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Commuter Air Pollution Exposure

Comparing **Perceived** and **Measured** Pollution Exposures in Daily Commutes

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ABOUT THE COVER

Commuting accounts for one of the highest daily air pollution exposure periods for workers in the U.S. In this month's cover article, "A Comparison of Perceived and Measured Commuter Air Pollution Exposures," commuters' perceived versus actual air pollution exposures across six modes of commuting were compared. As the cover shows, there is a disconnect in terms of what is perceived versus what is measured. Active modes of commuting such as walking and bicycling have lower perceived air pollution exposures yet have higher measured exposures. On the other hand, automobile and public transportation modes have higher perceived air pollution exposures yet have lower measured exposures. The study highlights the public's lack of understanding regarding factors that influence daily air pollution exposures during commuting.

See page 8.

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PRESIDENT'S MESSAGE

Priscilla Oliver, PhD

Ideas for Enhancing and Increasing Membership

As I joined the Board of Directors of the National Environmental Health Association (NEHA) as Second Vice-President in 2016, I was given the assignment of Membership Committee Chair. At the time, the goal was to increase NEHA membership to 5,000 members. NEHA had some 4,000 members at that time and now we have over 6,000 members.

I created this list of ideas that has helped NEHA and can assist state affiliates and student environmental clubs to enhance and increase membership. The list was created to become part of a membership strategy and can also apply to other volunteer and nonprofit organizations. These are a few suggestions and there are many more to supplement these ideas. Recruiting, retaining, and enhancing membership should be ongoing.

Here is the list.

60 Ways to Increase Membership

1. Hire a NEHA Membership Director and staff.
2. Coordinate Board of Director Membership Committee with Membership Director to create, discuss, revise, update, and execute the membership plans.
3. Form a Special Group of Past Presidents, key leaders, and key members to obtain more ideas for enhancing membership.
4. Kick off Membership Drives with the President and the Executive Director.
5. Hold a Membership Activity at the NEHA Annual Educational Conference (AEC) & Exhibition each year.

Recruiting, retaining, and enhancing membership should be ongoing.

6. Host online NEHA Open House.
7. Exhibit at conferences such as the America Public Health Association (APHA), state and local public health, and environmental meetings.
8. Create NEHA t-shirts, polo shirts, dri-fit shirts, casual dress shirts, and hats.
9. Offer recruitment fees and other incentives.
10. Create a Membership Blog.
11. Create a Membership Twitter Account.
12. Use an e-mail tagline: "Membership in NEHA Matters."
13. Offer a rebate to new NEHA members.
14. Have drawings for small incentive offers/rebates.
15. Create marketing ad upgrades for targeted audiences.
16. E-mail environmental health students for recruitment purposes.
17. Involve partner organizations such as the National Environmental Health Science & Protection Accreditation Council (EHAC), Association of Environmental Health Academic Programs (AEHAP), National Council on Diversity in Environmental (N-CODE) Health, APHA, etc.
18. Apply for grants and contracts to enhance membership.
19. Involve NEHA exhibitors, partners, friends, students, and environmental leaders.
20. Ask prominent donors and supportive politicians to help.
21. Create a "Dial a Future NEHA Member" Campaign.
22. Create and hang Membership Banners and Posters.
23. Create business cards on membership.
24. Create membership buttons and stickers.
25. Create a recruitment phone bank.
26. Offer lower membership rates for students and retired professionals.
27. Offer a Lifetime Membership Category.
28. Create a Newsletter Membership Corner Update.
29. NEHA TV "Spotlight a Member" video on the website.
30. Include a NEHA membership Facebook page.
31. Create a Reclaim a Member Campaign.
32. Offer 3-months of free membership.
33. Raffle off a Membership at special events.
34. Host a Membership Walk at the NEHA AEC.
35. Create a Membership PowerPoint Presentation for Online and a Traveling PowerPoint on CD for exhibiting and for leaders to utilize in speaking events.

36. Create a Payment Plan/Membership Renewal Notice strategy.
37. Create NEHA TV commercials.
38. Host Webinars on membership.
39. Exhibit at sustainability conferences, meetings, and events.
40. Create a theme: "**Let's Grow NEHA**."
41. Create a campaign: "**Each Member Recruit Three New Members**." Hold the campaign within a time frame and reward the recruiters that succeed.
42. Send congratulation letters to environmental health student graduates and ask them to join.
43. Create a "Friends of NEHA" membership category.
44. E-mail all members three times a year about membership.
45. Create NEHA pencils, pens, pins, styluses, and mouse pads.
46. Create a NEHA mug, bowl, plate, tie, and scarf.
47. Enhance Institutional Memberships.
48. E-mail environmental health professionals.
49. Enhance the First-Time Attendee Orientation with door prizes.
50. Get a NEHA credit card for members.
51. Get a Computerized System to handle membership.
52. Hire student interns for the membership office and NEHA AEC.
53. Recruit a Celebrity Spokesperson/Authors for environmental health to support the membership drive.
54. Announce NEHA successes in press conferences and releases.
55. Recognize new members and recruiters often.
56. Create a NEHA membership e-mail account.
57. Hold Membership Conference Call Meetings.
58. Host Focus Group Meetings on membership.
59. Hold Board Meeting Brainstorming Sessions on membership.
60. Create Membership Chat Sessions Online and at the NEHA AEC.

NEHA Executive Director, Dr. David Dyjack, the NEHA Board of Directors, NEHA Membership Manager, Jonna Ashley, and NEHA staff have implemented some of these ideas. NEHA has an improved membership structure and reduced membership rates for special groups like students, graduates, retirees, internationals, and lifetime membership. There are more improvements to come. NEHA now has a larger and stronger membership base. Thank you all for your membership and the role you play to retain, expand, and improve membership in NEHA. Each of us should commit to growing membership in NEHA. One Suggestion: Recruit at least one new NEHA member each month.

Priscilla

President@neha.org

SUPPORT THE NEHA ENDOWMENT FOUNDATION

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

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

Thank you.

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Vince Radke

A Comparison of Perceived and Measured Commuter Air Pollution Exposures

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Abstract **Commuting accounts for one of the highest daily air pollution exposure periods for workers in the U.S.; however, exposures vary greatly depending on transportation mode. In this study, we compared commuters' (*N* = 433) perceived versus actual air pollution exposures across six modes of commuting in Salt Lake City, Utah. Commuter perceptions of exposure were compared with measured (actual) fine particulate matter ($PM_{2.5}$) exposures. Comparisons were made using the Wilcoxon signed-rank test. Participants ranked active modes of commuting (walking and bicycling) as being less exposing to air pollution than automobile and public transportation modes, while actual exposures indicated that walking and bicycling yielded the highest exposures ($p < .001$). Our findings suggest the general public lacks an understanding of the factors that influence daily air pollution exposures during commuting. Public health programs could reduce commuters' lifetime exposures through education directed toward actions people can take to reduce daily inhaled doses of air pollution.**

Introduction

Ambient air pollution contributes to multiple respiratory and cardiovascular diseases (Anderson, Thundiyil, & Stolbach, 2012; Brandt, Perez, Künzli, Lurmann, & McConnell, 2012; Brook et al., 2010; Pope & Dockery, 2006). Within local geographical areas, personal air pollution exposures are highly influenced by individuals' time-activity patterns. Although chronic and high intensity exposures to ambient air pollution pose the greatest health risk (Brook et al., 2016), repeated low-dose exposures, such as those experienced during commuting, also pose significant risk. For example, Zuurbier and coauthors (2011) found that air pollution exposure while commuting via car, bus, and bicycle had a mild yet immediate effect on pulmonary function and nitrous oxide exhalation. Work-commute air pollution exposure is also dependent on one's choice of transportation mode, which influences exposure concentration, travel time, and breathing rate (Chaney et al., 2017; Good et al., 2016; Gulliver & Briggs, 2004; Int Panis et al., 2010). For example, the inhaled dose of fine particulate matter, defined as particles with an aerodynamic diameter ≤2.5 μm ($PM_{2.5}$), can be 2–21 times greater for active commuters (walking and cycling) compared with commuters using automobiles or public transportation (Briggs, de Hoogh, Morris, & Gulliver, 2008; Chaney et al., 2017; Zuurbier et al., 2010). Knowledge of how modal differences in transportation influence the inhaled dose of air pollution, however, may be esoteric, with few in the general population understanding relationships between commuting choices and exposure.

A body of research is emerging that explores the relationship between individual perception of air pollution and individual choices. For example, a study based in Los Angeles found that physicians (who were presumed to be more aware of the negative impacts of air pollution on health) were no more willing to sacrifice time or money than lay people of a similar demographic to live in an area with cleaner air (Morris & Smart, 2012). Another study from Canada reported significant differences in perceived air quality between neighborhoods, but in all neighborhoods the majority of residents responded that their perception of air quality affected their decision to go outside "almost never" or "never" (Simone, Eyles, Newbold, Kitchen, & Williams, 2012).

Likewise, an Australia-based study found that air quality perception had little effect on commuting decisions. It did conclude, however, that individuals with higher education and those living in larger cities were more likely to understand how work-commute air pollution negatively affects one's health (Badland & Duncan, 2009). Commuting to work accounts for one of the highest daily exposure periods for many working adults (Dons et al., 2011; Sloan et al., 2016); however, a need remains to examine the relationships between work-commute transportation choice and commuters' perceived exposures to air pollution.

In this study, we sought to determine if differences exist in individuals' perceived and actual air pollution exposures based on mode of commuting. Among specific air pollutants, $PM_{2.5}$ has received much attention for its role in cardiopulmonary and lung cancer mortality (Fann et al., 2012; Pope & Dockery, 2006; Valavanidis, Fiotakis, & Vlachogianni, 2008). In addition, motor vehicle exhaust is a primary contributor to $PM_{2.5}$ pollution along arterial roads during commuting (Chen, Watson, Chow, DuBois, & Herschberger, 2011; Thurston, Ito, & Lall, 2011). Thus, we considered $PM_{2.5}$ to be an appropriate comparison pollutant. We collected survey data for this study in downtown Salt Lake City, Utah, simultaneously with measurement of breathing zone $PM_{2.5}$ concentrations across six different modes of commuting (Chaney et al., 2017).

Methods

Participants were recruited via verbal interception in downtown Salt Lake City and were asked to complete a 16-question survey. Research assistants administered the survey, which was in an online format using Qualtrics (2016 version). The subject population included individuals who were at least 18 years. No compensation was provided for participation. Data were collected between 10:30 a.m. and 3:30 p.m. on August 8–11, 2016. This research study was reviewed and approved by Brigham Young University's institutional review board.

Survey Instrument

Survey questions pertained to participant's views on how air pollution affects health and how air pollution exposure differs by transportation choice. There were also seven demographic questions: sex, income, educational attainment, political orientation, ethnicity, marital status, and current employment status. The survey instrument was face validated by a panel of three experts and reviewed by five members of the target population. Test–retest with 14 days between was used to determine instrument reliability. Agreement with a tolerance of 1 was used for ranked questions (i.e., rank which mode of transportation best protects from air pollution [Koo & Li, 2016]) and ranged from 61.1–100%, with an average before–after agreement of 86.3%. Ranked comparisons were made between survey responses and actual $PM_{2.5}$ measurements for the six modes of commuting.

$PM_{2.5}$ Monitoring

Methods for the $PM_{2.5}$ measurements that we used in our study are detailed in Chaney and coauthors (2017). In our study, breathing zone $PM_{2.5}$ concentrations were measured using TSI SidePak AM510 personal exposure monitors (TSI, Inc.) along a 2.7 km (1.7 mi) route during peak commuting times. Samples were collected by attaching the SidePak inlet to the commuters' shirts so that measurements were collected from air within 25 cm (10 in.) of the person's nostrils. Samples were collected simultaneously across six different modes of commuting: walking, biking, riding the bus, riding the light rail system, driving with windows open, and driving with windows closed. Samples were collected between 600–1950 W North Temple, a heavily used road leading into downtown Salt Lake City. $PM_{2.5}$ measurements were made on the same days that survey data were collected for this study. The $PM_{2.5}$ measurements were collected at a location approximately 3.0 km from where the surveys were administered. We calculated the inhaled dose of $PM_{2.5}$ for each mode of commuting from the SidePak AM510 breathing zone measurements, commute time to traverse the 2.7 km route, and published minute ventilation rates.

Data Analysis

Data analysis was performed using R statistical software (version 3.4.3). We used Wilcoxon signed-rank test to determine differences in the ranked order of measured and perceived commuter air pollution exposures (Randles, 2006; Wilcoxon, 1945). Differences in perceived harm, air pollution effect on transportation choice, and contribution to overall air pollution among different demographics were determined using *t*-test for demographics with two groups. For multiple groups, analysis of variance (ANOVA) with Fisher's least significant difference test for multiple comparisons was used to determine where differences existed (Welch, 1951; Williams & Abdi, 2010). Data categories were collapsed for those with fewer than 30 responses (e.g., divorced, widowed, and separated were combined into the same grouping). Multiple linear regression analysis was performed on a full-variable model and reduced using backward elimination, which included checking for model assumptions (Faraway, 2004).

Results

Data collection yielded 433 responses, among which 60.8% were male, 74.2% were White, 8.5% had no high school diploma, 87.9% were single or married, the average household income was $50,000, 10.2% reported being unemployed, and a broad array of political orientations were represented (27% conservative, 38% neutral, 33% liberal, 15% no response). This sample closely mirrors the demographics of Salt Lake City, wherein the U.S. Census Bureau reports 54% male (U.S. Census Bureau, 2016a), 81% White (U.S. Census Bureau, 2016b), 12% no high school diploma (U.S. Census Bureau, 2016c), 83% single or married (U.S. Census Bureau, 2016d), median household income $50,353 (U.S. Census Bureau, 2016e), 5.5% unemployed (U.S. Census Bureau, 2016f), and a similar spread of political orientations (30% Republican, 27% Democrat, 35% Independent) (Bernick, 2017).

The most common mode of transportation for all activities surveyed was driving (work = 50.3%, errands = 71.2%, entertainment = 72.2%, eating out = 72.0%, school = 42.1%, and church = 65.6%), with the exception of exercise (23.0% reported driving and 72.3% reported using active transportation, walking, or biking). In general, respondents believed active commuting (i.e., walking and bicycling) to be the best modes of transportation for physical health, and public and private automobile transportation to be the worst (Table 1). There were differences in ranking by each mode of transportation with respect to perceived and actual air pollution exposure. The rank order of perceived air pollution exposure from commuting listed the two active transportation forms (walking and bicycling) as being least exposing and the two public transportation forms (bus and light rail train) as most exposing. These results differed from measured commuter air pollution exposures in that public transportation tended to be among the most protective (coming in behind driving with car windows closed), and active transportation modes were among the most exposing (Table 2).

There were differences in ranking by demographics with respect to perceived harm, mode choice, and contribution to overall air pollution. In particular, male participants, com-

TABLE **1**

Perceived Ranking of "Which Mode of Transportation Is Best for Your Physical Health?"

Mode of Transportation	Average Ranking of Perceived Physical Health Benefits
Walking	1.46
Bicycling	2.20
Light rail train	3.60
Bus	4.38
Car (windows closed)	4.45
Car (windows open)	4.91

Note. 1 = most healthy, 6 = least healthy.

TABLE **2**

Differences Between Measured and Perceived Air Pollution Exposures

Mode of Transportation	Average Perceived Rank of Commuting Air Pollution Exposure	Actual Measured Rank	Wilcoxon Signed-Rank Test
Car (windows closed)	3.79	1	V = 12,402*
Light rail train	4.36	2	V = 72,757*
Bus	3.87	3	V = 38,727*
Car (windows open)	3.16	4	V = 56,280*
Walking	2.71	5	V = 1,632*
Bicycling	3.10	6	V = 0*

Note. 1 = least exposing, 6 = most exposing.
*$p < .001$.

pared with female participants, tended to view air pollution as being harmful ($t(288.75) = 1.66$, $p = .09$) and that their mode of transportation contributed to ambient air pollution levels ($t(316.71) = 2.77$, $p = .006$). White and Latino participants, compared with other ethnicities, reported that breathing air pollution impacted their personal mode choice to a greater degree ($F(2, 376) = 3.57$, $p = .03$; using Fisher's least significant difference post hoc test). There were also differences between marital status and income with respect to air pollution perceptions. Divorced, widowed, or separated persons presented lower perceived harm compared with single or married persons. We found that higher wealth was associated with stronger beliefs that the likelihood of breathing air pollution impacts one's personal mode choice. We also found differences in perceived harm and contribution to overall air pollution based on participants' political orientation, in that self-identified liberal participants tended to perceive greater harm from air pollution exposure when compared with self-identified conservative participants. Furthermore, participants who identified as moderate liberals or moderate conservatives reported greater acknowledgement of their own contribution to overall air pollution levels compared with participants who identified as neutral or polar political affiliations such as very liberal or very conservative (Table 3).

A reduced model predicting perceived harm was composed of marital status, political orientation, belief that choice in mode of transportation impacts overall air pollution, and that exposure likelihood impacts choice in transportation mode. One's belief in the impact of personal choice on air pollution was predicted by perceived harm and that exposure likelihood impacts choice in transportation mode. Exposure likelihood impacts choice in transportation mode and was determined by ethnicity, income, perceived harm, and belief that choice in mode of transportation impacts overall air pollution. Full results are presented in Table 4.

Discussion

This study sought to explore if differences exist between individuals' perceptions of air pollution exposure during commuting and actual (measured) exposures. We found that participants' perceived ranking of air pollution exposure had little variation (i.e., were closely centered on the mean ranking) and were quite different from measured exposures. Badland and Duncan (2009) reported that participants recognized that air pollution exposure during commuting is harmful to health but that this knowledge did not necessarily discourage them from using active modes of commuting where exposures are typically higher. Our study adds to these findings in that our participants tended to underestimate differences in exposure based on mode of commuting, even while agreeing that air pollution exposure poses a moderate health risk. Together, these two studies suggest that a knowledge gap exists within the general population related to how mode of transportation influences one's air pollution exposure during commuting. Specifically, commuters might not be aware of how pollution concentration, commute time, and breathing rate interact to influence one's overall inhaled pollution dose—and that these factors can vary significantly by transportation mode.

Understanding how differences in transportation mode affect one's overall inhaled dose of air pollution can be particularly important for active commuters, who can experience significantly higher exposures than those using public transportation or private automobiles. For example, Briggs and coauthors (2008) reported that fine particulate matter exposures (defined as $PM_{2.5}$–$PM_{1.0}$ in their study) were 2.2 times higher among participants who commuted by walking compared with those who commuted by driving, and when the longer commute times for walkers were taken into account, the exposures were estimated to be 7.4 times higher for walkers. Chaney and coauthors (2017) reported similar findings of bicycle and walking commuter inhaled doses of $PM_{2.5}$ estimated to be 9 and 21 times greater, respectively, than commuters driving private automobiles with windows closed.

The benefits of active commuting are still thought to outweigh the risks of health problems associated with higher commute-

TABLE **3**

Differences in Perceived Air Pollution Exposure Perceptions Among Different Demographic Groups

Demographic	Perceived Harm of Breathing Air Pollution While Commuting (1 = Not at All, 5 = Very Harmful)	Belief That Breathing Air Pollution Impacts Personal Mode Choice (1 = Not at All, 5 = Great Deal)	Belief That Personal Mode Choice Affects Total Air Pollution (1 = Not at All, 5 = Great Deal)
Overall average	2.44/5	3.34/5	2.17/5
Sex	$t(288.75) = 1.66$* male (2.52), female (2.34)	$t(305.25) = -0.14$	$t(316.71) = 2.77$*** male (2.29), female (1.96)
Ethnicity	$F(2, 379) = 0.97$	$F(2, 376) = 3.57$** White = 3.44, Latino = 3.14, everyone else = 2.95	$F(2, 376) = 0.43$
Educational attainment	$F(6, 371) = 0.18$	$F(6, 369) = 0.27$	$F(6, 369) = 0.57$
Employment status	$F(3, 376) = 0.23$	$F(3, 373) = 0.35$	$F(3, 374) = 0.81$
Marital status	$F(2, 377) = 4.95$*** DWS = 2.02[a], married = 2.57[b], single = 2.44[b]	$F(2, 374) = 2.80$* DWS = 3.02[b], married = 3.52[a], single = 3.31[ab]	$F(2, 375) = 0.23$
Income	$F(5, 357) = 1.06$	$F(5, 354) = 2.34$** >$100K = 3.75[a], $80–100K = 3.12[b], $60–80K = 3.44[ab], $40–60K = 3.29[b], $20–40K = 3.32[ab], <$20K = 3.15[b]	$F(5, 355) = 0.58$
Political orientation	$F(4, 370) = 4.64$*** very liberal = 2.68[ab], liberal = 2.71[a], neutral = 2.45[bc], conservative = 2.17[cd], very conservative = 2.06[d]	$F(4, 367) = 1.85$	$F(4, 368) = 3.60$*** very liberal = 2.16[ab], liberal = 2.43[a], neutral = 1.99[b], conservative = 2.31[ab], very conservative = 1.79[b]

*$p < .10$; **$p < .05$; ***$p < .01$.

[a, b, c, d] = Significant groupwise differences reported in Fisher's least significant difference test.

DWS = divorced, widowed, or separated.

time air pollution exposures (Good et al., 2016; Götschi, Garrard, & Giles-Corti, 2016; Zuurbier et al., 2010). Helping active commuters to understand how breathing rate, air pollution concentration along urban arterial roads, and other factors influence their overall inhaled pollution dose, however, could empower them to make choices that could lower their lifetime exposure. For example, in many urban areas, active transportation modes such as walking and bicycling allow for more flexibility in route choice compared with motorized forms of transportation.

One can imagine a scenario where a car driver and a bicyclist are both traveling from point A to point B and have two route choices. One route is a shorter distance but goes through a residential neighborhood. A second route is slightly longer, but travels along a main, high-speed corridor. If both were allowed to choose, the car driver would be unlikely to choose the neighborhood route because speeds are slow and there are more stop signs. The bicyclist would fare better along this route due to slower traffic speeds and reduced traffic volume. In this case, exposures would be different. If both travelers were to choose the high-speed corridor option, the bicyclist would consume a greater quantity of polluted air than the car driver would. Indeed, several studies show that $PM_{2.5}$ and other pollutant exposures are lower when active commuters take alternate routes away from major urban arterial roads used for commuting (Good et al., 2016; Jarjour et al., 2013; Zuurbier et al., 2010). Public health interventions, therefore, might begin by educating commuters about factors that contribute to their commuting exposures and the benefits to active commuters of using alternative routes.

We were interested to find a large disparity between participants' perceptions of air pollution exposure when driving a car with windows up (closed) compared with our actual measured exposure. Based on our measured exposure concentrations, estimated breathing rates, and commute times, driving with windows up was the most protective mode of commuting (Chaney et al., 2017). Briggs and coauthors (2008) reported similar findings. Participants in our study, however, ranked driving with windows up as the third worst mode for contributing to an individual's air pollution exposure during commuting. In fact, participants ranked commuting with windows down (open) as being healthier (causing less air pollution exposure) than commuting with windows closed. This disparity might be due to a false belief that driving with windows down provides more "fresh" air for automobile occupants. We did not, however, measure participant beliefs about this subject in the current study.

In the U.S. in 2016, approximately 85% of workers commuted to work by automobile, which equates to over 128 million people (U.S. Census Bureau, 2016g). Motor vehicle exhaust is a major contributor to air pollution. In an effort to decrease vehicle exhaust and increase physical activity, many communities are expanding infrastructure to promote active modes of commuting and use of public transportation. Adoption of active commuting, however, appears to be slow in the general population. For example, from 2006–2016, the percentage of workers commuting by car, truck, or van decreased by 1.3%, while the percentage of workers commuting by bicycle increased by only 0.1% (U.S. Census Bureau, 2016g).

During the same time period, the percentage of workers commuting by walking decreased by 0.2%. In light of our finding that commuters tend to believe urban commuting with windows open is healthier than with windows closed—considering that increasing active modes of commuting and use of public transportation can take many years to affect a large proportion of the population and that commuting is one of the highest daily air pollution exposure periods for many people—there is a strong argument in favor of additional studies on the relationships between car window position (open versus closed), car ventilation system setting (recirculate versus nonrecirculate settings), and driver exposure to air pollution. If studies continue to show that, across vehicle models, driving with windows closed and ventilation systems set to recirculate cabin air result in lower pollution exposures, public health interventions could be directed at educating automobile commuters on simple ways they can significantly decrease their overall pollution exposures.

We observed differences among participants based on self-reported political orientation. Specifically, increasingly liberal participants perceived greater harm associated with air pollution exposure. This finding fits in a broader narrative described by McCright and Dunlap (2011) in which liberals were more likely to believe that global warming and environmental factors are harmful. Polar political orientations (i.e., very liberal or very conservative), when compared with more moderate political orientations (i.e., moderate liberal or moderate conservative), were associated with lower beliefs that their own personal mode of transportation affects total air pollution levels. This polarization could in part be due to a variety of underlying attitudes and behaviors. A liberal respondent might believe they are taking action to limit their overall contribution to air pollution (e.g., using electric-powered yard tools or driving an environmentally friendly vehicle), whereas a conservative respondent might not perceive that air pollution is problematic, thus resulting in a similar overall score.

TABLE **4**

Predictors of Commuter Air Pollution Exposure Attitudes

Variable	Perceived Harm	
	Full Model	Reduced Model
Sex	β = .10	
Ethnicity	β = .04	
Educational attainment	β = .01	
Employment	β = .02	
Marital status	β = .11*	β = -.10**
Income	β = .01	
Political orientation	β = .15***	β = .14***
Choice impacts air pollution	β = .15****	β = .16****
Breathing impacts transport choice	β = .23****	β = .23****
Perceived harm	–	–
R^2_{ADJ}	.19	.19

*$p < .10$; **$p < .05$; ***$p < .01$; ****$p < .001$.

Our study has several inherent limitations. Surveys were collected via intercept methodology during a 1-week summertime period in one metropolitan downtown area. Thus, our results might not be generalizable to other locations. In this study, we used $PM_{2.5}$ as a comparison pollutant. Among criteria air pollutants, we assumed that commuters within the Salt Lake City area would be more familiar with $PM_{2.5}$ than other pollutants primarily because it is featured in the media regularly due to poor air quality along the Wasatch Front. We did not measure participant perceptions of which air pollutants they associated with bad air quality, however, so our findings could be biased toward participants who associate air pollution with $PM_{2.5}$. Measures of air pollution exposure were also collected along a single route leading in and out of Salt Lake City and pollution exposures by mode of commuting might vary in other locations.

Conclusion

Findings from this study will be useful in developing air pollution and environmental interventions. An important finding is that individuals do not necessarily perceive exposure to the same degree that it is experienced. This disconnect has important implications in terms of policy making and environmental regulation. As such, experience, perception, and scientific knowledge of air pollution can lead to faulty decision making in regard to policy and environmental regulation. This phenomenon, likewise, could be observed in public perception of air quality. Future studies should seek to understand the potential implications of these findings, including views among elected officials and decision makers, and differences related to gender/sex and political orientation.

Individual perceived exposure to air pollution is quite different from actual measured exposure rates with noted differences among demographic groups. These findings can prove insightful for public health practitioners charged with developing environmental health interventions and public policies, as well as informing public health advocacy efforts.

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References

Anderson, J.O., Thundiyil, J.G., & Stolbach, A. (2012). Clearing the air: A review of the effects of particulate matter air pollution on human health. *Journal of Medical Toxicology*, *8*(2), 166–175.

Badland, H.M., & Duncan, M.J. (2009). Perceptions of air pollution during the work-related commute by adults in Queensland, Australia. *Atmospheric Environment*, *43*(36), 5791–5795.

Bernick, B. (2017, August 3). Analysis: Just how liberal is Salt Lake County? *UtahPolicy.com*. Retrieved from http://utahpolicy.com/index.php/features/today-at-utah-policy/13947-analysis-just-how-liberal-is-salt-lake-county

Brandt, S.J., Perez, L., Künzli, N., Lurmann, F., & McConnell, R. (2012). Costs of childhood asthma due to traffic-related pollution in two California communities. *The European Respiratory Journal*, *40*(2), 363–370.

Briggs, D.J., de Hoogh, K., Morris, C., & Gulliver, J. (2008). Effects of travel mode on exposures to particulate air pollution. *Environment International*, *34*(1), 12–22.

Brook, R.D., Rajagopalan, S., Pope, C.A., III, Brook, J.R., Bhatnagar, A., Diez-Roux, A.V., . . . Kaufman, J.D. (2010). Particulate matter air pollution and cardiovascular disease: An update to the scientific statement from the American Heart Association. *Circulation*, *121*(21), 2331–2378.

Brook, R.D., Sun, Z., Brook, J.R., Zhao, X., Ruan, Y., Yan, J., . . . Rajagopalan, S. (2016). Extreme air pollution conditions adversely affect blood pressure and insulin resistance: The air pollution and cardiometabolic disease study. *Hypertension*, *67*(1), 77–85.

Chaney, R.A., Sloan, C.D., Cooper, V.C., Robinson, D.R., Hendrickson, N.R., McCord, T.A., & Johnston, J.D. (2017). Personal exposure to fine particulate air pollution while commuting: An examination of six transport modes on an urban arterial roadway. *PLOS One*, *12*(11), e0188053.

Chen, L-W.A., Watson, J.G., Chow, J.C., DuBois, D.W., & Herschberger, L. (2011). $PM_{2.5}$ source apportionment: Reconciling receptor models for U.S. nonurban and urban long-term networks. *Journal of the Air & Waste Management Association*, *61*(11), 1204–1217.

Dons, E., Int Panis, L., Van Poppel, M., Theunis, J., Willems, H., Torfs, R., & Wets, G. (2011). Impact of time–activity patterns on personal exposure to black carbon. *Atmospheric Environment*, *45*(21), 3594–3602.

Fann, N., Lamson, A.D., Anenberg, S.C., Wesson, K., Risley, D., & Hubbell, B.J. (2012). Estimating the national public health burden associated with exposure to ambient $PM_{2.5}$ and ozone. *Risk Analysis*, *32*(1), 81–95.

Faraway, J.J. (2004). *Linear models with R.* Boca Raton, FL: CRC Press.

Good, N., Mölter, A., Ackerson, C., Bachand, A., Carpenter, T., Clark, M.L., . . . Volckens, J. (2016). The Fort Collins Commuter Study: Impact of route type and transport mode on personal exposure to multiple air pollutants. *Journal of Exposure Science & Environmental Epidemiology*, *26*(4), 397–404.

Götschi, T., Garrard, J., & Giles-Corti, B. (2016). Cycling as a part of daily life: A review of health perspectives. *Transport Reviews*, *36*(1), 45–71.

Gulliver, J., & Briggs, D.J. (2004). Personal exposure to particulate air pollution in transport microenvironments. *Atmospheric Environment*, *38*(1), 1–8.

Int Panis, L., de Geus, B., Vandenbulcke, G., Willems, H., Degraeuwe, B., Bleux, N., . . . Meeusen, R. (2010). Exposure to particulate matter in traffic: A comparison of cyclists and car passengers. *Atmospheric Environment*, *44*(19), 2263–2270.

Jarjour, S., Jerrett, M., Westerdahl, D., de Nazelle, A., Hanning, C., Daly, L., . . . Balmes, J. (2013). Cyclist route choice, traffic-related air pollution, and lung function: A scripted exposure study. *Environmental Health*, *12*(1), 14.

Koo, T.K., & Li, M.Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of Chiropractic Medicine*, *15*(2), 155–163.

McCright, A.M., & Dunlap, R.E. (2011). The politicization of climate change and polarization in the American public's views of global warming, 2001–2010. *The Sociological Quarterly, 52*(2), 155–194.

Morris, E.A., & Smart, M.J. (2012). Expert versus lay perception of the risks of motor vehicle-generated air pollution. *Transportation Research Part D: Transport and Environment*, *17*(1), 78–85.

Pope, C.A., III, & Dockery, D.W. (2006). Health effects of fine particulate air pollution: Lines that connect. *Journal of the Air & Waste Management Association*, *56*(6), 709–742.

Randles, R.H. (2006). Wilcoxon signed rank test. In S. Kotz, C.B. Read, N. Balakrishnan, B. Vidakovic, & N.L. Johnson (Eds.), *Encyclopedia of statistical sciences*. Hoboken, NJ: John Wiley & Sons, Inc. Retrieved from https://doi.org/10.1002/0471667196.ess2935.pub2

Simone, D., Eyles, J., Newbold, K.B., Kitchen, P., & Williams, A. (2012). Air quality in Hamilton: Who is concerned? Perceptions from three neighbourhoods. *Social Indicators Research*, *108*(2), 239–255.

Sloan, C.D., Philipp, T.J., Bradshaw, R.K., Chronister, S., Barber, W.B., & Johnston, J.D. (2016). Applications of GPS-tracked personal and fixed-location $PM_{2.5}$ continuous exposure monitoring. *Journal of the Air & Waste Management Association*, *66*(1), 53–65.

Thurston, G.D., Ito, K., & Lall, R. (2011). A source apportionment of U.S. fine particulate matter air pollution. *Atmospheric Environment*, *45*(24), 3924–3936.

U.S. Census Bureau. (2016a). *Age and sex, 2012–2016 American Community Survey 5-year estimates: Salt Lake City*. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_5YR_S0101&prodType=table

U.S. Census Bureau. (2016b). *ACS demographic and housing estimates, 2012–2016 American Community Survey 5-year*

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estimates: Salt Lake City. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_5YR_DP05&prodType=table

U.S. Census Bureau. (2016c). *Educational attainment, 2012–2016 American Community Survey 5-year estimates: Salt Lake City*. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_5YR_S1501&prodType=table

U.S. Census Bureau. (2016d). *Marital status, 2012–2016 American Community Survey 5-year estimates: Salt Lake City*. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_5YR_S1201&prodType=table

U.S. Census Bureau. (2016e). *Median income in the past 12 months (in 2016 inflation-adjusted dollars), 2012–2016 American Community Survey 5-year estimates: Salt Lake City*. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_5YR_S1903&prodType=table

U.S. Census Bureau. (2016f). *Employment status, 2012–2016 American Community Survey 5-year estimates: Salt Lake City*. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_5YR_S2301&prodType=table

U.S. Census Bureau. (2016g). *Sex of workers by means of transportation to work, Universe: Workers 16 and over, 2016 American Community Survey 1-year estimates*. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_1YR_B08006&prodType=table

Valavanidis, A., Fiotakis, K., & Vlachogianni, T. (2008). Airborne particulate matter and human health: Toxicological assessment and importance of size and composition of particles for oxidative damage and carcinogenic mechanisms. *Journal of Environmental Science and Health, Part C*, *26*(4), 339–362.

Welch, B.L. (1951). On the comparison of several mean values: An alternative approach. *Biometrika*, *38*(3/4), 330–336.

Wilcoxon, F. (1945). Individual comparisons by ranking methods. *Biometrics Bulletin*, *1*(6), 80–83.

Williams, L.J., & Abdi, H. (2010). Fisher's least significant difference (LSD) test. In N.J. Salkind (Ed.), *Encyclopedia of research design*. Thousand Oaks, CA: SAGE Publishing.

Zuurbier, M., Hoek, G., Oldenwening, M., Lenters, V., Meliefste, K., van den Hazel, P., & Brunekreef, B. (2010). Commuters' exposure to particulate matter air pollution is affected by mode of transport, fuel type, and route. *Environmental Health Perspectives*, *118*(6), 783–789.

Zuurbier, M., Hoek, G., Oldenwening, M., Meliefste, K., van den Hazel, P., & Brunekreef, B. (2011). Respiratory effects of commuters' exposure to air pollution in traffic. *Epidemiology*, *22*(2), 219–227.

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Equipment, Utensils and Linens
4-1 Materials for Construction and Repair
In Compliance
Not In Compliance
Not Observed
Not Applicable
4-2 Design and Construction
In Compliance
Not In Compliance
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4-202.16 Nonfood-contact Surfaces
The nonfood-contact surface of the [ ] was not designed and constructed for easy cleaning and maintenance.
Deficiency
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4-204.13
4-3 Numbers and Practices
In Compliance
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4-4 Location and Installation
In Compliance
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4-5 Maintenance and Operation
In Compliance
Not In Compliance
Not Observed
Not Applicable

Pesticide Poisonings in Minnesota, 2000–2015

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Abstract **This study investigated work- and nonwork-related pesticide poisonings in Minnesota. Counts, rates, trends, and spatial analysis of pesticide poisonings using data from the Minnesota Poison Control Center were produced. A total of 954 work- and 9,304 nonwork-related pesticide poisonings were reported from 2005–2015. Both showed statistically significant changes: there was a 0.52% decrease for nonwork cases and a small 0.06% decrease for work cases. After adjusting for geography and severity of medical outcomes, the prevalence of work to nonwork cases was 1.37 times higher. Work cases also had a 337% increase in major medical outcomes compared to nonwork cases. There was also a statistically significant interaction between seasonality and pesticide poisoning cases. Pesticide poisonings occurred 5.81 times more frequently during summer than during winter. This study shows the data can be mapped using caller location but should be carefully interpreted. Overall, poison control data continue to be a reliable method for pesticide poisoning surveillance.**

Introduction

Pesticides are a broad class of chemicals specifically designed to kill. A pesticide's intended target is generally an insect, plant, or small mammal but human exposure can occur. Routes of exposure include digestion, inhalation, and dermal absorption (Minnesota Department of Health, n.d.). It is estimated that the U.S. uses approximately 1 billion pounds of pesticide annually and markets over 20,000 pesticide products (Calvert et al., 2003; Calvert et al., 2004; Donaldson, Keily, & Grube, 2002). The U.S. Environmental Protection Agency (U.S. EPA) estimates approximately 20,000–40,000 work-related pesticide poisonings occur annually (Blondell, 1997).

Acute and chronic health effects have been associated with pesticide poisonings. Acute symptoms include diarrhea, pinpoint pupils, rashes, nausea, headache, and vomiting (California Department of Public Health, 2019). Chronic exposure can aggravate asthma symptoms, increase the risk of certain types of cancer and birth defects, or cause damage to immune systems (California Department of Public Health, 2019). Minnesota Poison Control Center (MN PCC) data provide information to investigate patterns of pesticide usages and exposures between different populations (Watson et al., 2005).

This study investigated suspected pesticide poisonings in Minnesota from 2000–2015 using MN PCC data. Poison control centers provide 24-hr professional assistance for all 50 states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and the Federated States of Micronesia, American Samoa, and Guam (Wolkin, Martin, Law, Schier, & Bronstein, 2012). All poison control centers receive calls regarding potentially adverse exposures to an extensive variety of substances including medications, poisonous and nonpoisonous animals and plants, and other chemicals (Bronstein et al., 2007). The information collected during these calls is recorded using the National Poison Data System.

The majority of calls stem from the resident's home (76%), followed by healthcare facilities (16%), workplaces (1%), and schools (0.5%) (Bronstein et al., 2010). Exposures in children ages <6 years account for the majority of calls (51.9%) (Bronstein et al., 2010). Most calls are self-reported and represent either voluntarily provided information or partially incomplete information (Wolkin et al., 2012). Not every call is a poisoning incident. Calls can range from callers seeking diagnostic or treatment recommendations, reporting a suspected or known chemical poison exposure, or requesting information about a potential exposure (Wolkin et al., 2012).

Methods

Suspected pesticide poisoning cases were obtained from MN PCC data for cases with a potential relationship to work that were available from 2000–2015 and cases with no potential relationship to work available from 2005–2015. The study focused on 1) annual incidence rates, 2) trend analysis, 3) descriptive epidemiological summary analysis, and 4) spatial analysis in work- and nonwork-related pesticide poisoning cases. MN PCC

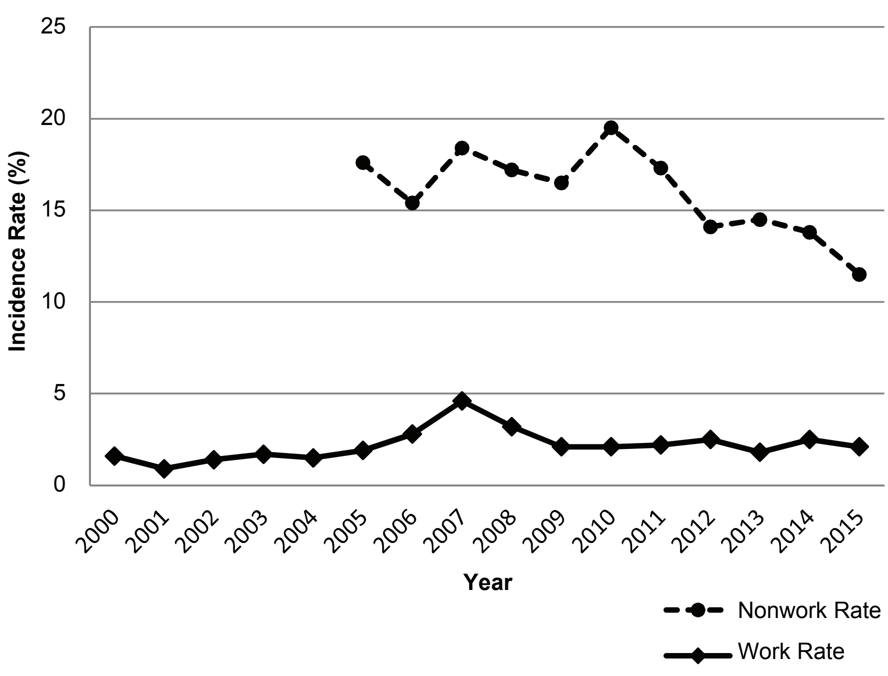
TABLE 1

Annual Incidence Rates for Work and Nonwork Cases

Year	Work Cases	Incidence Rate	Nonwork Cases	Incidence Rate
2000	42	1.6	–	–
2001	23	0.9	–	–
2002	39	1.4	–	–
2003	45	1.7	–	–
2004	41	1.5	–	–
2005	53	1.9	902	17.6
2006	77	2.8	796	15.4
2007	125	4.6	953	18.4
2008	85	3.2	898	17.2
2009	56	2.1	869	16.5
2010	56	2.1	1,036	19.5
2011	62	2.2	925	17.3
2012	70	2.5	757	14.1
2013	50	1.8	785	14.5
2014	70	2.5	754	13.8
2015	60	2.1	629	11.5

FIGURE 1

Pesticide Poisoning Incidence Rates



data were queried in an Access 2013 database and analysis was completed using SAS version 9.4. Cases were grouped into work and nonwork. The work case definition was based upon the Council of State and Territorial Epidemiologists (CSTE) and the National Institute for Occupational Safety and Health's (NIOSH) Occupational Health Indicators for work-related pesticide poisonings definition (CSTE, n.d.). The nonwork case definition was based on the Minnesota Environmental Public Health Tracking definition (Minnesota Department of Health, n.d.).

The cases defined were as follows.

Variables for Suspected Work Cases From 2000–2015:

- Reason for the call was occupational.
- Exposure site was at the workplace.
- Medical outcome resulted in a minor effect, moderate effect, major effect, or death; also included medical outcomes not followed, minimal clinical effects possible, and unable to follow but judged as a potentially toxic exposure.
- Excluded any suspected suicide, intentional abuse, intentional action but specific intention unknown, malicious, or unknown reasons.
- Age was ≥16 years; also included unknown adults ≥20 years, as well as adults in their 20s, 30s, 40s, 50s, 60s, 70s, 80s, and ≥90 years.
- Exposure to an agent that was a defined pesticide.

Variables for Suspected Nonwork Cases From 2005–2015:

- Reason for the call was not occupational.
- Medical outcome resulted in a minor effect, moderate effect, major effect, or death; also included medical outcomes not followed, minimal clinical effects possible, and unable to follow but judged as a potentially toxic exposure.
- Excluded any suspected suicide, intentional abuse, intentional action but specific intention unknown, malicious, or unknown reasons.
- Included all ages.
- Exposure to an agent that was a defined pesticide.

Annual Incidence Rates of Reported Work and Nonwork Cases

The annual incidence rates of reported work pesticide-poisoning cases are per 100,000 employed persons ages ≥16 years. The Geographic Profile of Employment and Unemployment provided the denominator. For nonwork cases, the U.S. Census Bureau's midyear Minnesota population estimates determined the annual number of persons residing in Minnesota.

Joinpoint Trend Analysis

Joinpoint is statistical software that uses permutation modeling for trend analysis. The "joinpoints" estimate where changes in trends can occur (Kim, Fay, Feuer, & Midthune, 2000). The program tests if the joinpoints, or changes in trend, are statistically significant (Kim et al., 2000). Trend analyses of the annual incidence rates were produced for work and nonwork cases to understand and compare the overall trends of these groups.

Epidemiological Summary Analysis

Summary analyses were performed for age, sex, severity of medical outcomes, and geographical factors (metro area and nonmetro area) in work and nonwork cases. We used as a reference a map created by the Minnesota Department of Agriculture (2016) that breaks the state into 10 different areas, with the metro area being Area 10 and the nonmetro areas being Areas 1–9. The metro area counties included Anoka, Carver, Dakota, Hennepin, Scott, Ramsey, and Washington.

Additional frequency tables were generated to describe pesticide usage and differences between work and nonwork cases. Large pesticide categories included disinfectants, fungicides (nonmedicinal), fumigants, herbicides, insecticides, repellents, and rodenticides. Caller location provided the ZIP code of where the individual called MN PCC to report the pesticide poisoning incident. This caller location was analyzed among the nonwork cases to identify the most frequent location, as well as to determine spatial analysis. This study also looked at work- and nonwork-related cases by geography. Related cases were defined as pesticide poisoning cases in people who were exposed from the same pesticide poisoning exposure (incident).

Poisson regression models were performed in SAS version 9.4 to produce unadjusted and adjusted risk ratios with 95% confidence intervals (*CIs*) in work versus nonwork cases. Regression models were adjusted for sever-

TABLE **2**

Distribution of Pesticide Poisoning Cases

	Work Cases (*n* = 954) # (%)	Nonwork Cases (*n* = 9,304) # (%)
Age		
<16 years (%)	0	64.5
≥16 years (%)	100	35.1
Average age (years)	36	20
Median age (years)	33	7
Mode age (years)	20	2
Sex		
Male	549 (57.5)	4,717 (50.7)
Female	320 (33.5)	4,524 (48.6)
Severity (%)		
Minor effects	87.3	98.0
Major effects	12.5	2.2
Geography (%)		
Nonmetro areas	82.8	75.9
Metro areas	17.2	24.1
Pesticides: Category description		
Disinfectants	428 (44.9)	4 (<0.1)
Insecticides	207 (21.7)	4,979 (53.5)
Herbicides	191 (20.0)	1,114 (12.0)
Fungicides (nonmedicinal)	99 (10.4)	125 (1.3)
Repellents	12 (1.3)	1,901 (20.4)
Rodenticides	9 (0.9)	1,168 (12.6)
Fumigants	8 (0.8)	12 (0.1)
Fertilizers	0	1 (<0.1)
Pesticides: Generic description		
Anticoagulant: Long-acting, superwarfarin rodenticide	0	**907**
Borate/boric acid	0	**1,859**
Chlorophenoxy	**38**	443
Glyphosate	**58**	342
Hypochlorite	**106**	0
Insect repellent	0	**1,475**
Naphthalene	3	103
Organophosphate	**41**	269
Pyrethrin	4	**538**
Pyrethroid	**104**	**1,899**

Note. All cases with an unknown age (40 cases) or sex (148 cases) were not considered. Bolded values represent the top 5 generic pesticide descriptions for work and nonwork cases (not including other/unknown description).

FIGURE 2

Distribution of Pesticide Poisoning Cases by Season

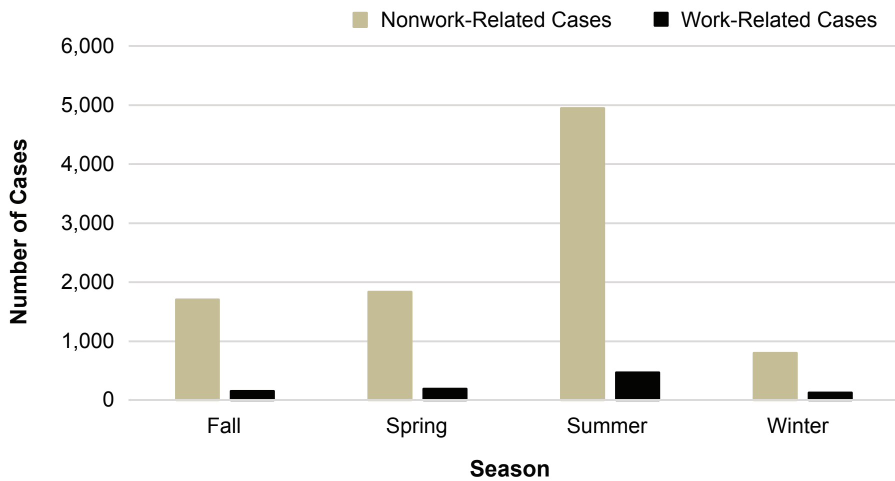


TABLE 3

Seasonal Pairwise Comparisons With Chi-Square and *p*-Values

Pairwise Comparison	Chi-Square Value	Unadjusted *p*-Value	Adjusted *p*-Value (Bonferroni)
Winter versus spring	12.1	**.0005**	**.0030**
Winter versus summer	24.6	**<.0001**	**<.0001**
Winter versus fall	18.7	**<.0001**	**<.0001**
Summer versus spring	1.3	.2518	1.0000
Summer versus fall	0	.8607	1.0000
Spring versus fall	1.1	.2859	1.0000

Note. Bolded *p*-values are statistically significant.

ity and geography. Severity was grouped into minor and major medical outcomes. Additionally, a Poisson regression model was performed to look at sex differences in work cases only.

We created a new variable, season, that grouped MN PCC pesticide poisoning cases into four seasons: spring (March 1–May 31), summer (June 1–August 31), fall (September 1–November 30), and winter (December 1–February 28 [29 in a leap year]). Pairwise comparisons among all seasons by work exposure were tested with their associated chi-square and *p*-values. We then performed a Bonferroni adjustment to obtain adjusted *p*-values. A Poisson log linear model was fitted to test winter against all other seasons by work exposure.

Spatial Analysis

Maps were generated in ArcMap 10.3 to spatially display the distribution of work and nonwork cases. This study used the Minnesota Department of Transportation to download the Minnesota county boundaries shapefile. The total work and nonwork rates by total area population were calculated (10 total areas) per 10,000 persons. The Minnesota Department of Agriculture (2019) clusters counties of similar geology, soils, and crops together.

Results

Annual incidence rates were identified for work and nonwork pesticide poisoning cases (Table 1). Trend analyses were created for work and nonwork pesticide poisoning cases. There was a very small but statistically significant 0.08% average annual increase for work cases (standard error = 0.03, *p*-value < .04) (Figure 1). This extremely small increase suggests that the annual incidence rate trend for work cases was stable throughout 2000–2015. There were two "joins" or directional trend changes detected within nonwork cases (Figure 1). From 2005–2010, there was a small but not statistically significant 0.29% average annual increase. Then from 2010–2015, there was a statistically significant 25% annual decrease (standard error = 0.3, *p*-value < .01).

A comparative trend analysis between work and nonwork annual incidence rates was completed for 2005–2015. Both work and nonwork annual incidence rates decreased during this period. There was a very small but statistically significant 0.06% decrease for work cases and a small but statistically significant 0.52% decrease for nonwork cases (work *p*-value < .05, nonwork *p*-value < .01).

The distribution of work cases (2000–2015) and nonwork cases (2005–2015) by age, sex, severity, and geography are presented in Table 2. The median and mode ages were compared because age distributions were heavily skewed. Most work cases were much older than nonwork cases: 20 years versus 2 years, respectively. The median age for work cases was 33 years, while the median age for nonwork cases was 7 years. There was a higher percentage of males (58%) to females (34%) among work cases, while the percentage of males (51%) and females (49%) in nonwork cases was relatively similar. Cases were categorized into metro areas (urban) and nonmetro areas (rural). Both work and nonwork cases occurred with greater frequency in nonmetro areas, as well as with greater frequency in severity resulting in minor medical outcomes.

The majority of nonwork cases were exposed at the resident's home (91.2%), while every other exposure site—other residence, public area, workplace (exposure reason was not occupational related), school, restaurant/food service, healthcare facility, unknown, and other—made up <6% of the nonwork cases.

Large pesticide categories were identified for all work and nonwork cases (Table 2). The top 4 pesticide categories included disinfectants (45%), insecticides (22%), herbicides (20%), and fungicides (10%). The top 4 pesticide categories for nonwork cases included insecticides (54%), repellents (20%), rodenticides (13%), and herbicides (12%).

The top 5 generic pesticide descriptions were also identified for all work and nonwork cases (Table 2). The top 5 generic pesticide descriptions for work cases included hypochlorite (disinfectant), pyrethroid (insecticide), glyphosate (herbicide), organophosphate (insecticide), and chlorophenoxy (herbicide). The top 5 generic pesticide descriptions for nonwork cases included pyrethroid (insecticide), borate/boric acid (insecticide), insect repellent (repellent), pyrethrin (insecticide), and anticoagulant such as the long-acting superwarfarin (rodenticide).

Related cases for work versus nonwork cases by geography were identified. Both work cases (87%) and nonwork cases (92%) occurred with greater frequency with single pesticide poisoning events (no related cases). Work cases with at least one related case, however, showed an overall higher percentage (14%) compared with nonwork cases with at least one related case (8%), which might suggest work cases have a higher risk of involving multiple individuals than a single pesticide exposure (event).

There was a 37% increase in the prevalence of work cases versus nonwork cases in nonmetro areas. In addition, there was a 337% increase in the prevalence of work cases resulting in major medical outcomes compared with nonwork cases. The prevalence of male work cases was 1.72 times higher than the prevalence of female work cases (95% *CI* [1.49, 1.97]).

A chi-square test of independence was performed to examine the relationship between seasonality and all work exposure cases (Figure 2). There was a significant relationship between these two variables, $\chi^2(3, N = 10{,}258) = 26.43$, $p < .0001$. After Bonferroni adjustment of all pairwise comparison *p*-values, only winter remained statistically different from all other seasons. Statistically significant interactions between seasons and work exposure cases were generated (Table 3). Pesticide poisoning cases occurring in the summer were 5.81 times higher compared with pesticide-poisoning cases occurring in the winter (Table 4).

TABLE **4**

Parameter Estimates and 95% Confidence Intervals for Work Exposure by Seasons

Parameter	Estimate	Standard Error	Wald 95% Confidence Interval	Wald Chi-Square Value	*p*-Value
Intercept	4.5	0.0450	4.38, 4.55	9,849.30	<.0001
Fall	0.7	0.0401	0.62, 0.77	300.91	<.0001
Spring	0.8	0.0395	0.70, 0.86	388.49	<.0001
Summer	1.8	0.0354	1.69, 1.83	2,464.66	<.0001
Winter	0	0	0, 0		
Scale	1.0	0	1.00, 1.00		

Maps for work and nonwork rates by total area population per 10,000 persons were generated (Minnesota Department of Agriculture, 2019). The spatial distribution for work and nonwork rates were similar (Figures 3 and 4). The Northwest Red River area was heavily concentrated for work cases, however, while the Central Sands area was heavily concentrated for nonwork cases.

Discussion

There were 9,304 nonwork pesticide poisoning cases reported from 2005–2015 and 968 work pesticide poisoning cases reported from 2000–2015. It was determined that 14 out of 968 work cases occurred in individuals <16 years and thus these cases were excluded from summary analyses. Trend analysis of the annual incident rates for work versus nonwork cases between 2005–2015 produced a statistically significant 0.52% decrease for nonwork cases and a very small but statistically significant 0.06% decrease for work cases. Annual incident rates for work cases from 2000–2015 demonstrated a statistically significant 0.08% average annual increase. The small average annual increase suggests a fairly flat trend for pesticide poisonings with a relationship to work. Annual incidence rates for nonwork cases suggest a statistically insignificant 0.29% average annual increase through the years 2005–2010. We see, however, that there was a statistically significant 25% annual decrease through the years 2010–2015. The cause of this decline is unknown.

Descriptive analyses investigated age, sex, severity of medical outcomes, and geographical factors in all work and nonwork pesticide poisoning cases. As the age distribution is log-linear, we provide the mode and median. For work cases, the mode and median age suggest prevention measures should target adults in their 20s and 30s. The male-to-female case ratio suggests greater exposure risk for males in the work setting. The results also show that more work cases happen in nonmetro areas than in metro areas. Potential areas to promote awareness and prevention could focus on the median age, males, predominantly rural locations, and factor in the pesticide categories of exposure and work in agriculture or agricultural settings.

For nonwork cases, the median age was 7 years, which suggests prevention measures should target children <7 years. Resident homes comprised 91% of the caller locations for nonwork cases, suggesting education might be warranted on appropriate insect repellent application as well as proper storage of products in homes with infants and young children present. There were also more nonwork cases in nonmetro areas than in metro areas. As repellents are predominantly used for outdoor reasons, it correlates with most pesticide poisoning cases occurring in rural areas of Minnesota.

The results also showed that significantly more work cases result in major medical outcomes compared with nonwork cases. Most work cases involve disinfectants, insecticides,

FIGURE **3**

Rates of Work-Related Pesticide Poisoning Cases by Area

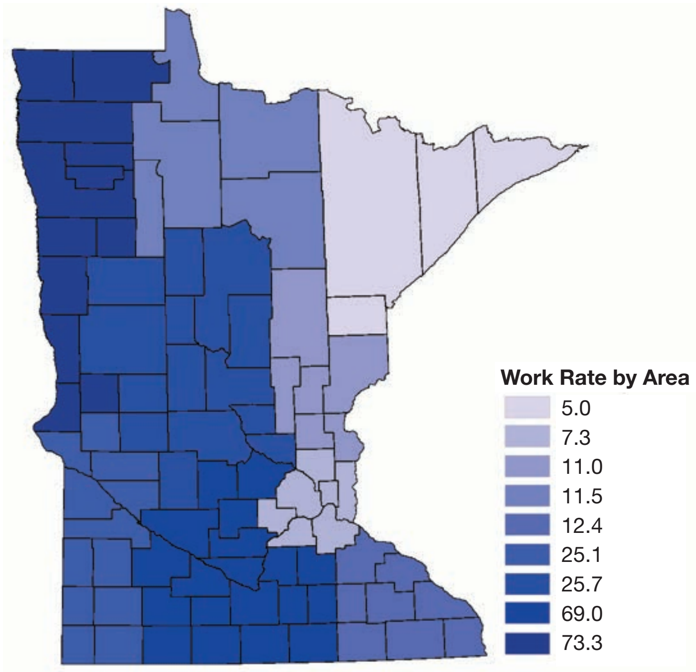
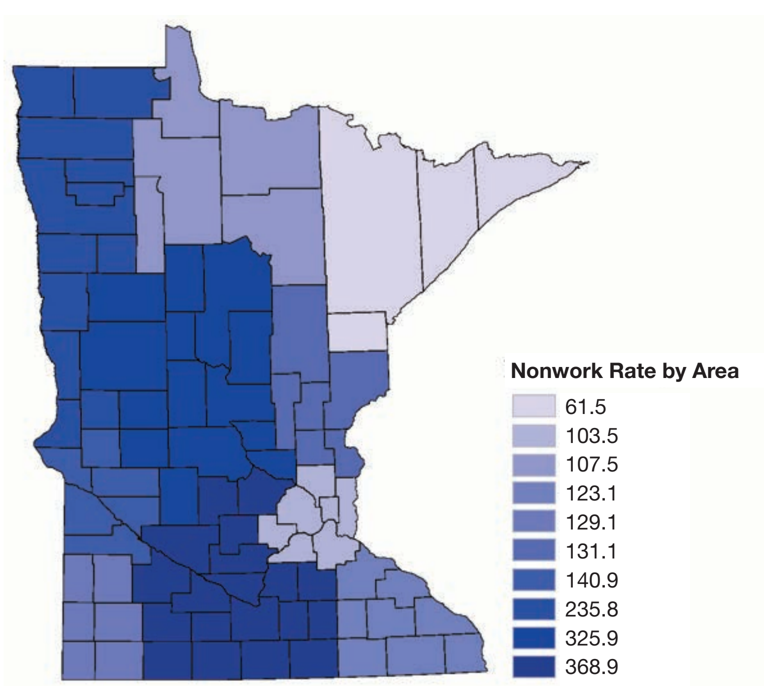


FIGURE **4**

Rates of Nonwork-Related Pesticide Poisoning Cases by Area



and herbicides, while most nonwork cases involve insecticides, repellents, and rodenticides. This finding suggests intervention efforts should target work and nonwork cases differently. Education about correct application and storage of pesticides should be in correlation with the seasonality of product usage. Proper use of insecticides and repellents in nonwork cases might decrease the number of nonwork cases. Protective equipment during the application of disinfectants, insecticides, and herbicides might decrease the number of work cases.

Both work and nonwork cases had a greater frequency of no related cases compared with having at least one related case. The proportion of having at least one related case was higher in work cases (14%) than in nonwork cases (8%), as well as higher in nonmetro areas for work cases (12%) than in nonwork cases (6%). The related cases for work cases might be due to inexperience, lack of awareness of bystanders, or a change in protocol or work environment. The related cases for nonwork cases might involve young children improperly applying insect repellents for each other—and thus exposing themselves and others to pesticides.

Season has a strong association with pesticide poisoning incidents. Pesticide poisoning cases occurring in the summer were 5.81 times higher compared to pesticide poisoning cases occurring in the winter. These odds might potentially change as climate change progresses. Longer warm periods could lead to an increased use of pesticides in response to an increase in mosquito and other insect populations.

Lastly, incidence rates by total area population were calculated and displayed in ArcMap to allow for comparison across all county areas (Figures 3 and 4). The distribution of work versus nonwork cases was similar. Work cases were predominantly in the Northwest Red River, West Central, Southwest Central, and South Central areas, while the nonwork cases included those areas as well as the Central Sands area. Some potential explanations for differences in nonmetro counties could include low prevalence of agriculture, access to healthcare facilities, land use, and pesticide usage.

Poison control center data are the best surveillance information available to estimate the number of pesticide poisonings for both work and nonwork cases annually. The reliability of poison control center data for research and surveillance depends on its completeness and accuracy. The American Association of Poison Control Centers (AAPCC) created a manual for all poison control centers to collect consistent data. Errors that are commonly made include the use and interpretation of abbreviations (Thienes, 1995, 2002), the initial substance reported (Lubbert, McVoy, Seifert, & Jacobitz, 2005), and the failure to properly document information (Seifert et al., 2005). Most U.S. poison control centers automatically upload a portion of the data to the AAPCC to conduct surveillance at the national level. Manual review of all poison control center records is impractical due to the large volume of calls (Jaramillo, Marchbanks, Willis, & Forrester, 2010). Because poison control centers serve almost the entire U.S. population, the data are useful for monitoring pesticide poisonings nationally, even though poison control centers capture only approximately 10% of acute occupational pesticide-related illness cases (Calvert et al., 2003).

Some limitations of poison control center data include, but are not limited to (Minnesota Department of Health, n.d.):

- Poison control center calls stem from a variety of reasons, including medical counseling for poisoning.
- Data are acquired through telephone calls, which limits data collection to those who have access to telephones, as well as to those who have knowledge of poison control center services.
- Mapping the data is highly dependent on whether the location of the caller was the same as the site of exposure. This study tried to determine whether the caller and site of exposure were the same. For work cases, call location occurred at a healthcare facility in about 46% of cases (438 out 954 cases) and about 1% was unknown. Assuming that individuals traveled to the nearest available healthcare facility and that the majority of healthcare facilities that called the poison control center were rural, one might assume that the call location was within the same county or an adjoining county.
- Some work cases might be reported as nonwork cases if people are reluctant to report a work site injury or exposure.
- Duplicate case numbers were removed to decrease the probability that more than one call was made for the same event. It is possible, however, that numerous calls for the same poisoning event might have been reported as different case numbers.

Conclusion

As stated above, poison control center data have limitations but continue to serve as an important resource in pesticide poisoning surveillance in the U.S. This study used MN PCC data to conduct an assessment and overview of both Minnesota work- and nonwork-related pesticide poisoning exposures. Further studies can use these results to conduct more focused studies about geography, gender/sex, seasonality, severity, and pesticide usage. As discussed earlier, the annual incidence rates for nonwork cases seem to be decreasing over time, which suggests efforts to promote education and awareness in nonwork-related groups are effective. The annual incidence rates for work cases seem to be stable; however, these rates might be affected in the next decade with changes in climate and agricultural practices.

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References

Blondell, J. (1997). Epidemiology of pesticide poisonings in the United States, with special reference to occupational cases. *Occupational Medicine*, *12*(2), 209–220.

Bronstein, A.C., Spyker, D.A., Cantilena, L.R., Jr., Green, J.L., Rumack, B.H., & Giffin, S.L. (2010). 2009 annual report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 27th annual report. *Clinical Toxicology*, *48*(10), 979–1178.

Bronstein, A.C., Spyker, D.A., Cantilena, L.R., Jr., Green, J., Rumack, B.H., & Heard, S.E. (2007). 2006 annual report of the American Association of Poison Control Centers' National Poison Data System (NPDS). *Clinical Toxicology*, *45*(8), 815–917.

California Department of Public Health. (2019). *Occupational Pesticide Illness Prevention Program, Publications: Surveillance/data.* Retrieved from https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/OHB/OPIPP/Pages/PesticidePubs.aspx#data

Calvert, G.M., Mehler, L.N., Rosales, R., Baum, L., Thomsen, C., Male, D., . . . Arvizu, E. (2003). Acute pesticide-related illnesses among working youths, 1988–1999. *American Journal of Public Health*, *93*(4), 605–610.

Calvert, G.M., Plate, D.K., Das, R., Rosales, R., Shafey, O., Thomsen, C., . . . Lackovic, M. (2004). Acute occupational pesticide-related illness in the US, 1998–1999: Surveillance findings from the SENSOR-pesticides program. *American Journal of Industrial Medicine*, *45*(1), 14–23.

Council of State and Territorial Epidemiologists. (n.d.). *Occupational health indicators: Indicator 11: Acute work-related pesticide poisonings reported to poison control centers.* Retrieved from http://www.cste.org/?OHIndicators

Donaldson, D., Kiely, T., & Grube, A. (2002). *Pesticides industry sales and usage: 1998 and 1999 market estimates*. Washington, DC: U.S. Environmental Protection Agency.

References

Jaramillo, J.E., Marchbanks, B., Willis, B., & Forrester, M.B. (2010). Evaluation of completeness of selected poison control center data fields. *Journal of Medical Systems*, *34*(4), 499–507.

Kim, H.J., Fay, M.P., Feuer, E.J., & Midthune, D.N. (2000). Permutation tests for joinpoint regression with applications to cancer rates. *Statistics in Medicine*, *19*(3), 335–351.

Lubbert, J., McVoy, J., Seifert, S.A., & Jacobitz, K. (2005). Accuracy and completeness of initial substance identification: Is what you hear, what they got? *Clinical Toxicology*, *43*(6), 764.

Minnesota Department of Agriculture. (2016). *2013 pesticide usage on four major crops in Minnesota* (Figure 1, p. 9). Retrieved from https://www.mda.state.mn.us/sites/default/files/inline-files/2013pesticiderpt.pdf

Minnesota Department of Health. (n.d.). *About the pesticide poisoning data*. Retrieved from https://apps.health.state.mn.us/mndata/pesticide_metadata

Seifert, S.A., Boyer, L.V., Bronstein, A.C., Jacobitz, K., McNally, J., & Meza, J.L. (2005). Reduction of medical error by introduction of a new clinical management protocol in a poison center. *Clinical Toxicology*, *43*(6), 767–768.

Thienes, C.H. (1995). Poster session A: Abbreviations as communication troubles. *Clinical Toxicology*, *33*(5), 513.

Thienes, C.H. (2002). 2002 North American Congress of Clinical Toxicology Annual Meeting—Exhibits and poster session II, abstracts 68–117: Abbreviation abuse—Still more "BS" (B–S). *Clinical Toxicology*, *40*(5), 631.

Watson, W.A., Litovitz, T.L., Belson, M.G., Wolkin, A.B., Patel, M., Schier, J.G., . . . Rubin, C. (2005). The Toxic Exposure Surveillance System (TESS): Risk assessment and real-time toxicovigilance across United States poison centers. *Toxicology and Applied Pharmacology*, *207*(Suppl. 2), 604–610.

Wolkin, A.F., Martin, C.A., Law, R.K., Schier, J.G., & Bronstein, A.C. (2012). Using poison center data for national public health surveillance for chemical and poison exposure and associated illness. *Annals of Emergency Medicine*, *59*(1), 56–61.

Study to Assess the Prevention of Microbial Cross-Contamination From Tables to Utensils Using Flatware Rests

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Abstract **Restaurants serve more than 70 billion meals in the U.S. each year. Annually, approximately 48 million foodborne illnesses occur in the U.S., yet only over 800 foodborne disease outbreaks get reported. From 1998–2013, 56% of the 17,445 outbreaks reported were associated with restaurants. While scientifically validated cleaning and sanitation strategies are available, microbial cross-contamination from environmental surfaces remains an issue. For instance, previous research shows that the cleaning tool itself can become a source of contamination. The objective of this study was to test if a flatware rest provides a physical barrier between contaminated tabletop surfaces and eating utensils. Data confirmed that flatware rests prevented the contamination of utensils from microorganisms when compared with utensils placed directly on surfaces inoculated with *E. coli, Salmonella* Typhimurium, and MS2 bacteriophage (a surrogate for norovirus). This study demonstrates that flatware rests are a practical solution to prevent cross-contamination of foodborne pathogens from tabletop to utensil, and potentially are an added layer of consumer protection.**

Introduction

Restaurants serve more than 70 billion meals in the U.S. each year (Jones & Angulo, 2006). In 2014, food-away-from-home sales surpassed food-at-home sales, comprising over 50% of total food expenditures (Saksena et al., 2018). Overall, adults ages 18–54 years in the U.S. consume food away from home at least 5 times per week and in 2017, consumer units (e.g., families, single persons living alone, etc.) spent on average $3,365 on food away from home (Saksena et al., 2018; U.S. Bureau of Labor Statistics, 2019).

Unfortunately, foodborne disease causes approximately 48 million illnesses each year in the U.S., yet only over 800 foodborne disease outbreaks are reported annually to the Centers for Disease Control and Prevention (Scallan, Griffin, Angulo, Tauxe, & Hoekstra, 2011; Scallan, Hoekstra, et al., 2011). From 1998–2013, 56% of the 17,445 outbreaks reported were restaurant-associated, with the most common contributing factors being those related to food handling and preparation (61%) and food worker health and hygiene (47%) (Angelo, Nisler, Hall, Brown, & Gould, 2017). Within these broad categories, cross-contamination contributed to 32% of issues linked to food handling and preparation.

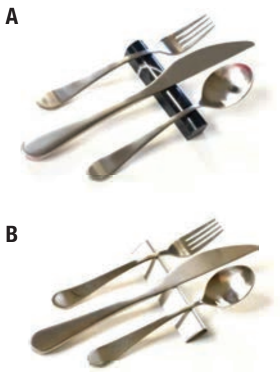
For prevention of cross-contamination from environmental surfaces, proper cleaning and sanitation are the primary tools available. Previous research, however, has shown that the cleaning tool itself can become the source of contamination (Hilton & Austin, 2000; Redmond, Griffith, Slader, & Humphrey, 2004; Scott & Bloomfield, 1990). Gibson and coauthors (2012) demonstrated that generic cotton terry towels—commonly used in food service establishments (FSEs)—can readily contaminate a surface if used previously to remove pathogens from a different surface. In addition, the sanitizing compounds most commonly used in FSEs (e.g., quaternary ammonium compounds) are ineffective against norovirus, which is the primary cause of foodborne disease in the U.S. (Feliciano, Li, Lee, & Pascall, 2012; Kingsley, Vincent, Meade, Watson, & Fan, 2014; Scallan, Hoekstra, et al., 2011).

Proper cleaning and sanitation to prevent the transmission of foodborne pathogens in FSEs should be an attainable goal, but additional approaches might be warranted for enhanced protection of public health. One option to enhance protection of public health is the addition of a physical barrier. In this study, the physical barrier is a flatware rest. While flatware rests likely had their beginnings in the late 17th century or even before, these items once again entered the marketplace in the 21st century as a tool to separate the flatware from the tabletop (Byer, 2016). Flatware rests are objects of different materials (e.g., stainless steel, marble, hard plastic) that are placed on the tabletop where the "head" or "neck" of the flatware is placed on the rest itself (Figure 1). The flatware rest provides a barrier between a tabletop and the eating utensil itself.

To our knowledge, there have not been any studies characterizing the efficacy of

FIGURE **1**

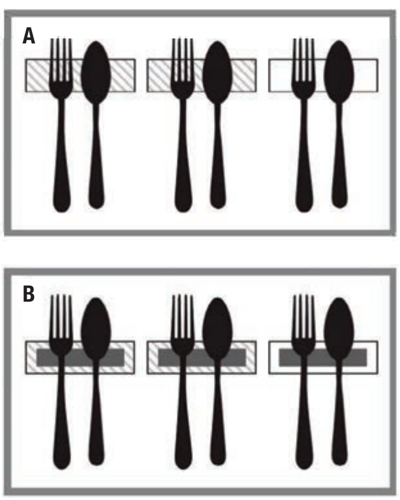
Example of Flatware Rests



A = marble flatware rest; B = stainless steel flatware rest.

FIGURE **2**

Experimental Setup for Evaluation of Flatware Rests



A = control setup with utensils (fork and spoon) placed directly on inoculated areas (gray diagonal stripes) or not inoculated area (white); B = treatment setup with the neck of the utensils (fork and spoon) oriented on the flatware rests (dark gray rectangle) with the flatware rests placed directly on inoculated areas (gray diagonal stripes) or not inoculated area (white).

flatware rests as a preventive control for microbial cross-contamination from surfaces. Therefore, the primary objective of this study was to evaluate the efficacy of flatware rests for the prevention of microbial cross-contamination from a contaminated tabletop to eating utensils.

Methods

Preparation of Microorganisms

E. coli C3000 (American Type Culture Collection [ATCC] 15507), *Salmonella* Typhimurium LT2 (ATCC 19585), and MS2 bacteriophage (ATCC 15597-B1)—a surrogate for norovirus—were used in the present study (Richards, 2012). Preparation of bacteria inoculum was done in accordance with AOAC International Official Method 920.09 and preparation of the MS2 bacteriophage was done as described previously (AOAC International, 2011; Gibson, Crandall, & Ricke, 2012). The tabletop surface was composed of a white, nonporous melamine material.

Experimental Setup

For each experiment, two 5 x 1.5-in. areas (12.7 x 3.81 cm) were inoculated with approximately 6 log colony forming units (CFUs) of each bacterial type or plaque forming units (PFUs) of MS2 and allowed to dry on the surface for 30 min. Two pieces of stainless steel flatware (spoon and fork) were placed on the contaminated areas with either the 1) head of the flatware resting directly in the contaminated area on the tabletop surface or 2) neck of the flatware placed on the marble or stainless steel flatware rest located on top of the contaminated area (Figure 2). The marble and stainless steel flatware rests measured 4 x 0.75 in. (10.16 x 1.91 cm) and 4.25 x 1 in. (10.8 x 2.53 cm), respectively. The utensils were left for 5 min followed by swabbing with calcium alginate-tipped swabs presoaked in 2.25 mL of buffered phosphate water. We also swabbed the bottom of the flatware rests that were in contact with the contaminated surfaces.

Recovery and Detection of Microorganisms

Swab samples were vortexed for 10 s, serially diluted in 0.1% peptone, and plated on 3M Petrifilm *E. coli*/Coliform Count Plates and XLT-4 agar plates for *E. coli* and *Salmonella* detection, respectively, or Tryptic Soy Agar using the double agar layer assay for MS2 detection as described previously (Almeida & Gibson, 2016; Conover & Gibson, 2016; Dusch & Altwegg, 1995). All plates were incubated for 18–24 hr at 37 °C. Following incubation, CFUs or PFUs were counted and recorded per milliliter.

Data Analysis

Concentrations of bacteria (CFU/mL) and bacteriophage (PFU/mL) were log-transformed for visual convenience without loss of generality in results (e.g., $\log_{10}$, CFU/mL, or PFU/mL + 1). All experiments were completed in duplicate with biological replicates, as well as positive and negative control samples for each type of microorganism.

Results

To determine the recovery efficiency of the microorganisms from the surface, we collected swabs from the inoculated areas on the tabletop after 5 min. Following the 5-min period, 4.56, 5.54, and 5.30 $\log_{10}$ (CFU/mL or PFU/mL + 1) were recovered from the tabletop surface for *E. coli*, *Salmonella*, and MS2, respectively. The transfer of microorganisms from the contaminated tabletop surface or flatware rests after a 5-min contact time is shown in Figure 3. On average, 3.82, 4.67, and 3.53 $\log_{10}$ (CFU/mL or PFU/mL + 1) were recovered from the utensils in direct contact with the contaminated surface for *E. coli, Salmonella*, and MS2, respectively. No microorganisms were recovered from the flatware placed on either the marble or stainless steel flatware rests.

We also swabbed flatware rests contacting the contaminated surfaces. For *E. coli*, *Salmonella*, and MS2, 4.50, 5.50, and 4.99 $\log_{10}$ (CFU/mL or PFU/mL + 1) were recovered from the bottom of the marble flatware rest, respectively. From the bottom of the stainless steel flatware rest, 3.75, 4.85, and 3.17 $\log_{10}$ (CFU/mL or PFU/mL + 1) of *E. coli*, *Salmonella*, and MS2 were recovered, respectively. No microorganisms were recovered from utensils or flatware rests placed in the control area (not inoculated; Figure 2).

Discussion

Cross-contamination events within FSEs are prevalent and can occur at numerous stages in the food preparation process. Previous researchers have determined that food preparation and food-adjacent surfaces (e.g., cutting boards, microwave oven controls, faucet handles on sinks, various handles, and ingredient lids) that were perceived to be clean by visual assessment were contaminated with microorganisms (Sharp & Walker, 2003; Tebbutt, Bell, & Aislabie, 2007). It has been indicated that pathogens can multiply on these surfaces and even after drying, some microorganisms can remain viable for weeks, resulting in cross-contamination of foods (Holtby, Tebbutt, Grunert, Lyle, & Stenson, 1997; Wilks, Michels, & Keevil, 2005). Even restaurant menus can become contaminated with pathogens and should be sanitized regularly to prevent the transmission of foodborne pathogens (Sirsat, Choi, Almanza, & Neal, 2013). Furthermore, as previously mentioned, cleaning tools such as towels and cloths can become the source of contamination. Two primary factors should be considered when determining the risk of foodborne disease associated with cross-contamination: 1) level of contamination on the surfaces and 2) prospect of the transfer of contamination to the food and ultimately, to the consumer (Bloomfield & Scott, 1997).

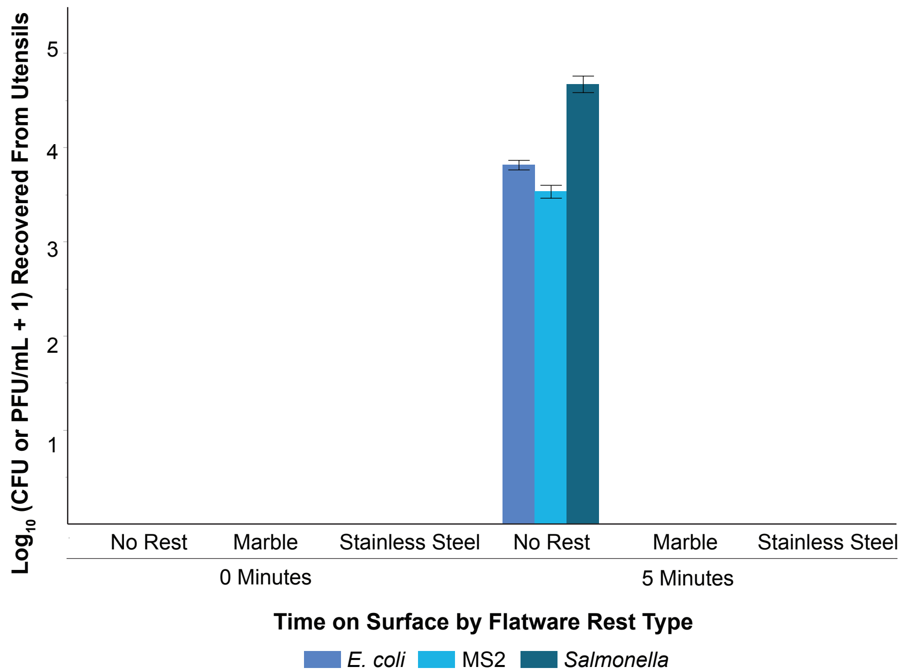
In a study conducted by Sirsat and coauthors (2013), researchers sampled surfaces of restaurant menus and concluded that there was 1 to 2 $\log_{10}$ CFU/cm^2 of aerobic microorganisms present on the laminated menus. Another investigation focusing on the microbial load of surfaces within communal kitchens revealed an average of 1.0 x 10^3 to 4.3 x 10^7 CFU/mL of total coliforms depending on the surface type and location (Sharp & Walker, 2003). During an investigation of microbial loads on food contact surfaces in schools, Illés and coauthors (2018) found that 70.3% of kitchen tables presented unsatisfactory (>2.40 $\log_{10}$ CFU/100 cm^2) mesophilic aerobic bacterial counts with a mean of 3.49 $\log_{10}$ CFU/100 cm^2.

While none of the aforementioned studies report on pathogens recovered from kitchens and FSEs, it is important to note the recovered microbial load in relation to the infectious dose of common foodborne pathogens. Human enteric viruses such as norovirus cause the most foodborne-related illnesses worldwide due to their ease of transmission and low infectious dose (Siebenga et al., 2009). The ingestion of as few as 18 to 1,000 viral particles on average can lead to illness (Kambhampati, Koopmans, & Lopman, 2015).

Another important group of pathogens, nontyphoidal salmonellae, are responsible for 11% of the estimated foodborne illnesses in the U.S. annually and are the second-most common foodborne disease agent (Scallan, Hoekstra, et al., 2011). The infective dose of salmonellae can vary depending on the immune status of the individual, the strain, and the food product. Data thoroughly reviewed by Blaser and Newman (1982) from outbreaks of salmonellae suggest that infections can be caused by the ingestion of <10^3 cells, but more commonly, higher doses are needed to overcome stomach acidity.

FIGURE **3**

Microbial Recovery From Utensils Based on Treatment



MS2 = bacteriophage that is used as a surrogate for norovirus.

Note. Bars indicate the mean value of microorganisms recovered from the utensils (fork and spoon) for each treatment (no rest, marble rest, or stainless steel rest) by time (0 and 5 min). Zero minutes represent the microbial status of the utensils prior to being placed on the contaminated surface or flatware rest. Error bars were constructed using one standard deviation from the mean.

Numerous other bacterial pathogens can be transmitted via direct food handler contamination or cross-contamination in FSE environments, including enterotoxigenic *E. coli*, *Campylobacter* spp., *Shigella* spp., and group A *Streptococcus* (Todd, Greig, Bartleson, & Michaels, 2007), although these are not nearly as prevalent as the previously discussed norovirus and nontyphoidal *Salmonella*. In general, these pathogens are of fecal origin—with the exception of group A *Streptococcus*—and have a range of reported infectious doses (e.g., approximately 100 to >10^6 cells) (Todd, Greig, Bartleson, & Michaels, 2008).

In addition to the low infectious dose of many pathogens and the risk of cross-contamination from surfaces, common chemicals for cleaning and sanitation do not effectively destroy all pathogens. For example, Joseph and coauthors (2001) reported no resistance in planktonic *Salmonella* Weltevreden cells to iodine and chlorine; however, biofilms of *S.* Weltevreden demonstrated resistance to similar treatments. Therefore, improper cleaning and "leftover" salmonellae could be a potential source of contamination. Moreover, chlorine, chlorine dioxide, peroxyacetic acid, hydrogen peroxide, and trisodium phosphate were all tested for the inactivation of norovirus (Kinglsey et al., 2014).

While some chemicals (e.g., trisodium phosphate) showed reduction of norovirus over a period of time, others (e.g., hydrogen peroxide) had no impact on the virus, providing further evidence that chlorine remains the most effective sanitizer for the inactivation of norovirus (Kinglsey et al., 2014). Another study, conducted by Feliciano and coauthors (2012), determined that quaternary ammonium compounds used regularly in FSEs to inactivate bacteria were unable to reduce the same level of murine norovirus—a norovirus surrogate—under similar conditions. This lack of virus reduction by many traditional sanitizers might be linked to the limited guidance measures for human enteric viruses within the food industry, as thoroughly reviewed by Bosch and coauthors (2018).

There are a few limitations related to the present study. First, a higher concentration of microorganisms (i.e., compared with naturally occurring levels) was inoculated onto the tabletop surface in order to demonstrate the potential magnitude of cross-contamination that can occur between the tabletop and eating utensils. This situation might be considered not representative of a real-world scenario. Based on the number of microorganisms transferred to the eating utensil from the tabletop surface (2–18% of original inoculum), however, one could speculate that even a low-level contamination event (10^2 CFU or PFU) could result in transference of a sufficient infectious dose to the utensil. Second, the flatware rest itself has its own limitation. More specifically, the flatware rest is introducing an additional surface that has the potential to become contaminated and will need to be sanitized properly. Unlike an entire tabletop surface, though, the flatware rests can be placed in a mechanical warewasher for microbe inactivation on the surface as specified in the Food and Drug Administration's *Food Code*, *Sanitization of Equipment and Utensils* (U.S. Department of Health and Human Services, 2017).

Conclusion

The results of this study show that flatware rests can prevent cross-contamination of microorganisms from tabletops to utensils, and thus might provide an added layer of protection to consumers. FSEs—and the hospitality industry in general—should consider physical barriers to microbial contamination as an additional preventive control for foodborne pathogens. FSEs must still ensure, however, that cleaning and sanitizing regulations established by state food codes are strictly adhered to in order to maintain an effective barrier (Food and Drug Administration, 2019). Thus, future studies should validate the cleaning and sanitation protocols applied to flatware rests if their use is implemented as a preventive control measure.

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References

Almeida, G., & Gibson, K.E. (2016). Evaluation of a recirculating dipper well combined with ozone sanitizer for control of foodborne pathogens in food service operations. *Journal of Food Protection*, *79*(9), 1537–1548.

Angelo, K.M., Nisler, A.L., Hall, A.J., Brown, L.G., & Gould, L.H. (2017). Epidemiology of restaurant-associated foodborne disease outbreaks, United States, 1998–2013. *Epidemiology & Infection*, *145*(3), 523–534.

AOAC International. (2011). Germicidal and detergent sanitizing action of disinfectants (Official Method SM 960.09). In G.W. Latimer, Jr. (Ed.), *Official methods of analysis*. Gaithersburg, MD: Author.

Blaser, M.J. & Newman, L.S. (1982). A review of human salmonellosis: I. Infective dose. *Reviews of Infectious Diseases*, *4*(6), 1096–1106.

Bloomfield, S.F., & Scott, E. (1997). Cross-contamination and infection in the domestic environment and the role of chemical disinfectants. *Journal of Applied Microbiology*, *83*(1), 1–9.

Bosch, A., Gkogka, E., Le Guyader, F.S., Loisy-Hamon, F., Lee, A., van Lieshout, L., . . . Phister, T. (2018). Foodborne viruses: Detection, risk assessment, and control options in food processing. *International Journal of Food Microbiology*, *285*, 110–128.

Byer, B. (2016). *Protecting the table and tablecloth with flatware rests, coasters, and placemats—A historical account.* Retrieved from https://hubpages.com/living/Proctecting-the-Table-and-tablecloth-with-Flatware-Rests-Coasters-and-Placemats-A-Historical-Account

Conover, D.M., & Gibson, K.E. (2016). Comparison of two plain soap types for removal of bacteria and viruses from hands with specific focus on food service environments. *Food Control*, *69*, 141–146.

Dusch, H., & Altwegg, M. (1995). Evaluation of five new plating media for isolation of *Salmonella* species. *Journal of Clinical Microbiology*, *33*(4), 802–804.

Feliciano, L., Li, J., Lee, J., & Pascall, M.A. (2012). Efficacies of sodium hypochlorite and quaternary ammonium sanitizers for reduction of norovirus and selected bacteria during ware-washing operations. *PLOS One*, *7*(12), e50273.

Food and Drug Administration. (2019). *Retail food protection: FDA* Food Code. Retrieved from https://www.fda.gov/food/retail-food-protection/fda-food-code

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References

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Gibson, K.E., Crandall, P.G., & Ricke, S.C. (2012). Removal and transfer of viruses on food contact surfaces by cleaning cloths. *Applied and Environmental Microbiology*, *78*(9), 3037–3044.

Hilton, A.C., & Austin, E. (2000). The kitchen dishcloth as a source of and vehicle for foodborne pathogens in a domestic setting. *International Journal of Environmental Health Research*, *10*(3), 257–261.

Holtby, I., Tebbutt, G.M., Grunert, E., Lyle, H.J., & Stenson, M.P. (1997). Outbreak of *Salmonella enteritidis* phage type 6 infection associated with food items provided at a buffet meal. *Communicable Disease Report, CDR Review*, *7*(6), R87–R90.

Illés, C.B., Tóth, A.J., Dunay, A., Lehota, J., & Bittsánszky, A. (2018). Evaluation of food safety knowledge and microbial status of food contact surfaces in schools. *Journal of Food Safety*, *38*(4), e12480.

Jones, T.F., & Angulo, F.J. (2006). Eating in restaurants: A risk factor for foodborne disease? *Clinical Infectious Diseases*, *43*(10), 1324–1328.

Joseph, B., Otta, S.K., Karunasagar, I., & Karunasagar, I. (2001). Biofilm formation by *Salmonella* spp. on food contact surfaces and their sensitivity to sanitizers. *International Journal of Food Microbiology*, *64*(3), 367–372.

Kambhampati, A., Koopmans, M., & Lopman, B.A. (2015). Burden of norovirus in healthcare facilities and strategies for outbreak control. *The Journal of Hospital Infection*, *89*(4), 296–301.

Kingsley, D.H., Vincent, E.M., Meade, G.K., Watson, C.L., & Fan, X. (2014). Inactivation of human norovirus using chemical sanitizers. *International Journal of Food Microbiology*, *171*, 94–99.

Redmond, E.C., Griffith, C.J., Slader, J., & Humphrey, T.J. (2004). Microbiological and observational analysis of cross-contamination risks during domestic food preparation. *British Food Journal*, *106*(8), 581–597.

Richards, G.P. (2012). Critical review of norovirus surrogates in food safety research: Rationale for considering volunteer studies. *Food and Environmental Virology*, *4*(1), 6–13.

Saksena, M.J., Okrent, A.M., Anekwe, T.D., Cho, C., Dicken, C., Effland, A., . . . Tuttle, C. (2018). *America's eating habits: Food away from home* (EIB-196). Washington, DC: U.S. Department of Agriculture, Economic Research Service. Retrieved from https://www.ers.usda.gov/webdocs/publications/90228/eib-196.pdf?v=1045.6

Scallan, E., Griffin, P.M., Angulo, F.J., Tauxe, R.V., & Hoekstra, R.M. (2011). Foodborne illness acquired in the United States—Unspecified agents. *Emerging Infectious Diseases*, *17*(1), 16–22.

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

Scott, E., & Bloomfield, S.F. (1990). The survival and transfer of microbial contamination via cloths, hands and utensils. *The Journal of Applied Bacteriology*, *68*(3), 271–278.

Sharp, K., & Walker, H. (2003). A microbiological survey of communal kitchens used by undergraduate students. *International Journal of Consumer Studies*, *27*(1), 11–16.

Siebenga, J.J., Vennema, H., Zheng, D.P., Vinjé, J., Lee, B.E., Pang, X.L, . . . Koopmans, M. (2009). Norovirus illness is a global problem: Emergence and spread of norovirus GII.4 variants, 2001–2007. *Journal of Infectious Diseases, 200*(5), 802–812.

Sirsat, S.A., Choi, J.K., Almanza, B.A., & Neal, J.A. (2013). Persistence of *Salmonella* and *E. coli* on the surface of restaurant menus. *Journal of Environmental Health*, *75*(7), 8–14.

Tebbutt, G., Bell, V., & Aislabie, J. (2007). Verification of cleaning efficiency and its possible role in programmed hygiene inspections of food businesses undertaken by local authority officers. *Journal of Applied Microbiology*, *102*(4), 1010–1017.

Todd, E.C., Greig, J.D., Bartleson, C.A., & Michaels, B.S. (2007). Outbreaks where food workers have been implicated in the spread of foodborne disease. Part 2. Description of outbreaks by size, severity, and settings. *Journal of Food Protection*, *70*(8), 1975–1993.

Todd, E.C., Greig, J.D., Bartleson, C.A., & Michaels, B.S. (2008). Outbreaks where food workers have been implicated in the spread of foodborne disease. Part 4. Infective doses and pathogen carriage. *Journal of Food Protection*, *71*(11), 2339–2373.

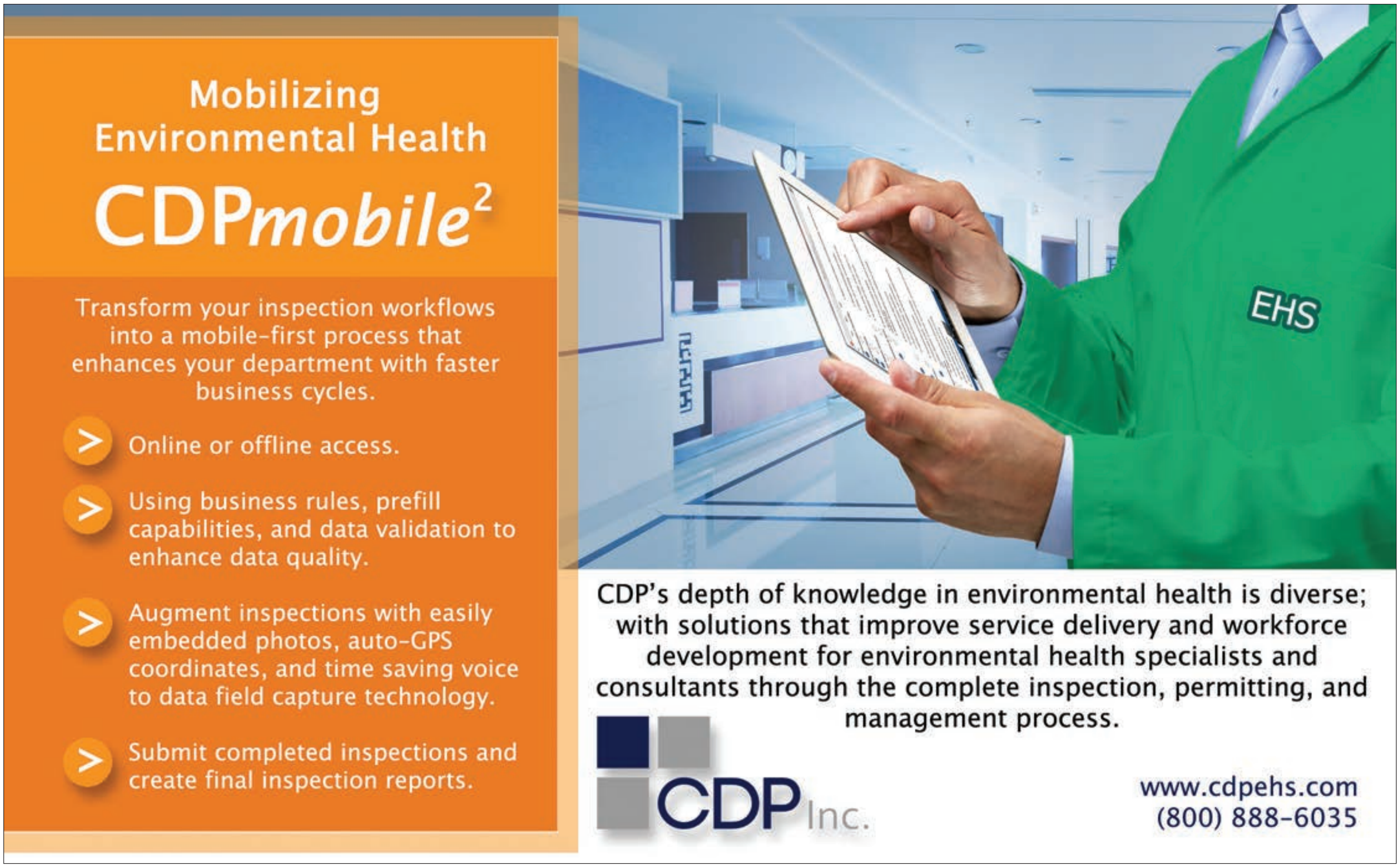
U.S. Bureau of Labor Statistics. (2018). *BLS Reports: Consumer expenditures in 2017* [Report 1080]. Retrieved from https://www.bls.gov/opub/reports/consumer-expenditures/2017/home.htm

U.S. Department of Health and Human Services, Public Health Service, Food and Drug Administration. (2017). *Recommendations of the United States Public Health Service Food and Drug Administration: Food Code.* Washington, DC: Government Printing Office. Retrieved from https://www.fda.gov/media/110822/download

Wilks, S.A., Michels, H., & Keevil, C.W. (2005). The survival of *Escherichia coli* O157 on a range of metal surfaces. *International Journal of Food Microbiology*, *105*(3), 445–454.

Did You Know?

World Toilet Day is November 19. This year's theme, "Leaving No One Behind," draws attention to those people being left behind without sanitation and the social, economic, and environmental consequences of inaction. Learn more at www.worldtoiletday.info.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GUEST COMMENTARY

Are We There Yet? In-Flight Food Safety and Cabin Crew Hygiene Practices

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Amid the rapid expansion of global air traffic, aviation food safety is a critical issue (Huizer, Swaan, Leitmeyer, & Timen, 2015). More than 1 billion in-flight meals are served annually (Jones, 2006) and the aviation catering market is expected to be worth $18 billion by 2021 ("Global $18 billion in-flight catering services market," 2017). Food served on planes is prepared in industrial kitchens close to airports and then transported to planes where it is stored, reheated, and served. The process is complex, with many opportunities for food contamination. Although food preparation on the ground is subject to considerable regulation at both the national and international level, similar rules do not apply to food served in-flight. Airline caterers might need to comply with local food safety regulations, those of the country of the aircraft registration, those of the destination country, and international food safety guidelines (Solar, 2019). While there are greater challenges to ensuring in-flight food safety, we argue that the same food safety principles used in establishments "on-ground" should be applied to in-flight food services. This guest commentary considers one key factor of in-flight food hygiene: the availability of hand washing facilities for cabin crew.

Food safety regulations are public health measures designed to prevent the spread of disease. Foodborne illness is a widespread and costly—yet preventable—public health problem (Centers for Disease Control and Prevention, 2018) that can arise in-flight because of the complexity of the food service environment and the confined conditions (Hatakka, 2000). Sheward (2008) sees cabin crews as the missing link in the food handler chain. Yet the nature of the onboard workspace and absence of legislative enforcement hamper adequate crew hygiene and food safety behaviors.

Maintenance of a consistently high food safety standard is ever more important, particularly on ultra-long-haul flights (i.e., flight operations that regularly exceed 16 hr of planned flight time [Flight Safety Foundation, 2005]), where increased handling of food over an extended period of time brings ever more opportunity for food safety lapses. Poor food safety management and foodborne illness in-flight can become a flight safety issue by incapacitating pilots or cabin crew, rendering them unfit to fly (McMullan et al., 2007; Mitchell & Evans, 2004). Additional pressures come from the fact that passengers and crew disperse rapidly after flights and any illnesses they suffer would be difficult to track (Aiello & Larson, 2002).

Hand washing has long been considered a basic public health measure (Foddai, Grant, & Dean, 2016). During a flight, cabin crew frequently handle food while simultaneously completing multiple tasks. While contaminated hands play a key role in foodborne illness incidents (Curtis & Cairncross, 2003), access to clean toilets and hand hygiene serve as primary barriers to reduce the risk of transmission of pathogens that cause foodborne disease (Aiello & Larson, 2002). Most national legislation requires compliance with food safety protocols and dictates that hand washing facilities should always be provided to food handlers in proximity to their workspace.

Staff toilets and hand washing facilities are mandated in on-ground food establishments (Food and Drug Administration, 2018; Food Standards Agency, 2018). Although aircraft kitchens usually have sinks, they are mostly inadequate due to limited space and the common use of spring-loaded faucets, which require one hand to keep the water on (Hedberg et al., 1992). These factors have been shown to negatively impact hand washing practices of cabin crew (Pragle, Harding, & Mack, 2007).

Although airlines have responded to the limited number of hand washing facilities by providing hand sanitizers as part of galley equipment, evidence from a systematic review questions the efficacy of hand sanitizers as a substitute for hand washing in food handling settings (Foddai et al., 2016). Kampf and coauthors (2010) reported limited efficacy of hand sanitizer gels and advised that hand sanitizers should be used only after hand washing and never as a substitute. Further barriers to adequate cabin crew hand hygiene in-flight include time pressure, insufficient food handler training, and usage constraints of disposable gloves. The use of gloves typically required for food handlers on-ground, for example, is a voluntary measure in-flight and depends on airline protocols (Flight Safety Foundation, 2003).

The International Health Regulations (World Health Organization, 2006) require the maintenance of sanitary conditions on conveyances and the World Health Organization Guide to Hygiene and Sanitation in Aviation (2009) notes that inadequate water supply for hand washing "may lead to an inability to prepare or serve food in a sanitary manner, thereby impacting on the provision of safe food to passengers." The International Health Regulations are legally binding but unenforceable; the World Food Safety Guidelines for Airline Catering and the International Air Transport Association Cabin Operations Safety Best Practices Guide also rely on voluntary compliance. In practice, there is no enforceable legal requirement for modern aircraft design to provide galley sinks for adequate hand washing. Even more remarkable, there is no legal requirement for aircraft to have installed toilets.

The context of aviation food has changed. New dynamics in air travel such as extended flight times and increasing passenger loads provide more opportunities for foodborne diseases to occur. A new regulatory approach to in-flight food safety needs to align as closely as possible to on-ground standards and be supported by effective compliance monitoring and enforcement. Structural improvements might be necessary to enable adherence to personal hygiene protocols. As a focal point of hand hygiene pressures, designated staff sinks can be an effective way to improve safe food handling on board. If hand sanitizer gels are provided as an alternative, their acceptance by cabin crew and their effectiveness in the cabin workspace should be determined. Such research could contribute evidence to inform policy as the aviation industry continues to increase the number and length of flights worldwide. Cabin crew need a more informed understanding of what food safety actually means.

Meeting the challenges of providing safe food amid increasing air travel requires an understanding of the complexities associated with the cabin workspace, the uncertainties relating to training and education of cabin crew, and the policy responses across relevant aviation and public health sectors. Food safety is a critical component of general aviation safety. Devising more effective ways to adhere to food safety standards inflight can result in significant public health benefits. Shifting policy is a slow proposition but the need for safe food handling on board will only increase.

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References

Aiello, A.E., & Larson, E.L. (2002). What is the evidence for a causal link between hygiene and infections? *The Lancet Infectious Diseases*, *2*(2), 103–110.

Centers for Disease Control and Prevention. (2018). *Foodborne illnesses and germs*. Retrieved from https://www.cdc.gov/foodsafety/foodborne-germs.html

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

Flight Safety Foundation. (2003). Procedural compliance prevents illnesses caused by microorganisms in food. *Cabin Crew Safety*, *38*(5), 1–8. Retrieved from https://flightsafety.org/ccs/ccs_sept-oct03.pdf

Flight Safety Foundation. (2005). Fourth workshop yields insight into early ultra-long-range operations. *Flight Safety Digest*, *24*(8–9), 1–15. Retrieved from https://flightsafety.org/wp-content/uploads/2016/12/fsd_aug-sept05.pdf

Foddai, A.C., Grant, I.R., & Dean, M. (2016). Efficacy of instant hand sanitizers against foodborne pathogens compared with hand washing with soap and water in food preparation settings: A systematic review. *Journal of Food Protection*, *79*(6), 1040–1054.

Food and Drug Administration. (2018). *Food guidance & regulation (food and dietary supplements)*. Retrieved from https://www.fda.gov/food/guidance-regulation-food-and-dietary-supplements

Food Standards Agency. (2018). *General food law.* Retrieved from https://www.food.gov.uk/business-guidance/general-food-law

Global $18 billion in-flight catering services market 2017–2022—Analysis of growth trends progress and challenges—Research and markets. (2017, February 13). *Business Wire*. Retrieved from https://www.businesswire.com/news/home/20170213006081/en/Global-18-Billion-In-Flight-Catering-Services-Market

Hatakka, M. (2000). *Hygienic quality of foods served on aircraft* (Doctoral thesis). Helsinki, Finland: University of Helsinki. Retrieved from http://ethesis.helsinki.fi/julkaisut/ela/elint/vk/hatakka/hygienic.pdf

Hedberg, C.W., Levine W.C., White, K.E., Carlson, R.H., Winsor, D.K., Cameron, D.N., . . . Osterholm, M.T. (1992). An international foodborne outbreak of shigellosis associated with a commercial airline. *JAMA*, *268*(22), 3208–3212.

Huizer, Y.L., Swaan, C.M., Leitmeyer, K.C., & Timen, A. (2015). Usefulness and applicability of infectious disease control measures in air travel: A review. *Travel Medicine and Infectious Disease*, *13*(1), 19–30.

Jones, P.L.M. (2006). Flight-catering. In H. Becker & U. Grothues (Eds.), *Catering-management Portrait einer Wachstumsbranche in Theorie und Praxis* (Ch. 1.4.1, pp. 39–55) [Chapter in German]. Hamburg, Germany: Behr's Verlag.

Kampf, G., Marschall, S., Eggerstedt, S., & Ostermeyer, C. (2010). Efficacy of ethanol-based hand foams using clinically relevant amounts: A cross-over controlled study among healthy volunteers. *BMC Infectious Diseases*, *10*, 78.

McMullan, R., Edwards, P.J., Kelly, M.J., Millar, B.C., Rooney, P.J., & Moore, J.E. (2007). Food-poisoning and commercial air travel. *Travel Medicine and Infectious Disease*, *5*(5), 276–286.

Mitchell, S.J., & Evans, A.D. (2004). Flight safety and medical incapacitation risk of airline pilots. *Aviation, Space, and Environmental Medicine*, *75*(3), 260–268.

Pragle, A.S., Harding, A.K., & Mack, J.C. (2007). Food workers' perspectives on handwashing behaviors and barriers in the restaurant environment. *Journal of Environmental Health*, *69*(10), 27–32.

Sheward, E. (2008). *Aviation food safety*. Hoboken, NJ: Wiley-Blackwell.

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References *continued from page 31*

Solar, L. (2019). Food safety takes off: Regulations, logistics and the challenges of airline catering. *Global Food Safety Resource*. Retrieved from https://globalfoodsafetyresource.com/safety-regulations-airline-catering/

World Health Organization. (2006). *International health regulations* (3rd ed). Geneva, Switzerland: Author. Retrieved from https://www.who.int/ihr/publications/9789241580496/en/

World Health Organization. (2009). *Guide to hygiene and sanitation in aviation* (3rd ed., see section 2.1.3.2). Geneva, Switzerland: Author. Retrieved from https://www.who.int/water_sanitation_health/hygiene/ships/guide_hygiene_sanitation_aviation_3_edition.pdf

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BUILDING CAPACITY

Building Capacity With Voice First

Darryl Booth, MBA

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

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

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

Introduction

The term "voice first" refers to the emerging practice of using natural voice speech as a primary means of requesting services, getting information, and making orders. You've certainly seen its possibilities in consumer devices such as the Apple HomePod, Google Home, and Amazon Echo.

Natural speech, featured in science fiction and much anticipated in technology, proved difficult in practice. Voice presents several inherent challenges, including the ability to discern all spoken words and context, and conclude meaning. Consider all the prominent accents and nuanced communications to support. The modern-day transformative technologies overcoming these challenges are increasingly faster computer processing and connected cloud computing.

Note that there exists just a tiny bit of circuitry on each device. It's just enough to identify the wake word (e.g., "OK, Google," "Hey Siri," or "Alexa"), record the commands that follow, connect to your network and Internet, and receive/voice a response. It's your connection to the Internet that makes the difference as those voice recordings are rapidly transmitted to ultra-powerful computers in the cloud. And it is the cloud computing power that parses your command and composes the proper response.

I attended a conference of city and county chief information officers recently. We identified both threats (e.g., security, privacy, workforce) and opportunities (e.g., cloud-cloud, analytics, and artificial intelligence/machine learning). The most memorable presentation declared that local government systems must be prepared to be where its residents live. That is, if mobile is at critical mass, be on mobile (noting that many health departments have embraced mobile). If voice is at critical mass, be available for voice.

During the National Environmental Health Association's (NEHA) 2019 Annual Educational Conference (AEC) & Exhibition this July in Nashville, Tennessee, we had a lot of fun with an educational session jokingly titled, "Alexa, Should I Eat at Big Billy's Drive-In?" In this session, we posited that health department staff and residents are ready for voice and that using voice is not out of reach for forward-looking health departments.

We used inspection data already published to the web and built and demonstrated a modest project using Amazon Echo, a device that is both inexpensive and popular. Our selection is not an endorsement of the product, rather it was based on the reasons previously stated. We then demonstrated how one could ask for inspection results and details for a named retail food facility. We also coded the "skill" with extra information that might help residents and health department staff.

Several examples follow:

- **Command:** "Alexa, ask my health department how Big Billy's Drive-In did in its last inspection."
  Response: "Big Billy's Drive-In was last inspected on September 30, 2019. The result was good with no violations."

- **Command:** “Alexa, ask my health department for its address.”
  Response: “The XYZ health department is located at 123 North Main Street and is open weekdays from 9:00 a.m. to 5:00 p.m.”
- **Command:** “Alexa, ask my health department for a food safety tip.”
  Response: “Surfaces should be washed with hot soapy water. A solution of 1 tablespoon of unscented liquid chlorine bleach per gallon of water can be used to sanitize surfaces.” (Source: U.S. Department of Agriculture, www.choosemyplate.gov/ten-tips-be-food-safe.)

Other ideas (not implemented) included an inspector reviewing prior violations on the way to an inspection, a food safety self-audit survey for operators, and voice-based consumer complaints.

One can appreciate how a small demonstration project like this one can potentially help renew interest in the health department’s mission—it gives health department inspectors and restaurant staff a relaxed way to start a conversation that ends in a meaningful message and awareness. It’s also fun and brings the spotlight back around to your department and your passion.

Elements of a Voice-First Demonstration Project

Select a Platform (or Platforms)

The path forward is different for each of the three major platforms: Apple, Google, and Amazon. In our project, we considered which platform had the most users and was easy to approach.

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We selected the Amazon Echo for its market penetration and its enthusiasm for businesses, governments, and hobbyists building additional capabilities like ours. See the Resources sidebar to begin your project journey.

Catalog Available Data Sources

There exists a plethora of public facing sources of inspection data. For our project, we selected a local health department with publicly available inspection history, violations, and ratings. We avoided the permissions issue by beginning with open data.

For your project, first check with your information technology (IT) department or software vendor and ask how your data could be made visible to devices like Amazon Echo.

Build, Market, Evaluate, Iterate

The build required some programming, trial, and error. Thankfully, the Internet provides a universe of tutorials and examples. Still, it is a task oriented towards the aspiring or working programmer as the final result required some JavaScript programming (although other languages are supported).

Before you release your project to the outside world, you’ll have ample opportunity to test it with your own device. This testing is what we did at the NEHA 2019 AEC.

When you are confident of its usability, there’s just one more step to make the skill visible to the outside world and to launch your marketing campaign. You need to complete a short checklist of best practices. Publish a YouTube video showing how it works. Who knows, it might go viral!

As we advanced our project, we found more and more ways to add capabilities. Repeating food safety tips was not among our first goals. As we followed tutorials, we got excited to see the possibilities for public health advocacy.

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Resources

- Steps to build a custom skill with Amazon Alexa: https://developer.amazon.com/docs/custom-skills/steps-to-build-a-custom-skill.html
- Sample code: https://github.com/darrylbooth/Alexa-MyHealthDepartment

DIRECT FROM ATSDR

A Fresh Look at Stress and Resilience in Communities Affected by Environmental Contamination

Ben Gerhardstein, MPH
Pamela G. Tucker, MD
Jamie Rayman, MPH
Christopher M. Reh, PhD
Agency for Toxic Substances and Disease Registry

Editor's Note: As part of our continued effort to highlight innovative approaches to improve the health and environment of communities, the *Journal* is pleased to publish a bimonthly column from the Agency for Toxic Substances and Disease Registry (ATSDR) at the Centers for Disease Control and Prevention (CDC). ATSDR serves the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. The purpose of this column is to inform readers of ATSDR's activities and initiatives to better understand the relationship between exposure to hazardous substances in the environment, its impact on human health, and how to protect public health.

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

Ben Gerhardstein is an environmental health scientist with ATSDR's Region 9 office. Dr. Pamela Tucker is a medical officer at ATSDR. Jamie Rayman is a health educator and community involvement specialist in ATSDR's Region 9 office. Dr. Christopher Reh is the associate director for ATSDR.

From toxic waste in Love Canal, New York, to lead in Flint, Michigan, environmental contamination can cause chronically elevated psychosocial stress (see sidebar) in individuals and across families and communities (Cuthbertson, Newkirk, Loveridge, & Skidmore, 2016; Edelstein, 2004; Levine, 1983). Stress is a normal reaction to environmental contamination, not a mental health disorder. Still, stress can affect people's health and quality of life.

Environmental contamination can cause psychosocial stress among affected community members for many reasons, including:

- **Uncertainty:** At the individual level, people might not know whether, at what level or for how long, they were exposed. Moreover, scientists and physicians might be uncertain about the possible health effects of exposure.
- **Health and safety concerns:** At a family level, parents might worry about their children's health. They might feel their home is not a safe place anymore.
- **Social conflict:** At the community level, there can be discord between community members who have differing beliefs about the seriousness of the threat.

In addition, lengthy environmental and health investigations, loss of trust in institutions, financial strains, and other concerns associated with environmental contamination are sources of stress.

For affected community members, the stress of living with environmental contamination can pose physiological health risks on top of risks associated with direct exposure to the contamination. Chronic stress has been linked with cardiovascular effects, increasing the risk for development of hypertension and plaque formation in atherosclerosis (Kaplan, Pettersson, Manuck, & Olsson, 1991; Melin, Lundberg, Söderlund, & Granqvist, 1999; Seeman et al., 2010). Stress can also trigger complex headaches (e.g., migraines) and flares in autoimmune (Stojanovich & Marisavljevich, 2008) and dermatological conditions (Arndt, Smith, & Tausk, 2008). Disadvantaged and vulnerable populations might also disproportionately suffer from other psychosocial and environmental stressors (e.g., institutionalized discrimination, adverse childhood events) (Collaborative on Health and the Environment, 2016; Morello-Frosch & Shenassa, 2006). Further, stress and chemical exposures can interact, producing worse health outcomes than either independently (McEwen & Tucker, 2011).

Conversely, individual and community resilience can promote physical and psychological health and enhance well-being. Community resilience is the ability of a community to adapt to changing conditions and prepare for, withstand, and rapidly recover from disruption (The White House, 2015). Communities able to develop an actionable plan to cope with and recover from a disaster tend to have better outcomes (Wulff, Donato, & Lurie, 2015). While acute disasters affect communities differently from chronic environmental contamination incidents (Table 1), resilience theory and principles can be applied to help communities prepare for, survive, and recover from natural and technological disasters (Sandifer & Walker, 2018).

The Agency for Toxic Substances and Disease Registry (ATSDR) and other federal,

TABLE **1**

Acute Disasters and Chronic Contamination Affect Communities Differently

Acute Disasters (e.g., Hurricane, Terrorist Attack)	Chronic Contamination (e.g., Toxic Chemical in Drinking Water)
Have a before and after	Becomes a context of community life with no clear beginning and end
Immediate visible damage	Relatively invisible
Clear human health and safety impacts	Uncertain human health impacts
Promote action	Promote study of potential remedies
People cycle through stages of warning/threat/impact, response, recovery	Traps some people in warning/threat/impact stages without a clear path to recovery

Adapted from Couch and Coles (2011) and Sandifer and Walker (2018).

What Is Psychosocial Stress?

Psychosocial stress is a term that combines "psychological stress" and "social stress." Psychological stress refers to emotional, behavioral, biochemical, and physiological reactions that people experience when confronted with a situation that strains their ability to cope. Social stress refers to feelings that can arise from a person's relationship to others, including family, neighborhoods, and the workplace, that can lead to psychological stress. Each type of stress can influence the other. Taken together, the terms are called psychosocial stress.

state, and local health professionals with experience in communities affected by environmental contamination recognize stress as a challenge. ATSDR's efforts to address this issue date back to a 1995 expert panel on the psychological effects of hazardous substances (Agency for Toxic Substances and Disease Registry [ATSDR], 1995). Following the expert panel, ATSDR established a community stress team that worked directly with communities to develop public health strategies to mitigate community stress from 1998–2002. The team also delivered trainings on stress and contamination for public health and environmental professionals, and in some communities, for local psychologists, healthcare providers, and social workers.

More recently, public health agencies, including ATSDR, have developed stress-focused materials for affected community members. These materials acknowledge stress and worry related to environmental contamination, validate these feelings as normal responses, offer ideas for coping, and point to helpful resources (ATSDR, 2017a; County of Los Angeles Public Health, 2018, Multnomah County, 2016). ATSDR also developed tips for health professionals to review before addressing this topic with community members (ATSDR, 2017b) and has provided awareness-level training for public health and environmental professionals (U.S. Environmental Protection Agency, 2018). ATSDR's fact sheet (in English and Spanish) and tips sheet are available at www.atsdr.cdc.gov/factsheets.html under the Stress and Environmental Contamination section.

Currently, ATSDR is taking a fresh look at psychosocial stress related to environmental contamination, with a focus on per- and polyfluoroalkyl substances (PFAS) in drinking water. This community-engaged project might enhance knowledge and understanding of PFAS contamination-related stressors, informing new tools, resources, and strategies to reduce stress and build resilience in affected communities.

The project includes the following activities:

- **Review literature:** A systematic literature review on the intersection of chronic environmental contamination, psychosocial health, and community resilience will inform other activities and be presented in a peer-reviewed manuscript and an online webinar.
- **Understand community experiences:** We conducted nine key informant interviews with community leaders and state health officials to learn more about how communities experience and cope with PFAS contamination events. While not a nationally representative picture of community responses to PFAS contamination, the interviews helped put community voices at the center of the project.
- **Develop educational materials:** We will revise and develop new educational materials on environmental contamination, stress, and community resilience for health professionals and affected community members based on the literature review and community experiences. The materials will be designed for and tested with health professionals and people living in PFAS-affected communities.
- **Develop a community stress resilience toolkit:** We will develop a toolkit for state and local health organizations with practical, evidence-based public health strategies for implementing stress resilience interventions in communities facing environmental contamination.
- **Convene stakeholder group:** A stakeholder group with community leaders, health professionals, disaster mental health experts, and others will provide input on toolkit content and implementation.

ATSDR looks forward to engaging community members and public health partner organizations in this work. Contact Ben Gerhardstein at bgerhardstein@cdc.gov to learn more.

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References

Agency for Toxic Substances and Disease Registry. (1995). *Psychological responses to hazardous substances: Report of the expert* *panel workshop*. Retrieved from https://www.atsdr.cdc.gov/risk/prhs/index.html

Agency for Toxic Substances and Disease Registry. (2017a). *Coping with the stress that environmental contamination can cause*. Retrieved from https://www.atsdr.cdc.gov/docs/factsheet/ATSDR-Stress-Fact-Sheet.pdf

Agency for Toxic Substances and Disease Registry. (2017b). *Tips on using the "coping with stress" fact sheet for ATSDR & health department staff*. Retrieved from https://www.atsdr.cdc.gov/docs/factsheet/Stress_Tips_Fact_Sheet-508.pdf

Arndt, J., Smith, N., & Tausk, F. (2008). Stress and atopic dermatitis. *Current Allergy and Asthma Reports*, *8*(4), 312–317.

Collaborative on Health and the Environment. (2016). *Psychosocial environment*. Retrieved from https://www.healthandenvironment.org/environmental-health/environmental-risks/psychosocial-environment

Couch, S.R., & Coles, C.J. (2011). Community stress, psychosocial hazards, and EPA decision-making in communities impacted by chronic technological disasters. *American Journal of Public Health*, *101*(Suppl. 1), S140–S148.

County of Los Angeles Public Health. (2018). *Community health outreach: Let's talk about Exide*. Retrieved from http://publichealth.lacounty.gov/eh/exide/

Cuthbertson, C.A., Newkirk, C., Ilardo, J., Loveridge, S., & Skidmore, M. (2016). Angry, scared, and unsure: Mental health consequences of contaminated water in Flint, Michigan. *Journal of Urban Health*, *93*(6), 899–908.

Edelstein, M.R. (2004). *Contaminated communities: Coping with residential toxic exposure* (2nd ed.). Boulder, CO: Westview Press.

Kaplan, J.R., Pettersson, K., Manuck, S.B., & Olsson, G. (1991). Role of sympathoadrenal medullary activation in the initiation and progression of atherosclerosis. *Circulation*, *84*(Suppl. 6), VI23–VI32.

Levine, A. (1983). Psychosocial impact of toxic chemical waste dumps. *Environmental Health Perspectives*, *48*, 15–17.

McEwen, B.S., & Tucker, P. (2011). Critical biological pathways for chronic psychosocial stress and research opportunities to advance the consideration of stress in chemical risk assessment. *American Journal of Public Health*, *101*(Suppl. 1), S131–S139.

Melin, B., Lundberg, U., Söderlund, J., & Granqvist, M. (1999). Psychological and physiological stress reactions of male and female assembly workers: A comparison between two different forms of work organization. *Journal of Organizational Behavior*, *20*(1), 47–61.

Morello-Frosch, R., & Shenassa, E.D. (2006). The environmental "riskscape" and social inequality: Implications for explaining maternal and child health disparities. *Environmental Health Perspectives*, *114*(8), 1150–1153.

Multnomah County. (2016). *Stress and worry: A normal response to potential environmental exposures*. Retrieved from https://multco.us/lead-testing-were-here-help-0/news/stress-and-worry-normal-response-potential-environmental-0

Sandifer, P.A., & Walker, A.H. (2018). Enhancing disaster resilience by reducing stress-associated health impacts. *Frontiers in Public Health*, *6*, 373.

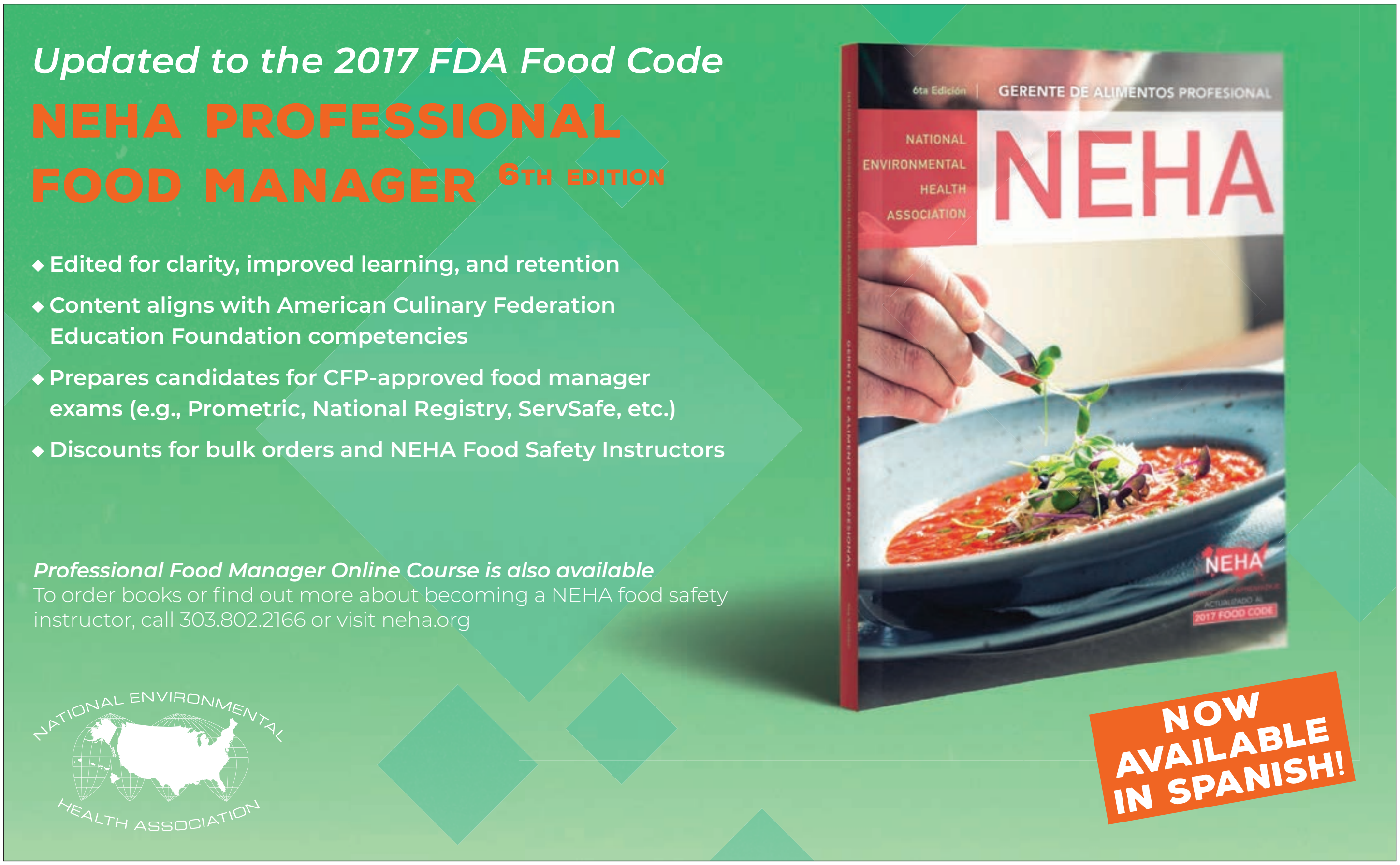
Seeman, T., Gruenewald, T., Karlamangla, A., Sidney, S., Liu, K., McEwan, B., & Schwartz, J. (2010). Modeling multi-system biological risk in young adults: The Coronary Artery Risk Development in Young Adults Study (CARDIA). *American Journal of Human Biology*, 22(4), 463–472.

Stojanovich, L., & Marisavljevich, D. (2008). Stress as a trigger of autoimmune disease. *Autoimmunity Reviews*, *7*(3), 209–213.

U.S. Environmental Protection Agency. (2018). *NARPM presents…Stress and environmental contamination: Tips and tools from ATSDR*. Retrieved from https://clu-in.org/conf/tio/NARPMPresents41/

The White House, Office of the Press Secretary. (2015, March 19). *Executive order—Planning for federal sustainability in the next decade*. Retrieved from https://obamawhitehouse.archives.gov/the-press-office/2015/03/19/executive-order-planning-federal-sustainability-next-decade

Wulff, K., Donato, D., & Lurie, N. (2015). What is health resilience and how can we build it? *Annual Review of Public Health*, *36*(1), 361–374.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DIRECT FROM CDC ENVIRONMENTAL HEALTH SERVICES

Tips and Tools to Get Your Environmental Health Message Across

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Katrina Pollard
Sabrina K. Riera, MPH
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Rebecca S. Noe
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Centers for Disease Control and Prevention

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

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

Maggie Byrne, Pamela Wigington, Jena Losch, Katrina Pollard, Sabrina Riera, and Germaine Vazquez are communicators in CDC's National Center for Environmental Health. Rebecca Noe and Nykiconia Preacely are epidemiologists in CDC's Center for Preparedness and Response.

As an environmental health professional, you undoubtedly spend a lot of time communicating. Do people you're communicating with understand your main message? Putting your main message first, supporting it visually, and keeping your audience in mind can help you improve your department's communications to the public and other audiences.

Put the Most Important Message First

What action do you want people to take as a result of reading your material? The clearer and more direct you can be about this action at the beginning, the better.

The Centers for Disease Control and Prevention's (CDC) Clear Communication Index is a research-based tool to help you develop and assess communication materials (CDC, 2019). It emphasizes putting your message up front and supporting it visually, such as with larger font or bolded text and a related image. Our Environmental Health Specialists Network (EHS-Net) uses it to develop plain language summaries of food safety research findings. Putting the main message first highlights the key recommended actions for food safety programs and the retail food industry (Figure 1).

Why is it so important to get to the point? People don't read when online, they scan (Nielsen Norman Group, 1997). If your main message is a punchline at the end, readers are unlikely to notice it. Getting to the point also shows respect for your readers' time.

Support Your Message With Related and Compelling Visuals

Data visualization techniques and tools are a great way to add compelling visuals to your work. Hearing the buzz about data visualization but not sure what it is or how to use it? CDC's National Environmental Public Health Tracking Network (Tracking) can help! Tracking collects, integrates, and standardizes noninfectious disease and environmental data from national, state, and local partners. Tracking has more than 450 environmental health measures and more than 2 billion rows of data. To make these data accessible, usable, and actionable, it uses powerful online data visualization tools such as:

- **Data Explorer:** Users can create customizable maps, charts, and tables on a variety of health and environmental topics (Figure 2). These data visualizations show patterns over time and/or within a geographical area that can be used when messaging environmental health trends and emerging issues.
- **Info by Location:** Users can create a custom infographic that displays health and environmental data for your county (Figure 3). This visualization type is easily understood by all health literacy levels and can introduce environmental health concepts to the general public.

In addition to enhancing public health messaging, data visualization tools can be used by public health professionals to target prevention activities, monitor community health, identify communities at risk, inform city or state planning, inform health policies, and support epidemiological studies.

Keep Your Audience in Mind

Creating materials that fit your audience preferences can increase the uptake of your message. The following CDC resources offer examples of developing materials with the audience in mind.

Radon Communication Toolkit

Whether in the workplace, homes, or schools, the threat of elevated levels of radon exposure is a public health issue. CDC's online

FIGURE **1**

Environmental Health Specialists Network (EHS-Net) Plain Language Summary Leads With Most Important Message

FIGURE **2**

National Environmental Public Health Tracking Network's Data Explorer Tool Offers Customizable Maps and Health and Environmental Data Visualizations

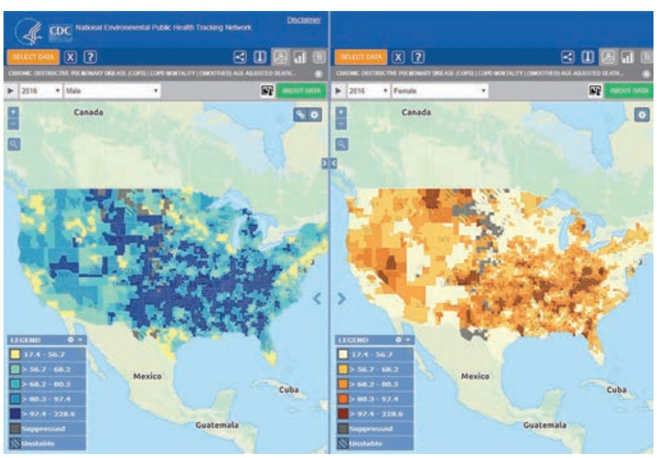

FIGURE **3**

National Environmental Public Health Tracking Network's Info by Location Tool Provides Health and Environmental Data by County in an Infographic Format

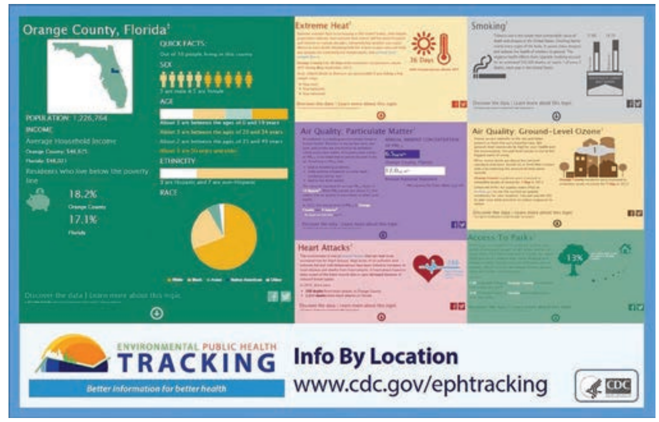

FIGURE **4**

Radon Communication Toolkit Offers Customizable Infographics in Response to Audience Feedback

Radon Communication Toolkit can be used to increase awareness of the dangers of radon exposure and smoking. The toolkit was built on materials developed by eight states. These states used Tracking data to bring awareness to the health hazards of radon and smoking through visualization, targeted communication messages, and Radon Awareness Month outreach. CDC tested the draft toolkit with several states and learned that a customizable format would increase the toolkit's use and value.

We designed the toolkit with environmental public health professionals and health educators in mind. It helps them

- create a framework for targeted communication activities and
- focus messages for specific audiences.

The toolkit includes a fact sheet, press release, shareable images, infographics, and social media content—all in one place. The materials can be used as is or customized for specific audiences. Users can add quotes, change regional information, update contact information, and use alternate main messages or branding to highlight a particular radon awareness event (Figure 4). State health departments can use the toolkit to develop statewide radon initiatives, organize local community events, or build social media campaigns.

Communication Quick Links

- Clear Communication Index: www.cdc.gov/ccindex
- National Environmental Public Health Tracking Network Data Visualization Tools: www.cdc.gov/ephtracking
- Environmental Health Specialists Network Plain Language Summaries: www.cdc.gov/nceh/ehs/ehsnet/plain_language
- Radon Communication Toolkit: www.cdc.gov/radon
- Preparedness and Safety Messaging for Hurricanes, Flooding, and Similar Disasters: www.cdc.gov/cpr/readiness/hurricane_messages.htm

FIGURE **5**

Preparedness and Safety Messaging Document Helps Officials Quickly Create and Tailor Health Communication Products

Preparedness and Safety Messaging for Hurricanes, Flooding, and Similar Disasters

Hurricanes, floods, and similar disasters can have long-lasting effects on communities. After a weather incident, communities face a wide range of physical, mental, and environmental risks, making it crucial to deliver health and safety information quickly. While CDC offers plenty of information and resources available to the public online, trying to navigate through these resources can be cumbersome—especially when time is limited!

Public health and emergency response officials are under high pressure to get critical prevention information out promptly to affected communities. For that reason, CDC developed a national preparedness resource, *Preparedness and Safety Messaging for Hurricanes, Flooding, and Similar Disasters* (Figure 5). The document contains predeveloped messages on preparedness, response, and recovery. Key messaging topics include food and water safety, carbon monoxide poisoning, and mold. The easy-to-navigate document includes an interactive table of contents that allows users to find the message they need quickly. Officials can use the resource to create and tailor a wide range of communication products, including social media messages, fact sheets, infographics, press releases, and more. It is available in both English and Spanish.

Start Writing!

Your program has important things to say. We hope this information helps you get your message across.

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References

Centers for Disease Control and Prevention. (2019). *The CDC Clear Communication Index*. Retrieved from https://www.cdc.gov/ccindex/index.html

Nielsen Norman Group. (1997). *How people read on the web: The eyetracking evidence*. Retrieved from https://www.nngroup.com/reports/how-people-read-web-eyetracking-evidence/

Did You Know?

Septic systems can be damaged and might fail to operate correctly after a disaster. Ensuring that these systems function properly is essential to providing safe waste disposal for millions of U.S. residents, yet there can be a lack of standard safety protocols for using septic systems after disasters occur. NEHA has worked with subject matter experts and national partners to develop a toolkit with guidance documents for different types of disasters such as hurricanes and flooding, wildfires, earthquakes, freezing temperatures, and power outages. Access the toolkit at www.neha.org/eh-topic/preparedness-response-septic-systems.

EH CALENDAR

UPCOMING NEHA CONFERENCES

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

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

NEHA AFFILIATE AND REGIONAL LISTINGS

Georgia
May 27–29, 2020: Annual Education Conference, hosted by the Georgia Environmental Health Association, Lake Lanier Islands, GA. For more information, visit www.geha-online.org.

Illinois
November 4–5, 2019: Annual Educational Conference, hosted by the Illinois Environmental Health Association, Utica, IL. For more information, visit www.iehaonline.org.

Michigan
March 18–20, 2020: Annual Education Conference, hosted by the Michigan Environmental Health Association, Traverse City, MI. For more information, visit www.meha.net/AEC.

Missouri
April 7–10, 2020: Annual Education Conference, hosted by the Missouri Environmental Health Association, Springfield, MO. For more information, visit https://mehamo.org.

Utah
May 6–8, 2020: Spring Conference, hosted by the Utah Environmental Health Association, Kanab, UT. For more information, visit www.ueha.org.

TOPICAL LISTINGS

Emergency Response
November 10–15, 2019: Environmental Health Training in Emergency Response Operations, held by the Federal Emergency Management Agency's Center for Domestic Preparedness, Anniston, AL. For more information, visit https://cdp.dhs.gov/find-training/course/PER-309.

January 26–31, 2020: Environmental Health Training in Emergency Response Operations, held by the Federal Emergency Management Agency's Center for Domestic Preparedness, Anniston, AL. For more information, visit https://cdp.dhs.gov/find-training/course/PER-309.

Food Safety
March 9–12, 2020: Integrated Foodborne Outbreak Response and Management (InFORM) 2020 Conference, Atlanta, GA. For more information, visit www.aphl.org/conferences/InformConf/Pages/default.aspx.

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

Did You Know?

You can share your event with the environmental health community by posting it directly on NEHA's Community Calendar at www.neha.org/news-events/community-calendar. Posting is easy, free, and a great way to bring attention to your event. You can also find listings for upcoming conferences and webinars from NEHA and other organizations.

NEHA ORGANIZATIONAL MEMBERS

Sustaining Members

LaMotte Company
www.lamotte.com

NSF International
www.nsf.org

Sweeps Software, Inc.
www.sweepssoftware.com

Note. As of October 1, 2018, NEHA no longer offers organizational memberships. We will continue to print this section in the Journal to honor the membership benefits due to these listed organizations until their memberships expire. For more information about NEHA membership, visit www.neha.org/membership-communities/join.

CAREER OPPORTUNITIES

Food Safety Inspector

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

United States
Albany, NY
Albuquerque, NM
Amarillo, TX
Billings, MT
Birmingham, AL
Boise, ID
Boston, MA
Buffalo, NY
Cedar Rapids, IA
Charleston, SC
Coeur d'Alene, ID
Corpus Christi, TX
Eureka, CA
Fresno, CA
Galveston, TX
Grand Junction, CO
Honolulu, HI
Idaho Falls, ID
Little Rock, AR
Los Angeles, CA
Lubbock, TX
Miami, FL
Midland, TX
Missoula, MT
Montgomery, AL
Oakland, CA
Odessa, TX
Orlando, FL
Owatonna, MN
Providence, RI
Rapid City, SD
Richmond, VA
Rochester, NY
Sioux Falls, SD
Syracuse, NY
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Canada
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Montreal
Toronto
Vancouver
Winnipeg

If you are interested in an opportunity near you, please send your resume to Attn: Garrison Ford at Garrison.Ford@ul.com or visit our website at www.evercleanservices.com.

In addition to food safety inspectors, we are also looking for GMP auditors for OTC, dietary supplement, and medical device applications. If interested, contact Diane Elliott at Diane.Elliott@ul.com to apply or receive further information.

DAVIS CALVIN WAGNER SANITARIAN AWARD

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

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

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

NOMINATIONS MUST BE RECEIVED BY APRIL 15, 2020.

Nomination packages should be e-mailed to Gary P. Noonan at gnoonan@charter.net. Files should be in Word or PDF format.

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

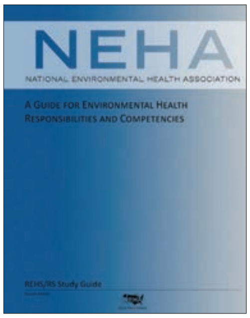
RESOURCE CORNER

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

NEHA BOOKSTORE
www.neha.org/store

REHS/RS Study Guide (4th Edition)

National Environmental Health Association (2014)

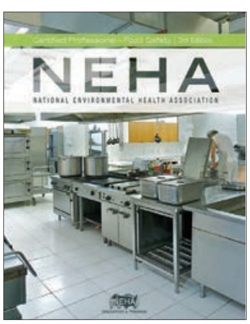


The Registered Environmental Health Specialist/Registered Sanitarian (REHS/RS) credential is the National Environmental Health Association's (NEHA) premier credential. This study guide provides a tool for individuals to prepare for the REHS/RS exam and has been revised and updated to reflect changes 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)

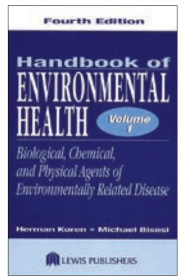


The Certified Professional–Food Safety (CP-FS) credential is well respected throughout the environmental health and food safety field. This manual has been developed by experts from across the various food safety disciplines to help candidates prepare for NEHA's CP-FS exam. This book contains science-based, 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)

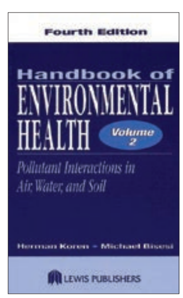


A must for the reference library of anyone in the environmental health profession, this book focuses on factors that are generally associated with the internal environment. It was written by experts in the field and copublished with NEHA. A variety of environmental issues are covered such as food safety, 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
Volume 1: 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.

876 pages / Hardback
Volume 2: Member: $215 / Nonmember: $245

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ACCEPTING NOMINATIONS NOW

2020 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, 2020.

National Environmental Health Association

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

2020 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, 2020.

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

National Environmental Health Association

NEHA NEWS

Call for Nominations

By Angelica Ledezma (aledezma@neha.org)

The National Environmental Health Association (NEHA) is governed by a board of directors who oversee the affairs of the association. There will be four board positions up for election in 2020:

- Region 1 vice-president (represents Alaska, Idaho, Oregon, and Washington; 3-year term);
- Region 5 vice-president (represents Arkansas, Kansas, Louisiana, Missouri, New Mexico, Oklahoma, and Texas; 3-year term);
- Region 7 vice-president (represents Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, and Tennessee; 3-year term); and
- second vice-president (national officer; 5-year term that progresses through the national offices and will serve as NEHA president in 2023–2024).

We seek diversity on the board in terms of gender and ethnicity, as well as a balance between regulatory, academia, and industry professionals. Most importantly, we want people who will help us develop a new strategic vision, have experience managing diverse organizations, and can open doors for NEHA in building relationships with industry, academia, federal and state agencies, foundations, and other associations.

Requirements to serve on the board include

- membership with NEHA (individual or life) for three consecutive years prior to assuming office on July 16, 2020;
- not simultaneously holding a voting position on the board of a NEHA affiliate;
- endorsement by at least five voting NEHA members (from members residing in the region for regional vice-president candidates and from members residing in at least three different regions for second vice-president candidates); and
- willingness to commit the time necessary to actively serve on the board.

If you are interested in serving on our board of directors, please visit www.neha.org/about-neha/governance/elections for information on the nomination and election process. You can also contact NEHA Immediate Past-President Vince Radke, chairman of NEHA's Nominations Committee, at immediatepastpresident@neha.org. The deadline to submit a nomination is **December 2, 2019**.

NEHA Staff Profiles

As part of tradition, NEHA features new staff members in the *Journal* around the time of their 1-year anniversary. These profiles give you an opportunity to get to know the NEHA staff better and to learn more about the great programs and activities going on in your association. This month we are pleased to introduce you to two NEHA staff members. Contact information for all NEHA staff can be found on page 49.

Natasha DeJarnett

In November 2018 I was honored to join NEHA's staff as research coordinator. NEHA's commitment to research and evaluation gave way for a great opportunity for me to join an organization that I had long admired. In this role, I lead research activities, including identifying the research needs of our staff, establishing our research agenda, developing strategies to increase publishing across our organization, and advancing our internal research culture. In addition, I lead children's environmental health activities. Professionally and personally, this endeavor fulfills my quest for advancing health equity, which is driven by protecting our most vulnerable from hazardous environmental health exposures. Lastly, I lend my expertise to our climate and health portfolio, which I deem urgently important as the environmental health workforce is an essential solution to address the greatest threat to public health we are currently facing.

It is an exciting time for research at NEHA. A partnership between NEHA, the Centers for Disease Control and Prevention, and Baylor University allowed for the creation of the groundbreaking Understanding the Needs, Challenges, Opportunities, Vision, and Emerging Roles in Environmental Health (UNCOVER EH) initiative, of which the first research paper was published in the June 2019 *Journal of Environmental Health* (www.neha.org/uncover-eh). Results from this study demonstrate the challenges and opportunities facing the environmental health workforce. Publishing this research is a powerful method of storytelling. Telling this story is important but these results also provide our organization clear direction on the types of programs and training needed to best support the environmental health workforce. I look forward to utilizing the results from UNCOVER EH to better understand the needs and more strategically serve environmental health practitioners.

Prior to NEHA I was a policy analyst in environmental health at the American Public Health Association (APHA). I had the opportunity to manage APHA's unprecedented 2017 Year of Climate Change and Health, which raised awareness and mobilized climate and health action. My effectiveness as a policy analyst was enhanced by my sound understanding of the science that informs policy, which I attribute to my experience in academic research and graduate education. As a postdoctoral fellow at the University of Louisville, I investigated the cardiovascular risks of air pollution exposures. I also completed my Master of Public Health and doctoral degree there, both concentrating in environmental health sciences. My experiences in informing environmental health policy and research are brought full circle in my role here at NEHA.

I am a board member for Citizens' Climate Education and Physicians for Social Responsibility. I also sit on the steering committees for the International Transformational Resilience Coalition and the

NEHA **NEWS**

Environmental Law Institute's Emerging Leaders Initiative, and am a member of the National Recreation and Park Association's Climate and Health Advisory Panel. Outside of work, I enjoy time with my family and dabble in photography and graphic design.

Since becoming a NEHA member in 2015, NEHA's members, staff, programs, and activities have inspired me and afforded me opportunities to become a stronger environmental health professional. Because of that, I am all the more grateful to serve NEHA through my position.

Joyce Dieterly

I began working at NEHA in November 2018 when I was hired on as evaluation coordinator. My role centers around assessing and strengthening the quality and impact of NEHA's work. This past year I have conducted program evaluation on funded projects supporting hurricane preparedness, response, and recovery. After serving as a Peace Corps volunteer in Mozambique, I discovered a passion for public health, went back to school, and received my Master of Public Health from Washington University in St. Louis, Missouri. Though it was through on-the-job learning, I found that evaluation allowed me to work with data while telling a story about the long-lasting impacts of public and environmental health programs.

I was able to continue learning from evaluation experts during my time as an Oak Ridge Institute for Science and Education (ORISE) fellow at the Centers for Disease Control and Prevention in Atlanta, Georgia, working with national heart disease and stroke prevention programs. After about 2 years, I made the move to Denver to begin working at NEHA and have enjoyed the opportunity to discover exciting things the area has to offer, including taking my dog out on the trails that run through the city.

As I am approaching 1 year with NEHA, I am looking forward to finding ways we can continually improve, as well as work with internal and external partners to build evaluation capacity across the association. I am excited to apply my evaluation expertise to the field of environmental health and ensure that the work we are doing is beneficial, useful, and impactful.

DirecTalk
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cesses, everything else happens organically. Relationships matter.

Talent Type #2: Someone who is intellectually engaged and applies themselves. Notice I didn't say smart. The world is rife with bright people who don't fully apply their talents productively or never seem to finish their work or finish on time. I believe organizations that try more things are more successful. Period. We benefit from a blend of employees who are linear thinkers and those who are more eclectic. We then figure out how to maximize the juice of both types, preferably in the same room at the same time.

Talent Type #3: Someone who is switched on. This characteristic is an intrinsic human quality that I can't figure out if it's inherent in the individual, a timing issue, or trickles to surface through organizational culture. This kind of person genuinely cares about members, their member experiences, and goes the extra step without being cajoled to meet that need. I was in Puerto Rico a couple weeks ago in support of our workforce efforts when a department of health employee gushed about the personal and individualized treatment she received at our 2019 AEC in Nashville, Tennessee. That's what I'm talking about.

The National Environmental Health Association staff on July 24, 2019. Photo courtesy of Santiago Ezcurra

We have experienced rapid growth over the last 4 years and it is unlikely we can maintain this rate into perpetuity. This dynamic environment has introduced amazing opportunities for us to demonstrate leadership. At the same time, let's embrace the truth that there are few opportunities to achieve great things. I believe now is one of those opportunities. By hiring the wrong people, organizations sized similar to ours tend to be like Calder Mobiles, you touch one part and the entire apparatus bounces and jiggles. This response is great if you are an infant experimenting with the effects of tactile stimulation but not so much if the machinery is firing on all cylinders, as it is for us now.

Dave

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▸ **DirecTalk** MUSINGS FROM THE 10TH FLOOR

David Dyjack, DrPH, CIH

Windmills and Calder Mobiles

Don Quixote's irrational assault on windmills is interpreted by some as a metaphor for the impractical pursuit of an idealistic goal. What author Miguel de Cervantes had in mind is anyone's guess. There are days I feel like Don Quixote, uncertain if the giants are real or imaginary.

The National Environmental Health Association (NEHA) has enjoyed a healthy, albeit uneven, growth trajectory for the last 4 years. As our current fiscal year (FY) draws to a close, our organization operates with a reasonable margin. We anticipate net revenue on our $10 million FY2019 budget, which means we can pay our bills with some money left over for the rainy day fund. This attainment is what a competent management team does and is an important step toward a sustainable future.

If we unpack this year's revenue structure, I'm projecting that membership dues will comprise around 5% of our budget. In other words, for every $1 in dues, we attract roughly $19 in alternate sources of revenue. That $19 is your NEHA staff at work—writing, submitting, and administering grants; designing and hosting the Annual Educational Conference (AEC) & Exhibition; managing credentials; and producing this *Journal*, among other products and services in support of the environmental health profession. The lion's share of our income is derived from grants and contracts, money that waxes and wanes. We're delighted when we have it and grieve when opportunities pass us by. Right now we're enjoying a surge of monetary resources because of targeted federal investments. We anticipate, however, for the flow to taper back effective September 2020.

> ***Organizations sized similar to ours tend to be like Calder Mobiles.***

We're also enjoying an increase in membership. In 2015 we recorded around 4,200 individual members. Today that number hovers above 6,300. That's a 50% increase. Our membership department—Jonna Ashley, association membership manager, and Alexus Nally, member services representative—have delivered exceptional growth. We are thankful for them and their leadership.

There's good evidence that we're amid a modest association revival. On most days it feels downright revolutionary. Therein lies the conundrum. A careful study of history suggests revolutions attract three personality types: thinkers, doers, and opportunists. As I write this column, we have six open positions. Once filled that will bring our ranks of employed to almost 50. How do we ensure that the right balance of thinkers and doers selectively join our staff? This question is more than abstract. Our Washington, DC, staff is currently at five employees, a number that gives me pause.

In parallel with the organizational growth lies an expanded sense of expectation of us. I am asked with increasing frequency to direct a portion of our association energy and resources to environmental issues that are not threaded to environmental health workforce priorities. Many of these issues represent things for which I am passionate: air pollution, firearms, vaccinations, occupational health and safety. These are noble initiatives but in most cases are not directly aligned with our mission.

So, I'm feeling a little fragile. How do we harness the substantial momentum we've generated and ensure we find the right people to join our team? And while we have made substantial progress in several performance metrics, I now spend more time contemplating the "so what" and much less time on the "what."

I am a believer in people's talents and less a believer in their degrees and credentials. Succinctly, I believe in the who, not the what. Some of the most productive individuals I've worked with had bachelor's degree, not master or doctoral degrees. There are three basic talents that I'm looking for in our new hires.

Talent Type #1: Someone who can cultivate and build relationships. After 30 some years in public health, I continue to be impressed by what happens through networking. The phone call. The e-mail. The text message. The whisper. The postconference conversation. The most meaningful intelligence is not from an article, a tweet, or a blog. It generally comes from someone I've worked with or known over the years. When people within an organization know and trust each other and authentically celebrate each other's suc-

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