

Focus on Public Health Laboratories: A Workforce Survey Report



MAY 2018

About This Series

This is the first in a series of state public health laboratory (PHL) data reports, based on information from a variety of longitudinal and cross-sectional APHL surveys conducted from 2010-2016. The surveys—including both laboratory-level and person-level analyses—address a number of topics, including funding, workforce characteristics, testing and specialized testing capabilities, and partnerships. This series focuses exclusively on the 50 state and District of Columbia PHLs. The intent is to provide reference data on salient characteristics of the US PHL system that can be used to (a) apprise stakeholders of PHL issues, (b) inform program planning and decision-making at individual laboratories, schools of public health and at the national level, (c) inform PHL advocacy efforts, (d) enable comparisons across US geographic regions and with other public health programs and (e) identify key data gaps.

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Executive Summary

The Association of Public Health Laboratories (APHL) conducted comprehensive surveys of public health laboratorians in 2011 and 2016. This report provides findings from analysis exploring trends and issues affecting the public health laboratory (PHL) workforce and focusing specifically on state public health laboratories (SPHL).

Below are selected findings which are based on descriptive and advanced statistical analysis of data from 1,415 laboratorians in 2011 and 1,337 in 2016—estimated to be roughly 20% of the total PHL workforce. These are discussed in-depth later in the report and are supported by data presented in the appendices.

Demographics

- The SPHL workforce is mostly white and female. In 2016, females made up 65% of the workforce. In addition, African Americans made up 7% of the workforce as compared to 13% in state public health agencies and Hispanics made up 3% of the workforce as compared to 7% in state public health agencies.
- A trend toward a greater feminization of the SPHL workforce is observed: 61% of the oldest cohort (age 51 and above) in 2016 was female, compared with 66% of Gen Xers (age 36-50) and 71% of Millennials (age 35 and below).
- The SPHL workforce is highly educated; in 2016, 86% had earned at least a bachelor's degree.

Tenure within the PHL System

- In 2016, 30% of the SPHL workforce had worked in PHL practice less than five years.
- After controlling for other factors, men reported slightly more time in PHL practice than women; there were no differences among ethnic groups.
- The most highly educated laboratorians were also the least tenured; doctoral-level respondents reported one year less experience in any PHL than respondents with no college degree.

Leadership in the SPHL System

- After controlling for other factors, the data show neither a gender gap nor a racial gap in SPHL management.
- The overriding factors distinguishing SPHL managers from non-managers were education and length of time in the PHL workforce.

Salary

- In 2016, the highest-paying SPHL positions were deputy director/director (median—\$100,000), lab scientist supervisor/manager (median—\$70,000) and IT systems specialist (median—\$70,000). The lowest-paying positions were administrative jobs and laboratory aid/technician (median—\$40,000).
- There was salary inequity between genders; after controlling for other factors (ethnicity, region, and education, length of service, position type, and age), males earned \$1,580 more annually than females.
- As education increased so did salary; after controlling for other factors, a laboratorian with a Master's degree made \$14,000 more annually than someone without a degree.

Attitudes and Perceptions

- The top reasons respondents reported for entering and/or remaining in the SPHL workforce were appropriate life/work balance, job security, benefits package and safe/secure work environment.
- Millennials (age 35 or below), more than other generations, valued continuing education and thought their PHL had a good and supportive workplace environment.
- Baby Boomers (age 51 and up), more than other generations, valued public service and thought that their PHL provided career advancement opportunities.

Satisfaction Levels

- A large proportion of the SPHL workforce were satisfied with their job (78%) and job security (76%) in 2016. A much smaller proportion (37%) were satisfied with their pay.
- After controlling for other factors, males and Millennials were generally less satisfied than their counterparts.
- The single overriding factor associated with job satisfaction for all laboratorians was the perception that the laboratory provided a good and supportive work environment. For Baby boomers, value of public service was associated with their job satisfaction and for Millennials, value of continuing education was associated with their job satisfaction.

Intention to leave

- In 2016, almost a third of SPHL workforce indicated an intent to leave within the next five years.
- After controlling for other factors, more men and Millennials (compared to Gen Xers) indicated an intent to leave.
- There is a strong association between intent to leave the PHL workforce within five years and level of dissatisfaction with one's job, organization, pay or job security.

This report attempts to provide the evidence-base for strategic decisions and advocacy to support a sustainable and robust laboratory workforce. The data contained within can be further analyzed to answer specific questions or to inform policy discussions.

Introduction

A functioning PHL system is the very foundation of the nation's surveillance and response system to achieve better population health outcomes. A critical component of this system is a competent, flexible, collaborative and practice-ready workforce. In order to achieve this, PHLs must be able to recruit and retain talent, ensure professional competencies, and be able to adapt to new technological realities. This requires optimal policies, adaptable operational structures, and better funding and resource allocation.

To assure that a highly performing workforce continues to support the PHL system, APHL has undertaken a number of workforce initiatives, including development of the first competency guidelines for PHL professionals to identify job responsibilities, inform individual performance assessments and inform the development of education and training programs.¹ Those guidelines illustrate the breadth of subject matter areas involved in modern PHL practice, such as quality management systems, emergency response, research and ethics, just as examples.

APHL also attempts to stimulate more thoughtful discussion and innovation on PHL workforce solutions by conducting research to understand current capacities and describing trends and other influences. In 2011 and 2016, APHL conducted comprehensive surveys of public health laboratorians. This report provides findings from analysis of these surveys focusing specifically on SPHLs. The analysis attempts to answer the following questions:

- What is the SPHL workforce demography and how is it changing over time?
- What types of positions make up the workforce and are there any inequities?
- How do SPHL salaries vary by region and over various workforce population groups?
- What are current rates of attrition/retention and how does this vary over workforce population groups?
- What factors are important for recruitment and retention?
- What are the levels of workforce satisfaction and how are these associated with recruitment and retention?

Data Sources and Analytical Methods

Findings are based on an analysis of data from APHL's 2011 Laboratorian Workforce Survey (N=1,415)* and 2016 Laboratorian Workforce Survey (N=1,337).† Both surveys were distributed via the Qualtrics® electronic survey platform to directors of the 50 US state PHLs and the District of Columbia PHL. The 51 directors, in turn, were asked to encourage their professional and administrative staff to complete the survey online. Altogether, 49 PHLs are represented in the 2011 survey dataset and 47 in the 2016 dataset.

Descriptive analysis was used to gauge workforce demographics, position and tenure within the PHL system, levels of job satisfaction, levels of compensation and intention to leave the workforce. Bivariate analysis was used to assess variation of key metrics (i.e., leadership position, compensation levels, job satisfaction and intention to leave) by demographics, as well as over time. Exploratory factor analysis was used to collapse 40 questions related to attitudes and workplace perceptions into five interpretable underlying factors:

- (1) Values continuing education, training, research;
- (2) Values salary/benefits package;
- (3) Values providing public service;
- (4) Perceives that the laboratory provides a supportive workplace environment; and
- (5) Perceives that laboratory provided career advancement, succession planning.

Multivariate logistical regression was used to examine variables that might be related to respondents' levels of compensation, job satisfaction and intention to leave, such as age, sex, race, geographic region, educational status, managerial position and individuals' values and perceptions.

Findings are subject to at least three limitations. First, survey respondents were self-selected and therefore may not be representative of the entire PHL workforce; a caveat readers should bear in mind when "the PHL workforce" is referenced when discussing survey findings below. Second, comparisons over time should be viewed with caution, since laboratorians participating in the 2011 workforce survey may differ somewhat, overall, from those participating in the 2016 survey. However, key demographic characteristics of the two groups are quite similar, with two exceptions. Compared with 2011, in 2016 there were:

- Significantly fewer respondents from the Mid-West‡ (16% in 2011 vs. 8% in 2016) and significantly more from New England§ (11% vs. 20%). (Appendix 2)
- Significantly more respondents with less than a bachelor's degree (8% vs. 14%)—although an equal percentage with a master's degree (20% each survey year) or doctoral degree (9% each survey year). (Appendix 8)

And third, because of the preceding two caveats, regression or bivariate analyses—focusing on relationships among variables—have greater validity than purely descriptive statistics (e.g., proportion of the workforce intending to leave).

In some cases, to highlight issues that may merit future exploration, APHL survey findings are compared with findings from the Public Health Workforce Interests and Needs Survey (PH WINS), coordinated by the Association of State and Territorial Health Officials (ASTHO)² in collaboration with the deBeaumont Foundation and other national partner organizations. However, because PH WINS is representative of the national public workforce—including responses from more than 10,000 individual public health professionals from 37 state health agencies³—comparisons with APHL's self-selected survey respondents should be viewed with caution.

Detailed findings from the analysis are included in Appendix A.

* Response rate not available

† Approximate response rate 21%, based on total FTE data supplied by state PHLs at the beginning of 2017 (=6,396).

‡ US HHS Regions 7 and 8, comprising CO, IA, KS, MI, MT, NE, ND, SD, UT, WY.

§ US HHS Regions 1 and 2, comprising CT, ME, MA, NH, NJ, NY, PR, RI, VT, VI.

Findings

Demographics

A snapshot of survey respondents in 2016 shows them to be a largely white (77%), female (65%), highly educated (86% with at least a bachelor’s degree) group, spanning multiple generations (62% aged 50 or less) (Figure 1). Most (58%) were employed at PHLs in the US South[†] or Mid-Atlantic^{**} regions. (Appendix A, 2-5)

In addition, most respondents were in non-supervisory positions (57%) (Figure 2), and a plurality are laboratory scientists (45%). The other positions represented in survey data are laboratory scientist supervisor/manager (24%), administrator (13%), technician (10%), deputy director/director (5%) and information technology specialist (2%). (Appendix A, 14, 23)

The largest cohort represented in survey data is the Baby Boom generation, comprising individuals age 51 and over (38%), followed by Generation X, age 36-50 (36%), and Millennials, age 35 or below (26%). On balance, the PHL workforce is significantly younger than the overall state public health workforce, which, in 2014, comprised a greater proportion of Baby Boomers (48% vs. 38%) and fewer Millennials (17% vs. 26%).⁴

While females significantly outnumbered males in each PHL cohort, survey data indicates a trend toward even greater “feminization” of the PHL workforce: 61% of the oldest cohort was female, compared with 66% of Generation Xers and 71% of Millennials (Figure 3). (Appendix A, 6)

Of note, individuals identifying as black/African American or Hispanic/Latino were under-represented among 2016 PHL workforce survey respondents, compared with both the overall US population in 2016, and with the overall state public health workforce in 2014 (Figure 1):^{5,6}

- Black/African American—7% (PHL) vs. 13% (state public health agencies) vs. 13% (US).
- Hispanic/Latino—3% (PHL) vs. 7% (state public health agencies) vs. 18% (US).

In contrast, the proportion of Asians in the 2016 PHL workforce (7%) was slightly, but significantly, greater than that in the 2014 state public health workforce (5%) and comparable to that in the 2016 US population (6%)

[†] US HHS Regions 4 and 6, comprising AL, AR, FL, GA, KY, LA, MI, NM, NC, OK, SC, TN, TX.

^{**} US HHS Regions 3 and 5, comprising DE, DC, IL, IN, MD, MI, MN, OH, PA, VA, WV, WI.

Figure 1: Demographics (2016)

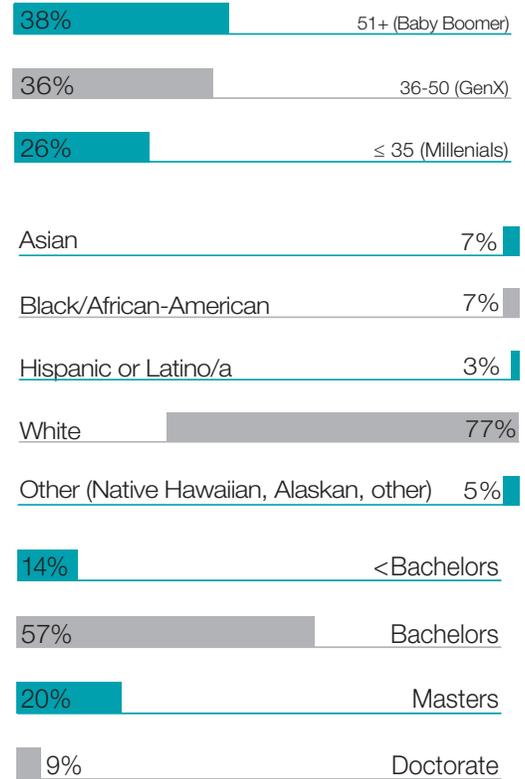


Figure 2: Supervisory Status (2016)

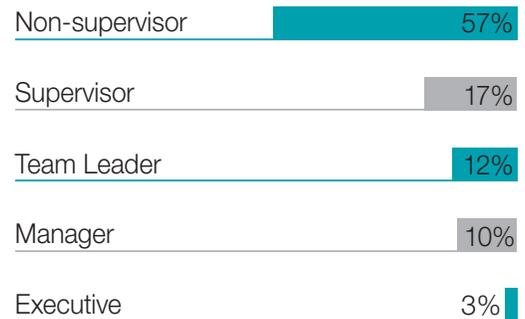
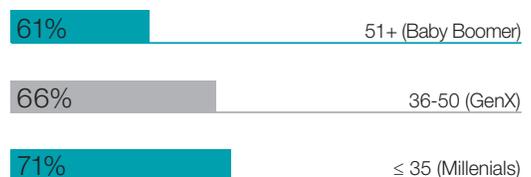


Figure 3: Proportion of Women by Generation (2016)



(Figure 1).

Tenure

A slight plurality of 2016 survey respondents (30%) had worked in PHL practice less than five years, and nearly as many (27%) had been in the PHL workforce 11-20 years (Figure 4). Just under a quarter of respondents had been in the workforce 5-10 years (22%) or more than 20 years (22%). (Appendix A, 9)

On average, men in the PHL workforce have more years of experience than women: in 2016, 28% of male survey respondents had more than 20 years of experience in PHL practice, compared with 18% of females. Yet, among the least tenured workers, women have the edge: in 2016, 32% of female respondents had been in PHL practice less than five years, compared with 26% of male respondents. (Appendix A, 10) There were no statistically significant correlations between race and years of PHL experience. (Appendix A, 12)

Regression analysis confirms that males reported more years of experience in any PHL, with no variation among ethnic and racial groups (Appendix B, Table 1). The analysis also shows that the most tenured laboratorians also tended to be the least highly educated: on average, after controlling for demographics, region and position, doctoral-level respondents reported one year less experience in any PHL than respondents with no college degree. Overall, New England laboratorians reported the longest length of employment—an average four months longer than those in the West. Finally, laboratorians in leadership positions (e.g., supervisor and deputy director/director) reported the longest tenure, and those in administrative positions reported the least tenure.

Leadership

In 2016, a greater proportion of male respondents (48%) than female respondents (40%) reported holding a leadership position, such as team leader, supervisor, manager or executive. In addition, just 12% of Millennial respondents reported holding a laboratory scientist supervisor/manager position, compared with 27% of Gen Xers and 29% of Baby Boomers. Similarly, no Millennials reported being a laboratory deputy director/director, while 5% of Gen Xers and 7% of Baby Boomers did so. Finally, there were no significant differences among ethnic groups in terms of leadership status with the PHL. (Appendix A, 15, 19, 27)

Regression analysis, however, provides greater insight on these findings, confirming some and refuting others (Appendix B, Table 2). After controlling for age, education and region, the data show neither a gender gap nor a racial gap in PHL management. Predictably, there was a positive correlation between leadership status and age.

The overriding factors distinguishing laboratory managers from non-managers are education and length of time in the PHL workforce. For example, in 2016 the odds of those with a master's degree occupying a leadership position were 4.5 times more than the odds for those with no college degree. And the odds for those with 5-10 years of PHL experience were 3.2 times more than the odds for those with less than five years of experience.

Salaries

As shown in Figure 5, 85% of PHL workers earned between \$25,000 and \$85,000 in 2016, while just 4% earned less than \$25,000 and 12% earned more than \$85,000—a salary structure that roughly mirrors that for the larger state public health workforce in 2014, in which an identical percentage of employees (85%) earned between \$25,000 and \$85,000 and 14% earned over \$85,000.⁷ However, the median 2014 state health agency salary (\$55,000-\$65,000) was greater than the median 2016 PHL salary (\$45,000-\$55,000), and the median state health agency

Figure 4: Years at PHL (2016)

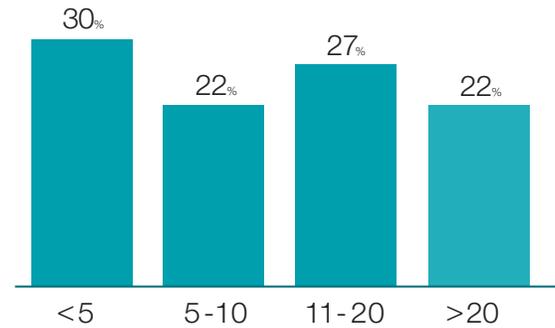
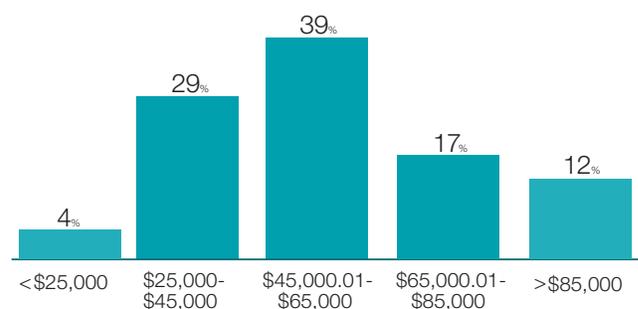


Figure 5: Annual Salary Distribution (2016)



administrative job salary (\$52,056) was substantially greater than the median PHL administrative job salary (\$40,000).⁸ (Appendix A, 31 and 33)

The highest-paying PHL positions in 2016 were deputy director/director (mean—\$100,000, median—\$100,000), lab scientist supervisor/manager (mean—\$70,972, median—\$70,000) and IT systems specialist (mean—\$68,275, median—\$70,000). The lowest-paying positions were administrative jobs and laboratory aid/technician (each with a mean of roughly \$45,000 and a median of \$40,000). There were variations by region, with New England area PHLs paying the highest for all positions and Midwest and South PHLs paying lowest for some positions (e.g., scientist, laboratory scientist supervisor/manager and administrative posts) (Figure 6). (Appendix A, 33-35)

In addition, more men than women earned salaries in the higher brackets. For instance, 24% of women reported earning over \$65,000 per year, compared with 38% of men. (Appendix A, 36)

Regression analysis shows that salary differences associated with job position, geographic region and demographic variables persist after controlling for possible confounders (Appendix B, Table 3). In general, state PHL salaries vary by position type, but generally rise with rising educational level, years in the PHL workforce, and age. For example, on average:

- PHL employees with a doctoral degree earned \$27,273 more annually than those with no college degree. And employees with a bachelor's degree earned an average of \$10,333 more than those with no college degree.
- On average, employees with 5-10 years' experience in the PHL workforce reported earning \$4,524 more annually than those with <5 years, employees with 11-20 years' experience reported earning \$7,968 more than those with <5 years, and employees with >20 years' experience reported earning \$10,607 more than those with <5 years.
- A laboratorian earned \$267 more annually for every year of age.
- Compared with laboratory scientists, PHL directors and deputy directors were paid \$32,042 more per year and scientist supervisors/managers were paid \$10,351 more per year, on average.

Although there were no statistically significant differences among salaries for white, black and Asian respondents (Appendix A, 38), the regression analysis revealed significant differences between men and women, between whites and Hispanics and among geographic regions. After controlling for other factors:

Figure 6: Annual Salaries by Region and Position (Mean) (2016)

MID-ATLANTIC

Scientist	\$53,384
Supervisor/Manager	\$74,416
Administrative	\$50,769
Lab Aid/Technician	\$38,000
Deputy/Director	\$100,769
Information Systems	\$61,667

MIDWEST

Scientist	\$49,487
Supervisor/Manager	\$63,429
Administrative	\$36,250
Lab Aid/Technician	\$44,444
Deputy/Director	\$94,000

NEW ENGLAND

Scientist	\$60,455
Supervisor/Manager	\$82,121
Administrative	\$58,214
Lab Aid/Technician	\$57,586
Deputy/Director	\$110,000
Information Systems	\$65,000

SOUTH

Scientist	\$46,893
Supervisor/Manager	\$62,174
Administrative	\$37,121
Lab Aid/Technician	\$43,111
Deputy/Director	\$96,875
Information Systems	\$77,500

WEST

Scientist	\$55,373
Supervisor/Manager	\$72,708
Administrative	\$48,519
Lab Aid/Technician	\$43,158
Deputy/Director	\$99,000
Information Systems	\$70,000

- Men reported being paid an average of \$1,580 more annually than women.
- Hispanics reported earning an average of \$3,835 less than whites.
- New England respondents reported earning an average of \$6,453 more than respondents from the West.^{††} Respondents from the Midwest and South reported earning \$5,218 less and \$6,665 less, respectively, than respondents from the West, on average. The average salaries in the West and Mid-Atlantic were not statistically different.

A detailed breakdown of mean and median salaries by position type within each region is provided in Appendix A, 31-39.

Recruitment and Retention

The substantial portion of respondents aged 51 and above—40% in 2011 and 38% in 2016—highlights concerns about workforce attrition due to retirement (Figure 1). In both 2011 and 2016, younger PHL workers, aged 35 or less, comprised about a quarter of survey respondents (26% each survey year).

The top reasons respondents reported for entering the PHL workforce and remaining in the PHL workforce are identical (based on mean respondent scores on a five-point scale from least important to most important), and were the same for both men and women (Appendix A, 40-42):

- Appropriate life/work balance
- Job security
- Benefits package (e.g., pension, parking, medical/dental plans, etc.)
- Safe/secure work environment

Among these four factors, appropriate life/work balance was a slightly greater inducement to enter the workforce, and a benefits package was a slightly greater inducement to remain. In addition, respondents indicated that providing public service was a reason to apply for a PHL position, and competitive salary was a reason to stay in the field of PHL practice.

Most of the least enticing reasons to enter or remain in the PHL workforce were also identical (Appendix A, 43):

- On-site childcare
- Opportunity for a joint academic appointment at a local university
- Opportunities to participate in applied research/teaching
- Access to online resources

In addition, respondents, overall, did not find limited on-call/weekend rotation responsibilities a compelling reason to enter the PHL workforce or the opportunity to become a technical expert in a laboratory specialty area a key reason to stay, in and of itself.

Among the three generations of PHL workers—Millennials (age 35 or below), Gen Xers (age 36-50) and Baby Boomers (age 51 and up)—more Millennials (Appendix A, 44, 45)

- Perceived their workplace environment to be good and supportive.
- Valued continuing education, training and research.

And, among the same three groups, more Baby Boomers than others:

- Perceived career advancement opportunities within the PHL.
- Valued providing public service.

There were no generational differences in the perceived value of salary, benefits, job security, and scheduling flexibility.

^{††} US HHS Regions 9 and 10, comprising AZ, AL, CA, HI, ID, NV, OR, WA, American Samoa, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Guam, Marshall Islands and Republic of Palau.

Satisfaction

No matter how the data is viewed—by gender, race/ethnicity, education level or leadership position—the two factors respondents were most likely to find satisfying about their employment in 2016 were their job and job security. And the one factor they were least likely to find satisfying was pay. (Figures 7-12, Appendix A, 46-52)

Overall, the percentage of respondents who were somewhat satisfied or very satisfied with four key aspects of their employment was:

- Job—78%
- Job Security—76%
- Organization—61%
- Pay—37%

However, there were some statistically significant nuances within this general finding:

- Satisfaction with pay is correlated with age: in 2016, just 30% of Millennials (age 35 or below) were somewhat satisfied or very satisfied with their pay, compared with 43% of Boomers (age 51 and up). As noted earlier, salaries also tend to rise with age (Figure 8).
- Satisfaction with a PHL job is correlated with education level: while 76% of PHL employees with less than a bachelor’s degree were somewhat satisfied or very satisfied with their jobs, that figure rises to 81% for those with a master’s degree and 88% for those with a doctoral degree (Figure 9).
- Among the four most prevalent racial/ethnic groups—white, Hispanic/Latino, black/African American and Asian—a larger proportion of Asians were somewhat or very satisfied with a PHL job (86%) or pay (47%), while a smaller proportion of blacks/African Americans reported some degree of satisfaction with a PHL job (68%) or pay (23%) in 2016 (Figure 10).
- Overall, more PHL leaders than non-supervisors reported being somewhat or very satisfied with every aspect of their work-life, except organization. (The same percentage of leaders and non-supervisors, 61%, reported some degree of satisfaction with the PHL organization (Figure 11).
- Compared with other laboratory positions (i.e., scientist supervisor/manager, administrator, deputy director/director and IT specialist),

Figure 7: Satisfaction (Gender) (2016)

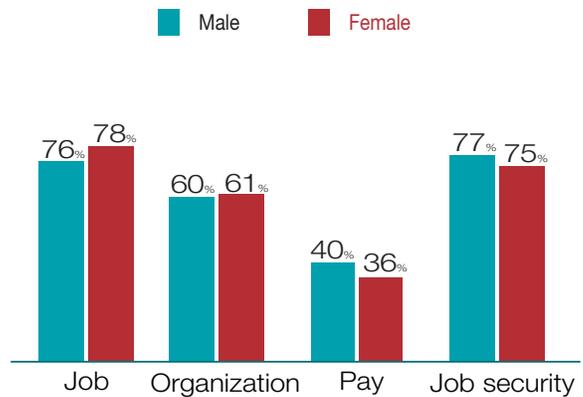


Figure 8: Satisfaction (Generation) (2016)

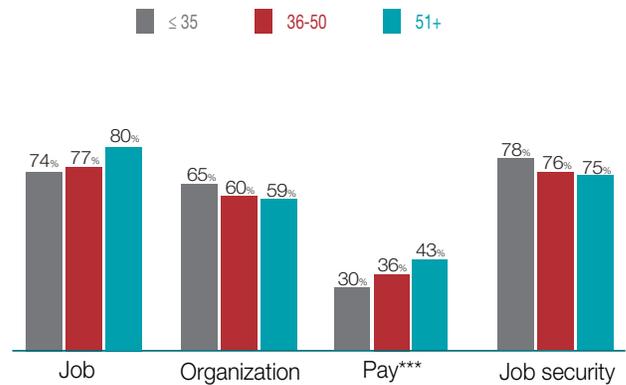
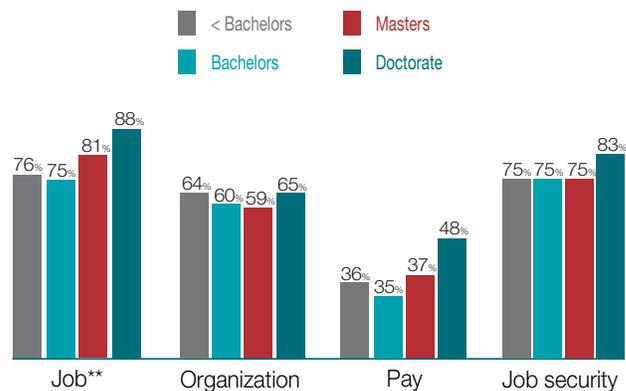


Figure 9: Satisfaction (Education) (2016)



*Significant P<0.05
 ** significant P<0.01
 *** significant P<0.001

fewer laboratory scientists and laboratory aids/technicians cite some degree of satisfaction with their jobs (74% and 70%, respectively vs. 78 – 95%) or pay (32% for both groups vs 40 – 62%). And more deputies/directors cited some degree of satisfaction with their jobs (95%) or pay (59%) (Figure 12).

A regression analysis of job satisfaction highlights factors that may truly be associated with satisfaction levels, while ruling out confounders (Appendix B, Table 4). Although similar percentages of men (76%) and women (78%) reported being somewhat satisfied or very satisfied with their jobs, after controlling for ethnicity, region, education, length of work in any PHL, position type, age and workplace values/perceptions, the odds of women citing job satisfaction were 1.61 times more than for men.

The single overriding factor influencing satisfaction with a PHL job is the belief that the laboratory provides a good and supportive work environment. The odds of those who held this view to report job satisfaction than those who did not was 12 times as much, regardless of age (Figure 13). A second important factor—though less so for the youngest group of workers—was a belief in the value of public service. Overall, those who reported valuing public service were more likely to report job satisfaction than those who did not (Figure 14). Finally, although continuing education was not highly associated with job satisfaction, Millennials who valued continuing education and training were less likely to report job satisfaction than Millennials who did not (Figure 15).

Figure 10: Satisfaction (Ethnicity) (2016)

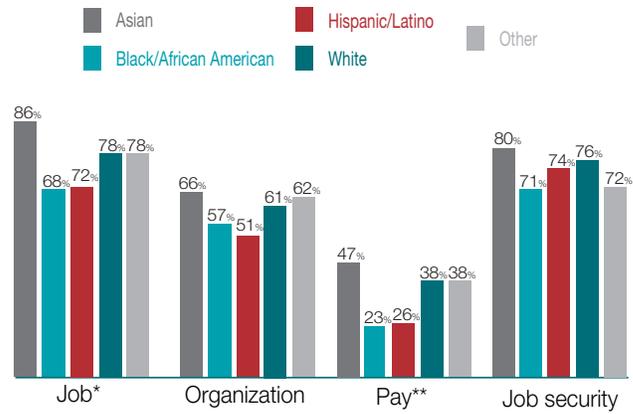


Figure 11: Satisfaction (Leadership) (2016)

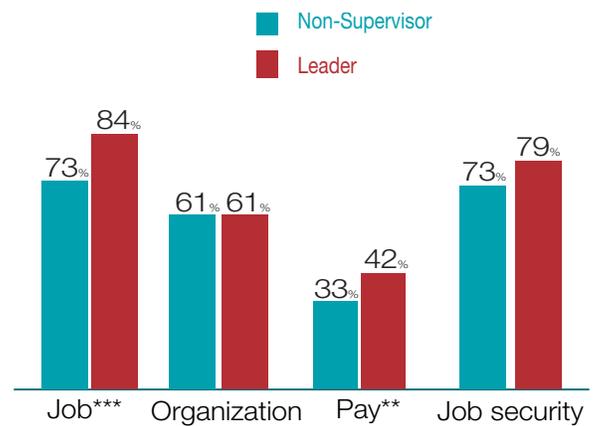
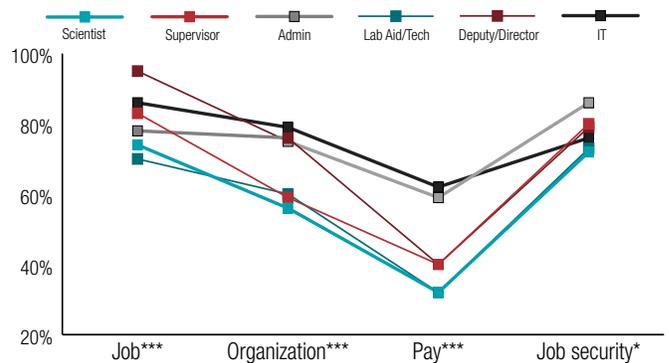


Figure 12: Satisfaction (Position) (2016)



*Significant P<0.05
 ** significant P<0.01
 *** significant P<0.001

Figure 13: Satisfaction vs Perception of Workplace Environment (2016)

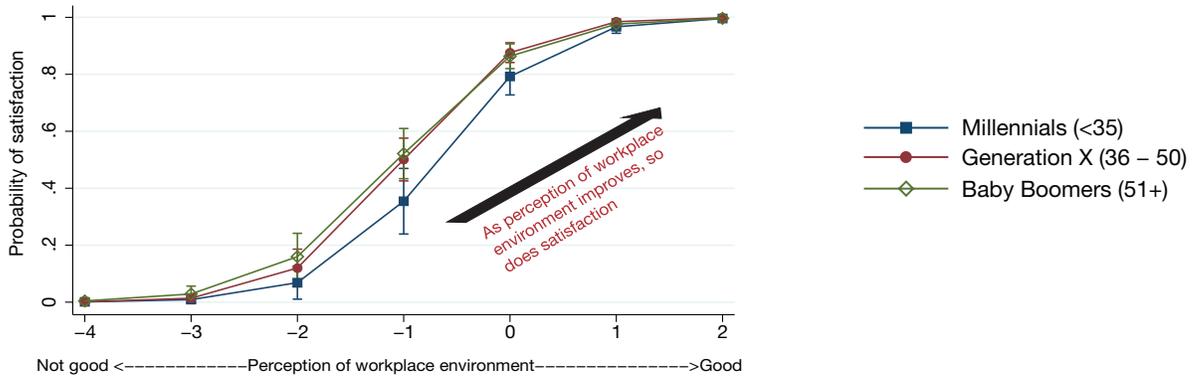


Figure 14: Satisfaction vs Value of Providing Public Service (2016)

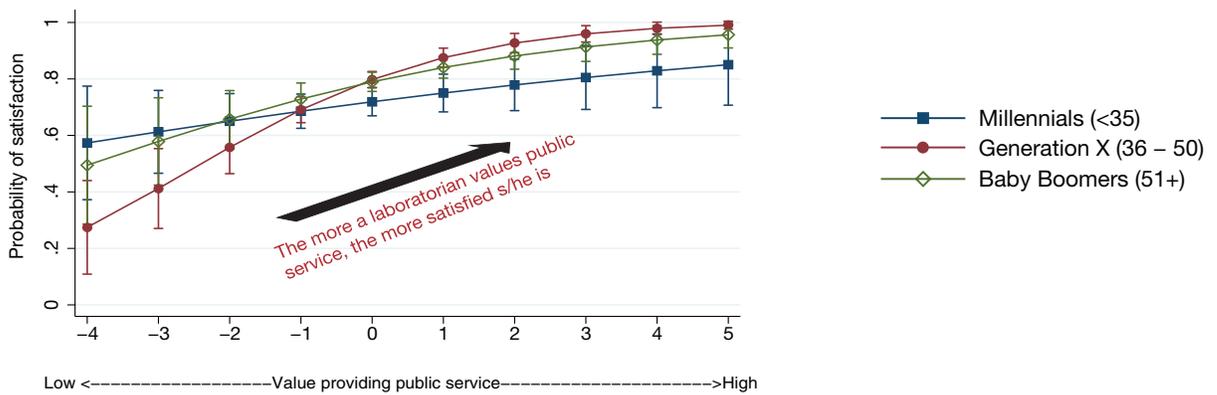
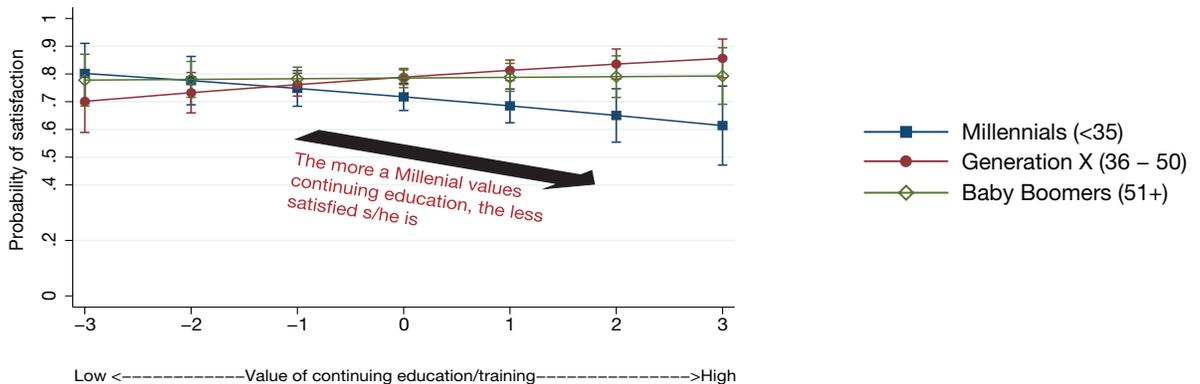


Figure 15: Satisfaction vs Value for Continuing Education (2016)



Intent to Leave

Almost a third of the 2016 survey respondents (30%) indicated an intent to leave the PHL workforce within the next five years, a finding unchanged from the 2011 workforce survey. An additional 26% planned to leave in five to ten years, which is a smaller proportion than in 2011 (31%), but not a statistically significant difference. (Appendix A, 53)

Unsurprisingly, there was a strong association between intent to leave the PHL workforce within five years and level of dissatisfaction with one's job, organization, pay or job security. A significantly smaller proportion of those reporting that they are somewhat or very satisfied with their job (26% vs. 47%), organization (24% vs. 40%), pay (26% vs. 33%) or job security (28% vs. 37%) indicated plans to leave PHL practice in the near term, compared with those who did not indicate these levels of satisfaction. (Appendix A, 58)

Analysis of the 2016 data via logistical regression revealed that some subgroups have greater odds of reporting an intent to leave PHL practice within five years than other subgroups (Appendix B, Table 5):

- Men had 1.6 times greater odds than women.
- Asians had 3.8 times greater odds than whites (who were comparable to other subgroups).
- Millennials (age 35 and below) had 3.8 times greater odds than Gen Xers (age 36 to 50). And Baby Boomers—those closest to retirement age—had 4.1 times greater odds than Gen Xers. (Overall, 34% of Millennials, 16% of Gen Xers and 41% of Baby Boomers indicated a plan to leave within five years.)

In general, Millennials and Gen Xers who believed the PHL provides a good work environment (Figure 16) or who valued their salary, benefits package and scheduling flexibility (Figure 17) were significantly less likely to report an intent to leave PHL practice within five years than those who did not. In addition, the more strongly a Gen Xer perceived opportunities for career advancement, the less likely he/she was to report a desire to leave the PHL workforce (Figure 18). Among Baby Boomers, those who viewed the PHL as a good work environment were somewhat less likely to report plans to leave within five years (Figure 16).

Figure 16: Intention to Leave vs Perception of Workplace Environment (2016)

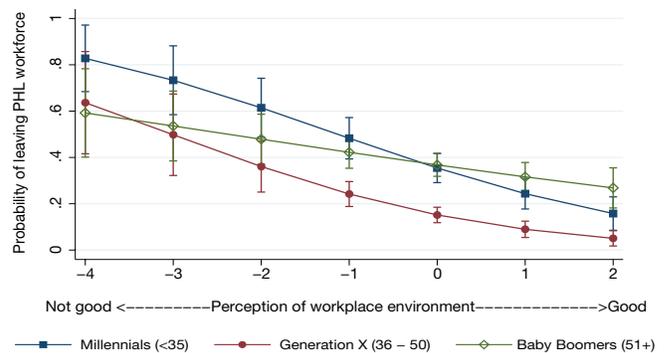


Figure 17: Intention to Leave PHL vs Value of Compensation, Flexibility and Security (2016)

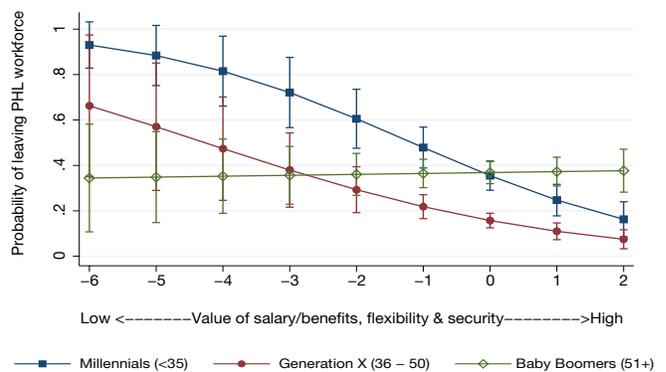
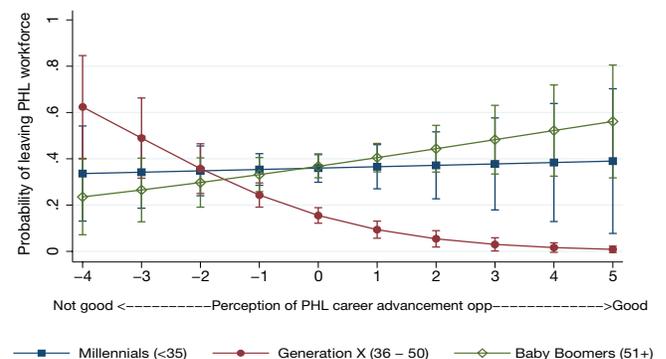


Figure 18: Intention to Leave and Perceptions of PHL Career Advancement Opportunities (2016)



Conclusions

The PHL workforce is the most critical, yet vulnerable, laboratory and system asset. The survey findings presented paint a picture of a highly educated and dynamic PHL workforce, comprising equal distribution among three generational cohorts, each with slightly different occupational values. Some key findings that can be seen as strengths:

- Education was rewarded in the workforce—as education increased, so did salary, and education level was not a factor to leave the workforce.
- Salaries have increased in the last five years, even taking into consideration for inflation.
- There was equity in PHL leadership—neither gender nor ethnicity were associated with leadership positions after controlling for other factors.
- Laboratorians were for the most part satisfied—more than three quarters of survey respondents reported being satisfied with their job and job security.
- Commitment to public service was a key factor to job satisfaction for the older generations—the more Baby Boomers and Generation Xers stated they valued public service, the more likely they were to be satisfied with their job.

The findings also underscore the urgency to address PHL workforce challenges:

- There was lack of diversity in the workforce and a trend towards feminization.
- Gender gap in salary was still evident in the PHL workforce—males earned more than women, even after controlling for other factors.
- Regardless of earning more, males, compared to women, were generally less satisfied and more likely to leave the workforce.
- A large percentage of the workforce were dissatisfied with their pay.
- For Millennials (the growing workforce), the correlation between the value of public service and job satisfaction was low.
- A third of Millennials intended to leave the workforce in the next five years.

As noted in an APHL position statement on the topic, a shortage of PHL professionals has been discussed and documented in the United States since at least 2001 and threatens laboratories' ability to carry out their public health missions.⁸ More recently, a 2011 survey of directors of US public health, environmental and agricultural laboratories (not among the studies analyzed below) found that about a third of surveyed laboratories expected 16–25% of their employees to retire, resign or be released within five years, while 13% anticipated losing 26–50% of their employees within five years.⁹ This report validates the directors' concerns.

While some of these findings continue to indicate the PHL workforce vulnerability, there are also opportunities:

- Satisfaction with workplace environment could be one critical factor of the workforce retention equation. The more a laboratorian was satisfied with the job and the less likely s/he was to leave the workforce
- For laboratorians in mid-career, clearly defined career ladders that minimize impediments to promotion might hold the key to retention—the more Generation Xers believed there were opportunities for career advancement, the less likely they were to leave the workforce
- For Millennials, continuing education might be a significant contributor to job satisfaction—more Millennials, than other groups, valued continuing education, and Millennials that valued education and training were less likely to be satisfied, perhaps indicating that they perceived that this was not available.

As Millennials continue to move in higher numbers into the workforce, there is a need for PHL leaders to develop different strategies that are adaptable to the differences between generations, while maintaining the larger perspective on overall organizational performance to support the PHL system.

The findings in this report also point to gaps in knowledge and the need to develop a new research agenda targeted to the most at-risk areas of concern. Potential questions include:

- **Diversity:** What strategies might be effective to increase and sustain diversity in the PHL workforce?
- **Millennials:** What are the key factors that motivate them and what might be effective strategies to retain them in the workforce? If their tenure in the workforce will continue to trend with a much shorter time period than previous generations, how can leaders adjust the workforce environment to recruit and support high performance, and sustain critical organizational knowledge?
- **Forecasting:** What are predicted gaps in laboratory workforce in the next 10 years and what effective strategies can be employed to fill these gaps?
- **Operations:** What opportunities exist to improve operational efficiencies while maximizing strengths from differences in generational characteristics?
- **Compensation:** Beyond increases in pay, what other benefits have value to the PHL workforce? What strategies are effective to increase compensation and how can those be implemented within different PHL governance structures?

As stated in APHL's workforce position statement, "Immediate and continuing actions are required to provide and sustain a workforce pipeline producing competent [governmental laboratory] scientists, managers and directors needed to monitor, detect and control deadly diseases and environmental hazards."¹⁰ APHL, along with its members, partners and stakeholders, will continue to collaborate to not only understand the challenges faced by PHLs, but just as essential, to identify practical strategies and effective interventions.

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⁶Sellers K, Leider JP, Harper E, Castrucci BC, Bharthapudi K, Liss-Levinson R, Jarris PE, Hunter EL. The public health workforce interests and needs survey: the first national survey of state health agency employees. *J Public Health Manag Pract Suppl*, 2015;21:S13-S27. doi: 10.1097/PHH.0000000000000331

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⁸APHL. APHL Position Statement. Public Health Laboratory Workforce Shortage. January 2013. Silver Spring, MD: APHL; 2013. Retrieved 31 May 2017 from https://www.aphl.org/policy/Position_Documents/WF_2013_Public_Health_Laboratory_Workforce_Shortage.pdf.

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¹⁰APHL. APHL Position Statement. Public Health Laboratory Workforce Shortage. January 2013. Silver Spring, MD: APHL; 2013. Retrieved 31 May 2017 from https://www.aphl.org/policy/Position_Documents/WF_2013_Public_Health_Laboratory_Workforce_Shortage.pdf.

Appendix A: Survey Data

Unless otherwise noted, all percentages in this document are by column.

Respondent Distribution

1. Survey respondents

	2011	2016
Number of respondents	1,415	1,337
% Response rate	Not Available	21% ^{***}

2. Proportion of responses by paired HHS regions

	2011	2016
West	13%	13%
Mid-West	16%	8%
New-England	11%	20%
South	35%	30%
Mid-Atlantic	25%	28%

Statistically significant differences in regional distribution between the years (P = 0.000)

Demographics of SPHL Workforce

3. Gender

	2011	2016
Female	63%	65%
Male	37%	35%

4. Age

	2011	2016
≤ 35 (Millennials)	26%	26%
36-50 (Generation X)	34%	36%
51+ (Baby Boomer)	40%	38%

5. Age by gender (2016)

	Female	Male
≤ 35 (Millennials)	28%	22%
36-50 (Generation X)	36%	35%
51+ (Baby Boomer)	36%	43%

Statistically significant difference in the distribution of age between genders (P = 0.008)

^{***}Response rate was calculated based on total FTE data supplied by SPHLs at the beginning of 2017 (=6396). Therefore, this response rate is a very rough approximation of actual response rate

6. Gender by age (2016)

	≤ 35 (Millennials)	36-50 (Generation X)	51+ (Baby Boomers)
Female	71%	66%	61%
Male	29%	34%	39%

Statistically significant difference in the distribution of age between genders (P = 0.008)

7. Race/ethnicity

	2011	2016
Asian	10%	7%
Black or African American	7%	7%
Hispanic or Latino	4%	3%
White	76%	77%
Other (Native Hawaiian, Alaskan, other)	4%	5%

Note: The racial distribution of 2011 and 2016 workforce data is not significantly different.

8. Educational attainment

	2011	2016
Less than Bachelors	8%	14%
Bachelors	62%	57%
Masters	20%	20%
Doctoral	9%	9%

Statistically significant difference in the distribution of educational attainment between the years (P = 0.001)

Excluding IT and Admin	2011	2016
Less than Bachelors	8%	7%
Bachelors	62%	61%
Masters	20%	21%
Doctoral	9%	11%

NO statistically significant difference in the distribution of educational attainment between the years (P = 0.368)

Position and Tenure Within PHL System

9. Years in any PHL

	2011	2016
< 5 years	25%	30%
5-10 years	28%	22%
11-20 years	21%	27%
> 20 years	26%	22%

Statistically significant difference in distribution of length of employment at a PHL between the years (P = 0.000)

Excluding IT and Admin	2011	2016
< 5 years	25%	28%
5-10 years	28%	22%
11-20 years	21%	27%
> 20 years	26%	23%

Statistically significant difference in distribution of length of employment at a PHL between the years (P = 0.000)

10. Years in any PHL by gender (2016)

	Female	Male
< 5 years	32%	26%
5-10 years	23%	19%
11-20 years	27%	27%
> 20 years	18%	28%

Statistically significant difference in distribution of length of employment at a PHL between genders (P = 0.000)

11. Years in any PHL by age (2016)

	≤ 35 (Millennials)	36-50 (Generation X)	51+ (Baby Boomers)
< 5 years	64%	24%	11%
5-10 years	29%	25%	13%
11-20 years	7%	37%	32%
> 20 years	0%	14%	43%

Statistically significant difference in distribution of length of employment at a PHL across age groups (P = 0.000)

12. Years in any PHL by ethnicity (2016)

	Asian	Black or African American	Hispanic or Latino	White	Other (Native Hawaiian, Alaskan, other)
< 5 years	27%	31%	47%	29%	30%
5-10 years	19%	26%	16%	22%	16%
11-20 years	26%	21%	21%	28%	29%
> 20 years	28%	23%	16%	21%	25%

13. Years in any PHL by education (2016)

	Less than Bachelors	Bachelors	Masters	Doctoral
< 5 years	28%	30%	30%	28%
5-10 years	18%	21%	28%	20%
11-20 years	33%	25%	24%	39%
> 20 years	21%	24%	18%	13%

Statistically significant differences in distribution of length of employment at a PHL across educational attainment levels (P = 0.003)

14. Supervisory status

	2011	2016
Non-supervisor	Not asked	57%
Team leader	Not asked	12%
Supervisor	Not asked	17%
Manager	Not asked	10%
Executive	Not asked	3%

15. Supervisory status by gender (2016)

	Female	Male
Non-supervisor	60%	52%
Team leader	13%	10%
Supervisor	15%	22%
Manager	9%	11%
Executive	3%	5%

16. Supervisory status by age (2016)

	≤ 35 (Millennials)	36-50 (Generation X)	51+ (Baby Boomers)
Non-supervisor	78%	53%	47%
Team leader	12%	13%	11%
Supervisor	7%	21%	21%
Manager	2%	10%	14%
Executive	0%	3%	6%

Statistically significant differences in distribution of supervisory status across age groups (P = 0.000)

17. Supervisory status by ethnicity (2016)

	Asian	Black or African American	Hispanic or Latino	White	Other (Native Hawaiian, Alaskan, other)
Non-supervisor	53%	64%	67%	56%	65%
Team leader	7%	10%	5%	13%	7%
Supervisor	26%	15%	21%	17%	17%
Manager	13%	7%	7%	10%	9%
Executive	1%	3%	0%	4%	1%

18. Supervisory status by education (2016)

	Less than Bachelors	Bachelors	Masters	Doctoral
Non-supervisor	73%	63%	46%	24%
Team leader	9%	12%	14%	11%
Supervisor	15%	17%	22%	15%
Manager	2%	8%	12%	28%
Executive	0%	0%	6%	22%

Statistically significant differences in distribution of supervisory status across educational attainment levels (P = 0.010)

19. Leadership status by gender (2016)

	Female	Male
Non-supervisor	60%	52%
Leader (Supervisor, Team lead, Manager, Executive)	40%	48%

Statistically significant differences in leadership positions between genders (P = 0.010)

20. Leadership status by age (2016)

	≤ 35 (Millennials)	36-50 (Generation X)	51+ (Baby Boomers)
Non-supervisor	78%	53%	47%
Leader (Supervisor, Team lead, Manager, Executive)	22%	47%	53%

Statistically significant differences in leadership positions across age groups (P = 0.000)

21. Leadership status by ethnicity (2016)

	Asian	Black or African American	Hispanic or Latino	White	Other (Native Hawaiian, Alaskan, other)
Non-supervisor	53%	64%	67%	56%	65%
Leader (Supervisor, Team lead, Manager, Executive)	47%	36%	33%	44%	35%

22. Leadership status by education (2016)

	Less than Bachelors	Bachelors	Masters	Doctoral
Non-supervisor	73%	63%	46%	24%
Leader (Supervisor, Team lead, Manager, Executive)	27%	37%	54%	76%

Statistically significant differences in leadership positions across educational attainment (P = 0.000)

23. Position type

	2011	2016
Laboratory Scientist	50%	46%
Laboratory Scientist Supervisor/ Manager	30%	24%
Administrative ⁺	0%	13%
Laboratory Aid/Technician	14%	10%
Deputy/Director	6%	5%
Information Systems ⁺	0%	2%

Statistically significant differences in distribution of position types between years (P = 0.001)

⁺Administrative staff and IT staff were not included in the 2011 survey

Excluding Admin and IT	2011	2016
Laboratory Scientist	50%	54%
Laboratory Scientist Supervisor/ Manager	30%	28%
Laboratory Aid/Technician	14%	12%
Deputy/Director	6%	6%

NO Statistically significant differences in distribution of position types between years (P = 0.202)

24. Position type by supervisory status (2016)

	Non-supervisor	Team leader	Supervisor	Manager	Executive
Laboratory Scientist	66%	55%	7%	2%	0%
Laboratory Scientist Supervisor/ Manager	1%	27%	74%	68%	9%
Administrative	16%	6%	12%	11%	9%
Laboratory Aid/Technician	14%	9%	6%	0%	0%
Deputy/Director	0%	1%	0%	16%	83%
Information Systems	2%	2%	1%	2%	0%

Statistically significant differences in distribution of position types across supervisory status (P = 0.000)

25. Supervisory status by position type (2016)

	Lab Scientist	Lab Scientist Supervisor/ Manager	Admin	Lab Aid/ Technician	Deputy/ Director	IT Systems
Non-supervisor	82%	3%	68%	80%	3%	66%
Team leader	15%	13%	5%	10%	3%	14%
Supervisor	3%	54%	16%	10%	2%	10%
Manager	0%	28%	9%	0%	33%	10%
Executive	0%	1%	2%	0%	59%	0%

Statistically significant differences in distribution of supervisory status across position types (P = 0.000)

26. Position type by gender (2016)

	Female	Male
Laboratory Scientist	47%	43%
Laboratory Scientist Supervisor/ Manager	21%	29%
Administrative	16%	9%
Laboratory Aid/Technician	10%	11%
Deputy/Director	4%	6%
Information Systems	2%	3%

Statistically significant differences in distribution of position types between genders (P = 0.001)

27. Position type by age (2016)

	≤ 35 (Millennials)	36-50 (Generation X)	51+ (Baby Boomers)
Laboratory Scientist	65%	44%	35%
Laboratory Scientist Supervisor/Manager	12%	27%	29%
Administrative	11%	13%	15%
Laboratory Aid/Technician	11%	8%	12%
Deputy/Director	0%	5%	7%
Information Systems	1%	3%	2%

Statistically significant differences in distribution of position types across age groups (P = 0.001)

28. Position type by ethnicity (2016)

	Asian	Black or African American	Hispanic or Latino	White	Other (Native Hawaiian, Alaskan, other)
Laboratory Scientist	38%	37%	47%	48%	41%
Laboratory Scientist Supervisor/Manager	34%	18%	26%	24%	19%
Administrative	7%	31%	14%	12%	9%
Laboratory Aid/Technician	13%	9%	12%	9%	28%
Deputy/Director	4%	4%	2%	5%	1%
Information Systems	4%	1%	0%	2%	3%

Statistically significant differences in distribution of position types across ethnicities (P = 0.000)

29. Position type by education (2016)

	Less than Bachelors	Bachelors	Masters	Doctoral
Laboratory Scientist	9%	57%	48%	27%
Laboratory Scientist Supervisor/Manager	3%	24%	32%	39%
Administrative	52%	8%	8%	0%
Laboratory Aid/Technician	33%	9%	3%	2%
Deputy/Director	1%	1%	7%	31%
Information Systems	3%	2%	2%	1%

Statistically significant differences in distribution of position types across education attainment levels (P = 0.000)

30. Education by position type (2016)

	Lab Scientist	Lab Scientist Supervisor/ Manager	Admin	Lab Aid/ Technician	Deputy/ Director	IT Systems
Less than Bachelors	3%	2%	54%	45%	2%	17%
Bachelors	71%	57%	34%	48%	9%	59%
Masters	21%	26%	13%	5%	30%	21%
Doctoral	5%	15%	0%	2%	59%	3%

Statistically significant differences in distribution of education attainment levels across position types (P = 0.000)

Salary Information

31. Annual salary

	2011	2016
< \$25,000	3%	4%
\$25,000 - \$45,000	40%	29%
\$45,000.01 - \$65,000	40%	39%
\$65,000.01 - \$85,000	12%	17%
> \$85,000.01	6%	12%
Median	\$53,349 ^{\$\$\$}	\$50,000
Mean*	\$54,721 ⁷	\$58,042

*Statistically significant difference in salary distribution between years (P = 0.000)

32. Annual salary by supervisor status (2016)

	Non-Supervisor	Team Leader	Supervisor	Manager	Executive
< \$25 K	6%	1%	1%	0%	0%
\$25K - \$45K	41%	16%	16%	3%	2%
\$45K - \$65K	41%	56%	37%	28%	7%
\$65K - \$85K	8%	21%	32%	31%	20%
> \$85K	4%	6%	15%	38%	72%
Median	\$55 - \$65K	\$65 - \$75K	\$65 - \$75K	\$85 - \$95K	\$112,500
Mean [95% CI]*	\$48,825 [47,457 - 50,193]	\$58,571 [55,588 - 61,554]	\$65,299 [62,361- 68,237]	\$81,298 [77,040 - 85,556]	\$106,522 [97,663 - 115,380]

*Statistically significant difference in salary distributions across supervisory status (P = 0.000)

^{\$\$\$} Adjusted to 2016 dollars using Bureau of Labor Statistics CPI inflation calculator; 6039 <https://data.bls.gov/cgi-bin/cpicalc.pl>

33. Annual salary by position type (2016)

	Lab Scientist	Lab Scientist Supervisor/ Manager	Admin	Lab Aid/ Technician	Deputy/ Director	IT Systems
< \$25 K	1%	0%	14%	15%	0%	0%
\$25K - \$35K	11%	1%	34%	29%	1%	7%
\$35K - \$45K	33%	10%	14%	27%	3%	10%
\$45K - \$55K	27%	24%	15%	15%	4%	14%
\$55K- \$65K	17%	26%	9%	8%	5%	17%
\$65K - \$75K	6%	16%	6%	3%	15%	24%
\$75K - \$85K	2%	10%	3%	1%	14%	10%
\$85K- \$95K	1%	4%	2%	1%	11%	7%
\$95K - \$105K	1%	4%	2%	0%	15%	0%
\$105K - \$115K	0%	2%	0%	0%	11%	3%
\$115K- \$125K	0%	0%	2%	0%	6%	0%
\$125K - \$135K	0%	1%	1%	0%	5%	3%
\$135K - \$145K	0%	0%	1%	1%	4%	0%
> \$145K	0%	0%	1%	0%	7%	3%

	Lab Scientist	Lab Scientist Supervisor/ Manager	Admin	Lab Aid/ Technician	Deputy/ Director	IT Systems
< \$25 K	1%	0%	14%	14%	0%	0%
\$25K - \$45K	34%	8%	47%	45%	3%	17%
\$45K - \$65K	49%	41%	23%	31%	6%	31%
\$65K - \$85K	12%	31%	9%	7%	27%	34%
> \$85K	4%	21%	7%	3%	64%	17%
Median	\$50,000	\$70,000	\$40,000	\$40,000	\$100,000	\$70,000
Mean [95% CI]*	\$53,002 [51,592 - 54,411]	\$70,972 [68,456 - 73,487]	\$45,170 [41,499 - 48,842]	\$44,964 [41,414- 48,513]	\$100,625 [93,382 - 107,868]	\$68,276 [57,955 - 78,597]

*Statistically significant difference in PHL salary distributions across position types (P = 0.000)

34. Annual salary by region (2016)

	West	Mid-West	New England	South	Mid Atlantic
< \$25 K	3%	6%	1%	4%	4%
\$25K - \$45K	25%	33%	14%	43%	25%
\$45K - \$65K	40%	35%	36%	39%	44%
\$65K - \$85K	19%	15%	28%	8%	17%
> \$85K	13%	11%	21%	6%	10%
Median	\$45 - 55K	\$45 - 55K	\$55 - 65K	\$45 - 55K	\$45 - 55K
Mean [95% CI]	\$60,730 [56,762 - 64,699]	\$55,688 [50,838 - 60,538]	\$67,941 [65,102 - 70,780]	\$50,941 [48,621- 53,260]	\$57,914 [55,484 - 60,345]

*Statistically significant difference in salary distributions across regions (P = 0.000)

35. Annual salary by region and position (2016)

Mean [95% CI]	West	Mid-West	New England	South	Mid Atlantic
Lab Scientist	\$55,373 [50,873 - 59,873]	\$49,487 [43,357 - 55,617]	\$60,455 [57,307 - 63,602]	\$46,893 [44,398 - 49,388]	\$53,384 [51,177 - 55,590]
Lab Scientist Supervisor/ Manager	\$72,708 [65,730 - 79,687]	\$63,429 [56,168 - 70,689]	\$82,121 [77,233 - 87,010]	\$62,174 [58,428 - 65,919]	\$74,416 [68,623 - 80,208]
Admin	\$48,519 [37,955 - 59,082]	\$36,250 [25,977 - 46,523]	\$58,214 [48,199 - 68,229]	\$37,121 [32,171 - 42,071]	\$50,769 [42,245 - 59,294]
Lab Aid/ Technician	\$43,158 [30,604 - 55,711]	\$44,444 [34,196 - 54,693]	\$57,586 [51,866 - 63,306]	\$43,111 [35,869 - 50,353]	\$38,000 [32,744 - 43,256]
Deputy/ Director	\$99,000 [81,657 - 116,343]	\$94,000 [71,079 - 116,921]	\$110,000 [98,160 - 121,840]	\$96,875 [78,343 - 115,408]	\$100,769 [81,746 - 119,793]
IT Systems	\$70,000 [36,654 - 103,346]		\$65,000 [1,469 - 128,531]	\$77,500 [49,682 - 105,318]	\$61,667 [49,909 - 73,424]

36. Annual salary by gender (2016)

	Female	Male
< \$25,000	4%	3%
\$25,000 - \$45,000	32%	23%
\$45,000.01 - \$65,000	41%	36%
\$65,000.01 - \$85,000	14%	22%
> \$85,000.01	10%	16%
Median	\$45K - 55K	\$55K - 65K
Mean [95% CI]*	\$55,863 [54,264 - 57,462]	\$62,160 [59,755 - 64,565]

Statistically significant difference in salary distributions across genders (P = 0.000)

37. Annual salary by age (2016)

	≤ 35 (Millennials)	36-50 (Generation X)	51+ (Baby Boomers)
< \$25 K	6%	3%	3%
\$25K - \$45K	53%	23%	17%
\$45K - \$65K	34%	46%	37%
\$65K - \$85K	4%	18%	23%
> \$85K	3%	9%	20%
Median	\$35 - 45K	\$45 - 55K	\$55 - 65K
Mean [95% CI]	\$45,101 [43,170 - 47,031]	\$58,117 [56,113 - 60,123]	\$66,725 [64,331 - 69,119]

Statistically significant difference in salary distributions across age groups (P = 0.000)

38. Annual salary by ethnicity (2016)

	Asian	Black or African American	Hispanic or Latino	White	other
< \$25 K	1%	5%	12%	3%	9%
\$25K - \$45K	18%	46%	44%	27%	28%
\$45K - \$65K	42%	33%	35%	40%	46%
\$65K - \$85K	24%	6%	5%	18%	12%
> \$85K	16%	9%	5%	12%	6%
Median	\$55 - 65K	\$35 - 45K	\$35 - 45K	\$45 - 55K	\$45 - 55K
Mean [95% CI]*	\$63,854 [59,119 - 65,589]	\$49,897 [44,754 - 55,039]	\$46,512 [40,897 - 52,126]	\$59,003 [57,473 - 60,533]	\$54,203 [47,949 - 60,456]

*Statistically significant difference in salary distributions across ethnicities (P = 0.000)

39. Annual salary by education (2016)

2016	Less than Bachelors	Bachelors	Masters	Doctoral
< \$25 K	17%	2%	1%	1%
\$25K - \$45K	49%	30%	22%	7%
\$45K - \$65K	24%	46%	38%	21%
\$65K - \$85K	9%	15%	23%	24%
> \$85K	2%	7%	16%	46%
Median	\$35K - 45K	\$45K - 55K	\$55K - 65K	\$75K - 85K
Mean [95% CI]	\$41,576 [38,619 - 44,533]	\$55,574 [54,090 - 57,058]	\$63,698 [60,788 - 66,608]	\$85,854 [80,298 - 91,409]

Attitudes and Perceptions

40. Top five reasons**** for entering/staying in the PHL workforce (2016)

	Entering the workforce	Staying in the workforce
1	Appropriate life/work balance	Benefits package – govt. pension, paid holidays, parking, medical/dental plans etc.
2	Job security	Job security
3	Benefits package – govt. pension, paid holidays, parking, medical/dental plans etc.	Appropriate life/work balance
4	Safe/secure work environment	Safe/secure work environment
5	Providing public service	Competitive salary

41. Top five reasons for entering/staying in the PHL workforce (females) (2016)

Females	Entering the workforce	Staying in the workforce
1	Appropriate life/work balance	Benefits package – govt. pension, paid holidays, parking, medical/dental plans etc.
2	Job security	Appropriate life/work balance
3	Benefits package – govt. pension, paid holidays, parking, medical/dental plans etc.	Job security
4	Safe/secure work environment	Safe/secure work environment
5	Providing public service	Competitive salary
6	Competitive Salary	Flexible workplace

42. Top five reasons for entering/staying in the PHL workforce (males) (2016)

Males	Entering the workforce	Staying in the workforce
1	Appropriate life/work balance	Benefits package – govt. pension, paid holidays, parking, medical/dental plans etc.
2	Job security	Job security
3	Benefits package – govt. pension, paid holidays, parking, medical/dental plans etc.	Appropriate life/work balance
4	Safe/secure work environment	Competitive salary
5	Competitive salary	Safe/secure work environment
6	Providing public service	Providing public service

43. Bottom five reasons†††† for entering/staying the PHL workforce (2016)

2016	Entering the workforce	Staying in the workforce
1	Onsite child care	Onsite child care
2	Opportunity for a joint academic appointment at a local university	Opportunity for a joint academic appointment at a local university
3	Opportunities to participate in applied research/teaching	Opportunities to participate in applied research/teaching
4	Access to online resources	Opportunity to become a technical expert in a laboratory specialty area
5	Limited on-call/weekend rotation responsibilities	Access to online resources

**** Based on means of scores

†††† Based on mean of scores – least important listed first

44. Factor analysis of attitudes and perceptions (2016)

Respondents were asked to rate 62 items on a range of topics that attempt to assess perceptions and values respondents hold. For some items, respondents were asked to indicate their level of agreement with a certain statement (e.g. “My laboratory provides a sufficient number of technical and professional job classifications”). In others, respondents were asked to indicate whether a certain issue is important to them or not (e.g. “Onsite childcare is an important reason for staying in the PHL workforce”). Principal components analysis was used to identify the underlying factors in these 62 items. The following five factors were identified and composite scores were calculated that will be used in further analysis.

	Factor description	Example items that loaded to factor	Statistics
1	Perceptions of good, supportive workplace environment	Supervisors/team leaders in my work unit support employee development I recommend my organization as a good place to work I am inspired to meet my goals at work Creativity and innovation are rewarded My co-workers and I have a good working relationship	Range: -3.62 – 2.05 Mean: 0
2	Values salary/benefits, job security and flexibility	Recruited/stay because of appropriate life/work balance Recruited/stay because of benefits package – govt. pension, paid holidays, parking, medical/dental plans etc. Recruited/ stay because of job security Recruited/stay because of competitive salary Recruited/stay because if flexible workdays	Range: -5.43 – 1.85 Mean: 0
3	Values continuing education, training, research	Recruited/stay because of opportunities to participate in applied research/teaching Recruited/stay because of continuing education opportunities I would pursue an advanced degree in a laboratory science if I could do so in my current employment	Range: -2.41 – 2.43 Mean: 0
4	Values providing public service	Recruited or stay because providing public service is important Providing public service is an important reason why I continue to work in this career The work I do is important	Range: -3.28 – 4.2 Mean: 0

5	Perception that PHL has career advancement opportunities	<p>My laboratory's set of job classifications provide career advancement options, including supervisory and applied research/technology development paths</p> <p>My laboratory's current technical and professional job classifications support employee retention and succession planning</p> <p>My laboratory provides a sufficient number of technical and professional job classifications</p>	<p>Range: -2.99 – 3.48</p> <p>Mean: 0</p>
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45. Value and perception factors by age (2016)

2016 - Mean [95% CI]	≤ 35 (Millennials)	36-50 (Generation X)	51+ (Baby Boomers)
1. Perceptions of good, supportive workplace environment**	0.13 [0.03 – 0.24]	-0.02 [-0.10 – 0.07]	-0.08 [-0.16 – 0.01]
2. Values salary/benefits, job security and flexibility	-0.00 [-0.10 – 0.10]	0.03 [-0.05 – 0.11]	-0.02 [-0.12 – 0.07]
3. Values continuing education, training, research***	0.26 [0.16 – 0.36]	0.01 [-0.08 – 0.09]	-0.19 [-0.28 – -0.11]
4. Values providing public service***	-0.17 [-0.27 – -0.08]	-0.07 [-0.15 – 0.01]	0.19 [0.11 – 0.27]
5. Perception that PHL has career advancement opportunities***	-0.22 [-0.31 – -0.13]	-0.10 [-0.19 – -0.02]	0.25 [0.17 – 0.33]

*Significant P<0.05; ** significant P<0.01; *** significant P<0.001

Satisfaction Levels in the PHL Workforce

46. Satisfaction – somewhat satisfied or very satisfied (2016)***

Job	78%
Organization	61%
Pay	37%
Job security	76%

*** Note that these tables do not add up to 100% as individuals were asked for their satisfaction levels of each of the items separately and therefore can indicate satisfaction to all items.

47. Satisfaction (somewhat/very)¹⁰ by gender (2016)

	Female	Male
Job	78%	76%
Organization	61%	60%
Pay	36%	40%
Job security	75%	77%

* Significant P<0.05; ** significant P<0.01; *** significant P<0.001

48. Satisfaction (somewhat/very)¹⁰ by age (2016)

	≤ 35 (Millennials)	36-50 (Generation X)	51+ (Baby Boomers)
Job	74%	77%	80%
Organization	65%	60%	59%
Pay***	30%	36%	43%
Job security	78%	76%	75%

* Significant P<0.05; ** significant P<0.01; *** significant P<0.001

49. Satisfaction (somewhat/very)¹⁰ by ethnicity (2016)

	Asian	Black or African American	Hispanic or Latino	White	other
Job*	86%	68%	72%	78%	78%
Organization	66%	57%	51%	61%	62%
Pay**	47%	23%	26%	38%	38%
Job security	80%	71%	74%	76%	72%

* Significant P<0.05; ** significant P<0.01; *** significant P<0.001

50. Satisfaction (somewhat/very)¹⁰ by education (2016)

	Less than Bachelors	Bachelors	Masters	Doctoral
Job**	76%	75%	81%	88%
Organization	64%	60%	59%	65%
Pay	36%	35%	37%	48%
Job security	75%	75%	75%	83%

* Significant P<0.05; ** significant P<0.01; *** significant P<0.001

51. Satisfaction (somewhat/very)¹⁰ by leadership position (2016)

	Non-supervisor	Leader
Job***	73%	84%
Organization	61%	61%
Pay**	33%	42%
Job security**	73%	79%

* Significant P<0.05; ** significant P<0.01; *** significant P<0.001

52. Satisfaction (somewhat/very)¹⁰ by position type (2016)

2016	Lab Scientist	Lab Scientist Supervisor/ Manager	Admin	Lab Aid/ Technician	Deputy/ Director	IT systems
Job***	74%	83%	78%	71%	95%	86%
Organization***	56%	59%	76%	60%	75%	79%
Pay***	32%	40%	40%	32%	59%	62%
Job security*	72%	80%	79%	73%	86%	76%

* Significant P<0.05; ** significant P<0.01; *** significant P<0.001

Intention to Leave

53. Plans to leave the PHL workforce

	2011	2016
< 1 years	6%	7%
1-2 years	11%	11%
3-4 years	13%	13%
5-10 years	31%	26%
>10 year	39%	44%
< 5 years	30%	30%

54. Intention to leave a PHL career in the next five years by gender

	2011	2016
Female	29%	27%
Male	31%	37%

55. Intention to leave a PHL career in the next five years by age^{§§§§}

	2011	2016
≤ 35 (Millennials)	35%	34%
36-50 (Generation X)	16%	16%
51+ (Baby Boomers)	37%	41%

56. Intention to leave a PHL career in the next five years by ethnicity^{§§§§}

	2011	2016
Asian	22%	29%
Black or African American	31%	33%
Hispanic or Latino	25%	53%
White	31%	30%
Other	26%	25%

§§§§ Percentages are within specific subgroup

57. Intention to leave a PHL career in the next five years by education^{§§§§}

	2011	2016
Less than Bachelors	34%	34%
Bachelors	28%	31%
Masters	32%	30%
Doctoral	29%	24%

58. Intention to leave a PHL career by satisfaction¹⁰ (2016)

2016	Not satisfied or neutral	Satisfied (somewhat/very)
Job***	47%	26%
Organization***	40%	24%
Pay**	33%	26%
Job security**	37%	28%

* Significant P<0.05; ** significant P<0.01; *** significant P<0.001

^{§§§§} Percentages are within specific subgroup

Appendix B: Regression Data

Table 1: Regression of Years of Experience in PHL

	Year Difference	95% Conf. Interval	P Value
Gender (compared to Female)			
Male***	0.16	0.06 - 0.26	0.001
Ethnicity (Compared to White)			
Asian	-0.04	(-0.22) - 0.13	0.624
Black	0.18	(-0.01) - 0.37	0.057
Hispanic	0.11	(-0.14) - 0.37	0.385
Other	0.21	(-0.02) - 0.44	0.076
Region (compared to West)			
Mid-West	0.08	(-0.11) - 0.27	0.417
New-England***	0.33	0.15 - 0.51	0
South	-0.08	(-0.24) - 0.07	0.293
Mid-Atlantic	0.12	(-0.05) - 0.28	0.157
Education (compared to no college)			
Bachelors	-0.13	(-0.32) - 0.05	0.156
Masters**	-0.32	(-0.53) - (-0.11)	0.002
Doctoral***	-1.05	(-1.3) - (-0.8)	0
Position type (laboratory scientist)			
Laboratory Scientist Supervisor/Manager***	0.49	0.38 - 0.61	0
Administrative***	-0.81	(-1.03) - (-0.59)	0
Laboratory Aid/ Technician***	-0.33	(-0.49) - (-0.16)	0
Deputy/Director***	0.51	0.28 - 0.75	0
Information Systems*	-0.47	(-0.94) - 0	0.05
Age (every year)***			
	0.08	0.07 - 0.08	0
Year (compared to 2011)			
2016	-0.06	(-0.16) - 0.03	0.205
Constant***	0.80	0.49 - 1.11	0

* Significant P<0.05; ** significant P<0.01; *** significant P<0.001

Table 2: Regression of Leadership Status

	Odds Ratio	95% Conf. Interval	P value
Gender (compared to Female)			

	Odds Ratio	95% Conf. Interval	P value
Male	1.11	0.86 - 1.43	0.44
Ethnicity (Compared to White)			
Black	1.08	0.55 - 2.13	0.82
Asian	1.04	0.45 - 2.43	0.92
Hispanic	1.31	0.8 - 2.16	0.29
Other	1.01	0.49 - 2.08	0.97
Region (compared to West)			
Mid-West	1.71	0.97 - 3	0.06
New-England	0.71	0.45 - 1.1	0.12
South	1.04	0.69 - 1.57	0.86
Mid-Atlantic	0.71	0.47 - 1.09	0.12
Education (compared to no college)			
Bachelors***	1.89	1.28 - 2.77	0.00
Masters***	4.53	2.9 - 7.06	0.00
Doctoral***	12.09	6.79 - 21.52	0.00
Length of work in any PHL (compared to < 5 years)			
5-10 years***	3.20	2.22 - 4.61	0.00
11-20 years***	3.86	2.64 - 5.64	0.00
> 20 year***	5.06	3.3 - 7.76	0.00
Age (compared to GenX)			
Millennials (≤ 35 years)***	0.50	0.35 - 0.72	0.00
Baby boomers (> 51 years)	1.05	0.78 - 1.41	0.73

* Significant P<0.05; ** significant P<0.01; *** significant P<0.001

Table 3: Regression Analysis of Salary

	Salary Difference	95% Conf. Interval	P value
Gender (compared to Female)			
Male*	\$1,580	\$317 - \$2,843	0.01
Ethnicity (Compared to White)			
Asian	(\$2,010)	(\$4,281) - \$262	0.08
Black	\$503	(\$1,880) - \$2,887	0.68
Hispanic*	(\$3,835)	(\$7,110) - (\$559)	0.02
Other	(\$1,662)	(\$4,606) - \$1,283	0.27
Region (compared to West)			
Mid-West***	(\$5,218)	(\$7,696) - (\$2,740)	0.00
New-England***	\$6,453	\$4,179 - \$8,727	0.00

	Salary Difference	95% Conf. Interval	P value
South***	(\$6,665)	(\$8,682) - (\$4,649)	0.00
Mid-Atlantic	(\$313)	(\$2,405) - \$1,779	0.77
Education (compared to no college)			
Bachelors***	\$10,333	\$7,980 - \$12,685	0.00
Masters***	\$14,030	\$11,386 - \$16,673	0.00
Doctoral***	\$27,273	\$24,033 - \$30,512	0.00
Length of work in any PHL (compared to < 5 years)			
5-10 years***	\$4,524	\$2,822 - \$6,227	0.00
11-20 years***	\$7,968	\$6,098 - \$9,838	0.00
> 20 year***	\$10,607	\$8,468 - \$12,747	0.00
Position type (laboratory scientist)			
Laboratory Scientist Supervisor/Manager***	\$10,351	\$8,844 - \$11,858	0.00
Administrative	(\$1,712)	(\$4,588) - \$1,164	0.24
Laboratory Aid/ Technician***	(\$5,300)	(\$7,459) - (\$3,141)	0.00
Deputy/Director***	\$32,042	\$28,992 - \$35,091	0.00
Information Systems***	\$12,885	\$6,908 - \$18,862	0.00
Age (every year)***			
	\$267	\$202 - \$332	0.00
Year (compared to 2011)			
2016***	\$3,350	\$2,087 - \$4,613	0.00
Constant***			
	\$23,259	\$19,176 - \$27,343	0.00

* Significant P<0.05; ** significant P<0.01; *** significant P<0.001

Table 4: Regression analysis of Job Satisfaction (somewhat/very)

	Odds Ratio	95% Conf. Interval	P value
Gender (compared to Female)			
Male*	0.62	0.42 - 0.91	0.016
Ethnicity (Compared to White)			
Black	0.51	0.18 - 1.4	0.191
Asian	0.46	0.13 - 1.62	0.229
Hispanic	0.69	0.29 - 1.61	0.39
Other	1.68	0.54 - 5.25	0.37
Region (compared to West)			
Mid-West	0.56	0.24 - 1.33	0.188

	Odds Ratio	95% Conf. Interval	P value
New-England	0.74	0.36 - 1.5	0.399
South	0.56	0.28 - 1.11	0.097
Mid-Atlantic	0.85	0.42 - 1.7	0.644
Education (compared to no college)			
Bachelors	0.73	0.39 - 1.36	0.322
Masters	0.82	0.39 - 1.71	0.593
Doctoral	1.13	0.4 - 3.24	0.816
Length of work in any PHL (compared to < 5 years)			
5-10 years	0.95	0.55 - 1.61	0.839
11-20 years	1.16	0.65 - 2.09	0.616
> 20 year	1.02	0.53 - 1.96	0.962
Position type (laboratory scientist)			
Laboratory Scientist Supervisor/Manager	0.90	0.56 - 1.44	0.655
Administrative*	0.47	0.24 - 0.91	0.025
Laboratory Aid/Technician	0.71	0.38 - 1.32	0.280
Deputy/Director	0.40	0.08 - 1.99	0.261
Information Systems	0.68	0.17 - 2.64	0.576
Age (compared to GenX)			
Millennials (≤ 35 years)**	0.36	0.19 - 0.7	0.002
Baby boomers (> 51 years)	0.65	0.36 - 1.19	0.164
Values/ perception			
Good, supportive workplace environment***	12.01	7.22 - 19.96	0.000
Value salary/benefits, job security and flexibility	1.25	0.88 - 1.78	0.205
Value continuing education, research	1.36	0.96 - 1.93	0.084
Value providing public service***	2.96	1.99 - 4.42	0.000
PHL has career advancement opportunities	1.39	0.98 - 1.96	0.064
Interactions:* Values/perception x Age (compared to GenX)			
Value continuing education x Millennials*	0.56	0.35 - 0.91	0.019
Value providing public service x Millennials**	0.44	0.26 - 0.76	0.003

* Only significant interactions at < 0.05 are presented in this table

	Odds Ratio	95% Conf. Interval	P value
Value providing public service x Baby boomers*	0.58	0.35 - 0.97	0.038

* Significant P<0.05; ** significant P<0.01; *** significant P<0.001

Table 5: Regression analysis of intention to leave PHL workforce

	Odds Ratio	95% Conf. Interval	P value
Gender (compared to Female)			
Male***	1.60	1.21 - 2.13	0.001
Ethnicity (Compared to White)			
Black	1.08	0.52 - 2.24	0.846
Asian**	3.82	1.57 - 9.3	0.003
Hispanic	0.99	0.57 - 1.73	0.970
Other	0.68	0.3 - 1.51	0.340
Region (compared to West)			
Mid-West	0.76	0.4 - 1.44	0.399
New-England	0.86	0.52 - 1.41	0.542
South	1.14	0.71 - 1.84	0.593
Mid-Atlantic	0.99	0.61 - 1.59	0.954
Education (compared to no college)			
Bachelors	1.59	0.99 - 2.57	0.055
Masters	1.55	0.9 - 2.69	0.117
Doctoral	1.12	0.53 - 2.39	0.761
Length of work in any PHL (compared to < 5 years)			
5-10 years	0.78	0.52 - 1.17	0.233
11-20 years**	0.58	0.37 - 0.91	0.018
> 20 year**	1.75	1.1 - 2.79	0.018
Position type (laboratory scientist)			
Laboratory Scientist Supervisor/Manager	1.22	0.85 - 1.74	0.282
Administrative*	2.61	1.6 - 4.27	0.000
Laboratory Aid/Technician	1.57	0.98 - 2.52	0.062
Deputy/Director	0.96	0.33 - 2.84	0.948
Information Systems	1.20	0.47 - 3.08	0.700
Age (compared to Gen-x)			
Millennials (≤ 35 years)***	3.79	2.38 - 6.04	0.000
Baby boomers (> 51 years)***	4.12	2.76 - 6.15	0.000

	Odds Ratio	95% Conf. Interval	P value
Values/ perception			
Good, supportive workplace environment***	0.51	0.38 - 0.69	0.000
Value salary/benefits, job security and flexibility***	0.62	0.47 - 0.83	0.001
Value continuing education, research	0.97	0.71 - 1.31	0.830
Value providing public service	0.82	0.61 - 1.1	0.185
PHL has career advancement opportunities***	0.52	0.38 - 0.7	0.000
	0.51	0.38 - 0.69	0.000
Interactions: * Values/perception x Age (compared to Gen-x)			
Good, supportive workplace environment x Baby boomers*	1.52	1.06 - 2.17	0.022
Value salary/benefits, job security and flexibility x Baby boomer **	1.64	1.17 - 2.3	0.004
PHL has career advancement opportunities x Millennials***	2.00	1.32 - 3.03	0.001
PHL has career advancement opportunities x Baby boomers***	2.30	1.59 - 3.33	0.000

* Significant P<0.05; ** significant P<0.01; *** significant P<0.001

* Only significant interactions at < 0.05 are presented in this table

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