2018 Training Needs Assessment Survey Report
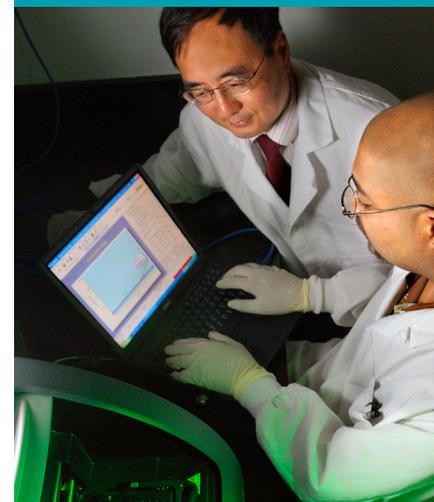
APHL ASSOCIATION OF
PUBLIC HEALTH LABORATORIES®

Acknowledgments

On the cover:

Top left: Scientists Jabulani Siyakangekani (left) and Wendy Sanyanga use the Virtual Load Data Management System to enter data results at Chinhoyi Provincial Hospital

Center: Clinical laboratorians participate in a training workshop at the State Hygienic Laboratory at the University of Iowa

Bottom right: CDC scientists perform a real-time PCR (polymerase chain reaction) assay using a 96-well plate format

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Executive Summary

Background

In an effort to revise and update its laboratory training offerings for its members and associates, the Association of Public Health Laboratories (APHL) held a quantitative online training needs assessment (TNA) survey, which surveyed a broad APHL and US Centers for Disease Control and Prevention (CDC) audience. The survey was performed concurrently with 10 live, virtual focus groups that collected comments from a selected group of public health laboratory (PHL) directors, managers and other key laboratory informants.

The intent of this survey was to identify broad categories of training need topics to get an overall perspective of training gaps in the PHL community of practice. In order to balance convenience and avoid survey fatigue, APHL chose to gather these broad categories and intends to conduct follow-up-outreach with key stakeholder audiences to clarify specifics. These broad categories provide a framework that supports the various levels of learning and content.

This report is a snapshot of PHL community training needs, rather than a comprehensive report of the survey data analysis.

Key Findings

Results of the TNA analysis revealed the following major findings in the areas of demographics, training topics and preferred learning methods of the PHL community.

Demographics

- The survey had a respondent population of 892, which included 576 PHL (65.0%), 243 non-governmental clinical laboratory (27.0%) and 73 other laboratory types (8.0%).
- Job classifications were almost evenly reported: 451 supervisors (50.6%) and 437 non-supervisors (49.0%), with 0.4% not reporting their classification.
- PHL supervisors accounted for 41.0% of all PHL respondents and PHL non-supervisors were 58.0%.
- Of the 576 PHL respondents, 68.9% were female, 25.7% were male, 0.1% were non-binary/third gender and 5.3% preferred not to say or did not report.
- More female PHL supervisors (68.0%) participated in the survey than male PHL supervisors (28.0%).
- The majority of total respondents (65.0%) were in the 35-55 age range.
- Of the 565 respondents reporting having worked in a PHL, 31.5% have 11-20 years of experience.
- PHL professionals from all 50 states plus the District of Columbia, Puerto Rico and outside the US responded to the survey (Appendix A, 6). The states with the largest participation were California (53), New York (39) and Texas (22). Non-governmental clinical laboratory respondents were from 36 states plus non-US locations. Tennessee (22) had the largest non-governmental participation, followed by California (17).

Training Topics

Respondents classifying themselves as a laboratory supervisor were asked to select topics seen as critical training needs for their staff. All respondents also rated the most critically needed topics for themselves. The training topics were separated into four categories:

- Scientific/Technical (88 topics)
- Technology (19 topics)
- Management (24 topics)
- Leadership and Personal Development (15 topics).

The top 10 training topics across the four categories rated by PHL supervisors as critical for their staff were:

1. Personnel - Effective communication [Management]
2. Personnel - Team building [Management]

3. Bioinformatics - Application in public health laboratory [Scientific/Technical]

4. Bioinformatics - Data analysis [Scientific/Technical]

5. Molecular Diagnostics - Sequencing technology and instrumentation (next-generation sequencing (NGS), whole genome sequencing (WGS)) [Technology]

6. Laboratory Standards and Guidelines - Regulations that affect laboratory practice (e.g., HIPAA, CLIA, EPA) [Scientific/Technical]

7. Molecular Diagnostics - Sequencing (next-generation sequencing (NGS), whole genome sequencing (WGS)) [Scientific/Technical]

8. Laboratory Science and Practice Fundamentals - Quality control/Quality assurance [Scientific/Technical]

9. Bioinformatics - Basics [Scientific/Technical]

10. Conflict resolution [Leadership]

The top 10 training topics across the four categories identified as critical by PHL individuals for themselves:

1. Laboratory Standards and Guidelines - Regulations that affect laboratory practice (e.g., HIPAA, CLIA, EPA) [Scientific/Technical]

2. Conflict resolution [Leadership]

3. Communication Techniques - Difficult conversations [Leadership]

4. Molecular Diagnostics - Sequencing technology and instrumentation (next-generation sequencing (NGS), whole genome sequencing (WGS)) [Technology]

5. Molecular Diagnostics - Sequencing (next-generation sequencing (NGS), whole genome sequencing (WGS)) [Scientific/Technical]

6. Laboratory Science and Practice Fundamentals - Test validation [Scientific/Technical]

7. Bioinformatics - Application in public health laboratory [Scientific/Technical]

8. Communication Techniques - Crucial conversations [Leadership]

9. Laboratory Science and Practice Fundamentals - Quality control/Quality assurance [Scientific/Technical]

10. Personnel - Effective communication [Management]

When comparing the top 10 lists of PHL supervisor selections for PHL staff and individual selections for themselves, there were very similar choices. The seven topics, not in ranked order, that appeared on both lists included:

- Personnel - Effective communication [Management]

- Bioinformatics - Application in public health laboratory [Scientific/Technical]

- Molecular Diagnostics - Sequencing (next-generation sequencing (NGS), whole genome sequencing (WGS)) [Scientific/Technical]

- Laboratory Standards and Guidelines - Regulations that affect laboratory practice (e.g., HIPAA, CLIA, EPA) [Scientific/Technical]

- Molecular Diagnostics - Sequencing technology and instrumentation (next-generation sequencing (NGS), whole genome sequencing (WGS)) [Technology]

- Laboratory Science and Practice Fundamentals - Quality control/Quality assurance [Scientific/Technical]

- Conflict resolution [Leadership]

Preferred Learning Methods

The preferred learning methods varied and depended on the topic. When combining the top five methods for each topic category, the following were selected most often, not in ranked order:

- Classroom

- Workshops

- Webinars

- Seminars

- Group activities with a tutor/teacher

Manufacturer-provided training is available and preferred for some technology training topics.

Recommendations

The recommendations are by no means all-inclusive of appropriate possible actions. However, this analysis supports implementing these recommendations as a positive step towards improving a range of skills for laboratorians. These recommendations can also influence individual career decisions in PHLs. Using the key findings listed above, in addition to further analysis of respondent input, APHL recommends the following:

Training Development

- Take a strategic, holistic approach to performance improvement by building a plan for different laboratory roles. The plan can be executed in phases and should contain a curriculum framework with success measurements that align to the MMWR competencies. These same plans can be used in an effort to cross-train individual laboratory professionals to obtain maximum coverage within a laboratory.

- Address the top five topics on the Overall Top 10 Topics list (pages 14-15) first. Then continue to the next item on each list as time, budget and need dictate.

- Compare the results of the online survey to the Focus Groups Report selections for similarities, looking for trends that intersect. Revise the priority topics as needed.

- Review APHL and CDC course offerings against findings from the online survey and the focus groups to determine which courses are still relevant and which can be either retired or updated. Align the list with the Top Five list, and develop a promotion plan of existing APHL and/or CDC courses.

- Research available training offered by vendors that meets APHL standards to avoid duplicating development effort.

- Plan and develop new training modules based on new and emerging technologies and processes.

- Create tools for laboratory management to conduct a gap analysis for their laboratory staff, including checklists and formative evaluations to measure current knowledge and capabilities.

- Prioritize the development of laboratory training activities to align with new industry methodology and developing technology, and partner with vendors to promote training offerings.

- Conduct additional data gathering through focus groups and other deep dive inquiries to identify content-specific needs from the top five lists generated in the TNA.

Training Methods

- Develop training that incorporates problem-based and scenario-based content providing practice and adequate exposure to build expertise. For example, employ content that integrates "Day-in-the-Life" scenarios to support behavior modeling.

- Consider alternate forms of presenting the content (e.g., what can be offered in different formats, locations, groupings and timings). For example, offer face-to-face, hands-on training using two-way video cameras.

- Develop 10-15-minute training modules on one topic that can become part of a series.

- Utilize the appropriate learning modalities based on identified learning objectives. This can include micro-learning where applicable, from training preparation to performance support.

- Support teach-back options for staff sent to training.

- Refine delivery method terminology (e.g., webinar vs online facilitated-synchronous) for consistency across APHL.

Technical Topics

Technical topics mentioned in common in the TNA and focus groups included:

- Molecular Diagnostics (NGS and WGS)
- Bioinformatics
- Laboratory Standards and Guidelines, e.g. CLIA

Top Management/Leadership topics

Management/leadership topics mentioned in common in the TNA and focus groups included:

- Conflict resolution
- Communications techniques (Difficult conversations, Crucial conversations)
- Personnel (Interpersonal communications, Team building)
- Scientific Ethics

Learning Methods

Preferred learning methods in the TNA and focus groups TNA depended on the training topic. The choices that were very similar included:

- Focus group participants most often mentioned hands-on and face-to-face learning methods. TNA respondents favored workshops, classrooms and seminars, which are also variations on face-to-face methods
- TNA respondents preferred webinars in the Scientific/Technical category (top 10) where the focus group participants chose webinars only 8% of the time overall
- Technology, Management and Leadership categories in the TNA favored classroom methods, followed closely by workshops. Again, these methods are a variation on face-to-face training. Focus group responses were not connected to a particular category of training, e.g., technical or management, only training in general. Since focus group participants were not presented with a list of training methods, they were more inclined to express that the method depended on the topic.

Background

An APHL priority is addressing the training needs of not just the current PHL workforce, but also the projected needs of the workforce within the next five years. The intent is to use the results of the TNA to create top-shelf training to sustain the future PHL workforce. Simply stated, APHL's goal is to provide training events that align with the gaps and needs of APHL members and stakeholders, while supporting emerging technology and sustaining PHL competencies.

According to the 2016 APHL Focus of Public Health Laboratories: Workforce Survey Report,[1] there is expected to be an approximate 30% loss of trained personnel in the PHL industry in the near future. This is attributed to both the impending retirement of an aging workforce and lower enrollments in related fields of study towards a laboratory science career.

To keep ahead of this trend, APHL conducted an online training needs assessment (TNA) survey to canvas APHL members, non-members, training partners and associated clinical laboratories. The survey aimed to assess current job-related training needs and identify any training gaps that must be addressed to help reach necessary performance levels. Viewed from perspectives of supervisory personnel for their staff and Individual participants' needs for themselves, the data gathered from the TNA survey provide specific training needs expressed by survey respondents. These data will be used in conjunction with APHL's 2018 TNA focus group discussion data to form a more complete training needs picture for the PHL community.

Methodology

The sampling methodology used was a convenience survey tool programmed and delivered through Qualtrics®. Convenience sampling (also known as availability sampling) is a specific type of non-probability sampling method that relies on data collection from population members who are available to participate in a study. Web-based polls or questions are a popular example for convenience sampling.

The strategy for organizing the survey participants was to contact laboratorians with the following APHL affiliations:

- Laboratory Leadership-Mentorship ColLABorate[*]
- Biosafety and Biosecurity ColLABorate
- Quality Assurance (QA) ColLABorate
- Training Partner (TrP) ColLABorate
- APHL laboratory directors
- APHL members who had registered for training in the last four years
- Non-APHL members who had registered for training in the last four years.

Preliminary announcements were circulated in APHL's *eUpdate* newsletter and sent out to the TrP ColLABorate Community of Practice to advertise the upcoming TNA survey. TrPs were encouraged to share the survey with their internal staff, as well as with clinical partners in their states/jurisdictions.

The TNA survey was active for eight weeks. The initial invitation to participate with a link to the survey was sent by email from August 27, 2018 through August 29, 2018. Reminder emails and subsequent invitations were sent on September 10, 2018 through September 21, 2018. A final contact was sent on October 2, 2018, and the survey was closed on October 17, 2018.

A total of 21,201 invitations were sent out to the identified audience. This number includes multiple contacts with the target audience. Of those various invitations, 4,966 opened the email (29.0%). From those opened emails, 1,232 (24.8%) clicked the link and participated in the TNA survey. The returned responses were then adjusted to remove 331 incomplete surveys and nine duplicate surveys for a total of 892 completed, accepted surveys.

Survey respondents were self-selected and represent a snapshot of the PHL community.

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*ColLABorate is APHL's online community where members can exchange ideas, share documents, upload presentations and ask questions.

Survey Questions

APHL developed a list of 30 questions (Appendix B) organized in sections to collect respondent demographics and training topic selections in the following categories from the perspective of the supervisor's need for their staff and from the perspective of each participant's need for themselves. Questions were organized to capture the following information:

- Demographics including type of laboratory, job classification, gender, age, tenure and education level
- Responsibility of those in supervisory positions regarding the size of their staff and involvement in training decisions
- Financial sources for training and continuing education
- Training topic priority for the following categories:
  - Scientific and Technical
  - Technology
  - Management
  - Leadership and Professional Development.

Respondents were asked to classify their current training need for a chosen topic as one of three levels—low need, important need or critical need. Lists of training topics they could choose from are in Appendix C. There are 88 Scientific/Technical topics, 19 Technology topics, 24 Management topics, and 15 Leadership and Personal Development topics. This report examines responses classified as critical training needs only.

Another set of questions asked respondents to select a preferred learning method for each of their selected critical training topics. These learning methods are listed below.

1. Classroom
2. Completing designated assignments
3. Conferences
4. Group activities with a tutor/teacher
5. Manufacturer-provided training
6. On demand eLearning (self-paced)
7. Online facilitated (synchronous)
8. On-the-job training
9. Self-teaching references
10. Seminars
11. Simulations
12. Videos
13. Webinars
14. Working alone through course materials
15. Workshops.

The survey was designed to take approximately 30 minutes to complete.

Key Findings

The following is a summation of the findings compiled from the TNA respondents relating to:

- Demographics of the respondent population
- Training topics viewed as a critical need by respondents
- Preferred learning methods for varying training topics
- Compared choices of supervisors for staff versus choices of staff for themselves.

Demographics

Of 892 survey respondents, the greatest response was from those who work in PHLs (65.0%), followed by non-governmental clinical (27.0%) and other laboratory types (8.0%) (Figure 1).

The total survey respondents were nearly equal in supervisory positions (50.6%) and non-supervisory positions (49.0%), with less than 1% not reporting their position (Figure 2).

Of all survey respondents, PHL supervisors make up a little over a quarter (26.6%) of all supervisors in the survey and 37.7% of all non-supervisors (Appendix A, 1). When examining only PHL respondents, 41.1% hold a supervisory role and 58.3% are non-supervisory.

Females (72.0%) outnumbered males (22.6%) in the respondent group overall (Figure 3). Non-binary/third gender accounted for 0.1%, while those who prefer not to reveal their gender and those who did not report totaled 5.3%.

When considering only PHL respondents, 68.9% are female and 25.7% are male (Appendix A, 2). More female PHL supervisors (68.0%) participated in the survey than male PHL supervisors (28.0%) (Appendix A, 3).

Gender proportions are relatively consistent across the age groups from 25 to 64 (Figure 4), where female respondents make up approximately two-thirds (66.0%) to three-fourths (75.0%) of those age groups. PHL respondents produced similar percentages (Appendix A, 3).

The greatest response from the survey's total self-selected population came from the 55-64 age group (26.9%) (Figure 5). Focusing on PHL participation (Appendix A, 3), PHLs made up 18.7% of the total population in the 35 to 44 age group and 29.0% in the same age group of the PHL only respondents' group.

Millennials and Gen-Xers—represented in the 25 to 34, 35 to 44, and the 44 to 54 age groups—comprise 65.0% of the total respondent population (Figure 5). This representation aligns with a 2016 Gallup report, *How Millennials Want to Work and Live,*[2] which sees Millennials and Gen-Xers supplying the bulk of the workforce in general. PHL respondents make up 45% of the same age groups (Appendix A, 3).

Figure 1: Respondent participation by laboratory (n=892)
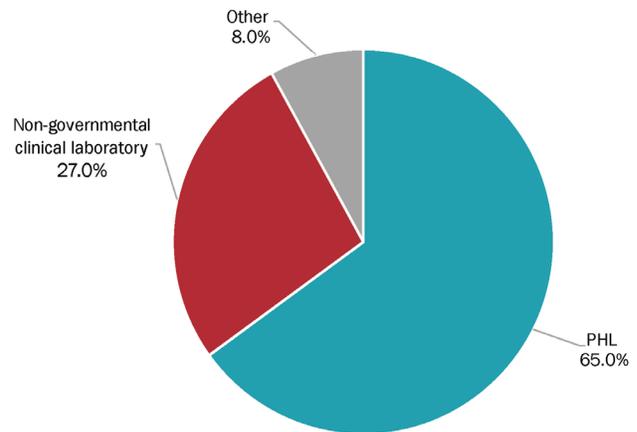
Figure 2: Respondent participation by job (n=892)
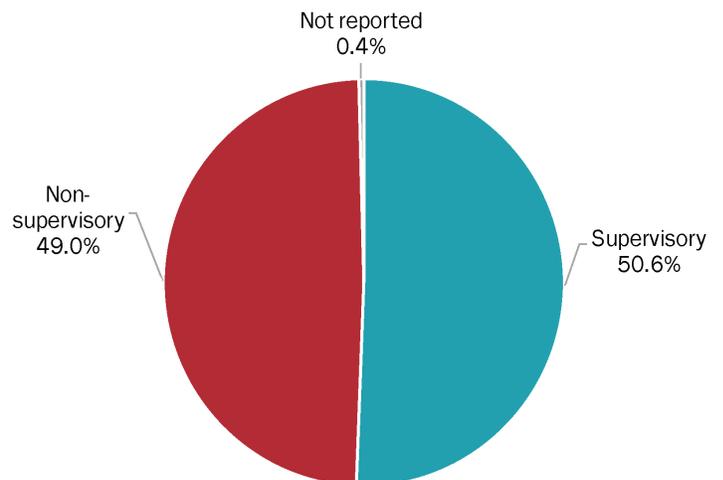
Figure 3: Respondent participation by gender (n=892)
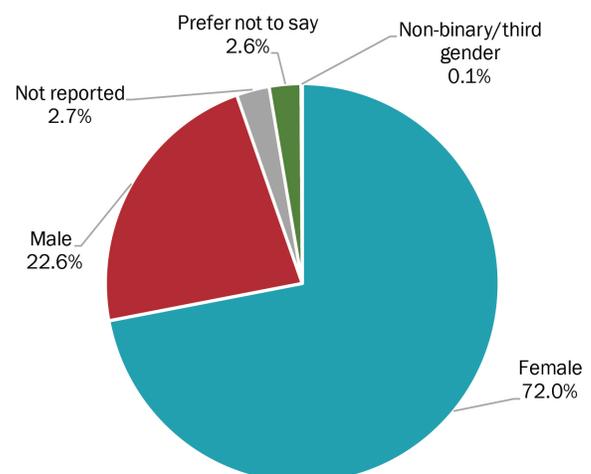
Of the 565 respondents having worked in a PHL, 31.5% reported having 11-20 years of experience (Appendix A, 5).

PHL professionals from all 50 states plus the District of Columbia, Puerto Rico and outside the US responded to the survey (Appendix A, 6). The states with the largest PHL participation were California (53), New York (39) and Texas (22). Non-governmental clinical laboratory respondents were from 36 states plus non-US locations. Tennessee (22) had the largest non-governmental participation, followed by California (17) (Appendix A, 6).

Training Topic Categories

Laboratory supervisors were asked to select topics seen as critical for their staff. Also, each respondent rated the most critical needed topics for themselves. Training topics were then separated into four categories:

- **Scientific/Technical** - Performance of analytical testing in a laboratory setting for the monitoring, detection, diagnosis and treatment of disease

- **Technology** - Development and application of laboratory instrumentation and computerization to perform complex work in an analytical laboratory setting

- **Management** - The processes of dealing with or controlling things or people. It is the organization and coordination of the activities of a business in order to achieve defined objectives

- **Leadership and Personal Development** - Activities by which a person influences others to maximize their efforts towards the achievement of a greater goal for themselves and others.

The following sections present the top 10 critical need topics selected by supervisors for their staff and for themselves in each category.

Figure 4: Respondent participation by age/gender (n=892)
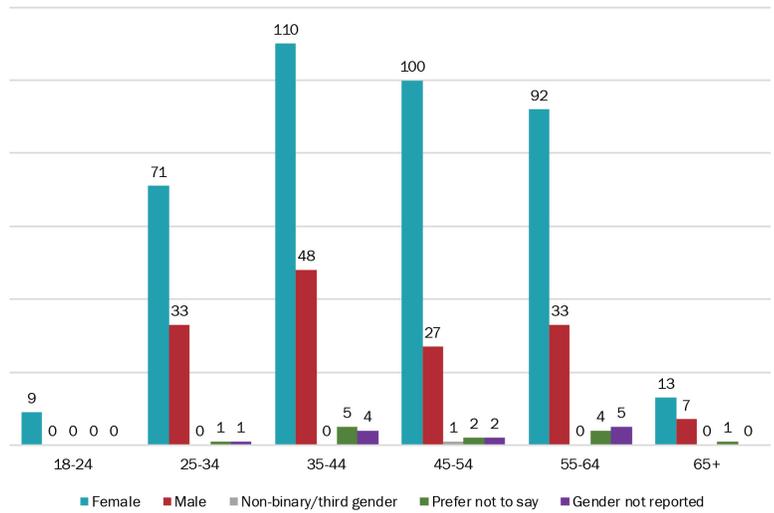
Figure 5: Respondent participation by age (n=892)
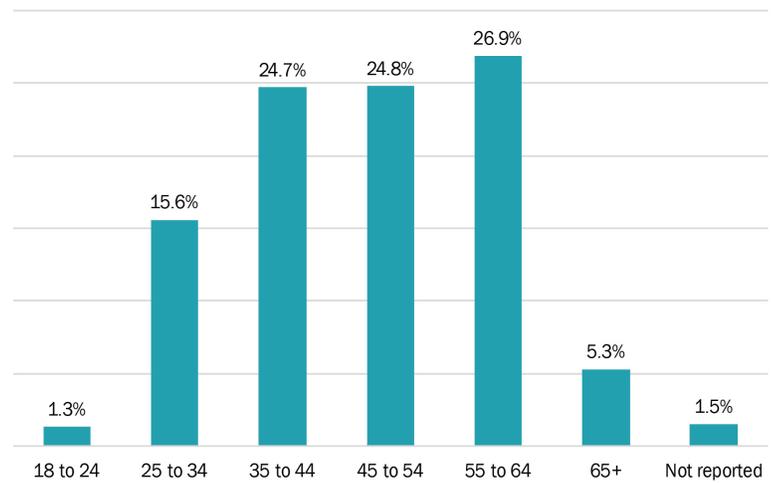
Scientific/Technical

Emerging methods and quality were two themes PHL supervisors prioritized as critical training needs for their staff, with five of the Top 10 topics on bioinformatics and molecular diagnostics, and the remaining within areas such as QA/QC, regulations, assessments and validation. This combination changes slightly when looking at responses from all PHL staff (both supervisory and non-supervisory), in which quality becomes even a more obvious need, growing to six out of the top 10 and includes additional training in emergency preparedness. Laboratory regulations that affect laboratory practice was within the top three critical needs for both groups of respondents. Eight of the same scientific technical topics (80%) appeared on both the "for Staff" and "for Self" lists, but in a different rank order.

Q 13a. How would you rate the need for training in the following scientific technical topics for YOUR STAFF? (Appendix D, 1)

Q 13. How would you rate the need for training in the following scientific technical topics for YOURSELF? (Appendix D, 2)

Topic	Ranked by Supervisors for Staff	Ranked by Staff (Supervisory and Non-Supervisory)
Bioinformatics - Application in public health laboratory	1	4
Bioinformatics - Data analysis	2	7
Laboratory Standards and Guidelines - Regulations that affect laboratory practice (e.g., HIPAA, CLIA, EPA)	3	1
Molecular Diagnostics - Sequencing (next-generation sequencing (NGS), whole genome sequencing (WGS))	4	2
Laboratory Science and Practice Fundamentals - Quality control/Quality assurance	5	5
Bioinformatics - Basics	6	
Laboratory Science and Practice Fundamentals - Test validation	7	3
Laboratory Safety - Biological	8	
Molecular Diagnostics - PCR / Real-time PCR	9	10
Laboratory Science and Practice Fundamentals - Quality assessments and auditing	10	8
Emergency Preparedness - Emerging pathogen preparedness		6
Laboratory Science and Practice Fundamentals - Quality management systems		9
Laboratory Standards and Guidelines - ISO standards		10

Technology

Informatics was the most common theme PHL supervisors prioritized as a critical training need for their staff, appearing in five of the top 10 topics. Molecular diagnostics, MALDI-TOF, and environmental technology such as LC/MS/MS and GC/MS/MS were also identified. Interestingly, these exact same topics were also identified in the top 10 when looking at responses from all PHL staff (supervisory and non-supervisory), although the order of ranking was slightly different. NGS/WGS and PC/real-time PCR were the top two critical needs for both groups of respondents

Q 14a. How would you rate the need for training in the following technology topics for YOUR STAFF? (Appendix D, 3)

Q 14. How would you rate the need for training in the following technology topics for YOURSELF? (Appendix D, 4)

Topic	Ranked by Supervisors for Staff	Ranked by Staff (Supervisory and Non-Supervisory)
Molecular Diagnostics - Sequencing technology and instrumentation (next-generation sequencing (NGS), whole genome sequencing (WGS))	1	1
Molecular Diagnostics - PCR/Real-time PCR	2	2
Matrix Assisted Laser Desorption/Ionization (MALDI-TOF)	3	8
Informatics - Electronic data exchange	4	3

Topic	Ranked by Supervisors for Staff	Ranked by Staff (Supervisory and Non-Supervisory)
Informatics - Analyzing and managing data from non-targeted analyses	5	4
Informatics - Digital tools	6	5
Informatics - Big data	7	6
Environmental Technology - LC/MS/MS	8	9
Informatics - Biomonitoring data	9	7
Environmental Technology - GC/MS/MS	10	10

Management

Personnel strategies such as communications, teams, competency assessment and training were the most common theme PHL supervisors prioritized as a critical training need for their staff, appearing in five of the top 10 topics. Personnel strategies were also the most common theme identified in five of the top 10 when looking at response from all PHL staff (supervisory and non-supervisory), although the topics varied slightly. Both groups also identified project management and quality systems management as critical needs. Effective communications and team building were the top two critical needs for both respondents.

Q 15a. How would you rate the need for training in the following management topics for YOUR STAFF? (Appendix D, 5)

Q 15. How would you rate the need for training in the following management topics for YOURSELF? (Appendix D, 6)

Topic	Ranked by Supervisors for Staff	Ranked by Staff (Supervisory and Non-Supervisory)
Personnel - Effective communication	1	1
Personnel - Team building	2	2
Personnel - Science communication	3	
Personnel - Team management work styles	4	3
Personnel - Competency assessment	5	6
Laboratory - Quality systems management	6	9
Organizational - Managing change	7	
Personnel - Training of trainer's skills	8	4
Project - Project management	9	8
Organizational - LEAN processes	10	
Organizational - Strategic planning		5
Financial/Budgeting - Grant writing		7
Project - Presentation training		10

Leadership and Professional Development

Communication techniques were the most common theme PHL supervisors prioritized as a critical training need for their staff, appearing in five of the top 10 topics. This theme was even strong with seven of the top 10 when look at responses from all PHL staff (supervisory and non-supervisory). Crisis management and epidemiology were identified in both top 10 lists, and conflict resolution and difficult conversations were the top two critical needs for both groups of respondents.

Q 16a. How would you rate the need for training in the following leadership and professional development topics for YOUR STAFF? (Appendix D, 7)

Q 16. How would you rate the need for training in the following leadership and professional development topics for YOURSELF? (Appendix D, 8)

Topic	Ranked by Supervisors for Staff	Ranked by Staff (Supervisory and Non-Supervisory)
Conflict resolution	1	1
Communication Techniques - Difficult conversations	2	2
Scientific ethics	3	
Communication Techniques - Crucial conversations	4	3
Crisis management	5	6
Communication Techniques - Presentation skills	6	10
Epidemiology for laboratory professionals	7	4
Competencies - Adoption and implementation of competencies	8	
Communication Techniques - Training delivery techniques	9	8
Competencies - Use of competencies in competence assessment	10	
Communication Techniques - Mentoring		5
Leadership theory and fundamentals		7
Communication Techniques - Coaching		9

Overall Top 10 Topics of All Categories

This section presents the overall top 10 topics from every category: Scientific/Technical, Technology, Management and Leadership. The tables were formed by combining all the top 10 supervisors' choices and then sorting by the highest to smallest count number. Seven topics appear on both lists, albeit in different order of rank. These matching topics are listed in Table 3.

Table 1: Supervisors' Top 10 Critical Training Needs Topics Overall for PHL Staff (by count)

Overall Rank	Topic	n=237	Category	Category Rank
1	Personnel - Effective communication	72	Management	1
2	Personnel - Team building	72	Management	2
3	Bioinformatics - Application in public health laboratory	69	Scientific/Technical	1
4	Bioinformatics - Data analysis	66	Scientific/Technical	2
5	Molecular Diagnostics – Sequencing technology and instrumentation (next-generation sequencing (NGS), whole genome sequencing (WGS))	66	Technology	1
6	Laboratory Standards and Guidelines - Regulations that affect laboratory practice (e.g., HIPAA, CLIA, EPA)	63	Scientific/Technical	3
7	Molecular Diagnostics - Sequencing (next-generation sequencing (NGS), whole genome sequencing (WGS))	63	Scientific/Technical	4
8	Laboratory Science and Practice Fundamentals - Quality control/Quality assurance	60	Scientific/Technical	5

Overall Rank	Topic	n=237	Category	Category Rank
9	Bioinformatics - Basics	59	Scientific/Technical	6
10	Conflict resolution	58	Leadership	1

Table 2: Top 10 Critical Training Needs Topics Overall for All PHL Staff (supervisory and non-supervisory) (by count)

Overall Rank	Topic	n=576	Category	Category Rank
1	Laboratory Standards and Guidelines - Regulations that affect laboratory practice (e.g., HIPAA, CLIA, EPA)	151	Scientific/Technical	1
2	Conflict resolution	139	Leadership	1
3	Communication Techniques - Difficult conversations	138	Leadership	2
4	Molecular Diagnostics – Sequencing technology and instrumentation (next-generation sequencing (NGS), whole genome sequencing (WGS))	137	Technology	1
5	Molecular Diagnostics - Sequencing (next-generation sequencing (NGS), whole genome sequencing (WGS))	135	Scientific/Technical	2
6	Laboratory Science and Practice Fundamentals - Test validation	133	Scientific/Technical	3
7	Bioinformatics - Application in public health laboratory	132	Scientific/Technical	4
8	Communication Techniques - Crucial conversations	123	Leadership	3
9	Laboratory Science and Practice Fundamentals - Quality control/Quality assurance	121	Scientific/Technical	5
10	Personnel - Effective communication	113	Management	1

Table 3: Matching Topics From Both Top 10 Lists

Ranked by Supervisors for Staff	Ranked by Staff (Supervisory and Non-Supervisory)	Topic	Category
1	10	Personnel - Effective communication	Management
3	7	Bioinformatics - Application in public health laboratory	Scientific/Technical
5	4	Molecular Diagnostics - Sequencing technology and instrumentation (next-generation sequencing (NGS), whole genome sequencing (WGS))	Technology
6	1	Laboratory Standards and Guidelines - Regulations that affect laboratory practice (e.g., HIPAA, CLIA, EPA)	Scientific/Technical
7	5	Molecular Diagnostics - Sequencing (next-generation sequencing (NGS), whole genome sequencing (WGS))	Scientific/Technical
8	9	Laboratory Science and Practice Fundamentals - Quality control/Quality assurance	Scientific/Technical
10	2	Conflict resolution	Leadership

Preferred Learning Methods

Respondents were prompted to choose their preferred learning method for their chosen topics. The following lists show the most popular methods that appeared in each topic category in the order most mentioned in a category. The actual rank of each method depended on the individual topic selected, although in-person and face-to-face learning was identified as the most requested approach to training.

Scientific/Technical

- Classroom
- Workshops
- Webinars
- On-demand eLearning (self-paced)
- Seminars
- Group activities with a tutor/teacher
- On-the-job training

Technology

- Classroom
- Workshops
- Webinars
- On-demand eLearning (self-paced)
- Online facilitated (synchronous)
- Group activities with a tutor/teacher
- Seminars
- Manufacturer-provided training

Management

- Classroom
- Workshops
- Webinars
- Seminars
- Group activities with a tutor/teacher
- On-demand eLearning (self-paced)

Leadership

- Workshops
- Webinars
- Seminars
- Classroom
- Group activities with a tutor/teacher
- On-demand eLearning (self-paced)

Non-governmental Clinical Laboratories

While the summary TNA report primarily addresses the priority training needs of PHLs, training needs were also captured from respondents in clinical laboratories (n=243), specifically sentinel laboratories. The priority needs of these sentinel laboratories will inform ongoing outreach and support of a sustainable and strong public health laboratory system and extended community of practice. The top priority items identified from these clinical laboratories, for staff and self, are included in Table 4 and Table 5 that follow.

Table 4: Non-governmental Laboratory Supervisors' Top 10 Critical Training Need Topics for Staff (by count)

Overall Rank	Topic	n=243	Category	Category Rank
1	Antimicrobial Resistance - Antimicrobial susceptibility testing	51	Scientific/Technical	1
2	Competencies - Development and use of competencies	46	Leadership	1
3	Conflict resolution	43	Leadership	2
4	Communication Techniques - Difficult conversations	42	Leadership	3
5	Competencies - Use of competencies in competence assessment	42	Leadership	4
6	Competencies - Adoption and implementation of competencies	41	Leadership	5
7	Crisis management	37	Leadership	6
8	Communication Techniques - Mentoring	34	Leadership	7
9	Communication Techniques - Crucial conversations	33	Leadership	8
10	Communication Techniques - Coaching	31	Leadership	9

Table 5: Non-governmental Laboratory Top 10 Critical Training Need Topics for Staff (supervisory and non-supervisory) (by count)

Overall Rank	Topic	n=243	Category	Category Rank
1	Antimicrobial Resistance - Antimicrobial susceptibility testing	67	Scientific/Technical	1
2	Microbiology - Emerging infectious diseases	56	Scientific/Technical	2
3	Emergency Preparedness - Emerging pathogen preparedness	54	Scientific/Technical	3
4	Laboratory Standards and Guidelines - Regulations that affect laboratory practice (e.g., HIPAA, CLIA, EPA)	52	Scientific/Technical	4
5	Personnel - Competency assessment	50	Management	1
6	Competencies - Development and use of competencies	46	Leadership	1
7	Conflict resolution	43	Leadership	2
8	Laboratory Science and Practice Fundamentals - Test validation	42	Scientific/Technical	5
9	Communication Techniques - Difficult conversations	42	Leadership	3
10	Competencies - Use of competencies in competence assessment	42	Leadership	4

Focus Group Correlation

In both the TNA and focus group study, there was a correlation between the importance of leadership and technical training. Areas in which the survey and focus group intersected most were in technical topics, management and leadership topics, and learning methods. The focus groups self-identified the topics of need, which then correlated with the lists of topics presented to respondents in the TNA. Correlation between the different efforts is not specifically one-to-one because the focus group questions addressed two topic groupings—technical topics and management/leadership topics. However, in the TNA, topics were presented more granularly in four groupings: scientific/technical, technology, management and leadership. These findings are currently detailed in a separate document.

Recommendations

The recommendations are by no means all-inclusive of appropriate possible actions. However, this analysis supports implementing these recommendations as a positive step towards improving a range of skills for laboratorians and impacting individual career decisions in public health laboratories. Analysis of respondent responses leads to the following recommendations.

Training Development

- Take a strategic, holistic approach to performance improvement by building a plan for different laboratory roles. The plan can be executed in phases and should contain a curriculum framework with success measurements that align to

the MMWR competencies. These same plans can be used in an effort to cross-train individual laboratory professionals to obtain maximum coverage within a laboratory.

- Address the top five topics on the Overall Top 10 Topics list (pages 14-15) first. Then continue to the next item on each list as time, budget and need dictate.

- Compare the results of the online survey to the Focus Groups Report selections for similarities, looking for trends that intersect. Revise the priority topics as needed.

- Review APHL and CDC course offerings against findings from the online survey and the focus groups to determine which courses are still relevant and which can be either retired or updated. Align the list with the Top Five list, and develop a promotion plan of existing APHL and/or CDC courses.

- Research available training offered by vendors that meets APHL standards to avoid duplicating development effort.

- Plan and develop new training modules based on new and emerging technologies and processes.

- Create tools for laboratory management to conduct a gap analysis for their laboratory staff, including checklists and formative evaluations to measure current knowledge and capabilities.

- Prioritize the development of laboratory training activities to align with new industry methodology and developing technology, and partner with vendors to promote training offerings.

- Conduct additional data gathering through focus groups and other deep dive inquiries to identify content-specific needs from the top five lists generated in the TNA.

Training Methods

- Develop training that incorporates problem-based and scenario-based content providing practice and adequate exposure to build expertise. For example, employ content that integrates "Day-in-the-Life" scenarios to support behavior modeling.

- Consider alternate forms of presenting the content (e.g., what can be offered in different formats, locations, groupings and timings). For example, offer face-to-face, hands-on training using two-way video cameras.

- Develop 10-15-minute training modules on one topic that can become part of a series.

- Utilize the appropriate learning modalities based on identified learning objectives. This can include micro-learning where applicable, from training preparation to performance support.

- Support teach-back options for staff sent to training.

- Refine delivery method terminology (e.g., webinar vs online facilitated-synchronous) for consistency across APHL.

Technical Topics

Technical topics mentioned in common in both studies included:

- Molecular Diagnostics (NGS and WGS)
- Bioinformatics
- Laboratory Standards and Guidelines, e.g. CLIA.

Top Management/Leadership topics

Management/leadership topics mentioned in common in both studies included:

- Conflict resolution
- Communications techniques (difficult conversations, crucial conversations)
- Personnel (interpersonal communications, team building)
- Scientific Ethics.

Learning Methods

Preferred learning methods in both the focus group and TNA depended on the training topic. The choices that were very similar included:

- Focus group participants most often mentioned hands-on and face-to-face learning methods. TNA respondents favored workshops, classrooms and seminars, which are also variations on face-to-face methods.

- TNA respondents preferred webinars in the Scientific/Technical category (top 10) while focus group participants chose webinars only 8% of the time overall.

- Technology, Management and Leadership categories in the TNA favored classroom methods, followed closely by workshops. Again, these methods are a variation on face-to-face training. Focus group responses were not connected to a particular category of training, e.g., technical or management, only training in general. Since focus group participants were not presented with a list of training methods, they were more inclined to express that the method depended on the topic.

References

1. APHL. Focus of Public Health Laboratories: Workforce Survey Report (2016). Available from https://www.aphl.org/aboutAPHL/publications/Documents/IR-2018May-2016-Workforce-Survey-Report.pdf

2. Fry, R. Millennials are the largest generation in the U.S. labor force. April 2018. Pew Research Center. Available from http://www.pewresearch.org/fact-tank/2018/04/11/millennials-largest-generation-us-labor-force/

Appendix A: Respondent Statistics

1. All Survey Respondents by Job Classification and Laboratory Type

	PHL	Clinical	Other	Total	% of Total	PHL % of Total	PHL % of Total PHL
Supervisor	237	161	53	451	50.6%	26.6%	41.1%
Non-Supervisory	336	81	30	437	49.0%	37.7%	58.3%
Not reported	3	1	0	4	0.4%	0.3%	0.6%
Total	**576**	**243**	**73**	**892**			

2. PHL Respondents by Job Classification and Gender

	Female	Male	Non-binary/ third gender	Prefer not to say	Not Reported	Total	% Female	% Male
Supervisor	160	67	1	3	6	237	68.0%	28.0%
Non-Supervisory	235	81	0	13	7	336	70.0%	24.0%
Not reported	2	0	0	0	1	3	67.0%	0.0%
Total	**397**	**148**	**1**	**16**	**14**	**576**	**69.0%**	**26.0%**

3. PHL Respondents by Age and Gender

	18 to 24	25 to 34	35 to 44	44 to 54	55 to 64	65+	Age Not Reported	Total	% of PHL
Female	9	71	110	100	92	13	2	397	68.9%
Male	0	33	48	27	33	7	0	148	25.7%
Non-binary/ third gender	0	0	0	1	0	0	0	1	0.2%
Prefer not to say	0	1	5	2	4	1	3	16	2.8%
Gender not Reported	0	1	4	2	5	0	2	14	2.4%
Total PHL	**9**	**106**	**167**	**132**	**134**	**21**	**7**	**576**	
% of All Respondents	**1.0%**	**11.9%**	**18.7%**	**14.8%**	**15.0%**	**2.4%**	**0.8%**	**65.0%**	
% of PHL	**1.6%**	**18.4%**	**29.0%**	**22.9%**	**23.3%**	**3.6%**	**1.2%**	**100.0%**	

4. Age and Gender Percentages for Total and PHL Respondent Groups
(Does not include non-binary/third gender, prefer not to say and gender not reported.)

		18 to 24	25 to 34	35 to 44	44 to 54	55 to 64	65+
% of All	Female	92.0%	69.0%	69.0%	76.0%	73.0%	68.0%
	Male	1.0%	29.0%	26.0%	19.0%	20.0%	25.0%
% of PHL	Female	100.0%	66.0%	66.0%	75.0%	69.0%	62.0%
	Male	0.0%	31.0%	29.0%	20.0%	25.0%	33.0%

5. Years of Experience in Public Health Laboratories by Gender

	None	<1 year	1-2 years	3-4 years	5-10 years	11-20 years	21-30 years	>30 years	Total
Female	4	25	41	50	79	130	46	20	395
Male	2	13	21	20	31	40	12	9	148
Non-binary/third gender	0	0	0	0	0	0	1	0	1
Prefer not to say	0	0	1	2	2	7	2	2	16
Gender Not Reported	0	0	0	0	4	1	0	0	5
Total	6	38	63	72	116	178	61	31	565
% of PHL Total	1.1%	6.7%	11.2%	12.7%	20.5%	31.5%	10.8%	5.5%	

6. Respondents by State

State	PHL Respondents	Non-governmental Clinical Respondents
Alabama	6	
Alaska	9	4
Arizona	10	7
Arkansas	20	
California	53	17
Colorado	9	4
Connecticut	16	5
Delaware	17	
District of Columbia	8	
Florida	7	3
Georgia	5	9
Hawaii	4	1
Idaho	5	
Illinois	1	2
Indiana	10	12
Iowa	18	8
Kansas	15	
Kentucky	4	
Louisiana	3	2
Maine	4	
Maryland	5	2
Massachusetts	3	8
Michigan	11	3
Minnesota	13	7
Mississippi	9	9
Missouri	19	9
Montana	3	1
Nebraska	5	11
Nevada	2	
New Hampshire	6	3
New Jersey	21	5

State	PHL Respondents	Non-governmental Clinical Respondents
New Mexico	7	
New York	39	4
North Carolina	17	10
North Dakota	1	1
Ohio	9	10
Oklahoma	4	1
Oregon	15	12
Pennsylvania	12	2
Puerto Rico	1	
Rhode Island	11	
South Carolina	8	
South Dakota	4	
Tennessee	14	22
Texas	22	12
Utah	9	4
Vermont	5	
Virginia	12	12
Washington	5	1
West Virginia	2	2
Wisconsin	11	
Wyoming	2	
Outside of the US	10	8
Not reported	35	8
Total	**576**	**243**

Appendix B: Survey Questions

Demographics

1. What type of laboratory do you work in? Please choose ONE that most closely matches your current place of employment.
- ☐ Public health laboratory
- ☐ Non-governmental clinical laboratory
- ☐ Other laboratory – please specify

1a. What best describes your current place of employment? Please choose ONE that most closely matches your current place of employment.
- ☐ State public health laboratory
- ☐ Local public health laboratory
- ☐ City public health laboratory
- ☐ Territorial public health laboratory
- ☐ Environmental health laboratory
- ☐ Agricultural laboratory
- ☐ Food safety laboratory
- ☐ Chemistry laboratory
- ☐ Forensics or Toxicology laboratory
- ☐ Other - please specify

1b. What best describes your current place of employment? Please choose ONE that most closely matches your current place of employment.
- ☐ Clinical laboratory
- ☐ Hospital laboratory
- ☐ Physician office laboratory
- ☐ Private laboratory
- ☐ Other – please specify

1c. What best describes your current place of employment? Please choose ONE that most closely matches your current place of employment.
- ☐ Federal organization/laboratory
- ☐ Pharmaceutical/Industry laboratory
- ☐ Private research laboratory
- ☐ University research laboratory
- ☐ Veterinary laboratory
- ☐ Other - please specify

2. What is your current job classification? Please choose ONE that most closely matches your current position.
- ☐ Supervisory
- ☐ Non-supervisory

2a. What is your current job title? Please choose ONE that most closely matches your current title.
- ☐ Laboratory Director
- ☐ Associate Director, Assistant Director or Deputy Director
- ☐ Quality assurance officer or manager
- ☐ Safety or biosafety officer
- ☐ Training supervisor or manager
- ☐ Technical supervisor or manager
- ☐ Administrative services or support services supervisor or manager
- ☐ Other - please specify

2b. What is your current job title? Please choose ONE that most closely matches your current title.
- ☐ Quality assurance officer or manager
- ☐ Safety or biosafety officer

☐ Training coordinator
☐ Other - please specify

3. In which area do you spend the majority of your time? Please choose ONE that most closely matches your area of work.
☐ Agricultural and food chemistry (e.g., human and animal food, dairy, water, pesticides, or radiologic testing)
☐ Agricultural and food microbiology (e.g., human and animal food, dairy, shellfish, water or animal diagnostic testing)
☐ Bacteriology
☐ Biosafety / Biosecurity
☐ Clinical chemistry
☐ Clinical hematology
☐ Clinical microbiology
☐ Clinical safety / security
☐ Clinical other (e.g., PCR, molecular)
☐ Education and training (e.g. development/delivery of training resources)
☐ Emergency preparedness and response
☐ Environmental chemistry (e.g., inorganics, organics, radiation, trace metals, water or air quality)
☐ Environmental health testing (e.g., pediatric lead testing, human biomonitoring)
☐ Environmental microbiology
☐ Forensics
☐ Information Technology (IT)
☐ Informatics
☐ Laboratory administration / operations
☐ Laboratory quality assurance and/or continuing quality improvement
☐ Laboratory regulation and inspection
☐ Molecular biology
☐ Mycology
☐ Newborn screening
☐ Parasitology
☐ Pharmaceuticals
☐ Research
☐ Serology/immunology
☐ Toxicology
☐ Veterinary laboratory services
☐ Virology
☐ Other – please specify

4. What is the approximate number of employees that work in your laboratory?
☐ 25 or less
☐ 26 to 50
☐ 51 to 100
☐ 101 to 250
☐ 251 to 500
☐ > 500
☐ Not sure

5. Please respond to the following questions regarding APHL:

	Yes	No	I don't know
Is your laboratory an APHL member?	☐	☐	☐
Are you currently an APHL member?	☐	☐	☐

6. What is your age?
☐ 18 to 24
☐ 25 to 34
☐ 35 to 44
☐ 44 to 54

- ☐ 55 to 64
- ☐ 65+

Responsibility

7. How many individuals do you manage?
- ☐ None
- ☐ 10 or less
- ☐ 11-15
- ☐ 16-20
- ☐ 21-25
- ☐ 26-50
- ☐ 51-100
- ☐ 101-250
- ☐ 251-500
- ☐ 501-1,000
- ☐ More than 1,000

8. What is your involvement in regard to training or continuing education? Check all that apply.

Internal Training
- ☐ Attend training
- ☐ Provide content
- ☐ Develop training
- ☐ Deliver training
- ☐ Set requirements
- ☐ Approve training
- ☐ Make recommendations
- ☐ Train internal staff
- ☐ Provide training resources

External Training
- ☐ Attend training
- ☐ Provide content
- ☐ Develop training
- ☐ Deliver training
- ☐ Set requirements
- ☐ Approve/provide training
- ☐ Make recommendations
- ☐ Train other organization's staff
- ☐ Provide training resources

9. In terms of your own training or continuing education, what choice do you have in what training provider you use?
- ☐ Primarily my decision
- ☐ Shared decision
- ☐ Others in the organization primarily make the decision

Financial Sources

10. Who pays for you to participate in training or continuing education? Check all that apply.
- ☐ Employer pays entire cost
- ☐ Shared between employer and me
- ☐ I am reimbursed by employer
- ☐ I pay for the entire cost
- ☐ I use personal time
- ☐ I use paid time off
- ☐ Sponsored by external partner (e.g. APHL, CDC, other)

☐ Part of organization benefits package

11. How are the training activities in your organization paid for? Check all that apply.
   ☐ Individual's personal funds
   ☐ Individual's training allowance
   ☐ Organization budget
   ☐ Grants
   ☐ Training awards
   ☐ No cost options

12. Does your organization have a formal plan or policy regarding training and continuing education?
   ☐ Yes
   ☐ No

Training Topics

To help prioritize training development, questions 13 through 16 are to identify those topics that are either an important or critical need. If this does not apply, leave the topic blank.

13. How would you rate the need for training in the following scientific/technical topics for YOURSELF?

   Low priority   Important need   Critical need

14. How would you rate the need for training in the following technology topics for YOURSELF?

   Low priority   Important need   Critical need

15. How would you rate the need for training in the following management topics for YOURSELF?

   Low priority   Important need   Critical need

16. How would you rate the need for training in the following leadership and professional development topics for YOURSELF?

   Low priority   Important need   Critical need

[Items 13a through 16a for supervisory respondents only]

13a. How would you rate the need for training in the following scientific/technical topics for YOUR STAFF?

   Low priority   Important need   Critical need

14a. How would you rate the need for training in the following technology topics for YOUR STAFF?

   Low priority   Important need   Critical need

15a. How would you rate the need for training in the following management topics for YOUR STAFF?

   Low priority   Important need   Critical need

16a. How would you rate the need for training in the following leadership and professional development topics for YOUR STAFF?

   Low priority   Important need   Critical need

[Items 17a through 17d - Drop-down list selections per individual topics]

   ☐ Classroom
   ☐ Seminars
   ☐ Completing designated assignments
   ☐ Conferences

- ☐ Group activities with a tutor/teacher
- ☐ Manufacturer-provided training
- ☐ On demand eLearning (self-paced)
- ☐ Online facilitated (synchronous)
- ☐ On-the-job training
- ☐ Self-teaching references
- ☐ Simulations
- ☐ Videos
- ☐ Working alone through course materials
- ☐ Workshops
- ☐ Webinars

17a. How do you prefer to learn for the following scientific technical topics?

17b. How do you prefer to learn for the following technology topics?

17c. How do you prefer to learn for the following management topics?

17d. How do you prefer to learn for the following leadership and development topics?

18. What state-of-the-art technology or processes would you like to incorporate in your lab? Check all that apply.
- ☐ Not applicable
- ☐ Artificial intelligence
- ☐ Bead-based multiplexing
- ☐ Bioinformatics
- ☐ Biomonitoring
- ☐ Bioterrorism Detection
- ☐ Chemical threat detection
- ☐ Digital Droplet PCR
- ☐ Electronic data exchange
- ☐ Genetic testing
- ☐ MALDI-TOF
- ☐ Metagenomics
- ☐ Privacy maintenance
- ☐ qPCR
- ☐ qRT-PCR
- ☐ Radiochemical threat detection Robotics
- ☐ Sequencing (next-generation sequencing (NGS), whole genome sequencing (WGS))
- ☐ Testing software/materials
- ☐ Other - please specify

19. How do you measure your employee training effectiveness as it relates to their job performance? Check all that apply.
- ☐ Customer satisfaction
- ☐ Few errors
- ☐ Faster turnaround
- ☐ Staff require less supervision
- ☐ Staff take on expanded work responsibility
- ☐ Documentation of competencies
- ☐ Passing of Proficiency Testing
- ☐ Performance reviews/evaluation
- ☐ Other - please specify

Demographics

20. How many TOTAL years of experience do you have working in one or more laboratories of ANY TYPE?
    - ☐ None
    - ☐ < 1 year
    - ☐ 1-2 years
    - ☐ 3-4 years
    - ☐ 5-10 years
    - ☐ 11-20 years
    - ☐ 21-30 years
    - ☐ >30 years

21. How many years of experience do you have working in your current laboratory?
    - ☐ None
    - ☐ < 1 year
    - ☐ 1-2 years
    - ☐ 3-4 years
    - ☐ 5-10 years
    - ☐ 11-20 years
    - ☐ 21-30 years
    - ☐ > 30 years

22. How many TOTAL years of experience do you have working in one or more PUBLIC HEALTH LABORATORIES?
    - ☐ None
    - ☐ < 1 year
    - ☐ 1-2 years
    - ☐ 3-4 years
    - ☐ 5-10 years
    - ☐ 11-20 years
    - ☐ 21-30 years
    - ☐ > 30 years

23. In what state or territory does your laboratory reside in?
    [displayed a drop down list of US states and territories]

24. What is your gender?
    - ☐ Female
    - ☐ Male
    - ☐ Non-binary/third gender
    - ☐ Prefer to self-describe
    - ☐ Prefer not to say

25. Please check your highest level of education.
    - ☐ High school diploma/GED
    - ☐ Associate's degree
    - ☐ Bachelor's level (BS, BA, etc.)
    - ☐ Masters level (MS, MPH, MBA, MPA, MPP, etc.)
    - ☐ Doctoral level (PhD, DrPH, DSc, ScD, MD, DVM, DDS, etc.)

26. In what field of study is your highest degree?
    - ☐ Chemistry/biochemistry
    - ☐ Biology/zoology
    - ☐ Medical technology/Medical laboratory science
    - ☐ Microbiology
    - ☐ Molecular biology

- ☐ Public health
- ☐ Other - please specify
- ☐ Not applicable

27. Are you required to hold licensure or certification for your current position?

- ☐ Yes
- ☐ No

27a. Are you required to obtain continuing education units (CEUs)?
- ☐ Yes
- ☐ No

27b. Which of the following licenses/certifications do you currently hold? Check all that apply.
- ☐ National generalist certification such as Medical Laboratory Scientist, Medical Technologist, Environmental Laboratory Technologist (ASCP BOC, AMT, AAB, ISCLT, NREP)
- ☐ National specialist certification, such as Microbiology, Molecular Biology or Analytical
- ☐ Chemistry (ABMM, ABMLI, NRCM, AAB, ASCP BOC)
- ☐ Licensure by a state entity to practice laboratory science
- ☐ Other lab licenses or certifications
- ☐ I do not currently hold any licenses or certifications

Training Quality

28. What other training providers have you used in the last 3 years? Check all that apply.
- ☐ American Association for Clinical Chemistry
- ☐ American Association of Bioanalysts
- ☐ American Association of Physician Offices and Laboratories
- ☐ American Medical Technologists
- ☐ American Proficiency Institute
- ☐ American Society for Clinical Laboratory Science
- ☐ American Society for Clinical Pathology
- ☐ American Society for Microbiology
- ☐ Association of Public Health Laboratories
- ☐ Centers for Disease Control and Prevention (CDC)
- ☐ Clinical Laboratory and Standards Institute
- ☐ Clinical Laboratory Management Association
- ☐ COLA
- ☐ College of American Pathologists
- ☐ Food and Drug Administration (FDA)
- ☐ National Laboratory Training Network (NLTN)
- ☐ Regional and Branch Groups of American Society for Microbiology
- ☐ State laboratories
- ☐ US Environmental Protection Agency
- ☐ Other - please specify
- ☐ None of these

29. What are the main reasons that you attend training? Check all that apply.
- ☐ Maintain accreditation
- ☐ Maintain certification/licensure
- ☐ Increase knowledge in a particular subject area/ nationally-recognized speaker
- ☐ Method of training delivery is very effective
- ☐ Staying current or up-to-date
- ☐ Available at no charge or minimal costs
- ☐ Opportunity to network

- ☐ Personal growth or career development
- ☐ Promotion or career advancement
- ☐ Required by my supervisor or management
- ☐ Other - please specify

30. In terms of hurdles toward your professional development training, how likely are you to agree or disagree with the following statements?

	Strongly disagree	Disagree	Agree	Strongly agree
Making time to learn is difficult.	☐	☐	☐	☐
Budgets often dictate what I can do.	☐	☐	☐	☐
I have no say in my training or continuing education.	☐	☐	☐	☐
Traveling to an off-site location is difficult.	☐	☐	☐	☐
Management doesn't value training or continuing education.	☐	☐	☐	☐
The price of training is high.	☐	☐	☐	☐
There are few trainings that interest me.	☐	☐	☐	☐
Online trainings are few and far between.	☐	☐	☐	☐
It is difficult to access online training because of IT and security in the lab.	☐	☐	☐	☐
I do not receive information in a consistent or timely manner about trainings.	☐	☐	☐	☐
Training budgets are adequate.	☐	☐	☐	☐

Appendix C: Training Topics Listings

1. Scientific/Technical

1. Antimicrobial Resistance - Antimicrobial susceptibility testing
2. Bioinformatics - Basics
3. Bioinformatics - Application in clinical laboratory
4. Bioinformatics - Application in public health laboratory
5. Bioinformatics - Data analysis
6. Biosafety/Biosecurity - Biothreat agents
7. Biosafety/Biosecurity - MALDI-TOF
8. Biosafety/Biosecurity - Risk assessment
9. Chemistry - Clinical chemistry
10. Chemistry - Biomonitoring
11. Chemistry - Lead testing
12. Emergency Preparedness - Chemical threat agents
13. Emergency Preparedness - Ebola preparedness
14. Emergency Preparedness - Emerging pathogen preparedness
15. Emergency Preparedness - MALDI-TOF
16. Emergency Preparedness - Sentinel bioterrorism
17. Emergency Preparedness - Gram stains
18. Emergency Preparedness - Plate reading
19. Emergency Preparedness - Radiological threats
20. Emergency Preparedness - Rule-in/Rule-out
21. Epidemiology - Epidemiology for laboratory professionals
22. Environmental - Environmental monitoring
23. Environmental - Environmental microbiology
24. Environmental - Environmental chemistry
25. Environmental - Environmental radiochemistry
26. Environmental - Instrument training
27. Environmental - Sample collection handling/transport (chain of custody)
28. Environmental - Data analysis
29. Environmental - Suggestion of platforms
30. Environmental - LIMS training
31. Environmental - Pesticide testing
32. Environmental - Opioids testing
33. Food Testing - Allergen testing in food
34. Food Testing - Bacterial foodborne diseases
35. Food Testing - Bovine spongiform encephalopathy (BSE) testing
36. Food Testing - Chemical dye testing in food
37. Food Testing - Food microbiology
38. Food Testing - Food chemistry
39. Food Testing - Filth testing in human food
40. Food Testing - Genomics and metagenomics
41. Food Testing - GOOD samples and GOOD test portions
42. Food Testing - Label review
43. Food Testing - Parasitic foodborne diseases
44. Food Testing - Viral foodborne diseases
45. Hematology - Flow cytometry
46. Information Systems - Data analysis
47. Information Systems - Digital tools
48. Information Systems - Electronic data exchange
49. Information Systems - Laboratory automation
50. Information Systems - Laboratory informatics
51. Laboratory Safety – Biological

52. Laboratory Safety – Chemical
53. Laboratory Safety – Radiation
54. Laboratory Science and Practice Fundamentals - Basic laboratory instrumentation
55. Laboratory Science and Practice Fundamentals - Laboratory math
56. Laboratory Science and Practice Fundamentals - Quality assessments and auditing
57. Laboratory Science and Practice Fundamentals - Quality control/Quality assurance
58. Laboratory Science and Practice Fundamentals - Quality management systems
59. Laboratory Science and Practice Fundamentals - Test validation
60. Laboratory Standards and Guidelines - Regulations that affect laboratory practice (e.g., HIPAA, CLIA, EPA)
61. Laboratory Standards and Guidelines - ISO standards
62. Microbiology - Conventional microbiology methods
63. Microbiology - Gram stain and other preparations
64. Microbiology - Emerging infectious diseases
65. Microbiology - Microscopy basics
66. Microbiology - Microscopy techniques
67. Microbiology - Mycobacteriology
68. Microbiology - Mycology basics
69. Microbiology - Mycology advanced
70. Microbiology - Parasitology: intestinal
71. Microbiology - Parasitology: bloodborne
72. Microbiology - Parasitology: molecular
73. Molecular Diagnostics - Sequencing (next-generation sequencing (NGS), whole genome sequencing (WGS))
74. Molecular Diagnostics - PCR / Real time PCR
75. Newborn Screening (NBS) - Genetic testing – Biochemical
76. Newborn Screening (NBS) - Genetic testing – Molecular
77. Newborn Screening (NBS) - Blood lead testing
78. Packaging and Shipping
79. Serology/Immunology - HIV/AIDS
80. Serology/Immunology - Sexually transmitted diseases (STD)
81. Toxicology
82. Vaccine Preventable Diseases
83. Virology - Ebola
84. Virology - Hepatitis
85. Virology - Rabies - PCR
86. Virology - Rabies - DFA
87. Virology - Vector borne virus
88. Virology – Zika

2. **Technology**
    1. Environmental Technology - IR
    2. Environmental Technology - FTIR
    3. Environmental Technology - GC/MS/MS
    4. Environmental Technology - Hyphenated technique
    5. Environmental Technology - ICP/MS
    6. Environmental Technology - LC/MS/MS
    7. Environmental Technology - RAMAN
    8. Flow Cytometry
    9. Informatics - Analyzing and managing data from non-targeted analyses

10. Informatics - Artificial intelligence
11. Informatics - Big data
12. Informatics - Biomonitoring data
13. Informatics - Electronic data exchange
14. Informatics - Opioids surveillance
15. Informatics - Robotics
16. Informatics - Digital tools
17. Matrix Assisted Laser Desorption/Ionization (MALDI-TOF)
18. Molecular Diagnostics – Sequencing technology and instrumentation (next-generation sequencing (NGS), whole genome sequencing (WGS))
19. Molecular Diagnostics - PCR/Real-time PCR

3. Management
1. Personnel - Effective communication
2. Personnel - Team building
3. Personnel - Team management work styles
4. Personnel - Training of trainers skills
5. Organizational - Strategic planning
6. Personnel - Competency assessment
7. Financial/Budgeting - Grant writing
8. Project - Project management
9. Laboratory - Quality systems management
10. Project - Presentation training
11. Organizational - Managing change
12. Project - Effective presentations
13. Project - Facilitating effective meetings
14. Personnel - Science communication
15. Organizational - LEAN processes
16. Laboratory - Electronic data exchange
17. Project - Storytelling
18. Laboratory - HIPAA guidelines and updates
19. Financial/Budgeting - Financial management
20. Financial/Budgeting - Billing
21. Laboratory - Electronic health records
22. Organizational - Media communication skills
23. Financial/Budgeting - Medicare
24. Financial/Budgeting – Coding

4. Leadership and Professional Development
1. Competencies - Development and use of competencies
2. Competencies - Adoption and implementation of competencies
3. Communication Techniques - Coaching
4. Communication Techniques - Crucial conversations
5. Communication Techniques - Difficult conversations
6. Communication Techniques - Mentoring
7. Communication Techniques - Presentation skills
8. Communication Techniques - Storytelling
9. Communication Techniques - Training delivery techniques
10. Competencies - Use of competencies in competence assessment
11. Conflict resolution
12. Crisis management
13. Epidemiology for laboratory professionals
14. Leadership theory and fundamentals
15. Scientific ethics

Appendix D: Top 10 Critical Need Training Topics for PHLs

1. Supervisors' Top 10 Critical Training Needs in Scientific/Technical Topics for PHL Staff (by count)

Q 13a. How would you rate the need for training in the following scientific/technical topics for YOUR STAFF?

Rank	Topic	n=237	% Respondent
1	Bioinformatics - Application in public health laboratory	69	29.0%
2	Bioinformatics - Data analysis	66	28.0%
3	Laboratory Standards and Guidelines - Regulations that affect laboratory practice (e.g., HIPAA, CLIA, EPA)	63	27.0%
4	Molecular Diagnostics - Sequencing (next-generation sequencing (NGS), whole genome sequencing (WGS))	63	27.0%
5	Laboratory Science and Practice Fundamentals - Quality control/Quality assurance	60	25.0%
6	Bioinformatics - Basics	59	25.0%
7	Laboratory Science and Practice Fundamentals - Test validation	57	24.0%
8	Laboratory Safety – Biological	56	24.0%
9	Molecular Diagnostics - PCR / Real time PCR	52	22.0%
10	Laboratory Science and Practice Fundamentals - Quality assessments and auditing	49	21.0%

2. Top 10 Critical Training Needs in Scientific/Technical Topics for All PHL Staff (supervisory and non-supervisory) (by count)

Q 13. How would you rate the need for training in the following scientific/technical topics for YOURSELF?

Rank	Topic	n=576	% Respondent
1	Laboratory Standards and Guidelines - Regulations that affect laboratory practice (e.g., HIPAA, CLIA, EPA)	151	26.2%
2	Molecular Diagnostics - Sequencing (next-generation sequencing (NGS), whole genome sequencing (WGS))	135	23.4%
3	Laboratory Science and Practice Fundamentals - Test validation	133	23.1%
4	Bioinformatics - Application in public health laboratory	132	22.9%
5	Laboratory Science and Practice Fundamentals - Quality control/Quality assurance	121	21.0%
6	Emergency Preparedness - Emerging pathogen preparedness	111	19.3%
7	Bioinformatics - Data analysis	108	18.8%
8	Laboratory Science and Practice Fundamentals - Quality assessments and auditing	107	18.6%
9	Laboratory Science and Practice Fundamentals - Quality management systems	103	17.9%
10	Laboratory Standards and Guidelines - ISO standards	98	17.0%
10	Molecular Diagnostics - PCR / Real time PCR	98	17.0%

3. Supervisors' Top 10 Critical Training Needs in Technology Topics for PHL Staff (by count)

Q 14a. How would you rate the need for training in the following technology topics for YOUR STAFF?

Rank	Topic	n=237	% Respondent
1	Molecular Diagnostics – Sequencing technology and instrumentation (next-generation sequencing (NGS), whole genome sequencing (WGS))	66	27.8%
2	Molecular Diagnostics - PCR/Real-time PCR	46	19.4%
3	Matrix Assisted Laser Desorption/Ionization (MALDI-TOF)	34	14.3%
4	Informatics - Electronic data exchange	30	12.7%

Rank	Topic	n=237	% Respondent
5	Informatics - Analyzing and managing data from non-targeted analyses	26	11.0%
6	Informatics - Digital tools	25	10.5%
7	Informatics - Big data	23	9.7%
8	Environmental Technology - LC/MS/MS	21	8.9%
9	Informatics - Biomonitoring data	20	8.4%
10	Environmental Technology - GC/MS/MS	18	7.6%

4. Top 10 Critical Training Needs in Technology Topics for All PHL Staff (supervisory and non-supervisory) (by count)

Q 14. How would you rate the need for training in the following technology topics for YOURSELF?

Rank	Topic	n=576	% Respondent
1	Molecular Diagnostics – Sequencing technology and instrumentation (next-generation sequencing (NGS), whole genome sequencing (WGS))	137	23.8%
2	Molecular Diagnostics - PCR/Real-time PCR	93	16.1%
3	Informatics - Electronic data exchange	72	12.5%
4	Informatics - Analyzing and managing data from non-targeted analyses	71	12.3%
5	Informatics - Digital tools	59	10.2%
6	Informatics - Big data	58	10.1%
7	Informatics - Biomonitoring data	51	8.9%
8	Matrix Assisted Laser Desorption/Ionization (MALDI-TOF)	42	7.3%
9	Environmental Technology - LC/MS/MS	38	6.6%
10	Environmental Technology - GC/MS/MS	37	6.4%

5. Supervisors' Top 10 Critical Training Needs in Management Topics for PHL Staff (by count)

Q 15a. How would you rate the need for training in the following management topics for YOUR STAFF?

Rank	Topic	n=237	% Respondent
1	Personnel - Effective communication	72	30.4%
2	Personnel - Team building	72	30.4%
3	Personnel - Science communication	53	22.4%
4	Personnel - Team management work styles	52	21.9%
5	Personnel - Competency assessment	48	20.3%
6	Laboratory - Quality systems management	42	17.7%
7	Organizational - Managing change	41	17.3%
8	Personnel - Training of trainers skills	39	16.5%
9	Project - Project management	39	16.5%
10	Organizational - LEAN processes	38	16.0%

6. Top 10 Critical Training Needs in Management Topics for All PHL Staff (supervisory and non-supervisory) (by count)

Q 15. How would you rate the need for training in the following management topics for YOURSELF?

Rank	Topic	n=576	% Respondent
1	Personnel - Effective communication	113	19.6%
2	Personnel - Team building	110	19.1%

Rank	Topic	n=576	% Respondent
3	Personnel - Team management work styles	107	18.6%
4	Personnel - Training of trainers skills	107	18.6%
5	Organizational - Strategic planning	105	18.2%
6	Personnel - Competency assessment	102	17.7%
7	Financial/Budgeting - Grant writing	101	17.5%
8	Project - Project management	99	17.2%
9	Laboratory - Quality systems management	95	16.5%
10	Project - Presentation training	95	16.5%

7. Supervisors' Top 10 Critical Training Needs in Leadership and Professional Development Topics for PHL Staff (by count)

Q 16a. How would you rate the need for training in the following leadership and professional development topics for YOUR STAFF?

Rank	Topic	n=237	% Respondent
1	Conflict resolution	58	24.0%
2	Communication Techniques - Difficult conversations	52	22.0%
3	Scientific ethics	46	19.0%
4	Communication Techniques - Crucial conversations	42	18.0%
5	Crisis management	42	18.0%
6	Communication Techniques - Presentation skills	36	15.0%
7	Epidemiology for laboratory professionals	35	15.0%
8	Competencies - Adoption and implementation of competencies	32	14.0%
9	Communication Techniques - Training delivery techniques	32	14.0%
10	Competencies - Use of competencies in competence assessment	31	13.0%

8. Top 10 Critical Training Needs in Leadership and Professional Development Topics for All PHL Staff (supervisory and non-supervisory) (by count)

Q 16. How would you rate the need for training in the following leadership and professional development topics for YOURSELF?

Rank	Topic	n=576	% Respondent
1	Conflict resolution	139	24.1%
2	Communication Techniques - Difficult conversations	138	24.0%
3	Communication Techniques - Crucial conversations	123	21.4%
4	Epidemiology for laboratory professionals	112	19.4%
5	Communication Techniques - Mentoring	110	19.1%
6	Crisis management	109	18.9%
7	Leadership theory and fundamentals	102	17.7%
8	Communication Techniques - Training delivery techniques	98	17.0%
9	Communication Techniques - Coaching	94	16.3%
10	Communication Techniques - Presentation skills	94	16.3%

Appendix E: Glossary of Terms

Baby Boomer	A member of the generation born between 1944 and 1964.
Classroom	A place in which all students interested in a particular topic or concept meet in person at certain time(s) under the supervision of a teacher who provide structured dissemination of information and content sharing.
Clinical	A laboratory where testing is performed on samples to obtain information about the health of a patient to aid in diagnosis, treatment and prevention of disease. Most hospital laboratories are considered clinical laboratories.
For self	A person (either supervisor or non-supervisor) sharing their personal training needs.
For staff	A supervisory person conveying the training needs of the people they lead.
Gen-Xer	A member of the generation born between 1965 and 1979.
Group activities with a tutor/teacher	Learners construct their own knowledge and learning supported by a guide or instructor.
Micro-learning	An instructional technology that deals with relatively small learning units and short-term learning activities. The term is used in e-learning and related fields in the sense of learning processes in mediated environments.
Millennial	A member of the generation born between 1980 to 1994.
Non-governmental	Laboratories found in organizations that are separate from a government structure (local, city, state, federal). For example, laboratories found in private hospitals or physician offices are considered to be non-governmental laboratories.
Non-manager	Laboratory staff who perform tasks and work under the direction of a lead person. Could also be referred to as laboratory staff.
Non-probability sampling method	A sampling technique where the samples are gathered in a process that does not give all the individuals in the population equal chances of being selected. Convenience sampling is probably the most common of all sampling techniques. With convenience sampling, the samples are selected because they are accessible to the researcher.
Other laboratories	Not clinical or public health laboratories. These laboratories are can be in universities, reference or research facilities.
PHL	Public health laboratories (PHL) focus on diseases and the health status of population groups. Most perform limited diagnostic testing. Laboratory testing is focused on reference testing, and/or disease surveillance. They also provide laboratory emergency response support, may perform applied research, and often conduct or support training for laboratory personnel, including those found in clinical, non-governmental and other laboratories.
Seminar	An in person conference or other meeting for discussion or training where a group of people address a specific topic or subject matter.
Sentinel	In the broadest sense, all laboratories capable of analyzing or referring samples that may contain microbial agents, biological toxins, chemical agents, chemical agent metabolites, or radiological agents of public health significance function as sentinels in the public health laboratory system.
Staff	Personnel who perform assigned tasks and work under the direction of a supervisor or manager.
Supervisory	Personnel who perform the organization's administrative tasks and work to direct and lead the staff in a work unit. A job classification that represents any of the following job titles: • Laboratory Director • Associate Director, Assistant Director or Deputy Director • Quality assurance officer or manager • Safety or biosafety officer • Training supervisor or manager • Technical supervisor or manager • Administrative services or support services supervisor or manager.

Webinar	An educational, informative or instructional presentation that is made available online, usually as either video or audio with slides. The activity may be attended as a live presentation or recorded, archived and viewed at another time or location.
Workshop	A usually brief intensive educational program for a relatively small group of people that focuses especially on techniques, discussion, activities and skills in a particular subject or project. There is a period of discussion or practical work on a particular subject in which a group of people share their knowledge or experience.

Notes

Association of Public Health Laboratories

The Association of Public Health Laboratories (APHL) works to strengthen laboratory systems serving the public's health in the US and globally. APHL's member laboratories protect the public's health by monitoring and detecting infectious and foodborne diseases, environmental contaminants, terrorist agents, genetic disorders in newborns and other diverse health threats.

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