OBJECTIVES OF TRAINING

CLINICAL MICROBIOLOGY TRAINING PROGRAM

DEPARTMENT OF LABORATORY MEDICINE AND PATHOLOGY
FACULTY OF MEDICINE AND DENTISTRY
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INTRODUCTION TO THE PROGRAM

Clinical Microbiology is the branch of microbiology, recognized as a specialty by the Canadian College of Microbiologists, which is concerned with the laboratory diagnosis of human diseases caused by bacteria, viruses, fungi, and parasites, as well as antimicrobial susceptibility testing, infection control, public health, and laboratory quality, safety, management, and regulation. The profession of Clinical Microbiology consists primarily of two major spheres of activity:

1. Scientific and administrative direction of a clinical microbiology laboratory and
2. Provision of clinical consultations on the investigation, diagnosis, and public health implications of patients suffering from infectious diseases.

In addition to these primary activities, clinical microbiologists are often responsible for teaching undergraduate and post-graduate medical students, students in other health disciplines, and post-graduate science students. They also provide continuing education to medical and other health professionals some provide expertise within public health institutions. Many are involved in medical research and in the supervision of research projects of graduate students.

This document outlines the objectives of training and the tools used to evaluate Trainees in the Program. All Trainees should receive a copy of this document at the commencement of their Program and should maintain familiarity with the Program’s expectations of them and all outstanding Program objectives as they move through the Program.

While this document is current and provides a detailed compendium of specific objectives, it cannot be considered exhaustive or all-inclusive. Clinical Microbiology Trainees, in the spirit of ever-increasing professionalism and attendant responsibility, are tasked with supplementing these objectives of training as needed as emerging diseases, trends, strains, interventions, and methods may result in these objectives becoming temporarily deficient.

On commencement of training, Trainees should receive basic Program orientation instructions from the Program Director as well as orientation materials. These materials should include:

- The Objectives of Training
- The Program Policies document
- A current copy of the Canadian College of Microbiologists Syllabus for Examination Preparation for Specialist in Clinical Microbiology (current version: 1997 [updated 2003])
BACKGROUND TO THE PROGRAM

The University of Alberta Clinical Microbiology Training Program is a 2-year integrated program that includes training at the Provincial Laboratory for Public Health/Division of Diagnostic and Applied Microbiology currently located in the University of Alberta Hospital (UAH) and a Private Laboratory provider (currently Dynalife Laboratories (DLL)). Each centre has Ph.D.-qualified and M.D.-qualified clinical microbiologists who are actively involved with the Program. The Program accepts one trainee each year or every other year as funding is available.

The Program requires qualified applicants with a Ph.D. degree in Microbiology and assets defined in the Program Policies document.

The Program is designed to provide increasing responsibility as the Trainee gains knowledge and experience. The Trainee gradually becomes involved in laboratory management and becomes familiar with laboratory funding, labour relations, conflict resolution, resource allocation, quality assurance, biosafety, accreditation, manual development, organizational structure, and inter-departmental affairs. The Trainee may become involved in ongoing research projects related to clinical and/or laboratory aspects of research.

The Program is designed to satisfy the requirements defined by the Canadian College of Microbiology (CCM) for training a Fellow in Clinical Microbiology (FCCM). For the Trainee to achieve the rank of FCCM they must complete an accredited fellowship training program and then pass both a written examination and subsequently an oral examination offered by the CCM.

In the course of training, Clinical Microbiology Trainees should attain knowledge that is up to date. Trainees shall be prepared to conduct their duties in an ethical and cost-effective manner. Emphasis is placed on effective communication in partnership with laboratory technologists, physicians, other health professionals, patients, and the community.

Trainees must demonstrate suitable knowledge, skills, and attitudes relating to gender, culture, and ethnicity pertinent to the practice of clinical microbiology. In addition, all Trainees must demonstrate an ability to incorporate gender, cultural, and ethnic perspectives into their communication with others and into the formal presentation of information.

On successful completion of the Program, the Trainee will be competent to function as a consultant in clinical microbiology.

See scope of activity:
DESCRIPTION OF THE PROGRAM

GENERAL OBJECTIVES

The Program follows the guidelines provided by the The Canadian College of Microbiologists (http://www.ccm.ca/) and provides training in each area outlined. The Canadian College of Microbiologists provides the following general overview of the expectations for candidates preparing for the Specialist in Clinical Microbiology examination (FCCM). Following the general objectives overview, the specific Syllabus guidelines for the Phase 1 Written Exam (Section I) and the Phase 2 Oral Exam (Section II) are provided.

The Scientific and Laboratory Basis of Microbiology
The candidates should be able to:
1. Discuss the various bacterial, viral, fungal, and parasitic pathogens in terms of their physiology, genetics, and molecular biology.
2. Describe the epidemiology of infections caused by these infectious agents.
3. Describe the elements of the immune system which relate to microbial defences and should know the tests required to evaluate immune function.
4. List the significant normal human indigenous microflora.
5. Describe the clinical criteria for the submission of specimens for microbiologic examination.
6. Discuss the procedures relevant to the collection, transport, storage, and processing of clinical specimens.
7. Discuss the appropriate methods for the examination of microbiology specimens and for the presumptive and definitive identification of microbial pathogens.
8. Describe the nature and activity of antimicrobial agents in general use and discuss the laboratory principles for testing antimicrobial activity and the measurement of antimicrobial levels.
9. Explain quality assurance principles applicable to each division of the microbiology laboratory.
10. Interpret the results of the microbiology testing to the clinician.
11. Discuss the laboratory principles of disinfection and sterilization.
12. Discuss WHMIS, biosafety cabinets; universal precautions and chemical spill clean up and be able to discuss their role in the provision of diagnostic services within a hospital.
13. Discuss their role in the provision of diagnostic services within the hospital.

Issues Related to Infection Control
The candidates should be able to:
1. Describe the epidemiology of hospital acquired infections and the principles involved in their prevention.
2. Discuss the structure and functions of a hospital infection control program.
3. Describe the infection control isolation procedures appropriate to specific disease entities.
4. Direct laboratory investigation of a nosocomial outbreak.

The Clinical Practice of Medical Microbiology Related to Infectious Diseases
The candidate should be able to:
1. Describe the clinical manifestations of infectious diseases, microbiologic diagnostic methodologies available, and treatment principles applicable to patients with infectious diseases.
2. Discuss the principles of passive and active immunization in the prevention of infectious diseases.
3. Discuss ethics and confidentiality as related to patients with infectious diseases.
In Addition to the Above Specific Objectives, Candidates should be able to:

1. Discuss the public health applications of the information generated by the microbiology laboratory.
2. Demonstrate basic statistical skills and discuss the principles and application of these tests to laboratory practice.
3. Discuss the apparent and inapparent costs incurred by the microbiology laboratory and develop a cost conscious approach to the provision of the diagnostic services.
4. Apply the principles of historical data analysis and usage estimate and test planning.
5. Use computers for data retrieval and analysis.
SPECIFIC OBJECTIVES

SECTION I: BASIC MICROBIOLOGY SYLLABUS (For Written Exam)

Study Guides
Below are suggested study guides for the written exam.


Basic Bacteriology
Understand and be able to discuss bacterial structural components (cell wall, capsule, pili, flagella, cytoplasmic membrane); bacterial growth, cell division and metabolism; normal flora; pathogenesis/virulence factors/host defenses; sterilization and disinfection; antimicrobial drugs: testing, mechanisms of action & resistance mechanisms; and bacterial vaccines
Clinical Bacteriology
For each group of organisms (listed below), understand and be able to discuss current knowledge regarding; disease(s) caused, pathogenesis, diagnostic approaches, antibiotic susceptibility, development of antibiotic resistance, epidemiology, public health issues, and prevention measures.

Bacteria - the following is a representative list of bacteria with which candidates should be familiar: Gram-positive cocci (*Staphylococcus*, *Streptococcus*, *Enterococci*, *Peptostreptococcus*); Gram-positive rods (*Mycobacterium*, *Corynebacterium*, *Listeria*, *Nocardia*, *Actinomyces*, *Bacillus*, *Clostridium*, *Propionibacterium*); Enteric Gram-negative rods (*Escherichia coli*, *Salmonella*, *Klebsiella*, *Enterobacter*, *Proteus*, *Morganella*, *Yersinia*, *Shigella*, *Vibrio*, *Aeromonas*, *Campylobacter*, *Helicobacter*, *Fusobacterium*, *Bacteroides*); Other Gram-negative rods (*Haemophilus*, *Bordetella*, *Pseudomonas*, *Legionella*, *Pasteurella*, *Brucella*, *Francisella*, *Burkholderia*); Gram-negative cocci (*Neisseria*, *Moraxella*); Spirochaetes (*Treponema*, *Borrelia*, *Leptospira*); Wall-less bacteria (*Mycoplasma*, *Ureaplasma*, *L-forms*); Obligate intracellular bacteria (*Chlamydiae*, *Rickettsiae*).

Basic Virology
Understand and be able to discuss structural components, viral replication, classification of medically important viruses, antiviral drugs, and antiviral vaccines.

Clinical Virology
For each group of viruses, be able to discuss current knowledge regarding; disease(s) caused, pathogenesis, diagnostic approaches, antiviral therapy, public health issues and prevention measures: DNA enveloped viruses (*Hepadnavirus*, *Herpes virus*, *Poxvirus*); DNA non-enveloped viruses (*Parvovirus*, *Papovavirus*, *Adenovirus*); RNA enveloped viruses (*Flavivirus*, *Togavirus*, *Retrovirus*, *Orthomyxovirus*, *Paramyxovirus*, *Rhabdovirus*, *Filovirus*, *Coronavirus*, *Arenavirus*, *Bunyavirus*); and RNA non-enveloped viruses (*Picornavirus*, *Calicivirus*).

Mycology
Medically important fungi; for each group of fungi (cutaneous mycoses, subcutaneous mycoses, systemic mycoses, opportunistic mycoses) be able to discuss current knowledge regarding disease(s) caused, pathogenesis, diagnostic approaches, antifungal therapy, public health issues, prevention measures, structure, replication, and susceptibility testing/resistance.

Parasitology
For each group of parasites (protozoa [*Entamoeba*, *Giardia*, *Cryptosporidium*, *Cyclospora*, *Trichomonas*]; blood protozoa [*Plasmodium*, *Toxoplasma*, *Trypanosoma*, *Leishmania*]; Cestodes; Trematodes; Nematodes) be able to discuss current knowledge regarding disease(s) caused, pathogenesis (life cycle), diagnostic approaches, anti-parasitic therapy, public health issues and prevention measures.

Immunology
Candidates should be familiar with laboratory techniques used for the detection and measurement of antigens and antibodies, e.g., immunoprecipitation, agglutination, complement fixation, counterimmunoelectrophoresis, ELISA, radioimmunoassay, and western blots. The following list provides a number of topics which serve as a study guide for immunology: lymphoid system and antibody; *in vitro* antibody interactions; B-cells and monoclonal antibody; complement; phagocytic cells; histocompatibility complex; lymphocyte traffic and T-cells; cell-mediated immunity; lymphokines, interferons, interleukins, tumor necrosis factor; regulation of humoral immunity;
mucosal immunity; mast cells; types of hypersensitivity; immunity to virus infections versus bacterial infections; humoral and phagocytic deficiencies; T-cell deficiency diseases; secondary immune deficiency; anaphylaxis; urticaria and food allergy; pathologic mechanisms of autoimmunity; loss of tolerance; HLA and disease; transplantation immunology; immunosuppression, immunization: active and passive; vaccines: live and dead.

SECTION II: DIAGNOSTIC LABORATORY SYLLABUS (For Oral Exam)

Reference Books
Clinical Microbiology Procedures Handbook - Isenberg Editor, ASM Publisher.

Bacteriology
1. Specimen Processing
Candidates will be expected to be able to discuss;
   a. How to keep records of specimens received, materials, supplies, and reagents used in this area of the laboratory.
   b. The special transport requirements for CSF, Bordetella, genital, and anaerobic specimens.
   c. The processing and planting protocols appropriate for specimens submitted.
   d. Biosafety concerns in this area of the laboratory.
   e. How specimen receiving and processing can be optimally integrated with the function of the rest of the laboratory.

2. Blood Culture
Candidates will be expected to be able to discuss:
   a. The indications for collecting blood cultures and the variables determining isolation and contamination rates.
   b. The advantages and disadvantages of the various blood culture systems available (e.g. Bactec, BacT/Alert, etc.).
   c. The rationale behind the routine processing of blood culture specimens.
   d. The procedures involved in the processing of blood cultures when unconventional microorganisms are suspected.
   e. How to evaluate the clinical significance of blood culture isolates; may involve reviewing the patient’s chart on the hospital ward.
   f. How to provide rapid, presumptive information to the clinician.

3. Respiratory
Candidates will be expected to be able to discuss:
   a. The indications for specimen submission to this section.
   b. The appropriate collection and transport of respiratory specimens such as sputum nasopharyngeal aspirates etc.
   c. The screening criteria for the evaluation of the quality of respiratory specimens.
   d. The epidemiology and pathogenesis of infections in the respiratory tract due to H. influenzae, S. pneumoniae, Moraxella catarrhalis, Chlamydia, Legionella, Mycobacteria and Enterobacteriaceae.
   e. The normal bacterial microflora of the respiratory tract.
4. Urine Processing
   Candidates will be expected to be able to discuss:
   a. The indications for submitting urine specimens to the microbiology laboratory and the principle of significant bacteriuria (≥100 x 10^6/L).
   b. The relevance of low urine bacterial counts (<100 x 10^6/L) in patients with acute symptomatic infection.
   c. The optimal methods of specimen transport and processing.
   d. List those bacteria that frequently cause urinary tract infections, both community and hospital acquired, and be able to discuss key tests used for identifying these organisms.
   e. Antimicrobial susceptibility testing as applied to urinary isolates and the different antibiotics tested for urinary tract isolates.
   f. The currently available methods for urine screening, their advantages and limitations.

5. Anaerobic Microbiology
   Candidates will be expected to be able to discuss:
   a. The normal anaerobic bacterial flora of the gastrointestinal tract, the skin, the oropharynx and the female genitourinary tracts and the male genitourinary tract.
   b. The clinical circumstances when one should suspect an anaerobic infection and the appropriate specimens which should be submitted for anaerobic culture.
   c. The appropriate methods for specimen collection and transport when anaerobic bacteria are suspected.
   d. The methods routinely employed to achieve anaerobiosis.
   e. The extent to which anaerobic microbiology should be performed in various laboratory clinical settings.
   f. The morphology of anaerobic bacteria frequently isolated in the clinical setting.
   g. The methods used for the definitive and presumptive identification of clinically significant isolates.
   h. The principles of anaerobic antimicrobial susceptibility testing, including the advantages and limitations of each methodology (e.g., E-test, broth dilution).
   i. When antimicrobial susceptibility testing is appropriate and the extent to which susceptibility testing should be performed.
   j. How to interpret the results of anaerobic cultures in the context of the patient’s own endogenous microflora.

6. Enteric Microbiology Section
   Candidates will be expected to be able to discuss:
   a. The indications for submitting specimens for bacterial culture, related to length of hospitalization as well as those settings in which unusual organisms should be requested.
   b. The appropriate methods for transport of specimens to the laboratory.
   c. The methods applied to processing stool specimens for the isolation of pathogens.
   d. The normal aerobic gastrointestinal flora.
   e. The morphologic features of pathogens frequently isolated from the gastrointestinal tract.
   g. The media commonly employed in this area of the lab, and in particular, the biochemical principles relevant to their use.
7. Sexually Transmitted Diseases Section
   Candidates will be expected to be able to discuss:
   a. The indications for submitting genital specimens and specimens from other sites when sexually transmitted pathogens are suspected.
   b. The methods available for the transport of genital specimens to the microbiology laboratory and/or direct bedside inoculation of specimen.
   c. The normal genital microflora.
   d. The morphologic characteristics of common genital pathogens.
   e. The schemes for the presumptive or definitive identification of genital pathogens e.g. Neisseria gonorrhoeae, Chlamydia trachomatis, Treponema pallidum. Haemophilus ducreyi, and Herpes simplex virus.
   f. The method(s) for screening Group B streptococci (S. agalactiae) in pregnant females.
   g. Use of nucleic acid test methods for STD screening and diagnostic testing.

8. Fluids, Tissues and Wound Swabs
   Candidates will be expected to be able to discuss:
   a. The appropriate collection and transport of specimens.
   b. The value and limitations of broth enrichment.
   c. The role of anaerobes in these specimens.
   d. The potential role of normal flora in these types of specimens.
   e. The types of microscopy stains that can help differentiate bacterial and fungal elements in these types of specimens.
   f. The pathogens most commonly isolated from these types of specimens.

9. Miscellaneous
   Candidates will be expected to be able to discuss:
   a. The methods routinely employed for the processing of body fluids from normally sterile sites.
   b. The indications for environmental sampling and the methodologies to be employed in this area.
   c. How to perform a cell count and differential using a haemacytometer chamber.
   d. The various important bacterial antigen detection kits available.

10. Specialized Bacteriology
    The candidates should be able to discuss specialized reference microbiology including: typing of enteric organisms (e.g. Salmonella spp.), Streptococcus spp., Haemophilus spp.; specialized toxin assays such as for C. difficile, verotoxin producing E. coli; diagnostic methods for the detection of Chlamydia trachomatis including fluorescence, enzyme immunoassay, PCR and ligase chain reaction methods.

    The candidates should be able to describe the appropriate technical methods and external reference services that provide backup facilities for bacteriology. The candidates should be familiar with both internal and external quality control programs in bacteriology.

11. Mycobacteriology Section
    The candidate will be expected to be able to discuss:
   a. The mycobacteria encountered in the clinical laboratory and their significance as human pathogens.
   b. The morphological factors, nutritional environmental requirements, and biochemical
reactions of the above that allow their detection in a clinical specimen and provide accurate identification.

c. The clinical indications for performing a mycobacterial work-up.
d. The optimal specimens required, for any given mycobacterial infection, as well as appropriate collection and transportation methods.
e. Decontamination processing of clinical specimens and be able to perform the necessary tests for detection, isolation and identification of the possible pathogen, including the principles and operation of the MGIT instruments.
f. The indications for antimicrobial susceptibility testing, the agents to be tested and the methods used.
g. The principles of interpretation of laboratory results in terms of significance for, and care of, the patient.
h. The reporting format and documentation of laboratory results in the T.B. section of the laboratory.
i. How molecular methods may speed up the process of detecting and/or identifying mycobacteria.

12. Mycology Section
The candidates will be expected to be able to discuss:

a. Classification of the fungi pathogenic for humans.
b. The morphological features, nutritional and environmental requirements and biochemical reactions of the above fungi which allow their detection in the clinical laboratory.
c. The clinical indications for performing a mycological work-up.
d. The clinical specimens required for any given mycoses, as well as be able to describe appropriate methods of collection and transportation of the specimens to the laboratory.
e. The indications for, and how to determine the minimal inhibitory concentrations and serum levels, of selected antifungal agents.
f. The methods, principles and limitations of the various serologic procedures available for the human mycoses.
g. The role of direct DNA probe methods for culture confirmation of systemic fungi (Blastomyces dermatitidis, Histoplasma capsulatum, Coccidioides immitis).

13. Quality Control Section
The candidates will be expected to be able to discuss:

a. The methods and established schedules for monitoring stains, reagents and media for expected performance.
b. The schedules and methods available for monitoring equipment used in the laboratory, including maintenance schedules to ensure ongoing optimal function for the full life of the equipment.
c. The various methods available for evaluating technologist and technician performance, including internal proficiency testing methods as well as appropriate external sources of proficiency testing programs, and evaluation of final culture reports.
d. The methods for maintenance of quality control cultures.
e. The methods available for quality control of the clinical specimen, including requisition documentation, screening methods for assessing the quality of specimen, guidelines for specimen collection and accepted methods for transportation of the clinical laboratory.
f. The requirements for documentation of specimens, laboratory procedures and quality control results.
g. How to monitor susceptibility testing results and the role that CLSI has in establishing
laboratory guidelines.
h. The performance of audits of laboratory performance as it relates to the patient’s
diagnosis, clinical course and/or response to therapy.
i. The federal postal requirements for shipping infected materials (Biohazardous transport
regulations).

14. Antimicrobial Susceptibility Testing
The candidates will be expected to be able to discuss:
a. The following susceptibility testing methods: Kirby-Bauer, Minimum Inhibitory
Concentration (MIC), Minimum Bactericidal concentration (MBC), Agar dilution and
E-test.
b. The CLSI guidelines regarding break points for different groups of organisms, and
which antimicrobials to report on the final report.
c. The organisms such as *H. influenzae*, *Enterococcus* spp., *S. aureus* and *S. pneumoniae*
that have shown changes in their susceptibility profile.
d. The basis for Oxacillin disk screening for *S. pneumoniae*.
e. The interaction with Infection Control needed to curtail the spread of multi-resistant, or
unusually resistant organisms in the hospital.
f. Surveillance procedures for MRSA and VRE.
g. Mechanisms of antibiotic resistance.

Molecular Techniques
The candidate should be able to discuss the molecular techniques available for diagnostic, culture
confirmation and typing of clinically relevant pathogens. The candidates should be able to discuss
the concepts of hybridization, amplification, sequencing, genotyping based on restriction fragment
methods and protein profile analysis and how these can be applied to the practice of Clinical
Microbiology in the areas of bacteriology, mycology, parasitology, and virology.

Candidates will be expected to be able to discuss:
1. Isolation and analysis techniques for DNA and RNA
   • Cell lysis for Gm (+) vs Gm (-)
   • DNA/protein determinations/quantitation
   • Agarose gel for separation of DNA and RNA fragments
   • Southern Blotting
   • DNA sequencing

2. Isolation and analysis techniques for Protein
   • Sodium dodecylsulfate - polyacrylamide gel electrophoresis (SDS - PAGE)
   • Western Blotting
   • Enzyme linked immunosorbent assay (ELISA)

3. Hybridization
   The candidate should be able to describe and discuss:
   • How hybridization occurs
   • The use of this technique for culture confirmation for *Mycobacterium* spp., and systemic
     fungi.
   • Limitations of nucleic acid based test methods for culture confirmation as well as direct
     specimen testing.
4. Amplification
   The candidate should be able to describe and discuss:
   - PCR, and other amplification techniques.
   - Rapid PCR thermocycler methods (e.g., light cycler etc.)
   - Application of these techniques to diagnostic microbiology (e.g., Chlamydia trachomatis, Mycobacterium tuberculosis, Herpes Simplex Virus, etc.)
   - Inhibitors in clinical material
   - Amplicon contamination control methods (uracil N-glycosylase)
   - Appropriate laboratory set up for PCR

5. Genotyping
   The candidate should be able to describe and discuss:
   - PFGE (pulsed field gel electrophoresis)
   - RFLP (restriction fragment length polymorphism)
   - RT-PCR (reverse transcriptase - polymerase chain reaction)
   - Ribotyping
   - The role these techniques play in infection control
   - How to interpret band patterns, and the reliability for each method listed above

6. DNA Sequencing
   - Methods such as dideoxy sequencing
   - How this can be used for identification and for typing of strains for epidemiology
   - Alternatives to radioactive labelling.
   - DNA databases (e.g. BLAST searches)
   - Whole genome sequencing (WGS)

7. Protein Analysis
   - How Western Blotting is used as a confirmatory test for HIV serology.

Virology: General
The candidates should be able to discuss viral taxonomy and the clinically relevant issues and molecular features of the major virus groups, their pathogenesis in human disease, host immune response, epidemiology, prevention and treatment, with an emphasis on the following viruses:

1. Respiratory tract viruses - respiratory syncytial virus (RSV), parainfluenza viruses, adenoviruses, and the influenza viruses, coronaviruses, rhinoviruses and SARs-associated coronavirus.
2. Sexually transmitted viruses - herpes simplex virus (HSV), cytomegalovirus (CMV), human papillomaviruses (HPV), human immunodeficiency virus (HIV) types 1 and 2, hepatitis B virus (HBV) and hepatitis C virus (HCV).
3. Viruses causing systemic disease in immunocompromised patients - herpes simplex virus, cytomegalovirus, varicella zoster virus (VZV), Epstein Barr virus (EBV), Adenovirus.
4. Enteric viruses - enteroviruses, rotaviruses, enteric adenoviruses, small round enteric viruses.
5. Vector-borne viruses - western equine encephalitis virus (WEE) (Dengue virus), West Nile Virus.
6. Viruses causing rash illness - measles, rubella, enteroviruses, human parvovirus B-19, human herpes virus 6 (HHV6) and human herpes virus 7 (HHV7).

The candidates should be able to describe the common technical methods of virus detection, including: cell culture with detection of virus cytopathic effect, ELISA, electron microscopy, PCR and nucleic acid hybridization, and immunological methods to identify viruses, including: neutralization, hemagglutination-inhibition, immunofluorescence, latex agglutination, and ELISA.

The candidates should be able to discuss optimal sampling method and transport conditions of specimens from patients with the above viral diseases.

The candidates should be familiar with the design, implementation, and review of quality control procedures for standard diagnostic viral methods described above. The candidates should be able to discuss which technical methods are used to provide more detailed reference diagnostic virology, and where the reference tests can be performed in Canada.

Virology: Specific Requirements

Objectives for Cell Culture:
The candidates should be able to describe:
1. The normal morphology of common cell lines and their growth and maintenance requirements.
2. How to trypsinize the monolayers and how to count cells.
3. The optimal procedures for long term storage of cell lines in the frozen state.
4. How to conduct mycoplasma contamination detection.
5. The general categories of cell lines and their properties, i.e. primary, continuous, etc.
6. The most appropriate cell line for each of the cultivable viruses.

Objectives for Rapid Viral Diagnosis:
The candidates should be able to discuss:
1. The principles and technical methods of direct and indirect immunofluorescence procedures, including the use of appropriate controls.
2. The principles and specific technical methods of enzyme immunoassay for antigen detection, with appropriate controls.
3. The principles and technical methods of latex agglutination tests for antigen detection, with appropriate controls.
4. The specimen preparation methods for direct EM and immune electron microscopy procedures. The resident should also be able to describe the morphology and size characteristics of the major human viral groups.
5. The principles and technical methods of PCR spot nucleic acid hybridization of Southern Blot analysis for the detection of virus genomes, and the appropriate use of controls.

Objectives for the Detection of Viruses by Cytopathic Effect:
The candidates should be able to describe:
1. The morphologic changes of the cytopathic effect of the major human virus groups.
2. The principles and technical methods used in identification of viruses by neutralization.
3. The technical methods used in virus identification by hemadsorption inhibition and hemagglutination inhibition, with appropriate use of controls.
4. How to inoculate the amniotic and allantoic cavities of embryonated eggs for myxovirus detection.
5. How to differentiate toxicity of clinical specimens from cytopathic effects of viruses.
Objectives for the Virology Specimen Receiving:
The candidates should be able to discuss:

1. The optimum specimen sampling site and method of sampling for each of the major human viruses.
2. The optimal specimen transport and storage methods for various types of clinical samples.
3. The principles of laboratory safety, especially the utilization of biohazard hoods and the processing of specimens that may contain hazardous viruses (hepatitis B virus or HIV).
4. The principles and practical methods of specimen treatment of all human specimens, including respiratory, gastrointestinal, and tissue specimens for both rapid diagnosis and cell culture methods.

Serology/Immunology
The candidates should be able to discuss the host immune response as it pertains to cell mediated immunity and the production of specific antibodies against a range of microbial pathogens. The understanding of the host response should apply to humans of various ages, those with natural infections, as well as those receiving vaccines, and for individuals who are immunocompromised. The candidate should be able to describe the molecular basis of antibody diversity, the hypothesized mechanisms of antigen-antibody interaction at the molecular level and factors which can interfere with antigen-antibody reactions.

The candidates should be able to discuss the standard approaches to technical methods of serological diagnosis: complement fixation, agglutination, immunofluorescence, enzyme immunoassay, radioimmunoassay and passive haemagglutination tests.

The candidates should be able to interpret and apply the appropriate serological tests for viral infections, bacterial infections (including toxin detection), unusual infections caused by Brucella spp., rickettsiae, legionella, fungi and parasites.

Serology
The candidates should be able to:

1. Describe the principles and applications of the following serological tests:
   - ELISA - both sandwich and competitive binding
   - Radioimmunoassay
   - Direct/Indirect Immunofluorescence
   - Complement Fixation Test (CFT)
   - Anti-complementary Immunofluorescence
   - Hemagglutination Inhibition
   - Direct-passive Hemagglutination
   - Western Blot analysis
   - IFA, both quantitative and qualitative

2. Discuss the protocols and procedures for proper specimen collection, submission and requisite information requirements for serological examinations.

3. Discuss quality control requirements for, and the interpretation of results of the following tests:
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- Hepatitis A, B, C antibody testing
- Hepatitis B markers
- CFT for respiratory viruses
- HIV screening and confirmatory tests
- Syphilis screening and confirmatory tests
- Immune status protocols for health care workers, organ donors and transplant recipients
- PCR-HCV, qualitative and quantitative
- Cryptococcal antigen determinations; detection and quantitation.
- Bacterial antigen detection - DFA & ELISA - Chlamydia, CNS pathogens

4. Discuss the application of methods used for:
   - Specific IgM testing, sucrose gradient and column separation techniques.
   - Removal of IgG from a serum sample using polyvalent anti-human IgG, recombinant protein G, or protein A.

5. Discuss the factors of serology related to:
   - The selection of tests based on patient history.
   - Time requirements for test completion.
   - The instrumentation required to perform serological tests.

Environmental Sciences
The candidates should be able to describe the common environmental pathogens (and their toxins) found in food, drinking water, as well as recreational water. These may include the Enterobacteriaceae, Staphylococcus aureus, Pseudomonas aeruginosa and Enterococcus spp. The candidates should be able to discuss the role of public health and environmental programs relating to analysis and monitoring.

The candidates should be familiar with technical methods for:
- Food microbiology
- Drinking water microbiology
- Recreational water microbiology

Parasitology
The candidates should be able to discuss the taxonomy, life cycle, immunology, diagnosis, treatment, prevention and control of important human parasitic diseases.

The candidates should be able to discuss:
1. The principles and applications of routine methods employed in the diagnosis of parasitic diseases.
2. Specimen preparation and examinations for the identification of common and less common parasites such as:
   - Plasmodium falciparum, P. vivax, P. ovale, and P. malariae
   - Entamoeba histolytica
   - Blastocystis hominis
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- *Giardia lamblia*
- *Enterobius vermicularis*
- *Ascaris lumbricoides*
- *Trichuris trichiuria*
- *Strongyloides stercoralis*
- *Cryptosporidium parvum*
- *Microsporidia*
- *Dientamoeba fragilis*
- *Echinococcus granulosus*
- *Schistosoma mansoni, S. hematobium, and S. japonicum*

3. The protocols and procedures for proper specimen collection, submission, and requisite information for parasitic examinations.

4. Test interpretation and reporting requirements.

**Safety**

The candidates must be able to discuss:

1. The Workplace Safety and Health Act and its applications to the clinical laboratory.

2. The Workplace Hazardous Materials Information System (WHMIS) related to:
   - What WHMIS is, its rationale and major elements.
   - Compliance mechanisms and penalties which accompany WHMIS legislation.
   - Educational and record keeping requirements under WHMIS.
   - How to classify and label regulated hazardous products.

3. The Transport of Dangerous Goods Regulations related to:
   - The nine classes of dangerous goods under the Acts.
   - The responsibilities of the shipper, the carrier and the receiver of dangerous goods.
   - The requirements for placards, labels and shipping documents.
   - Differentiating between consumer products and regulated dangerous goods.
   - Resources that may further assist in complying with the Acts.
   - Checklists to determine whether a shipment complies with Transport of Dangerous Goods Regulations before you release it to a carrier.
   - Incidence reports when necessary.

4. The Principles and Practices of Biosafety in the Clinical Laboratory related to:
   - Recognition and categorization of biohazards.
   - Categorization of containment levels and biosafety cabinets.
   - The requirements for certification of biosafety cabinets.
   - Decontamination of wastes and regulations regarding waste disposal.

5. Laboratory Acquired Infections
   - The role of aerosols, and direct contact in risk to health care workers.
   - The classification of biosafety level of various pathogens.
Other

1. Procedure Manual (Bench Protocol)
   The candidates should be able to:
   - Describe how to update bench protocols and discuss the various aspects that affect the decision making process (e.g. what is practical for the lab benches, vs what sounds good on paper).
   - Discuss how to get input from lab technologists in how to best update/change bench protocols and procedure manuals to make it an effect and useful document.
   - Discuss the CLSI and ASM recommendations pertaining to how procedure manuals should be developed and how often they should be updated and how this is documented.
   - Describe the role these procedure manuals play in accreditation.

2. Collective Agreement and Organizational Structure
   The candidates should be able to:
   - Describe the organizational structure and how the reporting lines function. Discuss how this may differ between institutions and the advantages/disadvantages of the various structures.
   - Discuss how the collective agreement may constrain management staff as it pertains to rates of pay, changes in schedule, holidays, promotion, etc.
   - Discuss the grievance process.

3. Workload Management Systems
   The candidates should be able to discuss the Guidelines for Management Information Systems in Canadian health care facilities related to:
   - Indicators for staffing, productivity workload and utilization.
   - The management use of these indicators and their limitations.
   - Development of a plan for equipment and staffing for a hypothetical laboratory.

4. Conflict Resolution
   The candidates should be able to discuss:
   - Guidelines for progressive discipline.
   - The guidelines for the institution and the laboratory for progressive discipline.
   - The function of the Human Resources Department and the Collective Agreement.
   - Hypothetical situations which will require these tools.

5. Accreditation
   The candidates should be able to discuss the general requirements under the protocols of:
   - The Canadian Council on Health Services Accreditation.
   - The College of American Pathologists.
   - The Provincial College of Physicians and Surgeons - Accreditation and Licensing requirements.

6. Government Regulation
   The candidates should be able to discuss:
   - The Medical Professions Act
   - The Hospital Services Act or its successor
7. **Information Systems**
   The candidates should be able to discuss the principles and applications of the following:
   - Laboratory Computer System:
     - What features are optimal
     - Confidentiality
   - Laboratory Information Systems:
     - Patient results
     - Epidemiology
   - Local area networks
   - The Internet and the Bulletin Board Systems

8. **Performance Appraisals**
   The candidates should be able to:
   - Determine performance standards for laboratory personnel;
   - Describe the limitations of proficiency testing;
   - Determine criteria that will link competence assurance and continuing education to performance standards;
   - Develop education action plans for deficient personnel.

9. **Confidentiality Issues**
   The candidates should be able to:
   - Describe what Public Health Information Access (PHIA) is about.
   - Recognize what would be deemed conflict situations where PHIA has not been properly observed.
   - Discuss what actions to take when PHIA transgressions occur.
CLINICAL MICROBIOLOGY TRAINING PROGRAM FACILITIES

THE PROVINCIAL LABORATORY FOR PUBLIC HEALTH (PROVLAB).
The Provlab and Division of Diagnostic and Applied Microbiology is a laboratory housed within the 650 bed tertiary care, teaching hospital (University of Alberta Hospital (UAH) located on the University of Alberta main campus. The laboratory was constructed in 1980/81. The UAH is joined to the Clinical Sciences building, the Medical Sciences building, the Katz Group-Rexall Centre for Pharmacy and Health Research, the Health Research Innovation Facility-East, the Heritage Medical Research Centre, the Edmonton Health Academy (ECHA) and the Kaye Edmonton Clinic. Together, these facilities house the Faculties of Medicine and Dentistry, Nursing, Pharmacy and Speech Pathology and Audiology. The Provlab and Division of Diagnostic and Applied Microbiology is located in the south portion of the UAH and covers 2 floors (floors 1 and 2). The following sections are contained within this laboratory structure: specimen accessioning, aerobic and anaerobic bacteriology, mycobacteriology, mycology, parasitology, serology, virology, molecular diagnostics, research and development, quality control, and media preparation. The mycology services offered are extensive and include molecular identification of fungi where necessary as well as antmycotic drug susceptibility testing. The molecular diagnostics section of the laboratory is tightly integrated with sections within the rest of the laboratory. It is responsible for providing molecular typing such as PFGE for MRSA, *E. coli* 0157, Salmonella etc. In addition, all molecular virology/serology testing is performed in this area. This includes HIV viral load, Hepatitis C genotyping, viral gastroenteritis diagnostics, as well as STD diagnostics etc. There are 90 technologists and 80 Laboratory Assistants within the Provlab. There are 6.5 board certified professional staff (4.25 FTE board certified Ph.D and 2.3 FTE board certified MD) within the Provlab. There are also 3.0 FTE laboratory scientists in the Provlab. This laboratory processes in excess of 1.3 million tests per year. This laboratory also provides clinical microbiology service to other institutions in the City of Edmonton besides the UAH such as the Cross Cancer Institute. It also serves as a referral centre for “esoteric” microbiology specimens for the City and surrounding area. The Provincial Level 3 laboratory is also housed within this structure and is primarily responsible for handling all mycobacteriology specimen requests in the province as well as any other Level 3 agent requests.

PRIVATE LABORATORY PROVIDER (CURRENTLY DYNALIFE DIAGNOSTIC LABORATORY SERVICES (Dldx)).
Dldx is a large privately owned laboratory located in downtown Edmonton (10150 102 Street). This laboratory provides clinical laboratory diagnostic services including Microbiology, to the City of Edmonton as well as selected sites in Northern Alberta.
LABORATORY SPECIFIC EVALUATION METHODS FOR CLINICAL MICROBIOLOGY TRAINEES

1. For each bench the Trainee is on, there are bench specific objective checklists outlining the material to be addressed as well as a checklist for lab tests that the Trainee should be knowledgeable about (see Appendices I-IV for these checklists). Trainees will be evaluated weekly by the technologist on the bench with the Trainee. Evaluation criteria will include (see Appendix V-VII for bench evaluation form):
   a. technical knowledge of organisms being looked at/for;
   b. knowledge of media used at that bench and the relevant biochemical principles;
   c. bench operational procedures and reasons for this approach;
   d. punctuality and interest.
   e. approach to problem-solving

2. Bench/section quizzes and unknown work-up reports will be reviewed by the Program Director and/or site coordinator and discussed with the Trainee.

3. For each rotation, Trainees will meet with the Program Director and/or site coordinator to review progress mid-rotation and at the end of their rotation. Subjective assessment by director/coordinator(s) will be made and recorded for each review.

4. A minimum of every six months, a more formal discussion between the Program Director and Trainees will take place to review progress. Strengths and weaknesses will be identified and corrective actions or additional training arrangement for weaknesses.

5. A slide review of tests, procedures and organisms relevant to the Training Program will be conducted every six months to review the Trainee’s progress.

6. Identified areas of weakness will be strengthened through discussion, bench review, and reading assignments.
LABORATORY ROTATIONS

Trainees are expected to attend their assigned bench and participate in daily work-flow (evaluated by Technologist). A set of “unknown” inoculated plates will be provided on each bench, and the Trainee is to record work-up and final identification (graded). Tutorials may be given on some topics where detection rate for pathogens is low (e.g., STD, Enterics). There will be a quiz for each bench rotation. The grade for each quiz will be incorporated in the overall performance evaluation. There will be a mid-rotation evaluation to determine the Trainee’s adequacy of exposure to benchwork. At the end of the each lab rotation, there will be an evaluation that includes: written questions, oral evaluation, and may include practical assessment (e.g., examination of cultures and/or stained microscopy samples). This end of rotation evaluation is aimed at ensuring the Trainee has assimilated the basic knowledge and can use this in a problem solving fashion.

During laboratory rotations, Trainees will attend the weekly infectious diseases/medical microbiology case presentations which are transmitted on the inter-hospital link on Fridays. Trainees will be responsible for presenting weekly plate rounds which review the current interesting problems which are being investigated by the laboratory. The teaching technologist or site coordinator will act as resource for plate rounds preparation for the Trainee.

Unless specifically involved in a post-graduate course or in a laboratory related project, Trainees will remain in the vicinity of the laboratory as a resource person to answer questions for clinicians and the laboratory technologists.

Note: Trainees are expected to reinforce/broaden their knowledge by reading references and literature searches while on laboratory rotations.
BENCH SPECIFIC OBJECTIVES: PROVLAB AND PRIVATE PROVIDER (CURRENTLY DLDX)

A. Specimen Processing:
Trainees will be expected to be able to discuss:
1. How to keep records of specimens received, materials, supplies, and reagents used in this area of the laboratory.
2. The criteria used to determine suitability of specimens submitted to the laboratory.
3. The special transport requirements for CSF, Pertussis, genital, and anaerobic specimens.
4. The processing and planting protocols appropriate for specimens submitted.
5. Biosafety concerns in this area of the laboratory.
6. How specimen receiving and processing can be optimally integrated with the function of the rest of the laboratory.

B. Blood Culture Section:
Trainees will be expected to be able to discuss:
1. The indications for collecting blood cultures and the variables determining isolation and contamination rates.
2. The advantages and disadvantages of the various blood culture systems available (e.g., Bactec, BacT/Alert, etc.).
3. The rationale behind the routine processing of blood culture specimens.
4. The procedures involved in the processing of blood cultures when unconventional microorganisms are suspected.
5. How to evaluate the clinical significance of blood culture isolates (e.g., it may involve reviewing the patient's chart on the hospital ward).
6. How to provide rapid, presumptive information to the clinician.

C. Respiratory Culture Section:
Trainees will be expected to be able to discuss:
1. The indications for specimen submission to this section.
2. The appropriate collection and transport of respiratory specimens such as sputum, nasopharyngeal aspirates etc.
3. The screening criteria for the evaluation of the quality of respiratory specimens.
4. The epidemiology and pathogenesis of infections in the respiratory tract due to Haemophilus influenzae, Streptococcus pneumoniae, Moraxella catarrhalis, and Enterobacteriaceae.
5. The normal bacterial microflora of the respiratory tract.

D. Urine Culture Section:
Trainees will be expected to be able to discuss:
1. The indications for submitting urine specimens to the microbiology laboratory and the principle of significant bacteriuria (≥10^8 cfu/L).
2. The relevance of low urine bacterial counts (<10^8 cfu/L) in patients with acute symptomatic infection.
3. The optimal methods of specimen transport and processing.
4. List those bacteria that frequently cause urinary tract infections, both community and hospital acquired, and be able to discuss key tests used for identifying these organisms.
5. Antimicrobial susceptibility testing as applied to urinary isolates and the different antibiotics tested for urinary tract isolates.
6. The currently available methods for urine screening, their advantages and limitations.
E. Anaerobic Culture Section:
The trainees will be expected to be able to discuss:
1. The normal bacterial flora of the gastrointestinal tract the oropharynx and the female genitoreproductive and urinary tracts and the male genitourinary tract.
2. The clinical circumstances when one should suspect an anaerobic infection and the appropriate specimens which should be submitted for anaerobic culture.
3. The appropriate methods for specimen collection and transport when anaerobic bacteria are suspected.
4. The methods routinely employed to achieve anaerobiosis.
5. The extent to which anaerobic microbiology should be performed in various laboratory clinical settings.
6. The morphology of bacteria frequently isolated in the clinical setting.
7. The methods used for the definitive and presumptive identification of clinically significant isolates.
8. The principles of anaerobic antimicrobial susceptibility testing, including the advantages and limitations of each methodology (e.g. E-test, broth dilution).
9. When antimicrobial susceptibility testing is appropriate and the extent to which susceptibility testing should be performed.
10. How to interpret the results of anaerobic cultures in the context of the patient’s own endogenous microflora.

F. Enteric Culture Section:
The trainees will be expected to be able to discuss:
1. The indications for submitting specimens for bacterial culture, related to length of hospitalization as well as those settings when unusual organisms should be requested.
2. The appropriate methods for transport of specimens to the laboratory.
3. The methods applied to processing stool specimens for the isolation of pathogens.
4. The normal aerobic gastrointestinal flora.
5. The morphologic features of pathogens frequently isolated from the gastrointestinal tract.
7. The media commonly employed in this area of the laboratory, and in particular, the biochemical principles relevant to their use.
8. The use of various non-culture techniques for the detection of enteric pathogens

G. STD Culture Section:
The trainees will be expected to be able to discuss:
1. The indications for submitting genital specimens and specimens from other sites when sexually transmitted pathogens are suspected.
2. The methods available for the transport of genital specimens to the microbiology laboratory and/or direct bedside inoculation of specimen.
3. The normal genital microflora.
4. The morphologic characteristics of common genital pathogens.
5. The schemes for the presumptive or definitive identification of genital pathogens (e.g., Neisseria gonorrhoeae, Chlamydia trachomatis, Treponema pallidum, Haemophilus ducreyi, and Herpes simplex virus).
6. The method(s) for screening Group B streptococci (Streptococcus agalactiae) in pregnant
females.
7. Methods used to aid in the diagnosis of vaginitis (bacterial, fungal, parasitic) and how to interpret these results in the context of the patient’s clinical findings
8. When antimicrobial susceptibility testing is appropriate, and the extent to which it should be performed.

H. Wound Culture Section:
The trainees will be expected to be able to discuss:
1. The appropriate collection and transport of specimens (including techniques to evaluate the suitability of specimens received for culture).
2. The value and limitations of broth enrichment.
3. The role of anaerobes in these specimens.
4. The potential role of normal flora in these types of specimens.
5. The types of microscopy stains that can help differentiate bacterial and fungal elements in these types of specimens.
6. The pathogens most commonly isolated from these types of specimens.
7. The principles, uses, and limitations of surveillance cultures
8. The principles, indications and limitations of referral of work-up on multiple samples from a single source.
9. The principles, uses and limitations of protocols to dictate work-up, and the use of interpretive comments on reports

I. Fluids and Tissue Culture from Normally Sterile Body Sites:
The trainees will be expected to be able to discuss:
1. The methods routinely employed for the processing tissue and body fluids from normally sterile body sites.
2. The value of various direct microscopy techniques (gram stain, fluorescence stains etc) in providing preliminary information
3. The situations, uses and limitations of bacterial antigen detection kits.
4. The situations and uses of quantitative cultures and the interpretation of results in the context of the clinical situation.

J. Specialized Bacteriology:
The trainees should be able to discuss:
1. Reportable organisms: what organisms are reported and to whom (review current list).
2. C. difficile testing using GDH and toxin antigen detection and cytotoxic assays.
3. Rapid urease and culture for H. pylori detection.
4. Sample Collection: e.g., what samples are best for C. trachomatis (culture, direct fluorescence antigen assays, probe based detection and Ligase chain reaction tests).
5. Epidemiologic typing for Salmonella spp., Haemophilus spp. and Streptococcus spp.
6. Verotoxin testing for stool samples to detect E. coli 0157:H7
7. Reference services available to diagnostic labs.
BENCH SPECIFIC OBJECTIVES: PROVLAB (ADDITIONAL OBJECTIVES)
(In addition to the rotations described in the previous section [BENCH SPECIFIC OBJECTIVES: PROVLAB AND PRIVATE PROVIDER], the following additional rotations are offered at PROVLAB)

A. Mycobacteriology Section:
The Trainee will be expected to be able to discuss:
1. The mycobacteria encountered in the clinical laboratory and their significance as human pathogens.
2. The morphological factors, nutritional and environmental requirements, and biochemical reactions of the above that allow their detection in a clinical specimen and provide an accurate identification.
3. The clinical indications for performing a mycobacterial work-up.
4. The optimal specimens required, for any given mycobacterial infection, as well as appropriate collection and transportation methods.
5. Decontamination processing of clinical specimens and be able to perform the necessary tests for detection, isolation and identification of the possible pathogen, including the principles and operation of the MGIT instruments.
6. The indications for antimicrobial susceptibility testing, the agents to be tested and the methods used.
7. The principles of interpretation of laboratory results in terms of significance for, and care of, the patient.
8. The reporting format and documentation of laboratory results in the T.B. section of the laboratory.
9. How DNA based molecular methods can speed up the process of detecting and/or identifying mycobacteria.
10. Biosafety issues pertaining to diagnostic mycobacteriology.

B. Mycology Section:
The Trainee will be expected to be able to discuss:
1. Classification of the fungi pathogenic for man.
2. The morphological features, nutritional and environmental requirements and biochemical reactions of the above fungi which will allow their detection in the clinical laboratory.
3. The clinical indications for performing a mycological work-up.
4. The clinical specimens required for any given mycoses, as well as to be able to describe appropriate methods of collection and transportation of the specimens to the laboratory.
5. The indications for and how to determine the minimal inhibitory concentrations and serum levels of selected antifungal agents.
6. The methods and the principles and limitations of the various serologic procedures available for the human mycoses.
7. The role of direct DNA probe methods for culture confirmation of systemic fungi (Blastomyces dermatitidis, Histoplasma capsulatum, Coccidioides immitis).
8. Biosafety issues pertaining to diagnostic mycology.

C. Parasitology Section:
The Trainee will be able to discuss:
1. The principles and applications of routine methods employed in the diagnosis of parasitic diseases.
2. Specimen preparation and examinations for the identification of common and less common parasites such as:
- *Plasmodium falciparum, P. vivax, P. ovale, P. malariae, and P. knowlesi*
- *Entamoeba histolytica*
- *Blastocystis hominis*
- *Giardia lamblia*
- *Enterobius vermicularis*
- *Ascaris lumbricoides*
- *Trichuris trichiura*
- *Strongyloides stercoralis*
- *Cryptosporidium parvum*
- *MicrosporidiaL spp.*
- *Dientamoeba fragilis*
- *Echinococcus granulosus*
- *Schistosoma mansoni, S. hematobium, and S. japonicum*

3. The protocols and procedures for proper specimen collection, submission, and requisite information for parasitic examinations.
4. Test interpretation and reporting requirements.

D. Quality Control Section:
The Trainee will be expected to be able to discuss:

1. The methods and established schedules for monitoring stains, reagents and media for expected performance.
2. The schedules and methods available for monitoring equipment used in the laboratory, including maintenance schedules to ensure ongoing optimal function for the full life of the equipment.
3. The various methods available for evaluating technologist and technician performance, including internal proficiency testing methods as well as appropriate external sources of proficiency testing programs, and evaluation of final culture reports.
4. The methods for maintenance of quality control cultures.
5. The methods available for quality control of the clinical specimen, including requisition documentation, screening methods for assessing the quality of specimen, guidelines for specimen collection and accepted methods for transportation of the clinical laboratory.
6. The requirements for documentation of specimens, laboratory procedures and quality control results.
7. How to monitor susceptibility testing results and the role that CLSI has in establishing laboratory guidelines.
8. The performance of audits of laboratory performance as it relates to the patient’s diagnosis, clinical course and/or response to therapy.

E. Antimicrobial Susceptibility Testing:
The Trainee will be expected to be able to discuss:

1. The following susceptibility testing methods: Kirby-Bauer, Minimum Inhibitory Concentration (MIC), Minimum Bactericidal Concentration (MBC), agar dilution and E-test.
2. The CLSI guidelines regarding; break points for different groups of organisms, and which antimicrobials to report on the final report.
3. The organisms such as *H. influenzae, Enterococci spp., S. aureus* and *S. pneumoniae* that
have shown changes in their susceptibility profile.

4. The basis for Oxacillin disk screening for *S. pneumoniae*.
5. The interaction with Infection Control needed to curtail the spread of multi-resistant, or unusually resistant organisms in the hospital.
6. How to accurately detect ESBLs.

F. **Molecular Diagnostics:**

The Trainee will be expected to be able to discuss:

1. Specimen collection and transport for samples to be tested by molecular methods (e.g. probe hybridization, and amplification methods such as PCR).
2. Basic concepts of probe and amplification methods for direct diagnostic testing and culture confirmation.
3. How molecular methods can be used for direct diagnostic testing.
4. What factors cause interference in molecular testing (e.g. inhibitors in sample)?
5. Q.C. for molecular testing methods (e.g. Amplicon contamination, internal positive controls).
6. How PFGE and amplification methods (e.g. RAPD PCR) can be used for epidemiological typing of a wide range of microorganisms. [including analysis and interpretation of results]
7. How molecular methods can be used to detect antimicrobial resistance in microorganisms (e.g. MRSA, VRE, HIV, *M. tuberculosis*).

G. **Infection Control:**

The Trainee will be expected to be able to discuss:

2. The appropriate use of Isolation Precautions including: Airborne precautions, Respiratory Precautions, Contact Precautions, and Strict Isolation Precautions.
3. The role of contact screening and cohorting in the prevention of nosocomial spread of pathogens including: *M. tuberculosis*, MRSA, VRE, *C. difficile*.
4. Specialized containment needed for construction in areas where immuno-compromised patients are present.
5. The role of the laboratory and Infection Control in ensuring that reporting of “Reportable Organisms and/or Syndromes” are appropriately communicated to Public Health and/or National agencies.
6. The role of handwashing in nosocomial infections and lab-acquired infection. [Trainees should have knowledge of relative efficacy of alcohol-based agents versus other handwashing agents].
7. The guidelines for preventing lab-acquired infection in staff in Microbiology Laboratory.
SECTION AND BENCH SPECIFIC OBJECTIVES: PROVINCIAL LABORATORY FOR PUBLIC HEALTH (PROVLAB-EDMONTON)

VIROLOGY: GENERAL OBJECTIVES:

The Trainee will be able to discuss viral taxonomy and the clinically relevant issues and molecular features of the major virus groups, their pathogenesis in human disease, host immune response, epidemiology, prevention and treatment, with an emphasis on the following viruses:


b. Sexually transmitted viruses – herpes simplex virus (HSV), human papillomaviruses (HPV), human immunodeficiency virus (HIV) types 1 and 2, hepatitis B virus (HBV) and hepatitis C virus (HCV), polyomaviruses (BK and JC viruses).

c. Viruses causing systemic disease in immunocompromised patients – herpes simplex virus, cytomegalovirus, varicella zoster virus (VZV), Epstein Barr virus (EBV), Adenovirus.

d. Enteric viruses – enteroviruses, rotaviruses, enteric adenoviruses, small round enteric viruses.

e. Vector-borne viruses – western equine encephalitis virus (WEE), West Nile Virus (WNV).

f. Viruses causing rash illness – measles, rubella, enteroviruses, human parvovirus B-19, human herpes virus 6 (HHV6) and human herpes virus 7 (HHV7).

g. Zoonotic viruses – Hantavirus, Orf.

The Trainee will be able to describe the common technical methods of virus detection, including: cell culture with detection of virus cytopathic effect, ELISA, electron microscopy, PCR and nucleic acid hybridization, and immunological methods to identify viruses, including: neutralization, hemagglutination-inhibition, immunofluorescence, latex agglutination, and ELISA.

The Trainee will be able to discuss optimal sampling method and transport conditions of specimens from patients with the above viral diseases.

The Trainee will be familiar with the design, implementation, and review of quality control procedures for standard diagnostic viral methods, described above. The Trainee should be able to discuss which technical methods are used to provide more detailed reference diagnostic virology, and where the reference tests can be performed in Canada.
VIROLOGY: SPECIFIC OBJECTIVES

Objectives for Cell Culture Bench:
The Trainee will be able to describe:
1. The normal morphology of common cell lines and their growth and maintenance requirements.
2. How to trypsinize the monolayers and how to count cells.
3. The optimal procedures for long-term storage of cell lines in the frozen state.
4. How to conduct mycoplasma contamination detection.
5. The general categories of cell lines and their properties, i.e. primary, continuous, etc.
6. The most appropriate cell line for each of the cultivable viruses.

Objectives for Rapid Viral Diagnostic Bench:
The Trainee will be able to discuss:
1. The principles and technical methods of direct and indirect immunofluorescence procedures, including the use of appropriate controls.
2. The principles and specific technical methods of enzyme immunoassay for antigen detection, with appropriate controls.
3. The principles and technical methods of latex agglutination tests for antigen detection, with appropriate controls.
4. The specimen preparation methods for direct EM and immune electron microscopy procedures. The resident should also be able to describe the morphology and size characteristics of the major human viral groups.
5. The principles and technical methods of PCR analysis for the detection of virus genomes, and the appropriate use of controls.

Objectives for the Detection of Viruses by Cytopathic Effect:
The Trainee will be able to describe:
1. The morphologic changes of the cytopathic effect of the major human virus groups.
2. The principles and technical methods used in identification of viruses by neutralization.
3. The technical methods used in virus identification by hemadsorption inhibition and hemagglutination inhibition, with appropriate use of controls.
4. How to inoculate the amniotic and allantoic cavities of embryonated eggs for myxovirus detection.
5. How to differentiate toxicity of clinical specimens from cytopathic effect of viruses.

Objectives for the Virology Specimen Receiving Bench:
The Trainee will be able to discuss:
1. The optimum specimen sampling site and method of sampling for each of the major human viruses.
2. The principles of laboratory safety, especially the utilization of biosafety cabinets and the processing of specimens that may contain hazardous viruses (hepatitis B virus or HIV) or prions.
3. The principles and practical methods of specimen treatment of all human specimens, including respiratory, gastrointestinal, and tissue for both rapid diagnosis and cell culture methods.
SEROLOGY/IMMUNOLOGY: GENERAL OBJECTIVES

The Trainee will be able to discuss the host immune response as it pertains to cell mediated immunity and the production of specific antibodies against a range of microbial pathogens. The understanding of the host response should apply to humans of various ages, those with natural infections, as well as those receiving vaccines and for individuals who are immunocompromised. The Trainee should be able to describe the molecular basis of antibody diversity, the hypothesized mechanisms of antigen-antibody interaction at the molecular level and factors which can interfere with antigen-antibody reactions.

The Trainee will be able to discuss with the standard approaches to technical methods of serological diagnosis: complement fixation, agglutination, immunofluorescence, enzyme immunoassay, and passive hemagglutination tests.

The Trainee will be able to interpret and apply the appropriate serological tests for viral infections, bacterial infections including toxin detection, unusual infections such as those due to Brucella, Rickettsiae, Legionella, and parasites.

SEROLOGY: SPECIFIC OBJECTIVES

1. The Trainee will be able to:
   Describe the principles and applications of the following serological tests:
   - ELISA – both sandwich and competitive binding
   - Indirect Immunofluorescence
   - Complement Fixation Test (CFT)
   - Anti-complementary Immunofluorescence
   - Hemagglutination Inhibition
   - Direct-passive Hemagglutination
   - Western Blot analysis
   - IFA, both quantitative and qualitative

2. Discuss the protocols and procedures for proper specimen collection, submission and requisite information requirements for serological examinations.

3. Discuss quality control requirements for, and the interpretation of results of the following tests:
   - Hepatitis A, B, C antibody testing
   - Hepatitis B markers
   - CFT for respiratory viruses
   - HIV screening and confirmatory tests
   - Syphilis screening and confirmatory tests
   - Immune status protocols for health care workers, organ donors and transplant recipients
   - PCR-HCV, qualitative and quantitative

4. Discuss the application of methods used for:
   - Specific IgM testing, serum gradient and column separation techniques update.
• Removal of IgG from a serum sample using polyvalent anti-human IgG, recombinant protein G, or protein A.

5. Discuss the factors of serology related to:
   • The selection of tests based on patient history.
   • Time requirements for test completion.
   • The instrumentation required to perform serological tests.

6. Describe the principles and applications of the following molecular methods:
   • HIV and Hepatitis C viral load determination
   • Polyomavirus PCR
   • Parvovirus B19 nested PCR

ENVIROMENTAL LABORATORY OBJECTIVES:

The Trainee will be able to describe the common environmental pathogens (and their toxins) found in food, drinking water, as well as recreational water. The Trainee will be able to discuss the role of public health and environmental programs relating to analysis and monitoring.

The Trainee will be familiar with technical methods for:
   • Food microbiology
   • Drinking water microbiology
   • Recreational water microbiology

PARASITOLOGY OBJECTIVES:

The Trainee should be able to discuss the taxonomy, life cycle, immunology, diagnosis, treatment, prevention and control of important human parasitic diseases.

The Trainee will be able to discuss:
1. The principles and applications of routine methods employed in the diagnosis of parasitic diseases.

2. Specimen preparation and examinations for the identification of common and less common parasites such as:
   • Plasmodium falciparum, P. vivax, P. ovale, P. malariae, and P. knowlesi
   • Entamoeba histolytica
   • Blastocystis hominis
   • Giardia lamblia
   • Enterobius vermicularis
   • Ascaris lumbricoides
   • Trichuris trichiura
   • Strongyloides stercoralis
   • Cryptosporidium parvum
   • MicrosporidiaL spp.
   • Dientamoeba fragilis
   • Echinococcus granulosus
   • Schistosoma mansoni, S. hematobium, and S. japonicum
3. The protocols and procedures for proper specimen collection, submission, and requisite information for parasitic examinations.

4. Test interpretation and reporting requirements.

SAFETY OBJECTIVES:
The Trainee will be able to discuss:

1. The Workplace Safety and Health Act and its applications to the clinical laboratory.

2. The Workplace Hazardous Materials Information system (WHMIS) related to:
   - What WHMIS is, its rationale and major elements.
   - Compliance mechanisms and penalties which accompany WHMIS legislation.
   - Educational and record keeping requirements under WHMIS.
   - How to classify and label regulated hazardous products.

3. The Transport of Dangerous Goods Regulation related to:
   - The nine classes of dangerous goods under the Acts.
   - The responsibilities of the shipper, the carrier and the receiver of dangerous goods.
   - The requirements for placards, labels and shipping documents.
   - Differentiating between consumer products and regulated dangerous goods.
   - Resources that may further assist in complying with the Acts.
   - Checklists to determine whether a shipment complies with Transport of Dangerous Goods Regulations before being released to a carrier.
   - Incident reports when necessary.

4. The Principles and Practices of Biosafety in the Clinical Laboratory related to:
   - Recognition and categorization of biohazards.
   - Categorization containment levels and biosafety cabinets.
   - The requirements for certification of biosafety cabinets.
   - Decontamination of wastes and regulations regarding waste disposal.

5. Laboratory Acquired Infections
   - The role of aerosols, and direct contact in risk to health care workers.
   - The classification of Biosafety level of various pathogens.
   - Prevention of laboratory acquired infection.

6. Bioterrorism Response

7. Waste Management
SECTION AND BENCH SPECIFIC OBJECTIVES: NATIONAL MICROBIOLOGY LABORATORY

A. THE ROLE OF THE NML
The Trainee should be able to describe activities at the NML with respect to:
1. The role of the NML within the Canadian Public Health Lab Network.
2. Role as a reference lab for infectious organisms requiring Level 3 and 4 containment facilities.
3. Relationship between hospital, provincial and national microbiology labs.
4. Field and lab response in outbreak situations.
5. Disease surveillance and relationship with provincial and national epidemiologists.
6. Interplay between surveillance, reference services, research and public health.

B. MOLECULAR TECHNIQUES FOR REFERENCE LAB SERVICES:
The Trainee should be able to describe the techniques and discuss strengths and weaknesses of the following:
1. PCR: Design and optimization of standard and real-time PCR methods for diagnostic testing
2. Sequencing: (e.g. for strain speciation, molecular epidemiology or human genetics)
3. Advanced bacterial typing: PFGE (pulsed field gel electrophoresis), MLST (multilocus sequence typing), plasmid profiling

C. UNIQUE REFERENCE LABORATORY TESTING SERVICES
Trainees will select one to two of the following areas. They should be able to describe the techniques used in each of the selected areas and discuss the specialized tests/services that are provided by NML for the following:
1. Zoonotic pathogens (e.g. including potential field study opportunities)
2. Prion disease (including human genetics and biochemical markers)
3. Vaccine preventable diseases
4. Emerging diseases (West Nile Virus, SARS)
5. Mycobacteria speciation and susceptibility testing
6. Advanced bacterial characterization
7. Bioterrorism related diagnostics

D. BIOSAFETY: NATIONAL ISSUES
This includes discussions of biosafety related issues with CSCHAH biosafety officers. The Trainee should:
1. Understand the principles of biosafety and biocontainment.
2. Understand the basic practical knowledge and operational aspects of high containment laboratories.
3. Participate in a one-day transport of dangerous goods (TDG) training course to obtain TDG certification (scheduling of both the course and the rotation permitting).
MANAGEMENT SPECIFIC OBJECTIVES:

1. **Budget:**

   The Trainee will be given a year-end budget and be asked a series of questions pertaining to the budget. The objectives of this exercise are to have the Trainee develop responses to “real-life” issues (e.g. variance reporting, budgeting, justification of expenses, etc). The responses are written-up by the Trainee and reviewed with the site coordinator and/or program director. After completion of this exercise, the Trainee will be able to:

   a. Discuss the yearly budget and be able to find specific information in the budget report.
   b. Discuss approaches to variances reporting using the 20/60 philosophy.
   c. Discuss and rationalize reasons for variability in expenses.
   d. Evaluate cost effectiveness of tests offered.

2. **WLU/Productivity:**

   There will be a tutorial on WLU/productivity to familiarize the Trainee with the STATS CAN workload unit measurement system that is used in Canada. Various problems relating to measurements of WLUs and productivity will be given to the Trainee who will develop a written response that will be discussed with the site coordinator and/or program director. After this problem solving session, the Trainee will be able to:

   a. Explain the basis for the WLU as a measure of productivity.
   b. Define expectation for WLU/EFT and how this relates to determining staffing levels in a department.
   c. Develop proposals related to reduction of increases in staff or workload, and how this will impact the functioning of the laboratory.

3. **Conflict Resolution and Negotiation Skills:**

   The Trainee will be presented with some “real-life” problems by the technologists. The Trainee will be expected to develop an approach to handling these conflicts and will be evaluated by the technologist on the advices given. The evaluation (from the technologist presenting the problem) and the solution (development and written up by the Trainee) will be reviewed with the site or program director to ensure that all issues were thought of. After completing this series, the Trainee will be able to:

   a. Develop and discuss approaches to handling conflicts that arise with laboratory staff.

The Trainee will be assigned a specific bench protocol to review critically. The Trainee will be expected to do a review of the literature and compare and contrast the bench protocol given to him/her with what is reported to be the optimal procedure based on the literature and cost/benefit analysis. The Trainee will write up any areas that are felt to require change, and these will be discussed with the site or program director. After this exercise, the Trainee will be able to:

   a. Describe how to update bench protocols and discuss the various aspects that affect the decision making process (e.g. what is practical for the lab benches versus what sounds good on paper).
   b. Discuss with lab technologists and get input in how to best update/change bench protocols and procedure manuals to make it an effect and useful document.
   c. Discuss the CLSI and ASM recommendations pertaining to how procedure manuals should be developed and how often they should be updated and how this is documented.
   d. Describe the role these procedure manuals play in accreditation.

5. Collective Agreement and Organizational Structure:

The Trainee will have a tutorial to familiarize him/her with the organizational structure of that institution, and what collective agreements are relevant to the staff in that hospital. A copy of the appropriate collective agreement will be provided to the Trainee along with a series of problems that require information from the collective agreement. The Trainee will write responses to these problems and these will be reviewed with the site or program director. After this session the Trainee will be able to:

   a. Describe the organizational structure and how the reporting lines function. Discuss how this may differ between institutions and the advantages/disadvantages of the various structures.
   b. Discuss how the collective agreement may constrain management staff as it pertains to rates of pay, changes in schedules, holidays, promotion, etc.
   c. Discuss the grievance process.

6. Continuing Education:

The Trainee will be actively involved in presenting sessions that will contribute to laboratory staff development. The methods that can be used for continuing education will be discussed. After this exercise the Trainee will be able to:

   a. Describe the various approaches to providing continuing education for laboratory staff.
   b. Develop an agenda of topics that would be relevant for Continuing Education.
   c. Compare and contrast the topics/approaches that would provide a significant Continuing Education contribution for technologists, versus hospital wards, versus Trainee.
7. **Accreditation**  
The Trainee will be able to discuss the general requirements under the protocols of:  
- The College of American Pathologists  
- The Alberta College of Physicians and Surgeons – Accreditation and Licensing requirements.

8. **Government Regulation:**  
The Trainee will be able to discuss:  
- Workplace Safety and Health  
- PHIA and FIPPA  
- The Public Health Act  
- The general structure of Alberta Health and Alberta Health Services  
- Governance by the College of Physicians and Surgeons

9. **Waste Management:**  
The Trainee will be able to describe:  
- The principles and general applications of reduction, recycling and reuse.  
- The segregation and treatment of biohazardous waste, especially sharps.

10. **Information Systems:**  
The Trainee will be able to discuss the principles and applications of the following:  
- Management Information Systems (CIHI) – WLU/Productivity  
- Laboratory Computer System:  
  - What features are optimal  
  - Confidentiality  
- Laboratory Information Systems:  
  - Patient results  
  - Epidemiology  
- Local area networks  
- The Internet and the Bulletin Board Systems

11. **Performance Appraisals:**  
The Trainee will be able to:  
- Determine performance standards for laboratory personnel;  
- Describe the limitations of proficiency testing;  
- Determine criteria that will link competence assurance and continuing education to performance standards;  
- Develop education action plans for deficient personnel.

12. **Continuing Quality Improvement, QA and QC**  
The Trainee will be able to distinguish and discuss elements of a Quality Program, and development and function of such a program.
APPENDIX I

BENCH SPECIFIC OBJECTIVE CHECKLIST: Rotations at Provlab or Private Provider (currently Dldx)

A. Specimen Processing:

1. How to keep records of specimens received, materials, supplies and reagents used in this area of the laboratory.
   Topic Reviewed Provlab
   Topic Reviewed Dldx

2. The criteria used to determine suitability of specimens submitted.
   ☐ ☐

3. The special transport requirements for CSF, Pertussis, genital, and anaerobic specimens.
   ☐ ☐

4. The processing and planting protocols appropriate for specimens submitted.
   ☐ sterile body fluids (CSF, Aspirates, Blood)
   ☐ urines
   ☐ tissues
   ☐ swabs (surgically acquired versus routine)
   ☐ respiratory secretions
   ☐ throat swabs
   ☐ stool
   ☐ ☐

5. Biosafety concerns in this area of the laboratory.
   ☐ ☐

6. How specimen receiving and processing can be optimally integrated with the function of the rest of the laboratory.
   ☐ ☐
B. Blood Culture Section:

1. The indications for collecting blood cultures and the variables determining isolation and contamination rates.

2. The advantages and disadvantages of the various blood culture systems available (e.g. Bactec, BacT/Alert). 

3. The rationale behind the routine processing of blood culture specimens.

4. The procedures involved in the processing of blood cultures when unconventional microorganisms are suspected.

5. How to evaluate the clinical significance of blood culture isolates. It may involve reviewing the patient's chart on the hospital ward.

6. How to provide rapid, presumptive information to the clinician.

7. Organisms reviewed:
   - *Escherichia coli*
   - *Pseudomonas aeruginosa*
   - *Klebsiella pneumoniae*
   - *Staphylococcus aureus*
   - Coagulase Negative *Staphylococcus*
   - *Enterococcus faecalis*
   - *Streptococcus pyogenes*
   - *Streptococcus pneumoniae*
   - *Streptococcus agalactiae*
   - *Corynebacterium species*
   - *Listeria monocytogenes*
   - *Propionibacterium species*
   - *Clostridium species*
C. Respiratory Culture Section:

1. The indications for specimen submission to this section.  

2. The appropriate collection and transport of respiratory specimens such as sputum, nasopharyngeal aspirates etc.  

3. The screening criteria for the evaluation of the quality of respiratory specimens.  

4. The epidemiology and pathogenesis of infections in the respiratory tract due to *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis*, and *Enterobacteriaceae*.  

5. The normal bacterial microflora of the respiratory tract.  

6. Organisms reviewed:
   - *Streptococcus pneumoniae*
   - *Streptococcus pyogenes*
   - *Moraxella catarrhalis*
   - *Haemophilus influenzae*
   - *Haemophilus parainfluenzae*
   - *Mycoplasma pneumoniae*
   - *Staphylococcus aureus*
   - *Escherichia coli*
   - *Klebsiella pneumoniae*
   - *Neisseria meningitidis*
   - *Bordetella pertussis*
   - *Bordetella parapertussis*
   - *Corynebacterium diphtheriae*
   - *Candida albicans*
D. Urine Culture Section:

1. The indications for submitting urine specimens to the microbiology laboratory and the principle of significant bacteriuria (≥10^8 cfu/L).

2. The relevance of low urine bacterial counts (<10^8 cfu/L) in patients with acute symptomatic infection.

3. The optimal methods of specimen transport and processing.

4. List those bacteria that frequently cause urinary tract infections, both community and hospital acquired, and be able to discuss key tests used for identifying these organisms.

5. Antimicrobial susceptibility testing as applied to urinary isolates and the different antibiotics tested for urinary tract isolates.

6. The currently available methods for urine screening, their advantages and limitations

7. Organisms reviewed:
   - Escherichia coli
   - Klebsiella species
   - Proteus species
   - Enterobacter species
   - Serratia species
   - Pseudomonas species
   - Enterococcus faecalis
   - Enterococcus faecium
   - Streptococcus agalactiae (Group B Streptococcus)
   - Streptococcus pyogenes
   - Staphylococcus aureus
   - Staphylococcus saprophyticus
   - Corynebacterium urealyticum
   - Diphtheroids
   - Alpha hemolytic streptococcus
   - Candida species
E. Anaerobic Culture Section:

1. The normal bacterial flora of the gastrointestinal tract, the oropharynx, the female genitoreproductive and urinary tracts and the male genitourinary tract.

2. The clinical circumstances when one should suspect an anaerobic infection, and the appropriate specimens which should be submitted for anaerobic culture.

3. The appropriate methods for specimen collection and transport when anaerobic bacteria are suspected.

4. The methods routinely employed to achieve anaerobiosis.

5. The extent to which anaerobic microbiology should be performed in various laboratory clinical settings.

6. The morphology of bacteria frequently isolated in the clinical setting.

7. The methods used for the definitive and presumptive identification of clinically significant isolates.

8. The principles of anaerobic antimicrobial susceptibility testing, including the advantages and limitations of each methodology (e.g. E-test, broth dilution).

9. When antimicrobial susceptibility testing is appropriate and the extent to which susceptibility testing should be performed.

10. How to interpret the results of anaerobic cultures in the context of the patient’s own endogenous microflora.

11. Organisms reviewed:

- Bacteroides fragilis
- Prevotella species
- Porphyromonas species
- Peptostreptococcus species
- Fusobacterium species
- Clostridium perfringens
- Clostridium septicum
- Clostridium difficile
- Veillonella species
F. **Enteric Culture Section:**

1. The indications for submitting specimens for bacterial culture, related to length of hospitalization as well as those settings when unusual organisms should be requested.

2. The appropriate methods for transport of specimens to the laboratory.

3. The methods applied to processing stool specimens for the isolation of pathogens.

4. The normal aerobic gastrointestinal flora.

5. The morphologic features of pathogens frequently isolated from the gastrointestinal tract.

6. The media commonly employed in this area of the lab, and in particular, the biochemical principles relevant to their use.


8. The use of various non-culture techniques for the detection of enteric pathogens.

9. Organisms reviewed:
   - [ ] Enterobacteriaceae (normal fecal flora)
   - [ ] *Salmonella typhi*
   - [ ] *Salmonella species*
   - [ ] *Shigella species*
   - [ ] *Campylobacter species*
   - [ ] *Escherichia coli* 0157:H7
   - [ ] *Yersinia species*
   - [ ] *Aeromonas species*
   - [ ] *Plesiomonas shigelloides*
   - [ ] *Vibrio species*
G.  STD Culture Section:

1. The indications for submitting genital specimens and specimens from other sites when sexually transmitted pathogens are suspected.

2. The methods available for the transport of genital specimens to the microbiology laboratory and/or direct bedside inoculation of specimen.

3. The normal genital microflora.

4. The morphologic characteristics of common genital pathogens.

5. The schemes for the presumptive or definitive identification of genital pathogens (e.g. *Neisseria gonorrhoeae*, *Chlamydia trachomatis*, *Treponema pallidum*, *Haemophilus ducreyi*, and *Herpes simplex* virus).

6. The method(s) for screening Group B streptococci (*S. agalactiae*) in pregnant females.

7. Methods used to aid in the diagnosis of vaginitis (bacterial, fungal, parasitic) and how to interpret these results in the context of the patient’s clinical findings.

8. When antimicrobial susceptibility testing is appropriate, and the extent to which it should be performed.

9. Organisms reviewed:

   - *Neisseria gonorrhoeae*
   - *Chlamydia trachomatis*
   - *Treponema pallidum*
   - *Haemophilus ducreyi*
   - *Herpes simplex*
   - HIV
   - *Streptococcus agalactiae* (Group B Streptococcus)
   - *Listeria monocytogenes*
   - *Candida albicans*
H. Wound Culture Section:

1. The appropriate collection and transport of specimens (including techniques to evaluate the suitability of specimens received for culture).

2. The value and limitations of broth enrichment.

3. The role of anaerobes in these specimens.

4. The potential role of normal flora in these types of specimens.

5. The types of microscopy stains that can help differentiate bacterial and fungal elements in these types of specimens.

6. The pathogens most commonly isolated from these types of specimens.

7. The principles, situations and limitations of referral of work-up on multiple samples from a single source.

8. The principles, uses and limitations of protocols to dictate work-up, and the use of interpretive comments on reports.

9. Organisms reviewed:

- *Staphylococcus aureus*
- Coagulase Negative *Staphylococcus*
- *Streptococcus pyogenes*
- *Streptococcus agalactiae*
- *Pasteurella species*
- *Eikenella species*
- *Escherichia coli*
- Other Enterobacteriaceae
- Non-fermentative bacteria
- *Pseudomonas aeruginosa*
- *Acinetobacter species*
- Anaerobes
I. Fluids and Tissue Culture From Normally Sterile Body Site:

1. The methods routinely employed for the processing tissue and body fluids from normally sterile body sites.

2. The value of various direct microscopy techniques (Gram stain, fluorescence stains etc) in providing preliminary information.

3. The situations, uses and limitations of bacterial antigen detection kits.

4. The situations and uses of quantitative cultures and the interpretation of results in the context of the clinical situation.

5. Organisms reviewed:
   - Neisseria meningitidis
   - Haemophilus influenzae
   - Streptococcus pneumoniae
   - Listeria monocytogenes
   - Staphylococcus aureus
   - Streptococcus pyogenes
   - Escherichia coli
   - Anaerobes
   - Coagulase Negative Staphylococcus
### J. Specialized Bacteriology Section:

<table>
<thead>
<tr>
<th>Topic Reviewed</th>
<th>Topic Reviewed</th>
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<tbody>
<tr>
<td>Provlab</td>
<td>Dldx</td>
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</tbody>
</table>

1. Reportable organisms: what organisms are reported and to whom (review current list).

2. *C. difficile* toxin testing using antigen detection and cytotoxic assays

3. Rapid urease and culture for *H. pylori* detection.

4. Sample Collection: testing for *C. trachomatis* (culture, Direct fluorescence antigen assays, PCR)

5. Epidemiologic typing for *Salmonella species*, *Haemophilus species* and *Streptococcus species*

6. Verotoxin testing for stool samples to detect *E. coli* 0157:H7

7. Reference services available to diagnostic labs.

8. Appropriate environmental sample collection (water, medical devices, hospital environment.)
APPENDIX II

BENCH SPECIFIC OBJECTIVE CHECKLIST: Provlab:

A. Mycobacteriology Section:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Topic Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The mycobacteria encountered in the clinical laboratory and their</td>
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<tr>
<td>significance as human pathogens.</td>
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<tr>
<td>2. The morphological factors, nutritional environmental requirements,</td>
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<td>and biochemical reactions of the above that allow their detection</td>
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<td>in a clinical specimen and provide and accurate identification.</td>
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<td>3. The clinical indications for performing a mycobacterial work-up.</td>
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<td>4. The optimal specimens required, for any given mycobacterial</td>
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<td>infection, as well as appropriate collection and transportation</td>
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<td>methods.</td>
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<td>5. Decontamination processing of clinical specimens and be able to</td>
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<td>perform the necessary tests for detection, isolation and</td>
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<td>identification of the possible pathogen, including the principles</td>
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<td>and operation of the Bactec 460.</td>
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<td>6. The indications for antimicrobial susceptibility testing, the</td>
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<td>agents to be tested and the methods used.</td>
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<td>7. The principles of interpretation of laboratory results in terms of</td>
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<td>significance for, and care of, the patient.</td>
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<td>8. The reporting format and documentation of laboratory results in</td>
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<tr>
<td>the T.B. section of the laboratory.</td>
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<tr>
<td>9. How DNA based molecular methods can speed up the process of</td>
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<tr>
<td>detecting and/or identifying mycobacteria.</td>
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<tr>
<td>10. Biosafety issues pertaining to diagnostic mycobacteriology.</td>
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<tr>
<td>11. Organisms reviewed:</td>
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<tr>
<td>• Mycobacterium tuberculosis</td>
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<tr>
<td>• Mycobacterium bovis</td>
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<tr>
<td>• Rapid growers:</td>
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<tr>
<td>• Mycobacterium chelonae</td>
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<tr>
<td>• Mycobacterium fortuitum</td>
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<tr>
<td>• Mycobacterium gordonae</td>
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<tr>
<td>• MAI complex</td>
<td></td>
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<tr>
<td>• Mycobacterium kansasii</td>
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</tr>
</tbody>
</table>
B. Mycology Section:

1. Classification of the fungi pathogenic for man. □

2. The morphological features, nutritional and environmental requirements and biochemical reactions of the above fungi which will allow their detection in the clinical laboratory. □

3. The clinical indications for performing a mycological work-up. □

4. The clinical specimens required for any given mycoses, as well as to be able to describe appropriate methods of collection and transportation of the specimens to the laboratory. □

5. The indications for and how to determine the minimal inhibitory concentrations and serum levels of selected antifungal agents. □

6. The methods and understand the principles and limitations of the various serologic procedures available for the human mycoses. □

7. The role of direct DNA probe methods for culture confirmation of systemic fungi (*Blastomyces dermatitidis*, *Histoplasma capsulatum*, *Coccidioides immitis*). □

8. Biosafety issues pertaining to diagnostic mycology. □

9. Organisms reviewed:

   - *Candida albicans*
   - *Candida glabrata*
   - *Candida krusei*
   - Dermatophytes
   - *Aspergillus species*
   - *Blastomyces dermatitidis*
   - *Coccidioides immitis*
   - *Histoplasma capsulatum*
   - *Cryptococcus neoformans*
C. Parasitology

1. The classification of human parasites.

2. The clinical indications for performing an “O & P” work-up.

3. The appropriate methods of specimen collection for “O & P” evaluation.

4. The various methods of parasitic evaluation: conventional, antigen detection and PCR.

5. The morphological features used to identify clinically significant human parasites.

6. Biosafety issues pertaining to diagnostic parasitology.

7. Organisms reviewed:
   - Intestinal amebae
   - Intestinal coccidial infection (Isospora/Cyclospora)
   - Cryptosporidium
   - Nematodes
   - Cestodes
   - Trematodes
   - Blood parasites
### D. Quality Control Section:

<table>
<thead>
<tr>
<th>TopicReviewed</th>
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</thead>
<tbody>
<tr>
<td>1. The methods and established schedules for monitoring stains, reagents and media for expected performance.</td>
</tr>
<tr>
<td>2. The schedules and methods available for monitoring equipment used in the laboratory, including maintenance schedules to ensure ongoing optimal function for the full life of the equipment.</td>
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<tr>
<td>3. The various methods available for evaluating technologist and technician performance, including internal proficiency testing methods as well as appropriate external sources of proficiency testing programs, and evaluation of final culture reports.</td>
</tr>
<tr>
<td>4. The methods for maintenance of quality control cultures.</td>
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<tr>
<td>5. The methods available for quality control of the clinical specimen, including requisition documentation, screening methods for assessing the quality of specimen, guidelines for specimen collection and accepted methods for transportation of the clinical laboratory.</td>
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<tr>
<td>6. The requirements for documentation of specimens, laboratory procedures and quality control results.</td>
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<tr>
<td>7. How to monitor susceptibility testing results and the role that CLSI has in establishing laboratory guidelines.</td>
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<tr>
<td>8. The performance of audits of laboratory performance as it relates to the patient’s diagnosis, clinical course and/or response to therapy.</td>
</tr>
<tr>
<td>9. The federal postal requirements for shipping infected materials (Biohazardous transport regulations).</td>
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</tbody>
</table>
E. **Antimicrobial Susceptibility Testing:**

<table>
<thead>
<tr>
<th>No.</th>
<th>TopicReviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The following susceptibility testing methods: Kirby-Bauer, Minimum Inhibitory Concentration (MIC), Minimum Bactericidal Concentration (MBC), Agar dilution and E-test.</td>
</tr>
<tr>
<td>2.</td>
<td>The CLSI guidelines regarding; break points for different groups of organisms, and which antimicrobials to report on the final report.</td>
</tr>
<tr>
<td>3.</td>
<td>The organisms such as <em>H. influenzae</em>, <em>Enterococci spp.</em>, <em>S. aureus</em> and <em>S. pneumoniae</em> that have shown changes in their susceptibility profile.</td>
</tr>
<tr>
<td>4.</td>
<td>The basis for Oxacillin disk screening for <em>S. pneumoniae</em>.</td>
</tr>
<tr>
<td>5.</td>
<td>The interaction with Infection Control needed to curtail the spread of multi-resistant, or unusually resistant organisms in the hospital.</td>
</tr>
<tr>
<td>6.</td>
<td>How to accurately detect ESBLs.</td>
</tr>
</tbody>
</table>
F. Virology Tutorials

<table>
<thead>
<tr>
<th>Topic</th>
<th>Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Overview of laboratory methods, principles and protocols</td>
<td></td>
</tr>
<tr>
<td>2. Time frames for results</td>
<td></td>
</tr>
<tr>
<td>3. Cell lines and utilization</td>
<td></td>
</tr>
<tr>
<td>4. Viral taxonomy</td>
<td></td>
</tr>
<tr>
<td>5. Molecular methods</td>
<td></td>
</tr>
</tbody>
</table>
G. Virology Benches

1. Viral Culture
   - Specimen reception and numbering
   - Specimen treatment, processing and inoculation
   - Specimen type (including buffy coats)
   - Specific cell lines and the viruses they support
   - Importance of patient history
   - Viral culture reading schedule
   - Cytopathogenic effects
   - Hemadsorption testing
   - Influenza identification by immunofluorescence and hemagglutination inhibition assays
   - Other viral identification methods

2. Rapid tests
   - Respiratory syncytial virus enzyme immunoassay
   - Influenza virus enzyme immunoassay
   - Herpes simplex virus enzyme immunoassay
   - Varicella-zoster virus cytopsin-IFA
   - Electron microscopy, and reading grids

3. Molecular testing
   - CMV
   - HSV
   - Enterovirus

4. Tissue (cell) culture
### H. Serology Tutorials

<table>
<thead>
<tr>
<th>Topic</th>
<th>Topic Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lab diagnosis and interpretation of results</td>
<td>□</td>
</tr>
<tr>
<td>2. Algorithm of testing for hepatitis and syphilis testing</td>
<td>□</td>
</tr>
<tr>
<td>3. Role of HIV and HCV genotyping and viral load testing in patient management.</td>
<td>□</td>
</tr>
<tr>
<td>4. Principles of Ag-Ab different testing methods.</td>
<td>□</td>
</tr>
<tr>
<td>5. Principles of PCR and RT-PCR</td>
<td>□</td>
</tr>
</tbody>
</table>
I. Serology Benches

6. Specimen Receiving
   - Importance of patient history for proper test selection

7. Molecular
   - HCV  - qualitative PCR
     - viral load
     - genotyping
   - HIV  - viral load
     - provirus PCR
     - genotyping
   - B19  - parvovirus

8. Syphilis
   - EIA
   - RPR (screen)
   - VDRL (quantitative)
   - TPPA (confirmatory)
   - FTA – ABS (reference)

9. Viral Serology
   - Complement Fixation
   - ELISA
   - IFA
   - HAI (only WEE, WNV)

10. Parasitology
    - Public Health procedures related to parasitology
    - Teaching material available on request

11. Hepatitis
    - Algorithm
    - Confirmatory Testing (HBsAg, HCV)

12. HIV
    - Screen
    - P24
    - HTLV 1/2
    - Western Blot
J. Molecular Diagnostics:

1. Specimen collection and transport for samples to be tested by molecular methods (e.g. probe hybridization, and amplification methods such as PCR).

2. Basic concepts of probe and amplification methods for direct diagnostic testing and culture confirmation.

3. How molecular methods can be used for direct diagnostic testing.

4. What factors cause interference in molecular testing (e.g. inhibitors in sample)?

5. Q.C. for molecular testing methods (e.g. Amplicon contamination, internal positive controls).

6. How PFGE and amplification methods (e.g. RAPD PCR) can be used for epidemiological typing of a wide range of microorganisms. [including analysis and interpretation of results]

7. How molecular methods can be used to detect antimicrobial resistance in microorganisms (e.g. MRSA, VRE, HIV, M. tuberculosis).
K. Infection Control:


2. The appropriate use of Isolation Precautions including: Airborne precautions, Respiratory Precautions, Contact Precautions, and Strict Isolation Precautions.

3. The role of contact screening and cohorting in the prevention of nosocomial spread of pathogens including: M. tuberculosis, MRSA, VRE, C. difficile-associated diarrhea.

4. Specialized containment needed for construction in areas where immunocompromised patients are present.

5. The role of the lab and Infection Control in ensuring that reporting of “Reportable Organisms and/or Syndromes” are appropriately communicated to Public Health and/or National agencies.

6. The role of handwashing in nosocomial infections and lab-acquired infection. [Trainee should have knowledge of relative efficacy of alcohol-based agents versus other handwashing agents].

7. The guidelines for preventing lab-acquired infection in staff in Microbiology Laboratory.

L. Public Health Microbiology Tutorial:

1. Application of DNA amplification techniques in the Clinical Microbiology section.

2. Use of DNA sequencing techniques for identification of bacterial isolates to genus and species level.

3. Application of Pulsed Field Gel Electrophoresis (PFGE) to outbreak investigations and routine surveillance

4. DNA-based typing of microorganisms and molecular epidemiology

5. Methicillin-resistant Staphylococcus aureus epidemiology.

6. PulseNet surveillance system.
7. *Chlamydia trachomatis* diagnosis
M. Public Health Microbiology Benches:

1. Describe the functions of a public health laboratory and list why these functions are necessary.

2. Describe culture of urine using the dip-slide method. List deviations from proper procedure either in collection or in culturing urine which may lead to erroneous results. Discuss advantages and disadvantages of this method compared to standard urine culture.

3. Describe principles of chromogenic medias. List advantages and disadvantages of these media compared to Mannitol Salt Agar and Blood Agar.

4. Describe one method for serotyping Salmonella to species level.

5. Describe principle of screening medium used for detection of ESBLs. List and describe confirmation methods available for ESBLs. Discuss limitation of confirmation using ESBL disk or E test.

6. Discuss culture and identification methods used to isolate and identify *Coryebacterium diphtheriae* and other *Corynebacterium* which may produce toxin. Describe principle of toxin detection using the Elek plate.

7. Describe proper collection and transport of stools for verotoxin testing. Discuss preparation and testing of stool filtrates and culture filtrates. Describe principle of this procedure.

8. One role of the public health laboratory is to detect bacterial pathogens causing food borne illness. List organisms commonly involved in food-borne illness. List organisms commonly involved in food borne disease which would not usually be tested for, in acute care centers or private laboratories.

9. Describe principle of Vitek 2 automated susceptibility and identification system. List advantages, disadvantages, and limitations of this system.

10. Discuss methods available for detection of *Neisseria gonorrhoeae* and *Chlamydia trachomatis*. List advantages and disadvantages of these methods.
N. Laboratory Safety Tutorial:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Permits and licenses</td>
<td></td>
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<tr>
<td>2. Fire safety</td>
<td></td>
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<tr>
<td>3. Mechanical and electrical</td>
<td></td>
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<tr>
<td>4. Chemical safety – WHMIS</td>
<td></td>
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<tr>
<td>5. Biosafety - HC Guidelines – Operational protocols and physical containment</td>
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<tr>
<td>7. Waste management</td>
<td></td>
</tr>
<tr>
<td>8. Emergency response and ERAP plans</td>
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</tbody>
</table>
O. Quality Assurance Tutorial:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accreditation</td>
<td>□</td>
</tr>
<tr>
<td>Quality Assurance/Quality Control</td>
<td>□</td>
</tr>
<tr>
<td>Media</td>
<td>□</td>
</tr>
<tr>
<td>Autoclaves</td>
<td>□</td>
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</tbody>
</table>
P. Public Health Information Management Tutorial:

1. Brief description of the travels of a requisition from entry to the building through to archiving.

2. Detailed discussion about each component of the requisition, their importance and uses.

4. Detailed discussion on the result entry process. the phoning of time sensitive results vs. the BBS (electronic reporting)

5. Explanation of the Patient Inquiry services, information required to search, online searching and searching the archives.

6. Detailed discussion on the report distribution options and methods (hard copy, BBS, mail, courier, etc.)

7. Discussion on the Special Study/Outbreak Code (what, why, how and where)

8. Simultaneous reporting of 'reportable' results to Alberta Health MOH and Alberta Health Services MOH.
Q. Public Health Infection Control Tutorial:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Overview of Infection Control Program</td>
<td></td>
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<tr>
<td>2. Infection Control Guidelines</td>
<td></td>
</tr>
<tr>
<td>3. Management of Antimicrobial Resistant Organisms</td>
<td></td>
</tr>
<tr>
<td>4. Management of Outbreaks</td>
<td></td>
</tr>
<tr>
<td>5. Liaisons with other Infection Control Practitioners and jurisdictions</td>
<td></td>
</tr>
<tr>
<td>11.6 Occupational Health and as it relates to Infection Control</td>
<td></td>
</tr>
<tr>
<td>11.7 Committee Work</td>
<td></td>
</tr>
</tbody>
</table>
R. Public Health Management Tutorial:

1. Trainees will understand the organizational structure as it pertains to:
   - Provlab’s role within the Government of Alberta (within Alberta Health and Wellness and Alberta Health Services)
   - Provlab’s Role within the province
   - Provlab’s internal management structure

2. Trainees will be expected to review provincial legislation:
   - Public Health Act
   - Diseases and Dead Bodies Regulations
   - The Personal Health and Information Act
   - The Health Professions Act

3. Trainees will be able to identify requirements for accreditation, and name the accrediting bodies specific to provlab

4. Trainees will be able to define the lab linked public health committees and the purpose of these:
   - Public Health Laboratory Committee
   - Alberta Advisory Committee of Infectious Diseases
   - Communicable Disease Control

5. Trainees will be able to understand strategic planning and the impact on laboratory business.

6. Trainees will be able to describe the Continuous Quality Improvement system employed at Provlab. As well describe the difference between Quality Control and Quality Assurance.

7. Trainees will learn various techniques to achieve a client-focused approach through the use of a guide to service manual, client satisfaction surveys, and clinical/laboratory advisory groups.

8. Trainees will get an understanding of the basic funding process, specifically estimates, business plans, cash flows, grant funding, revenue generation etc.
APPENDIX III

BENCH SPECIFIC OBJECTIVE CHECKLIST:

<table>
<thead>
<tr>
<th>A.</th>
<th>THE ROLE OF THE NML</th>
<th>Topic Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The role of the NML within the CPHLN:</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td>- Organizational structure and administration of the CPHLN.</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td>- Rationale for support services provided for the CPHLN.</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td>- Relationship between hospital, provincial and national labs.</td>
<td>☐</td>
</tr>
<tr>
<td>2.</td>
<td>Role as a reference lab for infectious organisms requiring Level 3 and 4 containment facilities.</td>
<td>☐</td>
</tr>
<tr>
<td>3.</td>
<td>Relationship between hospital, provincial and national microbiology labs.</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td>- Sending of specimens to the NML.</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td>- Reporting of results from the NML.</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td>- Role of NML research and technology transfer.</td>
<td>☐</td>
</tr>
<tr>
<td>4.</td>
<td>Examples of field and lab response in outbreak/urgent situations.</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td>- Food or water-borne outbreaks</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td>- West Nile Virus</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td>- Bioterrorism</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td>- SARS</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td>- Pandemic flu preparedness</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td>- Emerging blood-borne pathogens</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td>- Other</td>
<td>☐</td>
</tr>
<tr>
<td>5.</td>
<td>Disease surveillance and relationship with provincial and national epidemiologists.</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td>- Overview of infectious diseases where there is a national surveillance program with a laboratory component.</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td>- Reporting of lab surveillance information.</td>
<td>☐</td>
</tr>
<tr>
<td>6.</td>
<td>Understanding of the interplay between surveillance, reference services, research and public health.</td>
<td>☐</td>
</tr>
</tbody>
</table>
### B. MOLECULAR TECHNIQUES FOR REFERENCE LAB SERVICES

<table>
<thead>
<tr>
<th></th>
<th>Topic Reviewed</th>
</tr>
</thead>
</table>
| 1. | PCR: Design and optimization of standard and real-time PCR methods for diagnostic testing  
- Lab organization and workflow for optimal PCR diagnostics for minimizing contamination.  
- How to design PCR amplification primers.  
- How to optimize PCR reaction conditions when developing a PCR assay.  
- Theory of real-time PCR and application to rapid diagnostics and quantitative PCR.  
- Application of reverse-transcriptase (RT) PCR assays. |
| 2. | Sequencing:  
- Theoretical and practical aspects of DNA sequencing.  
- Applications of sequencing for strain speciation.  
- Application of sequencing for molecular epidemiology. |
| 3. | Advanced bacterial typing, theory and application of:  
- Pulsed field gel electrophoresis (PFGE)  
- Multilocus sequence typing (MLST)  
- Plasmid profiling  
- Whole genome sequencing |
<table>
<thead>
<tr>
<th>C.</th>
<th>UNIQUE REFERENCE LABORATORY TESTING SERVICES [Select one to two of the following]</th>
<th>Topic Reviewed</th>
</tr>
</thead>
</table>
| 1. | Zoonotic pathogens:  
- West Nile Virus  
- Hantavirus  
- Dengue virus  
- Lyme disease  
- Potential field study opportunity  
- Other | ☐ |
| 2. | Prion disease  
- Understanding of prion disease in different species (scrapie, mad cow, chronic wasting disease, nvCJD)  
- Human genetic testing for CJD  
- Strategies for developing diagnostics  
- Application of sequencing to mammalian genetics.  
- Strengths and weaknesses of biochemical markers as diagnostics. | ☐ |
| 3. | Vaccine preventable diseases:  
- Measles virus serology and molecular epidemiology.  
- Rubella virus antibody avidity testing.  
- Differentiation of vaccine and wild-type varicella-zoster virus.  
- Influenza strain typing and antiviral resistance testing.  
- Hepatitis B diagnostics and molecular epidemiology.  
- Meningococcal disease (*N. meningitidis*) - serotyping, PCR | ☐ |
| 4. | Emerging diseases:  
- West Nile Virus diagnostics.  
- SARS lab diagnostics issues. | ☐ |
| 5. | Mycobacteria:  
- speciation  
- susceptibility testing | ☐ |
| 6. | Advanced bacterial characterization  
- 16S ribosomal sequencing for species characterization.  
- cellular fatty acid analysis by gas chromatography.  
- biochemical characterization.  
- antimicrobial resistance characterization. | ☐ |
| 7. | Bioterrorism related diagnostics  
- Emergency response and preparedness (ERAP)  
- bioterrorism response lab network  
- anthrax testing  
- smallpox testing | ☐ |
D. BIOSAFETY

<table>
<thead>
<tr>
<th></th>
<th>Topic</th>
<th>Topic Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Understand the principles of biosafety and biocontainment</td>
<td>□</td>
</tr>
<tr>
<td>2.</td>
<td>Understand the basic practical knowledge and operational aspects of high containment laboratories.</td>
<td>□</td>
</tr>
<tr>
<td>3.</td>
<td>Participate in a one-day transport of dangerous goods (TDG) training course to obtain TDG certification.</td>
<td>□</td>
</tr>
</tbody>
</table>

E. QUALITY SYSTEMS

<table>
<thead>
<tr>
<th></th>
<th>Topic</th>
<th>Topic Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Understand the components and requirements of ISO17025 and ISO15189 laboratory quality systems.</td>
<td>□</td>
</tr>
<tr>
<td>2.</td>
<td>Understand ISO9001 quality systems.</td>
<td>□</td>
</tr>
</tbody>
</table>
APPENDIX VI

TESTS/PROCEDURES USED IN LABORATORY

<table>
<thead>
<tr>
<th>Test/Procedure</th>
<th>Date</th>
<th>Tech</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Routinely used tests:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform and interpret Gram stain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform and interpret catalase</td>
<td></td>
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</tr>
<tr>
<td>Perform and interpret tube and slide coagulase</td>
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<tr>
<td>Perform and interpret bacitracin sensitivity</td>
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<tr>
<td>Perform and interpret novobiocin sensitivity</td>
<td></td>
<td></td>
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<tr>
<td>Perform and interpret DNase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform and interpret TS-DNase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recognize and describe cultural characteristics including hemolysis on sheep blood agar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform and interpret PYR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform and interpret optochin sensitivity</td>
<td></td>
<td></td>
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<tr>
<td>Perform and interpret bile solubility (plate and tube)</td>
<td></td>
<td></td>
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<tr>
<td>Perform and interpret bile esculin</td>
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<tr>
<td>Perform and interpret 6.5% NaCl tolerance</td>
<td></td>
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<tr>
<td>Perform and interpret antigen grouping (Lancefield)</td>
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<tr>
<td>Perform and interpret LAP</td>
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<td></td>
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<tr>
<td>Perform and interpret MUG</td>
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<tr>
<td>Perform and interpret oxidase</td>
<td></td>
<td></td>
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<tr>
<td>Perform and interpret MUB test</td>
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<tr>
<td>Perform and interpret X and V factor growth requirements</td>
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<tr>
<td>Perform and interpret porphyrin</td>
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<tr>
<td>Perform and interpret TSI</td>
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<tr>
<td>Perform and interpret motility (semi-solid liquid)</td>
<td></td>
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<tr>
<td>Perform and interpret urease (rapid urease test, urea slant)</td>
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<tr>
<td>Perform and interpret indole (including spot indole)</td>
<td></td>
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</tr>
<tr>
<td>Perform and interpret slide agglutination for <em>Salmonella</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test/Procedure</td>
<td>Date</td>
<td>Tech</td>
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<tr>
<td>--------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Perform and interpret slide agglutination for <em>Shigella</em></td>
<td></td>
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<tr>
<td>Perform and interpret slide agglutination for <em>E. coli</em> 0157</td>
<td></td>
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<tr>
<td>Perform and interpret O-F</td>
<td></td>
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<tr>
<td>Perform and interpret growth on MacConkey agar without crystal violet</td>
<td></td>
<td></td>
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<tr>
<td>Perform and interpret growth on Tinsdale media</td>
<td></td>
<td></td>
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<tr>
<td>Perform and interpret wet prep</td>
<td></td>
<td></td>
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<tr>
<td>Perform and interpret India Ink prep</td>
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<td></td>
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<tr>
<td>Perform and interpret germ tube production</td>
<td></td>
<td></td>
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<tr>
<td>Perform and interpret BBE agar</td>
<td></td>
<td></td>
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<tr>
<td>Perform and interpret high potency discs for anaerobic identification</td>
<td></td>
<td></td>
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<tr>
<td>Perform and interpret beta-lactamase (Cefinase®)</td>
<td></td>
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<tr>
<td>Perform and interpret CAMP</td>
<td></td>
<td></td>
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<tr>
<td>Perform and interpret Reverse CAMP</td>
<td></td>
<td></td>
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<tr>
<td>Perform and interpret carbohydrate fermentation tests (fastidious organisms)</td>
<td></td>
<td></td>
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<tr>
<td>Perform and interpret citrate test</td>
<td></td>
<td></td>
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<tr>
<td>Perform and interpret hippurate hydrolysis</td>
<td></td>
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<tr>
<td>Perform and interpret lecithinase</td>
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</tbody>
</table>

B. Tests/Procedures Associated with identification (ID)/MIC:

<table>
<thead>
<tr>
<th>Test/Procedure</th>
<th>Date</th>
<th>Tech</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform and interpret commercial miniaturized ID system with generation of a numeric code</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-test® MIC testing</td>
<td></td>
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<tr>
<td>Vancomycin susceptibility for identification of Gram-positive organisms</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C. Serological Tests:

<table>
<thead>
<tr>
<th>Test/Procedure</th>
<th>Date</th>
<th>Tech</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform and interpret cell count - CSF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform and interpret cell count - CAPD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform and interpret cell count - fluid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform and interpret Cryptococcal Antigen Detection test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform and interpret Monospot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test/Procedure</td>
<td>Date</td>
<td>Tech</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td><strong>D. Specialty Procedures:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform and interpret direct fluorescent antibody stain (<strong>Legionella</strong>)</td>
<td></td>
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<tr>
<td>Perform and interpret direct fluorescent antibody stain (<strong>B. pertussis</strong>)</td>
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<tr>
<td>Perform and interpret <strong>C. difficile</strong> toxin - Triage®</td>
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<tr>
<td>Perform and interpret <strong>C. difficile</strong> toxin – Tissue culture assay</td>
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<tr>
<td>Perform and interpret Accuprobe (Mycobacteria)</td>
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<tr>
<td>Perform and interpret PBP2' (MRSA) latex agglutination</td>
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</tbody>
</table>

**COMMENTS**

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**STUDENT**

**TECHNOLOGIST**
<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>Did not meet expectations</th>
<th>Met expectations</th>
<th>Exceeds expectations</th>
<th>Comments and recommended improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MEDICAL EXPERT</strong></td>
<td></td>
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<tr>
<td>Understanding of lab or rotation protocols, including specimen requirements &amp; screening</td>
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<tr>
<td>Knowledge of lab or rotation procedures, including limitations, and interpretation</td>
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<tr>
<td>Technical skills</td>
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<tr>
<td>Ability to apply clinical use and usefulness</td>
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<tr>
<td>Able to describe an infection control program and consult appropriately</td>
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<tr>
<td><strong>COMMUNICATOR</strong></td>
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<tr>
<td>Facilitates team cohesion</td>
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<tr>
<td>Develops common and clear understanding of issues</td>
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<tr>
<td><strong>COLLABORATOR</strong></td>
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<tr>
<td>Effectively incorporates lab into practice</td>
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<tr>
<td>Interacts appropriately with lab team</td>
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<tr>
<td><strong>MANAGER</strong></td>
<td></td>
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<tr>
<td>Organized and timely</td>
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<tr>
<td>Understands and adopts quality management approach</td>
<td></td>
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<tr>
<td>Use resources appropriately</td>
<td></td>
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<tr>
<td><strong>HEALTH ADVOCATE</strong></td>
<td></td>
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<tr>
<td>Identifies needs for improvement based on patient/population need</td>
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<tr>
<td>Appreciates competing interests and barriers to care, including own conflicts</td>
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<tr>
<td><strong>SCHOLAR</strong></td>
<td></td>
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<tr>
<td>Assess and addresses knowledge and skills gaps</td>
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<tr>
<td>Critically appraises and teaches</td>
<td></td>
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<tr>
<td><strong>PROFESSIONAL</strong></td>
<td></td>
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<tr>
<td>Demonstrates commitment to specialty and profession</td>
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<tr>
<td>Sense of responsibility and limitations</td>
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<tr>
<td><strong>Other: (any category)</strong></td>
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</tr>
<tr>
<td>MEDICAL EXPERT</td>
<td>Did not meet expectations</td>
<td>Meets expectations</td>
<td>Above expectations</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
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<td></td>
</tr>
<tr>
<td>Understanding of lab or rotation protocols</td>
<td>Does not try to understand the rationale for the lab procedures.</td>
<td>Understands the steps used to elaborate a protocol.</td>
<td>Understands the steps used in protocol. Makes suggestions for improvement.</td>
<td></td>
</tr>
<tr>
<td>Knowledge of lab or rotation procedures</td>
<td>Experiences many difficulties in making appropriate identification of current pathogens. Insufficient knowledge of clinical microbiology.</td>
<td>Can reasonably easily identify current pathogens.</td>
<td>Very knowledgeable about current and more refined laboratory procedures.</td>
<td></td>
</tr>
<tr>
<td>Technical skills</td>
<td>Needs to be directed and extensively supervised for his laboratory work. Sloppy techniques.</td>
<td>Reasonably autonomous in the lab. Safe and neat. Attention to techniques is good.</td>
<td>Very good in performing bench work and special techniques. Needs almost no supervision. Meticulous.</td>
<td></td>
</tr>
<tr>
<td>Ability to describe and apply clinical use and usefulness</td>
<td>Unaware of use or usefulness. Poor grasp of intent of lab protocols.</td>
<td>Reasonably proficient at identifying use of lab services.</td>
<td>Able to use &amp; describe in detail the usefulness and use of lab protocols.</td>
<td></td>
</tr>
<tr>
<td>Able to describe an infection control program and consult appropriately</td>
<td>Unable to provide sufficient advice for routine infection control problems. Unaware of program elements.</td>
<td>Reasonably proficient at providing advice in infection control. Good Program knowledge.</td>
<td>Trusted to give good advice. Knowledgeable about protocols, programs, evidence and alternatives.</td>
<td></td>
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</tbody>
</table>

| COMMUNICATOR | | |
|----------------|--------------------------|--------------------|-------------------|
| Facilities team cohesion | Sometimes has difficult working with other team members. Occasionally lacks tact or consideration towards junior team members, inflexible. | Active team member, works well with other team members, flexible. Leadership skills not fully developed. | Active team member. Leadership qualities exceptional, flexible and receptive, achieves good results without antagonizing others. |
| Develops common and clear understanding of issues | Exhibits little inquisition into the issue. Relies on own viewpoints. | Able to elicit information from at least two perspectives. | Elicits all salient perspectives. Synthesizes the relevant disputes well. Communicates findings well. |

| COLLABORATOR | | |
|----------------|--------------------------|--------------------|-------------------|
| Effectively incorporates lab into practice | | |

| MANAGER | | |
|----------------|--------------------------|--------------------|-------------------|
| Organized and timely | Often late for work. Poorly organized when left alone. Takes more time than expected to do work. Easily distracted | Punctual. Well organized. Makes plans to be effective, to minimize undue delays. | Always punctual. Very well organized. Distributes and conducts tasks in a thoughtful manner. |
| Understands and adopts quality management of approach | Difficulties to determine priorities in terms of what is important to give a good service to clients. | Accurate perspective of what is needed to have a good service to clients. | Can adequately set up priorities and can plan ahead to improve the lab and provide new services. |
| Uses resources appropriately | | |

| HEALTH ADVOCATE | | |
|----------------|--------------------------|--------------------|-------------------|
| Identifies needs for improvement based on patient/population need | | |
| Appreciates competing interests and barriers to care | | |
| Appreciates own conflicts of interest | | |

| SCHOLAR | | |
|----------------|--------------------------|--------------------|-------------------|
| Assesses and addresses knowledge and skill gaps | Information not clearly presented. Irrelevance in selecting the information presented. | Information presented in an orderly way. Most important info. selected and presented. | Very complete lecture with up to date references and evident effort to evaluate the topic well. |

| PROFESSIONAL | | |
|----------------|--------------------------|--------------------|-------------------|
| Demonstrates commitment to specialty and profession | Unreliable, does less than the prescribed work, requires frequent or constant supervision, needs repeated reminders, sometimes dishonest. | Dependable, reliable, honest in all information and facts, completes assigned tasks, appropriate patient follow-up. | Very dependable, takes initiative, completing assigned tasks without supervision, |
| Sense of responsibility and limitations | Unaware of own limitations, requires frequent supervision because of lack of insight, unable to request assistance or to take advice. | Aware of own limitations. Seeks assistance or feedback to overcome limitations. | Recognizes limits of his competence. Seeks advice and assistance when appropriate. Values experience of others. Accepts critical suggestions. |
University of Alberta – Faculty of Medicine & Dentistry
In-Training Evaluation Report
Laboratory Rotation in Clinical Microbiology/Medical Microbiology/Infectious Diseases

Name of Candidate: __________________________________________________________

Name of Bench Technologist: ________________________________________________

Dates: From: ____________________ To: ____________________ Hospital: ____________

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Rating</th>
<th>Expectations</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Does Not Meet</td>
<td>Partially meets</td>
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<tr>
<td>Professional Attitudes</td>
<td></td>
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<tr>
<td>Sense of responsibility</td>
<td></td>
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<tr>
<td>Self-assessment ability</td>
<td></td>
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<tr>
<td>Teamwork and cooperation</td>
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<tr>
<td>Interaction with the laboratory team</td>
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<tr>
<td>Communication skills</td>
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<tr>
<td>Organization and timeliness</td>
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<tr>
<td>Teaching</td>
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<tr>
<td>Presentation/lectures (Plate Rounds or C.E. Session)</td>
<td></td>
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<tr>
<td>Clinical skills</td>
<td></td>
<td></td>
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<tr>
<td>Understanding of laboratory protocols</td>
<td></td>
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<tr>
<td>Specimen collection/set-up</td>
<td></td>
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<tr>
<td>Bench work-up</td>
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<tr>
<td>Knowledge of laboratory procedures</td>
<td></td>
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<tr>
<td>Time-frame for results</td>
<td></td>
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<tr>
<td>Interpretation of results</td>
<td></td>
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<tr>
<td>Technical skills</td>
<td></td>
<td></td>
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<tr>
<td>Subculturing</td>
<td></td>
<td></td>
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<tr>
<td>Gram stains</td>
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<tr>
<td>Laboratory Management</td>
<td></td>
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<tr>
<td>Prioritization</td>
<td></td>
<td></td>
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<tr>
<td>Clarity of requests</td>
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</table>
## Quality Assurance

<table>
<thead>
<tr>
<th>Does not meet expectations</th>
<th>Meets expectations*</th>
<th>Exceeds expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GENERAL ATTITUDES</strong></td>
<td></td>
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<tr>
<td><strong>Responsibility</strong></td>
<td>Unreliable, does less than the prescribed work, requires frequent or constant supervision, needs repeated reminders, sometimes dishonest</td>
<td>Dependable, reliable, honest in all information and facts, completes assigned tasks, appropriate patient follow-up</td>
</tr>
<tr>
<td><strong>Self-assessment ability</strong></td>
<td>Unaware of own limitations, requires frequent supervision because of lack of insight, unable to request assistance or to take advice.</td>
<td>Aware of own limitations. Seeks assistance or feedback to overcome limitations.</td>
</tr>
<tr>
<td><strong>Teamwork and cooperation</strong></td>
<td>Sometimes has difficulty working with other team members. Occasionally lacks tact or consideration towards junior team members, inflexible</td>
<td>Active team member works well with other team members, flexible. Leadership skills not fully developed.</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>Has difficulties to effectively communicated with colleagues, consultants, family members</td>
<td>Effectively communicates without conflict and with good understanding.</td>
</tr>
<tr>
<td><strong>Organization and timeliness</strong></td>
<td>Often late for work. Poorly organized when left alone. Takes more time than expected to do his/her work. Easily distracted</td>
<td>Punctual. Well organized. Makes plans to be effective in carrying out tasks without undue delays.</td>
</tr>
</tbody>
</table>

## TEACHING

| **Presentations/lectures (Plate Rounds or C.E. Session)** | Information not clearly presented. Irrelevance in selecting the information presented, literature not extensively researched. | Information presented in an orderly way. Most important information selected and presented. | Very complete lecture with up to date references and evident effort to evaluate the topic well. |

## LABORATORY SKILLS

| **Understanding of laboratory protocols** | Does not try to understand the rationale for the lab procedures | Understands the steps used to elaborate a protocol | Understands the steps used in a protocol. Can make suggestions for improvement. |
| **Knowledge of laboratory procedures** | Experiences many difficulties in making appropriate identification of current pathogens. Insufficient knowledge of clinical microbiology. | Can reasonably identify current pathogens easily. | Very knowledgeable about current and more refined laboratory procedures. |
| **Technical skills** | Needs to be directed and extensively supervised for his/her laboratory work. Sloppy techniques. | Reasonably autonomous in the laboratory. Meticulous. Attention to techniques is good. | Very good in performing bench work and special techniques. Needs almost no supervision. |
| **Laboratory management** | Difficulties to determine priorities in terms of what is important to give a good service to the clinicians and patients | Accurate perspective of what is needed to have a good microbiology laboratory in terms of service to the patients and clinicians. | Can adequately set up priorities and can plan ahead to improve the laboratory and give new services. |
| Quality assurance | The resident has incomplete perception of quality assurance | Resident understands and would be capable of developing adequate quality assurance program. | The resident has a high level of understanding of the principles of quality assurance and would be well qualified to develop a good quality assurance program. |

* Can be assessed as “partially meets” or “fully meets” expectations.
# University of Alberta – Faculty of Medicine & Dentistry
## Trainee Evaluation of Microbiology Laboratory Rotation

**Name of Trainee:** ________________________

**Date of Rotation:** ________________________  **Site:** _____________________________

<table>
<thead>
<tr>
<th>Instructor Evaluation</th>
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<tbody>
<tr>
<td>Unsatisfactory</td>
</tr>
<tr>
<td><strong>Comments</strong> (or N/A)</td>
</tr>
</tbody>
</table>

**Instructor Evaluated:**

- **Expert:** Substantiates decision with evidence where appropriate.
- **Communicator:** Communicates effectively.
- **Collaborator:** Provided appropriate level of autonomy and graded responsibility
- **Manager:** Demonstrated effective management of time and resources.
- **Health Advocate:** Understands and applies population/community interventions
- **Scholar:** Enthusiastic teacher, provides feedback.
- **Professional:** Supportive, available, punctual, a role model.

**Suggested Areas of Improvement**

---

**Site Evaluation**

- Training provided by bench technologists.
- Adequacy of benches/topics covered.
- Adequacy of opportunity to do “hands-on” work.
- Objective checklists adequately covered.
- Written bench quizzes useful to determine what had been learned.
- Unknowns useful to learn identification methods.
- Plate rounds a useful learning experience.
- Adequacy of opportunity to develop problem-solving skills.
- Adequacy of access to computers, internet, etc.
- Provided tutorials were a useful learning experience.

**Summary: How good is this rotation?**

**Suggestions for Improvement of this Rotation:**

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Please return to Dr. Tyrrell, Division of Medical Microbiology, Department of Laboratory Medicine and Pathology, UAH, 2B3.08 WMC, 8440-112 Street, Edmonton, Alberta, T6G 2J2.