Characterizing the Roles and Skill Gaps of the Environmental Health Workforce in State and Local Health Departments

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Abstract **Efforts to characterize environmental health workers (EHWs) are needed in order to strengthen the field. Data from the 2014 Public Health Workforce Interests and Needs Survey were used to describe the self-reported roles, important daily work tasks, and skill gaps of EHWs and to compare and contrast these characteristics between state health agencies (SHAs) and local health departments (LHDs). While EHWs at SHAs and LHDs share overall similarities in terms of important daily work tasks and skill gaps, the differences could reflect that the strengths of local-level environmental work fall within communicating and community interaction, whereas state-level strengths reside in administrative, policy, and scientific functions. Our findings also highlight a need for EHWs to strengthen their skills in budget- and policy-related competencies, especially at the local level. We found that number of years in current position was a significant predictor of the number of skill gaps, suggesting the utility of a peer-learning network.**

Introduction

Environmental health workers (EHWs) make up 8% of the local, state, and federal public health workforce and constitute the largest group of governmental public health workers, after administrative or clerical personnel and public health nurses (Beck, Boulton, & Coronado, 2014). EHWs ensure that the air we breathe, food we eat, and water we drink is safe. They work in the realms of land use, community design, and housing to create health-promoting environments (Srinivasan, O'Fallon, & Dearry, 2003). Their responsibilities are broad, including assessing, communicating, and managing risks related to air quality, drinking water

and food safety, industrial hygiene, healthy housing, waste management and disposal, and vector control (National Center for Environmental Health, Centers for Disease Control and Prevention [CDC], & American Public Health Association, 2001). In addition, the duties of EHWs are increasing in scope to include developing programs for climate change adaptation planning; environmental health tracking, which involves monitoring and surveillance of environmental hazards and associated exposures and health effects (CDC, 2018); and conducting health impact assessments (Association of State and Territorial Health Officials, 2011). As the environmental health workload is

broadening, however, it is necessary to evaluate the capacity of EHWs.

The environmental health workforce is strained by reductions in federal funding and decreasing capacity, especially in terms of workforce training (Association of State and Territorial Health Officials, 2011, 2014), as well as a dearth of leaders who are ready to fill newly vacated positions due to high rates of turnover, retirement, and voluntary turnover from the high percentage of workers who intend to leave their positions (Herring, 2006; Sellers et al., 2015). With a fluctuating workforce and changing scope of work, it is important to understand the skills and skill gaps of the workforce, as well as to explore potential differences by level of government, as environmental health agency functions can diverge in state versus local settings. Identifying skill gaps and potential training needs—and specifying these by level of government—enables application of relevant solutions to the appropriate setting.

Prior to the 2014 Public Health Workforce Interests and Needs Survey (PH WINS), little information has been available from the perspective of individual state and local health department workers on their tasks, responsibilities, and skill gaps (Sellers et al., 2015). This article, therefore, serves to address this gap in the literature by characterizing EHWs, and comparing and contrasting the following characteristics between state health agencies (SHAs) and local health departments (LHDs): 1) main roles of EHWs, 2) tasks that EHWs report as "very important" to their daily work, and 3) self-reported skill gaps of EHWs.

FIGURE 1

Categorized Role Classifications for Environmental Health Workers

Environmental Professionals	Public Health Professionals	Laboratory/Clinical Professionals	Other Professionals
• Environmentalist • Sanitarians/inspectors • Engineers	• Health officer • Department/bureau director • Program director • Deputy director • Public health manager/ program manager • Other management and leadership • Epidemiologist • Statistician • Public health informatics specialist • Health educator • Community health worker	• Technician • Laboratory aide/assistant • Laboratory technician • Laboratory scientist/ medical technologist • Laboratory scientist, supervisor • Laboratory scientist, manager • Laboratory developmental scientist • Registered nurse, unspecified • Licensed practical/ vocational nurse • Nutritionist • Public health veterinarian	• Other professional and scientific • Other

Methods

Public Health Workforce Interests and Needs Survey

Sampling and broader survey methodologies have been written about extensively elsewhere (Leider, Bharthapudi, Pineau, Liu, & Harper, 2015). In brief, PH WINS was conducted in three sampling frames: 1) a nationally representative sample of permanent, central office employees in SHAs; 2) employees of the Big Cities Health Coalition (BCHC), a membership group of the largest metropolitan health departments in the country (National Association of County and City Health Officials, n.d.); and 3) a pilot frame of local and regional health department employees. For BCHC and local and regional health department frames, the data have importance for the localities in which they were collected and were not intended to constitute a nationally representative sample (Leider, Bharthapudi, et al., 2015). The analyses presented were stratify by setting/sample frame and were also weighted by sample frame: SHAs (n = 910) and LHDs (n = 1,001). The LHD set-

ting includes staff from local and regional health departments, which includes 185 respondents from LHDs who are members of BCHC.

Population

The analyses in this article were limited to EHWs as defined in terms of those who are directly engaging in environmental health-subject matter related work, identified using a combination of two variables: program area and role classification. We determined EHWs to be those who meet either of the following criteria: those with the role classification of "environmentalist," excluding those in an administrative program (n = 1) or those in the program area of "environmental health," excluding those in the following roles: clerical personnel (n = 138), other business support (n = 21), information technology (n = 20), business support (n = 17), public information specialist (n = 11), grants and contracts (n = 10), students (n = 6), custodian (n = 3), and human resources (n = 3). Figure 1 characterizes the composition of this group in terms of role classifications.

Analyses

We conducted descriptive analyses for demographic information and work-related characteristics, as well as role classifications reported by EHWs, which were collapsed into the four categories shown in Figure 1.

We evaluated these demographic and job characteristic factors as predictors of skill gaps. We also conducted analyses for important daily work-related tasks and skill gaps, defined as those tasks that respondents reported being "somewhat" or "very important" to their daily work, but for which they reported low proficiency (unable to perform/ beginner). A composite variable totaling the number of skill gaps per individual EHW was created and used as the outcome. Poisson regression was used to determine predictors of skills gaps. We selected variables to be included in the model based on a manual stepwise selection process. We set the significance level at $p < .05$. All analyses for this article were conducted using STATA 14.1. PH WINS was deemed exempt by the Chesapeake Institutional Review Board.

Results

Characteristics

A total of 1,911 EHWs responded to PH WINS, representing 23,229 EHWs across all settings: 910 (9%) in SHAs and 1,001 (9%) in LHDs. Based on the weighted sample in each of the two settings, EHWs were mostly White (81% SHA, 79% LHD), with a bachelor's degree as their highest educational attainment (54% SHA, 70% LHD), with slightly more males than females (53% SHA, 52% LHD) (Table 1). Roughly half of EHWs across settings hold supervisory positions (52% SHA, 43% LHD) (Table 1) and have spent ≤5 years in their current position (49% SHA, 42% LHD) (Figure 2). About one third have spent ≥21 years in public health practice (38% SHA, 31% LHD), with 3–5% planning to retire from their current position within 1 year (Figure 2). Most EHWs are between 31–65 years of age (86% SHA, 87% LHD).

Role Categories

A substantial proportion of EHWs in each setting are environmentalists (23% SHA, 51% LHD). The proportion of EHWs reporting the role of public health manager/program manager is relatively consistent in both settings (5–6%). Figure 3 shows the breakdown of EHWs by role groupings into environmental professionals, public health professionals, laboratory/clinical professionals, and other.

Important Daily Work Tasks

Similar proportions of EHWs in both settings reported the following competencies as "very important" to their daily work, with a threshold of at least 50%: gathering reliable information, communicating to varied audiences, communicating persuasively, applying evidence-based approaches, and managing change (Table 2). Furthermore, nearly one third of all EHWs across all settings (29% or more) rated each of the 18 competencies listed on the survey instrument as "very important" to their daily work tasks (Table 2).

Skill Gaps

The greatest percentage of EHWs in both settings had zero skill gaps (42% SHA, 38% LHD), with little variation between settings (Figure 5). For those EHWs who had skill gaps,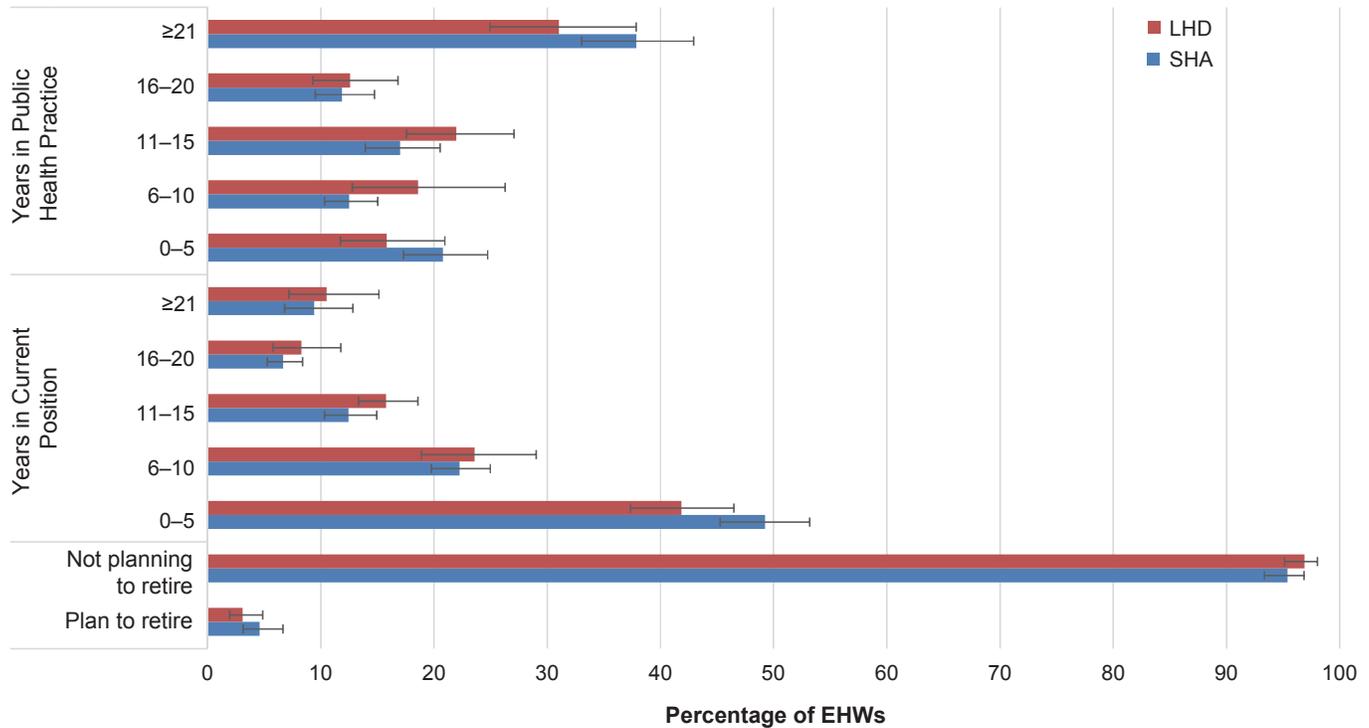 the average number of skill gaps reported was relatively similar in both settings: 4.73 in SHAs (95% confidence interval [CI] [4.12, 5.35]), 4.70 in LHDs (95% CI [4.19, 5.22]).

The top self-reported skill gaps, reported by over 30% of EHWs in both settings, were "influencing policy development" and "preparing a program budget with justification" (Figure 4). Of note, these most prevalent skill gaps were not among the top five important daily work tasks. Similar proportions of EHWs (ranging from 7–22%) across settings reported skill gaps for these top important tasks: 1) communication-related competencies, ≤16% of EHWs reported skill gaps and 2) applying evidence and managing change, at least 16% of EHWs reported skill gaps (Table 2, Figure 4).

Environmental Health Worker Demographics for State Health Agencies (SHAs) and Local Health Departments (LHDs)

Demographic	SHA		LHD	
	%	95% *CI*	%	95% *CI*
Sex				
Male	53	47, 58	52	48, 57
Female	47	42, 53	48	43, 52
Supervisory status				
Non-supervisor	48	45, 52	57	52, 62
Supervisor	52	48, 55	43	38, 48
Annual salary				
<$45,000.00	16	13, 19	44	38, 51
$45,000.01–$55,000.00	20	18, 23	17	12, 22
$55,000.01–$65,000.00	21	18, 25	20	14, 27
$65,000.01–$75,000.00	14	12, 16	9	7, 12
>$75,000.01	29	25, 33	10	7, 13
Race/ethnicity				
White	81	77, 84	79	75, 83
Black	6	4, 9	10	8, 13
Hispanic	5	4, 5	4	2, 5
Asian	4	2, 7	2	1, 4
Other	4	3, 6	5	3, 7
Highest educational degree				
Doctorate	9	7, 12	4	2, 9
Master's	30	26, 34	19	15, 23
Bachelor's	54	50, 57	70	66, 73
No bachelor's	7	6, 9	7	5, 10
Age (years)				
≤30	10	7, 13	11	10, 14
31–50	42	39, 46	53	48, 59
51–65	44	40, 48	34	28, 40
>66	4	2, 5	1	1, 3

CI = confidence interval.
Note. SHA estimated population size: 3,578–3,826. LHD estimated population size: 1,881–2,036.

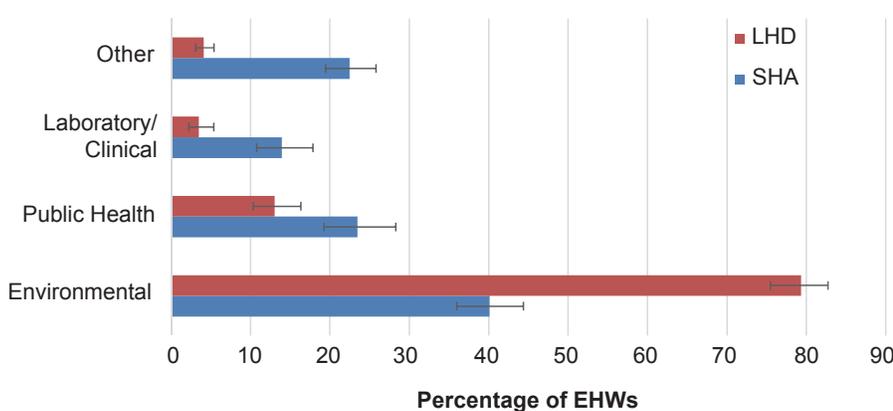**Environmental Health Worker (EHW) Experience and Plan to Retire by Setting**

LHD = local health department; SHA = state health agency.
Note. "Plan to retire" refers to plans to retire within 1 year of responding to the survey. SHA estimated population size: 3,701–3,787; LHD estimated population size: 1,962–2,007.

Environmental Health Workers (EHWs) in Each Role Group by Setting

LHD = local health department; SHA = state health agency.
Note. See Figure 1 for role classifications within each group. SHA estimated population size: 3,793; LHD estimated population size: 2,025.

Differences Between State Health Agencies and Local Health Departments

Earnings

Annual earnings for EHWs vary across settings: 44% of EHWs at LHDs make <$45,000 per year, compared with 16% at SHAs. And 43% of EHWs at SHAs make >$65,000, compared with only 19% of EHWs at LHDs (Table 1).

Role Categories

Sanitarians/inspectors make up a greater proportion of EHWs at the local level (26%) than at the state level (10%). A greater percentage of EHWs at SHAs report scientific and undefined roles (other, other professional and scientific, engineer, epidemiologist) compared with local settings (Figure 3). Compared with the local level, the state level has more epidemiologists (0% LHD, 6% SHA) and engineers (2% LHD, 8% SHA).

TABLE **2**

Very Important Daily Work Tasks and Skill Gaps Reported by Environmental Health Workers in State Health Agencies (SHAs) and Local Health Departments (LHDs)

Daily Work Task	Very Important				Skill Gap			
	SHA[a]		LHD[b]		SHA[c]		LHD[d]	
	%	95% *CI*	%	95% *CI*	%	95% *CI*	%	95% *CI*
Gathering reliable information to answer questions	77	73, 80	81	77, 85	7	5, 10	7	5, 10
Communicating ideas/information in a way that different audiences can understand	64	60, 68	77	71, 82	11	7, 17	10	8, 13
Communicating in a way that persuades others to act	56	52, 60	76	71, 80	16	13, 19	9	6, 12
Applying evidence-based approaches to solve public health issues	49	45, 54	58	53, 62	22	19, 25	17	13, 22
Managing change in response to dynamic, evolving circumstances	49	44, 53	50	46, 55	16	12, 22	19	15, 25
Interpreting public health data to answer questions	48	44, 53	49	44, 54	16	13, 19	20	16, 25
Engaging staff within your health department to collaborate on projects	46	42, 50	42	35, 49	18	14, 23	15	11, 20
Engaging partners outside your health department to collaborate on projects	43	39, 47	43	36, 51	19	15, 25	22	17, 29
Applying quality improvement concepts in your work	38	34, 42	46	40, 51	25	20, 30	24	18, 31
Anticipating the changes in your environment (physical, political, environmental) that might influence your work	38	33, 44	47	42, 51	26	21, 31	24	21, 29
Understanding the relationship between a new policy and many types of public health problems	35	31, 40	44	37, 50	27	24, 31	28	22, 34
Assessing the broad array of factors that influence specific public health problems	38	35, 42	39	34, 44	25	21, 29	21	15, 28
Addressing the needs of diverse populations in a culturally sensitive way	34	29, 40	44	40, 48	29	23, 36	22	18, 26
Collaborating with diverse communities to identify and solve health problems	34	30, 38	42	37, 47	29	24, 35	27	21, 33
Finding evidence on public health efforts that work	35	31, 39	38	33, 44	29	25, 34	26	21, 32
Ensuring that programs are managed within current and forecasted budget constraints	36	32, 39	35	30, 41	26	21, 31	36	28, 46
Influencing policy development	30	26, 34	30	25, 36	35	31, 39	42	35, 50
Preparing a program budget with justification	29	26, 32	30	26, 35	31	25, 38	49	40, 59

CI = confidence interval.
[a]SHA estimated population size: 3,617–3,705.
[b]LHD estimated population size: 1,887–1,980.
[c]SHA estimated population size: 1,575–3,554.
[d]LHD estimated population size: 758–1,932.
Note. Tasks in shaded rows were reported as very important by 50% of environmental health workers in one or both settings.

Daily Work Tasks
There were overall similarities in the competencies of EHWs in each setting reported as "very important" to their daily work. The exception, however, was "communicating in a way that persuades others to act," for which more EHWs at LHDs than at SHAs reported this as "very important" (76% LHD, 56% SHA).
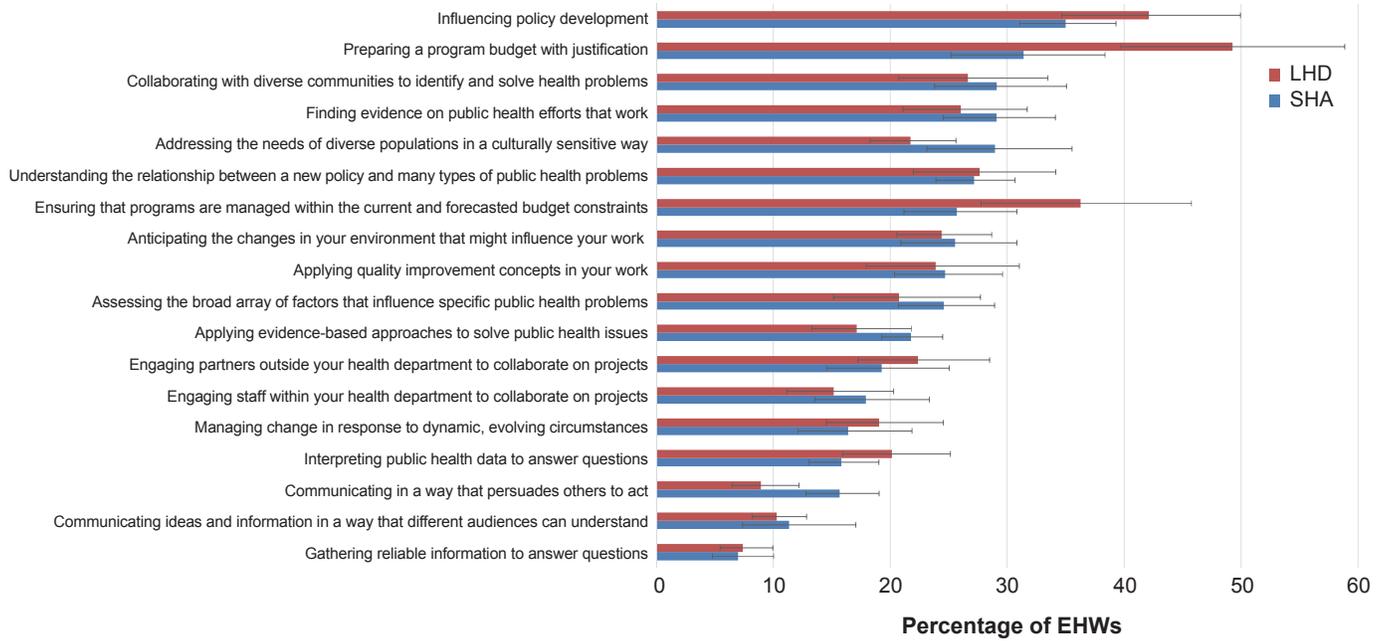
Skill Gaps
A greater percentage of state-level EHWs reported a skill gap than local-level EHWs for competencies related to working with diverse communities; finding, assessing, and applying evidence; and communicating. There was at least a 20% difference for communicating persuasively, addressing the needs of diverse populations, and applying evidence-based approaches (Table 2, Figure 4). Moreover, a greater percentage of local-level EHWs reported a skill gap than state-level EHWs for competencies related to budgeting, interpreting data, influencing policy, managing change, and external collaboration. There was at least a 20% difference for both budgeting competencies and for interpreting public health data (Table 2, Figure 4).
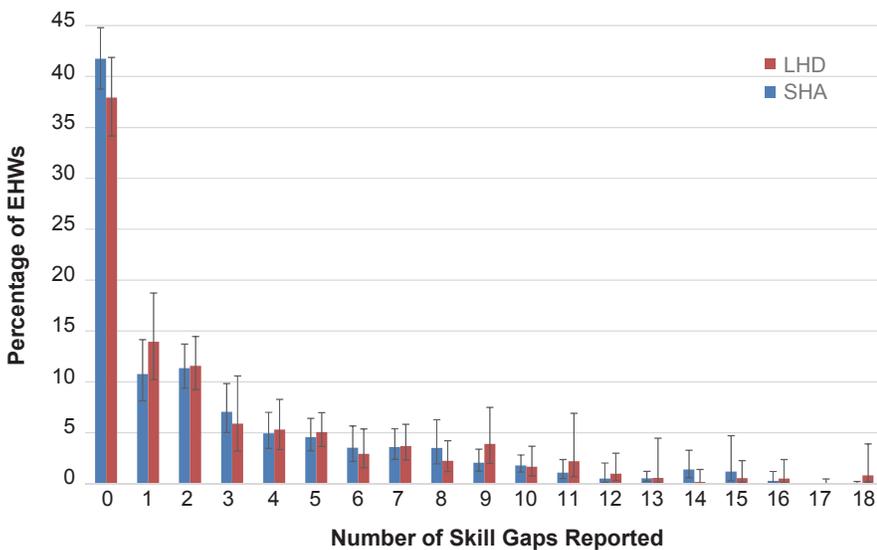
Skill Gaps Reported by Environmental Health Workers (EHWs)

LHD = local health department; SHA = state health agency.
SHA estimated population size: 1,575–3,554; LHD estimated population size: 758–1,932.

Number of Skill Gaps Reported by Environmental Health Workers (EHWs)

LHD = local health department; SHA = state health agency.
SHA estimated population size: 3,826; LHD estimated population size: 2,036.

Regression Results for Skill Gaps

The resulting incidence rate ratios (IRRs) predicting the number of skill gaps for an EHW for each predictor are presented in Table 3. One predictor, years in current position, was statistically significant at the state level, as were four significant predictors of number of skill gaps at the local level: years in current position, annual salary, status of plans to retire, and role category.

Regression Results: State Health Agencies
At SHAs, EHWs with ≥21 years of experience in their current position had a 64% lower rate of skill gaps (IRR: 0.36, 95% *CI* [0.18, 0.72]) than those with ≤5 years in their current position.

Regression Results: Local Health Departments
At LHDs, EHWs with 6–10 years in their current position had a 37% lower rate of skill gaps (IRR: 0.63, 95% *CI* [0.43, 0.92]) than those who have been in their position for ≤5 years.

TABLE **3**

Poisson Regression Results for Predictors of Skill Gaps of Environmental Health Workers by Setting

		State Health Agency (SHA)			Local Health Department (LHD)		
		IRR	95% *CI*	*p > t*	IRR	95% *CI*	*p > t*
Role	Environmental professional	reference					
	Public health professional	1.21	0.84, 1.74	0.30	1.77*	0.32, 3.17	0
	Laboratory/clinical professional	0.67	0.42, 1.06	0.08	0.88	-0.29, 0.39	0.77
	Other professional	1.13	0.66, 1.92	0.65	1.27	0.48, 0.63	0.64
Annual salary	<$45,000.00	reference					
	$45,000.01–$55,000.00	1.13	0.66, 1.95	0.65	1.21	0.78, 1.86	0.39
	$55,000.01–$65,000.00	0.86	0.57, 1.29	0.45	1.52*	1.02, 2.27	0.04
	$65,000.01–$75,000.00	1.01	0.48, 2.08	0.99	1.09	0.46, 2.56	0.84
	>$75,000.00	1.09	0.55, 2.16	0.80	1.42	0.83, 2.44	0.19
Plan to retire	Planning to retire by 2015	reference					
	Not planning to retire by 2015	0.93	0.42, 2.07	0.85	3.16*	1.39, 7.17	0.01
Race/ethnicity	White	reference					
	Black	0.84	0.35, 2.00	0.69	0.72	0.41, 1.27	0.25
	Hispanic	0.98	0.74, 1.30	0.87	0.62	0.24, 1.63	0.32
	Asian	1.74	0.83, 3.66	0.14	0.78	0.22, 2.80	0.69
	Other	0.83	0.36, 1.94	0.66	0.80	0.29, 2.19	0.65
Highest educational degree attainment	Doctorate	reference					
	Master's	1.34	0.92, 1.96	0.13	0.88	0.33, 2.35	0.79
	Bachelor's	1.33	0.92, 1.92	0.13	0.70	0.25, 1.99	0.49
	No bachelor's	1.66	0.90, 3.04	0.10	0.37	0.12, 1.12	0.08
Supervisory status	Non-supervisor	reference					
	Supervisor	0.93	0.66, 1.31	0.68	1.11	0.81, 1.53	0.49
Years in current position	0–5	reference					
	6–10	0.96	0.69, 1.32	0.78	0.63*	0.43, 0.92	0.02
	11–15	0.66	0.40, 1.08	0.09	0.78	0.47, 1.30	0.33
	16–20	0.74	0.37, 1.46	0.38	0.94	0.56, 1.57	0.79
	≥21	0.36*	0.18, 0.72	0.01	0.72	0.30, 1.70	0.44
Years in public health practice	0–5	reference					
	6–10	0.80	0.49, 1.30	0.36	0.97	0.58, 1.60	0.90
	11–15	0.99	0.58, 1.69	0.97	0.79	0.36, 1.75	0.56
	16–20	0.68	0.34, 1.39	0.29	0.81	0.38, 1.71	0.57
	≥21	0.86	0.39, 1.87	0.69	1.07	0.63, 1.83	0.80

IRR = incident rate ratio; *CI* = confidence interval.
*Significant at α = .05.
Note. SHA estimated population size: 3,285; LHD estimated population size: 1,726.

Furthermore, annual salary served as a statistically significant predictor for skill gaps for EHWs at LHDs. In terms of annual salary, compared with EHWs who make <$45,000, EHWs who make $55,000.01–$65,000 reported a 52% higher rate of skill gaps (IRR: 1.52, 95% *CI* [1.02, 2.27]), while holding the other variables constant in the model (Table 3). Additionally, EHWs at LHDs who were not planning to retire by 2015 had a rate of skill gaps more than 3 times higher (IRR: 3.16, 95% *CI* [1.39, 7.17]) than those planning to retire by 2015 (Table 3).

Finally, EHWs at LHDs who hold a role as a public health professional reported a 77% higher rate of skill gaps (IRR: 1.77, 95% CI [1.22, 2.55]) compared with those who hold environmental professional roles. While not statistically significant, EHWs with laboratory/clinical professional roles in both settings reported a lower rate of skill gaps (SHA IRR: 0.67, 95% CI [0.42, 1.06]; LHD IRR: 0.88, 95% CI [0.35, 2.18]) compared with those who hold environmental professional roles (Table 3).

Regression Results: Comparing Settings
While not statistically significant, diverging trends were seen in terms of education at SHAs versus LHDs. At SHAs, EHWs with educational attainment of no bachelor's, bachelor's, and master's reported higher rates of skill gaps compared with EHWs with doctorates. Whereas at LHDs, EHWs at each of the other highest educational attainment levels reported lower rates of skill gaps compared with EHWs with doctorates (Table 3).

Discussion

The diversity of means by which governments provide environmental health services to their jurisdictions poses a challenge to elucidating the roles and responsibilities of EHWs employed within governmental public health and to understanding potential differences between state and local levels (Salinsky, 2010). To these ends, we found that while EHWs at both levels share tasks they rate as "very important" to their daily work and their skill gaps, they diverge around strengths, which might be related to level of government.

Our findings indicate that the strengths of local-level environmental health work fall within communicating and community interaction, while state-level strengths reside in administrative, policy, and scientific functions. Communicating persuasively, applying quality improvement concepts, anticipating changes in one's environment, understanding policy–health relationships, and addressing the needs of diverse populations are very important to a greater relative percentage of EHWs at LHDs than at SHAs. Moreover, except for influencing policy, fewer EHWs at LHDs than SHAs have skill gaps for these tasks.

Strengths of state-level EHWs are related to budgeting, interpreting data, influencing policy, managing change, and external collaboration, as fewer state-level EHWs than

local-level EHWs have skill gaps for these competencies. Further differences exist for LHDs in terms of pay and education, with a larger proportion of EHWs earning less at LHDs and a larger proportion with bachelor's degrees as their highest educational attainment at LHDs compared with at SHAs.

Comparison With Previously Published Public Health Workforce Interests and Needs Survey Findings

EHWs are similar to the overall state-level workforce in terms of the breakdown between age categories and supervisory status, yet EHWs differ in terms of race, sex, job experience, and plans to retire (Sellers et al., 2015). The environmental health workforce is less racially diverse than the overall state-level workforce, indicating that engaging and recruiting underrepresented groups into the study and practice of environmental health needs to be elevated as a priority. Unlike the rest of the state-level public health workforce, which is 72% female (Sellers et al., 2015), the environmental health workforce is 48% female. EHWs have more experience than the overall state-level public health workforce: a greater percentage of EHWs (11% LHD, 9% SHA) have spent ≥21 years in their current position, in contrast with the overall state-level public health workforce (5%) (Sellers et al., 2015). A notably smaller percentage of EHWs (3% LHD, 5% SHA) reported planning to retire within 1 year of taking the survey, compared with the 27% of the overall state-level public health workforce who reported planning to retire (Sellers et al., 2015). These differences create opportunities for sharing expertise among EHWs with varying levels of experience.

Important Daily Work Tasks and Skill Gaps

EHWs are skilled in the tasks they report to be most important to their work, however, they also have gaps in areas important to the field of environmental health. Gathering information, communicating clearly and persuasively, applying evidence-based approaches, and managing change were identified by at least 50% of EHWs in either setting as "very important" tasks. Not only was "gathering reliable information to answer questions" the top-rated "very important"

task across settings, it was also the competency for which the smallest percentage of EHWs across all settings reported as a skill gap. Along the same lines, ≤20% of EHWs reported a skill gap for the top five competencies (those for which at least 50% of EHWs in at least one setting rated as "very important" to their daily work).

Over 30% of EHWs across all settings, however, reported skill gaps for "influencing policy development" and "preparing a program budget with justification," which aligns with the skill gaps for the state-level public health workforce (Sellers et al., 2015). Additionally, while there were relatively similar proportions of EHWs reporting skill gaps for most competencies in both settings, there was a slightly greater percentage of EHWs at LHDs reporting skill gaps related to managing programs within budget constraints, preparing a budget, influencing policy, interpreting data, managing change, and external collaboration. These skills, however, are especially necessary for effective environmental health work, as some of the most impactful environmental health successes rely upon data-driven, collaborative, adaptive work—and a broad range of policies, from water and food regulations to workplace safety standards. These findings highlight a need for EHWs to strengthen their skills in these budget- and policy-related competencies, especially at the local level.

Moreover, we found that EHWs at LHDs have a strength in communicating persuasively that is not similarly shared at the state level, as it was rated "very important" by a greater proportion of EHWs at LHDs (76% LHD, 56% SHA) and shown as a skill gap for a greater proportion of EHWs at SHAs (16% SHA, 9% LHD).

The nature of state-level work might explain why more state EHWs have skill gaps in a) working with diverse communities and b) communication when compared with local EHWs, where these skills are regularly practiced; however, mastering these skills could help those state health workers interact with local EHWs more efficiently.

Predicting Skill Gaps

Experience
Our finding that those not planning to retire at LHDs have a rate of skill gaps over 3 times

higher than those planning to retire is concerning because these EHWs with a relatively higher rate of skill gaps will remain in the workforce. One potential explanation is that those planning to retire have eliminated skill gaps through experience and learning during their time working in public health. This finding raises concerns, however, about losing personnel with valuable knowledge, skills, and abilities.

Across settings, these findings suggest that those with more years of experience in their current position have a significantly lower rate of skill gaps than those with less experience. While to be expected, this finding demonstrates that work experience is an important factor in gaining the skills most relevant to environmental public health work. Taken along with the fact that the highest percentage of EHWs in each setting have held their current position for ≤5 years (42–49%), these findings imply that a substantial portion of EHWs (i.e., those newest in their positions) are those with the highest rate of skill gaps and that there is an opportunity for EHWs to address skill gaps within the first 5 years of starting their position.

Furthermore, only 9–11% of EHWs have held their current position for >21 years, and these are the EHWs who have a relatively lower rate of skill gaps. Moreover, the significance of years in current position as a predictor of rate of skill gaps, along with the finding that neither years in public health practice nor highest educational attainment was a significant predictor, suggest that the experience in EHWs' present positions offer the unique opportunity to gain the skills that are important to their work, as opposed to their time and experience in the field of public health more broadly defined, or their academic training. A peer-learning network matching EHWs with varying levels of experience could help address these disparities in skill levels. Organizations such as the National Environmental Health Association offer the opportunity for such a learning network for their members.

Role
While 13% of EHWs at LHDs hold public health professional roles, these EHWs reported a significantly higher rate of skill gaps than those EHWs with environmental professional roles. This finding further supports the charac-

terization of environmental health work at the local level as more relevant to environmental health-specific functions/practice rather than broader scientific/public health programmatic functions. This finding also suggests that EHWs with public health professional roles at LHDs can benefit from additional training in competencies relevant to their work. In order to address these skill gaps, those who hold the title public health professional would benefit from employee exchanges with those holding the title EHW in order to gain field experience. Additionally, peer-to-peer learning might be helpful in setting up a "ride-along" program for transference of skills.

Earnings
While nearly half (44%) of EHWs at LHDs make <$45,000 per year, these EHWs have a significantly lower rate of skill gaps than EHWs who make $55,000.01–$65,000. This discrepancy raises some questions in terms of adequate compensation for work performance at the local level and might indicate that agencies with more funds available to pay EHWs also have more resources for training, or attract EHWs with higher skill levels due to higher pay. Thus, this finding might be symptomatic of the funding structures that segregate the functions of state and local governmental public health.

Limitations
A major limitation of this study is that while the SHA frame is a nationally representative sample, the LHD frames are not nationally representative. There are limits, therefore, to the generalizability of these findings. The data from these pilot frames, however, have importance at a local level. While we used several different fielding methods to gather the local pilot data, the weights for each approach were appropriately calculated (Leider, Harper, Bharthapudi, & Castrucci, 2015). While differential nonresponse bias was a concern for PH WINS, we used complex survey methodology and sample weighting to address this issue, with the nonresponse-adjusted weights constituting the sampling weights for the state and local frames (Leider, Harper, et al., 2015).

Recommendations
A peer-learning network could help institutional knowledge from being lost in govern-

mental environmental health. EHWs with more experience in their positions could be available as a resource to early-career EHWs. Adopting a model of "peer-to-peer mentor circles" (Kuhn & Castaño, 2016), in which small groups of early- and mid/late-career EHWs who have similar work responsibilities form a supportive network, could efficiently use the expertise already present in health departments without relying upon a potentially burdensome one-to-one mentor–mentee model.

Targeted but adaptable trainings and programs to address the most prevalent skill gaps should serve to complement peer learning. One approach to address the substantial proportion of EHWs with gaps for policy- and budget-related skills would be through a management or leadership training program that prepares new managers to a) communicate with policy makers and b) formulate budget documents. This program could be adjusted to fit the differing needs at state and local levels, as well as become a part of systematized trainings that could be offered to EHWs at a national level to address skill gaps in the first 5 years of employment.

A national repository could house trainings and a corresponding curriculum to address basic workforce competencies for EHWs, especially for more specialized roles at the local level. These skill gaps are not only unique to EHWs but also are prevalent in the overall governmental public health workforce—as such, these programs and trainings could be made available and developed to be adaptable to professionals throughout the field. Furthermore, environmental health curricula at academic institutions could be evaluated for their applicability to the skills most important for work at local and state health departments, so that graduates of these programs are well equipped to address the needs in these settings.

In order to identify why EHWs at LHDs with lower salaries have fewer skill gaps, as well as elucidate which environmental health activities receive the most funding or lack funding, future studies could explore how environmental health work is funded at the state and local level, identifying how resources are distributed across agencies and how these practices and funding structures might change to better serve local needs.

Conclusion

Overall, the shared top tasks and skill gaps across settings for EHWs suggest that they have similar functions and training needs in each level of governmental public health. The distribution of EHWs' roles in each setting suggests broad similarities across settings, but with some differences in terms of fewer, more specialized, and defined roles for EHWs at local levels with a broader scope of responsibilities at the state level—which might be due to the differences in funding mechanisms for state and local environmental health.

The top tasks important to an EHW's daily work include gathering information, communicating clearly and persuasively, applying evidence-based approaches, and managing change. Nearly one third of EHWs across settings, however, report a skill gap related to policy- and budget-related competencies. Work experience as an EHW is an important factor in gaining the skills most relevant to environmental public health work at state and local levels, suggesting the need for opportunities for EHWs to gain the skills that are important to their work and to bolster and preserve institutional knowledge, potentially through a peer-learning network.

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