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EVALUATING THE ASSOCIATION OF PUBLIC HEALTH LABORATORIES (APHL)/
CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC)
EMERGING INFECTIOUS DISEASE (EID) LABORATORY TRAINING FELLOWSHIP PROGRAM

BY

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K. Leigh Inge Vaughan
M.P.H., Emory University 2016
B.A., Boston University, 1985

Thesis Committee Chair: Kathleen R. Miner, PhD, MPH, MCHES

An abstract of
A Thesis submitted to the Faculty of the
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Abstract

EVALUATING THE ASSOCIATION OF PUBLIC HEALTH LABORATORIES (APHL)/CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC) EMERGING INFECTIOUS DISEASE (EID) LABORATORY TRAINING FELLOWSHIP PROGRAM

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Introduction
CDC believes laboratory training fellowship programs support the public health laboratory (PHL) workforce. The APHL/CDC EID Laboratory Training Fellowship Program began in 1995 to train and prepare scientists for PHL careers and support infectious disease initiatives. Program evaluation, which helps determine whether or not a program has achieved its intended effects, has never been conducted on this program. This thesis project's purpose is to:

- conduct a utilization-focused evaluation research study of this program, and
- provide recommendations for future evaluations of this and other programs.

Methods
Data were obtained from program archives, published program descriptions, and from a sample of 70 "final reports" submitted by 202 participating fellows between 2004 and 2014, which included fellows'

- fellowship experiences,
- program objectives,
- lab/research training,
- participation in: publications; outbreak investigations; conferences; short-term international assignments.

Fellows' activity data were quantitatively tabulated. Narrative data were qualitatively analyzed by using applied thematic analysis, with the final reports iteratively read, memoed, and coded.

Results
1. EID program's intended effects defined.
Fellows:

- gained knowledge of the PHL system by participating in activities.
- increased and/or initially acquired PHL or related skills.
- had their training and research objectives met.

2. Enumeration of fellows' activity participation; 69/70 participated in at least one activity.

3. Themes, sub-themes and codes. Four major themes were identified:

- Professional Capability: professional laboratory or related products (e.g. publication) benchmarks of experience (e.g. lab skills).
- Understanding Public Health: the "big picture" of public health and laboratories' role.
- Career Assistance: informing career plans; networking.
- Fellowship Experience: positive/negative influences.

4. The program met or exceeded the objectives of most (58/70) fellows.

5. An unintended program effect: the program's impact on fellows was frequently more pronounced in relation to the "Understanding public health" than "Professional capability" theme. The gist of the intended effects relates directly to laboratory experiences- the "Understanding public health" does not.

6. A retroactive logic model.

Conclusions

Recommendations for improving program accountability and evaluation:
Develop:

- tools for program success indicators, utilizing resources.
- metrics for benchmarks.
- an updated logic model, to aid gap identification.
- continuous quality improvement components.
- preparations for staff turnover to allow seamless transitions.

EVALUATING THE ASSOCIATION OF PUBLIC HEALTH LABORATORIES (APHL)/CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC) EMERGING INFECTIOUS DISEASE (EID) LABORATORY TRAINING FELLOWSHIP PROGRAM

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CHAPTER I: INTRODUCTION

Introduction

Public Health (PH) Laboratories are a vital part of public health (1) and the Centers for Disease Control and Prevention (CDC) considers laboratory training fellowship programs to be one way to aid the goal of training and preparing scientists for careers in the public health laboratory system. (2) (3)

To demonstrate the value of any program, the characteristics of the program need to be evaluated, relative to its goals and objectives. This optimally involves examining the metrics designed to measure whether or not benchmarks relative to program success have been met. Ideally, program developers define associated metrics for evaluation prior to the start of any program. This allows a process-based data-driven approach for continuous quality improvement (CQI) (4) as well as a gauge of program effectiveness. When a program's purpose is clearly understood, an evaluation of the program's outputs should indicate if the program has achieved its intended effects, relative to program goals and objectives.

A formal program evaluation is a valuable tool in determining whether or not, or to what degree, a program has achieved desired effects. From the 2012 CDC Guidelines (5), program evaluation is considered a "systematic collection of information about the activities, characteristics, and outcomes of programs, in order to make judgments about that program, improve program effectiveness, and/or inform future decisions about program development."

The Association of Public Health Laboratories (APHL)/CDC Emerging Infectious Disease (EID) Laboratory Fellowship Training Program has existed for over 20 years. No formal evaluation of this program has ever been conducted and specific metrics for the outputs and outcomes of the EID program have not been defined. Consequently, there have been no measurements to determine the effect(s) of this program or to inform potential laboratory training fellowship program improvements. A formal evaluation of the EID program would provide relevant information for this program as well as other laboratory training programs, which could help justify their continuation. One of the challenges in evaluating this program is that it has been inherited over the years by a variety of staff, and the initial set of guidelines and intentions by its developers are unavailable.

Objective and Purpose Statement

There is a strong belief by EID program stakeholders, that the EID program, and similar programs, have a positive impact on domestic public health by supporting a competent PH laboratory workforce.

The purpose of this project is to:

- conduct a utilization-focused evaluation research study on the APHL/CDC EID Laboratory Fellowship Program, and

- provide recommendations for evaluation of current and future laboratory fellowship training programs managed by the Scientific Program and Services Branch (SPSB) Partnerships and Training Programs (PTP) team at CDC.

Research Questions

The research questions for this evaluation research study are:

1. What were the intended effects of the EID program?
2. What was/were the unintended effect(s) of the EID program?

CHAPTER II: REVIEW OF THE LITERATURE

Introduction to Chapter II

In order to explain the relevance of this project, it is necessary to understand the importance and usefulness of public health laboratories (PHLs), their place in the public health field, the need for a robust PHL workforce, and the purpose served by a laboratory training fellowship program. Because this project focuses on evaluating the EID program, within the limits of available resources, the description of a fellowship program in general and the EID program, specifically, is given. "Program evaluation" is presented here as an organizational tool to inform stakeholders and help set standards and practices in support of successful programs. Additional available laboratory competency material that might be used for future program evaluations is described.

Public Health Laboratories

- Public health laboratories (PHLs) have a workforce that includes highly trained laboratory professionals. They are the "backbone" of a system geared to respond to a variety of public health emergencies, which arise from biological, chemical, foodborne or environmental causes. (6)
- Maintaining a system of quality laboratory testing is a vital part of the initial and continuing responses to public health threats. Decisions impacting health, economic and logistical factors rely on rapid and accurate laboratory testing, which are spearheaded by public health laboratories. (7)
- Public health laboratories provide services not available elsewhere. (8)
- A well-trained laboratory workforce is necessary for PHLs to carry out their activities. (9) (10) Maintaining our federal, state, territorial and local (PH) laboratory workforce is necessarily a vital part of a robust domestic public health laboratory system.

Evaluation

Program evaluation has been a factor over the years in helping to conclude to what extent a program has been implemented as expected, i.e. whether or not program goals and objectives (the intended effects) have been met, and what unexpected consequences (the unintended effects) resulted from the program.[11] A formal program evaluation revolves around a systematic examination of program activities, outputs and outcomes within the context of the program's purpose. Evaluations should be not only accurate, but useful and targeted to the intended users. A well-designed evaluation is therefore user-focused and attempts to meet the expectations of stakeholders regarding the assessment of program factors of greatest concern. (11) The intended user of the current evaluation is the Partnerships and Training Programs (PTP) team at CDC, who requested this evaluation research study as a means to inform future program evaluations.

A program's logic model, if available, can be an integral part of the evaluation process, as it can help give a "big picture" overview of the program and/or a focus on programmatic details. Program evaluation is considered an important component of program quality for both government and private agencies, including those in public health. (12) (13) (14) (15) (16) (17)

Emerging Infections Disease (EID) APHL/CDC Laboratory Fellowship Training Program

The EID fellowship program began in 1995 as an aid to supporting the PHL workforce. A fellowship program is designed to complement the educational experience(s) of the participants ("fellows") by providing a venue in which a fellow can gain more intensive on-the-job-type training, usually with active input and a degree of control of the experience by the fellow (18). A laboratory training fellowship focuses on providing training specific to laboratory science. These fellowships can include training in laboratory:

- technical methods,
- processes,
- procedures,
- analyses, and
- research disciplines.

An explicit description from the original program justification of the EID program, relative to its goals and objectives, is not available. However, institutional knowledge regarding the initiation of this program and its purpose exists from:

- APHL (the Association of Public Health Laboratories),
- CDC internal documentation, and
- published program-related material.

APHL and CDC, program partners from the inception of the program, have documentation for the EID program that describes the program's overarching goals:

1) training and preparing scientists for careers in public health laboratories, as a means to improve the public health workforce, and
2) supporting public health initiatives related to infectious disease research.

These goals were expected to be met by providing an opportunity for the fellows to gain:

- practical application experience in laboratory technology and methodology, including research skills, and
- general public health laboratory system knowledge and its relationship to other areas of public health.

The original public announcement of the program, published in 1995 (19) includes a similar explanation of the program.

CDC is an agency of the U.S. Department of Health & Human Services (HHS), which has a stated mission "To enhance and protect the health and well-being of all Americans." (20) The above description of the EID program demonstrates an alignment of CDC goals with HHS Strategic Goal 4, Objective C, of strengthening the nation's health and human services infrastructure and workforce, and has been given as a basis for the program's existence. (21)

Metrics specific to program benchmarks of achievements, which would allow a standardized review and evaluation of the effects of the EID program, were not included in the original program design. However, an end-of-fellowship questionnaire was answered by each fellow who finished the program and these answers are available as the fellows' final reports.

Since the instigation of the EID program, there have been advances in the identification of competencies relevant to training public health laboratory professionals. In May 2015, the CDC and APHL jointly published a comprehensive guideline, "Competency Guidelines for Public Health Laboratory Professionals", as a Morbidity and Mortality Weekly Report (MMWR) supplement. (22) This document encompasses 15 domain areas of public health laboratories, as determined by representatives from the professions of public and private laboratories and related fields. The domains and their four levels of proficiency (beginner, competent, proficient, and expert) for domain-specific knowledge, skills, and ability (KSAs) were vetted by approximately 170 subject matter experts. The 15 domain areas are:

1) Quality management systems: a collection of processes that integrate elements of the organization to ensure quality and provide for continual improvement.

2) Ethics: the expected integrity of actions in scientific areas and interpersonal relations.

3) Management and leadership: staff management/supervision and staff guidance, including training and mentoring.

4) Communication: writing or speaking that provides clear information to all target audiences, particularly in the scientific and/or laboratory fields, which includes developing and/or presenting scientific reports, papers or abstracts.

5) Security: meeting or exceeding regulations designed to create a secure working environment, including personal, physical (i.e. structural), and information security needs.

6) Emergency management and response: handling laboratory-specific emergencies, e.g. containing and resolving accidents involving biological, radiological, and/or chemical materials.

7) Workforce training: development and/or implementation of laboratory-specific adult education and training activities.

8) General laboratory practice: addressing basic responsibilities, such as skills (technical, mathematical, etc.) and quality/regulatory compliance, in public health laboratory sample analyses in the pre-examination, examination and post-examination phases of testing.

9) Safety: ensuring a safe work environment, particularly

- knowing and understanding the specifics & hazards of research animals as well as the chemical, biological and radiological substances being used and how to safely acquire, maintain, use and dispose of all materials,
- understanding and maintaining a safe physical work environment, and
- meeting all requirements for regulatory compliance and documentation.

The specific safety sub domains are:

- potential hazards: recognition of hazards,

- hazard control: ability to control or prevent hazards,
- administrative controls: compliance with regulations, accreditation & licensure,
- communication and training: safety-related KSAs necessary for an informed staff, and
- documents and records: safety-related documentation.

10) Surveillance: collection, analysis, and interpretation of health-related data for surveillance purposes.

11) Informatics: applications of information science, computer science, and information technology in support of any public health area.

12) Microbiology: detection, identification and reporting of infectious agents of public health concern.

13) Chemistry: detection, measurement and characterization of chemicals of public health importance in biological and environmental samples (e.g. human, animal, food, water, etc.).

14) Bioinformatics: collection, classification, and analyzes of biological and biochemical information using various technological and mathematical techniques (e.g. computer databases and statistics).

15) Research: systematic, hypothesis-driven study and related skills (e.g. research design, implementation and evaluation) for areas of public health.

This document did not inform the EID program, and had no effect on the data collection instrument (the end-of-fellowship questionnaire) or on data collected from participating fellows (i.e. the final reports). However, these competency guidelines, if translated into the form of an appropriate tool, have great potential for informing future evaluations of laboratory training fellowships, specifically with respect to what competencies relevant to PHLs may be acquired or improved upon during the course of a laboratory training fellowship.

For the current evaluation project, the EID program's intended and unintended effects were investigated by reviewing the historic descriptions of the program and other archived documents, then compiling, reviewing & analyzing data from a sample of fellows' final reports. In addition, a logic model of the program was developed as an aid to the evaluation.

Summary of Chapter II

The current project has relevance due to the EID program's connection to the important goal of maintaining a competent and diverse PHL workforce, and due to the value in performing a formal program evaluation. An overview of the Competency Guidelines for Public Health Laboratory Professionals, which describes areas of laboratory competency, highlights this document's potential utility in the development of a tool that could assist in future evaluations of laboratory training fellowship programs.

CHAPTER III: METHODOLOGY

Introduction to Chapter III

This section describes the data used and their origins, with definitions of the program's participants. There follows a description of the methods used to:

- define the evaluation research questions: the program's intended and unintended effect(s), and
- develop the components of a logic model that accurately depicts the activities, outputs and outcomes of the EID program.

Description of the Data and Program Participants

Data related to describing the program goals and objectives, as well as program activities, outputs and outcomes, were retrieved from CDC and APHL programmatic archives. Data regarding the program's unintended effect(s) were obtained from the text in a sample of final reports, which were supplied by scientists participating as fellows in the program's host laboratories.

All fellows participating in the program must:

- have, at a minimum, a bachelor's degree in a science discipline (e.g. biology).
- be interested in pursuing a career in the field of public health laboratory science-- particularly in the area of infectious disease.
- define their EID program objectives and goals.
- work in their host laboratory on:
    - a research project,
    - acquiring general PHL and PHL-related knowledge, and
    - gaining a practical application of practices related to emerging infectious diseases.
- answer an end-of-fellowship questionnaire survey in the form of a final report.

Host laboratories:

- are federal (CDC), state, or local public health laboratories.
- agree to sponsor and support a fellow's research project by providing:
    - mentoring and training necessary for the fellows' projects,
    - applicable additional training related to the fellows' areas of interest, and
    - materials, travel funds (if applicable), space capacities, and any other logistics necessary for fellows to conduct their program activities.

The end-of-fellowship questionnaire survey remained unchanged throughout the 20 years of the program. The first four survey questions, listed in Table 1, related directly to the participating scientists' fellowship experiences.

Table 1

Question #	Text (verbatim)
1	Provide a summary of your training and/or research experience. What were your most significant accomplishments?
2	List and describe any of the following in which you participated during your fellowship: • Participation in publications, including abstracts and/or posters. • Outbreak investigations. • Domestic and/or international meetings or conferences. • Short-term international assignments.
3	What impact did you have on your host laboratory? This may include procedures, policies, and/or new projects.
4	Did this program meet your training and research objectives as submitted in your original application? Describe.

All final reports were submitted to CDC's program partner, APHL.

- The first class (1995-1996) through the fifteenth class (2009-2010) were printed and archived.
- The sixteenth through the nineteenth classes remained in electronic text format.

For this evaluation project, a sample of fellows' final reports from class 10 (2004-2005) through class 19 (2013-2014) was retrieved and analyzed.*

Final reports that were in the APHL archives and only available as hardcopies were:

- scanned and emailed to CDC, and
- converted from PDF image files into Microsoft Word text documents using Adobe Acrobat Professional, version 11 OCR (optical character recognition) software.

Mistakes arising from the conversion process, such as incorrect or missing text characters, non-text results, or illegible words, were noted by comparing any unclear or incompatible results to the original image files and then manually corrected.

*Class 20 had not yet completed the program at the start of this evaluation.

Population & Sample Selection

The sample of final reports used in the analysis was selected from a population of final reports submitted by fellows enrolled in the last 10 years of the program: classes 10 through 19. This time-frame was selected after discussion with CDC and APHL partners, who all agreed that this timeframe would provide the best combination of diversity of fellows and "state of the art" public health laboratory technology and procedures.

Because data obtained in answer to Question #2 in the questionnaire (see Table 1) were quantitative in nature, the sample size was chosen on this basis. A CDC statistician consultant recommended selecting random samples from each class as the best method of sampling the population, and the paper "Determining Sample Size", by Glenn D. Israel (23), was used as a statistical reference to inform the sample size. In summary:

- population size N=202
- sample size n=70
- confidence level = 95%
- p = 0.5
- precision = +/- 10%

The same final report sample was used for the qualitative analyses, which:

- satisfied the qualitative analysis expectation that sample size be determined on the basis of theoretical saturation, and
- was convenient.

The point when new incoming final reports produced no changes to the existing codes occurred during examination of an initial 28 final reports. The conclusion that data theoretical saturation occurred was supported after the remaining 42 final reports in the sample were reviewed and coded, during which process no additional codes or themes were identified.

Developing the Research Questions

The research questions were developed to address the intended and unintended effects of the program. After reviewing the historical descriptions of the program and the specific questions contained in the end-of-fellowship questionnaire, the intended effects were defined. The program's unintended effect was determined during analysis of the final report sample.

Data Analysis: Final Reports

Quantitative data analysis

Positive responses to fellows' participation in certain PHL-related activities (question #2) were tabulated and the results are presented in Table 1 in the Results section. These data were used in the analysis regarding the participation in certain activities expected to increase fellows' knowledge of the general public health laboratory system.

Qualitative data analysis

The data in the responses to questions #1, #3, and #4 (see Table 1) of the final reports are qualitative (24) and were used in analyses related to:

1) fellows' experiences during the fellowship,
2) the unintended effect of the program, and
3) fellows' views on whether or not the program met their objectives.

The data from the final report sample were qualitatively analyzed by using applied thematic analysis (25) as described below. The resulting themes and sub-themes are defined in Tables 3-6 and the text

includes related narratives. Expanded definitions of all themes, sub-themes and codes are provided as a codebook in Appendix A. In addition, a variable was defined for each final report to address the fellows' direct answers about their objectives being met.

Analysis Step 1: Coding the final reports sample
Approximately one-third of the data sample (28/70) were iteratively read and memoed by:

- determining categories of responses, and
- defining thematic codes.

Analysis Step 2: Identifying themes

- The software MAXQDA, version 12 and Microsoft Excel, Office 15 version were utilized as analysis aids.
    - The MAXQDA program allowed efficient retrieval of coded segments to examine overviews of code groups and investigation of overlapping codes and to calculate code frequencies.
    - Excel spreadsheets containing code frequencies allowed generation of frequency data subsets for examination.
- All code frequencies reflect the number of final reports in which a particular code appears.
- Examination of the frequency dataset and subsets was performed to investigate codes, themes, potential thematic relationships and to help find patterns in the data.

Analysis Step 3: Variable creation as part of "fellows' objectives" analysis
The fellows' responses to the question about whether or not the program met their objectives (question #4) provided data directly addressing this question. All responses explicitly indicated one of three options:

1) The program met few or some of the fellow's objectives.
2) The program met many or most of the fellow's objectives.
3) The program met or exceeded all of the fellow's objectives.

A variable was generated for each final report in the sample and given the value of "1", "2", or "3" to correspond with each fellow's distinct answer to this question.

Analysis Step 4: Compiling the results
Results obtained from the quantitative tabulation of fellows' responses to their participation in selected public health activities are presented in Table 2. All qualitative analyses of the final reports' text were used to describe themes, illustrated with representative quotes taken directly from the text, and accompanied by relevant frequencies and narratives.

Limitations of the Data
The available data have limited depth, and care was taken to not over-analyze the information. The data limitations resulted from the following:

1) The wording of the questionnaire was very general. Although the respondents could give answers as lengthy as they desired, they were not prompted or encouraged by an interviewer to elaborate.

2) Some respondents referred to other documents, which were not available to review for this evaluation, e.g. one reply to question #4 stated: "As time and opportunity allowed, I completed the majority of the item[sic] listed in the Plan of Action submitted on September 24, 2005."

3) A few questions were left unanswered and those data are simply missing, e.g. if no answer was given to question #2: "**List and describe any of the following in which you participated during your fellowship...**", it meant that the fellow may or may not have participated in publications, outbreak investigations, etc., and there is no apparent way to recover that information.

Program Logic Model

A logic model providing a pictorial representation of the EID program was considered to be a potentially useful tool in the evaluation of this program. Since a "historic" logic model is not available, a "retroactive" logic model was developed using:

1) the available institutional knowledge, and
2) archived program documents, such as
    - timelines,
    - program checklists, and
    - emails describing activities during program implementation.

This information was translated into a written format, defining details of the program as the appropriate components of a logic model, then organized into a visual logic model using Microsoft Office Visio 2013 software. A synopsis of these EID program logic model components is given in the Results section, and a graphic representation of the logic model is provided in Appendix B**.**

Summary of Chapter III

The available data were retrieved from CDC and APHL programmatic archives. These data consisted of general descriptions of the start of the program, documents related to programmatic activities, (e.g. timelines, checklists, and emails) as well as the past 10 years of fellows' final reports. The majority of the analysis was qualitative and the data's limited depth were taken into account to avoid generating over-broad results. Expanded definitions of codes, sub-themes and themes are given in the Appendix. A logic model based on the actual activities, outputs and presumptive outcomes was designed.

CHAPTER IV: RESULTS

Introduction to Chapter IV

The results of this project are based on archived program documents, historical publications describing the EID program, and data from an analysis of a sample (n = 70) of the 202 EID fellows' final reports. The response data in the final reports used in the analysis came from survey questions 1-4.

Synopsis of survey topics:

1) A summary of the fellows' fellowship training and/or research experience, including their most significant accomplishments.

2) Participation by fellows, during the fellowship, in one of four public health-related activities. These were:

- publications, including abstracts and/or posters,
- outbreak investigations,
- domestic and/or international meetings or conferences, and
- short-term international assignments.

3) The fellows' impacts on their respective host laboratories.

4) Whether or not the program met the fellows' original objectives, with elaboration by the fellows.

The results section is divided into six parts:

1. A definition of the program's intended effects, extrapolated from the data.
2. Enumeration of the fellows' participation in the above activity options.
3. Themes, sub-themes, codes, and all related frequencies arising from the qualitative analysis. These are presented in table and narrative format.
4. Evaluation of an objective-related variable, from responses to the question "Did this program meet your...objectives..?"
5. Determination of the program's unintended effect(s).
6. Components of a logic model depicting the program's activities, outputs and outcomes.

Results Part 1: Definition of intended effects

The intended effects of the program were determined after reviewing the available program documentation and by examining the questions asked in the end-of-fellowship questionnaire survey.

It is implicit that participation by the fellows, during the fellowship program, in the above public health activities were expected to result in fellows' gaining knowledge of the public health laboratory (PHL) system.

The questionnaire also explicitly asked whether or not the fellows' objectives had been met. By requesting this information, it logically follows that meeting the fellows' training and research objectives were an intended effect of the program.

The historic descriptions of the EID fellowship program mention that this program should result in the participating fellows' gaining specific, tangible, laboratory-related training, in addition to

gaining an understanding of the national public health laboratory system. The end-of-fellowship questionnaire gave fellows the opportunity to explain their accomplishments and the impact that they had on their host laboratories, which included applied laboratory research. It is reasonable to conclude that the program intended that participants and host laboratories to work together in an effort to have fellows increase their base of competencies in the public health laboratory and related areas as well as gain specific research skills and techniques.

The intended effects of the EID program are therefore defined as:

1. Fellows gained knowledge of the public health laboratory system during their fellowship by participating in one or more selected public health laboratory-related activities.

2. Fellows increased and/or initially acquired public health laboratory or laboratory-related skills during their fellowship.

3. The program met the fellows' training and research objectives.

Results part 2: Activity participation responses

The survey results from question #2 are shown in Table 1 and refer to the program's intended effect of fellows' gaining general PHL and PHL-related knowledge through certain activities. One fellow in the survey sample did not answer the question. All but one of the 69 who responded said that they participated in at least one of the four public health activity options.

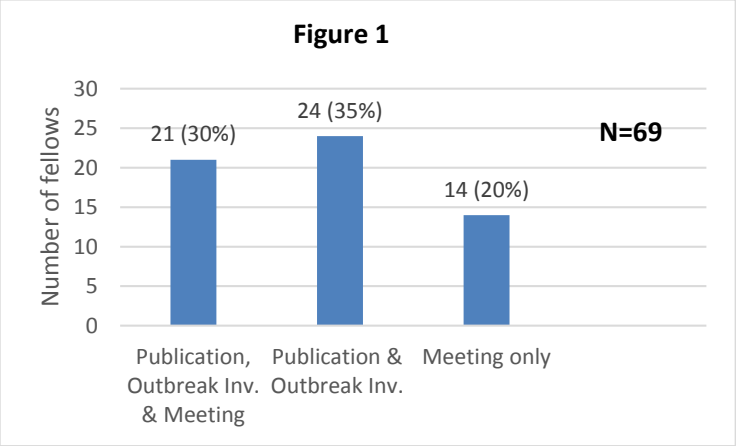
Because the participation in an activity by a fellow was counted only once, there was a maximum of one "occurrence" per final report. Thus, the results for each column in Table 1 reflect the number of individual fellows who participated in that particular activity.

Table 2: Number of fellows participating in selected PH activities (N=69)

Publication (paper/poster)	Outbreak Investigation	Meeting/Conference National & Int'l	Short-term International Assignment(s)
42 (61%)	**34 (49%)**	**63 (91%)**	**5 (7%)**

Of those who responded, three predominate response combinations were noted (see Figure 1).

Figure 1



Results part 3: Themes, sub-themes, and codes

Applied thematic analysis of the fellows' responses to survey topics related to their fellowship experience, impact on host lab, and objectives, yielded four major themes: professional capability, understanding public health, career assistance, and fellowship experience. Each major theme and their two to six sub-themes are listed and defined in Tables 3-6. A selection of illustrative examples, which are quoted directly from the final reports, are included. For each major theme, "N" is the number of final reports that contained that theme and "n" is the number of final reports containing a particular sub-theme.

The codebook, which contains expanded definitions of all themes, sub-themes and codes, is provided in Appendix A. Frequency tables of sub-themes and related codes are given in Appendix C. The frequencies reflect the number of final reports in which they were present.

Table 3

THEME	PROFESSIONAL CAPABILITY: Tangible professional laboratory or laboratory-related product or benchmark of experience		
	SUB-THEME	**DEFINITION**	**EXAMPLES**
	Project	**Completed one or more research projects.**	"[My] being able to see a project through from development to submission for publication—and from the field to the lab—has been an excellent comprehensive experience in public health laboratory science."
	Lab-related skills	**Skills directly related to laboratory research procedures or managing research data.**	"I was given a brief overview and some hands-on experience of the following departments: Serology/Virology, Environmental Microbiology, and General Microbiology.....I received a more thorough training experience in the Molecular Biology department: PCR: standard, nested, reverse-transcriptase, real-time including analysis also using different machine platforms (Cepheid vs ABI)."
			"I learned many new laboratory techniques and skills and I was also able to improve on the skills I already had."
			"[I was able to] gain the necessary molecular and technical skills needed to work in a public health related laboratory."
			"[I] learned a great deal about keeping a detailed and organized laboratory notebook."
	Introduction	**Introduced to many areas and/or disciplines in public health and public health laboratories.**	"I was able to attend many informative seminars given by incredible scientists from all over the world, learn a large variety of laboratory techniques and how they are applied in different contexts"
			"My fellowship experience has exceeded my expectations and exposed me to opportunities that I did not conceive as possible in my original application."
			"I also managed to cross train in the following departments: environmental microbiology, general microbiology, and molecular biology."
	Other prof. skills	**Professional skill(s) that are outside of laboratory research, e.g. leadership, speaking, and fiscal.**	"...I wrote the laboratory's procedure for the use of a Trek Sensititre..."

Table 4

THEME	UNDERSTANDING PUBLIC HEALTH: Knowing what the public health field, is all about & the part PHLs, etc. play within it		
	SUB-THEME	**DEFINITION**	**EXAMPLES**
	Big picture/ systems	**The intricacies of public health as a field.**	"[The fellowship] has helped me understand how public health at the national and international level is done."
	PH agencies	**Gained knowledge of federal, state, and/or local PH agencies.**	"Being at the CDC has also given me the opportunity to see how public health and government policies interplay, and the role politics play in public health." "I feel that I experienced one extra objective not listed on the billet. I was able to work closely with multiple state agencies to see how their collaborations with SLD functions. One of my larger interests had always been how different state agencies worked together." "[I] learn[ed] about how involved a reference lab can be with the local department of health."
	Real life	**Details of "real life" in a public health organization.**	"[I] acquire[d] "real-world" experience in global health research." "[It was] very rewarding to feel as though I was making a contribution to public health and possibly preventing foodborne illnesses." "[I had] many invaluable opportunities to put my laboratory and epidemiology training to use in real global health projects." "[I was able to] spend time in all the labs learning the actual day-to-day work."
	Role	**What different areas in public health do and how they interact.**	"My most significant accomplishment was being able to apply my method to real epidemiological investigations and obtaining results that make sense with the situation and aided in the overall picture of the situation" "I could witness firsthand the true intersection of research, public health, and medicine"

Table 5

THEME	CAREER ASSISTANCE: Inform career plans and/or create professional connections for the future		
	SUB-THEME	**DEFINITION**	**EXAMPLES**
	Future	**Fellowship experience informed future career plans**	"This program has helped me define my career goals"
			"This fellowship has greatly increased my interest in public health and helped to shape my future career plans."
	Network	**Networked, i.e. made professional contacts.**	"The fellowship...allowed me to meet many people in a variety of fields and further explore my career interests and goals."
			"Further, through conferences and collaborations, I have been exposed to an entire community of public health scientists, which has played an instrumental role in shaping my career outlook."
			"I am planning on staying in public health now that my fellowship has come to an end, and the contacts that I have made during my fellowship are helping me to achieve that."

Table 6

THEME	FELLOWSHIP EXPERIENCE: Positive and negative influences during the fellowship		
	SUB-THEME	**DEFINITION**	**EXAMPLES**
	Support	**Had a supportive environment during the fellowship.**	"I am also so thankful of how wonderful the people I work with at the NCSLPH are and how helpful they have been throughout the entire fellowship."
			"I have been particularly pleased with my mentor... one of complete ease and a nice balance of being allowed to try new techniques and study designs on my own while still have a concrete background and support network."
			"...my mentors and fellow researchers have listened to my contributions and maintained a healthy discourse with me."
	Freedom	**Input, independence, and initiative.**	"[The fellowship] put me a position of freedom when choosing projects and getting involved with different work."
			"I was able to design some aspects of [my research project] and incorporate some of my own input [into it]"
			"I greatly value having a scientific voice in the research process."
			"I have worked mostly independently during my time in my EID fellowship."
	Barriers	**The barriers involved in meeting objectives.**	"...there were issues with [the] screening primer and probe sets for St. Louis Encephalitis Virus."

The first, and most prominent, major theme was included in all 70 of the sample final reports (Appendix C, Table 7). This was the "professional capability" theme and was certainly an expected result, as it includes the sub-themes of lab-related skills, completion of a project, as well as other experiences and skills applicable to a public health laboratory, which was one of the intended effects of the program.

Almost all (69/70) of the responses within this theme included the sub-theme of lab-related skills, which involved the fellow acquiring or improving on laboratory "bench" work, equipment use, record-keeping, and/or analysis skills. As an aside, the only fellow who did not mention the development of lab skills as a part of his fellowship did note completion of a laboratory research project.

The second most frequent major theme arising from analysis of the final reports was "understanding public health" (Appendix C, Table 8). It is noted that within this theme, 16 of the 45 fellows who indicated the "Big picture/systems" sub-theme specifically mentioned this sub-theme as a fellowship program objective that was met.

The most numerous responses that are associated with the major theme "Career Assistance" (Appendix C, Table 9) occur within the sub-theme, "future" (30/34), which revolves around the fellows' gain of insight into their future success in the public health sector or, specifically, their own career paths. The sub-theme "network", while not as common (9/34), clearly showed the potentially valuable career-related opportunity during the fellowship of meeting and establishing a network with fellow professionals in the public health arena.

Within the final report essays, 28/70 fellows included information that can be considered, in part, as a description of the "fellowship experience", which is the final major theme (Appendix C, Table 10). The fellowship experience theme includes such factors as the fellows' learning or research environments, as well as other general factors that positively or negatively influenced their overall experiences during their time at their host laboratories.

A sub-theme common to a number of final reports (10/28) within this theme was that the fellowship experience was directly and strongly influenced by the degree of support and participation of the mentors, and to some degree their laboratory colleagues. The comments comprising this sub-theme were exceptionally positive, in that the fellows recognized and appreciated the effort their mentors put into making their experience a valuable one. The mentors' ability to broaden the fellows' objectives and learning opportunities was given as the primary cause of their impact; secondly, the mentors' interest and support (mentoring!) of the fellow was very positive.

Another sub-theme mentioned in by fellows in several (6/28) final reports was that of "freedom". For these fellows, this sub-theme of "freedom" was a powerful part of their fellowship description. The fact that the mentors were involving the fellows in the research process and that the fellows received respect for their opinions was portrayed as a great boon to their fellowship experiences. Most of these fellows elaborated that they had not previously had the advantages of this type of independence in the lab and/or the degree of respect and input allowed by their host

laboratory mentors and colleagues. Having a level of responsibility for research, e.g. having a specific project or providing tangible benefits to their host lab, was cited as valuable.

Barriers mentioned by fellows are also included within the "fellowship experience" theme, since they directly impacted the fellows' descriptions of their time in the program. With respect to the entire final report sample, 15/70 fellows indicated barriers to having a successful fellowship. With respect to the "fellowship experience" theme, only one of these 15 fellows concurrently included mention of mentor/colleague assistance (the "support" sub-theme) and none concurrently indicated the "freedom" sub-theme. However, only six of these 15 noted that their objectives were less-than-fully met (see Results, part 4, below).

Results Part 4: Fellows' objectives

In reviewing the answers to the specific question "Did this program meet your...objectives..?", each fellow's response explicitly indicated one of the following options:

1) The program met or exceeded all of the fellow's objectives (58/70).
2) The program met many or most of the fellow's objectives (10/70).
3) The program met few or some of the fellow's objectives (2/70).

While the majority of final reports indicated the program met or exceeded the fellows' objectives, some did fall short of that goal. For those that stated "many" or "most" objectives were met, a number pointed out that alternative goals to the original objectives were achieved. For example:

> *"The research projects did not take off as planned; however, I gained time in the laboratory working along side experienced microbiologists to learn the everyday techniques in detecting and identifying Mycobacteria. For me, these techniques are as valuable as any research project."*
>
> *"...my research objectives were modified to accommodate different projects, so while I did not complete all the research objectives originally stated in my plan of action [I accomplished alternative objectives]...*"

Two final reports indicated that only "few" or "some" objectives were met. One of these reports had very little additional description in that response. However, within this fellow's summarization of the fellowship experience in a previous answer, he noted "*I learned a significant amount of molecular biology laboratory techniques.*". He implied that his difficulty in meeting objectives were due to the fact that he encountered technical problems, namely, "*Unfortunately, due to a few setbacks and the time it took to troubleshoot a few of the techniques, I was unable to transform the Rhodococcus rhodnii bacterium with the RHBP and control plasmids to test their ability to make dsRNA in vivo.*"

The other final report in this category contained an extremely detailed and voluminous response, which described, in detail, a very poor fellowship experience. The recurring implication throughout this fellow's report was of a serious problem with the relationship, communication and/or collaboration between this fellow and the mentor in the host laboratory. For example, the fellow states:

> *"More important to me than general training objectives was the desire to complete a research project that would have a meaningful impact on patient outcomes in a clinical setting. I have had what I consider to*

be unreasonable restrictions placed on me with regard to the hours I am able to be in the laboratory that have not allowed me to complete my project - I am disappointed.....[With respect to] rotations through the following laboratory units throughout the year to learn laboratory procedures [in HIV], no training occurred. HIV laboratory staff were willing to provide training in HIV testing. [My Mentor] did not approve the rotation which would have required 1-3 days of my time to be spent in the HIV laboratory."

Results part 5: unintended effect of the program

All of the defined intended effects of the EID program relate to the program's laboratory-focused impact on the fellows via a gain in knowledge or skills in the laboratory system of public health, or on the fellows' objectives and experiences in the EID laboratory training fellowship itself. The "professional capability" theme illustrates these effects.

During the analysis, one unintended effect of the program was noted: the EID program's impact on fellows was frequently more pronounced in relation to the "understanding public health" theme than the "professional capability" theme. The "understanding public health" theme is not based on laboratory experiences, but on the public health field in general and how laboratories "fit" into it.

Responses to the survey questionnaire illustrated the programs' impact. Fellows described this impact in their answers regarding their training and/or research experiences and on their own influence on their host labs, as well as in their discussions of the topic of their program objectives. A broad understanding of public health as a general field and its relationship to areas of laboratory science was emphasized by many of the fellows as a great, or greater, component of their fellowship as compared to their laboratory-based experiences.

For example, in comparing the themes of "understanding public health" and "professional capability", it was found that nearly half (30/70) of the fellows noted the theme "understanding public health", but almost all of these fellows (27/30) did NOT note the theme "professional capability".

In another example, comparing the fellows' descriptions of their research and training experiences, including publications, with responses regarding their objectives revealed a difference in emphasis on the program's impact.

- All but one (69/70) of fellows' responses to topics on their fellowship experiences and their own impacts on host labs contained the theme "professional capability", but relatively few (20/70) noted this theme when describing their objectives being met.
- The "authorship" code was included in many (42/70) responses about participation in selected public health activities, but relatively few of these fellows (11/42) noted this tangible product as an objective that was met.
- Project completion was described by many fellows (54/70) in response to the topics of research/training experiences and/or their influence on the host lab, but less than half of these fellows (21/54) felt this merited mention as an objective met.

These examples imply that these fellows' perceptions of the program's impact was less around the "professional capability" theme than would have been expected. This occurred despite any laboratory-based experiences they may have had or products they achieved during the fellowship.

Results Part 6: Logic Model of EID Program

A logic model of the EID program, as it has existed, was determined. It describes activities, outputs and outcomes that occurred within four stages of the program's timeline, which are:
Stage 1: Prior to selection of the current class of fellows (pre-selection of fellowship class).

Stage 2: After selection of the fellows for the current class, but prior to the start of their fellowship (post-selection pre-fellowship).

Stage 3: During the fellowship itself (fellowship).

Stage 4: After the current class has come to the end of their fellowship (post-fellowship).

The activities for each stage are divided between:

- the CDC/APHL staff, and
- the fellows (or prospective fellows) and their mentors.

The outputs occur as a result of all their combined activities. The short-term, mid-term, and long-term outcomes reflect the intended effects of the program over time. A synopsis of the logic model is given below.

Stage 1:

- Host laboratories and mentors, as well as reviewers for the application process are identified.
- Prospective fellows' applications are submitted, which includes the fellows' research and training objectives.
- Applications are processed and reviewed.
- Fellowship offers are tendered and accepted (or not accepted).

Stage 2:

- Fellows receive orientation and prepare to relocate, if applicable.
- Fellow-mentor research plans focusing on infectious disease, which are to take place at the host laboratories, are finalized and approved.

Stage 3:

- Fellows progress with their research at their host labs, participating in one or more research projects.
- Fellows participate in available, targeted public health laboratory and public health laboratory-related activities, including applicable training.
- Some or most fellows participate in presentations and/or publications resulting from their fellowship work.
- Fellows complete mid-year reviews of their progress.
- Fellows meet or exceed their initially stated objectives.
- Fellows have increased their knowledge and skills related to public health laboratories.
- Fellows and mentors complete final reports of the fellowship.

Stage 4:

- The fellows' final reports are reviewed.
- Fellows' contact information is maintained.
- Post-fellowship publications occur, and fellows inform CDC/APHL staff about them.
- Fellows begin or continue in PHL careers, and they are well-prepared.
- The nation's PHL workforce is improved.
- Public health initiatives related to infectious disease research are supported.

A graphic representation of the logic model is available in Appendix B.

Summary of Chapter IV

The analysis of available data for the last 10 years of the EID program yielded:

- a definition of the program's intended effects,
- quantification of the fellows' participation in selected public health laboratory-related activities, in response to question #2 of the end-of-fellowship survey questionnaire,
- themes, sub-themes and code frequencies from analysis of survey questions 1,2 &4,
- frequencies of a variable created to address the direct responses to question #4, on the topic of fellows' program objectives being met.
- relationships between themes and code frequencies, from the comparison of frequency data, that helped describe the occurrence of the intended effects and the determination of the one unintended program effect, and
- a descriptive logic model for the program.

CHAPTER V: CONCLUSIONS AND RECOMMENDATIONS

Introduction to Chapter V

This project involved an evaluation of the APHL/CDC EID laboratory training fellowship program, which operated for over 20 years. For reasons not directly related to this evaluation, this program is currently suspended or on "hold" status. The goals of the EID program were to:

- train and prepare scientists for careers in public health laboratories, as a means to improve the public health workforce, and
- support public health initiatives related to infectious disease research.

Although anecdotal evidence has previously been collected regarding program alumni's appreciation of the fellowship, with quotations by fellows and their mentors culled from the text of fellows' final reports, a formal program evaluation has never been performed. It was decided that performing an evaluation of the program would be of use, partly because a program requires some evidence of having achieved its intended effects (i.e. its "success") in order to have ongoing support from stakeholders. The program's current suspended status, which began after the start of this evaluation, perhaps emphasizes the need to justify the program's continuance.

The purpose of this evaluation was to inform the primary intended users, the CDC's Partnerships and Training Program Team, of the evaluation results. Briefly stated, this involved addressing the following three questions at the completion of the evaluation (26):

1) What? What was seen in the program data?

2) So what? So, what new understanding of the program now exists?

3) Now what? Now, what available actions are recommended?

What was seen in the program data?

The answer to the first question, "What?" is given in the Results section, Chapter 4. Examination of the data from published descriptions of the program and the actual questions asked in the end-of-fellowship questionnaire survey illustrated the intended effects of the program. Other data from the questionnaire provided information that showed program details, including:

- All but one fellow participated in one or more of the PHL-related activities listed in the survey, with the greatest number (91%) participating in a national or international meeting/conference.
- Four major themes were evident:
    - Professional capability,
    - Understanding public health,
    - Career assistance, and
    - Fellowship experience (including barriers).
- All direct answers to the survey question "Did this program meet your training and research objectives as submitted in your original application?" were given as one of three options:
    - The program met or exceeded all of the fellow's objectives,

    - The program met many or most of the fellow's objectives,
    - The program met few or some of the fellow's objectives.
- Fellows' expectations, challenges, successes and future aspirations were all, to some extent, described. Two clearly described factors that were seen to have influenced fellows' responses were:
    - An appreciation of the impact that the fellowship had on fellows broad understanding of public health and the role played by PHLs in this field,
    - The very positive, or very negative, role that the host lab mentor could potentially play in the fellows' meeting objectives and overall fellowship experiences.
- Data from numerous sources (program documents, email communications, etc.) provided information about the program's activities, outputs, and objectives during the program's operation.

So, what new understanding of the program now exists?

The answer to the second question, "So What?" has three parts:

- The design of this program does not include intrinsic measurable indicators of success, which makes evaluation of the program a challenge.
- Sufficient information was obtained to determine:
    - the program's intended and unintended effects,
    - a number of themes, sub-themes and codes, which allowed a more in-depth understanding of the program, and
    - whether or not fellows' program objectives were met.
- A logic model was generated which provided an overall representation of the program as it has operated over its 20 year tenure.

The EID program was initiated at a time when it was not standard practice to include program evaluation, as understood today, as a part of program design. The program consequently lacks benchmark metrics, which would allow regular evaluation of the program's progress to see if the program is having its intended effects as expected. The current evaluation of the EID fellowship program presented a number of challenges, which included:

- Explicit goals and objectives, which could be linked to programmatic activities, were not defined.
- Metrics for determining whether or not benchmark outputs were achieved were not available.
- Extracting information from available data was problematic. For example, data from all but the last five years of fellows' final reports were kept as hardcopy only.
- The available data were not optimal (see Chapter III, "limitations of the data").

Despite the challenges, the results of data analysis provided some pertinent information, summarized below.

- Definition and description of three intended effects of the program. These were:

1) The fellows gained PHL system knowledge by participating in selected public health activities, as described in the end-of-fellowship questionnaire survey. In fact, all fellows engaged in one or more of the listed options.

2) The fellows gained PHL &/or PHL-related skills. All fellows noted in their final reports that they acquired or improved on lab or lab-related skills and/or completed a research project.

3) The fellows achieved their training and research objectives. In their final reports, fellows described a broad array of objectives. It was also possible to conclude whether or not fellows' objectives were met, from the fellows' perspective. Most (58/70) fellows related that the program met or exceeded their research and training objectives and all but two of the others stated that many or most objectives were met. The host lab mentor's influence was concluded to be a major factor.

- Determination of themes, sub-themes and codes; four major themes were observed, the two most prominent being "Understanding Public Health" and "Professional Capability".
- Determination of an unintended effect, namely that the program's impact on the fellows often related to the "Understanding Public Health" theme in lieu of the "Professional Capability" theme.

There was sufficient information in the available data to develop a logic model, which shows programmatic activities, outputs, and outcomes. This logic model may be useful in the future as a tool to illuminate program gaps, and as a basis for developing logic models of future programs.

Now, what available actions are recommended?

It remains to answer the third and final evaluation question: "Now what?" In other words, moving forward with this or other laboratory fellowship training programs, what recommendations can be made to help ensure that these programs' intended effects occur, i.e. that they are "successes" with their objectives and goals met?

Recommendation #1

Clearly define the objectives of the program, addressing specific intended effects and how they are expected to come about. A revised logic model would be an aid in visualizing the gaps between activities, outputs and outcomes. Once gaps are identified, clearly define the path to ultimately achieving objectives.

Recommendation #2

Build in benchmarks, which have defined metrics, for intended effects of the program. This would allow an evaluator to determine if the program is on track for achieving outputs and/or objectives. A questionnaire survey of fellows can be used to collect information on benchmarks. However, instead of only conducting surveys after the fellowship has begun, consider using coordinated pre- and post-fellowship questionnaire surveys, which would allow comparison of the fellows' self-evaluations and potentially note changes arising between the beginning and end of the fellowship.

For example, one type of benchmark might be the attainment of PHL-related competencies. The APHL-CDC publication *Competency Guidelines for Public Health Laboratory Professionals*, which was described in

Chapter II, is a source reference of comprehensive competencies for public health laboratory professionals. Of course, not all of the competencies included in this publication are necessarily applicable to one- or two-year laboratory training fellowships. Fellows are expected to already have a degree of proficiency in some of these competency areas prior to beginning their fellowship, and competency in other areas might not be attainable during a fellowship. However, the competency guidelines could be a resource to develop a tool for use in the design of laboratory training fellowship data collection instruments, such as pre- and post- fellowship questionnaire surveys. These surveys could be used, in part, to determine if applicable competencies were gained or improved upon by fellows during their fellowships. A potentially useful tool for designing the PHL-related competency component of a questionnaire survey is shown below as Table 11. This table contains a summary subset of the competency guidelines, which are believed applicable to a laboratory training fellowship. An expanded table with competency descriptions is given in Appendix D.

Table 11: Tool for competency component of future laboratory fellowship program evaluations

DOMAIN/SUB-DOMAIN	COMPETENCY/sub-competency
Specific Area/Laboratory*	Training
	Sample/material handling
	Sample/material verification
	Sample/material preparation
	Sample/material examination
	Analysis
	QA &/or QMS
	Sample/material disposal
Bioinformatics	Biology & computer science
	Statistics
	Data analysis
	Data management
Research	Research programs
	Ethical conduct
	Research foundation
	Testing methodology development
	Research project execution
	Research data management, analysis and application
	Dissemination of research findings
	Translation
Management & Leadership	General management
	Financial management
	Leadership
Communication	Communication techniques
	Active listening skills
	Comprehension of materials
	Communication technology
	Communication professionalism
	Professional reports
Security	Risk mitigation
	Information security

In addition to the benchmarks of PHL-related competencies, another example of a benchmark could be fellows' meeting one or more of their pre-defined program objectives. A metric for this could be the number of objectives met, tabulated for each fellow, and managed by keeping the relevant database up to date.

Finally, there is the benchmark of fellows' participation in activities that are expected to lead to enhanced PHL and PHL-related knowledge and experience. It is recommended to continue measuring this benchmark; however, it is recommended to expand the list of PHL & related activities currently "captured" in the fellows' experience descriptions from the current four. It might also be useful to formalize a curriculum that includes desirable instruction, and/or maintain a list of suggested PHL-related activities, which would be available as a resource for fellows before, during, and even after completion of their fellowships.

*Competencies in this area are summarized from a selection taken from the *Competency Guidelines for Public Health Laboratory Professionals* domains "General Laboratory Practice", "Microbiology" and "Chemistry".

Recommendation #3

Build a continuous quality improvement (CQI) component into any ongoing laboratory training fellowship. Have a mechanism for feedback from fellows, mentors and perhaps other professionals involved in the PHL workforce, e.g. public health laboratory management and human resource departments, to help ensure that the program is realistically moving towards the goals of improving the public health laboratory workforce and supporting infectious disease initiatives.

Recommendation#4

An ongoing system of quality for any program includes maintaining institutional knowledge of the program and keeping current all processes, procedures, and data acquisition methods. Therefore, it is recommended that a transition mechanism be in place for the EID program, in the case of program staff retiring or leaving for new positions, or agency reorganization, to ensure program continuity.

Summary of Chapter 5

Program evaluation can be a useful tool in determining whether or not the intended effects of a program have been met, i.e. whether or not the program has been a "success", as defined by the program's objectives and goals. Despite the challenges in evaluating the EID program, data were obtained, which assisted in gaining an understanding of the program as it has existed over its 20 year tenure.

Recommendations made for moving forward to improve program accountability and evaluation options include:

- utilizing resources, such as the APHL CDC Guidelines for PH Lab, to develop tools for measuring indicators or "benchmarks" of program success,
- determining metrics for other benchmarks of programmatic activities,
- creating a new logic model for the program as an aid in identification of gaps,
- including in the program design a system to support CQI, and
- prepare for staff turnover or agency reorganization by having a mechanism to allow seamless transition of programmatic responsibilities.

It is anticipated that the intended primary users of this evaluation, the CDC's Partnership and Programs Training Team, will be able to use this evaluation in their own internal discussions of laboratory training fellowship program evaluations and development, as well as share it with other partners involved in managing these fellowships.

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APPENDIX A: CODEBOOK

SUMMARY OF MAJOR THEMES AND SUB-THEMES

THEME	SUB-THEME	DEFINITION
Professional Capability: Tangible professional laboratory or laboratory-related product or benchmark of experience.	**Research experience**	Acquired training specific to the research experience itself during the fellowship, e.g. learned how to design experiments and/or a project.
	Authorship	Participated in publication(s), poster or abstract, &/or presentation(s) that happened during fellowship itself or is/are expected to occur as a result of the fellowship.
	Project	Completed one or more laboratory research projects.
	Lab-related skills	Learned new lab bench &/or equipment techniques, analysis methods, &/or laboratory notebook requirements and value.
	Other prof. skills	Gained leadership, speaking, and/or fiscal experience.
Understanding Public Health: Knowing what the public health system, is all about & the part PHLs, etc. play within it.	**Big Picture/Systems**	One or more of the following: • Obtained an overview of public health, e.g. seeing the "big picture" @ national, international, &/or programmatic levels. • Learned intricacies of public health as a field, and what different areas or "parts" accomplish. • Gained experience with laboratory systems, workflow paths, &/or surveillance activities.
	PH Agencies	Learned how public health agencies work, cooperate and/or collaborate.
	Real Life	Engaged in day-to-day public health laboratory work and/or made tangible contributions to public health.
	Role in PH	Gained knowledge of the application (or overlap) of fellows' area of specialty (e.g. epidemiology, basic science, research) to other specific public health areas or to public health in general.
Career Assistance: Inform career plans and/or create professional connections for the future.	**Future**	Obtained knowledge and/or experience that informed future career plans.
	Network	Networked/made professional contacts; namely, developed a network of professional contacts, particularly in the area of public health laboratories.
Fellowship experience: Positive and negative influences during the fellowship.	**Support**	Found that the host lab Mentor &/or laboratory colleagues facilitated a supportive environment during the fellowship.
	Freedom	Had the freedom to provide input into research, work independently &/or acquire knowledge additional to which was expected.
	Barriers	Identified barriers to meeting objectives.

EXPANDED DEFINITIONS OF SUB-THEMES AND CODES

PROFESSIONAL CAPABILITY

Tangible professional laboratory or laboratory-related product or benchmark of experience

Sub-theme = code: completed project:

Completed one or more research projects.

The fellow, with support from the mentor and host lab colleagues, designed, began & completed a laboratory research project during the fellowship

Sub-theme: Lab-related skills:

Skills directly related to laboratory research procedures or managing research data.

Codes for lab-related skills

Lab = **New lab "bench", equipment training &/or notebook training.**
New lab "bench" training, such as the development of specific lab techniques. In addition, learning how to run complex laboratory testing and analysis equipment.

Analysis = **New or improved data analysis skills.**
Gained analysis experience, learned new analysis methods, to use in analyzing data that was acquired during the fellowship.

Sub-theme: Introduction

Introduced to many areas and/or disciplines in public health and public health laboratories.

Codes for Introduction

Broad/other = **Broad variety of lab and educational experiences.**
Had the opportunity to acquire education & experiences above & beyond the main focus of the host lab or research project, e.g. seminars, conferences, journal clubs, and additional laboratory areas of research.

Prep = **Experience &/or work in emergency preparedness.**
Either direct lab work or educational experiences that gave the fellow knowledge &/or skills in areas related to emergency preparedness. This would include actual laboratory work, e.g. testing done for outbreaks, water contamination, and/or other public health emergencies.

Local PH= **Attended local meetings, seminars, &/or webinars related to public health.**

PROFESSIONAL CAPABILITY, continued

Sub-theme: Other professional skills

Professional skill(s) that are outside of laboratory research, e.g. leadership, speaking, and fiscal.

Talk big= **Presented a talk at a national or international meeting/conference.** The fellow gained professional speaking experience by presenting a formal talk in the professional setting of a national or international meeting or conference.

Talk local= **Presented a talk at a local meeting or seminar.** The fellow gained professional speaking experience by presenting a formal or informal talk in a local professional setting, such as a community health event or school seminar.

Lead = **Gained management or leadership experience during the fellowship**. The fellow had experiences that gave the fellow the opportunity to learn and use management and/or leadership skills. Examples include: mentoring or teaching others lab techniques, developing new lab techniques for the host lab or other partners, being charged with coordinating lab work with colleagues.

KSA$ = **Gained fiscal awareness, knowledge, and/or skills.** During the fellowship, had training, direct experience and/or contact with general knowledge in fiscal issues. Examples include: assisting in the researching, writing and/or the application process for grants or other funding opportunities; performing a cost analyses for a project, and assisting with budgetary tasks for the laboratory.

THEME: UNDERSTANDING PUBLIC HEALTH

Knowing what public health, as a system, is all about and the part PHLs, etc., play within it.

Learning information to help understand public health goals and identifying the personnel and agencies that work within the field of public health. Learning how various areas of laboratory science "fit in" the scope of the public health system, e.g. the part played by a public health laboratory professional and how this interacts, compliments, and helps accomplish the goals of public health as a whole.

Sub-theme = code: big picture/systems: The intricacies of public health as a field.

Having an overview of public health. Understanding the “big picture” of public health at international, national, local and programmatic levels. Experience/work with laboratory systems, workflow path, &/or surveillance activities.

Sub-theme = code: PH agencies: Gained knowledge of federal, state, and/or local PH agencies.

Learning the intricacies of one or more public health agency, and/or how federal, state, and/or local public health agencies work, cooperate and collaborate.

Sub-theme = code: Real Life: Details of "real life" in a public health organization.
Becoming familiar with the realities of a public health laboratory and/or other PH organization. Day-to-day public health laboratory work and tangible contributions to public health. Participating in actual public-health related investigations, e.g. outbreaks, and making a tangible contribution to public health. Learning about the actual dynamics and challenges of scientific publishing, e.g. the competition and potential for being "scooped".
UNDERSTANDING PUBLIC HEALTH, continued

Sub-theme = code: Role: What different areas in public health do and how they interact.
The application or overlap of fellows' areas or specialty (e.g. epidemiology or basic science) to public health. Learning of the role of public health in various areas.

THEME: CAREER ASSISTANCE:
Inform career plans and/or create professional connections for the future

Sub-theme = code: Future: Fellowship experience informed future career plans.
Having the time and experience through the fellowship to inform the decision on whether or not working in a public health laboratory is the "correct" career choice.

Sub-theme = code: Network: Networked, i.e. made professional contacts.
Activities of networking, (i.e. meeting and having the expectation of further contact with) other public health professionals in or out of the laboratory. Developed a network of professional contacts,
Particularly in the area of public health laboratories.

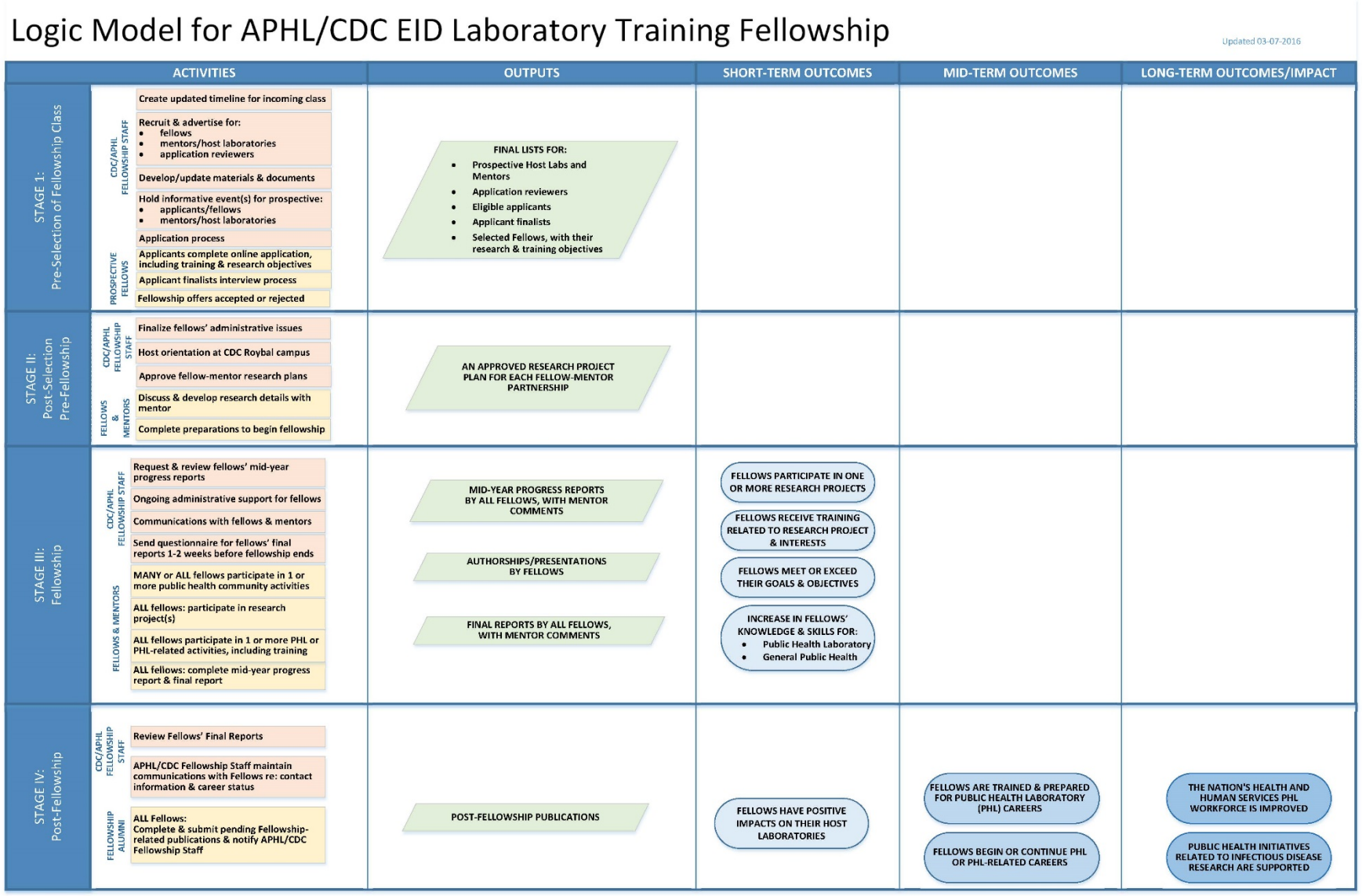
THEME: FELLOWSHIP EXPERIENCE: Positive and negative influences during the fellowship
The fellowship experience" includes the fellows' learning or research environments, as well as other general factors that positively or negatively influenced their overall experiences during their time at their host laboratories.

Sub-theme = code: Support: had a supportive environment during the fellowship.
Having a positive, supportive fellowship environment. Receiving help, encouragement and advice from the mentor and/or host laboratory colleagues.

Sub-theme = code: Freedom: Input, independence, and initiative.
Having the freedom to provide input into fellows' own research, e.g. design, work independently and create additional research opportunities, and/or acquire additional knowledge.

Sub-theme = code: Barriers: The barriers involved in meeting objectives.
Identifying barriers to meeting objectives. Technical, personal, or environmental barriers to meeting objectives and goals during the fellowship. Either not all objectives were met, or the barriers were overcome but noted.

APPENDIX B: LOGIC MODEL GRAPHIC OF EID FELLOWSHIP PROGRAM



APPENDIX C: FREQUENCY TABLES

Note:

The frequencies reflect the number of final reports in which they were present (not the total number of times they were indicated in all final reports).

Table 7

THEME	PROFESSIONAL CAPABILITY N=70									
Sub-Theme	Lab-related skills n=69		Project Completed n=54	Exposure n=44			Other Professional Skills n=37			
CODE	LAB	ANALYSIS		Broad/ Other	Prep	Local PH	Talk Big	Talk Local	Lead	KSA$
Frequency	69	28	54	29	8	24	13	20	15	7

Table 8

THEME	UNDERSTANDING PUBLIC HEALTH N = 45			
SUB-THEME	Big picture/ systems	PH agencies	Real Life	Role in PH
Frequency	45	6	14	18

Table 9

THEME	CAREER ASSISTANCE N=34	
Sub-Theme	Future	Network
Frequency	30	9

Table 10

THEME	FELLOWSHIP EXPERIENCE N=28		
Sub-Theme	Support	Freedom	Barriers
Frequency	10	6	15

APPENDIX D: TOOL FOR COMPETENCY COMPONENT OF FUTURE LABORATORY FELLOWSHIP PROGRAM EVALUATIONS

Table 11, expanded defintions

DOMAIN/SUB-DOMAIN	COMPETENCY/sub-competency	
	NAME	DESCRIPTION
Specific Area/Laboratory	Training	All required and/or necessary training, inc. relevant biosafety level cabinet use.
	Sample/material handling	Proper handling of samples/materials, inc. receipt, documentation, transport, storage, etc.
	Sample/material verification	Ensurance of sample/material integrity, quality, &/or suitability for testing/use.
	Sample/material preparation	Appropriate pre-testing preparation of sample/material, inc. regents &/or equipment involved in testing/use.
	Sample/material examination	Correct procedures followed in testing/use of sample/material.
	Analysis	Specific analysis processes for sample/material, inc. result recording & interpretation.
	QA &/or QMS	Adherence to QA and/or QMS procedures and policies.
	Sample/material disposal	Safe, legal disposal of sample/material as required, inc. documentation.
Bioinformatics	Biology & computer science	Integrates knowledge of biology and computer science
	Statistics	Applies knowledge of statistical methods during analysis of data.
	Data analysis	Applies relevant analysis procedures on data acquired during examination phase.
	Data management	Conducts data management, storage, and retrieval.

Table 11, continued

DOMAIN/SUB-DOMAIN	COMPETENCY/sub-competency	
	NAME	DESCRIPTION
Research	**Research programs**	Develops research programs, including: Research objectives and agenda.
	Ethical conduct	Understands & adheres to applicable rules and professional codes of conduct. Includes: Human and non-human subjects.
	Research foundation	Integrates scientific and technical knowledge for use as a foundation for research. Includes: Literature searches. Critique of scientific literature. Statistical concepts and tests. Study designs. Scientific and technical concepts and procedures. Emerging trends.
	Testing methodology development	Develops new testing methodology(ies). Includes: New methods conceptions. Pilot testing, method validation and performance verification. New methodology application.
	Research project execution	Conducts research to address an issue or answer a question. Includes: Research project design (of the overall project). Experimental strategy & design (for individual experiments). Conduct of experiments (protocols & methods).
	Research data management, analysis and application	Conducts research according to professional standards of data management, analysis, and application.
	Dissemination of research findings	Disseminates research findings via different mechanisms. Includes: Meeting and conference presentations. Manuscript preparation. Manuscript peer review process.
	Translation	Translates research findings to public health practice or for laboratory's use.

Table 11, continued

DOMAIN/SUB-DOMAIN	COMPETENCY/sub-competency	
	NAME	**DESCRIPTION**
Management & Leadership	**General management**	Ensurance of sound management of lab operations.
	Financial management	Manages fiscal-related issues. Includes: Budgets. Revenue/income. Expenditures. Resource management.
	Leadership	Models leadership behavior. Includes: Communication. Teamwork & collaboration. Staff recognition. Coaching & mentoring. Critical thinking. Systems thinking. Strategic thinking.
Communication	**Communication techniques**	Appropriately communicates to target audiences. Includes: Written communication. Oral communication.
	Active listening skills	Listens attentively & non-judgmentally, then restates message to ensure full information and comprehension is obtained.
	Comprehension of materials	Demonstrates comprehension of written documents and directions.
	Communication technology	Utilizes technology to communicate information.
	Communication professionalism	Ensures professionalism in all communications.
	Professional reports	Prepares professional written reports and oral presentations.
Security	**Risk mitigation**	Applies the laboratory's risk mitigation plan.
	Information security	Meets security requirements for data & other information.