Clinical Performance Objectives in MEDT 473
Clinical Practice in Microbiology
Department of Medical and Research Technology
University of Maryland School of Medicine

Upon completion of the **Clinical Microbiology** rotation the **MLS** student will be able to:

I. SPECIMEN HANDLING AND PROCESSING

Follow departmental protocol and demonstrate safe work practices by:

a. Wearing personal protective equipment (PPE) as required.
b. Handling and disposing of contaminated materials according to standard precautions.
c. Handling chemicals according to safety procedures.
d. Properly used biologic safety cabinet when needed.

1. List criteria for evaluating specimens and requisitions for acceptability using laboratory defined criteria.

2. Apply proper specimen handling to microbiological specimens in regard to timeliness, appropriateness of specimen submitted for analysis requested, safety and security of collection system, and completeness of essential patient information, to the satisfaction of the clinical instructor.

3. Document rejected specimens according to laboratory's procedures for specimen rejection.

4. Given any routine specimen for culture:
   a. State the collection system, storage conditions, and acceptable length of storage
   b. Explain the selection and use of appropriate primary culture media for initial plating
   c. State the proper incubation temperature and atmosphere conditions for each medium

5. Given plating instructions and media selection criteria:
   a. Process a minimum of **20** bacterial specimens of different types and prepare smears for Gram stain (if appropriate), to the satisfaction of the clinical instructor.
   b. Demonstrate proper aseptic technique and streaking method, obtaining isolated colonies.

II. QUALITY CONTROL and QUALITY ASSURANCE

1. State the purpose of quality control in the microbiology laboratory.

2. Perform or state the daily or weekly maintenance checks on equipment (i.e. refrigerators, incubators, water baths, instruments) with 100% accuracy.

3. Perform quality control procedures (i.e. stains, media, biochemical tests, antisera, and susceptibility tests) with 100% accuracy.

4. Record all Q C results with 100% accuracy.

5. Report divergent results to instructor and suggest corrective actions

6. Observe basic laboratory computer operations where relevant.

7. State the patient confidentiality policy of the facility during testing procedures and reporting, according to HIPAA guidelines.

III. BACTERIOLOGY

1. Perform Gram stains on a minimum of **15** samples, including both direct smears and cultured colonies, following established laboratory procedures..

2. Evaluate stained smears for stain quality, according to established criteria.

3. Read a minimum of **15** direct Gram stained smears, matching the interpretation of the technologist 80% of the time.
    a. Describe Gram reaction and morphology
    b. Quantitate bacteria and polymorphonuclear cells

4. Demonstrate the ability to select isolated colonies from a culture plate, streak for isolation, and obtain isolated colonies.

5. Correlate Gram stain results with isolates on culture plates to the satisfaction of the clinical instructor.

6. List the criteria for an acceptable sputum specimen.

7. Screen sputum smears for the quality of the specimen to the satisfaction of the clinical instructor.

8. Recognize alpha (α), beta (β) and gamma (γ) hemolysis with 100% accuracy.

9. Distinguish between gram-positive and gram-negative organisms using their Gram stain characteristics and/or their growth on selective media with 100% accuracy.

10. Determine the required biochemical tests for a cost-effective identification of the unknown pathogens.

11. Inoculate all biochemical media and identification systems used in the laboratory, within a reasonable time limit, as determined by the clinical instructor.

12. Determine a positive or negative reaction for each test to include (but not limited to, or exclusive of) the following, matching the technologist's results:

a. Catalase
b. Slide & tube coagulase
c. Novobiocin susceptibility
d. Bile esculin/6.5% NaCl
e. PYR/bacitracin/SXT
f. Spot indole
g. Hippurate hydrolysis/CAMP
h. Optochin/bile solubility
i. Commercial bacterial ID system(s)
j. Haemophilus ID & Neisseria ID systems
k. Oxidase
l. *Streptococci* identification

13. Using the information obtained from Gram stain, isolation on select media, and biochemical testing, demonstrate the ability to utilize flow charts and coded systems to identify the following organisms with a 90% rate of success in identification.

E. coli	*Neisseria gonorrhoeae*
Klebsiella / Enterobacter /Serratia	*N. meningitidis*
Citrobacter spp.	*Moraxella catarrhalis*
Salmonella spp.	*Haemophilus influenzae*
Shigella spp.	*Haemophilus parainfluenzae*
Proteus / Providencia / Morganella	*Campylobacter jejuni*
Staphylococcus aureus	*Clostridium perfringens*
Staphylococcus – coagulase-negative	*Bacteroides fragilis / fragilis* group
Group D *Streptococcus*	*Fusobacterium nucleatum*
Enterococcus faecalis / faecium	*Prevotella spp.*
Viridans streptococci	*Stenotrophomonas maltophilia*
Streptococcus pneumoniae	*Acinetobacter baumanii*
Beta (β) streptococci Gp A /Gp B / others	*Pseudomonas aeruginosa*
Vibrio ssp.	*Listeria monocytogenes*
Yersinia enterocolitica	*Peptostreptococcus/Peptoniphilus*
Abiotrophia spp. (NV *Streptococci*)	*Eikenella/P. multocida*

14. Discuss the isolation and identification of the following organisms:

Mycoplasma/ Ureaplasma
Nocardia asteroides
Aeromonas ssp.
Burkholderia cepacia and other NFB
Pasteurella multocida
Legionella ssp.
Propionibacterium

15. Urine cultures:

a. List common uropathogens.
b. Recognize urethral contaminants vs. potential pathogens.
c. Differentiate between lactose vs. non-lactose-fermenters with 100% accuracy.
d. Quantitate colony counts according to laboratory protocol, matching the instructor's counts.
e. Using laboratory criteria, determine which colony counts/isolates require identification and susceptibility testing, according to the criteria of the laboratory.
f. Perform appropriate identification and susceptibility tests on significant isolates with 90% accuracy.

16. Respiratory cultures:

a. Recognize normal respiratory flora on a minimum of **10** samples to the satisfaction of the clinical instructor.
b. List the primary pathogens detected in throat vs. sputum cultures.
c. Using laboratory criteria, determine which isolates are considered significant for identification and susceptibility tests with 90% accuracy.
d. Rule out group A streptococci in throat cultures with 100% accuracy.
e. Perform or discuss the test procedure for rapid group A streptococcal (GAS) antigen test.

17. Genital cultures (vaginal, cervical, urethral, etc.):

a. Recognize normal vaginal flora, i.e. lactobacilli.
b. Evaluate specimens for the presence of potential pathogens, i.e. *Neisseria gonorrhoeae*, *Gardnerella vaginalis* and group B *Streptococci*.
c. Perform presumptive identification procedures, confirmatory tests and susceptibility tests on suspected pathogens.

18. Stool cultures:

a. List the possible bacterial pathogens for which stool cultures are routinely examined.
b. Describe the appearance of each enteric pathogen on selective/differential media used in the laboratory.
c. Recognize and isolate any suspicious organism to the satisfaction of the clinical instructor.
e. Perform or discuss appropriate identification tests including serological confirmatory tests.
f. State the selective media to isolate the following and describe their appearance on this medium:
   - *E. coli* O:157 H:7
   - *Yersinia enterocolitica*
   - *Campylobacter jejuni*
   - *Salmonella enterica* subsp.
   - *Vibrio* spp.
   - *Aeromonas* spp.
   - *Pleisiomonas* spp.
   - *Shigella* spp
g. State the optimum temperature and atmosphere requirements for *C. jejuni* and *Y. enterocolitica*

19. Blood cultures:

a. Describe the media used for blood cultures and the principle of the blood culture detection system.
b. After performing staining of suspicious or positive cultures, detect the presence/ absence of organisms in the smears with 100% accuracy.
c. Using proper sterile techniques, subculture positive cultures to appropriate media, obtaining isolated colonies.
d. Perform or observe rapid testing methods when indicated.

20. Wound/body fluid cultures:

a. List normal flora and possible pathogens isolated from the site.
b. Perform appropriate identification and susceptibility tests of isolated pathogens with 90% accuracy.
c. Using laboratory criteria, determine which isolates are considered significant for identification and susceptibility tests.

21. Anaerobic cultures:

a. Compare and contrast the Gas Pak™ and anaerobic chamber systems.
b. List the types of clinical specimens that are acceptable/ unacceptable for anaerobic culture.
c. List the media used for primary isolation of anaerobes and the purpose of each.
d. Observe or isolate suspected anaerobic colonies.
e. Perform appropriate identification and susceptibility tests of isolated pathogens using laboratory criteria.

22. Susceptibility testing:

a. Explain the choice of antibiotics in relation to the test organism and clinical source.
b. Perform the Kirby-Bauer disk diffusion procedure according to the procedure manual.
c. Measure zone sizes accurately, within 1-2 mm of technologist's results.
d. Using CLSI chart, interpret and record results without error.
e. Explain potential sources of error in the Kirby-Bauer procedure and appropriate corrective actions.
f. Explain the principles of the MIC microdilution procedure and the E-test.
g. Perform MICs or E-tests to the satisfaction of the clinical instructor.
h. Interpret results of MICs, matching the technologist's results.
i. Perform a test for beta-lactamase with 100% accuracy.
j. Describe the procedures to identify VRE, MRSA, clindamycin-resistant *S. aureus* (D-test), penicillin resistant *S. pneumonia,* ESBL, and CRE.
k. Recognize "typical" susceptibility patterns of commonly isolated organisms.
l. Discuss the significance of susceptibility patterns (results) in VRE, MRSA, VISA, VRSA , ESBL, penicillin-resistant *S. pneumoniae*, and CRE.

IV. MYCOBACTERIOLOGY

1. Describe or demonstrate the safety precautions to be taken when working with mycobacteria.

2. List the specimens most likely to be received for culture of mycobacteria and identify which specimens need digestion/decontamination.

3. List the media that are used in the isolation and cultivation of mycobacteria.

4. Explain why the genus *Mycobacterium* is often referred to as "acid-fast bacilli" (AFB).

5. Observe, perform or discuss the Ziehl-Neelsen, Kinyoun, or fluorochrome acid-fast stain, where applicable.

6. Recognize AFB in clinical or QC stained slides, where applicable.

7. State the criteria and proper report format for numbers of acid-fast bacilli observed in stained smears.

8. Outline the method used to digest, decontaminate, concentrate, and culture specimens for mycobacteriae.

9. Observe the digestion and concentration procedure on culture specimens for mycobacteriae (if performed in lab).

10. State the optimal growth requirements (temperature and atmosphere) for *M. tuberculosis*.

V. PARASITOLOGY

1. State the purpose of each of these techniques used for O&P specimens:
   a. Saline direct smear
   b. Iodine direct smear
   c. Trichrome stain
   d. Concentration (formalin ethyl-acetate)
   e. Cellophane tape prep
   f. Modified acid-fast stain

2. Perform the following techniques to the satisfaction of the clinical instructor (if available):
   a. Trichrome stain
b. Concentration (*e.g.,* formalin ethyl-acetate)

3. Using reference slides, electronic images, CD-ROM or preserved specimens, identify these parasites:
   - *Ascaris lumbricoides*
   - *Strongyloides stercoralis*
   - Hookworm
   - *Enterobius vermicularis*
   - *Hymenolepis nana*
   - *Taenia spp.*
   - *Entamoeba histolytica*
   - *Giardia lamblia*
   - *Entamoeba coli*
   - *Trichuris trichiura*
   - *Plasmodium spp.*, if applicable

4. Identify *Cryptosporidium* on acid-fast smears or DFA.

5. In addition to the parasites listed in objective #3, identify the following parasites, using reference slides and/or preserved specimens (where available):
   - *Dientamoeba fragilis*
   - *Diphyllobothrium latum*
   - *Clonorchis sinensis*
   - *Schistasoma spp.*
   - *Toxoplasma gondii*

VI. MYCOLOGY

1. Describe or demonstrate the safety precautions to be taken when working with fungal isolates.

2. Explain the purpose of each medium used for the isolation of fungi from clinical specimens and the optimum temperature for incubation

3. Recognize yeast vs. filamentous fungi on culture media

4. Identify the presence of *Candida albicans* in a germ tube test (or cornmeal agar or equivalent rapid yeast test) with 100% accuracy.

5. Perform the yeast identification system used in the laboratory with 100% accuracy

6. Describe the preparation **OR** set-up a slide culture for fungal identification

7. Perform latex agglutination test for detection of cryptococcal antigen with 100% accuracy, where applicable.

8. Prepare a LPCB and calcuflor/ KOH preps, to the satisfaction of the clinical instructor.

9. Using prepared slides, colony morphology on fungal media, CD-ROM, and/or electronic images, identify the following molds with 90% accuracy

    - *Rhizopus* spp.
    - *Mucor* spp.
    - *Penicillium* spp.
    - *Aspergillus fumigatus*
    - *Microsporum* spp.
    - *Trichophyton* spp.
    - *Epidermophyton flocossum*
    - *Pneumocystis Jiroveci*

10. Describe the microscopic and macroscopic identifying features of the dimorphic fungi.

VII. VIROLOGY

1. Perform or discuss an RSV antigen detection assay to the satisfaction of the clinical instructor.

2. Perform or discuss at least one additional immunoassay viral detection test to the satisfaction of the clinical instructor.

VIII. MOLECULAR AND RAPID DIAGNOSTICS

1. Discuss the principles and procedures of molecular testing (including GC, *Chlamydia*, *Mycobacterium*)

2. Discuss or perform EIA/molecular methods for *C. difficile* toxin detection.