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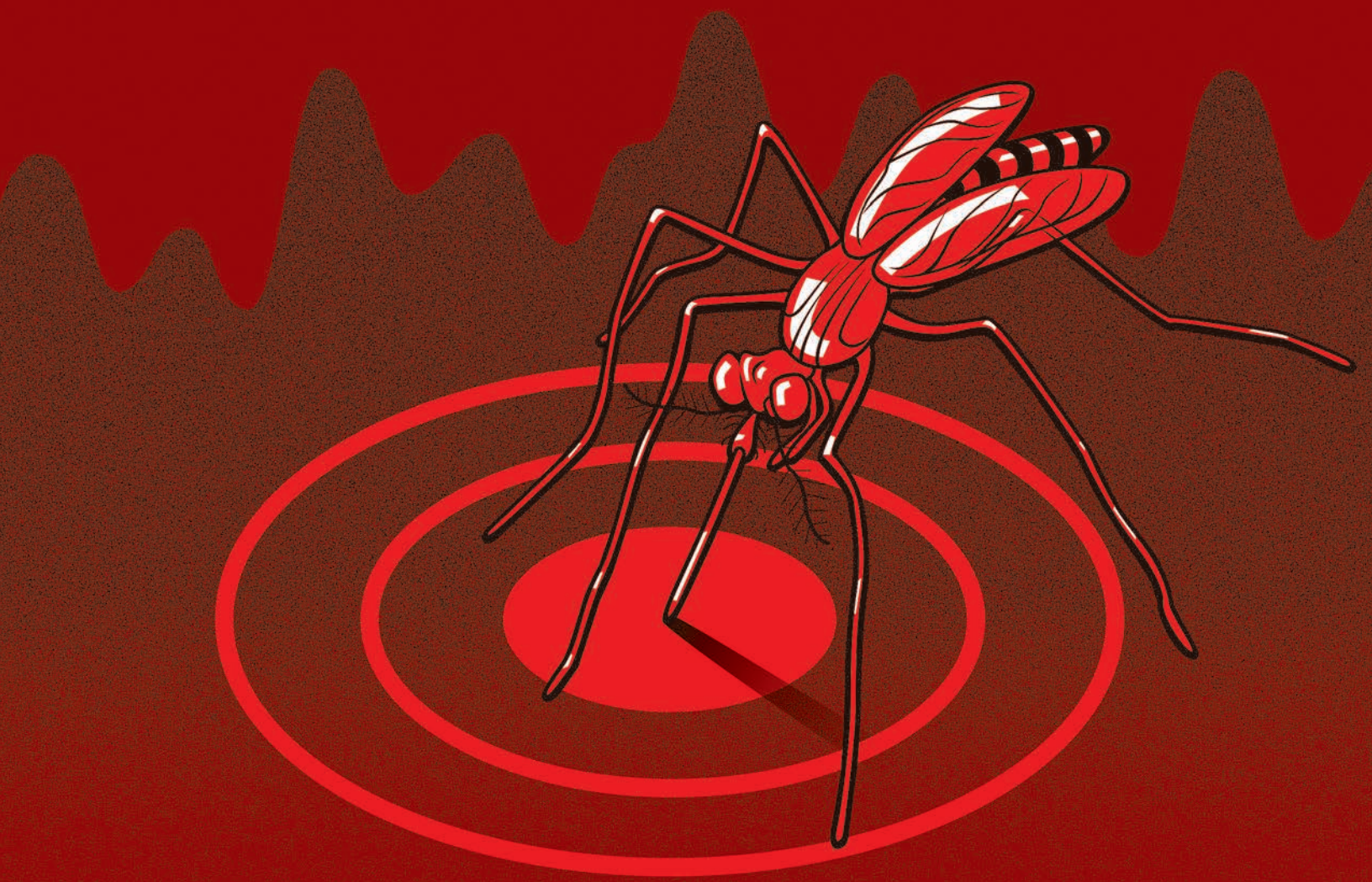
Evaluation of Barrier Sprays to Control Mosquitoes

Field Study in a Suburban Environment



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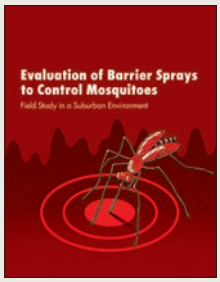

Barrier sprays are a common method for controlling a variety of mosquito species, especially for residential backyard applications. This month's cover article, "Evaluation of Barrier Sprays Containing a Pyrethroid and an Insect Growth Regulator to Control *Aedes albopictus* in a Suburban Environment in North Carolina," explores the extent to which barrier sprays containing insect growth regulators affect immature mosquito development and life table characteristics. The study evaluated the extent to which different application rates and frequencies of three different barrier spray treatments affect *Ae. albopictus* in a suburban environment through field and laboratory methods. The findings of the study can inform environmental health and mosquito control professionals about the efficacy of barrier sprays against this mosquito species.

See page 8.

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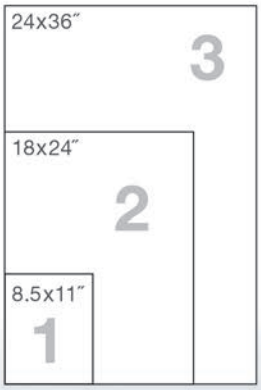

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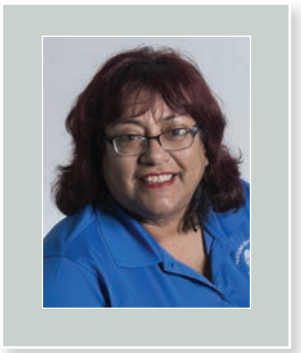

Sandra Long, REHS, RS

Credentialing: Would You Go to a Plumber if You Had the Flu?

As environmental health professionals, we understand that environmental health is the area of public health that deals with all the different ways the world around us can impact us. Environmental health monitors and addresses those physical, chemical, and biological factors that we might not have direct control over. It is one of the most diverse professional fields in terms of scope and reach. Environmental health professionals can be found performing food inspections, monitoring air and water quality, conducting soil analyses, and engaging in emergency management and disease control, to name a few. With all that environmental health encompasses, why is it not a credential-required profession in all states and counties?

What does it mean to be credentialed? A simple definition is that a credential is something that gives credit or qualifies someone to be suitable for a particular job. It identifies that person as having met a specific criteria, knowledge, training, or educational level that can be verified. Credentials signify competency. A credential attests that the person has completed a process verifying their level of competency. Professional credentials are earned through a formal process of examination.

Some states have their own credentialing programs that provide verification of the level of competency as set forth by that state. The point is that there are guidelines and criteria to be met to achieve a level of competency to qualify for an examination for a credential. Someone cannot simply wake up one morning and decide they have the knowledge and experience to be a nurse and start putting RN (registered nurse) after their name. Nor can someone apply for a nursing credential examination or begin working as a nurse without verification of their education, training, and experience. I am not aware of a state that will allow someone to work as a nurse without a valid credential. So, why are environmental health professionals not required to obtain a credential in all states? The work of environmental health professionals to ensure safe food, water, and air and to respond to emergencies has a significant impact on the public and public health.

The most compelling reason for credentialing is a qualified, competent workforce.

Quality work requires a competent workforce. A competent workforce must be well trained, educated, and knowledgeable in providing the appropriate services. With the broad scope of services provided by environmental health professionals, it is essential that a competent workforce is maintained.

The most compelling reason for credentialing is a qualified, competent workforce. Credentialing ensures that environmental health professionals are qualified and knowledgeable, as well as that their education and training can be verified and meets a set criteria. Additionally, the requirement of continuing education to maintain the credential ensures the workforce remains relevant.

The requirement of a credential is the key element, whether that credential be the National Environmental Health Association's Registered Environmental Health Specialist/Registered Sanitarian (REHS/RS), Certified Professional–Food Safety (CP-FS), or a similar credential as it is named in your state. The credential provides recognition of expertise and distinction as a professional.

The work of the environmental health professional improves quality of life by providing a safe and wholesome environment in which to live. In order to provide this safe and wholesome environment, the environmental health professional must have the scientific knowledge to achieve these goals—knowledge that comes from specific education and training. Verification and validation of this knowledge and training ensures a standard of performance. Credentialing ensures a standard within the profession.

Achieving a credential demonstrates commitment to your profession and sets you apart as a professional in your field. It also demonstrates how well you perform to set standards. It provides a level of confidence in your job performance and enhances trust in your knowledge. Credential holders are an asset to the workplace and the profession. Credentials reflect achievement, build self-esteem, improve career opportunities, and enhance professional image.

So, why are credentials not required for all environmental health professionals? Is it because there is not an emphasis on the importance of a credential? It is important to have a professional workforce with set standards of knowledge, education, training, and skill levels. This type of workforce can be achieved through credentialing.

A credential makes you credible. It attests to your knowledge or competency in the profession, a goal we should all strive toward. As environmental health professionals, we need to increase the awareness of the importance of the profession and the credentialing of the professional.

President@neha.org

Did You Know?

Members are extremely important to NEHA and its mission. NEHA's membership structure includes five different membership categories—Professional, Emerging Professional, Retired Professional, International, and Life. Environmental health professionals can benefit from NEHA membership at any career stage. NEHA membership provides credibility (credentials and leadership opportunities), learning (*Journal*, conferences, and continuing education), community (events, blogs, and webinars), and influence (advocacy and position papers). Learn more at www.neha.org/join.

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

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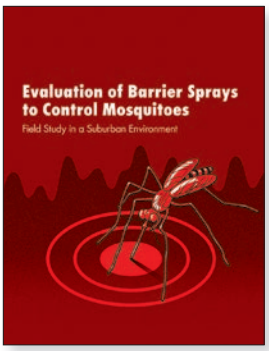


Evaluation of Barrier Sprays Containing a Pyrethroid and an Insect Growth Regulator to Control *Aedes albopictus* in a Suburban Environment in North Carolina

Stephanie L. Richards, MSEH, PhD
Megan N. Rhyne, MSEH
Justin P. Bunn, MSEH
Avian V. White, MSEH
Environmental Health Program,
East Carolina University

Abstract **Barrier sprays are a common method for controlling a variety of diurnal and crepuscular mosquito species, especially for residential backyard applications. Little is known, however, about the extent to which barrier sprays containing insect growth regulators (IGR) such as pyriproxyfen affect immature mosquito development and life table characteristics. To learn more, we carried out a field study in a suburban Eastern North Carolina neighborhood from May 16–November 2, 2017. We evaluated the effect of Demand CS (pyrethroid adulticide with active ingredient lambda-cyhalothrin) and Archer (IGR with active ingredient pyriproxyfen) exposure with respect to reproduction (measured by fecundity, fertility, and adult emergence) and abundance of host-seeking mosquitoes *Aedes albopictus* (Diptera: Culicidae). These mosquitoes were collected using BG-Sentinel 2 traps; oviposition intensity was monitored using ovitraps for each property involved in the study. Eggs from ovitraps were reared in the laboratory to assess life table characteristics. Significantly more *Ae. albopictus* eggs ($p < .05$) were detected in ovitraps located in control lots, whereas no significant differences were observed in host-seeking adult abundance of *Ae. albopictus* between treatments. Potential reasons for this finding are discussed with respect to oviposition and host-seeking behavior of *Ae. albopictus*. Pyriproxyfen could be a useful control method for some populations of *Ae. albopictus*, especially where resistance to other active ingredients or cryptic oviposition sources are present.**

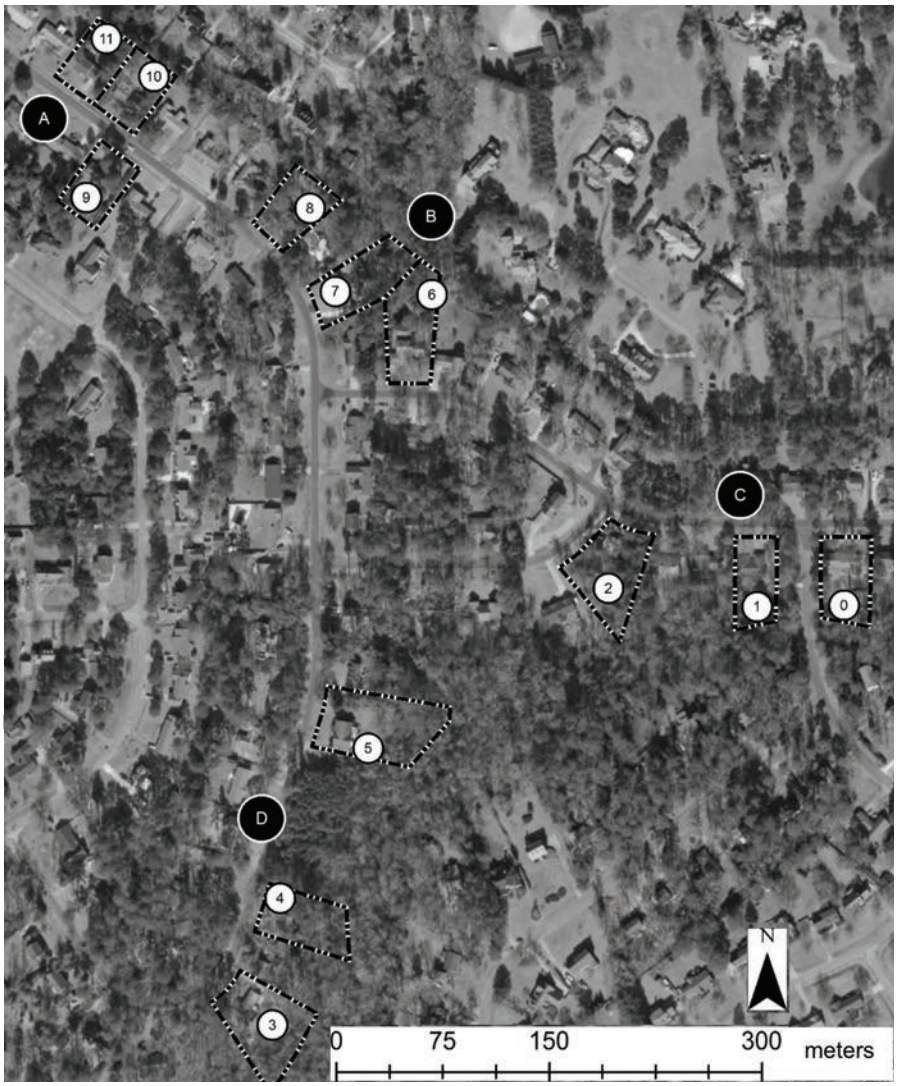
Introduction

Aedes albopictus (Skuse) is an invasive mosquito species and a competent vector of several arboviruses (e.g., dengue, chikungunya, Zika). In the absence of effective vaccines, vector control is the primary means of controlling the spread of these arboviruses (Chandel et al., 2016). Larval oviposition sites for *Ae. albopictus* are diverse, ranging from natural sites (e.g., tree holes, bromeliads) to artificial containers (e.g., discarded tires, plant pot receptacles, birdbaths) (Hawley, 1988). Reducing routine sources of water-holding containers can help reduce populations of container-ovipositing mosquitoes. Furthermore, larvicides can be applied to mosquito oviposition sites to control mosquitoes before they emerge as adults. It can be difficult for larvicides, however, to reach cryptic oviposition sources and therefore larval control has proved to be difficult over large urban areas (Chandel et al., 2016; Fonseca et al., 2013).

Pyriproxyfen is an insect growth regulator (IGR) that mimics natural juvenile hormones to stop young insects (such as mosquitoes) from maturing into adults (Cross et al., 2015). The efficacy of pyriproxyfen autodissemination stations was assessed for *Ae. albopictus* and showed that *Ae. albopictus* carrying pyriproxyfen (from autodissemination stations) on body parts effectively contaminated cryptic cups (59–85%) and resulted in >29% pupal mortality (Chandel et al., 2016). A study with pyriproxyfen applied as a barrier spray in conjunction with the adulticide lambda-cyhalothrin showed efficacy at controlling *Ae. albopictus* for up to 4 weeks and suggested that increased scale (number of properties treated), frequency/timing of application during peak *Ae. albopictus* activity periods, and technique for application of barrier sprays are important for maximizing control (Unlu et al., 2018). Other studies have shown that sublethal doses of pyriproxyfen can have negative effects on life

FIGURE **1**

Aerial View of the Study Area



Dotted outlines represent lots included in the study for: A. Demand CS 0.03% + Archer 0.005% (every 30 days, code DA30); B. Demand CS 0.06% + Archer 0.010% (every 60 days, code DA60); C. Demand CS 0.03% (every 30 days, code D30); and D. control. White circles indicate BG-Sentinel 2 and oviposition traps. Numbers indicate de-identified codes for house addresses.

table characteristics of adult *Aedes aegypti* (Linnaeus). After exposure of *Ae. aegypti* larvae to pyriproxyfen, fecundity and fertility were measured in blood-fed adult females (Harburguer et al., 2014). In larval groups of *Ae. aegypti* exposed to a dose of pyriproxyfen (0.2 g/kg pyriproxyfen fumes for 8 min), adult emergence was reduced by 40% and fecundity and fertility were significantly reduced (Harburguer et al., 2014).

Lambda-cyhalothrin is a type II pyrethroid that is used in barrier sprays for adult mosquito control. Muzari et al. (2014) used leaves treated with lambda-cyhalothrin in a laboratory bioassay against *Ae. aegypti* and demonstrated high (>94%) knockdown after 1 hr of exposure to lambda-cyhalothrin and 100% mortality after mosquitoes were held for 24 hr in a clean container. Demand, with active ingredient lambda-cyhalothrin, 25 g/L, was applied as a barrier spray in Australia and caused a significant decrease in mosquito populations, primarily *Verallina lineata* (Taylor) as measured using sweep net collections between treated and control sites (Muzari et al., 2014). A study in China evaluated Demand CS, with active ingredient lambda-cyhalothrin, 20 mg/m^2, used as a barrier spray against *Ae. albopictus*. In this study, human landing counts were used to assess differences in abundance of mosquitoes between treatment and control properties and a reduction of 83–98% of *Ae. albopictus* was observed in treatment compared with control sites (Li et al., 2010).

Many mosquito control programs do not possess the personnel and/or financial resources to consistently suppress *Ae. albopictus* effectively through source reduction and public education campaigns in peridomestic environments (Del Rosario et al., 2014; Faraji & Unlu, 2016). In many cases, the public turns to private pest management companies for assistance with mosquito control (e.g., barrier sprays) on their properties. Therefore, it is vital that the efficacy of different barrier spray products be evaluated.

We evaluated the extent to which different application rates and frequencies of a barrier spray containing Demand CS with Archer (active ingredient: pyriproxyfen) affects life table characteristics (fecundity, fertility, adult emergence rates) of *Ae. albopictus* in a suburban environment. We hypothesized that pyriproxyfen would negatively affect life table characteristics in *Ae. albopictus* because the mosquito would contact the IGR on foliage and potentially transfer it to multiple containers within the environment, as this mosquito is known to exhibit skip-oviposition behavior. We used a combination of field and laboratory methods to evaluate impacts on mosquito abundance and life table characteristics.

Methods

Recruitment of Participants

Our study was conducted in Pitt County in Eastern North Carolina in the Cherry Oaks neighborhood historically known for abundant *Ae. albopictus* populations (data not shown). Homeowners were invited to participate in the study via door-to-door invitation. If homeowners were home at the time

of the investigators' inquiry, we provided a verbal description with details of the study. For homeowners who were not home, we left a handout at their front door with contact information for investigators. Investigators conducted two to three follow-up visits until the homeowner was contacted and invited to participate in the study.

In total, 12 residences (grouped by three nearby residences for each treatment type) were targeted for recruitment in our study. Control properties were recruited and were at least 100 m from treatment properties. Participants were instructed not to carry out any insecticide treatments in their yards for the duration of the study. Barrier sprays were provided to homeowners free of charge for the duration of the study to encourage participation. The institutional review board (IRB) at East Carolina University was consulted and determined that the study did not meet the federal definitions of research involving human participants, hence full IRB review was not required.

Treatments

Certified pest control operators from Clegg's Pest Control (private company with a franchise location in Greenville, North Carolina) carried out barrier sprays for the project. Properties were treated via barrier sprays (Stihl SR 200 backpack blower mister) by a Clegg's Pest Control operator as follows (Figure 1):

1) Demand CS 0.06% + Archer 0.010% (every 60 days; treatment dates of June 13, August 15, and October 17) (code DA60).
2) Demand CS 0.03% + Archer 0.005% (every 30 days; treatment dates of June 13, July 13, August 15, September 15, and October 17) (code DA30).
3) Demand CS 0.03% (every 30 days; treatment dates of June 13, July 13, August 15, September 15, and October 17) (code D30).
4) Control (not treated).

The label recommends Demand CS be applied at the 0.06% rate for residual control of mosquitoes. In our study, we used this rate at an interval of 60 days and a lower rate (0.03%) at a more frequent interval of 30 days to evaluate efficacy. Similarly, the label recommends Archer be applied at the 0.010% rate for residual control of mosquitoes and in our study, we used this rate at an interval of 60 days and a lower rate (0.005%) at a more frequent interval of 30 days to evaluate efficacy. Operators, following label instructions, applied 2–5 gallons of the finished solution per 305 m^2 in circular patterns to vegetation until runoff. Treatments were not conducted in high winds or misty/rainy conditions. We coordinated with the Pitt County Vector Control manager and the City of Greenville Public Works mosquito control operators to let them know of the ongoing study and requested that no insecticides be sprayed in the study area for the duration of the project.

TABLE **1**

Total Adult Mosquitoes Collected From BG-Sentinel 2 Traps

Mosquito Species	Treatment			
	Control	Demand CS 0.03% (Every 30 Days)	Demand CS 0.03% + Archer 0.005% (Every 30 Days)	Demand CS 0.06% + Archer 0.010% (Every 60 Days)
Aedes albopictus	371	193	396	392
Ae. atlanticus	311	199	22	21
Ae. canadensis	3	4	0	0
Ae. japonicus	1	1	2	1
Ae. tormentor	60	29	2	11
Ae. triseriatus	3	7	1	0
Ae. vexans	26	9	10	36
Anopheles crucians complex	4	4	3	1
An. punctipennis	118	88	70	112
An. quadrimaculatus	5	4	7	7
Culex erraticus	44	51	17	26
Cx. pipiens/ quinquefasciatus	23	16	8	9
Cx. restuans	1	0	0	0
Cx. salinarius	0	0	0	1
Orthopodomyia signifera	3	1	0	0
Psorophora ciliata	5	1	6	2
Ps. columbiae	25	29	76	60
Ps. ferox	51	106	16	103
Ps. howardii	0	0	0	1
Toxorhynchites rutilus	1	0	0	0

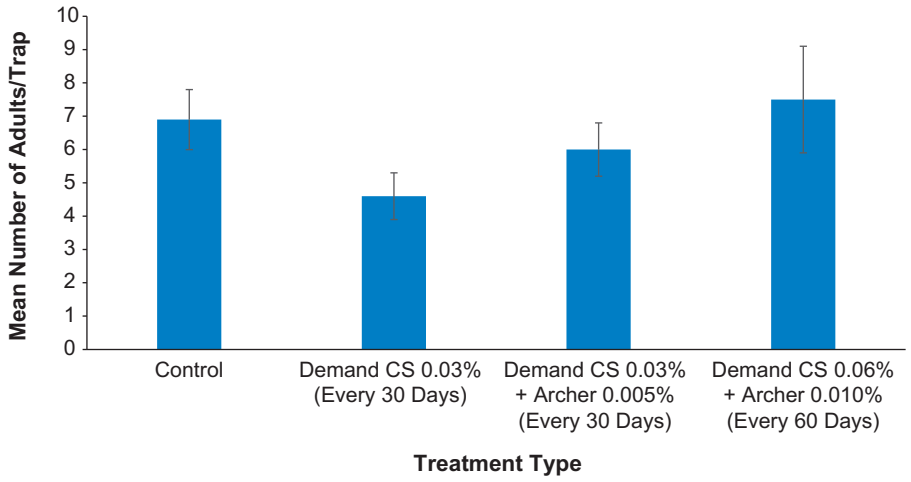
Host-Seeking Mosquitoes

Host-seeking mosquitoes were sampled weekly May 16–October 31, 2017, using BG-Sentinel 2 traps (BioQuip) baited with human scent lure, octanol, and carbon dioxide. Carbon dioxide tanks containing regulators set to release gas at 200 ml/min (BioQuip) were affixed upright to a shepherd's hook pole and a clear vinyl tube (1/4-in. outside diameter; 1/8-in. inside diameter) was clipped to the opening of the BG-Sentinel 2 trap. Each week, a BG- Sentinel 2 trap was set at each study residence (N = 12 traps) for a 24-hr period starting at approximately 9 a.m.

BG-Sentinel 2 traps were placed in a shaded area in the approximate center of properties within the barrier zone. When traps were retrieved the next morning at approximately 9 a.m., adult mosquitoes were transported to the laboratory on ice, identified to species using a dichotomous key (Harrison et al., 2016), and counted using a dissecting microscope. Data for each trap were tracked in Excel according to property address and date.

FIGURE **2**

Mean Numbers (± *SE*) of Adult Female *Aedes albopictus* per BG-Sentinel 2 Trap in Different Treatment Areas After Treatment Commenced



Note. No significant differences were observed between treatment areas.

Assessment of Oviposition Intensity

Egg-laying intensity of container-ovipositing mosquitoes was monitored to determine whether treatments affected this measure of fecundity. We expected eggs laid in ovitraps to originate from gravid mosquitoes residing in the same yards, as well as from mosquitoes immigrating into the yards from other yards in the vicinity. Eggs were collected weekly at all 12 sites (treatment and control) by using a standard oviposition trap (i.e., black plastic 500-ml cup half filled with tap water containing an oviposition substrate of seed germination paper (2.5 x 7 cm) placed inside around the circumference and drainage holes drilled 4 cm from the lip. The cup was zip tied to the same shepherd's hook pole to which the carbon dioxide tank (for the BG-Sentinel 2 trap) was affixed.

At each property, one ovitrap was placed continuously on the ground. The oviposition substrate was replaced weekly (when BG-Sentinel 2 traps were retrieved) for the duration of the study. Each week, the oviposition substrate was transported back to the laboratory and eggs were identified to mosquito species (Bova et al., 2016), counted, and added to data sheets coded for each property. The water in the cups was poured into Whirl-Pak bags each week, because larvae sometimes hatched on the strips; we tracked this information, also. After emptying each cup, fresh tap water was poured into the ovitraps.

Assessment of Life Table Characteristics

After eggs on oviposition substrates were counted, egg strips were dried (to stimulate hatching) and then submerged in 450–750 ml of tap water in emergence cages (Bio-Quip). For the purposes of this study, fecundity equals the number of eggs laid per trap, although we did not track how many mosquitoes laid eggs in each trap. We kept emergence cages in an incubator at 28 °C and fed larvae liver powder ad libitum. Approximately 5 days post-hatching, the number of larvae were counted to calculate fertility (fertility equals the number of larvae per trap divided by number of eggs on ovistrips per trap) and allowed to reach adulthood. Larvae that had hatched prior to the egg strip being retrieved (i.e., collected in Whirl-Pak bags) were also counted in the life table characteristics measures. Adults (females and males) from each brood, separated by date and address, were identified to species, counted, and sacrificed.

Weather Monitoring

Weekly averages for temperature and precipitation were retrieved and tabulated from Weather Underground, an online source of historical weather data. Time lags of 1, 2, 3, and 4 weeks were computed and used in statistical analyses of weather variables in relation to mosquito abundance.

Data Analyses

Statistical analyses were carried out using SAS and comparisons with $p < .05$ were considered significant. Kolmogorov–Smirnov tests were used to determine if the numbers of adult mosquitoes collected in different treatments and weeks were normally distributed. A non-normal distribution was detected, hence data were log transformed (log [x + 1]) prior to statistical analyses to improve normality. A mixed model using repeated measures (traps; control properties were used as a reference) determined the extent to which these variables differed between treatments and weeks: host-seeking adult *Ae. albopictus*, *Ae. albopictus* eggs (fecundity), all species of larvae (fertility), and all species of adults (including *Ae. albopictus*) that had emerged in the laboratory. We list all species collected in BG-Sentinel 2 traps (Table 1). Our analyses, however, focused primarily on *Ae. albopictus* because this species is targeted by BG-Sentinel 2 traps. Analyses of treatment effects were conducted after treatments had commenced (i.e., after week 24 in mid-June). The life span of mosquitoes is variable; therefore, time lags (1, 2, 3, and 4 weeks) were introduced into a regression model for weekly total rainfall amounts in relation to abundance of both *Ae. albopictus* eggs and host-seeking adults.

Results

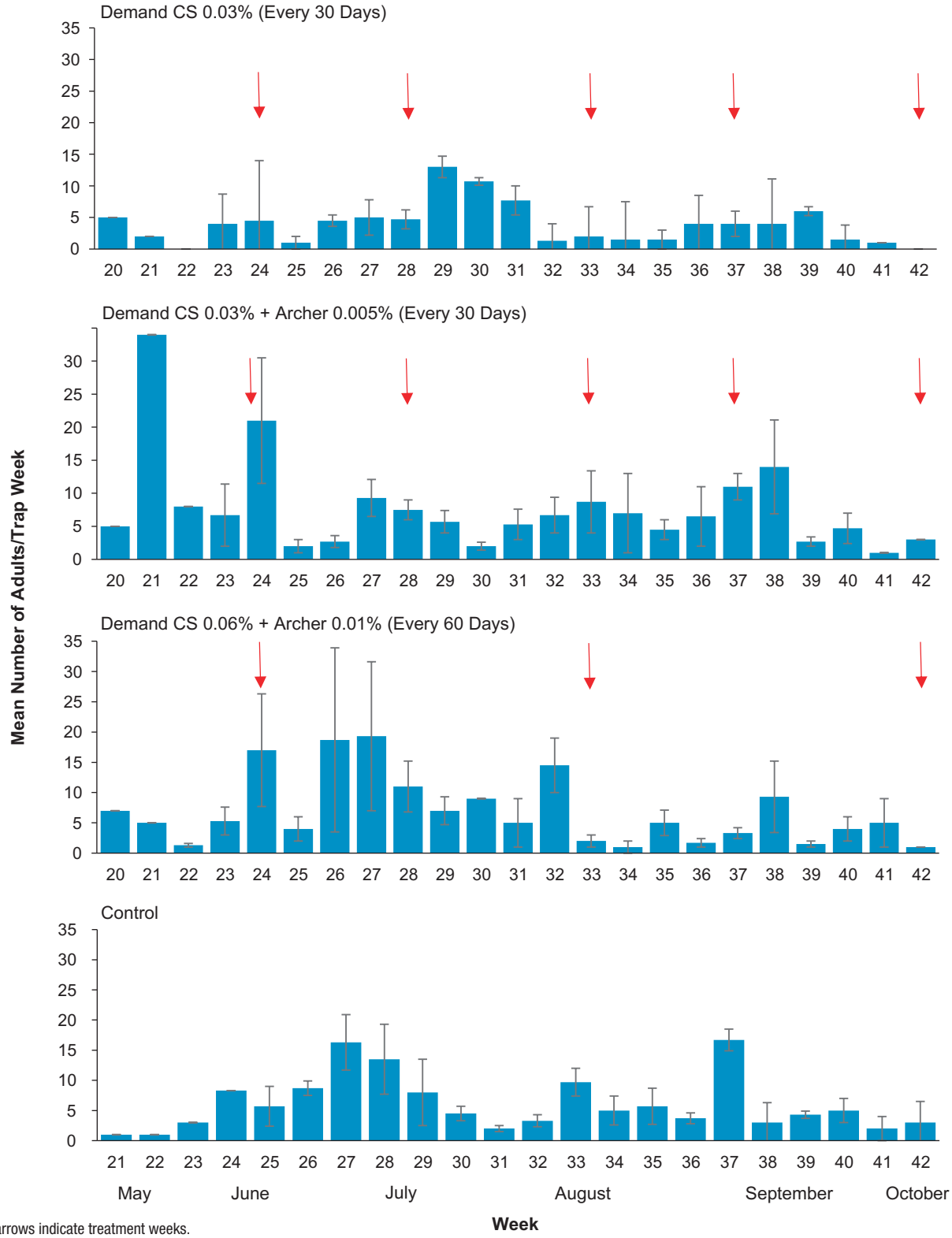
Host-Seeking Mosquitoes

We collected a total of 3,220 adult female mosquitoes from 6 genera and 20 species in BG-Sentinel 2 traps over 24 weeks from May 16, 2017, to October 31, 2017 (Table 1). Of these, 1,352 were *Ae. albopictus* adults (42% of total adults collected). The mean numbers of adults per trap week for each treatment are shown in Figure 2.

Week 24 (before treatments had started; traps set and retrieved June 12 and 13, 2017) and week 27 (before second treatment for lots treated every 30 days; July 6 and 7, 2017)

FIGURE **3**

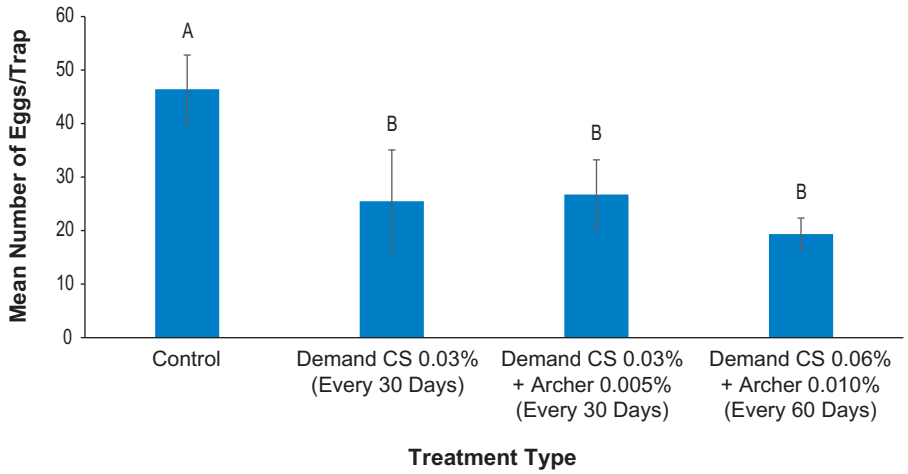
Weekly Means (± *SE*) of *Aedes albopictus* Adults Collected in BG-Sentinel 2 Traps



Note. Red arrows indicate treatment weeks.

FIGURE **4**

Mean Numbers (± *SE*) of *Aedes albopictus* Eggs per Ovitrap in Different Treatment Areas



Note. Means with different letters indicate significant differences ($p < .05$).

showed a significantly higher mean number of *Ae. albopictus* per BG-Sentinel 2 trap than the other weeks of the study ($df = 22$; $F = 2.65$; $p = .002$); however, no differences between treatments were observed ($df = 3$; $F = 1.06$; $p = .417$; Figure 3).

After week 24 (when treatments had commenced), no significant differences were observed in the abundance of host-seeking female *Ae. albopictus* between treatments ($df = 3$; $F = 0.99$; $p = .444$). We did observe, however, differences in abundance of *Ae. albopictus* adults between weeks when all treatments were considered in the analyses ($df = 17$; $F = 2.41$; $p = .003$). When analyses were performed for each treatment type individually, analyses after week 24 indicated no significant differences in mean numbers of host-seeking *Ae. albopictus* between weeks in traps placed at DA60 lots ($df = 17$; $F = 1.36$; $p = .243$) or DA30 lots ($df = 17$; $F = 1.31$; $p = .259$). Significant differences, however, were observed in mean numbers of host-seeking *Ae. albopictus* per trap between weeks in D30 lots with the highest in week 29 (July 19 and 20) ($df = 16$; $F = 2.58$; $p = .022$) and also in control lots, with the highest in week 27 (July 6 and 7) and week 37 (September 14 and 15) ($df = 22$; $F = 2.45$; $p = .009$). Figure 3 presents this information.

The numbers of host-seeking *Ae. albopictus* collected in control lots ($df = 17$; $F = 2.66$; $p = .002$), D30 lots ($df = 16$; $F = 2.78$; $p = .015$), and DA60 lots ($df = 17$; $F = 2.86$; $p = .012$) could be predicted by average temperatures during the week of collection, but not for DA30 lots ($df = 17$; $F = 1.31$; $p = .259$). Likewise, rainfall during the week of collection was a positive predictor of host-seeking *Ae. albopictus* collected in traps in the D30 lots ($df = 17$; $F = 3.92$; $p = .05$).

Aedes albopictus Eggs

We collected a total of 4,423 *Ae. albopictus* eggs in ovitraps during the study from May 16, 2017, to November 2, 2017. The mean numbers of *Ae. albopictus* eggs per trap for each treatment are shown in Figure 4. Significant differences were observed in the abundance of *Ae. albopictus* eggs between treatments ($df = 3$; $F = 4.62$; $p = .037$), with the control lots having higher abundance compared with treatment lots. Conversely, we did not observe statistically significant differences in abundance of *Ae. albopictus* eggs between weeks ($df = 19$; $F = 1.05$; $p = .412$; Figure 5).

Data for ovistrips collected from the field and mosquitoes reared in the laboratory are shown in Figures 5 and 6. Significant differences were observed in the mean numbers of larvae hatched per ovitrap (fertility) between treatment groups ($df = 3$; $F = 4.32$; $p = .043$). Significantly more larvae of all species hatched from eggs on strips collected from control lots compared with other groups. We observed a similar pattern in the mean numbers of *Ae. albopictus* adults (females and males that were reared in the laboratory from ovistrips collected in the field; $df = 3$; $F = 2.82$; $p = .041$) and total adults of all species ($df = 3$; $F = 4.04$; $p = .050$) among treatment groups. Furthermore, significantly more adult *Ae. albopictus*—and adults of all species—emerged in the control group compared with other groups.

The number of *Ae. albopictus* eggs collected could be predicted by average rainfall 4 weeks before collections in control lots ($p = .013$) and DA30 lots ($p = .014$), as well as by temperatures 3 weeks before collections in DA60 lots ($p = .026$). No other significant relationships were observed between weather variables and *Ae. albopictus* abundance.

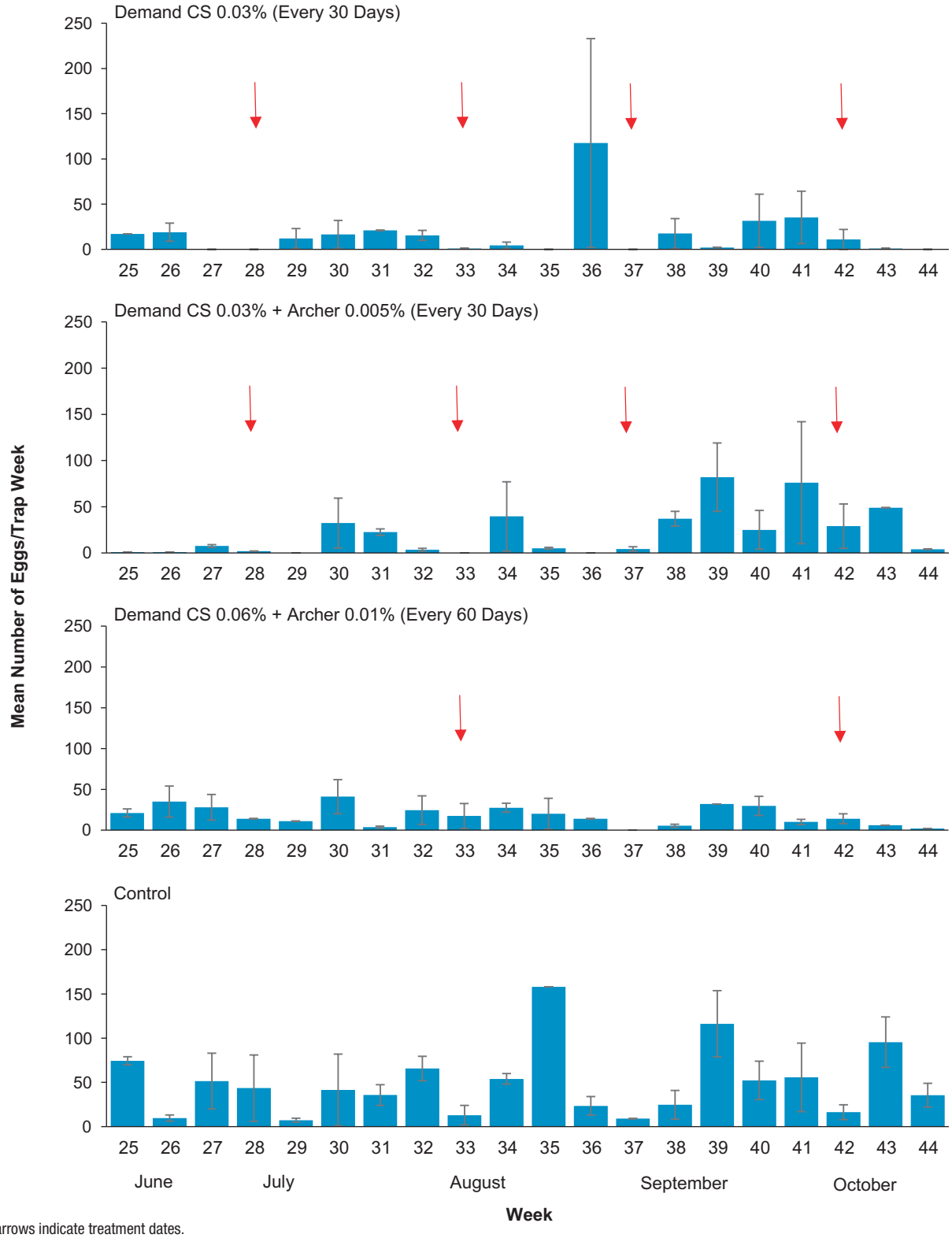
Discussion

Week 24 was one of the weeks with a significantly high abundance of host-seeking *Ae. albopictus* in BG-Sentinel 2 traps. The trapping for week 24 occurred the day prior to the first barrier spray treatments of the study and provided a baseline of early-season mosquito populations in a North Carolina suburban neighborhood. After treatments had commenced, no significant differences in host-seeking *Ae. albopictus* abundance were observed for DA60 or DA30 lots between weeks. Hence, these two treatment regimens might have interrupted *Ae. albopictus* occurrence and abundance within the study lots. Of note, however, we observed significantly higher host-seeking *Ae. albopictus* adults in D30 lots in mid-July compared with the other weeks of the study; this finding suggests a lack of interruption in these lots during this time of year. As bimodal peaks (early July and mid-September) of *Ae. albopictus* adults were detected in control lots, the DA60 lot and DA30 lot treatments might have interrupted host-seeking *Ae. albopictus* occurrence during these periods.

As others have reported, the movement of *Ae. albopictus* from untreated properties into treated properties can confound the interpretation of adult trap counts (VanDusen et al.,

FIGURE **5**

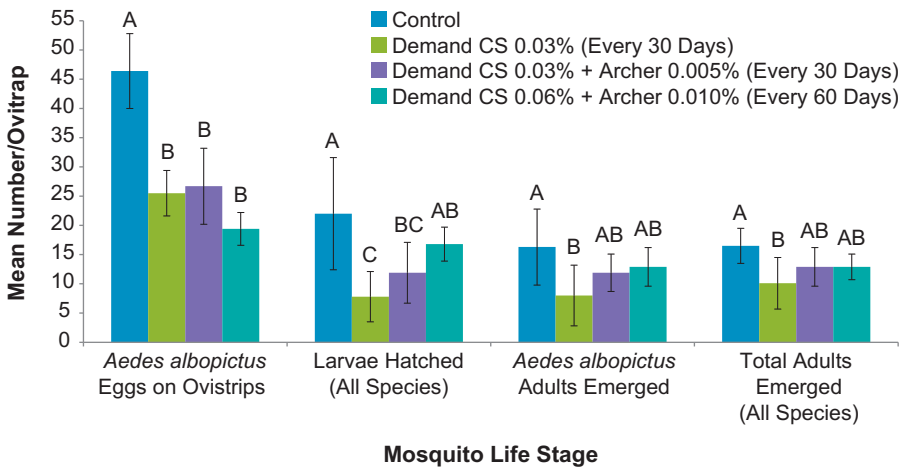
Weekly Means (± *SE*) of *Aedes albopictus* Eggs Collected in Ovitraps



Note. Red arrows indicate treatment dates.

FIGURE **6**

Mean Numbers of Mosquitoes at Different Life Stages Collected in Ovitraps and Reared in the Laboratory



Note. Means with different letters indicate significant differences within variables ($p < .05$).

2016), especially when single properties are treated but are surrounded by untreated properties. A greater distribution of BG-Sentinel 2 traps within the neighborhood could improve the estimation of adult mosquitoes (VanDusen et al., 2016); however, the skip oviposition behavior of *Ae. albopictus* increases the likelihood that these mosquitoes will oviposit in containers from neighboring yards within its flight range of <200 m. It is likely that application technique; frequency of application; scale (i.e., number of adjacent properties treated); number, size, and organic content of water-holding containers present; and other unknown factors impact efficacy (Unlu et al, 2018). This type of barrier spray treatment using a mixture of adulticide and IGR shows promise and should be evaluated further.

Truck-mounted ultralow volume application of pyriproxyfen has also been shown effective for control of *Ae. albopictus* (Doud et al., 2014; Unlu et al., 2017) and should be investigated further as a control method for *Ae. albopictus* and other container-ovipositing mosquitoes. We noted that foliage and brush was cut away at one of the properties within the DA30 lot during weeks 38–39 (late September, approximately 2 weeks after a treatment), which might have affected trap counts during this period. Furthermore, the same property within the DA30 lot was only partially treated during the mid-September monthly treatment due to a pet left outdoors. This variable might have affected the results for the traps set at this residence during the latter part of September.

Significantly more *Ae. albopictus* eggs were observed in control lots; therefore, treatments might have negatively affected mosquito egg-laying. As expected, these effects varied across weeks. These findings are similar to another study that used a different delivery method via pyriproxyfen autodissemination stations and showed significantly lower numbers of eggs collected from treatment compared with control ovitraps (Unlu et al., 2017). Pyriproxyfen has a delayed effect on *Ae. albopictus* populations because the adults that contact the IGR then deliver the active ingredient to containers in their environment during oviposition—hence these dynamics should be considered when interpreting results.

The greater numbers of hatched larvae per ovitrap and *Ae. albopictus* adults emerging from ovistrips collected in control lots makes sense, as these lots were not treated with any insecticides. We expected, however, the lowest numbers of larvae and emerged adults in the lots where high-frequency treatments occurred every 30 days with the pyrethroid and IGR (DA30). This group was equivalent to larvae collected from DA60 lots that had a lower insecticide application frequency, but higher insecticide concentration, of the IGR. It might be possible, therefore, to treat with a higher-labeled concentration of Demand CS with Archer less frequently depending on labor, weather, and other constraints of mosquito control applicators.

While we did not detect any differences in overall host-seeking mosquito abundance between treatments, we did detect week-to-week variation in abundance based on weather variables, treatment dates, and other unknown factors. In field studies, year-to-year variation in mosquito populations is likely and should be considered and analyzed. There might even be differences in levels of insecticide susceptibility and resistance in mosquito populations within the same season; we did not address these questions in our study. One possibility is that a greater number of adjacent properties should be treated in order to increase the potential effects of barrier treatments. This increased scale potentially could minimize the number of mosquitoes immigrating into treated properties—and potentially into CO_2-baited traps or to lay eggs in ovitraps—from untreated properties.

We expected mosquito abundance to vary over time and under different biological and environmental conditions. In our study, there was no predictive relationship between time-lagged rainfall or temperature with host-seeking *Ae. albopictus* abundance. We found it interesting that temperature the same week of trapping was a significant predictor of host-seeking *Ae. albopictus* in properties within control, D30, and DA60 lots, which indicates that temperature likely plays a role in host-seeking activity. Rainfall 4 weeks prior (properties within control and DA30 lots) and temperatures 3 weeks prior (DA60) to trapping were predictive of numbers of *Ae. albopictus* eggs. This finding strengthens the assumption that rainfall and temperature are factors that, in part, drive mosquito abundance and could influence the efficacy of barrier treatments due to degradation of active ingredients with environmental pressure. It makes sense, though, that these trends were not consistent across all groups, as there likely was variation in abundance of water-holding containers, influence of neighboring

properties, and other unknown factors that we did not assess.

Interestingly, the lowest number of hatched larvae and *Ae. albopictus* adults that emerged came from the D30 group, which could illustrate some degree of natural variation in *Ae. albopictus* abundance between lots and/or that the adulticides affected egg laying and/or hatch rates. The reason for assessing life table characteristics (i.e., fecundity, fertility) for eggs laid in the field in the different control and treatment properties was to determine if the IGR and/or adulticide affected egg laying or hatching. While it would be difficult to ascertain the degree to which mosquitoes from adjacent untreated properties laid eggs in our ovitraps, we see this study as a starting point for evaluating this specific IGR-adulticide mixture used in barrier spray applications. Laboratory studies are ongoing and we will further analyze the relationship between IGR exposure in adult mosquitoes and subsequent measures of fecundity and fertility.

As *Ae. albopictus* continues to expand its geographic range, additional research into alternative approaches, such as barrier treatments with mixtures of IGRs and adulticides, are needed to improve mosquito management programs. To maximize *Ae. albopictus* control, mosquito control personnel should remove or empty water-holding containers, treat containers with larvicide during each visit to the property, and inform homeowners how to eliminate mosquito oviposition sites. Individual homeowners and/or homeowner's associations should consider implementing neighborhood education campaigns to inform homeowners about preventable mosquito issues. These education and source-reduction practices, along with barrier treatments, can be used together as part of an integrated mosquito management approach to prevent and reduce nuisance mosquitoes to protect public health.

Conclusion

Pyriproxyfen might be a useful control method for some populations of *Ae. albopictus*, especially where resistance to other active ingredients or cryptic oviposition sources are present. Comparisons could be done to evaluate the efficacy of autodissemination stations, barrier sprays, and/or other methods of application for this IGR, as well as this IGR/adulticide mixture. In addition, the size, level of organic content, and occurrence and abundance of water-holding containers in the landscape could be assessed throughout the mosquito season to test the efficacy of pyriproxyfen at controlling mosquitoes in a variety of container types. The results from this field study have led us to conduct a controlled laboratory study to further evaluate the impacts of pyriproxyfen on life table characteristics in *Ae. albopictus* (Rhyne & Richards, 2020). Taken together, the data gained from these studies will inform mosquito control personnel about the efficacy of barrier sprays against *Ae. albopictus*.

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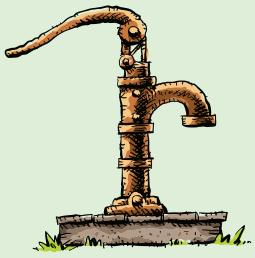

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Rodent Bite Injuries Presenting to Emergency Departments in the United States, 2001–2015

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Abstract **While an increasing number of households are keeping rodents as pets, rats and mice are considered pests and efforts are undertaken to control rodent populations to avoid human–rodent encounters. Tracking the burden of rodent bite injuries can guide prevention efforts. Data for this study were from the 2001–2015 National Electronic Injury Surveillance System-All Injury Program (NEISS-AIP), a stratified probability sample of U.S. hospitals. Records included information about age, body part affected, cause, diagnosis, case disposition, and sex. We coded narrative descriptions for the source of the bite. Every year, an estimated 12,700 injuries from rodent bites are treated in emergency departments, amounting to roughly one rodent bite injury treated every hour. Rats, mice, and squirrels were the most frequently reported rodents that bit people. The largest percentage of bites, approximately 27%, occurred in individuals <10 years and most bites occurred during the summer months. Injuries, zoonotic diseases, allergies, mental health adverse effects, and the environmental impact of rodent exposures exemplify the need for a multisectoral approach to prevention.**

Introduction

Rodents (over 1,400 species worldwide) can cause damage to crops (both in the field and in storage), forestry, nursery and ornamental plants, rangeland, cable, and irrigation pipes; they also can bite and transmit diseases to humans and other mammals. Rodents can even lead to the extinction of native flora and fauna when introduced to islands (Witmer & Eisemann, 2007). In the U.S., native species that cause significant damage in various regions include beavers (*Castor canadensis*), deer mice (*Peromyscus* spp.), ground squirrels (*Spermophilus* spp.), marmots (*Marmota* spp.), mountain beavers (*Aplodontia rufa*), pocket gophers (*Thomomys* spp., *Geomys* spp.), porcupines (*Erethizon dorsatum*), and voles (*Microtus* spp.). Some non-native species are widespread in the U.S. and cause damage as well: commensal rats (*Rattus* spp.), house mice (*Mus musculus*), and nutria (*Myocastor coypus*) (Witmer & Eisemann, 2007).

Domesticated and wild animals cause millions of injuries each year to persons worldwide (Forrester et al., 2018; World Health Organization, 2018). An increasing trend in pet ownership of specialty or exotic animals, such as ferrets, gerbils, guinea pigs, hamsters, lizards, poultry, rabbits, snakes, or turtles, has been noted in the U.S. In a survey of U.S. households, 84.6 million households reported owning a pet (American Pet Products Association, 2018). Cats and dogs constituted the majority of mammalian pets owned, but 6.7 million households owned 14 million small animals (American Veterinary Medical Association, 2018). Well-known rodents include beavers, chipmunks, gerbils, guinea pigs, hamsters, mice, porcupines, prairie dogs, rats, and squirrels. Some rodents such as gerbils, hamsters, mice, and rats are common pets. Less commonly, other rodents such as prairie dogs and squirrels are taken in as pets as well.

Rodents can cause traumatic injuries such as bites and scratches; transmit various infectious diseases to humans; and cause allergic reactions from proteins in their saliva, dander, and urine. Rats and mice spread over 35 diseases worldwide (Centers for Disease Control and Prevention [CDC], 2010). These diseases can be spread to humans directly through rodent bites or handling rodents, or indirectly through human contact with rodent feces, urine, or saliva. Rat bite fever is caused by either *Streptobacillus moniliformis* (also called Haverhill fever) or *Spirillum minus* and can be transmitted by a rodent bite. People also acquire Rat bite fever through consumption of food or water contaminated with the urine and droppings of rodents carrying either bacteria. Prevention is important, as the infection can result in joint damage (polyarthritis), meningitis, and heart infection (endocarditis) and has a potential 10% mortality rate (CDC, 2019a).

Leptospirosis, caused by *Leptospira interrogans*, usually is spread via rodent urine. The disease is known to have variable clinical presentations and severe cases (called Weil's disease) can lead to liver and kidney failure or meningitis (CDC, 2019b). In addition, diseases carried by rodents can be spread to humans indirectly via arthropods such as ticks, mites, or fleas that have fed on an

TABLE **1**

Species of Rodent Responsible for Bite Treated in Emergency Departments, United States, 2001–2015 (*n* = 3,173, Unweighted Count)

Rodent Type	Weighted Annual Estimate	%	95% Confidence Interval	Crude Rate (per 100,000 Persons)
Total	12,733	100	–	4.2
Chipmunk	269	2.1	1.2, 3.0	0.1
Gerbil	97	0.8	0.4, 1.1	0
Gopher	125	1.0	*	*
Groundhog	275	2.2	*	*
Guinea pig	242	1.9	1.4, 2.4	0.1
Hamster	1,069	8.4	5.6, 11.2	0.4
Mouse	3,072	24.1	12.5, 35.7	1.0
Rat	4,282	33.6	*	*
Squirrel	2,848	22.4	16.3, 28.5	0.9
Other rodent**	453	3.6	2.0, 5.2	0.2

*Injury estimates were identified as unstable if the number of sample cases was <20, the weighted estimate was <1,200, or the coefficient of variation was >30%.
**Other rodent type includes beaver, chinchilla, degu, muskrat, porcupine, prairie dog, river rat, more than one rodent source, and unspecified rodent.

infected rodent. Signs and symptoms of allergic reactions from rodents can include angioedema, asthma, bronchospasm, conjunctivitis, rhinitis, urticaria—and rarely, anaphylaxis (Hesford et al., 1995; Matsui, 2013; Rankin et al., 2007; Sheehan et al., 2010; Trummer et al., 2004). In addition, the mental health impacts of rat exposure on urban residents is underappreciated (Lam et al., 2018).

The prevalence of asthma and rat infestation is high in inner cities. In one study in New York City, 13% of apartments were found to have mice present and 37% of the apartments had one or more residents with asthma (Chew et al., 2006). In a study of animal bites in Jefferson County, Alabama, 11% were due to rodents, both wild and pets (Maetz, 1979). A 2003–2006 New York City emergency department (ED) survey (Bregman & Slavinski, 2012) cataloged over 24,000 animal bites, and of these, 8.5% were from rodents (1,614 were from mice and rats, 273 from squirrels, and 173 from hamsters).

Bites and allergic reactions from rodents are also well-recognized occupational hazards in laboratory animal workers, veterinarians, and animal control officers (Anderson et al., 1983; Kampitak & Betschel, 2016; Mann et al., 1984). In a national study of non-canine bite-related injuries in EDs in the U.S. from 2001–2010, there was an annual average of 13,707 rodent bites reported, accounting for 1.4% of reported non-canine animal-related injuries (Langley et al., 2014). Of these bites, rats caused 4,697 (34%) of the bites, while mice caused 3,332 (24%) (Langley et al., 2014). That study, however, did not characterize the affected population or the nature of the rodent injuries.

Continued surveillance of rodent bite injuries can alert local officials to emerging threats and allows for an informed public health response. Our study updates the number of rodent bite injuries reported in hospital EDs in the U.S. and describes the affected patients.

Methods

The National Electronic Injury Surveillance System-All Injury Program (NEISS-AIP) is used to monitor all nonfatal injuries and poisonings treated in hospital EDs in the U.S. NEISS collects injury data from a nationally representative sample of hospital EDs. NEISS-AIP uses a subsample of those EDs for its data collection derived from a national stratified probability sample drawn from all hospitals that provide 24-hour emergency service and have ≥6 beds. NEISS hospitals were sampled with five strata, four of which were defined by hospital size (i.e., small, medium, large, very large) based on the annual number of ED visits, plus one stratum for children's hospitals. This surveillance system is a collaborative effort of the Centers for Disease Control and Prevention's (CDC) National Center for Injury Prevention and Control and the U.S. Consumer Product Safety Commission.

Individuals are included in the surveillance system if they present for a first-time visit for a condition that receives an injury diagnosis after medical evaluation in the ED. Patients who are transferred to a NEISS-AIP hospital are not eligible to be included in the surveillance system and are not double-counted because they do not qualify as a first-time visit. Repeat visits for injuries treated in the same or another ED are excluded from the surveillance system. Individuals whose reason for visit was pain or possible injury but with no injury diagnosis are also excluded. More detailed descriptions of the NEISS-AIP system have been reported in previously published reports (Quinlan et al., 1999; Vyrostek et al., 2002).

NEISS-AIP data were analyzed for a 15-year period from 2001–2015. For this study, cases were defined as persons treated at a NEISS-AIP hospital for bite injuries, where the source was specified as a rodent. For the purposes of analysis in this study, rodent types included chipmunk, gerbil, groundhog, guinea pig, hamster, mouse, rat, and squirrel. Other rodent types included beaver, chinchilla, degu, gopher, muskrat, porcupine, prairie dog, river rat, and woodchuck; however, because there were few cases among these types, they were combined with "more than one rodent" and "unspecified rodent" into the "other rodent" category. Persons who were dead on arrival or who died in the ED were excluded because mortality data are not captured completely by NEISS-AIP. Variables abstracted from the ED record included: age, body part affected, cause, case disposition, sex, treatment date, and a brief narrative description of the injury incident. Cases of patients transferred from NEISS-AIP

hospitals were combined with patients hospitalized, as both case dispositions indicate a need for a higher level of care.

We coded the narrative descriptions for the source of the bite. The source was extracted from the narrative using text string queries and then each comment line was read to verify that the correct one was coded. We replicated this verification twice. A sample weight was calculated for each injured person treated at a NEISS-AIP hospital based on the inverse probability of selection of that hospital. In addition, sample weights were adjusted for nonresponse and poststratified to adjust for changes in the annual number of ED visits over time. Unfortunately, classification of the rodent as a pet or wild animal was not available. Rates were calculated using bridged race population estimates from the U.S. Census Bureau. Injury estimates were identified as unstable if the national estimate was <1,200, the number of sample cases used was <20, or coefficient of variation (CV) was >30%, where CV = (*SE*/national estimate) x 100 (Vyrostek et al., 2002). Analyses were conducted with SAS version 9.4.

Results

From 2001–2015, an estimated 190,900 rodent bites were reported in EDs across the U.S., amounting to over 12,700 treated bites annually. Injury estimates are presented by source, demographics, month, case disposition, and affected body part. The most frequently reported rodent bites were from rats (33.6%), mice (24.1%), and squirrels (22.4%). Bites from rodents traditionally considered pets (hamsters 8.4%, guinea pigs 1.9%, and gerbils <1%) were a much smaller proportion of reported bites (Table 1).

More than one quarter of the patients (26.7%) were <10 years of age and 12.5% were 25–34 years of age (Table 2). There were no significant differences by sex (females 52.1%, males 47.9%). While the number of cases was generally lower in the winter months, overall, cases hovered around 1,000/month and as such, we felt these differences were not significant. The majority (57.7%) of bites occurred at home; however, the location was unknown or not noted in the ED record in over one quarter (27.7%) of the cases. In nearly all cases (97.4%), patients were treated and released from the ED. Extremities, notably arms and hands, were the most frequently

TABLE **2**

Annual Estimates, Percentages, and Rates of Nonfatal, Unintentional Rodent Bite Injuries Treated in Emergency Departments by Selected Characteristics, United States, 2001–2015

	Weighted Annual Estimate	%	95% Confidence Interval*	Crude Rate (per 100,000 Persons)
Age				
0–9	3,398	26.7	17.1, 36.2	8.5
10–14	1,308	10.3	7.9, 12.6	6.3
15–19	947	7.4	5.3, 9.6	4.4
20–24	934	7.3	5.2, 9.4	4.4
25–34	1,596	12.5	7.6, 17.4	3.9
35–44	1,310	10.3	5.1, 15.5	3.1
45–54	1,307	10.3	6.2, 14.4	3.0
55–64	873	6.9	3.7, 10	2.6
≥65	1,059	8.3	4.3, 12.3	2.7
Sex				
Male	6,097	47.9	31.6, 64.1	4.1
Female	6,636	52.1	33.6, 70.6	4.3
Month of emergency department visit				
January	949	7.5	3.2, 11.7	10.8
February	804	6.3	3.4, 9.2	9.2
March	960	7.5	4.4, 10.7	10.9
April	1,160	9.1	6.5, 11.8	13.2
May	1,090	8.6	6.1, 11.1	12.4
June	1,260	9.9	7.0, 12.8	14.3
July	1,247	9.8	6.9, 12.7	14.2
August	1,108	8.7	5.3, 12.1	12.6
September	1,115	8.8	6.4, 11.2	12.7
October	1,190	9.3	4.9, 13.7	13.5
November	1,042	8.2	5.0, 11.4	11.9
December	808	6.3	3.5, 9.2	9.2
Location				
Home	7,351	57.7	34.0, 81.5	2.4
School	828	6.5	3.0, 10.0	0.3
Street	195	1.5	0.9, 2.1	0.1
Other	808	6.3	4.6, 8.1	0.3
Farm	25	0.2	*	*
Unknown	3,526	27.7	17.3, 38.1	1.2
Case disposition				
Treated/released	12,402	97.4	65.1, 129.7	4.1
Hospitalized	93	0.7	*	*
Observed, left without being seen, or unknown	238	1.9	*	*

*Injury estimates were identified as unstable if the number of sample cases was <20, the weighted estimate was <1,200, or the coefficient of variation was >30%.

TABLE **3**

Annual National Estimates, Percentages, and Rates of Nonfatal, Unintentional Rodent Bite Injuries by Affected Body Part, Treated in Emergency Departments, United States, 2001–2015

Primary Body Part Affected	Weighted Annual Estimate	%	95% Confidence Interval	Crude Rate (per 100,000 Persons)
Head and neck	424	3.3	*	*
Trunk	218	1.7	*	*
Arm and hand	10,171	79.9	59.2, 100.6	3.4
Leg and foot	1,803	14.2	*	*
More than one area or unknown	117	0.9	0.4, 1.4	0.04

*Injury estimates were identified as unstable if the number of sample cases was <20, the weighted estimate was <1,200, or the coefficient of variation was >30%.

affected body part (79.9%) and 14.2% of the injuries were to legs and feet. Less than 5% of bites occurred to the face (Table 3).

Discussion

This study is the first to detail rodent bites injuries treated in hospital EDs in the U.S. at the national level. An estimated 12,700 rodent bite injuries are treated in EDs annually, amounting to approximately one rodent bite every hour. This overall number is in line with earlier reports using the same data: Langley et al. (2014) reported a yearly average of 13,707 bites and O'Neil et al. (2007) reported 15,832 bites annually. In a study of rodent bites in Philadelphia, Pennsylvania, from 1974–1996, most bites occurred in the warmer months, similar to our findings, and occurred between 12 and 6 a.m. (Hirschhorn & Hodge, 1999). A study in New York City, New York, found that between 1974 and 1978, there were 1,069 reported rat bites (Coombe & Marr, 1980). The highest number of rat bites occurred in children <5 years, with 41.4% occurring on the hand and 87.9% occurring indoors. Another study of bites treated in New York City EDs between 2003 and 2006 reported 1,614 rat and mouse bites or 5.1 bites/100,000 population (Bregman & Slavinski, 2012). Rat and mouse bite rates were highest among children <2 years (13.1/100,000) and children 2–4 years (8.7/100,000). In a survey of residents in Baltimore, Maryland, 64% of respondents observed rats in streets and alleys, 6% saw rats inside residences, and 1–2% had experienced a rodent bite in their life (Childs et al., 1991).

Our study found that in 57.7% of cases, the person was at home at the time of the bite. Ordog et al. (1985) reviewed 50 rat bite cases and noted 72% occurred when the person was sleeping. Persons living in substandard housing or on the streets are at an increased risk of rodent bites. Homeless individuals are also at increased risk from ectoparasite exposure and exposure to rodent-borne pathogens (Brouqui & Raoult, 2006; Leibler et al., 2018).

Infants, paraplegics, and persons incapacitated by drugs, alcohol, or other causes could be more susceptible to rodent bites (Clinton, 1969). Individuals with peripheral vascular disease and peripheral neuropathy, as often noted in poorly controlled diabetes mellitus, could be at increased risk for complications from rodent bites to the extremities because they might be unaware of the bite. Foot and hand injuries can become infected and lead to soft tissue loss, bone loss, and the need for amputation (Abbas et al., 2005; Donate et al., 2008; Jarial et al., 2016; Kalra et al., 2006).

We found that most bites occurred to the extremities, with 80% occurring on the hands and arms. Other studies also have noted the preponderance of bites to hands or feet. Hirschhorn & Hodge (1999) reported in a study of 358 rat bites that 48.3% were on the hand, 15% on the foot, and 9% on the leg. O'Neil et al. (2007) reported that 68.2% of rat bites occurred to the hand and arm. Ordog et al. (1985) reviewed 50 rat bite cases at one hospital and found that 84% involved the upper extremities and face. Rodent bites can cause severe facial injuries (Ibraheem et al., 2014; Ouazzani et al., 2006; Wykes, 1989) and while rare, can be severe enough to cause hypovolemia from blood loss (Donoso et al., 2004) or death (Forrester et al., 2018; Scott 1965; Yanai et al., 1999).

Rodents are capable of transmitting a variety of diseases, and in many places, they live in close contact with humans (CDC, 2010). Understanding rodent behavior and ecological factors that can increase the risk for a bite are essential to public health interventions and prevention programs. Injuries caused by rats are more common under crowded conditions, in substandard housing, in areas with poor environmental sanitation, or in neighborhoods where rat-infested property is being eliminated (Clinton, 1969).

In an investigation of rat sightings in New York City from 2010–2014, 43,542 rat sightings were reported to the Department of Health and Mental Hygiene from all five city boroughs. The investigation identified proximity to open spaces and subway lines, the presence of vacant housing units, and low education of the population as features corresponding to increased encounters reported between humans and rats (Walsh, 2014). Johnson et al. (2016) analyzed results from a survey in New York City to identify risk factors for rat infestation. They found that property-specific characteristics associated with a high volume of garbage—including large numbers of residential units, public ownership, and open-space designation (parks, outdoor recreation, or vacant land)—were the most important factors in explaining increased rat presence across neighborhoods.

Other neighborhood characteristics—such as being near a railroad or subway line, having a school nearby, the presence of numerous restaurants, or having older infrastructure—also contributed to the increased likelihood of rat encounters. Clustering of rodent bites among city blocks has been noted (Clinton, 1969). Factors such as distance to subways, waste stations, railroads, and parks were shorter for case blocks where more bites occurred. Blocks with a greater number of vacant housing were also considered higher

risk (Childs et al., 1998). Interventions that involved improved garbage management and street sanitation within a designated area reduced the likelihood of finding rats.

Natural disasters (e.g., hurricanes, earthquakes) can change the ecology of a particular area, making it more favorable for rats and other pests at a time when community services are already taxed (National Science Foundation, 2015). Rain, wind, and flooding can damage natural nesting areas of rodents, forcing them to seek higher ground and food sources inside homes, barns, and poultry and swine houses—thus potentially encountering human occupants.

Control of rodents, primarily rats and mice, is important to prevent damage of buildings and to protect the health and safety of occupants (CDC, 2006). Damage to a structure can occur when rats and mice gnaw on structural components, such as wiring, wood, and plastics. The gnawing on wire insulation can result in electrical shorts and fires (Desoky, 2018a). A variety of methods can be used to manage rodent populations directly or to reduce the damage caused by rodents. Like humans, rodents require food, water, and shelter. Long-term damage mitigation and population control results generally are best achieved if a variety of methods are used (CDC, 2006, 2010; CDC & U.S. Department of Housing and Urban Development, 2006; Desoky 2018a, 2018b; Witmer, 2019).

Integrated pest management (IPM) is a comprehensive interventional approach that emphasizes the health and safety of the environment, humans, and nontarget animal species (e.g., pets, birds, and agricultural animals). Successful IPM programs require an understanding of the behavior, ecology, and activity of the target rodent pest in the environment, as well as the changes that periodically occur in the pest's environment (i.e., human-driven and climatic events) (CDC, 2006). Conducting rodent surveillance of exterior areas of residential and abandoned buildings; commercial (e.g., restaurants) and public buildings (e.g., schools); vacant lots and other public areas (e.g., parks); and agricultural production facilities is necessary to assess the conditions of infestation in a community.

A multisectoral approach includes managing rodents by preventing and treating rodent infestations and reducing future infestations through a combination of eliminating access points, removing food sources and shelter, and using traps to remove existing rodents (CDC, 2010; Desoky, 2018b). An IPM strategy on the exterior incorporates multiple methods to minimize the presence of rodents in the area. Methods might include elimination of rodent attractants such as minimizing spilled garbage, moving dumpsters away from the structure, and removing standing water and excess vegetation. Barriers to minimize entrances into the building could include door sweeps and thresholds that allow for a tight fit when closed. Locating and sealing entry points can help keep rodents out of buildings (CDC, 2006, 2010; CDC & U.S. Department of Housing and Urban Development, 2006).

Limitations

NEISS-AIP provides national estimates but does not include state or local estimates. Information on prior rodent allergies was not available for this study but would be useful information to know in cases of anaphylaxis. In addition, the total extent of bites is underestimated because this study did not include individuals who were treated in an urgent care clinic or physician's office, those who self-treated, or those who went untreated. Also, we did not obtain information on whether a bite injury resulted in a wound infection or whether the person developed a zoonotic disease.

Conclusion

While this study did not evaluate infections after a rodent bite, there are numerous zoonotic infections that can occur from exposure to rodents (Bonnefoy et al., 2008; CDC, 2010; Chomel, 2015; Easterbrook et al., 2007). Persons bitten by a rodent should be evaluated by a healthcare professional and followed closely for signs of infection. Understanding rodent behavior and ecological factors are important to control the rodent population and decrease human–rodent encounters.

A multisectoral approach is imperative to educate the public and to prevent infestations, disease, and injury associated with rodents. Healthcare professionals, veterinarians, public health officials, city planners, emergency responders, environmental health officials, and pest control professionals play key collaborative roles. Education of rodent pet owners and persons in occupations with exposure to rodents can include increasing awareness of rodent diseases and transmission, preventing direct and indirect exposures to rodents and their excreta, and emphasizing the importance of hand washing (CDC, 2010).

It is also important to follow tips for safe pet handling (CDC, 2017). Regarding environmental and social conditions, rodent-inflicted injuries are most common in crowded, substandard housing in areas with poor environmental sanitation or in neighborhoods where rodent-infested property is being eliminated. IPM programs should be an integral component of prevention efforts to decrease human–rodent contact.

Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the views of CDC or the North Carolina Division of Public Health. The authors have no financial disclosures or conflicts of interest to declare.

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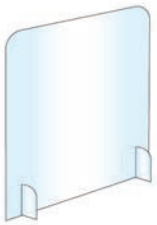

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INTERNATIONAL PERSPECTIVES

Exploring the Perceived Health, Community, and Employment Impacts of an Announced Closure of a Coal-Fired Power Station in Upper Hunter Valley, Australia

Janet Roden, MA, PhD, RN, RM
New South Wales Nurses and Midwives' Association

Abstract **The announcement by AGL Energy Ltd. that it would close its aging Liddell coal-fired thermal power station outside of Muswellbrook in New South Wales, Australia, in 2022 and concentrate on energy generation from renewable sources produced the ideal opportunity to conduct a study of how accepting communities in the Upper Hunter Valley (UHV) were of the closure of the power station. A mixed-methods approach was conducted by means of focus group meetings and interviews using qualitative data, as well as surveys collecting qualitative and quantitative data. Analysis of the qualitative and quantitative data showed that the communities were divided regarding issues about personal and family health. Of the respondents, 71% clearly agreed that the transition away from coal would have a significant impact on the economic and social life of UHV communities. Although there was a suggestion of an authority being established to guide the transition, a renewable energy hub would seem to be an important development opportunity. Before initiating changes that could lead to a transition, the author believes that the "underlying culture of ignorance" should be extinguished. The lack of understanding about toxic chemicals and health, as well as the lack of knowledge about renewable energy, needs to be addressed through investment in community health education, renewable energy education, and educational support to provide new renewable training opportunities for power workers.**

Introduction

Climate change is the biggest threat in the 21st century (Watts et al., 2019); many advocate that now is the time the world has to deal with the climate crisis (Ripple et al., 2020). Extreme weather events in many countries range from earthquakes, typhoons, hurricanes, floods, and extreme heat leading to fires and toxic smoke. In global terms, emissions reduction is essential if we want to reduce our carbon footprint by 2 °C to return to pre-industrial averages (Group of Seven, 2015).

In regard to global coal production, China is the biggest producer; however, China has closed its four big coal-fired power stations in Beijing due to extreme pollution, but is now building coal-fired power stations in many other countries (Inskeep & Westerman, 2019). China remains the world's biggest producer of carbon emissions, but in 2018 also contributed to one third of the global renewables investment (Hutchens, 2020). China sees itself as a leader in renewables, but also is working to get other countries to produce coal-fired power.

Many countries, including the U.S. and UK, currently are reducing their dependency on coal ("Coal in a Hole," 2019; Thomas et al., 2019). In the U.S., many power stations have been retired or switched to other fuels (U.S. Energy Information Administration, 2020). In the U.S., however, it must be noted that since 2000, coal-fired advanced power stations are cleaner, more efficient, and less costly because of their low emission boiler systems and high-performance power systems (Ruth, 2001). Coal-fired power stations produce 40% of Germany's electricity; however, Germany plans to phase out all of its coal-fired power stations by 2038 (Kirschbaum, 2019).

Many articles have focused on toxic pollution and health impacts of coal-fired power stations. For example, Lin et al. (2019) analyzed lung cancer incidence from all countries with coal-fired power stations and found that exposure to ambient particulate matter is associated with long-term health consequences (i.e., lung cancer). A systematic review of epidemiological literature about impacts of coal-fired power stations has produced toxicological research showing that coal combustion by-products are carcinogens, endocrine disrupters, and cardiorespiratory toxins (Amster, 2019). Other articles on assessment of mortality have noted that ischemic health disease, cardiopulmonary disease, and lung cancer were all reported as health outcomes from recent and earlier understanding of $PM_{2.5}$ emissions from coal-fired power stations (Kuo et al., 2014; Venners et al., 2003).

In 2015, 196 countries committed to the United Nations Framework Convention on Climate Change and adopted the Paris Agreement to tackle climate change by reducing emissions caused by fossil fuels such as coal. All countries involved were obligated to contribute to climate change mitigation and adaptation. Issues have been raised regarding this universal, legal framework such as the fact that there are few mandatory provisions that are enforceable (Abbott et al., 2000) and many details have not been worked out or negotiated (Streck et al., 2016). Furthermore, another issue is the difference occurring between developed countries that targeted the contributions of their economies in contrast to developing countries that wanted a project-based approach with no targets (Bolscher et al., 2012; Ecologic Institute et al., 2012).

Ambitious, committed countries will need to step forward, or there is the risk that individual country contributions will not be adequate to meet climate change (Streck et al., 2016). Four years after the Paris Agreement was adopted, eight signatories (Kyrgyzstan, Lebanon, Turkey, Iran, Iraq, Angola, Eritrea, and Libya) have not formally backed the agreement, with Turkey and Iran being the two biggest emitters. Another blow to the agreement was that in 2019, the U.S., second largest emitter after China, decided to leave the Paris Agreement (Apparicio & Sauer, 2020).

The Paris Agreement has its own challenges. To avoid becoming a framework that lacks action and support, its member countries must bring renewed vigor to international efforts to form coalitions and agreements to address the collective action problem of climate change (Streck et al., 2016). In line with its obligations under the Paris Agreement, the Australian Government has committed to reducing emissions to 26–28% below 2005 levels by 2030 (Australian Government, 2015). According to the Intergovernmental Panel on Climate Change, to reduce Australia's coal-generated energy usage by 78%, 12 of the 21 coal-fired power stations would need to close by 2030 to avoid catastrophic effects of climate change (Slezak, 2018). The Liddell and Vales Point B coal-fired power stations in New South Wales (NSW) are two of the four coal-fired power stations older than 45 years in Australia (Slezak, 2018). Fossil fuels remain important for the present coalition government (Parkinson, 2020); however, renewable technology is gaining in importance as many companies are investing in solar in the central west of NSW (Nicholas, 2020).

AGL Energy Ltd., the owner of the Liddell Power Station, is focusing on renewable energy; they clearly propose in their corporate direction to move toward developing renewable energy sources, including some on the existing Liddell site (AGL 2016, 2017; Construction, Forestry, Maritime, Mining, and Energy Union [CFMEU], 2017). AGL stated it is committed to an orderly transition and instituted the Liddell Innovation Project to build on the work of Hunter Energy Transition Alliance by calling for proposals from organizations for the optimal use of available Liddell land and resources. The assessment criteria reflect AGL's intent to work alongside industry, the community, and workers to best manage the local and regional challenges while maximizing the opportunities a transition presents (AGL, 2018).

In the Upper Hunter Valley (UHV), there are eight coal mines and two power stations close to Muswellbrook in New South Wales, Australia (Roden, 2018). The estimated local health costs of coal from mining and power generation in UHV are on the order of $700 million/year (Climate and Health Alliance, 2015). The announcement by AGL that it would close the Liddell coal-fired thermal power station outside of Muswellbrook in 2022 (AGL, n.d.) and concentrate on energy generation from renewable sources presented an opportunity to explore how this transition from coal would impact the health, economy, and social life of communities in UHV. Since that time, AGL has been forced by the government to stay open until 2023 to meet energy demands over summer (Cox, 2019). AGL has given 7 years' notice about the closure and has been consistent in messaging about how existing workers will be treated, as well as the overall transition to power generation from renewable sources (AGL, 2017; CFMEU, 2017).

For this article, research aims were centered around:

1. Exploring the health of people and their families in UHV.
2. Addressing people's views on the general transition away from coal and what this would mean to UHV.
3. Acknowledging people's feelings and exploring issues they might have about the closure of the Liddell Power Station.
4. Addressing personal assistance and discussing people's views on supporting their communities.
5. Exploring and encouraging development of alternative and diverse industries, especially those involved in renewable energy.

Methods

A research grant from Climate Action Network Australia enabled this exploration on how the transition to renewable energy would affect those most affected, such as power workers and miners (Sweeney & Treat, 2018). Preliminary interviews commenced in July 2017, with surveys distributed from March 21–May 21, 2018, with focus groups and analysis following. The project aimed to involve local nurses and midwives in the research process; ethics approval was obtained from the Hunter New England Human Research Ethics Committee (17/11/15/5.08). Numerous nurses and midwives completed the survey. Some nurses also assisted with survey distribution, but none volunteered to assist in an ongoing advocacy support role.

To achieve a sampling fraction of 0.2, 500 respondents from a population of 50,000 would be required in a bigger quantitative study. This small, mixed-methods pilot study was also qualitative, with 10 interviews undertaken to gain an understanding of the key community personnel, along with follow-up focus groups. To achieve adequate participant representation, the sample of 98 people included of a diverse group of local nurses, Liddell power workers, miners, agricultural workers, viticulture employees, horse industry employers, educators, administrators, community members, and local elected officials including the mayor of Muswellbrook.

Interviews and Discussions

To obtain an in-depth understanding of the situation in UHV, the chief and assistant researcher attended community meetings as well as interviewed and held discussions with key players in the area. Key people included: the mayor of Muswellbrook, officials from the main trade unions covering power workers from the Electrical Trades Union of Australia (ETU) and miners from the Construction, Forestry, Maritime, Mining, and Energy Union (CFMEU), a representative of AGL, a Newcastle Technical and Further Education (TAFE) lecturer, a state

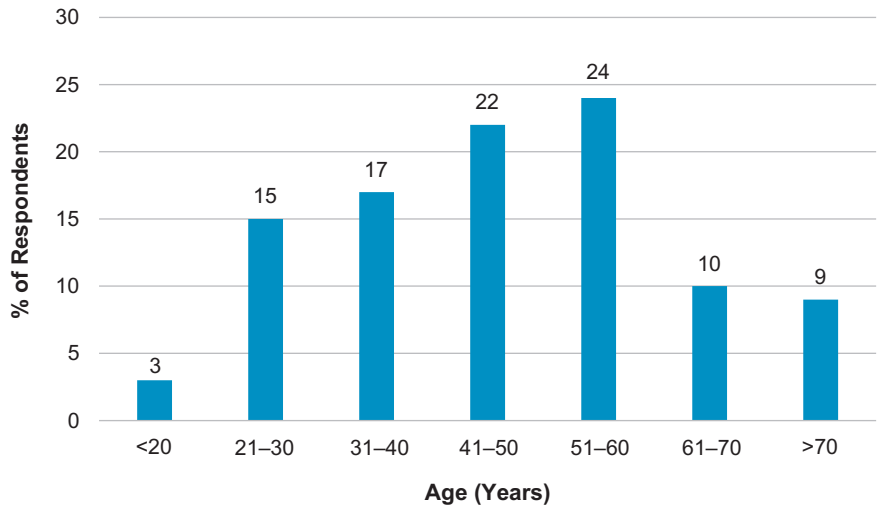
government agency staff member, two local elected officials, and a number of community and health activists.

It was important for the researchers to understand the community issues from the different points of view of the community members interviewed. During this process, we discovered that the important organizations involved had vested interests. For example, both ETU and CFMEU representatives were supportive of their workers, with the ETU representative stating that pressure needed to be placed on AGL to assist workers without jobs to diversify through assistance with start-up companies. This statement was followed by the CFMEU representative suggesting that the Australian Labor Party had a worker retrenchments/redundancies plan for dealing with Liddell while the national CFMEU representative was sure a worker transfer plan, such as the one used in Latrobe Valley, Victoria, would be effective for Liddell workers.

On the other hand, AGL's communications representative shared with the researchers the company's renewables plan without any reference to worker needs. Taking another position, the mayor of Muswellbrook was keen to discuss what had been done to develop partnership opportunities with universities and other organizations for initiatives in UHV. The mayor commented, "When council consults with community, there is a repeated and consistent concern threaded through our feedback—where will our kids work in 20 years from now?"

FIGURE **1**

Age of Survey Respondents



Survey

In order to complement the qualitative approach, the author developed a survey during February 2018 that included closed- and open-ended questions about:

- individual and family health and well-being,
- types of assistance that might be required by those affected by the Liddell closure,
- community impacts of the Liddell closure,
- whether the Liddell closure was the beginning of a transition away from reliance on coal,
- whether a transition away from coal in UHV would have a significant impact on the life of their communities,
- types of assistance that might be required if the transition away from coal was occurring in UHV,
- whether people were interested in working with renewables, and
- demographic questions including participant age and the type of work done by the individuals and their spouses/partners.

In the survey, 10 of the questions involved a 5-point Likert scale (strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree), 5 open-ended questions, and 9 closed-ended questions. After a survey draft was distributed to colleagues for review and comment, distribution of the final survey in paper form commenced in March 2018 and in electronic form in April 2018. The survey closed in late May 2018.

To obtain a wider cross section of the community, surveys were distributed at the two advertised community meetings and via street stalls in the main street, and at a local Muswellbrook pharmacy. The electronic version of the survey was completed by people working for Liddell after AGL approved its distribution and announced it to staff via e-mail on May 8, 2018. Of the 98 surveys returned (60 in paper form and 38 in electronic form), 5 were incomplete but were included in survey analysis.

Community Meetings in Muswellbrook

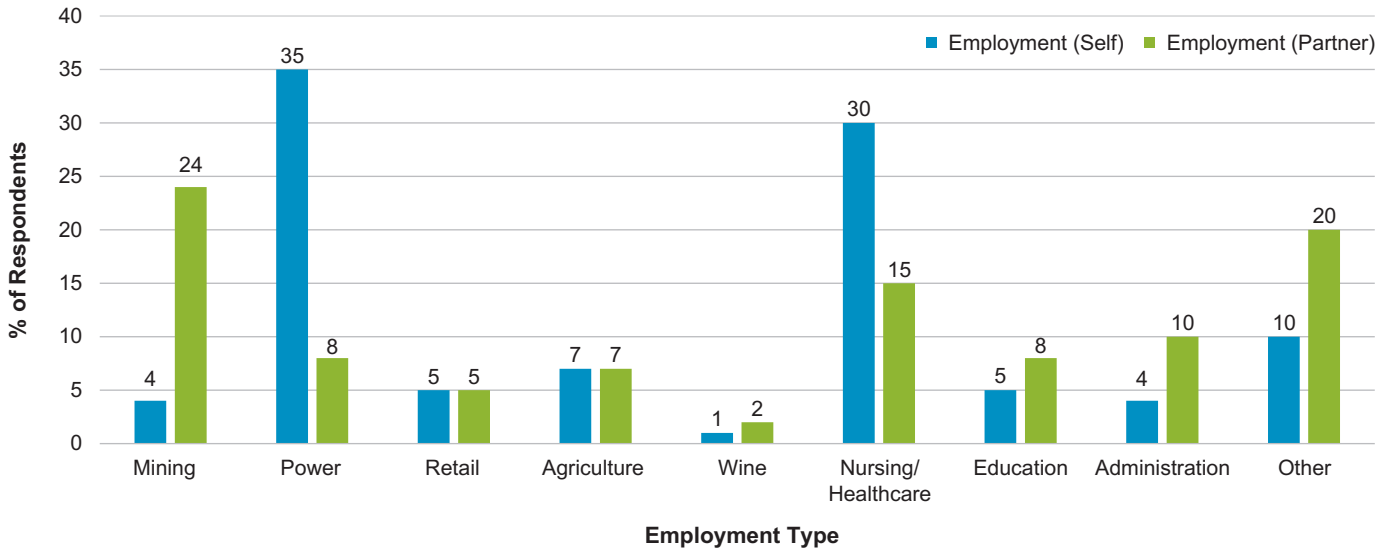
There were eight people at the first workshop held in Muswellbrook on March 21, 2018, with two people attending on the following day. Paid advertisements were placed in local papers and electronic and paper invitations were forwarded to many community groups, the New South Wales Nurses & Midwives' Association UHV members, elected officials including two mayors, and representatives from schools and preschools in UHV.

The first workshop was led by Dr. James Whelan, a community organizer and chief researcher with Environmental Justice Australia. Respondents explored the issues related to expected community impact following the announced closure of Liddell; the likely impacts on Muswellbrook and surrounding communities of a wider transition away from coal to renewables; and elements of a transition policy for those individuals, communities, and businesses most affected. The two respondents at the second workshop the next day were introduced to the same issues covered during the first workshop. Notes of these discussions were taken at the time and later transcribed for use in the analysis of community responses and survey data. Feedback from the workshop participants included:

- The closure of Liddell is not going to affect the mines around the Muswellbrook area and AGL will be giving people other jobs, not firing people. The perception among the community, however, is fear and there is a general feeling that the closure will affect people.

FIGURE **2**

Survey Respondent Employment Types for Self and Partner



- People worry for their children's job future, especially because young apprentices thought they would be working at Liddell. Discussion about redeployment is disappointing because there are not many diverse industries around Muswellbrook.
- Disagreement occurred about Muswellbrook's coal being the last to shut down. One viewpoint was that mining would be shut down through global sanctions because more people will go off the grid, banks will pull out of funding for mining, and the world will become "realistic."
- Government policy and planning is lacking. The community needs inspirational bipartisan leadership.
- The local community does not care about these issues. It could be ignorance, lack of education, or not wanting to know. One respondent who was a local elected official offered that she got hate mail about her support of renewables on social media, which could reflect some attitudes in UHV communities.

Focus Group Meetings

Once all the surveys had been collected, the quantitative data were analyzed statistically and the qualitative data from surveys and community meetings were examined for themes. The themes were separately identified by the chief researcher and research assistant and agreed on, resulting in a set of preliminary findings that could be discussed with the two focus groups. Notes were taken at the focus groups. For the purpose of validation, four people attended the focus group meetings held in Muswellbrook on June 14 and 20, 2018, to discuss, review, and agree with the preliminary findings, as well as add their understanding. The survey asked respondents whether they wanted to participate in the focus groups. People indicating interest were contacted by phone. In addition to scheduled participants, on June 14, a friend of a focus group participant and a Muswellbrook elected official attended; on June 20, a worker from Liddell also attended to provide his input.

Results

Demographics

A total of 98 surveys were returned (60 paper and 38 online). Of the respondents, 54% were women and 46% were men. The age of respondents ranged from <20 to >70 years (Figure 1). In regard to employment, 82% of respondents stated they were working, 11% were retired, and 5% were not working. A small number (2%) said they were concerned about losing their job or someone close to them losing their job.

Respondents shared a wide range of areas of employment, as did their spouses/partners, with the two biggest combined groups being power plant and nursing/healthcare workers (Figure 2). The majority of respondents (58%) stated they lived in Muswellbrook, with the remainder split evenly across nearby locations.

Community Uncertainty

Our research shows that respondents are divided about the health, social, and economic impacts of the Liddell closure. They are confused about what is happening at Liddell and whether they and their families will be personally affected by the closure. As previously noted, this uncertainty remains even though AGL has given 7 years' notice of their closure and has provided consistent messaging about the plan for workers. At the first Muswellbrook workshop, initial comments from respondents were about the confusion from the community around the Liddell closure.

Research results showed that only 12% reported being happy about the plant closure in regard to health and the environment, with no mention of social or economic impact. In contrast, 34% reported worrying about loss of jobs, economic factors, and whether renewables

would power the town. The remaining respondents' answers suggested they were ambivalent about the closure. Nearly three quarters of respondents (71%) indicated that the transition away from coal will significantly impact the economic and social life of UHV communities.

Health and Well-Being

A majority of respondents (55%) saw themselves and their families as being affected by the announced closure of Liddell, with most respondents being in the 51–60 age group. In contrast, 22% of all respondents that they would be affected. Additionally, 72% of power workers agreed they would be affected, while 42% of the nursing/healthcare group saw themselves as being affected.

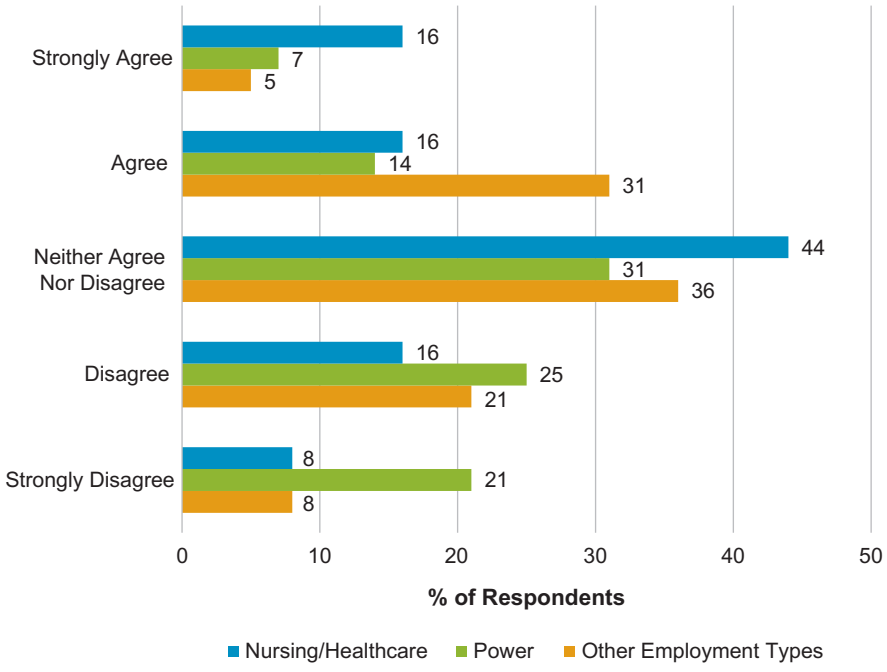
Of the respondents, >40% stated that they were not feeling uncertain about their situation, 34% said they were, and 25% neither agreed nor disagreed. The results for "sometimes I feel tense and worried" were similar. Compared with female power workers, 72% of male power workers felt somewhat less certain. Overall, power workers were more uncertain than the nursing/healthcare group or other occupational groups. Of the 25% of respondents who said they "felt tense and worried," 47% were power workers, with only a small proportion (6%) who answered that they "had to go to the doctor more often."

As with the previous well-being questions, there were widespread results regarding confidence about the future, with responses being almost evenly split three ways between agreeing, neither agreeing nor disagreeing, and disagreeing (Figure 3). Women were a little more confident about the future than men, and the nursing/healthcare group (32%) was somewhat more confident about the future than power workers (21%).

The majority of survey respondents (46%) were undecided about the question "my health will not improve when the Liddell power station closes." On the other hand, the remaining respondents were divided equally between those disagreeing and those agreeing that their health would not improve (Figure 4). This result might have occurred because of confusion, as the question was phrased in the negative. It is interesting to note that an equal number of respondents agreed as well as disagreed that there were health benefits. The open-ended question that followed, however, confirmed that some people were aware of the negative effects of power emissions on respiratory health.

FIGURE **3**

Survey Respondent Indications of Confidence About the Future



Nearly one half of the survey respondents (46%) answered that assistance to change jobs (20%) was important, with other assistance (11–14%), retraining and relocating (14%), financial planning (13%), living on a lower income (12%), and transition to retirement (11%) indicated as approaches that would help them to deal with the closure. Of note, only 8% of respondents indicated mental health services as an approach that would help them deal with the closure.

Transition Away From Reliance on Coal

In addressing the transition away from reliance on coal, "a significant impact on the life of our communities" was the question with the most consistent response. In total, 71% of respondents agreed that such a transition would have a significant impact (Figure 5), with no significant differences between occupational groups or sex. Comments were about loss of high-paying mining jobs and the domino effect on housing prices, businesses, and families moving for alternative employment. Most respondents (60%, both women and men) agreed that the Liddell closure marked the beginning of a transition away from coal. Power workers (36%), who will be most affected by the closure, also strongly agreed with this viewpoint (Figure 5).

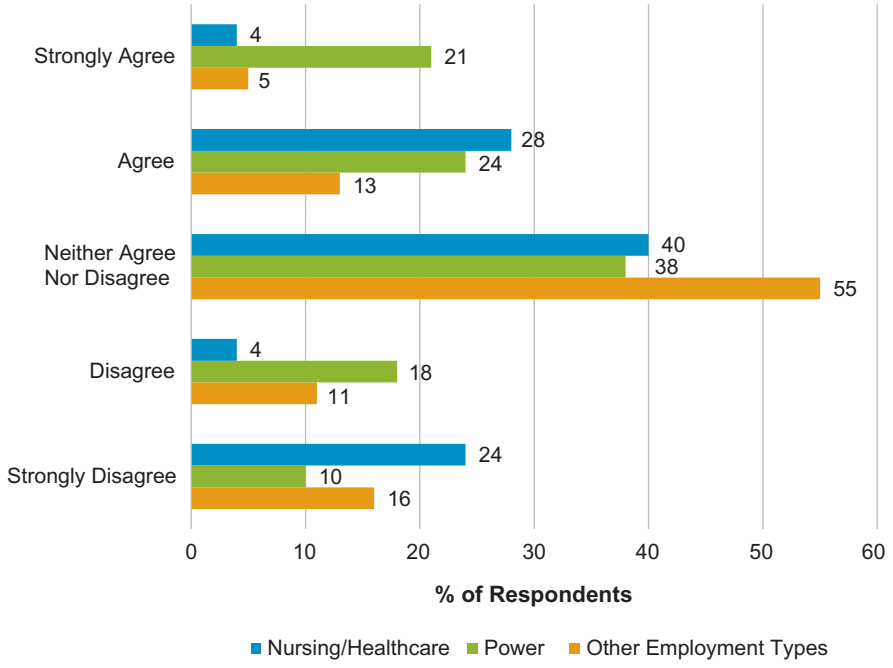
Establishing an authority for transition planning received only 8% of responses, but there was a cluster of six types of assistance options (10–14% of responses) such as 1) renewable employment, 2) planning for start-up industries, 3) talking to people, and 4) decommissioning of mines, with other important assistance seen as being 5) community participation and 6) negotiation to ensure retraining opportunities being available through TAFE.

Interest in Working With Renewables

A high number of power workers (79%) stated they would be "interested if these renewable industries were to develop in the Upper Hunter Valley." About one third of respondents who answered no to this ques-

FIGURE **4**

Survey Respondent Indications Regarding Health Not Improving With the Closure of the Liddell Power Station



tion also expressed doubts about the reliability of renewable energy to generate sufficient electricity at a good price, which also appeared linked to respondents' concerns over transferability of their skills (Figure 6).

The difficulty getting accurate information about coal and its health hazards, as well as about renewables and their capabilities, was noted by the focus groups. Additionally, because coal is an important economic factor in their community, some people had formed a denial response.

Discussion

Due to concern shown in the study findings regarding the lack of community knowledge about their health and renewable energy, the author's focus is on these aspects in the discussion, recommendations, and conclusion.

Health

It has been previously shown that toxic chemicals produced by power stations contribute to community illness, along with huge estimated health costs from coal mining and power generation per annum in UHV (Climate and Health Alliance, 2015). AGL's self-reported pollution data state that for 2016–2017, the Liddell Power Station emitted 28 kinds of pollutants, the most deadly being sulphur dioxide (33,490 tonnes), nitrogen oxides (18,627 tonnes), $PM_{2.5}$ (18.3 tonnes), in addition to emissions of carbon dioxide (8,855,569 tonnes) (Australian Government, Clean Energy Regulator, 2018; Australian Government, Department of the Environment and Energy, 2018).

Fiona Plesman, former acting general manager of Muswellbrook Shire Council, acknowledged that the levels of nitrogen oxides would be a real community concern, especially for regulators and the council, as they were 3 times the rate of global emissions (Millington, 2018). Focus group members were surprised that so many respondents believed their health would not improve (26%) or were undecided about any health improvement (46%) with the power station closure. Survey comments included, for example, "As far as I am aware only steam is emitted from the Liddell Power Station" and "There are so many mines around us that one more source of pollution won't make any difference."

A Renewable Energy Hub for Upper Hunter Valley

Power workers had the highest interest in working with the renewable energy and technology sectors because they could transfer their existing skills to alternative employment such as renewable energy, working with new start-up industries as well as the decommissioning of power stations and mines.

As stated previously, AGL is developing renewable energy sources, including some on the existing Liddell site (AGL, 2017; CFMEU, 2017). In June 2008, the Centre of Full Employment and Equity at The University of Newcastle published their policy report, *A Just Transition to a Renewable Energy Economy in the Hunter Region, Australia* (Bill et al., 2008). This report models and analyzes two different renewable energy scenarios for the Hunter and Wyong regions. Furthermore, it highlights that if there is a shift from coal-fired power generation to a renewable energy economy, the creation of thousands of well-paid jobs in research, design, manufacture, installation, maintenance, and export of energy efficiency and renewable energy technologies will happen (Bill et al., 2008).

Although published a decade ago, the report still provides a detailed and useful model for considering the development of a renewable energy hub in the Hunter Valley. In July 2016, the Hunter Energy Transition Alliance published its *Blueprint Report* that discusses the main strength of the area being water, new energy innovation, land use opportunities, and opportunities for agribusiness and innovation (Energy & Resources Knowledge Hub, 2016). According to the focus groups, diversification of industries would mean a greater chance of returning communities to a more balanced, healthier economic and social lifestyle rather than the main heavy mining emphasis; some participants said they felt "solastalgia," which is a neologism to describe depressed feelings produced by the chaotic appearance of the environment around them (Albrecht et al., 2007; Daley, 1999).

Establishing an Authority for Transition Planning

Australia does not have a strong track record of dealing with major changes such as industry transitions (Armstrong et al., 2008). To this end, in November 2016, the Australian Council of Trade Unions released its discussion

paper, *Sharing the Challenges and Opportunities of a Clean Energy Economy*. The policy paper argues for navigating and managing Australia's transition to a clean energy economy (Australian Council of Trade Unions, 2016; Slezak, 2016). Global discussion on this topic is ongoing (Sweeney & Treat, 2018).

In planning for the future, collaboration and cooperation should include state and local government, representatives of chambers of commerce, relevant industry bodies, union representatives, and community groups, in line with recommendations of the Liddell Innovation Project (AGL, 2018). Respondents are supporting a broad-based, inclusive community planning and delivery approach with key players ensuring new start-up industry opportunities and retraining through TAFE, which might fit well into the Liddell Innovation Project.

Communication and Education

The focus group participants identified the difficulty in obtaining clear, accurate, and consistent information about the health impacts of coal and the features of the various kinds of renewable energy technologies. This finding spotlighted that communication is a major issue. A communication change management program led by parties involved in the focus on transition would need to have both education and communication roles.

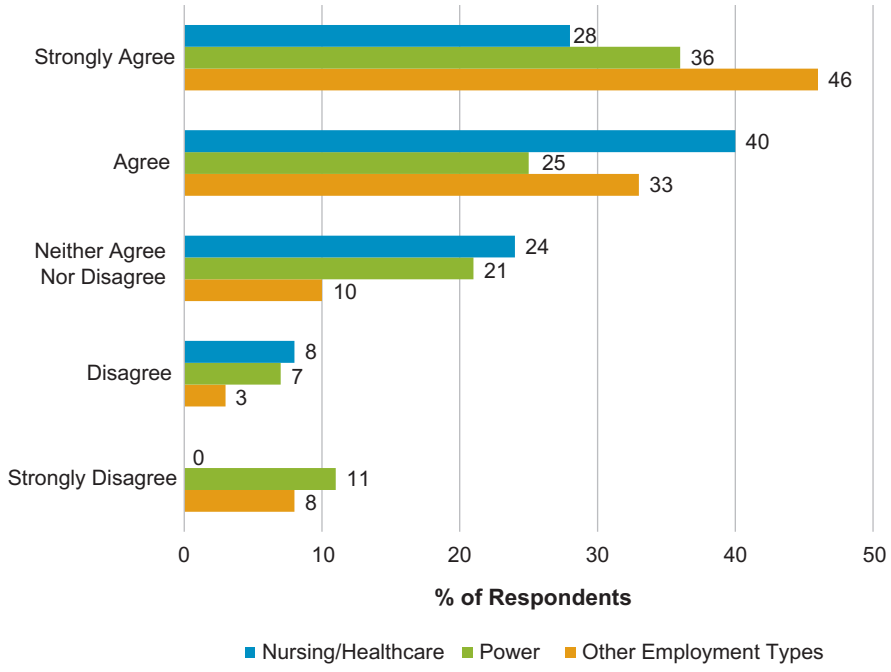
Limitations

This study was conducted at a time when the coal-fired Liddell Power Station was under fire from political sabotage. This timing could have had an influence on the research findings. The federal government has put pressure on Liddell to stay open using tactics such as fines or enacting laws that could force Liddell to remain open (Cox, 2019). Liddell still generates 10% of NSW's power supply despite its age, condition, and high maintenance costs. AGL is keen to replace Liddell with a combination of renewables, gas, and storage, which they argue would be cheaper than keeping Liddell open (Macdonald-Smith & Potter, 2018).

Another limitation could be the small sample size of this survey. A mixed research method using the triangulation approach to validate survey data provided evidence to support this research project (Noble & Heale, 2019). In addition, this study included a reasonable cross section of the local community (e.g., nursing/healthcare professionals, mining, retail, agriculture, viticulture, education, administration, and Liddell power workers).

FIGURE **5**

Survey Respondent Indications on Significance of Transition Away From Coal and Community Impact



Recommendations

Although mine dust is a problem that needs to be tackled, the first concern prior to the closure of Liddell should be that it is unacceptable to allow this power station to emit nitrogen oxides at a rate much higher than international standards (Millington, 2018). Coal-fired air pollution continues at the same rate despite a recent license review in January 2019 by the NSW Environment Protection Authority and population research evidence of resultant serious health problems (Ewald, 2018; Smith et al., 2013).

The second concern is a lack of awareness and understanding of the serious health effects of power station emissions. This knowledge gap was illustrated by respondents believing their health would not improve (26%) or those who were undecided about any health improvements (46%) resulting from the Liddell closure. Also, respondents were more worried about the dust produced by coal mining than the toxic emissions from Liddell. This gap needs to be addressed with an educational program focused on how mine and power station emissions affect health. The Muswellbrook Shire Council, working with NSW Department of Education, NSW Ministry of Health, and AGL, should fund and develop these health promotion and community education programs.

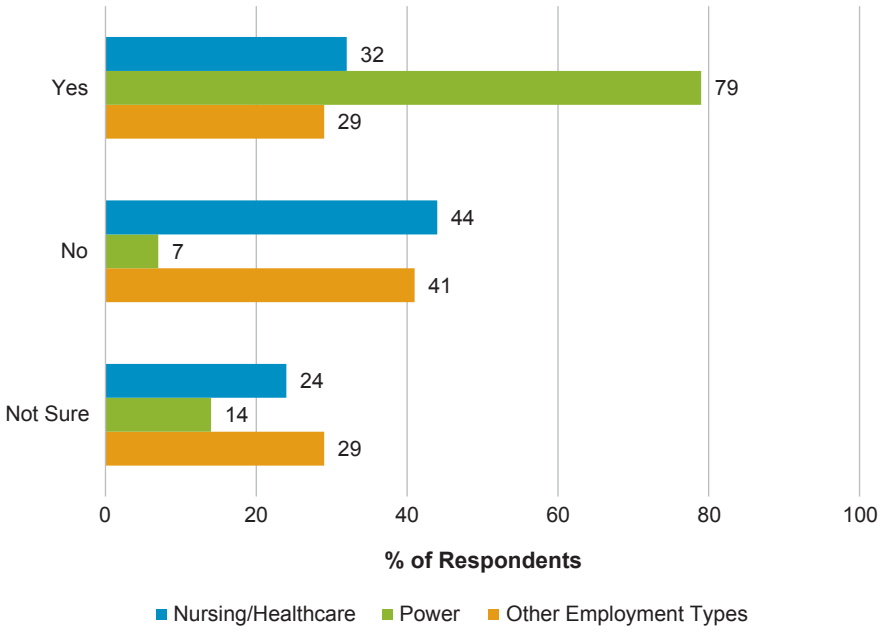
Conclusion

Through a mixed-methods research approach consisting of community and focus group meetings, key community personnel interviews, and a survey, the author was able to provide evidence that respondents were uncertain about the effects on their own health and that of their family. Many respondents were unclear whether the closure of Liddell would affect them; however, 71% of respondents clearly agreed that the transition away from coal would have a significant impact on the economic and social life of UHV communities.

There was only a small group of respondents (12%) who could see the benefits and

FIGURE **6**

Survey Respondent Interest in Working in the Renewables Industry



positive outcomes of the transition away from coal. Although the establishment of an authority to guide the transition was a possibility, the development of a renewable energy hub was considered an important opportunity. Currently, it is likely that the development of a renewable energy hub in UHV will move forward, as AGL and the Liddell Innovation Project have submitted a grant application.

Before a successful transition can take place, however, the "underlying culture of ignorance" associated with a lack of understanding about toxic chemicals and health, as well as the lack of knowledge about renewable energy, needs to be addressed through investment in community health education, renewable energy education, and educational support to provide retraining opportunities for power workers.

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Environmental Health Education in a Pandemic: Lessons and Opportunities

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

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

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

The COVID-19 pandemic has emphasized the universal importance of and need for environmental health. As a result of the pandemic, institutions of higher education have faced unprecedented changes. Decisions to keep students, faculty, and staff healthy did not come without unintended consequences as traditional means of teaching and learning were disrupted. Like faculty, students were thrust into the virtual classroom with little to no time to prepare and reported that the mid-semester transition negatively affected the overall quality of courses, which were viewed as less engaging and less instilling of learning (Garris & Fleck, 2020).

Academia collectively limped over the finish line of spring 2020 still facing a future of uncertainties. Environmental health programs scrambled to coordinate internships and meet degree requirement needs throughout the summer months in light of stay-at-home orders and nationwide emergencies. As educators, we grappled with pedagogic uncertainties surrounding the 2020–2021 academic year and anticipated the forms our classrooms could take as a result of the pandemic. The timing of instructional modality announcements throughout higher education varied, leaving some programs little time to solidify course designs and acquire the resources necessary to educate and engage students. In many ways, it felt like March 2020 was stuck on repeat.

Hurdles in higher education will continue to be encountered as a result of the pandemic; however, environmental health programs have the opportunity to reflect on their experiences from the past year and identify opportunities allowing for the relevance and value of environmental health to be demonstrated during the pandemic and beyond. We owe it to the students of our programs, whose unbelievable flexibility and resiliency during the pandemic demonstrates their commitment to the environmental health field. In this column, we reflect on the lessons learned from the spring and summer 2020 terms and explore opportunities to enhance the means by which we recruit, engage, educate, and prepare students and future professionals.

Prepare for Instructional Adaptability

Learning is hard, especially for science-heavy based curriculums like environmental health programs across the U.S. Adding the virtual layer makes the learning process even more difficult, especially for students who can lack the necessary resources and support to fully engage in online coursework. Along with the shift to online learning, the support services and scaffolding that many of our disadvantaged students relied upon were also online and oftentimes unreachable (Gannon, 2020). The use of videoconferencing and live-streaming platforms makes it difficult for faculty to rely on student body language and nonverbal clues to help gauge understanding (Supiano, 2020). If we are to rely on instructional methods that require the use of video-

conferencing and live-streaming without all students having adequate access, we could be exasperating the inequalities we are trying to fix (Gannon, 2020). While students did not begin the spring 2020 term anticipating online learning and overall student perspectives were negative, they appreciated the flexibility afforded by online learning and research suggests that student acceptance and views of online learning might improve with familiarity, ideal instruction, and instructor confidence (Garris & Fleck, 2020).

This situation presents environmental health faculty the opportunity to critically evaluate the role of traditional classroom instruction in their programs. Investments in professional development and incentives for faculty to expand their pedagogic toolboxes can result in effective content delivery and fuel student engagement. Online educational opportunities might also boost student recruitment and accessibility to help meet demands for midcareer training and fulfill growing needs in the environmental health workforce (Goodman et al., 2019). These opportunities could become essential as higher education considers relying on virtual learning in the postpandemic world in order to allocate appropriate resources to didactic and experiential learning (Govindarajan & Srivastava, 2020). Whether or not we are willing, we must leverage virtual learning to our advantage to educate and engage environmental health students in the face of instructional uncertainties.

Embrace Innovative Means of Didactic Learning

Hands-on learning is a vital component of environmental health education because it provides students with the practical experience needed to link theory to practice. Engaging environmental health practitioners in those didactic environments has also been key to helping students obtain real-world experience that helps facilitate their transition from student to practitioner. How do we, however, simulate those environments in a virtual platform to achieve the same student learning outcomes?

Instructional materials for virtual laboratories can include free YouTube videos and commercially available software packages, and virtual laboratory training has been shown to increase student confidence and facilitate deep learning (Smith et al., 2019). Reliance on these resources as substitutes for hands-on learning, however, assumes that their content is applicable, accurate, and accessible.

The shortcomings of available virtual materials highlight an opportunity for environmental health programs to create resources that align with course outcomes and develop skills necessary for environmental health practice. The development of virtual materials that enhance didactic learning can foster connectivity between students, faculty, and practitioners to promote student engagement within programs and the environmental health profession. The creation of a platform through which to share those materials that is accessible to environmental health programs can further support virtual didactic instruction while providing opportunities for collaboration between environmental health programs. We have the chance to reevaluate the boundaries of hands-on learning by pulling from the collective strengths of our environmental health programs to create virtual resources that set environmental health students up for academic and career success.

Explore Nontraditional Forms of Experiential Learning

Many students were not able to complete in-person internships in summer 2020 due to state, federal, and/or institutional limitations. As such, virtual internship opportunities were created to help meet environmental health degree requirements. Resources from the National Environmental Public Health Internship Program (NEPHIP), offered in partnership by the National Environmental Health Association and Centers for Disease Control and Prevention, were made available to all National Environmental Health Science and Protection Accreditation Council-accredited degree programs. NEPHIP resources allowed students to obtain valuable certifications and trainings they might not otherwise have had an opportunity to gain with other more traditional internships. It also provided a broad perspective for students to gain a variety of environmental health knowledge as compared with more traditional internships that might be narrower or focused on a specific area. These virtual internship experiences have opened the door to consider what experiential learning looks like and how it is defined by evaluating the skills that can be obtained in person versus virtually, as well as how virtual internships affect student learning, engagement, and preparedness for the environmental health profession.

Expand Use of Social Media for Engagement and Recruitment

The unique dynamics of recruiting in the COVID-19 era might contribute to more inequalities among colleges (Gardner, 2020). If lower-income, disadvantaged students do not have the appropriate access to resources and technology to be successful in this new learning environment, they could choose to go a different route. It is more important now than ever to place even greater effort in strategic recruitment efforts to target minority students to continue to increase diversity in our programs and the environmental health field.

High-touch and personalized approaches have been shown to be the most successful in student engagement and recruitment in the digital age (Gardner, 2020). Environmental health programs can use social media to their advantage to create a broad reach of recruitment efforts beyond traditional open houses and campus visits, engage students in activities such as student environmental health association chapters, and demonstrate the value of the environmental health profession to public health and society.

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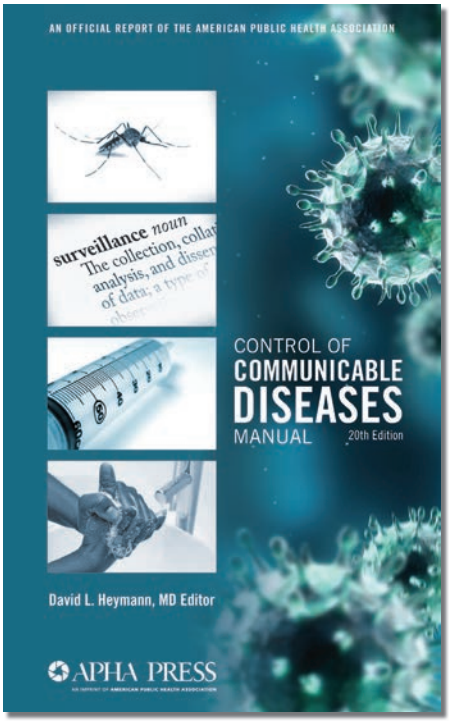

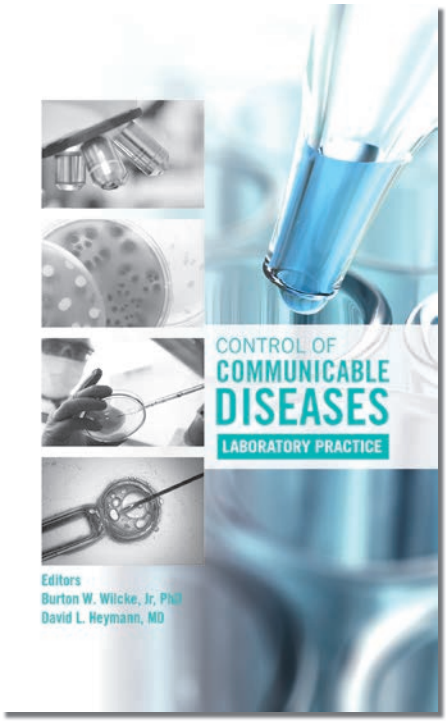

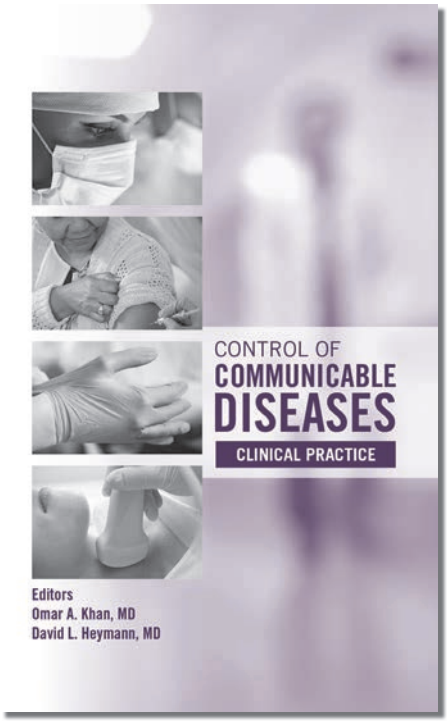

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DIRECT FROM CDC ENVIRONMENTAL HEALTH SERVICES

Laura Brown, PhD

Using Data to Improve Practice: Looking Back on 20 Years of Restaurant Food Safety Research

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

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

Laura Brown is with the Water, Food, and Environmental Health Services Branch. She conducts research through the Environmental Health Specialists Network (EHS-Net) to understand the environmental factors that lead to foodborne illness.

In 2000, the Centers for Disease Control and Prevention (CDC), recognizing the important role environmental health programs play in food safety, funded a new cooperative agreement program on retail food safety called the Environmental Health Specialists Network (EHS-Net, pronounced S-Net). EHS-Net is a network of environmental health programs in state and local health departments focused on understanding how retail food service establishment policies and practices contribute to foodborne illness and outbreaks. EHS-Net staff collaborate closely with their counterparts in epidemiology and laboratory programs, and with CDC, the Food and Drug Administration (FDA), and the U.S. Department of Agriculture (USDA) Food Safety and Inspection Service (FSIS). EHS-Net staff are experienced in food safety and uniquely positioned to collect high-quality data on food safety policies and practices.

In its 20-year history, EHS-Net has conducted 15 retail food safety studies. These studies focused on restaurants because over one half of foodborne outbreaks are linked with restaurants (e.g., sit-down, fast food, deli) (Centers for Disease Control and Prevention [CDC], 2019). These studies, based primarily on data collection from observations of and interviews with restaurant staff, resulted in 50 scientific articles and 25 plain language summaries with key findings and recommendations (www.cdc.gov/nceh/ehs/ehsnet/publications/index.htm). A recent review of these findings revealed key restaurant actions linked with food safety: having/adopting procedures to minimize food safety risks, training staff on those procedures, and monitoring to ensure procedures are followed (Food and Drug Administration, 2018).

Food Safety Procedures

EHS-Net found links between food safety procedures (e.g., policies, plans) and food safety.

- Restaurants with written slicer cleaning policies cleaned their food slicers more often (Brown et al., 2016).
- Workers in restaurants with a staffing plan for when workers couldn't come to work and with an ill worker policy were less likely to have worked while ill with foodborne illness symptoms (Sumner et al., 2011).
- Restaurants with a cleaning policy had smaller norovirus outbreaks (Hoover et al., 2020).
- Restaurants with a date-marking policy practiced proper date-marking more often (Brown et al., 2021).
- Workers in restaurants with a policy prohibiting bare-hand contact with ready-to-eat food had less frequent behaviors that could lead to pathogen cross-contamination (Masters et al., 2018).

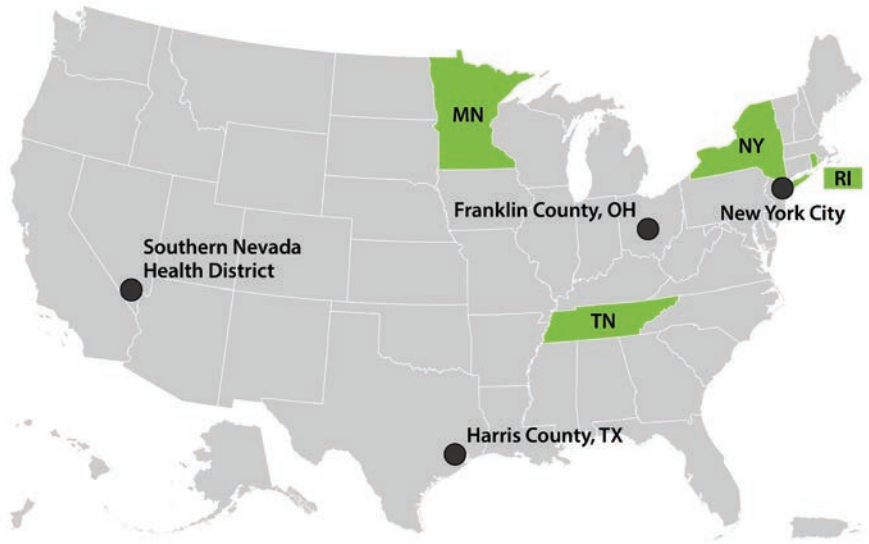
Staff Training and Certification

EHS-Net studies consistently show links between training and certification and food safety.

- Restaurants with a certified manager had
  - » proper refrigerator temperatures more often (Brown et al., 2018).
  - » fewer critical violations on their inspections (Cates et al., 2009).

FIGURE **1**

Environmental Health Specialists Network (EHS-Net) 2020–2025 Sites



» smaller norovirus outbreaks (Hoover et al., 2020).

- Restaurants with managers trained in food safety more often used recommended food cooling methods (Reed et al., 2020).
- Restaurants with workers trained in food safety were more likely to have properly maintained food slicers (Lipcsei et al., 2018).
- Workers in restaurants that provided food safety training washed their hands when they needed to more often (Green et al., 2007).

Monitoring

EHS-Net has less frequently studied monitoring but has found links between food safety and monitoring.

- Restaurants that monitored cooling food temperatures more often held cooling food at appropriate temperatures (Schaffner et al., 2015).
- Restaurants that recorded refrigerator temperatures more often had proper refrigerator temperatures (Brown et al., 2018).
- Workers said that monitoring activities, such as completing hand washing and temperature logs, improved their ability to prepare food safely (Green & Selman, 2005).

EHS-Net findings support the concept that strong food safety management systems—composed of procedures, training, and monitoring—improve restaurant food safety and provide critical details about the management system components that are particularly important to system effectiveness. EHS-Net findings have been used to inform and improve national food safety policies and practices. These findings can also help the restaurant industry and environmental health programs improve restaurant food safety and reduce foodborne illness and outbreaks.

EHS-Net Findings Helped Strengthen Food Safety Policies and Practices

- **FDA *Food Code***: EHS-Net findings on links between certification and food safety were used to strengthen kitchen manager certification provisions in the 2017 FDA *Food Code*. The *Food Code* provides the basis for state and local food safety regulations and strongly influences retail food safety policies and practices (U.S. Department of Health and Human Services, 2017).
- **USDA FSIS Beef Grinding Log Rule**: EHS-Net found that most retail establishments did not record all the information needed about their beef grinding activities to allow investigators to trace the source of ground beef outbreaks. These findings informed a new rule requiring retail establishments to record specific information in their beef grinding logs (Records To Be Kept, 2015). As compliance with this rule increases, the ability to trace the source of outbreaks should increase.
- **USDA FSIS guidance on controlling *Listeria monocytogenes***: EHS-Net identified gaps in retail deli policies and practices on preventing *L. monocytogenes* cross-contamination and growth. These data informed USDA FSIS (2015) to create a guidance document for retailers on best practices to control *L. monocytogenes*.
- **CDC's *Vital Signs* guidance on norovirus outbreak prevention**: EHS-Net found that restaurants with policies that facilitated workers staying home when they are sick had workers that were less likely to have worked while sick. These findings informed CDC's *Vital Signs* guidance on foodborne norovirus outbreak prevention (CDC, 2014).

Conclusion

Recently, EHS-Net embarked on a new 5-year cooperative agreement (2020–2025) with many of the same partners that contributed to past successful work (Figure 1). We look forward to addressing new food safety challenges together, with the goal of improving retail food safety practices and policies and restaurant food safety, as well as reducing foodborne illness and outbreaks. A primary focus going forward will be on preventing ill workers and norovirus outbreaks.

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Did You Know?

The NEHA Vector Program Committee has posted a blog that highlights a new resource from the Centers for Disease Control and Prevention's Division of Vector-Borne Diseases: A National Public Health Framework for the Prevention and Control of Vector-Borne Diseases in Humans. The framework was constructed with input from five federal departments and the U.S. Environmental Protection Agency. The framework offers guidance in five key areas, including a better understanding of the risks associated with vectors and how to better support vector control agency efforts. Read the blog and learn more at https://www.neha.org/membership-communities/get-involved/day-in-life.

2021 Walter F. Snyder Award

Call for Nominations

Nomination deadline is May 15, 2021

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

❖ ❖ ❖

Nominations for the 2021 *Walter F. Snyder Award* are being accepted for environmental health professionals achieving peer recognition for:

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

❖ ❖ ❖

Past recipients of the *Walter F. Snyder Award* include:

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The 2021 Walter F. Snyder Award will be presented at the NEHA 2021 Annual Educational Conference & Exhibition Three-Part Virtual Series.

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

DAVIS CALVIN WAGNER SANITARIAN AWARD

The American Academy of Sanitarians (AAS) announces the annual Davis Calvin Wagner Sanitarian Award. The award consists of an individual plaque and a perpetual plaque that is displayed in NEHA's office lobby.

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

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

NOMINATIONS MUST BE RECEIVED BY APRIL 15, 2021.

Nomination packages should be e-mailed to

Dr. Robert W. Powitz at powitz@sanitarian.com

Files should be in Word or PDF format.

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

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Applications for the 2021 National Environmental Health Association/American Academy of Sanitarians (NEHA/AAS) Scholarship Program are now being accepted.

Undergraduate and graduate students enrolled in an accredited college or university with a dedicated curriculum in environmental health sciences are encouraged to apply.

Nomination deadline is March 31, 2021.

For eligibility information and to apply, visit www.neha.org/scholarship.

NEW IN 2021!

Dr. Bailus Walker, Jr. Diversity and Inclusion Awareness Award

The Dr. Bailus Walker, Jr. Diversity and Inclusion Awareness Award honors an individual or group who has made significant achievements in the development or enhancement of a more culturally diverse, inclusive, and competent environment.

Application deadline is April 15, 2021.

To access the online application, visit www.neha.org/about-neha/awards/dr-bailus-walker-jr-diversity-and-inclusion-awareness-award.

EH CALENDAR

UPCOMING NATIONAL ENVIRONMENTAL HEALTH ASSOCIATION (NEHA) CONFERENCE

2021: **NEHA 2021 Annual Educational Conference & Exhibition Three-Part Virtual Series**, www.neha.org/aec

NEHA AFFILIATE AND REGIONAL LISTINGS

California

April 8–May 6, 2021: **2021 California Conference of Directors of Environmental Health (CCDEH) Training Series (Virtual)**, CCDEH and the California Environmental Health Association, www.ccdeh.org

Iowa

April 5–9, 2021: **Public Health Conference of Iowa—Public Health in Action: Taking on a Pandemic, Health Equity, Natural Disasters, and More! (Virtual)**, www.ieha.net/event-4026991

Michigan

March 2021 (Dates TBA): **Annual Educational Conference**, Michigan Environmental Health Association, Port Huron, MI, www.meha.net/AEC

Nevada

May 4–5, 2021: **NvEHA/NFSTF Joint Virtual Conference: Evolutions in Environmental Health**, Nevada Environmental Health Association (NvEHA) and the Nevada Food Safety Task Force (NFSTF), www.nveha.org

Utah

May 5–7, 2021: **Spring Conference**, Utah Environmental Health Association, Kanab, UT, www.ueha.org/events.html

Washington

May 2021 (Dates TBA): **Annual Educational Conference (Virtual)**, Washington State Environmental Health Association, www.wseha.org/2021-aec

TOPICAL LISTINGS

Water Quality

March 9–10, 2021: **Special Virtual Session—*Legionella* Conference: Prevention of Disease and Injury From Waterborne Pathogens During an Emergent Health Crisis**, NSF Health Sciences and NEHA, www.legionellaconference.org

August 2021 (Dates TBA): ***Legionella* Conference: Prevention of Disease and Injury From Waterborne Pathogens in Health Care (Virtual)**, NSF Health Sciences and NEHA, www.legionellaconference.org

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JEH QUIZ

FEATURED ARTICLE QUIZ #5

Evaluation of Barrier Sprays Containing a Pyrethroid and an Insect Growth Regulator to Control *Aedes albopictus* in a Suburban Environment in North Carolina

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

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

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

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

1. Read the featured article and select the correct answer to each *JEH* Quiz question.
2. Log in to your MyNEHA account at https://neha.users.membersuite.com/home.
3. Click on Credentials located at the top of the page.
4. Select Report CEs from the drop-down menu.
5. Enter the date you finished the quiz in the Date Attended field.
6. Enter 1.0 in the Length of Course in Hours field.
7. In the Description field, enter the activity as "*JEH* Quiz #, Month Year" (e.g., *JEH* Quiz 5, March 2021).
8. Click the Create button.

JEH Quiz #3 Answers

December 2020

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

➔ Quiz effective date: March 1, 2021 | Quiz deadline: June 1, 2021

1. In the absence of effective vaccines, vector control is the primary means of controlling the spread of arboviruses.
   a. True.
   b. False.
2. The efficacy of pyriproxyfen autodissemination stations was assessed for *Aedes albopictus* and showed that *Ae. albopictus* carrying pyriproxyfen on body parts effectively contaminated cryptic cups and resulted in __ pupal mortality.
   a. >19%
   b. >29%
   c. >39%
   d. >49%
3. A study with pyriproxyfen applied as a barrier spray in conjunction with the adulticide lambda-cyhalothrin showed efficacy at controlling *Ae. albopictus* for up to __ weeks.
   a. 2
   b. 3
   c. 4
   d. 5
4. This study used __ to evaluate impacts on mosquito abundance and life table characteristics.
   a. field methods
   b. laboratory methods
   c. a and b
   d. none of the above
5. In total, __ residences were targeted for recruitment in this study.
   a. 9
   b. 10
   c. 11
   d. 12
6. Host-seeking mosquitoes were sampled weekly using BG-Sentinel 2 traps baited with
   a. human scent lure.
   b. octanol.
   c. carbon dioxide.
   d. all of the above.
   e. none of the above.
7. Through the study, a total of 3,220 adult female mosquitoes from __ genera and __ species were collected in BG-Sentinel 2 traps.
   a. 6; 12
   b. 6; 20
   c. 6; 24
   d. 6; 30
8. When analyses were performed for each treatment type individually, analyses after week 24 indicated __ differences in mean numbers of host-seeking *Ae. albopictus* between weeks in traps placed at DA60 lots or DA30 lots.
   a. no significant
   b. significant
9. Significantly __ larvae of all species hatched from eggs on strips collected from control lots compared with other groups.
   a. less
   b. more
10. Week __ was one of the weeks with a significantly high abundance of host-seeking *Ae. albopictus* in BG-Sentinel 2 traps.
    a. 22
    b. 23
    c. 24
    d. 25
11. In this study, there was a predictive relationship between time-lagged rainfall or temperature with host-seeking *Ae. albopictus* abundance.
    a. True.
    b. False.
12. The lowest number of hatched larvae and *Ae. albopictus* adults that emerged came from the __ group.
    a. D30
    b. DA30
    c. DA60
    d. control

2021

ACCEPTING NOMINATIONS NOW

Walter S. Mangold Award

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

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

Nomination deadline is March 15, 2021.

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

2021 Joe Beck Educational Contribution Award

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

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

Nomination deadline is March 15, 2021.

To access the online application, visit www.neha.org/about-neha/awards/joe-beck-educational-contribution-award.

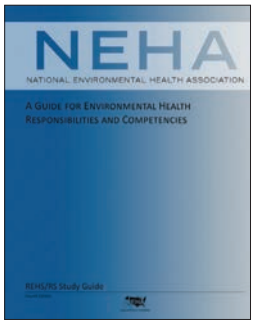
RESOURCE CORNER

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

NEHA BOOKSTORE
www.neha.org/store

REHS/RS Study Guide (4th Edition)

National Environmental Health Association (2014)



The Registered Environmental Health Specialist/Registered Sanitarian (REHS/RS) credential is the National Environmental Health Association's (NEHA) premier credential. This study guide provides a tool for individuals to prepare for the REHS/RS 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

Certified Professional–Food Safety Manual (3rd Edition)

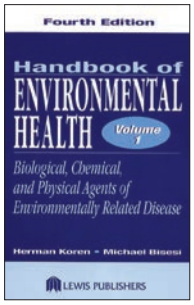
National Environmental Health Association (2014)

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

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

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

Herman Koren and Michael Bisesi (2003)

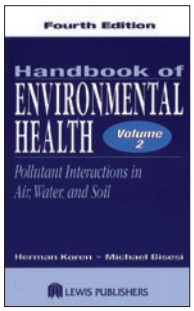


A must for the reference library of anyone in the environmental health profession, this book focuses on factors that are generally associated with the internal environment. It was written by experts in the field and copublished with NEHA. A variety of environmental issues are covered such as food safety,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

790 pages / Hardback
Member: $215 / Nonmember: $245

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

Herman Koren and Michael Bisesi (2003)



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

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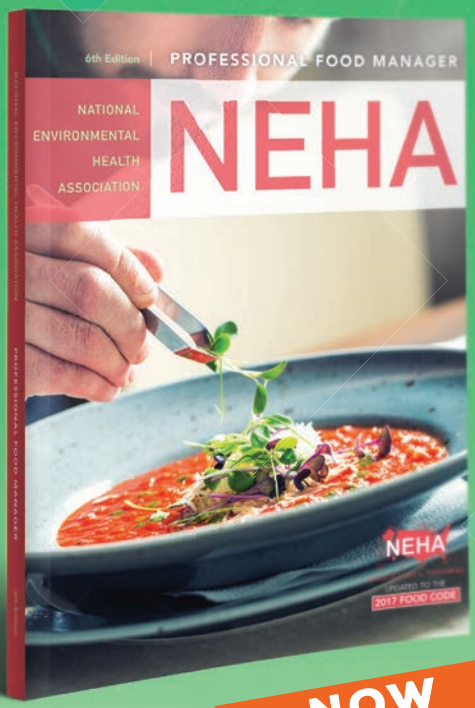

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NEHA SECOND VICE-PRESIDENTIAL CANDIDATE PROFILES

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

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

CDR Anna Khan, MA, REHS/RS

NEHA has worked tirelessly to educate environmental health practitioners and ensure that they have the guidance, recommendations, and resources needed to perform their work. I am running for Second Vice-President of NEHA because I want to lift up the great work that NEHA does while helping NEHA reach their future goals and elevate the role of EH practitioners because they are the true heroes, especially during the COVID-19 Pandemic. Also, I want to emphasize the importance of environmental health including climate change and environmental justice, areas that can no longer be ignored. Furthermore, I want to put us on the map as an organization that our counterparts in other countries can look to for the most up-to-date information, guidance, and recommendations.

I grew up in Maryville, TN, and attended Eastern Kentucky University (EKU) for undergraduate education in environmental health science and received my graduate education through Tulane University and the American Military University in Emergency and Disaster Management. During my time at EKU, I had the opportunity to intern at the local health department in Somerset, KY, and a Public Health Service CO-STEP with the Indian Health Service (IHS) in Arizona and saw some of the challenges that health departments and environmental health practitioners struggle with including operating with very tight budgets. I received my NEHA REHS/RS certification in 2007, a gold standard for environmental health practitioners, and I rely upon NEHA for the latest information and insight. NEHA is an integral part of environmental health. Through NEHA's support, guidance, and recommendations, environmental health practitioners are prepared with the latest evidence-based guidance and recommendations. This year, we have encountered many challenges in environmental health. The COVID-19 Pandemic has emphasized the critical mission of environmental health from food safety, worker safety, air, and water quality. We have also confronted 30 hurricanes costing the U.S. more than $38 billion dollars and 340 fatalities; and over 100 wildfires that cost the U.S. $2.7 Billion, destroyed more than 13,800 buildings, and caused 46 fatalities. Environmental health plays a key role in protecting the public's health and the need for environmental health practitioners continues to grow. Without environmental health practitioners' guidance and their willingness to step up and do their jobs in some of the most difficult times, many of our businesses as well as public health would have been adversely impacted this year. We need to acknowledge the current changes happening in our communities and the impact of the issues as our world becomes even more connected.

I have been a USPHS officer for 14 years, currently serving as a Commander. I have worked for FDA and CDC. I am the Associate Director for Communication at the Division of Environmental Health Science and Practice (DEHSP), a division of ~300 environmental health professionals, in the National Center for Environmental Health (NCEH) at CDC. My strategic efforts established partnerships, leveraged various communication platforms and crosscutting CDC channels, and amplified our outreach to tackle some of our most difficult environmental health messaging and combatting misinformation during COVID-19 Pandemic.

I have also worked on the global stage on emergency management, environmental health, health communication, and situational awareness. I was instrumental in the success of CDC's Public Health Emergency Management Fellowship, a gold standard for training global public health emergency management leaders. I increased annual training capacity from 8 to 32 fellows. As a WHO Infodemic Management Ambassador, I am rostered for senior leadership positions in global health emergency preparedness and response and will represent CDC, PHS, and environmental health with professionalism and poise.

I have actively served on PHS Applied Public Health Team for 10 years, awarded the Field Medical Readiness Badge, and the National Emergency Preparedness Award. I completed a master's degree in Emergency and Disaster Management to further my expertise and represented CDC and PHS admirably during emergency responses (Ebola, Zika, Polio, Unaccompanied Children, etc.) in multiple roles (operations chief, environmental health analyst, LNO, etc.) Most recently, I led the implementation of the COVID-19 Environmental Health Task Force's communication activities including managing and fielding 2,400 public inquiries and 300 media requests.

I think my contributions to the success of the National Center for Environmental Health (NCEH) at CDC and the United States Public Health Service (USPHS) including leadership, dedication to environmental health, program management, and emergency management experience will complement the great work being done at NEHA. I am a dedicated PHS officer in a prominent and high impact position at CDC and my recognition by leadership,

and my dedication to constantly lead by example, innovation, and a devotion to protecting and promoting the Nation's health makes me a good candidate for the Second Vice-President position at NEHA.

Rachel Stradling, JD, BSc (Hons), CP-FS, REHS, MCIEH

If I am fortunate enough to be elected as the National Environmental Health Association's Second Vice-President, I will work diligently to promote NEHA and the vital work that our profession does every day to keep our communities safe. I will help to be the voice of Environmental Health, using my varied background to help tell our story. I will pledge to help mentor new students and work with the NEHA board to create new opportunities and programs that help promote our profession.

I have had a hugely varied and exciting career in Environmental Health, which has spanned over twenty years and two different countries. I started my career as a trainee Environmental Health professional, spending four years learning the theory and practice of our profession with some of the most amazing mentors, that helped shape the professional I am today. Those mentors not only taught me environmental health, but they showed me the real difference we can make to a family, to a community and to our profession.

After four years of intense training and a First Class Honors Degree in Environmental Health, I moved into a corporate environment as a risk management and legal compliance manager for the fifth largest UK food retailer. The role was challenging, offering me my first experience of managing staff, and learning hard lessons in the need to delegate. I quickly learned the art of negotiation and perfected my communication skills to achieve corporate legal compliance during a period of scarce resourcing and ever increasing media attention. After the corporate world, I formed my own consulting company, helping to train food safety professionals, giving advice to new startup businesses and providing my services to some of the busiest boroughs in central London. Owning your own business is an amazing but terrifying experience - the buck definitely stops with you!

In 2011, my family made the biggest move of all, to the United States where I met my next generation of mentors, who helped me navigate a new culture and fulfil my career potential. I have worked with the Virginia Department of Health for 8 years, having started as an Environmental Health Specialists and working my way back up the career ladder to manage my own team of professionals, running a small but mighty team in Alexandria, Virginia.

I believe that my varied background, spanning private and public sector work makes me uniquely qualified for this elected position. I hope that being able to reflect on my own struggles to restart a career in a new country, will help guide others that are perhaps turning to Environmental Health as a second career, or those just starting out for the first time. I passionately believe in the concept of mentorship, and believe strongly that when we work together that everyone benefits from our combined success.

Environmental Health is an exciting but often unknown profession. Many of us stumble into it accidently, but we do truly inspiring work that should be shouted from the roof tops. We're often the backbone of public health, preventing disease and ensuring wellbeing, but our work goes un-noticed.

I know that my background makes me think about situations a little differently. When other environmental health departments were discussing regulating COVID-19 requirements and enforcement, I was looking at ways to help businesses stay open, but safely. I firmly believe that working together to solve a problem comes up with the best solutions. My team worked with businesses, economic development groups and the tourism industry to find a way to reopen safely, and in the process created an award winning program that asked businesses to go above and beyond mandated requirements and pledge a promise to the safety of their customers and staff. This program was only possible with open and honest dialogue. I know I don't have all the answers, but my biggest strength is an ability to bring the best minds around the table, and find solutions.

I care passionately about our profession, and more importantly the next generation of Environmental Professionals. I strongly believe in the values and goals of the National Environmental Health Association. The pandemic has caused many of us and our teams to face new challenges, and I hope that if elected I'm able to use some of that experience to work with the NEHA membership to create support networks and mentorship opportunities across the country.

Did You Know?

National Groundwater Awareness Week is March 7–13. This year's observation is dedicated to the advocacy of groundwater safety and protection and increasing its access across the country. Learn more about this observance and how you can get involved at www.ngwa.org/get-involved/groundwater-awareness-week/groundwater-awareness-week-2021.

NEHA REGIONAL VICE-PRESIDENTIAL CANDIDATE PROFILES

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

Election policy specifies that candidate profiles for RVPs be limited to 400 words in total length. If a candidate's profile exceeds that limit, the policy requires that the profile is terminated at the last sentence before the 400-word limit is exceeded. In addition, the submitted profiles have not been grammatically edited, but presented as submitted and within the 400-word limitation. Three regions are up for election this year—Region 2, Region 3, and Region 8. The candidates for these regions are listed alphabetically by region.

Region 2

Michele DiMaggio, REHS

My name is Michele R. DiMaggio and I was recently appointed as the National Environmental Health Association (NEHA) Regional 2 Vice-President in December 2019.

Over the past 25 years, I have gained experience as an Agricultural Biologist, Public Health Biologist, and as a Vector Control Technician. Since 2001, I have been a Registered Environmental Health Specialist working for Contra Costa County, Environmental Health Services. I am currently a Supervising Environmental Health Specialist managing the following programs: Retail Food, Temporary Food Facilities, Certified Farmer's Markets, New Employee Training and Standardization, and Schools. I also co-manage my division's Outbreak Response and Recall Team. Additionally, I participate as the Environmental Health liaison to the Health Services Department Emergency Management Team (EMT) where I serve on the EMT's Emergency Operations Response Plan Committee and act as Chair to the Training and Recruitment Committee. During the COVID-19 epidemic, I am now humbly serving as a Disaster Service Worker for the department's Public Health Branch.

For the past 11 years, I have been a NEHA member, functioning as a Food Safety Subject Matter Expert, Food and Emergencies Technical Adviser, and a Temporary Food Establishments and Epi-Ready Course Instructor. I diligently represent NEHA on CDC's Board of Scientific Counselors, Food Safety Modernization Act Surveillance Working Group. Recently, I had the honor and privilege of being part of NEHA's team to the U.S. Virgin Islands, training their newly hired Environmental Health Inspectors on Food Safety and Food Safety Inspections.

I am also an active member of the Partnership for Food Protection (PFP) Training & Certification Workgroup and PFP Surveillance, Response and Post-Response Workgroup. I participate as a FDA Food Safety Subject Matter Expert collaborating on the Integrated Food Safety System National Curriculum Standard Retail Framework. I contributed to the Council to Improve Food-borne Outbreak Response 3rd Edition Guidelines Chapter 3 and 7 workgroups. Locally, I am an active member of the California Retail Food Safety Coalition.

I consider myself a Food Safety Geek, I dabble in Emergency Response, but I will always be a Vector Control Nerd!

I look forward to meeting you virtually or in-person in the upcoming years.

Region 3

Rachelle Blackham, MPH, REHS

Rachelle Blackham is a trailblazer that has a passion for public health. She is regularly asked by others for her insightful input on mentorship, goal making and environmental health fieldwork. Rachelle is a proven leader that is able to think "outside the box" and isn't afraid to work hard. Currently working as the Director for the Davis County Environmental Health Services Division in Clearfield, Utah, Rachelle has established a new way of tackling issues and set a standard of excellence. Attending graduate school on the weekends and at night, she graduated as the valedictorian of the Public Health program. She is a team player that has successfully worked on a number of large projects and programs throughout the environmental health field. Rachelle firmly believes that environmental health can make a real difference in the lives of people and she would be honored to be reelected as the NEHA Regional 3 Vice-President.

Region 8

LCDR James Speckhart, MS, USPHS, REHS

LCDR James Speckhart (REHS) is a U.S. Public Health Service – Environmental Health Officer since 2008. He is currently assigned since 2014 as an Occupational Health and Safety Officer with the FDA - Center for Medical Devices and Radiological Health (CDRH) supporting the BSL-2 research labs in Silver Spring, MD.

His previous USPHS assignments included the U.S. Dept. Agriculture – Food Safety Inspection Service [FSIS] in PA and the U.S. Coast Guard in AK and VA.

LCDR Speckhart was honored to serve in a mission critical function during a 4-month period March to July 2020 with the

NEHA REGIONAL VICE-PRESIDENTIAL CANDIDATE PROFILES

FDA COVID-19 Emergency Call Center as the only environmental health officer on a 25-member officer team directly answering 1,000+ calls of a 20,000 call volume total which was received from all 50 states and numerous international calls with questions regarding emergency use authorization for diagnostic test kits, PPE, hand sanitizer, automated ventilators, PPE decontamination methods and various aerosol sterilization or sanitation methods. He answered many basic telemedicine questions and had numerous opportunities to utilize his bi-lingual speaking skills to answer similar telehealth inquiries.

He has been a NEHA member since 2004 the same year he earned the NEHA AAS graduate student scholarship.

He has been grateful to serve on the NEHA board of directors since 2012 to present as an elected Region 8 Vice-President encompassing the mid-Atlantic States (Wash DC, WV, VA, MD, DE, PA, and all the uniformed services).

He is an alumnus with Old Dominion University Environmental Health program and active with the ODU College of Health Sciences Advisory Board since 2018. He is an active mentor to students and young professionals.

LCDR Speckhart currently chairs a NEHA Ad Hoc committee focused on Research and Innovation. He recently co-authored a NEHA policy paper on Research and Innovation that Enhance EH Science and practice published in October 2020. He is coordinating outreach with NEHA staff to develop strategic goals to foster the association's capacity to promote and appropriately support research, development, and entrepreneurship for current field employees and aspiring student professionals.

THANK YOU for Supporting the NEHA/AAS Scholarship Fund

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To donate, visit www.neha.org/about-neha/donate.

PEOPLE **ON THE MOVE**

NEHA President Sandra Long Recognized for COVID-19 Leadership

National Environmental Health Association (NEHA) President Sandra Long was recently named Employee of the Year by the Town of Addison, Texas. President Long was honored with this award for her leadership during the COVID-19 pandemic, especially in keeping restaurants safe through the development and implementation of virtual inspections. While geographically small (just 4.2 square miles), Addison is home to approximately 280 food establishments and food safety is extremely important. "People come to Addison for the restaurants, which is why food safety must be my top priority," stated Long.

Long is the environmental health manager for the Town of Addison and has been in that position for over two years. She oversees the Environmental Health Division and her responsibilities include food and pool inspections and plan review, vector control, maintenance and evaluation of environmental health data, complaint investigations, and apartment/multitenant licensing. She also supervises the environmental health and code enforcement staff.

On March 13, 2020, a local public health emergency was declared in Dallas County and within one week, all restaurants in Addison were limited to takeout and delivery, and many other retail establishments were closed. As everyone struggled to understand the affect of the pandemic on local businesses, residents, and the community, many looked to Long for guidance and she helped her town navigate the COVID-19 pandemic.

To ensure food safety, virtual food inspections were adopted to provide routine food inspections during the pandemic. These virtual inspections enabled Long and her staff to assure proper food handling and preparation processes were being carried out while keeping staff and food service employees safe from exposure to the virus. In addition, Long and her staff were a resource to food establishments, often going door-to-door to make sure they were aware of regulation changes that were happening almost daily. Restaurants and businesses contacted her on nights and weekends to ask questions and get help figuring out solutions to keep their businesses open. She was always positive and upbeat even though the conversations were difficult ones.

Long has emerged as a leader in the implementation of virtual inspections. She has shared the protocols her division developed for virtual inspections with others regionally and nationally through training videos, webinars, and virtual presentations. As stated in her nomination for this award, "Sandra's leadership of the Environmental Health Division exemplifies innovation, flexibility, and a dedication to employees, customer service, and public health that is deserving of recognition."

In addition to her food safety work, Long assisted in the drafting of COVID-19 emergency response plans for employee health and safety, illness prevention, office processes, cleaning and disinfecting, and temporary housing and quarantine. She coordinated with the town's marketing department for information and messaging to food establishments and the public. She played a key role in the implementation and enforcement of county and state orders for food establishments and the public, and made herself available to the public to help them understand protocols and safety measures. Long also helped draft reopening plans and protocols for food establishments, recreational centers, bars, gyms, schools, and courts, as well as provided guidance on how to implement these plans and protocols.

"I am overwhelmed by this honor and am excited to have the work of environment health recognized," stated Long. NEHA congratulates President Long on this award and commends her for the leadership she has demonstrated on local and national levels during the COVID-19 pandemic.

Dr. Leon Vinci Honored by the Virginia Environmental Health Association

The 2020 A. Clark Slaymaker Honor, given annually by the Virginia Environmental Health Association (VEHA), was presented to Dr. Leon F. Vinci, RS, at the VEHA Fall Educational Conference. VEHA President Sandy Stoneman presented the award to Dr. Vinci for outstanding contributions to the environmental health profession and programs across the state of Virginia. She commented, "Leon's contributions and expertise have greatly benefited the profession. He has made a difference through his service on the VEHA board and to the field of environmental and public health."

"It is indeed a great honor and privilege to receive this award," stated Dr. Vinci. During the fall conference, Dr. Vinci was elected as a vice president of VEHA and has served on the VEHA board for 4 years. As an internationally renowned leader in public health and epidemiology, he is also an ecoAmerica Climate and Health Leader and a Climate Ambassador with NEHA.

To learn more about the award, visit http://virginiaeha.org.

People on the Move is designed to keep NEHA members informed about what their peers in environmental health are up to. If you or someone you know has received a promotion, changed careers, or earned a special recognition in the profession, please notify Kristen Ruby-Cisneros at kruby@neha.org. It is NEHA's pleasure to announce our reader's achievements and new directions of fellow members. This feature will run only when we have material to print—so be sure to send in your announcements!

REGISTRATION OPENS
MARCH 1

NATIONAL ENVIRONMENTAL HEALTH ASSOCIATION

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KEYNOTE SPEAKER - JOHN WILSON

Communication and De-escalation

The capacity to maintain our own behavior, coupled with the ability to successfully gain compliance or create cooperation, may be one of the most important contemporary skills of this decade.

John is the founder of CBL Training and Consulting. He served as a sergeant in a major California law enforcement agency where he led a crisis intervention training unit and is a U.S. Army veteran.

NATIONAL ENVIRONMENTAL HEALTH ASSOCIATION

Visit us online for the latest information.
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NEHA **NEWS**

NEHA Announces the Dr. Bailus Walker, Jr. Diversity and Inclusion Awareness Award

Organizations around the country are striving to increase diversity awareness and the National Environmental Health Association (NEHA) is no exception. Each NEHA member has immense value and together we can achieve common goals if we foster equality and inclusion in our association. The conflicts within our society that stemmed from incidents of injustice and inequity in 2020 have prompted reactions from many individuals and organizations. One step NEHA leaders are taking to denounce racism and promote diversity is the introduction of the Dr. Bailus Walker, Jr. Diversity and Inclusion Awareness Award.

Dr. Bailus Walker, Jr. had a long career as a researcher, faculty member, and administrator in public, environmental, and occupational health. Dr. Walker was a professor of environmental and occupational medicine and toxicology in the College of Medicine, Department of Community and Family Medicine at Howard University in Washington, DC. He was a consultant to public health programs seeking accreditation. He wrote prolifically in the field of public, environmental, and occupational health. He was a long-time member and supporter of NEHA. Many of his students, leaders, employees, and mentees speak highly of his teaching, consulting, and the examples he set. He worked in several states—Alabama, California, Massachusetts, Minnesota, New York, Oklahoma, and Washington, DC—affecting many schools of public health during his career.

Dr. Walker wrote and spoke on public health, toxicology, and diversity in the field of environmental health. He was the recipient of numerous awards for his work, including NEHA's highest honor, the 1984 Walter S. Mangold Award. He chaired a congressional CSPAN meeting on environmental racism in 1993 that pulled in several experts on the topic and shed light on the harm to communities of color. Dr. Walker headed various state and federal government working groups, committees, and task forces. He was a past president of the American Public Health Association (APHA). APHA Executive Director Dr. Georges C. Benjamin called Dr. Walker a "true public health champion." It is a fitting honor for NEHA to recognize Dr. Walker by naming the new Diversity and Inclusion Awareness Award after him. It is our hope that his endeavors in diversity and environmental health will be remembered through this award.

The Dr. Bailus Walker, Jr. Diversity and Inclusion Awareness Award will be given annually to recognize an individual or group who made significant achievements in the development and enhancement of a more culturally diverse, inclusive, and competent environment. The qualified individual or group will demonstrate diversity in performance in their organization and community. The application period will be open from January 15–April 15, 2021. Eligibility requirements and the award application can be found at www.neha.org/about-neha/awards/dr-bailus-walker-jr-diversity-and-inclusion-awareness-award.

NEHA Thanks the Colorado Gives Campaign Supporters

Thank you for supporting the NEHA/AAS Scholarship during NEHA's first Colorado Gives campaign. Colorado Gives Day brought in a record number of donations made to the NEHA/AAS Scholarship fund in one single day, as well as a wealth of first-time supporters. We are tremendously thankful for the NEHA community. Your support of environmental health students and NEHA's mission to advance the environmental health professional for the purpose of providing a healthful environment for all means the world to us. Read more about the campaign results online at www.neha.org/about-neha/donate/neha-participates-colorado-gives-day.

NEHA Updates REHS/RS Study Guide and Exam

A new study guide for NEHA's Registered Environmental Health Specialist/Registered Sanitarian (REHS/RS) credential will be available for purchase in mid-June 2021. In addition, the new REHS/RS exam will begin being administered on September 1, 2021. Virtual town hall sessions will be presented February–April for anyone who wants to learn more. Town hall dates and times are available on the NEHA website at www.neha.org/rehs.

You can also visit our FAQs and the updated REHS/RS exam blueprint for further details at www.neha.org/node/61744. Questions can be directed to Sarah Hoover, credentialing manager, at shoover@neha.org.

No issues are more important to the communities in which we live and work than clean air, safe food, and potable water. An individual with an REHS/RS credential has the skill set to ensure that these basic community necessities are met, as well as manage other critical functions such as emergency response, vector control, sewage sanitation, hazardous material handling, and more.

The REHS/RS is the most prevalent NEHA credential and professionals demonstrate competency in an impressive range of environmental health issues, directing and training personnel to respond to routine or emergency environmental situations, and providing education to their communities on environmental health concerns. In addition, REHS/RS credential holders are key members in ensuring communities are in compliance with local, state, and federal environmental health regulations.

You Are Essential to NEHA's Government Affairs

Environmental health professionals are critical but the value of their work is not always fully understood. NEHA knows better than any other association why environmental health professionals are so vital, which is why NEHA partners with our members to tell the stories of their essential service and promote a deeper understanding of environmental health with policy makers and the public.

Policies and legislation made at national and state levels directly affect the environmental health profession. It has never been more important to stay informed and exercise our influence as a com-

munity. NEHA is a trusted source that can speak directly about the issues that matter to you. Here are some of the ways that NEHA's Government Affairs is working to keep you informed:

Your Insider in Government Affairs Blog: Stay informed on critical and timely issues through this regularly updated blog at www.neha.org/government-affairs/your-insider-government-affairs-blog.

Government Affairs Webinar Series: If you missed any of our recent Government Affairs webinars, you can view them anytime on our website at www.neha.org/node/61387. Past webinars include: "Environmental Health Priorities at CDC, FDA, and EPA Under the Biden Administration;" Environmental Health Within the New Administration and Congress;" "Bridging the Gaps Between Environmental Quality and Public Health;" and "Food Safety Legislation Now and Future."

Position Statements and Declarations: These documents guide NEHA's efforts on public policy, directing our response to specific issues affecting environmental health. Issues covered include COVID-19 vaccination, research and innovation in environmental health science, climate change, food safety, onsite wastewater systems, and more. A list of current policy statements and declarations can be found at www.neha.org/publications/position-papers.

NEHA's Government Affairs work is done on behalf of the members who support the work of our organization. This year we hope to grow our membership so that we can wield more influence and bring our members more of the resources that matter. Please consider spreading the word about NEHA as we can do so much more together than apart. Learn more about NEHA membership at www.neha.org/membership-communities.

Thank you for being involved. We could not do what we do without your participation.

Did You Know?

You can stay up-to-date on environmental health issues within the various levels of government through NEHA's Government Affairs page at www.neha.org/government-affairs. Check out the Your Insider in Government Affairs blog, view one of the Government Affairs webinars, read a recent position paper or sign-on letter, or learn about recent state and federal legislative alerts.

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EH LAND REUSE

NEHA, in partnership with the Agency for Toxic Substances and Disease Registry, is excited to announce the Environmental Health and Land Reuse Certificate Program! Join us for a comprehensive, online course exploring the environmental and health risks and social disparities associated with contaminated land properties, key players in land reuse planning and policy, and redevelopment techniques to improve community health.

- Earn an official NEHA certificate and become eligible for continuing education credits.
- Visit **www.neha.org/ehlr** to enroll.
- Take the next step to creating a lasting, positive environmental health impact on areas that need it most.

DirecTalk
continued from page 62

3. **Human Capital:** We, along with public health nurses, are the backbone of public health. The reason we were called upon to work on the opioid epidemic and COVID-19 pandemic in such large numbers is because we are highly trained professionals who are grounded in the sciences and accompanied by a high degree of relational trust throughout our communities. To be clear, on most days, when people think of public health, it is environmental health with which they identify. The postpandemic universe should emphasize a renewed alignment between us and public health nurses.
4. **Physical Assets:** The visible symbols of public health are generally environmental health. The Prop 65 signage in California, warnings against swimming in unhealthy surface waters, and restaurant grades are among the visible manifestations of the profession. Is there an opportunity to reframe how the public perceives us through our highly visible, and often emotionally activating, regulatory functions?

On January 16, 2020, Jesse Bliss, our Program and Partnership Development director, and I recorded a video on the implications of the novel coronavirus. The video was posted on January 30, 2020. You can find it at www.neha.org/news-events/latest-news/neha-actively-monitoring-coronavirus-disease-2019-outbreak. Regretfully, it took 2–3 months after that video was posted for some elements of our society to begin to take the virus seriously. Like the curse of Cassandra in Greek mythology, our warnings were ignored. But what can we learn from this? What role do we have in the postpandemic healing processes? I respectfully recommend we not brush aside the deaths of hundreds of thousands of Americans lost because of the pandemic. Now is the time to plan a path forward.

Public health at low tide. Photo courtesy of David Dyjack.

We should honor the deceased by revitalizing our professional enterprise. Environmental health should conduct local after-action assessments, alone, and with the larger communities that we serve. Leo Tolstoy once quipped, "Everyone thinks of changing the world, but no one thinks of changing himself." If we desire a better outcome during the next pandemic, let's ask ourselves some tough questions and offer solutions that reflect our best thinking and insight.

History is replete with stories anchored in conspiracy, revenge, and retribution. The pandemic tide left many public health boats aground and subject to pilfering and looting. These conditions will not fix themselves. We should insert ourselves into conversations centered on rebuilding. Above all, the pain and loss of the pandemic can lead to distorted thinking. Let us not fall prey to that default condition.

Dave

ddyjack@neha.org
Twitter: @DTDyjack

Employers increasingly require a professional credential to verify that you are qualified and trained to perform your job duties. Credentials improve the visibility and credibility of our profession and they can result in raises or promotions for the holder. For 80 years, NEHA has fostered dedication, competency, and capability through professional credentialing. We provide a path to those who want to challenge themselves and keep learning every day. Earning a credential is a personal commitment to excellence and achievement.

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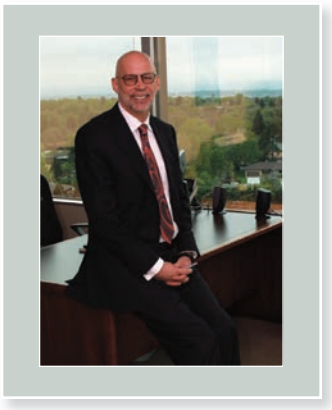

David Dyjack, DrPH, CIH

Tears to Motivate Us

Kigali is a study in contrasts. The city streets are clean and virtually free of abandoned and randomly discarded trash. For those of you interested in microplastics, Rwanda began regulating plastics in 2008, a law that applies to the production and importation of most plastics, including shopping bags. The country takes this environmental practice seriously. In fact, as I transited through their border in 2010, customs officials riffled through my luggage aiming to unearth plastic bags. They succeeded in identifying and confiscating a plastic hotel laundry sack I thoughtlessly used to separate soiled from clean clothing. I was favorably impressed by this African country's environmental policy as I have chaffed at carelessly tossed shopping bags and other plastic litter in the streets of urban environments worldwide. While this policy is a beacon of hope on a polluted planet, Kigali is also home of the Genocide Memorial, a grim reminder of humanity's most despicable and abhorrent behavior.

I visited the memorial one Saturday afternoon after spending a couple weeks ensconced in nearby Goma. While the experience of working in the Democratic Republic of the Congo was sobering, the memorial left me a changed person. The facility faithfully attempted to portray the events that led to the death of an estimated 800,000 people during the 1994 genocide. It is also a place of learning and remembrance that documents the worst of human predispositions centered on the politics of conspiracy, revenge, and retribution. I sat in silence for the better part of one hour in the memorial's garden reflecting on the horrors of East Timor, Srebrenica, and Darfur, all of which occurred in my lifetime.

Now is the time to plan a path forward.

I have thought about my experience in Rwanda and sought to identify what we can learn from it and its recovery from the 1994 genocide. Are there lessons we might apply to the healing necessary for us in the postpandemic U.S.? Before you rush to judgement, think for a moment. The U.S. is home to approximately 4% of the global population and yet we represented roughly 25% of the global COVID-19 case load. Our mortality experience is equally depressing. An estimated 18–20% of global COVID-19 deaths occurred in the U.S. For us to meander into the future in the absence of reflection would be unconscionable. Where do we as a nation go from here and what is our role as environmental health professionals in our nation's journey into recovery?

I offer four principles that might frame out our next steps.

1. **Social Capital:** I have spoken at affiliate meetings on how our profession offers three unique characteristics that make us exceptionally valuable to the public health enterprise. Those are access, axis, and affect. In aggregate, we know and understand our communities and their various subcultures, commercial enterprises, and attendant risks. We should sustainably and permanently scale-up our professional relationships with the clinical and social service professions over time and share with them the valuable intelligence we possess on how our communities function. With few exceptions, health officials who have dominated the news over the last year have scarcely acknowledged our profession's essential role in contact tracing, policy development, and other support functions. Let's cultivate our relational trust because it is the lubricant that allows the public health machinery to drive with greatest efficiency.
2. **Cultural Capital:** Let us be honest, there is no United (Public Health) States at the moment. There are 50 states and five major U.S. territories, each making pandemic decisions in-line with the political identities, values, and beliefs of their elected officials. I'm not judging the federated model of governance. I am calling it what it is. Through a public health lens, it is fragmented and ineffective in a global infectious disease outbreak. At the same time, I admire how our profession is largely a local construct. That is where the action is. We understand and operate under local political norms. Consider the three core functions of public health—assessment, assurance, and policy development. We are players in each or should be. As we move forward in time, let's assert ourselves within the local social environment in which we operate and reassure the public and elected officials that we "got this."

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Thank You!

Thank you to all who've tirelessly pursued public health and safety since COVID began, upholding NEHA's mission "To advance the environmental health professional for the purpose of providing a healthful environment for all." Our country needs more people like you.

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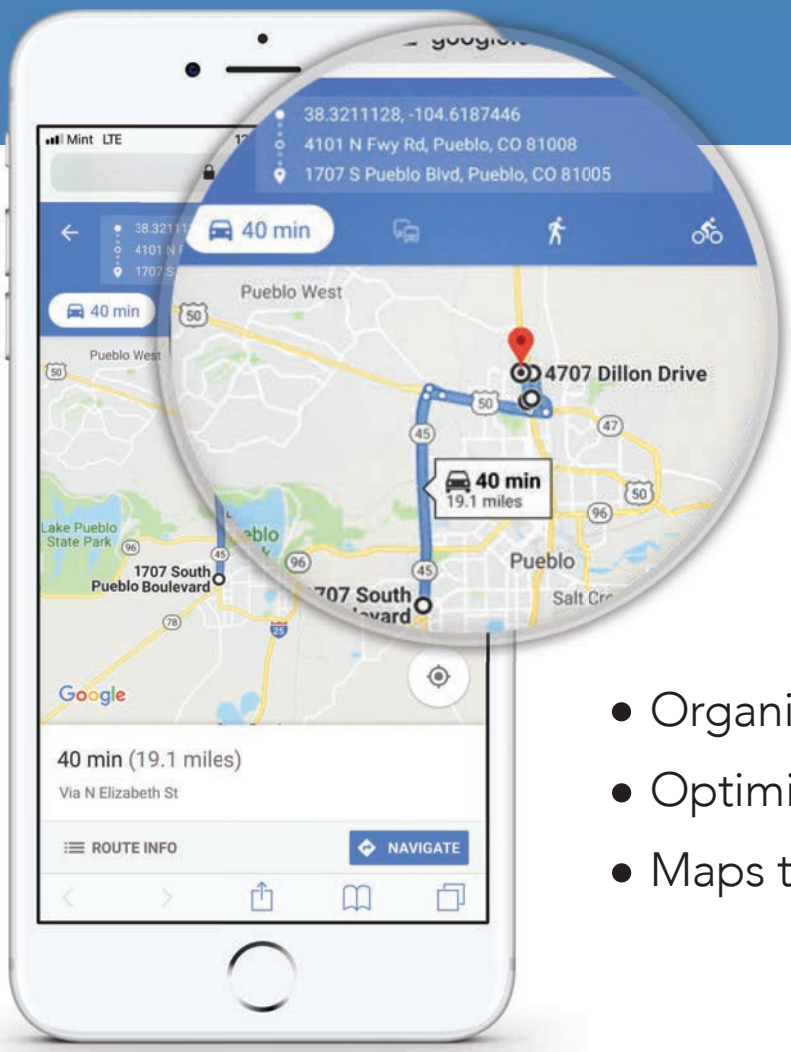

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