Public Health Informatics in Local and State Health Agencies: An Update From the Public Health Workforce Interests and Needs Survey

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ABSTRACT

Objective: To characterize public health informatics (PHI) specialists and identify the informatics needs of the public health workforce.
Design: Cross-sectional study.
Setting: US local and state health agencies.
Participants: Employees from state health agencies central office (SHA-COs) and local health departments (LHDs) participating in the 2017 Public Health Workforce Interests and Needs Survey (PH WINS). We characterized and compared the job roles for self-reported PHI, "information technology specialist or information system manager" (IT/IS), "public health science" (PHS), and "clinical and laboratory" workers.
Main Outcome Measure: Descriptive statistics for demographics, income, education, public health experience, program area, job satisfaction, and workplace environment, as well as data and informatics skills and needs.
Results: A total of 17 136 SHA-CO and 26 533 LHD employees participated in the survey. PHI specialist was self-reported as a job role among 1.1% and 0.3% of SHA-CO and LHD employees. The PHI segment most closely resembled PHS employees but had less public health experience and had lower salaries. Overall, fewer than one-third of PHI specialists reported working in an informatics program area, often supporting epidemiology and surveillance, vital records, and communicable disease. Compared with PH WINS 2014, current PHI respondents' satisfaction with their job and workplace environment moved toward more neutral and negative responses, while the IT/IS, PHS, and clinical and laboratory subgroups shifted toward more positive responses. The PHI specialists were less likely than those in IT/IS, PHS, or clinical and laboratory roles to report gaps in needed data and informatics skills.
Conclusions: The informatics specialists' role continues to be rare in public health agencies, and those filling that role tend to have less public health experience and be less well compensated than staff in other technically focused positions. Significant data and informatics skills gaps persist among the broader public health workforce.

KEY WORDS: information needs, public health informatics, state health agency, survey research, workforce

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Nearly a decade after the Health Information Technology for Economic and Clinical Health Act of 2009, electronic health record adoption continues to increase in the health care sector, with 80.5% of hospitals deploying at least a basic electronic health record.[1] Widespread electronic health record implementation creates an opportunity to improve the flow of data between health care and

public health, supporting data-intensive public health services such as infectious disease surveillance,[2] notifiable disease reporting and investigation,[3] and community health assessment.[4] However, to leverage the clinical data, public health needs a trained informatics workforce to develop the necessary tools, work processes, and data interfaces.

While the need for academic and workforce training in public health informatics (PHI) has been discussed for more than 2 decades,[5,6] recent studies indicate unmet informatics needs at both state health agencies (SHAs) and local health departments (LHDs),[7] and public health staff and leadership commonly cite lack of training and expertise as top barriers to establishing bidirectional connections between health care and public health.[8-11] To match the data and informatics needs of public health departments, the job title "PHI specialist" has emerged.

In practice, PHI specialists apply informatics principles to develop work processes and technologies that improve the quality and availability of information used to improve the public's health.[12] Using data from the 2014 Public Health Workforce Interests and Needs Survey (PH WINS), Dixon and colleagues[13] estimated that self-reported PHI specialists constitute 1.3% of the SHA workforce. While the proportion of staff identifying as PHI specialists is small, the informatics needs agency-wide are large, and other public health staff try to fill the gap. As a result, informatics skills have been added to essential competencies across public health disciplines,[14,15] and the Council on Education for Public Health has included informatics as a crosscutting competency for master of public health programs.[16]

As public health departments, schools of public health, apprenticeships, and fellowships incorporate informatics competencies into their curricula, it is important to monitor the skills and needs of the workforce and to identify informatics skills gaps. Recognizing the importance of understanding and addressing workforce development, in 2014, the Association of State and Territorial Health Officials (ASTHO) and the de Beaumont Foundation collaborated to field PH WINS, the first nationally representative sample of SHA public health workers in the United States. With the second fielding of PH WINS, we can continue to track characteristics and informatics needs among PHI workers and the broader public health workforce. In this article, we present an updated analysis of the PH WINS, with a focus on comparisons between those who self-reported that they serve a PHI role and other self-reported public health roles. This will clarify the current role of PHI workers within the health department structure and the informatics-related training needs of the broader public health workforce, informing public health agencies, schools

of public health, Centers for Disease Control and Prevention (CDC) apprenticeships, and postdoctoral fellows.

Methods

To characterize and compare PHI specialists with other public health workforce segments and to identify their informatics training needs, we performed a cross-sectional study using the nationally representative PH WINS 2017. The Indiana University Institutional Review Board deemed the secondary analysis of de-identified data as nonhuman subjects research.

Survey instrument

PH WINS was designed to influence workforce development; identify trends in attitudes, morale, and climate; and understand the needs and skills gaps across the workforce.[17] The 2017 questionnaire maintained the 4 major domains pertaining to demographics, workplace environment, training needs, and emerging concepts in public health. Changes between the 2014 and 2017 PH WINS as well as a detailed description of the instrument can be found in an article by Leider and colleagues.[18]

In 2017, PH WINS added a nationally representative probability sample of mid- and large-sized LHDs. The LHDs included in the 2017 PH WINS included 26 of the 30 public health departments that make up the Big City Health Coalition (BCHC), which serve the top 30 most populous urban areas in the United States. In some analyses, we divide the LHD group into BCHC member agencies and other health departments (OHD). Other health departments are defined as those employing a minimum of 25 staff and serving populations of 25 000 or more.

Classification of job roles and program area

Details on the PH WINS data set construction can be found in the article by Leider et al.[18] Of interest to the current study were respondents' self-reported job role and program area. Respondents were asked to "identify the classification that best represents your role in the organization" from a list of 61 options. We grouped the available options into the following job roles: "public health informatics specialist" (PHI); "information technology specialist or information system manager" (IT/IS); "public health science" (PHS); and "clinical and laboratory" (CL). For our analysis, the PHI and IT/IS roles consisted of a single response option from the survey. The PHS group included 24 noninformatics job roles, such as environmental health worker, public health manager or program manager, epidemiologist, and health

educator. The Clinical and Laboratory (CL) group included 17 noninformatics job roles, such as registered nurse, nutritionist, laboratory scientist, and community health worker.

In addition to their role, the respondents were asked to "specify your primary program area" from a list of 33 public health programs, including the option of working in multiple programs. We grouped this self-reported program area into 3 categories: (1) informatics; (2) multiple programs including informatics; and (3) noninformatics. Examples of noninformatics program areas include administrative support, clinical services, communicable disease, community health assessment, epidemiology surveillance, maternal and child health, public health laboratory, and program evaluation.

Classification of informatics training needs

The PH WINS training needs assessment captured respondents' perceived skills and needs using 21 questions across 8 "strategic skill" domains.[18] For the current analysis, we focused on questions addressing core public health competencies possessing the greatest overlap with PHI competencies.[19] Selected training questions included the following: identifying appropriate sources of data and information to assess the health of a community; collecting valid data for use in decision making; participating in quality improvement processes for agency programs and services; and identifying evidence-based approaches to address public health issues.

Respondents were asked to rate selected public health competencies with respect to the importance to their day-to-day work (ie, not important, somewhat unimportant, somewhat important, and very important) and their current skill level (eg, not applicable, unable to perform, beginner, proficient, expert). To identify the highest priorities for future workforce training, we present skill gaps. A skill gap was defined as discordance between self-reported importance (ie, need) and skill level, for example, those reporting the competency as "somewhat important" or "very important" and "unable to perform" or "beginner."

Response weighting and data analysis

Responses were weighted to account for the complex sampling frame and to match the national distributions of SHA and LHD employees. All analyses accounted for the full weighting structure to ensure correct estimates of standard errors.

We calculated descriptive statistics for demographics and selected job satisfaction, workplace environment, and training questions. For the SHA-CO sample, we compared PHI specialists with persons in IT/IS, PHS, and CL job roles because these roles are often technical and information intensive, because PHI specialists often work with staff in these other roles, and these are the staff who tend to address informatics needs in the absence of PHI specialists. The Rao-Scott χ^2 test, a design-adjusted version of the Pearson χ^2 test, was used to test for differences in the distribution of positive responses (agree or strongly agree) versus neutral or negative (disagree or strongly disagree) between job roles related to job satisfaction and work environment. We compared responses between PH WINS 2014 and 2017 by examining the proportion of positive responses as well as distributions of responses on a 5-point scale (from strongly disagree to strongly agree). Differences in skill gaps between job roles were also tested using the Rao-Scott χ^2 test. In the event of a zero cell, the hypothesis test was not performed. All analyses were performed with SAS 9.4 (SAS Institute, Inc, Carey, NC) using the PROC SURVEYMEANS and PROC SURVEYFREQ procedures.

Results

Participants

The percentages of public health employees indicating PHI, IT/IS, PHS, and CL are displayed in Table 1. Of all public health employees surveyed, the PHI specialist workforce accounted for 1.1% of SHA-CO respondents, 0.5% of BCHC respondents, and 0.2% of OHD respondents.

Detailed demographic and work-related information for SHA-CO employees, stratified by self-reported public health role, is presented in Table 2. Within SHA-COs, PHI staff most closely resembled PHS staff, often being female, having a bachelor's or master's degree, having widely distributed ages, and working in more decentralized SHA-COs. Differences include PHI specialists having less experience in public health, lower salaries, and fewer leadership roles. One-third of SHA-CO PHI specialists worked primarily in informatics or in programs that included informatics. Similar to SHA-COs, PHI specialists at LHDs were dispersed throughout noninformatics agency programs; only 26.1% of BCHC and 21.5% of OHD respondents reported working primarily in informatics programs.

Program area of the state and local public health informatics workforce

Given that up to one-third of PHI specialists worked in an informatics program, we investigated noninformatics program areas in detail. The

TABLE 1
Self-Reported Job Roles Among State Health Agencies, Big City Health Departments, and Other Mid- to Large-Sized Local Health Departments

	Health Department Setting					
	State Health Agency—Centralized Office (n = 17 136)		Big City Health Department (n = 7489)		Other Health Department (n = 19 070)	
Job Role[a]	n	Weighted % (95% CI)[b]	n	Weighted % (95% CI)[b]	n	Weighted % (95% CI)[b]
Public health informatics specialist	187	1.1 (0.9-1.2)	35	0.5 (0.2-0.7)	57	0.2 (0.1-0.3)
Information technology specialist or information system manager	615	3.4 (3.1-3.7)	97	1.3 (0.5-2.2)	241	0.9 (0.6-1.1)
Public health science	6419	36.6 (35.7-37.5)	2456	32.8 (29.0-36.5)	4741	28.7 (23.7-33.8)
Clinical and laboratory	2658	15.6 (15.0-16.2)	1780	23.58 (21.1-26.0)	5687	28.2 (26.0-30.3)

Abbreviation: CI, confidence interval.
[a] Self-reported job role.
[b] Weighted percentages do not sum to 100% because of omission of other job roles (eg, administrative, social sciences). Job role not reported among 460 (2.7%) state health agency-centralized office, 445 (3.7%) Big City Health Department, and 681 (3.6%) other local health department respondents.

TABLE 2
Weighted Proportions, Standard Errors, and Raw Counts for Demographic, Education, Salary, Geographic Location, and Health Department Governance Characteristics for Selected State Health Agency and Centralized Office Worker Job

	Public Health Informatics (n = 187)[a]		Information Technology (n = 615)[a]		Public Health Science (n = 6 419)[a]		Clinical and Laboratory (n = 2 658)[a]	
	n[b]	Weighted % (SE %)	n[b]	Weighted % (SE %)	n[b]	Weighted % (SE %)	n[b]	Weighted % (SE %)
Sex								
Female	119	63.7 (4.9)	212	34.7 (2.3)	4223	66.7 (0.6)	2095	78.8 (1.3)
Male	65	36.2 (4.9)	390	64.6 (2.2)	2128	32.9 (0.6)	537	20.5 (1.3)
Non-binary	1	0.1 (0.1)	4	0.6 (0.3)	26	0.4 (0.1)	16	0.6 (0.1)
Race/Ethnicity								
American Indian or Alaska Native	0	0 (0)	3	0.4 (0.3)	29	0.4 (0.1)	7	0.3 (0.1)
Asian	15	7.8 (2.0)	71	13.5 (2.0)	326	5.8 (0.3)	205	8.6 (0.8)
Black or African American	18	9.8 (1.8)	48	8.8 (1.6)	573	11.7 (0.5)	220	10.0 (0.6)
Hispanic or Latino	23	11.5 (2.7)	35	5.4 (0.8)	475	7.4 (0.3)	217	7.7 (0.5)
Native Hawaiian or Pacific Islander	0	0 (0)	2	0.4 (0.3)	21	0.4 (0.6)	14	0.6 (0.2)
White	120	67.2 (3.9)	404	65.5 (1.7)	4574	69.4 (0.5)	1817	66.8 (1.0)
Two or more races	6	3.6 (1.6)	37	6.0 (0.8)	308	5.0 (0.2)	140	6.1 (0.7)
Age, y								
≤30	22	11.7 (2.5)	25	4.7 (1.3)	658	10.6 (0.4)	217	7.8 (0.6)
31-40	41	24.5 (5.1)	104	19.1 (1.9)	1489	24.3 (1.1)	489	18.7 (1.1)
41-50	40	22.1 (3.3)	155	25.2 (2.3)	1559	24.6 (0.7)	615	23.7 (1.1)
51-60	50	27.6 (4.1)	214	35.5 (2.0)	1735	27.3 (0.7)	811	31.4 (1.0)
>60	28	14.1 (2.9)	97	15.5 (1.6)	829	13.2 (0.4)	478	18.4 (1.3)
Tenure in public health, y								
0-5	60	33.9 (5.2)	216	39.3 (2.6)	1517	24.3 (0.9)	824	30.8 (1.1)
6-10	39	21.1 (3.3)	99	16.2 (1.4)	1179	18.9 (0.6)	482	19.0 (0.9)
11-15	32	16.2 (2.9)	106	17.0 (1.8)	992	15.5 (0.5)	367	14.1 (1.4)
16-20	26	15.8 (2.9)	72	11.1 (1.3)	925	14.6 (0.4)	289	11.6 (1.3)
≥21	27	13.0 (2.7)	93	16.4 (1.6)	1685	26.8 (0.6)	645	24.5 (0.8)

(*continues*)

TABLE 2

Weighted Proportions, Standard Errors, and Raw Counts for Demographic, Education, Salary, Geographic Location, and Health Department Governance Characteristics for Selected State Health Agency and Centralized Office Worker Job Roles (*Continued*)

	Public Health Informatics (n = 187)[a]		Information Technology (n = 615)[a]		Public Health Science (n = 6 419)[a]		Clinical and Laboratory (n = 2 658)[a]	
	n[b]	Weighted % (SE %)	n[b]	Weighted % (SE %)	n[b]	Weighted % (SE %)	n[b]	Weighted % (SE %)
Supervisory status								
Nonsupervisor	144	74.7 (4.9)	445	71.7 (1.8)	3660	55.1 (0.8)	2068	77.4 (1.0)
Supervisor	31	17.2 (3.7)	96	15.1 (1.2)	1309	20.8 (0.5)	413	15.0 (0.8)
Manager	12	8.1 (2.3)	65	11.1 (1.1)	1183	19.5 (0.8)	150	6.0 (0.5)
Executive	0	0 (0)	8	2.1 (1.1)	263	4.5 (0.5)	22	1.5 (0.5)
Highest educational attainment								
Doctoral	17	9.0 (2.2)	10	1.7 (0.6)	633	10.4 (0.3)	269	10.9 (0.7)
Masters	55	31.8 (4.3)	128	21.7 (2.1)	3006	48.7 (0.7)	626	25.0 (0.7)
Bachelors	65	34.1 (4.1)	291	48.1 (1.8)	2110	31.2 (0.8)	1267	46.4 (1.2)
Associates	18	9.3 (2.4)	108	17.5 (1.4)	318	4.8 (0.3)	404	14.3 (0.8)
No bachelor or higher	31	15.9 (2.0)	73	11.0 (1.3)	337	4.8 (0.3)	89	3.4 (0.4)
Annual salary								
≤$35 000	27	14.7 (3.4)	9	1.5 (0.6)	188	2.8 (0.2)	182	7.8 (0.8)
$35 000.01-$45 000	33	18.1 (4.1)	44	9.4 (1.7)	660	10.4 (0.4)	259	10.0 (0.7)
$45 000.01-$55 000	35	18.4 (2.7)	89	16.7 (1.8)	1190	19.3 (0.5)	488	19.6 (1.3)
$55 000.01-$65 000	25	17.4 (4.1)	83	13.9 (1.2)	1197	19.3 (0.5)	395	15.6 (0.8)
$65 000.01-$75 000	25	14.6 (3.3)	96	17.0 (1.4)	942	16.1 (0.5)	348	15.9 (1.4)
$75 000.01-$85 000	12	8.3 (1.9)	96	15.3 (1.4)	623	11.7 (0.5)	295	13.3 (1.0)
$85 000.01-$95 000	5	3.5 (1.7)	62	11.2 (1.4)	487	8.5 (0.3)	149	6.4 (0.6)
>$95 000	9	5.1 (2.1)	75	15.1 (1.8)	645	11.8 (0.5)	240	11.2 (1.3)
Region								
New England and Atlantic (HHS 1 & 2)	30	15.2 (1.8)	54	6.7 (1.6)	1064	15.1 (0.3)	424	14.6 (0.7)
Mid-Atlantic and Great Lakes (HHS 3 & 5)	40	18.6 (2.9)	138	19.2 (1.3)	1525	20.5 (0.5)	609	19.8 (0.5)
South (HHS 4 & 6)	60	33.5 (3.9)	211	38.1 (1.9)	1827	34.0 (0.7)	798	33.1 (1.0)
Mountain/Midwest (HHS 7 & 8)	26	15.1 (2.9)	27	4.4 (1.1)	838	11.7 (0.3)	288	10.1 (0.6)
West (HHS 9 & 10)	31	17.6 (2.8)	185	31.7 (1.8)	1167	18.7 (0.5)	546	22.4 (0.6)
Health department governance								
Centralized/largely centralized	34	16.6 (2.6)	157	18.9 (1.2)	1256	16.4 (0.5)	409	13.1 (0.4)
Shared/largely shared	7	7.4 (3.4)	61	14.8 (1.2)	537	15.7 (0.7)	219	13.1 (1.1)
Decentralized/largely decentralized	133	68.4 (3.9)	337	54.2 (1.9)	4095	59.6 (0.7)	1840	66.1 (1.0)
Mixed	13	7.6 (1.6)	60	12.1 (1.3)	533	8.3 (0.3)	197	7.7 (0.4)
Program area								
Primary informatics	57	31.4 (4.6)	136	23.2 (2.3)	84	1.5 (0.2)	4	0.2 (0.1)
Multiple, including informatics	4	2.8 (1.5)	17	3.1 (1.0)	42	0.7 (0.2)	5	0.2 (0.1)
Other, noninformatics	116	65.6 (4.4)	395	73.7 (2.8)	5959	97.9 (0.2)	2364	99.6 (0.1)

Abbreviations: HHS, Health & Human Services; SE, standard error.
[a] A total of 6493 other administrative staff, 269 social sciences and "other," and 418 without a reported job role omitted from table.
[b] Number of completed surveys.

SHA-CO PHI specialists worked in 23 different noninformatics program areas, most commonly epidemiology and surveillance (18%), vital records (8%), communicable disease (7%), health promotion and wellness (4%), and clinical immunization services (3%). Within BCHC, PHI specialists worked in 13 noninformatics programs, most commonly communicable disease (18%), vital records (12%), maternal and child health (5%), and community health assessment and planning (3%). The OHD PHI specialists worked in 14 program areas, most commonly administrative support (16%), immunization services (9%), community health assessment and planning (8%), epidemiology and surveillance (8%), and vital records (8%).

Satisfaction and workplace environment

In the Figure, we summarize the 2017 SHA-CO responses regarding job satisfaction, training needs, and workplace environment by job role. We also include the relative changes in responses from PH WINS 2014. Overall, the workforce responded positively when asked whether they were satisfied with their job, with satisfaction among IT/IS being somewhat lower than among the other roles. Similarly, the workforce was largely satisfied with job security. On average, PHI specialists were slightly more satisfied with their organizations (71%) than the other roles (69%-66%) ($P = .01$). While satisfaction with pay was relatively low among all roles, it was significantly lower among
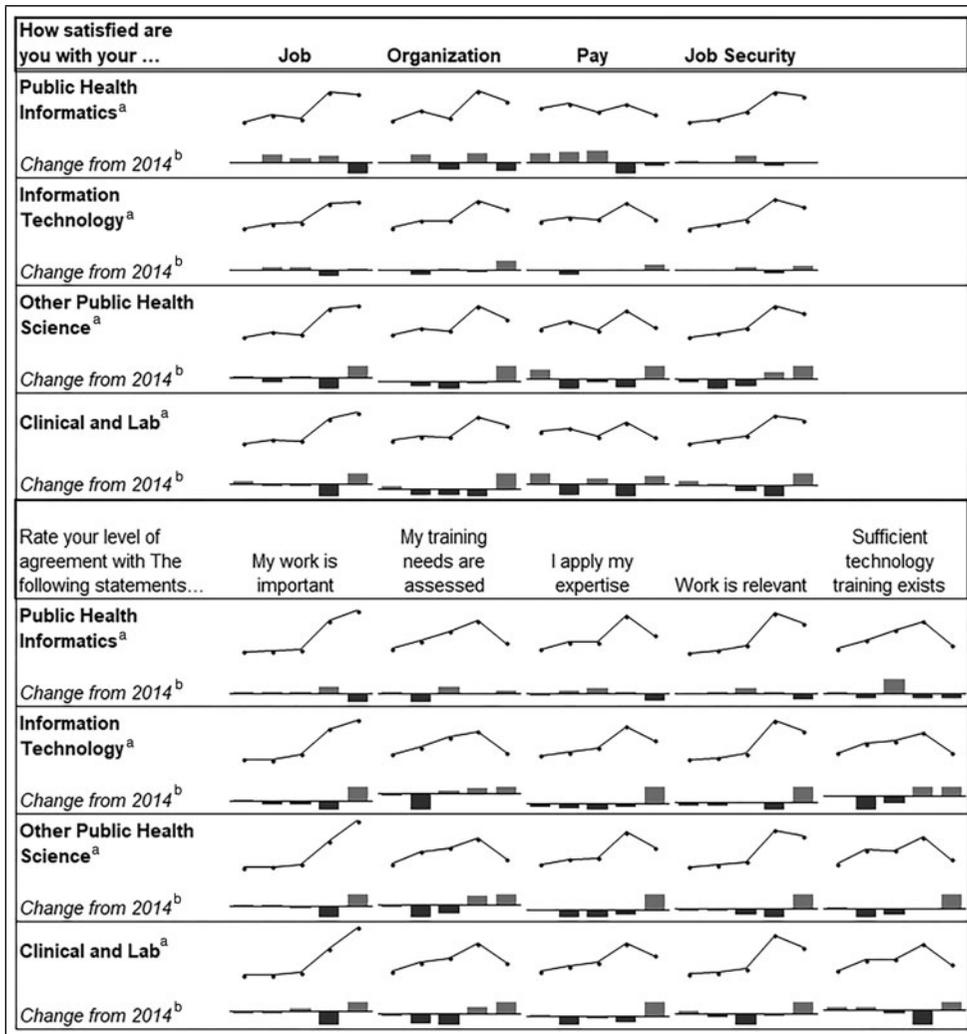

FIGURE Job Satisfaction, Workplace Environment Characteristics, and Training Needs Among Selected State Health Agency Employee Job Roles
[a]Sparkline minimum = 0%, maximum = 61%.
[b]Change bar minimum = −24%, maximum = 15%.

the PHI subgroup (38%) than the IT/IS (54%), PHS (52%), and CL (44%) segments of the workforce ($P < .001$).

Respondents were further asked how much they agree with statements about their workplace environment and training. In general, the workforce indicated that they felt the work they do is important and relevant to their agency's goals and priorities. Across roles, greater than 90% and 86% agreed or strongly agreed with statements about the importance and relevance of their jobs, respectively. Regarding whether their training needs were assessed, PHI specialists reported a greater agreement (53%) than IT/IS (46%) and PHS (49%) but not CL (57%) roles ($P < .001$). Similarly, CL roles were more likely to report sufficient training for technology (54%) than PHI (50%), PHS (50%), and IT/IS (45%; $P = .01$). Finally, all 4 roles agreed at close to 70% that they had the ability to apply their expertise.

Overall, compared with the 2014 PH WINS, positive responses among PHI specialists for satisfaction with pay dropped by 27.4%, job satisfaction declined by 8.5%, and satisfaction in their ability to apply their expertise dropped by 5.8%. Current PHI respondents' satisfaction with their job and workplace environment moved toward more neutral and negative responses, while the IT/IS, PHS, and CL subgroups shifted toward more positive responses (Figure). It is important to note that in 2014, the proportion of positive responses was greater for PHI specialists than IT, PHS, and CL for all 9 questions, ranging from a difference of 0.2% to 26.0%. In 2017, only 2 of the same 9 questions were unanimously more positive among PHI than other roles, with differences ranging from 0.05% to 2.6%. The largest changes between 2014 and 2017 among PHI specialists pertained to satisfaction with pay, organization, ability to apply expertise, and importance of work.

Data and informatics needs and skills

Table 3 details the discordant skill gaps for the PHI, IT/IS, PHS, and CL roles by setting (SHA-CO, BCHC, or OHD). In general, low need-high skill gaps were reported among less than 10% of employees regardless of role and agency type, apart from the OHD CL group regarding skills for identifying appropriate data sources and information. In most cases, PHI specialists reported lower or similar low need-high skill gaps than other roles.

While low need-high skill gaps represent underutilized informatics and data skills, high need-low skill gaps represent a shortage of key skills in the

workforce. Across all settings, PHI specialists were less likely to report high need-low skill gaps than the other roles. Within SHA-COs, PHI specialists were less likely than the other roles to have a high need-low skill gap with respect to identifying appropriate sources of data ($P < .001$) and collecting data for decision making ($P < .001$). The PHI specialists and PHS roles reported a similar skill gap for identifying evidence-based approaches (15% and 13%, respectively), which were lower skill gaps than IT (24%) and CL (18%) roles ($P < .001$).

Discussion

Building on our prior analysis of the PH WINS,[13] we used the second (2017) fielding of the PH WINS to describe the characteristics, satisfaction, workplace factors, and informatics-based training needs among a nationally representative sample of SHA-CO PHI specialists. In addition, we established a nationally representative baseline for tracking the PHI workforce within LHDs. Our aim was to clarify the current role of PHI workers within health departments and the training needs of the broader public health workforce.

Overall assessment of the public health informatics workforce

The PHI specialists remain a small segment of the overall public health workforce. We found that 1.1% and 3.4% of SHA-CO respondents self-reported their role as PHI or IT/IS, respectively. These findings are similar to the inaugural PH WINS findings where the PHI and IT segments were estimated as 1.3% and 4.1%.[13] Among LHDs, an estimated 0.5% and 1.3% of the BCHC workforce and 0.2% and 0.9% of the OHD workforce self-reported PHI and IT/IS roles, respectively. These estimates are similar to results from studies by the National Association of County & City Health Officials (NACCHO)[20] and Leider et al,[11] which suggested PHI accounted for approximately 1.2% of the LHD workforce.

The survey further characterizes PHI as diffuse within health departments. The prior version of the PH WINS did not include informatics as a program area choice, so this analysis is the first to examine where PHI specialists sit within health department structures. While some health departments now have an informatics program, PHI specialists most commonly work in noninformatics program areas. This was especially true in LHDs where more than 75% of PHI respondents worked exclusively in noninformatics areas. Where informatics programs do exist, they are often supported by IT/IS and PHS workers. These patterns suggest that many public health

agencies may address informatics needs through discrete projects, rather than through a coordinated, agency-wide program.[21]

Public health informatics specialists' attitudes toward job and salary

While PHI specialists reported positive attitudes overall toward their job and agency, attitudes toward salary were less positive than other roles within SHA-COs. More importantly, we observed that attitudes of PHI specialists shifted downward since the prior fielding of PH WINS. The PHI specialists in the most recent fielding of the survey are less satisfied with their job, organization, and salary. Given that reported salaries are lower than IT/IS, PHS, and CL roles, it is not surprising that satisfaction with salary is low. Perhaps related to salary, PHI specialists in SHA-COs were less likely than IT/IS, PHS, and CL staff to be in leadership positions. This may be related to having less public health experience, although their distribution of years in public health was similar to staff in the IT/IS role. Negative views of pay among PHI specialists were not observed in 2014, so the change is cause for concern. In combination with decreasing satisfaction with job and organization, a follow-up study is warranted to examine PHI specialists' attitudes, the reasons why they are less satisfied than other public health workers, and whether these attitudes affect likelihood of leaving their agency for other public health or non–public health positions.

Public health informatics training needs

An informatics-savvy health department requires PHI competencies not just among PHI specialists but also among workers, program area managers, and executive leadership.[22] While it is encouraging that PHI specialists generally reported having the skills needed for their jobs, our findings suggest that additional informatics training is necessary for the broader public health workforce. Specifically, non-PHI specialists reported significantly larger gaps for the ability to "identify appropriate sources of data and information to assess the health of a community" and "collect valid data for use in decision making." Similar levels of discordance were observed for the competencies pertaining to quality improvement and evidence-based approaches. The discordance suggests that health departments should examine ways to enhance training for PHI-related competencies throughout their workforce, perhaps with assistance from PHI specialists.

Since our prior analysis of PH WINS, academic training options in PHI have increased, including graduate certificates,[23,24] PHI master's degrees,[25,26] and PHI concentrations within other MPH degrees at a broader range of universities.[27] Baccalaureate programs are also emerging.[28]

On the contrary, training for public health practitioners has become more limited since the 2014 PH WINS. Previously, the Centers for Disease Control and Prevention (CDC) offered an extramural, interprofessional education program (referred to as SHINE), which included training in place for public health agency staff, as well as fellowship positions throughout the country, but that initiative lost funding in 2017. At the same time, cuts in funding from the CDC to informatics programs in the large, national public health associations have greatly reduced their activities to build and support the existing network of PHI practitioners. Some opportunities still exist. Postgraduate fellowships in PHI are still offered for work within the CDC,[29] and fellowships are offered by the US National Library of Medicine.[30] Some non-degree training in PHI is also available from the Informatics Academy of the Public Health Informatics Institute[31] as well as the American Medical Informatics Association.[32]

Limitations

Depending on how respondents interpreted the PH WINS questionnaire, their role or program may be misclassified. For example, employees with an epidemiology degree may self-identify as epidemiologists, despite primarily serving an informatics role. Given the PH WINS sampling frame, our findings are not generalizable to LHDs serving populations of less than 25 000. Furthermore, due to the small proportion of self-reported PHI, employees at BCHC and OHD demographic- and work-related estimates were unstable and therefore omitted. The small proportion of self-reported PHI employees also limited the ability to adjust comparisons of characteristics such as salary and training skills gaps for potentially confounding variables, including supervisory role, years in public health, and education. Differences in the sampling frames between 2014 and 2017 included different participating SHA-COs and inclusion of decentralized SHA employees in 2017. Although an agency-linked data set would be preferred for examining changes between the 2 surveys, each analysis was response-weighted to represent the same target population (ie, SHA-CO workforce).

The selected training needs survey questions were not strictly informatics competencies. Rather, they represented broader public health business processes and services that may be enhanced through the application of informatics. While these competencies

TABLE 3
Data and Informatics Self-Reported Skills Gaps by Job Role for State Health Agencies, Big City Health Departments, and Other Mid- to Large-Sized Local Health Departments

	Identify Appropriate Sources of Data and Information to Assess the Health of a Community				Collect Valid Data for Use in Decision Making				Participate in Quality Improvement Processes for Agency Programs and Services				Identify Evidence-Based Approaches to Address Public Health Issues			
	Low Need, High Skill		High Need, Low Skill		Low Need, High Skill		High Need, Low Skill		Low Need, High Skill		High Need, Low Skill		Low Need, High Skill		High Need, Low Skill	
	n	w% (SE)	n	w% (SE)	n	w% (SE)	n	w% (SE)	n	w% (SE)	n	w% (SE)	n	w% (SE)	n	w% (SE)
SHA-CO																
PHI	2	1.4 (1.1)	12	8.3 (2.6)	0	0 (0)	6	3.8 (2.2)	5	4.3 (2.0)	44	26.1 (3.4)	3	2.0 (1.2)	23	14.7 (2.8)
IT/IS	23	7.0 (1.7)	48	18.6 (4.0)	14	2.9 (0.7)	29	6.7 (1.5)	15	4.2 (1.2)	106	32.4 (3.5)	25	8.5 (1.6)	67	24.5 (3.1)
PHS	168	2.9 (0.3)	851	16.1 (0.8)	85	1.3 (0.2)	577	9.3 (0.5)	188	3.7 (0.5)	1530	29.4 (0.7)	147	2.7 (0.2)	761	13.3 (0.7)
CL	48	2.5 (0.4)	433	22.9 (1.0)	43	1.6 (0.3)	298	13.3 (0.5)	54	2.8 (0.5)	625	32.7 (1.3)	56	2.9 (0.5)	363	18.5 (0.7)
P[a]		NR		<.001		NR		<.001		.39		.12		<.001		<.001
BCHD																
PHI	0	0 (0)	4	17.8 (12.8)	0	0 (0)	1	4.3 (4.3)	3	6.8 (3.7)	4	12.2 (6.0)	1	2.9 (4.7)	3	8.6 (5.4)
IT/IS	3	5.6 (3.1)	12	22.1 (7.7)	2	2.4 (1.5)	8	10.0 (2.8)	1	1.2 (1.0)	22	45.2 (8.7)	1	1.1 (0.9)	17	31.1 (10.5)
PHS	64	2.8 (0.3)	343	16.9 (1.0)	47	2.1 (0.4)	270	12.2 (0.4)	48	2.3 (0.3)	612	32.1 (2.0)	51	2.3 (0.3)	288	13.6 (0.8)
CL	38	2.7 (0.5)	320	22.5 (1.5)	25	2.0 (0.4)	247	17.0 (1.4)	20	1.6 (0.5)	491	39.3 (1.9)	20	1.4 (0.3)	293	20.9 (1.7)
P[a]		.03				NR		<.001		.10		.001		.23		<.001
OHD																
PHI	0	0 (0)	5	8.1 (4.2)	1	3.5 (3.3)	5	6.7 (3.5)	1	1.0 (1.0)	12	25.9 (7.2)	0	0 (0)	10	15.1 (5.9)
IT/IS	6	5.1 (2.6)	22	18.3 (5.1)	4	5.4 (4.8)	16	5.2 (4.8)	4	2.5 (1.4)	42	32.8 (5.9)	9	7.1 (3.1)	25	27.4 (6.5)
PHS	115	2.5 (0.7)	800	18.7 (3.9)	58	1.0 (0.3)	553	12.0 (2.4)	85	2.1 (0.4)	1168	33.0 (1.3)	86	1.8 (0.3)	699	20.2 (2.4)
CL	69	18.7 (5.1)	1176	26.7 (2.3)	70	1.4 (0.3)	830	17.8 (1.3)	51	1.3 (0.2)	1658	41.6 (1.4)	47	1.0 (0.2)	1003	21.9 (1.2)
P[a]		NR		<.001		.06		<.001		.0698		<.001		NR		.62

Abbreviations: BCHD, Big City Health Department; CL, clinical and laboratory; IT/IS, information technology specialist or information systems manager; NR, not reported (due to zero cell); OHD, other mid- to large-sized local health department; PHI, public health informatics specialist; PHS, public health science; SE, standard error; SHA-CO, State Health Agency—Centralized Office; w%, weighted percentage. p = .07.
[a]Rao-Scott χ^2 test for the distribution of skills gap.

Implications for Policy & Practice

- The PHI specialist's role continues to be rare in public health agencies, and those filling that role tend to have less public health experience and be less well compensated than staff in other technically focused positions.

- PHI specialists' skills tend to be well matched to the data and informatics needs of public health agencies.

- The increased dissatisfaction among PHI specialists since 2014 indicates the importance of reversing the recent decrease of federal investment in state and local public health informatics.

- Relative dissatisfaction with pay and relatively sparse leadership roles point to a need for greater focus on developing and retaining people in the PHI role.

- Public health information technology specialists and information system managers, workers in the public health sciences, and workers in the clinical and laboratory roles have unmet needs in data and informatics skills.

are representative of desired skills for noninformatics jobs roles, they do not provide detailed assessment of training needs for PHI specialists. Future studies should include questions more specific to PHI, for example, designing, implementing, and evaluating information systems; use of methods in capturing, storing, exchanging, and using data; and applying technologies and standards to enhance timeliness, completeness, and accuracy. Additional PHI-specific competencies have been suggested by Wholey and colleagues.[19]

Conclusion

The second iteration of PH WINS monitored the growth and maturation of the SHA PHI workforce and established a baseline among mid- and large-sized LHDs. Despite the trend of increasing demand for informatics in public health, the percentage of the PHI workforce within SHAs remained relatively stable between the 2014 and 2017 PH WINS. While PHI specialists tended to possess the data and informatics skills necessary for their job, our results suggest that the broader public health workforce needs additional informatics training.

References

1. Adler-Milstein J, Holmgren AJ, Kralovec P, Worzala C, Searcy T, Patel V. Electronic health record adoption in US hospitals: the emergence of a digital "advanced use" divide. *J Am Med Inform Assoc.* 2017;24(6):1142-1148.
2. Richards CL, Iademarco MF, Anderson TC. A new strategy for public health surveillance at CDC: improving national surveillance activities and outcomes. *Public Health Rep.* 2014;129(6): 472-476.
3. Dixon BE, Siegel JA, Oemig TV, Grannis SJ. Electronic health information quality challenges and interventions to improve public health surveillance data and practice. *Public Health Rep.* 2013; 128(6):546-553.
4. Perlman SE, McVeigh KH, Thorpe LE, Jacobson L, Greene CM, Gwynn RC. Innovations in population health surveillance: using electronic health records for chronic disease surveillance. *Am J Public Health.* 2017;107(6):853-857.
5. Friede A, Blum HL, McDonald M. Public health informatics: how information-age technology can strengthen public health. *Ann Rev Public Health.* 1995;16:239-252.
6. Kirkwood J, Jarris PE. Aligning health informatics across the public health enterprise. *J Public Health Manag Pract.* 2012;18(3): 288-290.
7. Beck AJ, Leider JP, Coronado F, Harper E. State health agency and local health department workforce: identifying top development needs. *Am J Public Health.* 2017;107(9):1418-1424.
8. Shah GH, Leider JP, Castrucci BC, Williams KS, Luo H. Characteristics of local health departments associated with implementation of electronic health records and other informatics systems. *Public Health Rep.* 2016;131(2):272-282.
9. Shah GH, Vest JR, Lovelace K, McCullough JM. Local health departments' partners and challenges in electronic exchange of health information. *J Public Health Manag Pract.* 2016;22(suppl 6): Public Health Informatics: S44-S50.
10. Massoudi BL, Chester K, Shah GH. Public health staff development needs in informatics: findings from a national survey of local health departments. *J Public Health Manag Pract.* 2016;22(suppl 6): Public Health Informatics:S58-S62.
11. Leider JP, Shah GH, Williams KS, Gupta A, Castrucci BC. Data, staff, and money: leadership reflections on the future of public health informatics. *J Public Health Manag Pract.* 2017;23(3):302-310.
12. Thiebaut R, Thiessard F. Public health and epidemiology informatics. *Yearb Med Inform.* 2017;26(1):248-251.
13. Dixon BE, McFarlane TD, Dearth S, Grannis SJ, Gibson PJ. Characterizing informatics roles and needs of public health workers: results from the public health workforce interests and needs survey. *J Public Health Manag Pract.* 2015;21(suppl 6): S130-S140.
14. Ned-Sykes R, Johnson C, Ridderhof JC, et al. Competency guidelines for public health laboratory professionals: CDC and the association of public health laboratories. *MMWR Suppl.* 2015;64(01): 1-81.
15. Moser M, Ramiah K, Ibrahim M. Epidemiology core competencies for master of public health students. *Public Health Rep.* 2008; 123(suppl 1):59-66.
16. Calhoun JG, Ramiah K, Weist EM, Shortell SM. Development of a core competency model for the master of public health degree. *Am J Public Health.* 2008;98(9):1598-1607.
17. Association of State and Territorial Health Officials. PH WINS. http://www.astho.org/phwins/. Published 2018. Accessed June 20, 2018.
18. Leider JP, Pineau M, Bogaert L. The methods of PH WINS 2017: approaches to refreshing nationally-representative state-level estimates and creating nationally-representative local-level estimates of public health workforce interests and needs. *J Public Health Manag Pract.* 2019;25(suppl 2):S49-S57.
19. Wholey DR, LaVenture M, Rajamani S, Kreiger R, Hedberg C, Kenyon C. Developing workforce capacity in public health informatics: core competencies and curriculum design. *Front Public Health.* 2018;6:124.
20. National Association of County & City Health Officials. *National Profile of Local Health Departments.* Vol 7. Washington, DC; 2017.
21. LaVenture M, Brand B, Ross DA, Baker EL. Building an informatics-savvy health department: part I, vision and core strategies. *J Public Health Manag Pract.* 2014;20(6):667-669.
22. LaVenture M, Brand B, Baker EL. Developing an Informatics-Savvy Health Department: From Discrete Projects to a Coordinating Program Part II: Creating a Skilled Workforce. *J Public Health Manag Pract.* 2017;23(6):638-640.

23. Johns Hopkins University. Certificate in public health informatics Web site. https://www.jhsph.edu/departments/health-policy-and-management/certificates/public-health-informatics/index.html. Accessed June 20, 2018.

24. Emory University. Certificate in public health informatics Web site. https://www.sph.emory.edu/academics/professional-development/certificate-phi/index.html. Accessed June 20, 2018.

25. Indiana University. MPH—public health informatics Web site. https://fsph.iupui.edu/academics/masters/mph/informatics/index.html. Accessed June 20, 2018.

26. University of Minnesota. MPH—public health informatics Web site. http://sph.umn.edu/site/docs/degrees-programs/informatics/mph_phi.pdf. Accessed June 20, 2018.

27. Joshi A. Population health informatics workforce, competencies, and training programs. In: Joshi A, Thorpe L, Waldron L, eds. *Population Health Informatics: Driving Evidence-Based Solutions Into Practice.* Burlington, MA: Jones & Bartlett Learning; 2017: 31-62.

28. Indiana University. BS in health data science Web site. https://fsph.iupui.edu/academics/undergraduate/bshds/index.html. Accessed July 27, 2018.

29. Centers for Disease Control and Prevention. Public health informatics fellowship program (PHIFP) Web site. https://www.cdc.gov/phifp/index.html. Accessed June 20, 2018.

30. US National Library of Medicine. NLM's university-based biomedical informatics and data science research training programs Web site. https://www.nlm.nih.gov/ep/GrantTrainInstitute.html. Accessed July 27, 2018.

31. American Medical Informatics Association. AMIA 10x10 courses Web site. https://www.amia.org/education/10x10-courses. Accessed June 20, 2018.

32. Informatics Academy Web site. https://informaticsacademy.org/. Accessed June 20, 2018.