

Clinical Performance Objectives in Microbiology
Department of Medical and Research Technology
University of Maryland School of Medicine
Spring 2015

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

I. SPECIMEN HANDLING AND PROCESSING

Following departmental protocol, 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 using biologic safety cabinet when needed.
1. Appropriately handle microbiological specimens in regard to timeliness, appropriateness of specimen submitted for analysis requested, safety and security of collection system appropriate storage conditions, acceptable length of storage and completeness of essential patient information, to the satisfaction of the clinical instructor.
 2. Document rejected specimens according to laboratory's procedures for specimen rejection.
 3. Given any routine specimen for culture:
 - Evaluate specimens and requisitions for acceptability using laboratory defined criteria.
 - Select primary culture media for initial plating
 - Incubate media at the proper temperature and atmosphere conditions.
 4. Given plating instructions and media selection criteria:
 - Process a minimum of 10-20 bacterial specimens of different types and prepare smears for Gram stain (if appropriate), to the satisfaction of the clinical instructor.
 - Demonstrate proper aseptic technique and streaking method, obtaining isolated colonies.

II. QUALITY CONTROL and QUALITY ASSURANCE

1. Perform or observe the daily or weekly maintenance checks on equipment (i.e. refrigerators, incubators, water baths, and instruments) with 100% accuracy.
2. Perform quality control procedures (i.e. stains, media, biochemical tests, antisera, and susceptibility tests) with 100% accuracy.

3. Record all QC results with 100% accuracy.
4. Report divergent results to instructor.
5. Suggest corrective actions for divergent results.
6. Perform or observe basic laboratory computer operations where relevant.
7. Read the patient confidentiality policy of the facility on 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. Read a minimum of 15 direct Gram stained smears, matching the interpretation of the technologist 80% of the time.
 - Evaluate stained smears for stain quality
 - Describe Gram reaction and morphology
 - Quantitate bacteria and polymorphonuclear cells
3. Demonstrate the ability to select isolated colonies from a culture plate, streak for isolation, and obtain isolated colonies.
4. Correlate Gram stain results with isolates on culture plates to the satisfaction of the clinical instructor.
5. Evaluate acceptable sputum specimens by screening sputum smears according to the lab procedure manual.
6. Recognize alpha (α), beta (β) and gamma (γ) hemolysis with 100% accuracy.
7. Distinguish between Gram-positive and Gram-negative organisms using Gram stain characteristics and/or growth on selective media with 100% accuracy.
8. Determine the required testing for a cost-effective identification of the unknown pathogens.
9. Inoculate all available media and identification systems used in the laboratory, within a reasonable time limit, as determined by the clinical instructor.

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

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

11. 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.

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

12. Summarize the procedure for the isolation and identification of the following organisms as found in the laboratory procedure manual:

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|--------------------------------|--------------------------------|
| • <i>Mycoplasma/Ureaplasma</i> | • <i>Pasteurella multocida</i> |
| • <i>Nocardia asteroides</i> | • <i>Legionella ssp.</i> |
| • <i>Aeromonas ssp.</i> | • <i>Propionibacterium</i> |
| • <i>Burkholderia cepacia</i> | |

13. Urine cultures:

- Recognize or summarize the list of urethral contaminants vs. potential pathogens as described in the lab procedure manual.
- Differentiate between lactose vs. non-lactose-fermenters with 100% accuracy.

- Quantitate colony counts according to laboratory protocol, matching the instructor's counts.
- Using laboratory criteria, determine which colony counts/isolates require identification and susceptibility testing, according to the criteria of the laboratory.
- Perform appropriate identification and susceptibility tests on significant isolates with 90% accuracy.

14. **Respiratory Cultures:**

- Recognize normal respiratory flora on 5-10 samples to the satisfaction of the clinical instructor.
- Recognize primary pathogens detected in throat vs. sputum cultures.
- Using laboratory criteria, determine which isolates are considered significant for identification and susceptibility tests with 90% accuracy.
- Rule out group A streptococci in throat cultures with 100% accuracy.
- Perform or discuss the test procedure for rapid group A streptococcal (GAS) antigen test, if available.

15. **Genital Cultures** (vaginal, cervical, urethral, etc.) if available:

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

16. **Stool Cultures:**

- Summarize the list of possible bacterial pathogens for which stool cultures are routinely examined after reading the lab procedure manual..
- Recognize and isolate any suspicious organism on selective/differential media to the satisfaction of the clinical instructor. Organisms should include the following:
 - *E. coli* O:157 H:7
 - *Yersinia enterocolitica*
 - *Campylobacter jejuni*
 - *Salmonella enterica* subsp.
 - Vibrio* spp.
 - Aeromonas* spp.
 - Pleisiomonas* spp.
 - Shigella* spp
- Perform or discuss appropriate identification tests including serological confirmatory tests.
- Select optimum temperature and atmosphere requirements for *C. jejuni* and *Y. enterocolitica*

17. **Blood Cultures:**

- Select media for blood cultures based on laboratory procedure.
- Observe the operation of the blood culture detection system available at the site.
- After performing staining of suspicious or positive cultures, detect the presence/absence of organisms in the smears with 100% accuracy.
- Using proper sterile techniques, subculture positive cultures to appropriate media, obtaining isolated colonies.
- Perform or observe rapid testing methods when indicated.

18. **Wound/body fluid Cultures:**

- Summarize the list of normal flora and possible pathogens isolated from the site after reading the lab procedure manual.
- Perform appropriate identification and susceptibility tests of isolated pathogens with 90% accuracy.
- Using laboratory criteria, determine which isolates are considered significant for identification and susceptibility tests.

19. **Anaerobic Cultures:**

- Demonstrate use of an available anaerobic chamber system.
- Identify the types of clinical specimens that are acceptable/ unacceptable for anaerobic culture after reading the lab procedure manual..
- Select media used for primary isolation of anaerobes based on the purpose of each.
- Observe or isolate suspected anaerobic colonies.
- If available, perform appropriate identification and susceptibility tests of isolated pathogens using laboratory criteria.

20. **Susceptibility Testing:**

- Select the correct choice of antibiotics in relation to the test organism and clinical source.
- Perform the Kirby-Bauer disk diffusion procedure according to the procedure manual.
 - i. Measure zone sizes accurately, within 1-2 mm of technologist's results.
 - ii. Using CLSI chart, interpret and record results without error.
- b. Discuss potential sources of error in the Kirby-Bauer procedure and appropriate corrective actions.
- e. After reading the lab manual, summarize the principles of the MIC microdilution procedure and the E-test.
- f. Perform MICs or E-tests to the satisfaction of the clinical instructor.
- b. Interpret results of MICs, matching the technologist's results.
- c. Perform a test for beta-lactamase with 100% accuracy.
- d. After reading the lab manual, summarize the procedures to identify VRE, MRSA,

clindamycin-resistant *S. aureus* (D-test), penicillin resistant *S. pneumonia*, ESBL, and CRE.

- e. Construct a table listing “typical” susceptibility patterns of the 10 most commonly isolated Gram positive and Gram negative organisms throughout the course of the rotation.
- f. Discuss the significance of susceptibility patterns (results) in VRE, MRSA, VISA, VRSA , ESBL, penicillin-resistant *S. pneumoniae*, and CRE.

IV. MYCOBACTERIOLOGY

1. Demonstrate the safety precautions to be taken when working with samples suspected of harboring Mycobacteria and Mycobacterial cultures.
2. Classify specimens most likely to be received for culture of mycobacteriae.
3. Identify specimens that require digestion/decontamination in processing for mycobacterial culture.
4. From a list of commonly used microbiological media, identify the media that are used in the isolation and cultivation of mycobacteriae.
5. Differentiate the genus *Mycobacterium* and "acid-fast bacilli" (AFB) from other organisms not referred to as "acid-fast"
6. Perform the Ziehl-Neelsen, Kinyoun, or fluorochrome acid-fast stain, where applicable and in accordance with established laboratory protocol.
7. Recognize AFB in clinical or QC stained slides, where applicable.
8. Diagram the criteria and proper report format for numbers of acid-fast bacilli observed in stained smears.
9. Identify the method used to digest, decontaminate, concentrate, and culture specimens for mycobacteriae.
10. Perform the digestion and concentration procedure on 10 culture specimens for mycobacteriae (if performed in lab) over the course of the clinical rotation.
11. Select the optimal growth requirements (temperature and atmosphere) for *M. tuberculosis*.

V. PARASITOLOGY

1. After reading the laboratory manual, identify the purpose of each of these techniques used for O&P specimens:
 - a. Saline direct smear
 - b. Iodine direct smear
 - c. Trichrome stain
 - d. Cellophane tape prep
 - e. Concentration (formalin ethyl-acetate)
 - 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:

<ul style="list-style-type: none"> • <i>Ascaris lumbricoides</i> • <i>Strongyloides stercoralis</i> • Hookworm • <i>Enterobius vermicularis</i> • <i>Hymenolepis nana</i> • <i>Taenia spp.</i> • <i>Entamoeba histolytica</i> • <i>Giardia lamblia</i> • <i>Entamoeba coli</i> 	<ul style="list-style-type: none"> • <i>Trichuris trichiura</i> • <i>Dientamoeba fragilis</i> • <i>Diphyllobothrium latum</i> • <i>Clonorchis sinensis</i> • <i>Schistosoma spp.</i> • <i>Toxoplasma gondii</i> • <i>Plasmodium spp.</i>, if applicable
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4. Identify *Cryptosporidium* on acid-fast smears or DFA.

VI. MYCOLOGY

1. Describe or demonstrate the safety precautions to be taken when working with fungal isolates.
2. After reading the lab manual, summarize 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. If available, perform the yeast identification system used in the laboratory with 100% accuracy
6. Observe 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 calcofluor/ 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*
- *Microsporium* spp.
- *Trichophyton* spp.
- *Epidermophyton floccosum*
- *Pneumocystis Jiroveci*

10. Create a table describing the microscopic and macroscopic identifying features of the dimorphic fungi.

VII. VIROLOGY

1. Summarize the procedures of the available viral testing available at the site.
2. Perform or discuss an RSV antigen detection assay to the satisfaction of the clinical instructor after reading the laboratory procedure manual
3. Perform or discuss at least one additional immunoassay viral detection test to the satisfaction of the clinical instructor.

VIII. MOLECULAR AND RAPID DIAGNOSTICS

1. Select appropriate procedures for the molecular testing of *Neisseria gonorrhoeae*, *Chlamydia*, and *Mycobacterium* where available and in accordance with established laboratory protocols.
2. Perform EIA methods for *C. difficile* toxin detection in 10 samples over the course of the clinical rotation.

VII. PROFESSIONAL QUALITIES

1. Arrive at the laboratory on time and return from lunch/breaks on time.
2. Adhere to the established student uniform policy of the MLS program.
3. Notify the clinical supervisor of any unavoidable absences prior to the scheduled arrival time and make arrangements to make up the time on a mutually convenient date.
4. Demonstrate the ability to follow verbal and written instructions including written protocols and procedures and ask pertinent questions.
5. Communicate in a constructive, professional manner (i.e. polite, considerate, pleasant and unhurried) with members of the laboratory and hospital staff, peers and patients.
6. Organize work in a logical sequence.
7. Complete work and assignments within established deadlines.

8. With the approval of the clinical instructor, demonstrate the initiative to perform tasks without being reminded.
9. Demonstrate constructive utilization of all training time by examining available study materials during periods of time not devoted to instruction.
10. Demonstrate flexibility in changes to the scheduled daily learning activities due to laboratory staffing, emergencies, etc.
11. Demonstrate the ability to recognize and admit mistakes or discrepancies in laboratory protocols and/or results and, take appropriate corrective measures, including seeking help and notifying staff when needed.
12. Demonstrate the ability to accept professional constructive criticism regarding work.
13. Maintain the confidentiality of all patient information at all times in accordance with HIPPA regulations. This applies to patients or other unauthorized individuals and extends beyond the confines of the clinical setting.
14. Adhere to all published safety regulations in the laboratory.
15. Demonstrate professionalism in attitude, appearance and work ethic 100% of the time.
16. Adhere to standards and regulations regarding proper access and utilization of institutional computers.
17. Adhere to policies of the affiliate regarding the use of ALL electronic devices, including but not limited to, portable music players such as MP3 and Smart/cell phones.