

**UW Department of Laboratory Medicine
Postdoctoral Training Program in Medical and Public
Health Laboratory Microbiology
Program Objectives**

Table of Contents

Overall Objectives	1
I. Bacteriology and Antimicrobial Susceptibility Testing	3
II. Virology & Chlamydia	4
III. Mycology.....	5
IV. Mycobacteriology	6
V. Parasitology.....	7
VI. Infectious Disease Serology and Immunology	8
VII. Public Health Microbiology	8
VIII. Infection Control	9
IX. Clinical Infectious Diseases and Pathogenesis	10
X. Laboratory Management	10
XI. Research	11
XII. Molecular Diagnostics	12
XIII. Laboratory Safety.....	13
XIV. Training Methodology	13
XV. Laboratory Automation and Computerization	14
XVI. Requirements for Completion of Program	14
XVII. Summary of Rotations	15

Overall Objectives

1. Goals and objectives of the training program: The program is designed to provide doctoral scientists and physicians with the training that will enable them to take positions as directors of clinical microbiology laboratories in academic centers as well as in community hospitals and public health laboratories.
2. Duration of Training: The standard length of the program is two years. According to the Committee on Postdoctoral Training Programs (CPEP):

Although ABMM ... may give credit for participating one year in an approved program in the certification of individuals, it is generally agreed that most trainees need two years to cover the subject matter and develop the desired competencies in medical and public health laboratory microbiology. Trainees should not cover subjects that they have already mastered. Most if not all individuals will have other training needs that can fill any available time. (Essentials and Guidelines of an Accredited Postdoctoral Residency Program in Medical and Public Health Laboratory Microbiology, May 2006)

Accordingly, the length of a training rotation may be adjusted downward by the program directors, depending on the prior experience of the trainee. The directors may also require a trainee to spend more than the minimum amount of time in a rotation should a deficiency in the trainee's knowledge be noted. Year two of participation in the training program requires a written proposal of specific aims for the second year, approved by the directors before the end of Spring Quarter of year one of support. The duration listed for each section is approximate as there is continuing ongoing training. For example the fellows are involved in many unusual fungal, parasite and bacterial cases throughout the two years, not just during their rather short formal time in the rotations. In addition some rotations overlap in time--for example the infection control rotation takes only part of the day and the fellow would combine this with other activities.

3. Laboratory procedures: Trainees will learn to develop and manage a microbiology diagnostic service or public health laboratory that will support clinical diagnosis and treatment as well as epidemiological investigation. They will have skill and knowledge in the performance of the tests required. They will be informed regarding the advantages and limitations of manual, semi-automated, automated and nucleic acid-based methods available to diagnostic laboratories. They will become aware of recent developments in clinical laboratory methods that result in increased accuracy, reliability, and speed and cost effectiveness of laboratory procedures.
4. Interpretation and reporting: Trainees will develop skill in interpreting and assessing the clinical relevance of laboratory results so that they will be able to consult with clinicians and health care professionals in the application of laboratory tests used for diagnosis, treatment and epidemiology. They will become familiar with both the laboratory and hospital information systems so that they can confirm the accuracy and effectiveness of laboratory reports.
5. Scientific: Based on their broad scientific and clinical background, trainees will be able to assess the merit of new technology in the laboratory. They will effectively apply their scientific knowledge to develop and evaluate new tests, to assist in the diagnosis of unusual diseases, to detect and resolve epidemiological problems, and to conduct meaningful, clinically based research. They will understand the fundamental mechanisms of pathogenesis, both microbial attributes and host immune and inflammatory responses, that underlie the clinical and laboratory manifestation of infectious diseases.
6. Infection control: Effective control of the hospital-acquired infections relies on the accuracy of laboratory-based information/investigation. Graduates will be able to contribute to the development of guidelines and programs for controlling all manner of hospital-acquired infections.
7. Management: Trainees will acquire knowledge that enables them to effectively manage laboratory personnel and budgets. They will be familiar with current laboratory regulations and pending legislation that affects the diagnostic and public health laboratories. Graduates will be able to form

productive working relationships with clinical services, hospital administrators, local and state public health laboratories and other hospital laboratories.

8. Molecular tests: The principles, advantages and disadvantages of the commercially available systems based on molecular biology will be understood by the trainee. In addition, the trainee will acquire the skills to develop in-house protocols for molecular epidemiology, direct detection, and identification.
9. Educational: Trainees will learn to plan, organize and conduct courses and continuing education programs for physicians, technologists and other health care professionals.
10. Method of evaluation: Trainees will be evaluated using the following: Initial evaluation by program directors upon arrival; section checklists, to be completed by section instructors, and reviewed by the trainee and directors; periodic meetings with the program directors; final evaluation by the program directors.

Specific Objectives

I. Bacteriology and Antimicrobial Susceptibility Testing

A. Objectives

1. To gain in-depth knowledge in:
 - a) The collection, transport, and processing of clinical specimens.
 - b) The isolation, recognition and identification of clinically important bacteria, ureaplasmas, and mycoplasmas.
 - c) The principles of antimicrobial susceptibility testing (AST) and therapeutic drug monitoring.
 - d) The mechanisms of reporting results and result verification.
 - e) The clinical relevance of procedures conducted in the laboratory.

B. Duration of rotation

1. Minimum of three weeks of basic bacteriology each in the UWMC, HMC, and VAMC bacteriology labs
2. Three weeks in the UWMC bacteriology lab at the Antibiotics, Set-up, and Serology benches
3. Two weeks in the CHRMC microbiology labs
4. Two weeks didactic, UWMC Lab Medicine Core Course
5. CPEP Guidelines: Minimum three months; Range three-six months

C. Specific goals

Trainees will develop a thorough understanding of the following:

1. Specimen collection, transport, and processing
 - a) Transport devices and acceptable transport conditions.
 - b) Acceptable methods of specimen collection from all body sites, and rejection criteria of improperly collected specimens.
 - c) Different types of primary plating media, specimen processing, and incubation such that reliable and cost-effective primary inoculation protocols can be devised.
2. Direct examination of specimens
 - a) Selection, performance and interpretation of wet preparations, as well as acid-fast, acridine orange, fluorescent antibody, Giemsa, Gram, KOH/calcofluor, and other stains used on clinical materials, including tissue sections.
 - b) Immunological and molecular methods of direct microorganism detection.
3. Culture evaluation and organism identification
 - a) Relevant considerations in determining the extent of identification procedures to be used by type and quality of specimen received.
 - b) Identification of all classes of medically important bacteria.
 - c) Methodology, advantages and disadvantages of commercial identification kits and systems.
 - d) Methodology, uses, and limitations of commercial and in-house molecular identification procedures.
4. Antimicrobial Susceptibility Testing (AST)
 - a) Principles, approaches and limitations of various automated and manual AST procedures including the AMS Vitek, Epsilometer, agar and broth dilution, disk diffusion methods.
 - b) Principles and methodology of specialized tests including synergy testing, the serum bactericidal assay, serum drug level determination, and minimum bactericidal concentration determination.
 - c) AST considerations, and the mechanisms of action, toxicity, and organism resistance for each class of antimicrobial agent.
 - d) NCCLS documents that pertain to AST.
 - e) Hospital antibiotic formulary (including participation in the biennial Formulary Review).

5. Clinical
 - a) Selection of antimicrobial agents for the clinical treatment of infections caused by specific organisms.
 - b) Uses and limitations of serological testing in the diagnosis and confirmation of bacterial and rickettsial infections.
 - c) Common types of infections associated with specific bacteria, their pathogenic mechanisms, the epidemiology of disease transmission, and the methods of disease prevention.
 - d) Appropriate methods of communication with the clinical staff about laboratory procedures and data, hospital pharmacy, P&T committee, and infection control committee including PK/PD.
 - e) The general concepts related to the approach to patients with bacterial infections.

II. Virology/Chlamydia

A. Objectives

1. To provide in-depth training in:
 - a) The collection, transport, and processing of clinical specimens for viral and chlamydial detection.
 - b) The isolation, recognition and identification of medically important viruses and chlamydiae.
 - c) The utility of various cell cultures and lines, immunoassays, and molecular diagnostic tests in the detection and identification of viruses and chlamydiae.
 - d) The mechanisms of reporting results, result verification, and awareness of the clinical relevance of procedures conducted in the laboratory.
 - e) The mechanisms of action of antiviral and antichlamydial agents, their clinical applications, and the methodologies of antiviral susceptibility testing.
 - f) The clinical relevance of work performed in the laboratory.

B. Duration of rotation

1. Two weeks, Clinical Virology lab, CHRMC
2. Two days, HMC Retrovirus and Hepatitis labs
3. Five weeks, FHCRC Molecular Virology lab
4. One day, Chlamydia lab, HMC
5. One week didactic, UWMC Lab Medicine Core Course
6. CPEP Guidelines: Minimum 2 months; Range 2-3 months

C. Specific goals

Trainees will develop a thorough understanding of the following:

1. Specimen collection, transport, and processing
 - a) Proper containers, transport media, acceptable methods of specimen collection, and rejection criteria for both classical and molecular virology techniques.
 - b) The utility of various primary cell cultures and cell lines for primary inoculation of specimens and for sub culture of isolates.
 - c) Methods of culture inoculation and incubation.
 - d) The methods of specimen processing for molecular tests.
2. Immunofluorescent assays (IFAs)
 - a) The principles and limitations of various IFAs.
 - b) The various applications of IFAs in the direct examination of clinical materials and the identification of isolates.
 - c) The interpretation of direct and indirect immunofluorescent assays.
3. Identification
 - a) The relevant considerations necessary for determining the extent of identification procedures to be used by type and quality of specimen received.
 - b) The identifying characteristics of cytopathic effects of commonly encountered viruses.
 - c) Molecular and immunological methods of viral and chlamydial identification.
 - d) The application algorithms and interpretation of HIV tests.

4. Clinical
 - a) The serologic and molecular methods used for diagnosis of viral and chlamydial diseases.
 - b) Antiviral agents of potential value, and the tests for determining susceptibility to these agents.
 - c) Common types of infections associated with specific viruses and chlamydiae, their pathogenic mechanisms, the epidemiology of disease transmission, and the methods of disease prevention.
 - d) The appropriate methods of communication of laboratory procedures and data to the clinical staff.
 - e) The general concepts related to the approach to patients with viral and chlamydial infections, including the immunocompromised host (e.g., HIV-positive and hematopoietic stem cell transplant [HSCT] recipients).

III. Mycology

A. Objectives

1. To provide in-depth training in:
 - a) The recognition of fungi of medical importance.
 - b) The procedures required for proper collection of specimens.
 - c) The methods of isolation and identification.
 - d) The use of antifungal therapy, and the performance of fungal antimicrobial susceptibility testing (AST).
 - e) The correlation of clinical, histopathological, epidemiological, serological, and mycological data to provide a diagnosis of fungal disease.

B. Duration of rotation

1. Two weeks dedicated in UWMC mycology lab
2. One month joint rotation between the UWMC mycology and HMC mycobacteriology labs
3. One week didactic, UWMC LM Core Course
4. CPEP Guidelines: Mycology/Mycobacteriology: Minimum 2 months; Range 2-3 months

C. Specific goals

Trainees will develop a thorough understanding of the following:

1. Specimen collection, transport, and processing
 - a) The basis for choosing proper containers and the acceptable methods of collection and transport of specimens for fungal isolation.
 - b) Important considerations in media selection for primary plating of specimens.
 - c) Methods of inoculating and incubating cultures.
2. Direct examination of clinical specimens
 - a) The principles, uses, and limitations of KOH, Calcofluor White and Lactophenol Cotton Blue preparations, and tissue stains for recognition of fungi.
 - b) The performance of cryptococcal latex agglutination antigen detection and India ink tests.
3. Isolation and identification
 - a) Relevant considerations in the extent of identification procedures by type and quality of specimens received.
 - b) The macroscopic and microscopic morphological features of the monomorphic and dimorphic moulds that may be found in clinical specimens.
 - c) Other conventional and molecular tests used to identify moulds, including those used specifically on dermatophyte and dimorphic fungi.
 - d) The microscopic and macroscopic characteristics of clinically relevant yeasts.
 - e) Methodology, uses, and limitations of conventional and commercial biochemical yeast identification systems.
4. Other laboratory techniques
 - a) Methodology, uses, and limitations of immunological tests in the diagnosis of mycotic disease.
 - b) The principles, performance, and uses of fungal AST.

5. Clinical
 - a) The following principles of antifungal therapy: choice of agent for specific organisms, mechanisms of action, and toxicities.
 - b) Common types of infections associated with specific fungi, pathogenic mechanisms, the epidemiology of disease transmission, and methods of disease prevention.
 - c) Proper methods of communication with the clinical staff about laboratory procedures and data.
 - d) The general concepts related to the approach to patients with mycotic infections.

IV. Mycobacteriology

A. Objectives

1. To provide in-depth training in:
 - a) The principles and applications of a Biosafety Level 3 (BSL 3) lab in the work up of mycobacterial cultures.
 - b) The procedures required for proper collection and transport of specimens.
 - c) The isolation and identification of mycobacteria.
 - d) The recognition of mycobacteria of importance.
 - e) The performance of mycobacterial antimicrobial susceptibility testing (AST).
 - f) The clinical relevance of procedures conducted in the laboratory, including the use of appropriate antimycobacterial therapy.

B. Duration of rotation

1. Two weeks dedicated in HMC mycobacteriology lab
2. One month joint rotation between the UWMC mycology and HMC mycobacteriology labs
3. CPEP Guidelines: Mycology/Mycobacteriology: Minimum two months; Range two-three months

C. Specific goals

Trainees will develop a thorough understanding of the following:

1. Specimen collection, transport, and processing
 - a) The proper containers and acceptable methods of collection of specimens for mycobacterial isolation.
 - b) Principles and limitations of various decontamination and concentration procedures of clinical specimens.
 - c) The formulations and uses of mycobacterial culture media, and the unique requirements of fastidious species such as *Mycobacterium genavense* and *M. haemophilum*.
 - d) Unique temperature requirements of *M. chelonae*, *M. haemophilum*, *M. marinum*, and *Mycobacterium ulcerans*.
2. Direct examination
 - a) The principles, methodology and limitations of various acid fast staining techniques.
 - b) Principles and applications of direct molecular detection systems.
3. Isolation and identification
 - a) Relevant considerations in the extent of identification procedures by type and quality of specimen received.
 - b) The characteristic macroscopic and microscopic morphologies of clinically relevant mycobacteria.
 - c) Conventional biochemical tests used in the identification of mycobacteria.
 - d) The principles, methodology and limitations of automated mycobacterial culture systems.
 - e) Other identification systems, including nucleic acid probes and genomic sequencing.
4. Antimicrobial susceptibility testing (AST)
 - a) Principles, approaches and limitations of various manual and automated AST procedures for *Mycobacteria tuberculosis*, and for mycobacteria other than *M. tuberculosis* including the rapid growers.
 - b) The mechanisms of action, toxicity, and organism resistance for each class of antimicrobial agent.

5. Clinical
 - a) Common types of infections associated with specific mycobacteria, their pathogenic mechanisms, the epidemiology of disease transmission, and methods of disease prevention.
 - b) The use of antimicrobial agents in the treatment of mycobacterial infections.
 - c) Proper methods of communication with the clinical staff about laboratory procedures and data.
 - d) The general concepts related to the approach to patients with mycobacterial infections.

V. Parasitology

A. Objectives

1. To provide in-depth training in:
 - a) The procedures required for proper collection and transport of specimens.
 - b) The recognition of medically important parasites and their life cycles.
 - c) The microscopic and immunological methods of identification.
 - d) The clinical relevance of procedures conducted in the laboratory.

B. Duration of rotation

1. Two weeks, HMC microbiology lab
2. One week didactic, UWMC LM Core Course
3. Core component of the public health lab rotation
4. CPEP Guidelines: Minimum 1 month; Range: 1-2 months

C. Specific goals

Trainees will develop a thorough understanding of the following:

1. Specimen collection, transport and processing
 - a) The various techniques for collection, transport and processing of specimens.
 - b) Contaminants that will affect parasite recovery.
 - c) The various preservatives used, including the newer low environmental impact products.
 - d) Procedures, uses and limitations of various stool concentration techniques.
2. Microscopic analysis
 - a) The uses and limitations of the Tri-chrome, Iron Hematoxylin, partial acid fast, and modified Tri-chrome stains.
 - b) The preparation and reading of wet mounts of direct and concentrated stool using saline, Lugol's Iodine, and Methylene Blue.
 - c) The performance and reading of Giemsa-stained blood smears.
 - d) Ocular micrometer calibration and use.
3. Identification
 - a) The microscopic (and also macroscopic where applicable) morphologies of intestinal and extra-intestinal parasites, including all life-cycle stages that may be encountered in clinical samples.
 - b) The various classes of human ectoparasites, and the infectious diseases that they may transmit.
4. Immunology
 - a) The principles, methodology and limitations of direct antigen detection systems.
 - b) Serologic methods of practical value for identification of parasites.
5. Clinical
 - a) Common types of infections associated with specific human parasites, their pathogenic mechanisms and life cycles, the epidemiology of disease transmission, and methods of disease prevention.
 - b) Proper forms of communication with the clinical staff about laboratory procedures and data.
 - c) The general concepts related to the approach to patients with parasitic infections.

VI. Infectious Disease Serology and Immunology

A. Objectives

1. To provide in-depth training in:
 - a) The diagnosis of infectious diseases by antigen/antibody detection methods.
 - b) The procedures required for proper specimen collection.
 - c) The mechanisms of reporting, verifying and storing results.
 - d) The clinical relevance of procedures conducted in the laboratory.

B. Duration of rotation

1. One week at UWMC bacteriology lab
2. One day, UWMC LM Core Course
3. Trainees will also be exposed to infectious disease immunology during their other laboratory rotations
4. CPEP Guidelines: Minimum 0.5 month; Range: 0.5-2 months

C. Specific goals

Trainees will develop a thorough understanding of the following:

1. The principles, methodology and interpretation of coagglutination, complement fixation, counter immunoelectrophoresis, enzyme-linked immunoassays, fluorescent antibody assays, latex agglutination, immunoblotting, and precipitation.
2. Automated instruments for performing serological testing.
3. Specific disease states for which immunological methods are appropriate initial or supplementary approaches to diagnosis.
4. The statistical methods needed to evaluate immunological assays (i.e. sensitivity, specificity, positive and negative predictive values).

VII. Public Health Microbiology

A. Objectives

1. To become familiar with:
 - a) The scope of public health responsibilities assigned to the Washington Department of Health (WDOH) and Seattle/King County (SKC) public health laboratories.
 - b) Laboratory procedures conducted by a public health lab.
 - c) State and county epidemiological approaches to public health issues, including the safety of the environment, control of communicable diseases including food borne illness, and the control of disease vectors.

B. Duration of rotation

1. Two weeks at Washington State and/or Seattle-King County Public Health Laboratories.
2. CPEP Guidelines: Minimum 0.5 months; Range: 0.5-2 months, including at least 2 weeks in a public health laboratory

C. Specific goals

Trainees will develop a thorough understanding of the following:

1. The mission, major challenges, and overall management of the WDOH and SKC public health labs.
2. Special concerns of specimen collection and transport over long distances.
3. The following laboratory procedures:
 - a) Enteric pathogen analysis and food microbiology including botulism and paralytic shellfish poisoning analyses;
 - b) Sexually transmitted diseases testing;
 - c) Tuberculosis testing;
 - d) Identification of unusual isolates;
 - e) Newborn/developmental screening;
 - f) Environmental microbiology, including potable and waste water testing;
 - g) Immunological studies for viral diseases and syphilis;

- h) Legionella, Corynebacterium diphtheriae and Bordetella pertussis isolation and identification;
 - i) Molecular epidemiology and microbial typing;
 - j) Virology, including rabies virus detection.
4. The state health lab's roles in disease prevention and control.
 5. The state health lab's interactions with the Centers for Disease Control and Prevention.
 6. The state health lab's computerized correlation of laboratory and epidemiological data.
 7. Identification of BT agents; safe handling and notification practices; clinical syndromes produced by the respective organisms.
- D. Trainees will perform one of the following:
1. Participate in an off-site investigation of an infectious disease outbreak with a state epidemiologist, should one occur during the trainee's rotation.
- OR
2. Review the final report of a previous outbreak with a state epidemiologist, should no outbreak occur during the training period.

VIII. Infection Control

A. Objectives

1. To become familiar with:
 - a) The roles of the clinical microbiology lab and laboratory directors in hospital infection control;
 - b) The major etiologic agents and sources of nosocomial infections.
 - c) The principles employed by hospital infection control practitioners (ICP) to both prevent and control the spread of nosocomial infections.
 - d) The functions of a hospital Infection Control Committee.
 - e) The roles of a hospital infection control program and the ICP in the prevention of infectious disease dissemination by the hospital employee, and the protection of that employee from nosocomial diseases.

B. Duration of rotation

1. Two weeks, UWMC, VAMC, or HMC Infection Control
2. CPEP Guidelines: Minimum 0.5 months; Range 0.5-2 months

C. Specific Goals

Trainees will develop a thorough understanding of the following:

1. An historical perspective of hospital infection control.
2. The most common nosocomial pathogens, the anatomical sites they commonly infect, their routes of transmission, and their reservoirs within the hospital and the community.
3. The role of the clinical microbiology laboratory and directors in designing and maintaining a successful hospital infection control program.
4. Host and clinical factors that predispose towards nosocomial infection, and the specific risks to the various patient sub-populations that may be encountered in a health care facility.
5. The principles of surveillance, recognition, and control of nosocomial infections.
6. Major types of epidemiological studies, and their uses and limitations.
7. The principles and applications of patient isolation.
8. Policy of Standard Precautions, and its derivatives.
9. The rationale and current recommendations of employee immunization, and of employee post-exposure prophylaxis
10. Computer based epidemiology software applications available to the ICP.
11. Application of various strain typing methods now available.
12. The uses and limitations of hand washing, environmental sampling, and routine culturing.
13. Investigating a community or hospital outbreak.

IX. Clinical Infectious Diseases and Pathogenesis

A. Objectives

1. To become familiar with pediatric, general adult, and transplant infectious diseases consultative services.
2. To observe patients with infectious diseases.
3. To participate in the decision-making process of the infectious diseases team.

B. Duration of rotation

C. Two weeks pediatric ID service, CHRMC

D. One month general and solid organ transplant infectious diseases service, UWMC, which includes pharmacy infectious diseases

E. CPEP Guidelines: Minimum one; Range one-three months

F. Specific goals

Trainees will develop a thorough understanding of the following:

1. The manner in which contact is initiated between physicians and the infectious disease service.
2. Approach of infectious disease specialists in evaluating patients with infectious diseases.
3. The approach of infectious disease specialists in communicating with other physicians.
4. The development of a differential diagnosis based on clinical history, epidemiology, and the immune status of the adult or pediatric patient thought to have an infectious disease.
5. Major infectious disease syndromes including endocarditis, gastroenteritis, hepatitis, meningitis/encephalitis, osteomyelitis, sepsis, sexually transmitted diseases, skin and soft tissue infection, upper and lower respiratory infection, and urinary tract infection.
6. The role of the clinical microbiology laboratory in supporting the infectious disease service from the perspective of both the infectious disease consultant and the clinical microbiologist.
7. The role of the clinical microbiology laboratory in the approach to the diagnosis of specific infectious disease syndromes.
8. Common types of infections associated with specific microorganisms, their pathogenic mechanisms, the epidemiology of disease transmission, and methods of disease prevention.
9. The applications of antimicrobial agents currently in use at UWMC from the perspective of the infectious disease clinician.

X. Laboratory Management

A. Objectives

1. Learn to develop and manage a diagnostic or public health microbiology laboratory that will support clinical diagnosis and treatment, as well as surveillance and epidemiological investigation.
2. Develop skill in interpreting and assessing the clinical relevance of laboratory results.
3. Become familiar with approaches to controlling costs and the process of developing a budget.
4. Develop the ability to assess the merits of new technologies.
5. Understand the requirements of quality management.
6. Be familiar with current and pending regulations that apply to diagnostic and public health laboratories.

- B. Duration of rotation
 - 1. One year as assistant director of a microbiology section
 - 2. Participate in day-to-day operations and decision-making in the lab, including daily plate rounds, staff meetings, molecular case conference, and other pertinent meetings as they arise
 - 3. Attend divisional faculty meetings and annual Management by Objectives (MBO) planning sessions
 - 4. Participate in CAP self and outside inspections of the training laboratory, and in a CAP inspection of an outside laboratory if possible
 - 5. Attend the Seminar in Organization and Management in Laboratory Medicine (LM520) course
 - 6. Participation in other management activities as they occur
 - 7. CPEP Guidelines: Minimum 0.5 months, Range 0.5-2 months, in combination with LIS/Computer training

- C. Specific goals

Trainees will develop a thorough understanding of the following:

 - 1. Approaches to personnel management including job advertising, interviewing, hiring restrictions, job descriptions, employee orientation, performance evaluations, counseling, disciplinary action, continuing education, and job satisfaction.
 - 2. Approaches to material management and budgeting, including purchases or rental of supplies and equipment, new product evaluation, regulations for purchases, orientation to new products and equipment, equipment maintenance, physical plant design and remodeling.
 - 3. Techniques of policy change and implementation.
 - 4. Inspection requirements for accreditation and the government agencies responsible for regulation (CAP, CLIA '88, OSHA, HIPAA, IRB).
 - 5. Regulations for laboratory safety.
 - 6. Methods of cost and time accounting and assessing new testing methods and technologies for implementation in the clinical laboratory.
 - 7. Personal attitudes toward financial, time, personnel, and material management.
 - 8. Methods of designing, funding, performing, and reporting research studies.
 - 9. Quality management
 - a) The three elements of a quality management program: structure, process, and outcome.
 - b) The hospital's continuous quality improvement program.
 - c) Trainees will assist in periodically reviewing the laboratory's quality control data, will participate in the selection of quality assurance indicators and will present the results of a quality assurance project in a written report.

XI. Research

- A. Objectives
 - 1. To provide trainees with the opportunity to:
 - a) Learn and apply advances in biotechnology and instrumentation to solving problems in diagnostic microbiology, pathogenesis of infectious diseases, or antimicrobial resistance mechanisms.
 - b) Apply skills they have already acquired in doctoral training to answer currently significant questions in clinical microbiology.
 - c) Demonstrate their ability to design and carry out logical experimental approaches for the successful completion of scientific projects.
 - d) Gain experience in writing and publishing scientific manuscripts in peer-reviewed journals.

- B. Duration of rotation
 - 1. Up to 50% of two-year training period is available for research.
 - 2. CPEP Guidelines: open

C. Schedule

Flexible, but will include an introductory meeting for coordination of project ideas with the program directors

1. Meet with faculty project advisors to devise project, write a protocol, define the duration of the study, tabulate the results, and write a manuscript.
2. Coordinate project ideas with program directors in advance of year two of training.
3. Trainees will also regularly attend research conferences that address areas of interest, as determined by the program directors and the trainee.

D. Specific goals

Trainees will develop a thorough understanding of the following:

1. How research ideas originate within the clinical laboratory.
2. How to judge the feasibility and relevance of research ideas; define scope of project.
3. How to research and write a protocol that states the problem, the hypothesis, the methods of gathering and analyzing the data, and the expected clinical importance of the information gained.
4. How budget needs are estimated, and how supplies and equipment are purchased in a cost effective manner.
5. The methods of statistical data analysis as they are applied to the project.
6. The techniques of writing scientific abstracts and manuscripts, the proper methods of presentation at scientific meetings, and the steps to publication in a peer reviewed journal.

E. Publication in a peer reviewed journal will be strongly encouraged, but is not required.

XII. Molecular Diagnostics

A. Objectives

1. To provide in-depth training in:
 - a) The principles of molecular biology.
 - b) The use and limitations of molecular biology techniques for the detection, identification and typing of infectious disease agents.
 - c) The principles of molecular taxonomy and DNA sequence analysis.

B. Duration of rotation

1. Five weeks in FHCRC molecular virology labs (See Section II).
2. At least two weeks in UWMC Infectious Diseases Molecular Diagnostics lab .
3. Participation in weekly molecular diagnosis case conference.
4. A core component of the public health lab rotation.
3. Research projects which may have a molecular component.
4. CPEP Guidelines: Minimum one month; Range one-two months.

C. Specific goals

Trainees will develop a thorough understanding of the following:

1. Basic tenants of molecular biology including fundamentals of microbial transcription, translation and recombination.
2. The standard techniques for preparation of nucleic acids from different sources.
3. Theory and practical applications of various nucleic acid hybridization detection assays including Southern, Northern and dot blot analysis, and liquid and solid phase hybridization assays.
4. Theory and practical applications of various nucleic acid amplification technologies including qualitative, quantitative and continuously monitored PCR, bDNA, TMA, LCR, RT-PCR, FRET.
5. The theory of molecular typing methods, including PFGE, RFLP, RAPD and MLST analysis, ribotyping, and sequencing, and their applications in epidemiological investigations.
6. Laboratory and work-flow considerations.
7. Instrument maintenance and RSI prevention (repetitive strain injury).
8. Validation of proficiency testing; QA and QC.

XIII. Laboratory Safety

- A. Objectives
 - 1. To provide in-depth training in the provision of a safe working environment for all laboratory employees.
 - 2. To develop an understanding of the published and proposed regulations from local, state and federal sources.
- B. Duration of rotation
 - 1. Ongoing
 - 2. CPEP Guidelines Minimum/Range: open
- C. Specific goals
 - Trainees will develop a thorough understanding of the following:
 - 1. The modes of transmission of laboratory acquired infections.
 - 2. The principles and practices of the following safety topics:
 - a) Composition and use of a laboratory safety manual
 - b) Standard precautions
 - c) OSHA requirements, including bloodborne pathogens and TB control
 - d) Biosafety hazards
 - e) Waste management, including disposal of biohazard material and sharps
 - f) Safe handling of radioactive materials
 - g) Physical and chemical hazards, including carcinogens
 - h) Methods of disinfection and sterilization
 - i) Baseline medical testing (immune status, protection immunization)
 - j) Laboratory design as it applies to safety and the use of biosafety cabinets
 - k) Policy for managing laboratory accidents, including managing a safety emergency with calm and control
 - l) Rules and regulations related to mailing biohazardous materials
 - j) HIPAA requirements.
 - 3. Accepted laboratory policies for managing laboratory accidents and worker illnesses.

XIV. Training Methodology

- A. Objective: To provide experience in designing and operating a training program for students of microbiology.
- B. Duration of rotation
 - 1. One week with the UWMC microbiology lab training coordinator
 - 2. Presentation of daily plate rounds at UWMC, HMC and VAMC, as assigned
 - 3. Lecturing to medical technology students and medical residents at UWMC
 - 4. CPEP Guidelines: open
- C. Specific goals
 - 1. The trainee will work with the microbiology lab training coordinator to develop and implement a training program for one of the following: medical technology students, Laboratory Medicine 680 students, pathology residents, or infectious disease fellows.
 - 2. Trainees will develop a thorough understanding of the following:
 - a) The different needs of students at different levels of training in microbiology.
 - b) How training objectives and instructional materials are developed and written.
 - c) The various training techniques appropriate for adult audiences.
 - d) Methods of evaluating trainee performance and providing feedback.
 - e) How satisfactory completion of a training program has been achieved.
 - f) Design or revise a competency testing program.

XV. Laboratory Automation and Computerization

- A. Objectives
 1. To develop expertise in the application and utilization of automated instruments.
 2. To have a through understanding of hospital, laboratory and personal computer based information systems.
 3. To be able to evaluate the cost effectiveness of such systems.
 4. To be able to use software for management, quality control, safety, and infection control data, as well as data base use for managing cumulative data sets.

- B. Duration of rotation
 1. Ongoing
 2. CPEP Guidelines: Minimum 0.5, Range 0.5-2 months in combination with Management training

- C. Specific goals
Trainees will develop a through understanding of the following:
 1. LIS, personal computers, automated diagnostics systems and the World Wide Web.
 2. Automated and semi-automated system technology for detection, identification, and susceptibility testing of clinical isolates.
 3. The comparative accuracy of automated and semi-automated methods relative to conventional methods, and how these may be changed.
 4. The processes involved in purchasing and implementing a laboratory instrument.
 5. Methods used to determine the cost effectiveness of an automated instrument.
 6. The advantages and disadvantages of available laboratory computer systems.
 7. How computers record, analyze, and report laboratory data.
 8. How computer systems can be utilized as management tools for quality control, infection control, laboratory safety and hospital-wide dissemination of information.

XVI. Requirements for Completion of Program

- A. Successful completion of all laboratory rotations.

- B. Evidence of research activity with published results (abstract at a minimum).

- C. Evidence of appropriate interactive skills with technical personnel and hospital staff in consultative situation.

- D. Agreement of the program directors and of competence to direct a clinical laboratory.

Summary of Rotations

CPEP Guidelines
Minimum (Range) in months

Bacteriology/Antimicrobial Susceptibility Testing	3 (3-6)
Virology/Chlamydia	2 (2-3)
Mycology/Mycobacteriology	2 (2-3)
Parasitology	1 (1-2)
Infectious Disease Serology	0.5 (0.5-2)
Public Health Microbiology	0.5 (0.5-2)
Infection Control	0.5 (0.5-2)
Clinical Infectious Diseases and Pathogenesis	1 (1-3)
Management & LIS/Computer Training	0.5 (0.5-2)
Research	Open
Molecular Diagnostics	1 (1-2)
Laboratory Safety	Open
Teaching	Open