FELLOWSHIP TRAINING ACTIVITY GUIDE

GENERAL LABORATORY PRACTICE

APHL ASSOCIATION OF PUBLIC HEALTH LABORATORIES

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ABOUT GENERAL LABORATORY PRACTICE

This general laboratory practice training guide addresses the knowledge, skills and abilities needed to fulfill basic responsibilities for performing analyses of specimens across the wide spectrum of scientific and technical activities found in public health laboratories.

The broad practices we will discuss here will apply to most fellowship participants, regardless of their specific area of scientific or technical expertise.

In this guide, we focus on three aspects of good laboratory practice:

- rules
- results
- quality assurance

Laboratory testing is heavily regulated, so it is essential that specific protocols and standard procedures are followed to ensure accurate test results. Regulation also applies to how those results are reported and stored. Quality assurance practices play a key role in guaranteeing both the accuracy of testing procedures and, ultimately, test results.

LEARNING OBJECTIVES

Once you have completed all the activities in this guide and met with your mentor, you should be able to:

- Locate regulations applicable to testing specimens in a public health laboratory
- Identify and describe the standard steps necessary to complete the pre-analytical, testing and post-analytical phases of specimen testing in a public health laboratory
- Describe the relationship between quality assurance practices and accurate test results

REFLECTION

Describe how the objectives above can help you in your position as a fellow:

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FELLOW PROFILE: KATE

Kate is a new fellow at a public health laboratory tasked with molecular testing. Her laboratory has been notified of a recent outbreak of norovirus at two nursing homes in the area. Kate will be part of the team working to determine if specimens from both locations indicate infection by the same virus strain.

Before testing can begin, Kate will first register the request and order the test within her facility's laboratory information management system (LIMS). The laboratory receives stool specimens from the hospital, labels each one and delivers them to Kate in the microbiology laboratory.

Steps Kate will take to test the samples:

- Identifies the instruments and other equipment she will require and reviews the operating procedure for

each instrument, as provided by the equipment manufacturer.

- Gathers and reviews the laboratory's own standard operating procedures (SOP) and policies that address each task she will perform. She makes sure that any required maintenance, cleaning and calibration of the equipment, as outlined in these procedures, has been completed.
- Performs quality checks using control specimens and confirms that the equipment will complete the test accurately.
- Performs the required tests and confirms that the same strain of norovirus is present in specimens from both nursing homes.
- Reports her results to her supervisor who reviews her results. Her laboratory will report the results to the health department and healthcare providers.

CLINICAL LABORATORY IMPROVEMENT AMENDMENTS (CLIA)

Public health laboratories like Kate's are subject to many important regulations and this depends on a number of variables, including the type of testing performed.

Public health laboratories must be certified or accredited by one or more appropriate regulatory bodies. Laboratory accreditation serves to determine the technical competence of laboratories to perform specific types of testing, measurement and calibration and not all laboratories are certified to conduct all kinds of testing. As Kate's laboratory is called upon to test human specimens and report results to healthcare providers, her laboratory is regulated and accredited under the Clinical Laboratory Improvement Amendments of 1998, or CLIA.

CLIA is a set of regulatory standards that apply to all clinical laboratory testing performed on humans in the United States. All US facilities or sites that test human specimens for health assessment or diagnose, prevent or treat disease fall under CLIA regulation. Each laboratory must have a CLIA Certificate of Compliance that specifies a list of laboratory specialties the laboratory is allowed to perform. Requests can be made for waiver of CLIA regulations in certain circumstances.

It is important to note that CLIA does not necessarily apply to specimen testing conducted for clinical trials or basic research. Epidemiological surveillance testing, where no patient specific results are reported, is also not subject to CLIA.

Three federal agencies are responsible for CLIA: The Food and Drug Administration (FDA), Centers for Medicare and Medicaid Services (CMS) and the Centers for Disease

Control and Prevention (CDC). Each agency has a unique role in assuring quality laboratory testing.

FOOD AND DRUG ADMINISTRATION (FDA)

- Categorizes tests based on complexity
- Reviews requests for Waiver by Application (see above)
- Develops rules/guidance for CLIA complexity categorization

CENTERS FOR MEDICARE AND MEDICAID SERVICES (CMS)

- Issues laboratory certificates
- Collects user fees
- Conducts inspections and enforces regulatory compliance
- Approves private accreditation organizations for performing inspections and approves state exemptions
- Monitors laboratory performance on Proficiency Testing (PT) and approves PT programs
- Publishes CLIA rules and regulations

CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC)

- Provides analysis, research and technical assistance
- Develops technical standards and laboratory practice guidelines, including standards and guidelines for cytology
- Conducts laboratory quality improvement studies
- Monitors proficiency testing practices
- Develops and distributes professional information and educational resources

See the Additional Resources section of this document for additional information about CLIA.

ACTIVITY: WHAT CERTIFICATIONS AND ACCREDITATIONS ARE HELD BY YOUR LABORATORY?

Take a few minutes to locate the CLIA Certificate of Compliance for your laboratory. It will specify the tests your lab is permitted to perform. What are three tests that your lab can perform?

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Ask your laboratory supervisor and colleagues for more information about the certifications and accreditations your laboratory holds.

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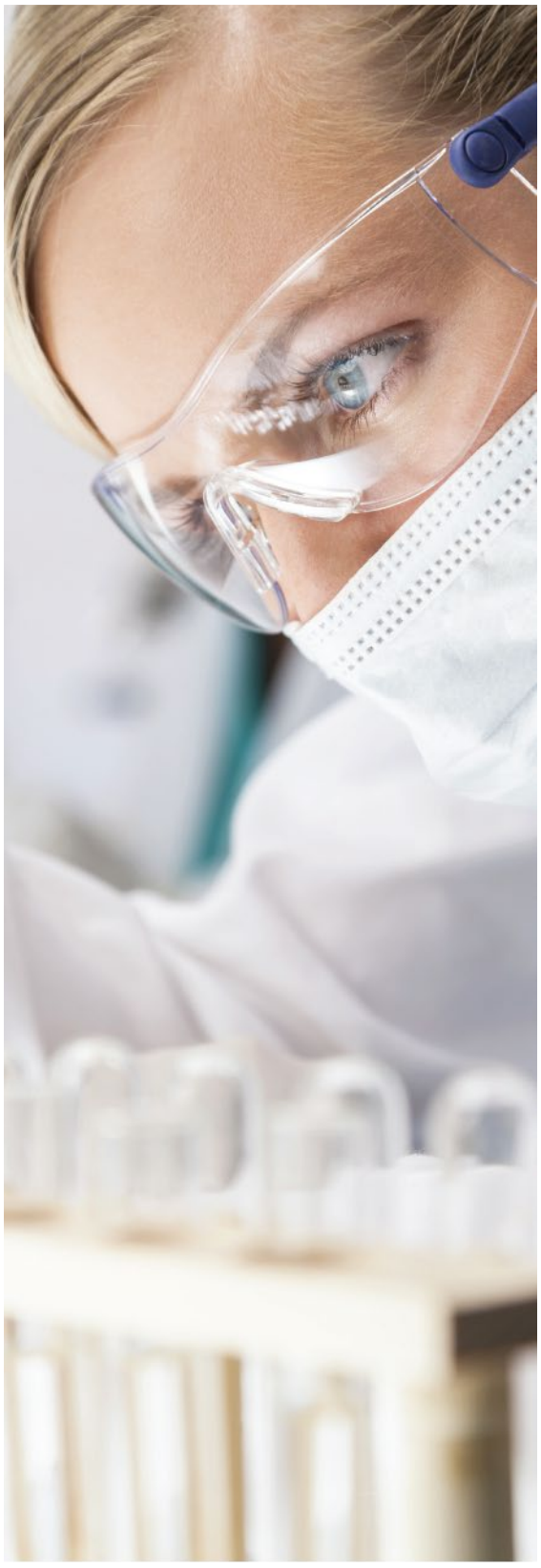
PROTOCOLS AND PROCEDURES

Regulations require that written procedures are made available for every step of the specimens testing process. CLIA Standard 493.1251, for example, specifies provision of a manual for all tests, assays and examinations performed by the laboratory.

These manuals include items such as:

- Procedures for patient preparation, specimen collection, labeling, storage and preservation
- Step-by-step performance of the test procedure, including test calculations and interpretations of results
- Preparation of materials such as solutions, controls, reagents and other materials, as required
- Calibration and calibration verification procedures
- Corrective action to take when calibration or control results fail to meet criteria for acceptability

Manufacturer's test system instructions may be used, but if any items specified by CLIA are not included they must be provided by the laboratory.



SPECIMEN TESTING

Specimen testing is considered one of the core functions of public health laboratories. Laboratories are tasked with monitoring and detecting health threats in the human population, as well as the environment. This can

range from foodborne outbreaks and communicable diseases to manmade and natural disasters.

While policies and procedures vary along with the mission of a particular laboratory, specimen testing can generally be described as a three-phase process:

- Pre-analytic
- Analytic
- Post-analytic

PRE-ANALYTIC TESTING PHASE – PART 1

The pre-analytical stage encompasses the time from when the test is ordered until the sample is ready for analysis. Specimen testing can require extensive preparation, so there are many steps in the pre-analytical phase of the testing process.

Regulation requires every laboratory to have policies and standard operating procedures (SOPs) in place for tasks like equipment maintenance, operation and cleaning of equipment, quality control and of course, testing procedures.

In most cases, this step of the process will also involve interaction with a laboratory information management system, as specimens must be tracked, and tests ordered. A laboratory information management system (LIMS) is computer

software that processes, stores and manages data from all stages of medical processes and tests.

The actual pre-analytical testing process varies widely depending on the test being performed. Some tests require specialized equipment with specific standard operating procedures (SOPs) provided by the equipment manufacturer. Other tests have been developed by the individual laboratories themselves and they will have their own SOPs and protocols.

ACTIVITY: ACCESS TO YOUR LABORATORY INFORMATION MANAGEMENT SYSTEM AND STANDARD OPERATING PROCEDURE

1. Confirm you can identify and access your laboratory information management system (LIMS). If you have not received a login password, contact your system administrator.

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2. Identify and access a standard operating procedure for specimens testing. Standard operating procedures at your laboratory may be stored on a compliance management system, such as Medialab or iPassport. Obtain your login information from your laboratory supervisor

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3. Do you have access? (Y/N)

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PRE-ANALYTIC TESTING PHASE – PART 2

Once the required tests have been ordered and the specimens collected and processed in the information system, the pre-analytical phase continues with preparations for the test:

- All required equipment must be checked, and calibrations verified.
- Instruments and equipment may need to be cleaned or maintained, as needed.
- All solutions, reagents and other materials must be checked.
    - Have they been stored correctly?
    - Are they available in sufficient quantities?

Quality control tests should be performed to ensure that all results are accurate and reliable. Incorrect quality control test results alert the user to potential problems.

Pre-analytical variables can account for up to 75% of laboratory errors, so it is essential that correct procedures are followed, particularly quality control checks.

Some examples of errors include:

- Inappropriate patient preparation
- Patient ingesting drugs which interfere with the testing process
- Improper collection of specimen or an inadequate specimen
- Delay in transporting specimen to the lab
- Storing specimen at wrong temperature

ANALYTIC PHASE

The analytic phase includes what is usually considered the "actual" laboratory testing or the diagnostic procedures, processes and products that ultimately provide results.

This phase will vary widely depending on the exact test performed and it is important to be aware of the variety of steps, materials and equipment needed for each one.

Procedures for handling instruments and other equipment that may be shared with others during testing are also very important.

As with the pre-analytic phase, it is imperative to follow procedures that specify how every step of the testing process should be documented.

Improper documentation can affect the future handling of the sample, causing more mistakes throughout the process. This can create a situation, such as the improper identification of a biological organism, which can cause further harm to a patient or population by hampering effective treatment or containment procedures.

Quality assurance and personal safety protocols should always be followed carefully. Maintaining safety protocols is important while conducting any testing but it is particularly important to follow procedures that apply to the handling of biohazard waste and sharps containers.

POST-ANALYTIC PHASE

Once testing procedures have been completed, we move to the post-analytic phase. The primary task in this phase is reporting of results. In our norovirus example, Kate confirmed that a number of specimens she tested contained the same virus strain and this was an indication of a possible outbreak. In such a case, the results would be reported back to the submitting facility, which would coordinate with the healthcare facility to contact the patients for treatment purposes. Since these results also indicate a possible outbreak, they should be reported to the appropriate HAI (Healthcare-Associated Infections) program coordinator or epidemiologist, and in some cases, the county or state health department as per regulatory requirement.

CASE STUDY: JAIME

Jaime is a new fellow at a state laboratory tasked with molecular testing. His laboratory is responding to new reported cases of Zika virus. Jaime will be conducting tests to confirm the presence of the virus in samples collected by an area hospital.

- What questions should Jaime ask before he begins?
- What are the steps that Jaime should take to test the specimens?
- Test results will be reported to the hospital. What regulations will apply?

CASE STUDY: RESOLVED

1. In this situation, Jaime should first make sure that he is familiar with regulations and policies pertaining to the specimen testing and his laboratory.
2. Jaime should also make sure that he has access to the laboratory's information system and equipment SOPs.
3. As part of the pre-analytic phase, Jaime should make sure the appropriate tests have been ordered and equipment has been maintained and is ready to use. He should also identify control specimens for verifying the results of the testing process.
4. When Jaime is ready to begin the analytic phase or testing the specimens, he should use proper procedures for analyzing and testing specimens to prevent errors.
5. When all specimens have been appropriately processed according to the relevant procedures, Jaime will need to accurately report the results of the testing in the post-analytic phase.

NEXT STEPS: MENTOR MEETING

Meet with your mentor and discuss:

- Types of specimen testing done at your laboratory
- Plans for testing a specimen. Identify all of the necessary regulations and protocols that apply to your test.

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Discuss other considerations, such as:

- Is the test for clinical, surveillance or research purposes?
- What regulations apply to your test? What is the impact of those regulations?
- What happens to the test results? Where are they reported?

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ADDITIONAL RESOURCES

Resource Name/Title	Institution	Website/Periodical Information
Laboratory Techniques Training	Arizona Department of Health Services	This website provides training on laboratory skills and competencies. The resources provided are applicable to a wide audience from beginner to proficient level. Videos and other materials are tools intended to be used along with internal procedures or policies.
CLIA Home/Overview	CDC	This webpage outlines the Clinical Laboratory Improvement Amendments of 1988 (CLIA) regulations, which include federal standards applicable to all U.S. facilities or sites that test human specimens for health assessment or to diagnose, prevent, or treat disease.
Field Science and Laboratories	FDA	This webpage contains profiles for each of Office Regulatory Affair's field laboratories.
Electronic Code of Federal Regulations	US Government Publishing office	This webpage contains the list of Subpart K—Quality System for Nonwaived Testing regulations.
Botched Zika Testing at D.C. Public Health Lab Was a Failure of 'Basic Arithmetic'	Washington Post	Article illustrating a mistake in testing and the severe consequences for both the people tested and the lab.
Lab Training.com	Lab-Training.com	This free online training has been developed based on some of the essential training modules for a scientist joining a lab. Free resources.

The Role of Local Public Health Laboratories	National Library of Medicine	This public health reports article synopsis contains links to additional resources.