.us/297/Health-Services

**LaMotte Company**
www.lamotte.com

**Maricopa County Environmental Services**
www.maricopa.gov/631/Environmental-Services

**Multnomah County Environmental Health**
https://multco.us/health

**Nashua Department of Health**
http://nashuanh.gov/497/Public-Health-Community-Services

**National Environmental Health Science and Protection Accreditation Council**
www.ehacoffice.org

**New Mexico Environment Department**
www.env.nm.gov

**NSF International**
www.nsf.org

**Opportunity Council/Building Performance Center**
www.buildingperformancecenter.org

**Otter Tail County Public Health**
www.co.ottertail.mn.us/494/Public-Health

**Ozark River Portable Sinks**
www.ozarkriver.com

**Paster Training, Inc.**
www.pastertraining.com

**Polk County Public Works**
www.polkcountyiowa.gov/publicworks

**QuanTEM Food Safety Laboratories**
www.quantemfood.com

**SAI Global, Inc.**
www.saiglobal.com

**Seminole Tribe of Florida**
www.semtribe.com

**Skogen's Festival Foods**
www.festfoods.com

**Sonoma County Permit and Resource Management Department, Well and Septic Division**
www.sonoma-county.org/prmd/divpages/wellsepdiv.htm

**Southwest District Health Department**
www.swdh.org

**Starbucks Coffee Company**
www.starbucks.com

**Stater Brothers Market**
www.staterbros.com

**Steritech Group, Inc.**
www.steritech.com

**Sweeps Software, Inc.**
www.sweepssoftware.com

**Taylor Technologies, Inc.**
www.taylortechnologies.com

**Tri-County Health Department**
www.tchd.org

**UL**
www.ul.com

**The University of Findlay**
www.findlay.edu

**Waco-McLennan County Public Health District**
www.waco-texas.com/cms-healthdepartment

**Waukesha County Environmental Health Division**
www.waukeshacounty.gov/environmental_health

**Wegmans Food & Pharmacy, Inc.**
www.wegmans.com

**West Virginia Department of Health and Human Resources, Office of Environmental Health Services**
www.dhhr.wv.gov

## Educational Members

**Baylor University**
www.baylor.edu

**Michigan State University Extension**
www.msue.anr.msu.edu

**Michigan State University, Online Master of Science in Food Safety**
www.online.foodsafety.msu.edu

**University of Georgia, College of Public Health**
www.publichealth.uga.edu

**University of Washington, Department of Environmental & Occupational Health Sciences**
www.deohs.washington.edu

**University of Wisconsin–Oshkosh, Lifelong Learning & Community Engagement**
www.uwosh.edu/llce

**University of Wisconsin–Stout, College of Science, Technology, Engineering, and Mathematics**
www.uwstout.edu

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# SPECIAL **LISTING**

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adamelondon@gmail.com

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vradke@bellsouth.net

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POliverMSM@aol.com

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sandral@plano.gov

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davideriggs@comcast.net

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ddyjack@neha.org

## Regional Vice-Presidents

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mreighte@starbucks.com
Alaska, Idaho, Oregon, and Washington. Term expires 2020.

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kallenrehs@yahoo.com
Arizona, California, Hawaii, and Nevada. Term expires 2018.

**Region 3—Roy Kroeger, REHS,** Environmental Health Supervisor, Cheyenne/Laramie County Health Department, Cheyenne, WY.
roykehs@laramiecounty.com
Colorado, Montana, Utah, Wyoming, and members residing outside of the U.S. (except members of the U.S. armed forces). Term expires 2018.

**Region 4—Sharon Smith, REHS/RS,** Sanitarian Supervisor, Minnesota Department of Health, Underwood, MN.
sharon.l.smith@state.mn.us
Iowa, Minnesota, Nebraska, North Dakota, South Dakota, and Wisconsin. Term expires 2019.

**Region 5—Tom Vyles, REHS/RS, CP-FS,** Environmental Health Manager, Town of Flower Mound, TX.
tom.vyles@flower-mound.com
Arkansas, Kansas, Louisiana, Missouri, New Mexico, Oklahoma, and Texas. Term expires 2020.

**Region 6—Lynne Madison, RS,** Environmental Health Division Director, Western UP Health Department, Hancock, MI.
lmadison@hline.org
Illinois, Indiana, Kentucky, Michigan, and Ohio. Term expires 2019.

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tim.mitchell@publix.com
Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, and Tennessee. Term expires 2020.

**Region 8—LCDR James Speckhart, MS, USPHS,** Health and Safety Officer, FDA, CDRH-Health and Safety Office, Silver Spring, MD.
jamesmspeckhart@gmail.com
Delaware, Maryland, Pennsylvania, Virginia, Washington, DC, West Virginia, and members of the U.S. armed forces residing outside of the U.S. Term expires 2018.

**Region 9—Larry Ramdin, REHS, CP-FS, HHS,** Health Agent, Salem Board of Health, Salem, MA.
lramdin@salem.com
Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. Term expires 2019.

## Affiliate Presidents

**Alabama—Stacy Williamson, MSM, REHS,** Public Health Environmental Supervisor, Covington County Health Dept., Red Level, AL.
president@aeha-online.com

**Alaska—John Walker,** Soldotna, AK.
john@jtakfoodsafety.com

**Arizona—Steve Wille,** Maricopa County Environmental Services Dept., Phoenix, AZ.
swille@mail.maricopa.gov

**Arkansas—Jeff Jackson,** Camden, AR.
jeff.jackson@arkansas.gov

**Business & Industry—Shelly Wallingford, MS, REHS,** Retail Quality Assurance Manager, Starbucks, Denver, CO.
swalling@starbucks.com

**California—Ric Encarnacion, REHS, MPH,** Assistant Director, County of Monterey Environmental Health Bureau, Salinas CA.
EncarnacionR@co.monterey.ca.us

**Colorado—Tom Butts, MSc, REHS,** Deputy Director, Tri-County Health Dept., Greenwood Village, CO.
tbutts@tchd.org

**Connecticut—Matthew Payne, REHS/RS, HHS,** Environmental Health Inspector, Town of Manchester, Colchster, CT.
mattpayne24@gmail.com

**Florida—Michael Crea,** Sarasota, FL.
crea@zedgepiercing.com

**Georgia—Tamika Pridgon.**
tamika.pridgon@dph.ga.gov

**Hawaii—John Nakashima,** Sanitarian IV, Food Safety Education Program, Hawaii Dept. of Health, Hilo, HI.
john.nakashima@doh.hawaii.gov

**Idaho—Tyler Fortunati,** Idaho Dept. of Environmental Quality, Meridian, ID.
tyler.fortunati@deq.idaho.gov

**Illinois—David Banaszynski,** Environmental Health Officer, Hoffman Estates, IL.
davidb@hoffmanestates.org

**Indiana—Patty Nocek, REHS/RS, CP-FS,** La Porte County Health Dept., La Porte, IN.
pnocek@laportecounty.org

**Iowa—Michelle Clausen Rosendahl, MPH, REHS,** Director of Environmental Health, Siouxland District Health Dept., Sioux City, IA.
mclausen@sioux-city.org

**Jamaica—Rowan Stephens,** St. Catherine, Jamaica.
info@japhi.org.jm

**Kansas—Guy Crabill,** Lawrence, KS.
gcrabill@franklincoks.org

**Kentucky—Don Jacobs,** Three River District Health Dept., Falmouth, KY.
donalde.jacobs@ky.gov

**Louisiana—Bill Schramm,** Louisiana Dept. of Environmental Quality, Baton Rouge, LA.
bill.schramm@la.gov

**Maryland—James Lewis,** Westminster, MD.
jlewis@mde.state.md.us

**Massachusetts—Leon Bethune,** Director, Boston Public Health Commission, West Roxbury, MA.
bethleon@aol.com

**Michigan—Sara Simmonds, MPA, REHS/RS,** Grand Rapids, MI.
ssimmonds@meha.net

**Minnesota—Nicole Hedeen,** Epidemiologist, Minnesota Dept. of Health, White Bear Lake, MN.
nicole.hedeen@state.mn.us

**Mississippi—Susan Bates,** Mississippi Dept. of Health/Webster County Health Dept., Pheba, MS.
susan.bates@msdh.state.ms.us

**Missouri—Kristi Ressel,** KCMO Health Dept., Kansas City, MO.
kristiressel@gmail.com

**Missouri Milk, Food, and Environmental Health Association—Roxanne Sharp,** Public Health Investigator II, Springfield/Greene County Health Dept., Springfield, MO.
rsharp@springfieldmo.gov

**Montana—Alisha Johnson,** Missoula City County Health Dept., Missoula, MT.
alishaerikajohnson@gmail.com

**National Capital Area—Kristen Pybus, MPA, REHS/RS, CP-FS,** Fairfax County Health Dept., VA.
kpybus@ncaeha.com

**Nebraska—Ericka Sanders,** Nebraska Dept. of Agriculture, O'Neill, NE.
ericka.sanders@nebraska.gov

**Nevada—Erin Cavin, REHS,** Environmental Health Specialist II, Southern Nevada Health District, Las Vegas, NV.
nevadaeha@gmail.com

**New Jersey—Paschal Nwako, MPH, PhD, CHES, DAAS,** Health Officer, Camden County Health Dept., Blackwood, NJ.
pn2@njlincs.net

**New Mexico—Cecelia Garcia, MS, CP-FS,** Environmental Health Specialist, City of Albuquerque Environmental Health Dept., Albuquerque, NM.
cgarcia@cabq.gov

**New York—Contact Region 9 Vice-President Larry Ramdin.**
lramdin@salem.com

**North Carolina—Stacey Robbins,** Brevard, NC.
stacey.robbins@transylvaniacounty.org

**North Dakota—Grant Larson,** Fargo Cass Public Health, Fargo, ND.
glarson@cityoffargo.com

**Northern New England Environmental Health Association—Brian Lockard,** Health Officer, Town of Salem Health Dept., Salem, NH.
blockard@ci.salem.nh.us

**Ohio—Paul DePasquale, MPA, RS,** Stark County Health Dept., Canton, OH. depasqualep@starkhealth.org

**Oklahoma—James Splawn, RPS, RPES,** Sanitarian, Tulsa City-County Health Dept., Tulsa, OK. tsplawn@tulsa-health.org

**Oregon—William Emminger, REHS/RS,** Corvallis, OR. bill.emminger@co.benton.or.us

**Past President—Bob Custard, REHS, CP-FS,** Lovettsville, VA. BobCustard@comcast.net

**Rhode Island—Dottie LeBeau, CP-FS,** Food Safety Consultant and Educator, Dottie LeBeau Group, Hope, RI. deejaylebeau@verizon.net

**South Carolina—Melissa Tyler,** Environmental Health Manager II, SCDHEC, Cope, SC. tylermb@dhec.sc.gov

**South Dakota—John Osburn,** Pierre, SD. john.osburn@state.sd.us

**Tennessee—Eric L. Coffey,** Chattanooga, TN. tehapresident@gmail.com

**Texas—Victor Baldovinos,** Environmental Health Director, City of South Padre Island, TX. vbaldovinos@myspi.org

**Uniformed Services—CDR Katherine Hubbard, MPH, REHS,** Senior Institutional Environmental Health Consultant, Alaska Native Tribal Health Consortium, Anchorage, AK. knhubbard@anthc.org

**Utah—Phil Bondurant, MPH,** Director of Environmental Health, Summit County Health Dept., Heber City, NV. pbondurant@summitcounty.org

**Virginia—David Fridley,** Environmental Health Supervisor, Virginia Dept. of Health, Lancaster, VA. david.fridley@virginiaeha.org

**Washington—Joe Graham,** Washington State Dept. of Health, Olympia, WA. joe.graham@doh.wa.gov

**West Virginia—Brad Cochran,** Charleston, WV. brad.j.cochran@wv.gov

**Wisconsin—Sonja Dimitrijevic,** Dept. of Agriculture, Trade, and Consumer Protection, WI. sonja.dimitrijevic@wisconsin.gov.

**Wyoming—Todd Denny,** Basin, WY. todd.denny@wyo.gov

## Technical Advisors

**Air Quality—Vacant**

**Aquatic Health/Recreational Health—Tracynda Davis, MPH,** Davis Strategic Consulting, LLC. tracynda@yahoo.com

**Aquatic Health/Recreational Health—CDR Jasen Kunz, MPH, REHS, USPHS,** CDC/NCEH. izk0@cdc.gov

**Children's Environmental Health—Anna Jeng, MS, ScD,** Old Dominion University. hjeng@odu.edu

**Climate Change—Leon Vinci, DHA, RS.** lfv6@aol.com

**Drinking Water/Environmental Water Quality—Craig Gilbertson,** Minnesota Dept. of Health. craig.gilbertson@state.mn.us

**Emergency Preparedness and Response—Marcy Barnett, MA, MS, REHS,** California Dept. of Public Health, Center for Environmental Health. marcy.barnett@cdph.ca.gov

**Emergency Preparedness and Response—Martin Kalis,** CDC. mkalis@cdc.gov

**Food (including Safety and Defense)—Eric Bradley, MPH, REHS, CP-FS, DAAS,** Scott County Health Dept. eric.bradley@scottcountyiowa.com

**Food (including Safety and Defense)—John Marcello, CP-FS, REHS,** FDA. john.marcello@fda.hhs.gov

**General Environmental Health—Tara Gurge,** Needham Health Dept. tgurge@needhamma.gov

**General Environmental Health—ML Tanner, HHS.** mlacesmom@gmail.com

**Hazardous Materials/Toxic Substances—Crispin Pierce, PhD,** University of Wisconsin-Eau Claire. piercech@uwec.edu

**Healthy Communities/Built Environment—Kari Sasportas, MSW, MPH, REHS/RS,** Cambridge Public Health Dept. ksasportas@challiance.org

**Healthy Homes and Housing—Judeth Luong,** City of Long Beach Health Dept. judeth.luong@longbeach.gov

**Industry—Nicole Grisham,** University of Colorado. nicole.grisham@colorado.edu

**Informatics and Technology—Darryl Booth, MPA,** Accela. dbooth@accela.com

**Injury Prevention—Alan Dellapenna, RS,** North Carolina Division of Public Health. alan.dellapenna@dhhs.nc.gov

**Institutions—Robert W. Powitz, MPH, PhD, RS, CP-FS,** R.W. Powitz & Associates, PC. powitz@sanitarian.com

**International Environmental Health—Sylvanus Thompson, PhD, CPHI(C),** Toronto Public Health. sthomps@toronto.ca

**Land Use Planning and Design—Robert Washam, MPH, RS.** b_washam@hotmail.com

**Occupational Health/Safety—Tracy Zontek, PhD,** Western Carolina University. zontek@email.wcu.edu

**Onsite Wastewater—Joelle Wirth, RS,** Environmental Quality Division, Coconino County Health Dept. jwirth@coconino.az.gov

**Onsite Wastewater—Denise Wright,** Indiana State Dept. of Health. dhwright@isdh.in.gov

**Radiation/Radon—Bob Uhrik,** South Brunswick Township. ruhrik@sbtnj.net

**Risk Assessment—Jason Marion, PhD,** Eastern Kentucky University. jason.marion@eku.edu

**Schools—Stephan Ruckman,** Worthington City Schools. mphosu@yahoo.com

**Sustainability—Tim Murphy, PhD, REHS/RS, DAAS,** The University of Findlay. murphy@findlay.edu

**Vector Control/Zoonotic Disease Control—Steven Ault,** PAHO/WHO (retired). aultstev@hotmail.com

**Vector Control/Zoonotic Disease Control—Zia Siddiqi, PhD, BCE,** Orkin/Rollins Pest Control. zsiddiqi@rollins.com

**Workforce Development, Management, and Leadership—George Nakamura, MPA, REHS, RS, CP-FS, DAAS,** Nakamura Leasing. gmlnaka@comcast.net

## NEHA Staff: (303) 756-9090

**Seth Arends,** Graphic Artist, NEHA Entrepreneurial Zone (EZ), ext. 318, sarends@neha.org

**Jonna Ashley,** Association Membership Manager, ext. 336, jashley@neha.org

**Rance Baker,** Program Administrator, NEHA EZ, ext. 306, rbaker@neha.org

**Trisha Bramwell**, Sales and Training Support, NEHA EZ, ext. 340, tbramwell@neha.org

**Vanessa DeArman,** Project Coordinator, Program and Partnership Development (PPD), ext. 311, vdearman@neha.org

**Kristie Denbrock,** Education Coordinator, ext. 313, kdenbrock@neha.org

**David Dyjack,** Executive Director, ext. 301, ddyjack@neha.org

**Santiago Ezcurra,** Media Production Specialist, NEHA EZ, ext. 342, sezcurra@neha.org

**Eric Fife,** Learning Media Manager, NEHA EZ, ext. 344, efife@neha.org

**Soni Fink,** Strategic Sales Coordinator, ext. 314, sfink@neha.org

**Nancy Finney,** Technical Editor, NEHA EZ, ext. 326, nfinney@neha.org

**Michael Gallagher,** Operations and Logistics Planner, NEHA EZ, ext. 343, mgallagher@neha.org

**TJay Gerber,** Credentialing Coordinator, ext. 328, tgerber@neha.org

**Arwa Hurley,** Website and Digital Media Specialist, ext. 327, ahurley@neha.org

**Faye Koeltzow,** Business Analyst, ext. 302, fkoeltzow@neha.org

**Elizabeth Landeen,** Associate Director, PPD, (702) 802-3924, elandeen@neha.org

**Matt Lieber,** Database Administrator, ext. 325, mlieber@neha.org

**Bobby Medina,** Credentialing Dept. Customer Service Coordinator, ext. 310, bmedina@neha.org

**Marissa Mills,** Human Resources Manager, ext. 304, mmills@neha.org

**Eileen Neison,** Credentialing Specialist, ext. 339, eneison@neha.org

**Carol Newlin,** Credentialing Specialist, ext. 337, cnewlin@neha.org

**Solly Poprish,** CDC Public Health Associate Program Intern, ext. 335, spoprish@neha.org

**Barry Porter,** Financial Coordinator, ext. 308, bporter@neha.org

**Kristen Ruby-Cisneros,** Managing Editor, *Journal of Environmental Health*, ext. 341, kruby@neha.org

**Rachel Sausser,** Member Services/Accounts Receivable, ext. 300, rsausser@neha.org

**Christl Tate,** Program Manager, PPD, ext. 305, ctate@neha.org

**Sharon Unkart,** Instructional Designer, NEHA EZ, ext. 317, sdunkart@neha.org

**Gail Vail,** Director, Finance, ext. 309, gvail@neha.org

**Sandra Whitehead,** Director, PPD, swhitehead@neha.org

**Joanne Zurcher,** Director, Government Affairs, jzurcher@neha.org

# NEHA **NEWS**

## Note of Thanks to Departing Board Members

We would be remiss if we did not acknowledge the dedication, hard work, and efforts of three members of the NEHA board of directors on the occasion of their departure from the board: Immediate Past-President Bob Custard, Region 7 Vice-President Tim Hatch, and Region 1 Vice-President Ned Therien.

**Immediate Past-President Bob Custard** leaves the board after 14 years of dedicated service and leadership. Bob was a strong advocate for strengthening the relationship between NEHA and its affiliates. As NEHA president, Bob made the effort to attend and speak at more than 20 affiliate conferences. Bob also was a champion for establishing a NEHA office in Washington, DC, and was gratified to see that vision come to fruition during his term as president. As a strong advocate for expanding NEHA's engagement internationally, Bob helped create the international membership category and the international partner organization structure. Bob was honored to represent NEHA on trips to Canada, Jamaica, Uganda, and Zambia.

Bob played a key role in helping NEHA through its recent leadership transition and helped orient NEHA's new executive director. As chairman of NEHA's finance committee, Bob worked diligently to help assure NEHA's financial stability. He also helped develop NEHA's investment policy. Bob also played an important role in revising NEHA's bylaws and developing many policies and position papers.

Going forward, Bob will continue to work in the environmental health field through Environmental Health Leadership Partners, his consulting firm that specializes in training and mentoring young environmental health professionals. Bob and his wife Roz will also continue their work to improve drinking water supplies in rural areas of foreign countries.

Reflecting on the past 14 years, Bob describes his service on the board as "the most rewarding experience of my career." He goes on to state, "It was my privilege to work closely with some of the giants of our profession. I learned so much and made so many friends as a result of the experience."

Bob is currently president of the Past Presidents affiliate and will continue to be actively involved in NEHA.

**Region 7 Vice-President Tim Hatch** leaves the board after three years of dedicated service and leadership. Tim is the director of Environmental Programs, Planning, and Logistics at the Alabama Department of Public Health's Center for Emergency Preparedness. He also holds a part-time faculty position at The University of Findlay. Tim has served as the president of the Alabama Environmental Health Association and was named its Environmentalist of the Year in 2009. Along with his service to NEHA, Tim currently serves as the Americas Region director of Disaster Risk Reduction for the International Federation of Environmental Health.

**Region 1 Vice-President Ned Therien** leaves the board after three years of dedicated service and leadership. Ned is retired from the Washington State Department of Health after a 38-year career in public health. He began his career in 1976 at the California Public Health Laboratory and then decided to switch to environmental health. He specialized in drinking water, hazardous waste, institutional sanitation, food safety, shellfish sanitation, and environmental health policy over the course of his career.

Ned has been active in the Washington State Environmental Health Association for many years. He received the Jack B. Hatlen Inspirational Award in 1998 and the Environmental Health Professional of the Year in 2003. He also served as chairperson of its conference committee in 2002 and was president from 2007–2008. While a NEHA Regional Vice-President (RVP), Ned served on the Finance Committee, Annual Educational Conference & Exhibition Committee, Affiliate Engagement Committee, and Retail Curriculum Framework Work Group.

"It has been an enlightening experience to serve a term as a NEHA RVP," states Ned. "I gained great respect for the many people who work to make NEHA function to improve our profession. I encourage younger professionals to consider volunteering for a NEHA position or support activity at some time. And if not for NEHA, they certainly should do volunteer work for their state environmental health associations."

## Did You Know?

NEHA has switched to a new membership database and shopping system. Our goal is to ensure that you have a simple and efficient way to purchase and renew memberships and credentials, as well as shop for our products and educational resources. Learn more at www.neha.org.

**DirecTalk**
*continued from page 58*

through the refreshing of equipment for laboratories in the network.

The next step is to revise the Public Health Preparedness Capabilities: National Standards for State and Local Planning document. Some have advocated for a separate environmental health capability, but instead we are working to strengthen the language about environmental health in a majority of the capabilities, which provides an overall larger environmental health presence throughout the document.

All of these improvements are positive steps toward increasing environmental health activities throughout state, local, and territorial public health departments. NCEH and ATSDR stand ready to support jurisdictions as they continue to develop their public health emergency preparedness programs.

## For More Information

- 2017–2022 Hospital Preparedness Program—Public Health Emergency Preparedness Cooperative Agreement to State, Local, and Territorial Public Health and Healthcare Systems Request for Applications: www.grants.gov/web/grants/view-opportunity.html?oppId=290860
- National Center for Environmental Health's (NCEH) Community Assessment for Public Health Emergency Response: www.cdc.gov/nceh/hsb/disaster/casper
- NCEH's National Environmental Public Health Tracking Network: https://ephtracking.cdc.gov/showHome.action
- Agency for Toxic Substances and Disease Registry's (ATSDR) Social Vulnerability Index: https://svi.cdc.gov
- Disaster Epi: Health Study Branch Staff's Field Experience Boosts National Data Reporting: www.cdc.gov/nceh/hsb/success_stories/experience_leads.htm
- ATSDR's Rapid Response Registry: www.atsdr.cdc.gov/rapidresponse/index.html
- National Institute for Occupational Safety and Health's Emergency Responder Health Monitoring and Surveillance: www.cdc.gov/niosh/topics/erhms/default.html
- ATSDR's Assessment of Chemical Exposures Program: www.atsdr.cdc.gov/ntsip/ace.html
- NCEH's Laboratory Response Network for Chemical Threats: https://emergency.cdc.gov/lrn/chemical.asp
- Office of Public Health Preparedness and Response's Public Health Preparedness Capabilities: National Standards for State and Local Planning: www.cdc.gov/phpr/readiness/capabilities.htm

**DirecTalk** MUSINGS FROM THE 10TH FLOOR

David Dyjack, DrPH, CIH

# Long Overdue: Environmental Health and Public Health Emergency Preparedness Collide

## Introduction

For those of you who regularly read my column, you will immediately recognize the profound importance of Dr. Funk's well-written guest editorial below. The Public Health Emergency Preparedness (PHEP) cooperative agreement is the 800-pound gorilla that drives emergency preparedness capabilities across the U.S. Environmental health is explicitly called out in the new PHEP cooperative agreement, and I am delighted. At the same time, Dr. Funk concludes her column with the caveat, "some have advocated for a separate environmental health capability." That "some" is me. And I'm still working on it.

ddyjack@neha.org
Twitter: @DTDyjack

## Increased Environmental Health Activities in the 2017–2022 Hospital Preparedness Program–Public Health Emergency Preparedness Cooperative Agreement to State, Local, and Territorial Public Health and Healthcare Systems

CAPT Renée Funk, MPH&TM, MBA, DVM, DACVPM
*Associate Director for Emergency Management*
*National Center for Environmental Health/Agency for Toxic Substances and Disease Registry*

Increasing environmental health activities were identified as a priority for the new Public Health Emergency Preparedness (PHEP) cooperative agreement (CDC-RFA-TP17-1701). The purpose of this funding is to strengthen and enhance the capabilities of state, local, and territorial public health and healthcare systems to respond effectively (i.e., mitigate the loss of life and reduce the threats to the community's health and safety) to evolving threats and other emergencies within the U.S. and its territories and freely associated states. The 2017–2022 funding is anticipated to be awarded July 1, 2017.

Highlights of the environmental health activities are as follows. Under the Characterizing Populations At-Risk section, grantees can now conduct a Community Assessment for Public Health Emergency Response (CASPER) with their funding in addition to attending CASPER training. Grantees may use PHEP funds to support environmental public health tracking data to identify populations at risk for natural, chemical, and radiological events. To identify the at-risk populations, they are encouraged to use the Agency for Toxic Substances and Disease Registry's (ATSDR) Social Vulnerability Index. These all provide more flexibility for grantees to identify populations at risk for natural, chemical, and radiological events in addition to biological events.

In the Share Situational Awareness Across the Healthcare and Public Health Systems section, grantees are required to develop informatics systems to more rapidly share these data between healthcare systems and public health. This system is something that the National Center for Environmental Health (NCEH) has been working on for years to improve reporting after disasters. Successes have included developing consensus case definitions and standards for certifying disaster-related deaths and developing guidelines and best practices for consistent cause of death reporting using electronic death registration systems.

The Conduct Epidemiological Surveillance Investigation section adds guidance to implement processes for using poison control center data for surveillance. Poison control centers have data that can be particularly helpful in 1) providing situational awareness during a known public health threat, 2) identifying an emerging public health threat, 3) identifying unmet public health communication needs following a public health threat, and 4) providing surveillance for specific exposures or illnesses of concern to health departments. This section continues to recommend disaster epidemiology training in the following: Rapid Response Registry, Emergency Responder Health Monitoring and Surveillance, and Assessment of Chemical Exposures Program. These important programs and trainings have been developed by NCEH/ATSDR and the National Institute for Occupational Safety and Health over the years.

Under the Conduct Laboratory Testing section, the Laboratory Response Network for Chemical Threats program continues to remain an important part of the PHEP program. This program continues to work

*continued on page 57*

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INTERNATIONAL PERSPECTIVES

# Assessment of Food Business Operator Training on Parasitological Risk Management in Sushi Restaurants: A Local Survey in Florence, Italy

Andrea Armani, DVM, PhD
Priscilla D'Amico, DVM
*FishLab, Department of Veterinary Sciences, University of Pisa*
Luca Cianti, DVM
*Local Health Authority of Florence*
Marco Pistolesi
*FishLab, Department of Veterinary Sciences, University of Pisa*
Francesca Susini, DVM
*Experimental Zooprophylactic Institute of Lazio and Tuscany*
Lorenzo Castigliego, PhD
*FishLab, Department of Veterinary Sciences, University of Pisa*
Marcella Guarducci, DVM
*Experimental Zooprophylactic Institute of Lazio and Tuscany*
Daniela Gianfaldoni, PhD
Guidi Alessandra, DVM
*FishLab, Department of Veterinary Sciences, University of Pisa*

**Abstract** **Food business operators (FBOs) are required to implement hazard analysis and critical control points (HACCP) procedures to manage risks associated with products they handle. The aim of this study was to assess the level of knowledge on zoonotic parasites associated with raw seafood of 23 FBOs responsible for sushi restaurants. The survey, carried out in the city of Florence in 2012, and repeated in 2014, was based on a questionnaire focusing mainly on the freezing treatments applied to manage parasitological risks. Despite a slight increase between the two surveys (70% in 2012 to 89% in 2014) in the awareness of FBOs of the need for a preventive treatment to be applied to fishery products before being served raw, our results highlight that FBOs who act in accordance with this regulation is low. In particular, only 40% of FBOs in 2012 and 54.5% in 2014 used the blast chiller according to the relevant regulations. We observed shortcomings in the use of inappropriate temperatures and/or treatment duration. Thus, there is an urgent need to raise the training level of FBOs and to increase their awareness on the parasitological hazards related to the serving of raw seafood.**

## Introduction

Over the last few decades, typical Japanese dishes made of raw fish, such as sushi and sashimi, have become more common in the diet of the Western world (Bestor, 2000). The reason for this success is mainly the growing interest of Western consumers for both exotic tastes and "lightly preserved" seafood products, perceived as more wholesome and genuine than processed ones (Bucci et al., 2013).

It has been estimated that the number of sushi restaurants outside of Japan ranged from 14,000–18,000 (Matsumoto, 2007). In the U.S., Japanese cuisine began to spread in the 1970s and between 1988–1998, the number of sushi restaurants quadrupled. Currently in the U.S. there are about 5,000 sushi restaurants (Hsin-I Feng, 2012; Japan External Trade Organization, 2013). In the European Union (EU), the first Japanese restaurant opened in Düsseldorf (Germany) in 1973, but the sushi boom began in the late 1990s and the first sushi chain opened in London in 1997 (Japan External Trade Organization, 2013). Then, the exponential growth of Japanese restaurants was mostly determined by the conversion of other ethnic food business activities in sushi bars or restaurants (Farrer, 2015; Latham & Wu, 2013; Matsumoto, 2007). In fact, some Chinese restaurateurs began to realize as early as in the 1990s that switching to Japanese food business activities, or including Japanese delicacies in their menus, would give their enterprises a greater mass appeal and financial boost (Cwiertka, 2001).

The preparation of sushi and sashimi has always required qualified personnel because these products need continuous and constant attention during all stages of preparation and serving. In Hong Kong for example, sushi and sashimi are classified as restricted foods

(Food Business Regulation, 2010) and both producers and vendors have to obtain a specific endorsement (Hsin-I Feng, 2012).

Beyond the microbiological and chemical issues (Atanassova, Reich, & Klein, 2008; Food and Environmental Hygiene Department of Hong Kong, 2000; Hsin-I Feng, 2012), one of the main risks associated with the consumption of raw fish is the presence of infective parasites such as tapeworms (cestodes), flukes (trematodes), and roundworms (nematodes) (Hsin-I Feng, 2012). Although fish-borne zoonotic trematodes are estimated to infect >18 million persons, those at risk equal more than half a billion worldwide; trematodes are a major public health problem in particular in Southeast Asia, where they are found in mainly freshwater and brackish water fish species (Chai, Murrell, & Lymbery, 2005; World Health Organization, 1995).

In Italy, all the confirmed cases of opisthorchiasis were associated with the consumption of raw fillets of tench (*Tinca tinca*) (Pozio, Armignacco, Ferri, & Gomez Morales, 2013). In regard to cestodes, the most important fish-borne zoonosis is diphyllobothriasis, an intestinal infection caused by the fish tapeworm *Diphyllobothrium* spp. (Chai et al., 2005). Infective larvae (plerocercoid) of *Diphyllobothrium latum*, the species most often associated with human infections, reside in the muscles of trout, salmon, pike, and sea bass (Nawa, Hatz, & Blum, 2005). Additionally, *D. nihonkaiense*, the Asian species, has been identified in Japanese patients who had eaten wild salmon sashimi (Ando et al., 2001); it has also been involved in human cases in Switzerland and in France related to consumption of raw Pacific Chum salmon (*Oncorhynchus keta*) (Wicht, de Marval, & Peduzzi, 2007). Freshwater fish species, however, are not commonly used for the preparation of sushi and sashimi in Europe (Armani et al., 2017).

Roundworms, such as Anisakidae, represent a very high risk for sushi consumers as they are widely distributed in marine aquatic environments and their very small infectious larvae are difficult to visually detect in muscle (Hsin-I Feng, 2012). In humans, Anisakidae are responsible for a zoonotic disease called anisakidosis (Kassai et al., 1988), which may be associated to either noninvasive forms, generally asymptomatic, or invasive forms, characterized by gastrointestinal symptoms (acute or chronic). Moreover, an IgE-mediated allergic reaction can be developed after ingestion of anisakids (alive and dead) (Daschner, Alonso-Gómez, Cabañas, Suarez-de-Parga, & Lopez-Serrano, 2000; Domínguez-Ortega et al., 2001).

Most human infections are caused by the ingestion of raw fish infected with live third-stage larvae (L3) of *Anisakis* spp. and *Pseudoterranova* spp. (Anisakidae family) (Chai et al., 2005; Lymbery & Cheah, 2007), whereas the zoonotic potential of *Contracaecum* spp. (Anisakidae family) is questionable (Yagi et al., 1996) and *Hysterothylacium* spp. (Raphidascarididae family) is considered a nonzoonotic nematode (Angelucci et al., 2011). In the last decade, there have been about 20,000 cases of human anisakidosis, with a marked prevalence in Japan (90% of the cases) (Abe, 2008; Bucci et al., 2013).

In Europe, the incidence seems to be, on an average, 20 cases per country per year (Lima dos Santos & Howgate, 2011; Orphanet, 2014). In Italy, where the species most frequently associated with human cases is *Anisakis pegreffii* (Mattiucci et al. 2013), 54 cases were described between 1996–2011, mainly in the southern regions. This finding is probably related to the frequent consumption of traditional preparations made from raw fish (marinated anchovies) (Griglio et al., 2012; Pozio, 2004). It is not possible, however, to have a precise estimation of the confirmed cases of anisakidosis and of the sources of infection because anisakidosis is still misdiagnosed (Beaudry, 2012; De Liberato et al., 2013; Mattiucci et al., 2011). Moreover, no data on human cases of anisakidosis were reported in the last available EU summary report on trends and sources of zoonoses, zoonotic agents, and foodborne outbreaks (European Food Safety Authority [EFSA], 2015).

To limit as much as possible the risk from foodborne parasitic zoonoses, particularly anisakidosis, a series of regulations aimed at the management of such risk have been issued in EU and the 28 EU member states (D'Amico et al., 2014). According to EU regulations, the FBO has become the main responsible person for food products and—in order to guarantee the health of the consumers—the FBO is required to develop, implement, and maintain procedures based on hazard analysis and critical control points (HACCP) procedures. Regarding the control of parasites, the regulation and its amendments (Specific Hygiene for the Hygiene of Foodstuffs Regulation, 2004) state that fishery products, to be consumed raw or almost raw, and those that undergo a cold smoking process (core temperature <60 °C), must be previously frozen at a temperature not exceeding -20 °C (in each part of the mass) for at least 24 hours or at -35 °C for at least 15 hours. These treatments are effective for the killing of larvae of parasites different from trematodes, such as cestodes and nematodes (Treatment to Kill Viable Parasites in Fishery Products for Human Consumption Regulation, 2011).

Since 2011, according to the regulations, the preventive treatment also can be carried out at the retail and catering level. In this regard, FBOs must be equipped with an appropriate and certified blast chiller, which is a device that quickly lowers the temperature of foodstuffs, and is exclusively used to perform the freezing treatment and not to preserve foods (D'Amico et al., 2014).

Therefore, it is clear that adequate training of FBOs is essential for a proper management of the parasitological risk associated with raw fish products and for an effective implementation of specific procedures (Jones, Anderson, Schulkin, Parise, & Eberhard 2011; Kojima, Usuki, Mizokami, Tanabe, & Machi, 2013; Pekmezci, 2014). It follows that managers of sushi restaurants should thoroughly educate employees on the proper way to prepare and handle raw-fish products (Hsin-I Feng, 2012). In particular, employees should be able to monitor the critical control points (CCPs) and take corrective actions.

The survey performed in this study was made to evaluate the training level of some FBOs operating in the city of Florence who are responsible for the preparation and serving of raw seafood dishes at ethnic restaurants. Through the use of a questionnaire, we tried to understand the level of knowledge of the respondents regarding parasitological risk related to the presence of nematodes and the management measures required by European laws to reduce such risk to an acceptable level. A first survey, carried out in 2012, was subsequently repeated at the same ethnic restaurants in 2014, to assess any improvements.

## Materials and Methods

The survey was developed and conducted by the Department of Veterinary Sciences (In-

TABLE 1

**Type of Ethnic Food Activity Analyzed**

| Ethnic Food Activity | 2012 # (%) | 2014 # (%) |
|---|---|---|
| Traditional restaurant | 3 (13.0) | 1 (5.5) |
| Sushi bar | 1 (4.4) | 1 (5.5) |
| Traditional restaurant and take away | 10 (43.5) | 10 (55.8) |
| Traditional restaurant and sushi bar | 0 | 1 (5.5) |
| Sushi bar and take away | 2 (8.7) | 3 (16.6) |
| Traditional restaurant, sushi bar, and take away | 6 (26.0) | 2 (11.1) |
| Food business activity with weekly production of sushi | 1 (4.4) | 0 |

spection Section) at the University of Pisa, together with the staff of the Local Health Authority (LHA) No. 10 of Florence and the Experimental Zooprophylactic Institute (Section of Pisa). Initially, a census of the ethnic restaurants serving sushi in the city of Florence was done by selecting them both from the registry office of LHA and through an online search using keywords, such as sushi, Florence, restaurants, raw fish, take-away, Japanese food, and sushi bars. Then, FBOs were approached in person for approval to conduct an interview. During the first survey, carried out in the period May–September 2012, 23 FBOs agreed to participate. During the second round of surveys (between May–September 2014), however, only 18 of the 23 FBOs previously interviewed partook in the survey (Table 1).

The 16-question survey was structured in three main sections. Section 1 aimed at collecting the main characteristics of the food business activity such as the category (traditional restaurant, sushi bar, take away, other), the activity carried out (preparation and serving on site, preparation on site and take away, or catering) and the frequency of production (daily, weekly, on demand, other). Section 2 focused on the type of preparations made (raw or almost raw products, marinated and/or salted products, composite products), the seafood species used (fish, mollusks, crustaceans) and the suppliers (fishermen, wholesalers, fishmongers [fish shops], fish markets), as well as whether raw materials were purchased fresh, frozen, or thawed. Lastly, in section number 3, in order to better understand the degree of FBO knowledge, we posed some open questions about the parasitological risks associated with the consumption of raw fish, and the treatments and corrective measures implemented by the FBOs.

## Results

With regard to the activities category, in 2012, 13% of FBOs prepared and served sushi on site (i.e., traditional Japanese restaurant); in addition to this, 43.5% also offered take-away service and 26% offered serving on site, in a sushi bar, or take away. In 2014, we interviewed only 18 FBOs because four of them refused to participate again in the survey and one FBO had closed his activity, but the survey responses were quite similar (Table 1).

In both surveys, most of the ethnic restaurants analyzed were managed by FBOs of Chinese origin (68% in 2012 and 78% in 2014), followed by Japanese (45% in 2012 and 11% in 2014), and Italian (27% in 2012 and 11% in 2014).

With regard to the type of product, in 2012, the majority (61%) of FBOs prepared raw or almost raw fishery products, such as sashimi, carpaccio, and sushi, while 26% also prepared marinated or salted products. The remaining 13% prepared only sushi. In 2014, there were no restaurants that prepared only sushi: 50% of FBOs carried out preparations as sushi, sashimi, and carpaccio, while the remaining FBOs also prepared marinated and/or salted products. The species of fish most commonly used for the preparations of raw dishes were tuna, salmon, sea bass, and sea bream (Figure 1), which, in most of the cases (86.6% in 2012 and 88% in 2014), were purchased as fresh seafood. Among bivalve mollusks, cephalopods, and crustaceans, the most used were octopus, shrimp, and scallop, mainly purchased as frozen (78% in 2012 and 82% in 2014). In much lower percentages, amberjack, turbot, cuttlefish, crab, scampi, and eel were employed (Figure 1). Overall, both in 2012 and 2014, seafood was purchased mostly fresh (87%) and only in a small percentage frozen (3%). The majority of FBOs (89% in 2012 and 91% in 2014) reported they sourced seafood at large-scale retail distributors (wholesalers) and only a small percentage of them (9% in 2012 and 10% in 2014%) from fishmongers.

During both surveys, all the interviewed FBOs claimed to have a self-monitoring plan including the management of food made of raw or almost raw fish. In 2012, 69.5% of FBOs reported being aware that parasites dangerous to consumer health can be present in raw fish. In 2014, the situation was slightly improved: 83% of FBOs asserted to being aware of the risks associated with the presence of anisakids during the preparing and serving of raw or almost raw fish. In 2012, 69.5% of them reported to being aware of the recommended preventive treatment to be applied to fishery products before being served raw. In 2014, this percentage increased to 89%. The majority of FBOs reported that their food business was equipped with a blast chiller and that they applied a freezing treatment on fresh products at their business, while the rest declared that they did not accomplish any type of treatment (Table 2). Only 40% in 2012 and 54.5% in 2014, however, made a proper use of it, according to the parameters set by EU Regulations No. 853/2004 and No. 1276/2011. In both surveys, approximately 20% of FBOs used completely inappropriate temperatures (-5 or -12 °C), while 80% applied adequate temperatures but for too a short time (15 min–12 hr).

## Discussion

The lack of a proper preparation found in several Japanese restaurants and sushi bars analyzed in this study, which were newly opened and frequently managed by staff of Asian origin, brings to the fore the inadequate application of good practices in the preparation of raw fish. A similar survey conducted by Kwon and coauthors (2011) highlighted the need for training in food safety for staff working in ethnic restaurants, especially with regard to risk behaviors related to the parameters of temperature/time. Although our survey

FIGURE **1**

**Seafood Species Used for the Preparation of Raw Dishes**

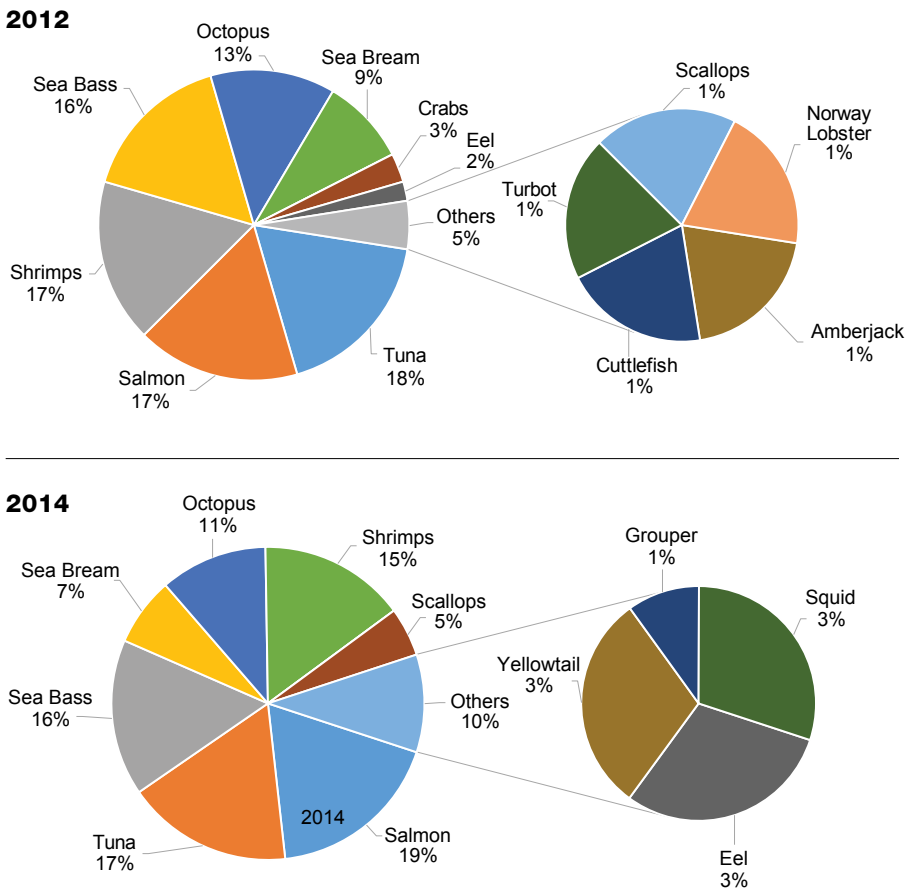


TABLE **2**

**Questions Asked for the Evaluation of Parasitic Risk Management**

| Question | Yes | |
|---|---|---|
| | 2012 # (%) | 2014 # (%) |
| Does your self-monitoring plan include the preparation of raw/almost raw fish products? | 23 (100) | 18 (100) |
| Are you aware of the existence of parasites that might be found in the flesh of fish and that can be harmful for the consumer? | 16 (69.5) | 15 (83.0) |
| Are you aware of the preventive treatment for parasites in fishery products? | 16 (69.5) | 16 (89.0) |
| Are you equipped with a blast chiller? | 17 (73.9) | 15 (83.0) |
| Do you apply the freezing treatment at your food business activity? | | |

brought to light a slight improvement (2014 compared with 2012) in the knowledge of FBOs on the requirements relating to the freezing treatment (Table 2), there remains a lack of awareness regarding the proper management of parasitological risk. In fact, a good percentage of FBOs interviewed (60% in 2012 and 45.5% in 2014) applied combinations of time/temperature that were noncompliant and poorly effective in killing the live larvae of anisakids.

Within a sushi foodservice, when raw materials are purchased as fresh, the preventive freezing treatment is the key (and only) CCP of the whole production process for controlling and lowering to an acceptable level the parasitological risk. In addition to strict compliance with EU time/temperature parameters, it is of fundamental importance that FBOs constantly check the correct working temperature of the blast chiller (e.g., through physical measurements such as temperature readings) and that they ensure regular maintenance.

In the catering sector, a proper knowledge of the etiologic agents responsible for foodborne illness and their contributing factors are of pivotal importance, and food handlers must adopt and implement the most effective management practices for preventing outbreaks (Green & Selman, 2005). In fact, improper food handler practices contribute to approximately 97% of foodborne illnesses (Howes, McEwen, Griffiths, & Harris, 1996; Lambrechts, Human, Doughari, & Lues, 2014; Prabhu & Shah, 2014). Therefore, the education of food handlers and managers represent a key element for achieving high quality standards (McIntyre, Vallaster, Wilcott, Henderson, & Kosatsky, 2013; Mortlock, Peters, & Griffith, 1999). Moreover, trained and qualified staff contributes to better inspection scores during official controls (Averett, Nazir, & Neuberger, 2011; Cates et al., 2009). For the aforementioned reasons, the training of FBOs should be relevant to the tasks and activities they hold and must be supervised by the food business managers, who must ensure that staff receive adequate training in food hygiene and in the application of HACCP principles.

It should be noted, however, that shortcomings in ethnic food services are largely due to the language difficulties of foreign-born FBOs, which hamper a proper acquisition of the food safety principles and interfere in communication with local control authorities (Armani, Castigliego, Gianfaldoni, & Guidi, 2011; D'Amico et al., 2014; Green & Selman, 2005; Guidi et al., 2010; Pham, Jones, Sargeant, Marshall, & Dewey, 2010; Rudder, 2006). During the survey, we encountered that many FBOs have a difficult time understanding specific technical terms related to

food safety. For those who deal with and are in charge of training courses for foreign-born FBOs, the language barriers should not be underestimated. In fact, worldwide, ethnic workers represent a driving force in the restaurant industry and, to properly communicate the nuances of food safety to them, it becomes indispensable to meet their language needs and therefore adopt language-specific training in the classroom (Niode, Bruhn, & Simonne, 2011). It is pointless to subject operators to educational programs if language barriers are not addressed—ignoring this problem risks ineffective promotion of correct operating procedures. Moreover, the adoption of practical and interactive activities and role-playing to support the theoretical teaching could probably result in a better understanding of the basic principles of food safety and improve retention of safety knowledge by ethnic operators (Clayton, Griffith, Price, & Peters, 2002; Niode et al., 2011).

The risk of infection with anisakid larvae, mainly *Anisakis* spp., by eating sushi and sashimi is higher in countries where regulations on preventive treatment have not been implemented. Therefore, sushi and sashimi served in Japanese restaurants in the EU can be considered safer and the risk of infection is not as significant as is generally feared (Nawa et al., 2005). Many factors, however, can influence the overall probability of contracting an infection. In fact, because of the culinary tradition, most cases of infection have been reported in Japan (Abe, 2008; Bucci et al., 2013), where the consumption of raw fish is common. Also, the familiarity with raw fish preparation can be crucial for good management and safety of these products. The risk of infection seems to be lower when sushi and sashimi are prepared by professional chefs, who are experts in identifying larval infestation (Chai et al., 2005; Lymbery & Cheah, 2007; Nawa et al., 2005).

In Western countries, in contrast, parasitic infections can be favored by the nonapplication of freezing treatment, which can be intentionally avoided by FBOs so as not to alter the flavor of sushi and other raw fish delicacies (Nieuwenhuizen & Lopata, 2013). Moreover, as our investigation and other studies have showed (Cwiertka, 2001; Farrer, 2015; Matsumoto, 2007), sushi food services outside of Japan are frequently run by people who are Chinese, Korean, or Vietnamese. Consumption of raw fish is a more recent trend in China, where many traditional fishery products are salted, dried, and fermented. For this reason, Chinese cooks are less accustomed to the handling and management of raw foods. This failure of proper handling might not be intentional, but rather is often due to the involvement in restaurant operations of family members who are not formally employed (and therefore not formally trained). In these circumstances, food safety and health codes might not be understood or followed (Kwon, Roberts, Shanklin, Liu, & Yen, 2011; Ram, Sanghera, Abbas, Barlow, & Jones, 2000).

The increasing popularity of sushi and sashimi worldwide is one of the factors contributing to the growing incidence of anisakidosis globally over the past 20 years (De Liberato et al., 2013; Mattiucci et al., 2013). The only positive finding of our survey is that almost all respondents seem to have never experienced an infected fish by parasite larvae. This finding is probably because the majority of FBOs buy raw materials at large fishing platforms, which are subject to stringent control systems.

Considering the species mostly commonly used (sea bream, sea bass, and salmon) and also the modest selling price of the finished products, it is plausible that in the majority of cases the seafood came from aquaculture and thus is at a lower risk to contain parasitic larvae. According to the European Food Safety Authority (EFSA) panel report, *Scientific Opinion on Risk Assessment of Parasites in Fishery Products,* while all wild-caught seafood must be considered at risk of containing any viable parasites, fishery products from aquaculture, such as Atlantic salmon, are raised in floating cages or onshore tanks within free marine areas and fed on compound feedstuffs, and therefore can be considered "*Anisakis*-free" (EFSA Panel on Biological Hazards, 2010). A research project of the Spanish Asociación Empresarial de Productores de Cultivos Marinos showed that aquacultured sea bass and sea bream reared in floating cages or onshore tanks have a negligible risk of infection from *Anisakis* spp. larvae (Asociación Empresarial de Productores de Cultivos Marinos de España, 2012; Peñalver, Dolores, & Muñoz, 2010). These findings notwithstanding, FBOs operating in Japanese restaurants should be aware that *Anisakis* spp. can induce severe allergic reactions in sensitive individuals not only after ingestion (the preventive treatment is not able to prevent hypersensitivity reactions), but also during manipulation and handling of infected fish, representing for FBOs an occupational health hazard (Nieuwenhuizen & Lopata, 2013).

## Conclusion

The results of this survey, also supported by the findings of inspection controls carried out by LHA of Florence, reveal a worrying situation about the training of FBOs who work in the food businesses under investigation. Participants lacked management practices, knowledge, and science-based resources for dealing with raw-fish products. Despite the undeniable lack of knowledge of FBOs interviewed, the low selling price of the products allows for the assumption that the raw materials were mostly from aquaculture, and therefore naturally less infected by parasitic larvae, which could result in the reduction of the parasitological risk of gastrointestinal anisakidosis associated with sushi consumption.

Although this study was limited to a small geographical area and a small number of samples, it definitely highlights the main problems that many foreign operators and environmental health food safety practitioners face every day around the world. The findings of this study should encourage other more rigorous research to address these issues regarding the safe handling of seafood to be served raw, as it is evident that there is an immediate need to raise the training quality level and make FBOs more aware of the risks related to the products they handle. In this regard, the development of food safety resources, such as written material, flyers, or booklets, in different languages and the use of native speakers during training events, can provide enhanced support to foreign-born FBOs.

*Acknowledgement:* This study was supported by the Italian Ministry of Health, Projects Code: Current Research Grant IZSLT13/12RC "Valutazione della qualità igienico-sanitaria e commerciale dei prodotti ittici destinati alla ristorazione scolastiche, ospedaliere ed etniche."

*Corresponding Author:* Andrea Armani, FishLab, Department of Veterinary Sciences, University of Pisa, Via delle Piagge 2, 56124, Pisa, Italy. E-mail: andrea.armani@unipi.it.

## References


Abe, N. (2008). Application of the PCR-sequence-specific primers for the discrimination among larval *Anisakis simplex* complex. *Parasitology Research, 102*(5), 1073–1075.

Ando, K., Ishikura, K., Nakakugi, T., Shimono, Y., Tamai, T., Sugawa, M., . . . Chinzei, Y. (2001). Five cases of *Diphyllobothrium nihonkaiense* infection with discovery of plerocercoids from an infective source, *Oncorhynchus masou ishikawae*. *Journal of Parasitology, 87*(1), 96–100.

Angelucci, G., Meloni, M., Merella, P., Sardu, F., Madeddu, S., Marrosu, R., . . . Salati, F. (2011). Prevalence of *Anisakis* spp. and *Hysterothylacium* spp. larvae in teleosts and cephalopods sampled from waters off Sardinia. *Journal of Food Protection, 74*(10), 1769–1775.

Armani, A., Castigliego L., Gianfaldoni, D., & Guidi, A. (2011). L'insicurezza alimentare della nuova ristorazione cinese [Article in Italian]. *Industrie Alimentari, 50*(514), 7–11.

Armani, A., Tinacci, L., Lorenzetti, R., Benvenuti, A., Susini, F., Gasperetti, L., . . . Guidi, A. (2017). Is raw better? A multiple DNA barcoding approach (full and mini) based on mitochondrial and nuclear markers reveals low rates of misdescription in sushi products sold on the Italian market. *Food Control*, *79*, 126–133.

Asociación Empresarial de Productores de Cultivos Marinos de España. (2012). *Evaluación de la presencia de nematodos del genero* Anisakis *en los pescados de acuicultura marina españoles* [Report in Spanish]. Retrieved from http://www.apromar.es/Proyecto-Anisakis/APROMAR-Informe-ANISAKIS-2012.pdf

Atanassova, V., Reich, F., & Klein, G. (2008). Microbiological quality of sushi from sushi bars and retailers. *Journal of Food Protection, 71*(4), 860–864.

Averett, E., Nazir, N., & Neuberger, J.S. (2011). Evaluation of a local health department's food handler training program. *Journal of Environmental Health, 73*(6), 65–69.

Beaudry, C. (2012). *Anisakis* simplex and related worms. In *Bad bug book. Foodborne pathogenic microorganisms and natural toxins handbook* (2nd ed). Washington, DC: Center for Food Safety and Applied Nutrition, Food and Drug Administration. Retrieved from http://www.fda.gov/downloads/Food/FoodborneIllnessContaminants/UCM297627.pdf

Bestor, T.C. (2000). How sushi went global. *Foreign Policy*, *121*, 54–63.

Bucci, C., Gallotta, S., Morra, I., Fortunato, A., Ciacci, C., & Iovino, P. (2013). *Anisakis*, just think about it in an emergency! *International Journal of Infectious Diseases, 17*(11), e1071–1072.

Cates, S.C., Muth, M.K., Karns, S.A., Penne, M.A., Stone, C.N., Harrison, J.E., & Radke, V.J. (2009). Certified kitchen managers: Do they improve restaurant inspection outcomes? *Journal of Food Protection, 72*(2), 384–391.

Chai, J.Y., Murrell, K.D., & Lymbery, A.J. (2005). Fish-borne parasitic zoonoses: Status and issues. *International Journal for Parasitology, 35*(11–12), 1233–1254.

Clayton, D.A., Griffith, C.J., Price, P., & Peters, A.C. (2002). Food handlers' beliefs and self-reported practices. *International Journal of Environmental Health Research, 12*(1), 25–39.

Cwiertka, K.J. (2001). Japanese food in Holland: The global trend spreads. *Food Culture*, *3*, 15–19.

D'amico, P., Malandra, R., Costanzo, F., Castigliego, L., Guidi, A., Gianfaldoni, D., & Armani, A. (2014). Evolution of the *Anisakis* risk management in the European and Italian context. *Food Research International, 64*, 348–362.

Daschner, A., Alonso-Gómez, A., Cabañas, R., Suarez-de-Parga, J.M., & Lopez-Serrano, M.C. (2000). Gastroallergic anisakiasis: Borderline between food allergy and parasitic disease: Clinical and allergologic evaluation of 20 patients with confirmed acute parasitism by *Anisakis* simplex. *Journal of Allergy and Clinical Immunology, 105*(1), 176–181.

De Liberato, C., Bossù, T., Scaramozzino, P., Nicolini, G., Ceddia, P., Mallozzi, S., . . . D'Amelio, S. (2013). Presence of anisakid larvae in the European anchovy, *Engraulis encrasicolus*, fished off the Tyrrhenian coast of central Italy. *Journal of Food Protection, 76*(9), 1643–1648.

Domínguez-Ortega, J., Alonso-Llamazares, A., Rodríguez, L., Chamorro, M., Robledo, T., Bartolomé, J.M., & Martínez-Cócera, C. (2001). Anaphylaxis due to hypersensitivity to *Anisakis* simplex. *International Archives of Allergy and Immunology, 125*(1), 86–88.

European Food Safety Authority. (2015). The European Union summary report on trends and sources of zoonoses, zoonotic agents, and food-borne outbreaks in 2014. *EFSA Journal, 13*(12), 4329.

European Food Safety Authority Panel on Biological Hazards. (2010). Scientific opinion on risk assessment of parasites in fishery products. *EFSA Journal, 8*(4), 1543.

Farrer, J. (Ed.). (2015). *The globalization of Asian cuisines: Transnational networks and culinary contact zones*. New York, NY: Palgrave Macmillan.

Food and Environmental Hygiene Department of Hong Kong. (2000). *Sushi & sashimi in Hong Kong. Risk assessment studies report No. 2. Microbiological hazards evaluation*. Retrieved from http://www.cfs.gov.hk/english/programme/programme_haccp/files/ss_ras2_eng.pdf

Food Business Regulation, Public Health and Municipal Services of Hong Kong. (2010). Chapter 132X L.N.57.

Green, L.R., & Selman, C. (2005). Factors impacting food workers' and managers' safe food preparation practices: A qualitative study. *Food Protection Trends*, *25*(12), 981–990.

Griglio, B., Marro, S., Marotta, V., Testa, A., Sattanino, G., Civera, T., . . . Decastelli, L. (2012). *Anisakidae:* Valutazione del rischio e indicazioni operative per i controlli ufficiali alla luce del quadro normativo [Article in Italian]. *Associazione Italiana Veterinaria Medicina Pubblica*, *4*, 7–20. Retrieved from http://www.ceirsa.org/fd.php?path=201402/anisakis.pdf

## References


Guidi, A., Armani, A., Castigliego, L., Li, X.N., Fanzone, F., Fusco, S., . . . Gianfaldoni, D. (2010). Labeling of ethnic food in the Prato Chinese community. *Veterinary Research Communication, 34*(Suppl. 1), 163–166.

Howes, M., McEwen, S., Griffiths, M., & Harris, L. (1996). Food handler certification by home study: Measuring changes in knowledge and behavior. *Dairy, Food and Environmental Sanitation, 16*(7), 737–744.

Hsin-I Feng, C. (2012). The tale of sushi: History and regulations. *Comprehensive Reviews in Food Science and Food Safety*, *11*(2), 205–220.

Japan External Trade Organization. (2013). *Special report: Serving Japanese food to the world, aided by the health conscious boom*. Retrieved from https://www.jetro.go.jp/ext_images/en/reports/survey/pdf/2013_11_other.pdf

Jones, J.L., Anderson, B., Schulkin, J., Parise, M.E., & Eberhard, M.L. (2011). Sushi in pregnancy, parasitic diseases—Obstetrician survey. *Zoonoses and Public Health, 58*(2), 119–125.

Kassai, T., Cordero del Campillo, M., Euzeby, J., Gaafar, S., Hiepe, T., & Himonas, C.A. (1988). Standardized nomenclature of animal parasitic diseases (SNOAPAD). *Veterinary Parasitology, 29*(4), 299–326.

Kojima, G., Usuki, S., Mizokami, K., Tanabe, M., & Machi, J. (2013). Intestinal anisakiasis as a rare cause of small bowel obstruction. *American Journal of Emergency Medicine, 31*(9), 1422.e1–2.

Kwon, J., Roberts, K.R., Shanklin, C.W., Liu, P., & Yen, W.S. (2011). Food safety training needs assessment for independent ethnic restaurants: Review of health inspection data in Kansas. *Food Protection Trends, 30*(7), 412–421.

Lambrechts, A.A., Human, I.S., Doughari, J.H., & Lues, J.F.R. (2014). Bacterial contamination of the hands of food handlers as indicator of hand washing efficacy in some convenient food industries in South Africa. *Pakistan Journal of Medical Sciences, 30*(4), 755–758.

Latham, K., & Wu, B. (2013). *Chinese immigration into the EU: New trends, dynamics and implications*. London: Europe China Research and Advice Network. Retrieved from http://eeas.europa.eu/china/docs/division_ecran/ecran_chinese_immigration_into_the_eu_kevin_latham_and_bin_wu_en.pdf

Lima dos Santos, C.A.M., & Howgate, P. (2011). Fishborne zoonotic parasites and aquaculture: A review. *Aquaculture, 318*(3–4), 253–261.

Lymbery, A.J., & Cheah, F.Y. (2007). Anisakid nematodes and anisakiasis. In K.D. Murrell & B. Fried (Eds.), *Food-borne parasitic zoonoses* (Vol. 11, pp. 185–207). New York, NY: Springer U.S.

Matsumoto, H. (2007). The internationalization of sushi. *Food Culture, 15*, 2–6.

Mattiucci, S., Fazii, P., De Rosa, A., Paoletti, M., Megna, A.S., Glielmo, A., . . . Nascetti, G. (2013). Anisakiasis and gastroallergic reactions associated with *Anisakis pegreffii* infection, Italy. *Emerging Infectious Diseases, 19*(3), 496–499.

Mattiucci, S., Paoletti, M., Borrini, F., Palumbo, M., Palmieri, R.M., Gomes, V., . . . Nascetti, G. (2011). First molecular identification of the zoonotic parasite *Anisakis pegreffii* (Nematoda: Anisakidae) in a paraffin-embedded granuloma taken from a case of human intestinal anisakiasis in Italy. *BMC Infectious Diseases, 11*, 82.

McIntyre, L., Vallaster, L., Wilcott, L., Henderson, S.B., & Kosatsky, T. (2013). Evaluation of food safety knowledge, attitudes and self-reported hand washing practices in FOODSAFE trained and untrained food handlers in British Columbia, Canada. *Food Control, 30*(1), 150–156.

Mortlock, M.P., Peters, A.C., & Griffith, C.J. (1999). Food hygiene and hazard analysis critical control point in the United Kingdom food industry: Practices, perceptions, and attitudes. *Journal of Food Protection*, *62*(7), 786–792.

Nawa, Y., Hatz, C., & Blum, J. (2005). Sushi delights and parasites: The risk of fishborne and foodborne parasitic zoonoses in Asia. *Clinical Infectious Diseases, 41*(9), 1297–1303.

Nieuwenhuizen, N.E., & Lopata, A.L. (2013). *Anisakis*—A foodborne parasite that triggers allergic host defences. *International Journal for Parasitology, 43*(12–13), 1047–1057.

Niode, O., Bruhn, C., & Simonne, A.H. (2011). Insight into Asian and Hispanic restaurant manager needs for safe food handling. *Food Control, 22*(1), 34–42.

Orphanet. (2014). *Prevalence of rare diseases: Bibliographic data* (Orphanet Report Series, Rare Diseases collection, No.1). Retrieved from http://www.ineip.org/content/report/351/orphanet-prevalence-rare-diseases

Pekmezci, G.Z. (2014). Occurrence *of Anisakis simplex sensu stricto* in imported Atlantic mackerel (*Scomber scombrus*) represents a risk for Turkish consumers. *International Journal of Food Microbiology, 185*, 64–68.

Peñalver, J., Dolores, E.M., & Muñoz, P. (2010). Absence of anisakid larvae in farmed European sea bass (*Dicentrarchus labrax L.*) and gilthead sea bream (*Sparus aurata* L.) in Southeast Spain. *Journal of Food Protection*, *73*(7), 1332–1334.

Pham, M.T., Jones, A.Q., Sargeant, J.M., Marshall, B.J., & Dewey, C.E. (2010). Specialty food safety concerns and multilingual resource needs: An online survey of public health inspectors. *Foodborne Pathogens and Diseases, 7*(12), 1457–1462.

Pozio, E. (2004). *Zoonosi parassitarie trasmesse da prodotti ittici* (p. 28). *Workshop di aggiornamento su problematiche emergenti nel settore dei prodotti ittici* [Report in Italian]. Retrieved from http://www.iss.it/binary/publ/publi/05-24.1129716985.pdf

Pozio, E., Armignacco, O., Ferri, F., & Gomez Morales, M.A. (2013). *Opisthorchis felineus*, an emerging infection in Italy and its implication for the European Union. *Acta Tropica, 126*(1), 54–62.

Prabhu, P.M., & Shah, R.S. (2014). A study of food handlers in public food establishments in Maharashtra, India. *International Journal of Science and Research, 3*(7), 1485–1489.

## References


Ram, M., Sanghera, B., Abbas, T., Barlow, G., & Jones, T. (2000). Ethnic minority business in comparative perspective: The case of the independent restaurant sector. *Journal of Ethnic and Migration Studies, 26*(3), 495–510.

Rudder, A. (2006). Food safety and the risk assessment of ethnic minority food retail businesses. *Food Control, 17*(3), 189–196.

Specific Hygiene Rules for the Hygiene of Foodstuffs. (2004). EC Regulation (European Parliament and Council), Regulation (EC) No. 853/2004 OJEU L139. Retrieved from http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32004R0853R(01)

Treatment to Kill Viable Parasites in Fishery Products for Human Consumption. (2011). EU Regulation (European Parliament), Regulation (EU) No. 1276/2011 OJEU, L327.

Wicht, B., de Marval, F., & Peduzzi, R. (2007). *Diphyllobothrium nihonkaiense* (Yamane et al., 1986) in Switzerland: First molecular evidence and case reports. *Parasitology International, 56*(3), 195–199.

World Health Organization. (1995). *Control of foodborne trematode infections: Report of a WHO study group*. Geneva, Switzerland: Author. Retrieved from http://apps.who.int/iris/handle/10665/41544

Yagi, K., Nagasawa, K., Ishikura, H., Nakagawa, A., Sato, N., Kikuchi, K., & Ishikura, H. (1996). Female worm *Hysterothylacium aduncum* excreted from human: A case report. *Japanese Journal of Parasitology*, *45*(1), 12–23.