MLT-2482: CLINICAL MICROBIOLOGY

Cuyahoga Community College

Viewing: MLT-2482 : Clinical Microbiology

Board of Trustees:
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Academic Term:
Fall 2025

Subject Code
MLT - Medical Laboratory Technology

Course Number:
2482

Title:
Clinical Microbiology

Catalog Description:
Application of the principles and procedures utilized in clinical microbiology, mycology, parasitology and virology in the collection, identification and serological detection of organisms. Pathogenesis and prevention of disease. Media, methods of culture and isolation, biochemical and susceptibility testing, aseptic and staining techniques, sterilization and safety protocols are studied. Analysis of case studies, problem solving and clinical significance of results in diagnosis.

Credit Hour(s):
5

Lecture Hour(s):
3

Lab Hour(s):
6

Requisites

Prerequisite and Corequisite
MLT-1001 Introduction to Medical Laboratory Science, and MLT-2490 Immunology & Serology, and BIO-2500 Microbiology.

Outcomes

Course Outcome(s):
A. Demonstrate safe and accountable behaviors within the laboratory setting.

Objective(s):
1. Apply knowledge of personal protective equipment (PPE) and Standard Precautions to ensure personal safety and prevent contamination.
2. Operate laboratory equipment safely and correctly to minimize risk and achieve accurate results.
3. Adhere to laboratory safety protocols and procedures to maintain a secure working environment for oneself and others.

Course Outcome(s):
B. Review the fundamental characteristics of clinical microorganisms and utilize bacterial taxonomy properly.

Objective(s):
1. Classify and differentiate the major types of microorganisms based on their fundamental characteristics.
2. Describe and apply the principles of bacterial taxonomy, nomenclature, and identification.
3. Explain the phenotypic characteristics of bacteria.
4. Identify and interpret the staining characteristics and microscopic morphologies of bacteria.

Course Outcome(s):

C. Explain the clinical microbiology laboratory's role in diagnosing and managing infectious diseases.

Objective(s):

1. Outline the clinical microbiology laboratory's pivotal role in healthcare by evaluating its contributions to infectious disease diagnosis and management, including pathogen identification, antimicrobial susceptibility testing, and implementation of infection control measures.
2. Explain the purpose of reporting relevant cultures and organisms to infection control personnel and public health agencies.
3. Discuss the contribution the clinical microbiology laboratory makes in surveilling infectious diseases.

Course Outcome(s):

D. Describe standard safety precautions to prevent laboratory-acquired infections.

Objective(s):

1. Describe standard safety precautions to prevent laboratory-acquired infections, including PPE, engineering controls, aseptic technique, and safe handling of biohazardous materials.
2. List steps to prevent the aerosolization of microbial agents.
3. Properly collect, handle, and discard infectious waste materials in compliance with regulations.
4. Safely handle and dispose of biohazardous materials following protocols.

Course Outcome(s):

E. Define epidemiological terms related to disease transmission and describe the modes of transmission.

Objective(s):

1. Define key terms related to epidemiology and disease transmission and differentiate between community-acquired and healthcare-acquired infections.
2. Describe different modes of disease transmission, including droplet, airborne, fomite, vector, and endogenous/exogenous routes.
3. Differentiate between colonization, infection, and carrier states.

Course Outcome(s):

F. Assess patient risk factors for infectious diseases and apply knowledge of transmission routes to recognize appropriate infection prevention strategies.

Objective(s):

1. Identify patient-specific factors that increase the risk of acquiring infectious diseases.
2. Apply knowledge of disease transmission to facilitate training and education.
3. Explain the role of immunizations and appropriate treatments in preventing and controlling infectious diseases.

Course Outcome(s):

G. Accurately evaluate microbiological specimens to determine their suitability for testing.

Objective(s):

1. Correctly identify and classify different types of clinical specimens.
2. Assess the acceptability of specimens based on collection methods, transport conditions, and other relevant criteria.
3. Select appropriate storage conditions for specimens when processing is delayed.
4. Discuss accessioning of specimens, including requestions, labeling, and routing.

Course Outcome(s):

H. Examine bacterial cultures to differentiate potential pathogens and normal flora.

Objective(s):

1. Prepare and interpret direct microscopic smears of specimens, identifying organism morphology, cellular components, and artifacts.
2. Prepare specimens for inoculation based on type of specimen and collection site.
3. Select and inoculate the appropriate media correctly, including appropriate selective media for isolating fastidious or uncommon organisms.
4. Incubate media in optimal conditions to support the growth of appropriate bacteria.
5. Describe bacterial growth on various culture media, including colony morphology, changes in surrounding media, growth characteristics on different media types, and characteristic odors.
6. Differentiate between normal flora and potential pathogens based on culture findings, Gram stain results, clinical diagnosis, and specimen source.

Course Outcome(s):

I. Apply principles of bacterial identification to accurately identify isolates using a variety of laboratory techniques and established algorithms with databases.

Objective(s):

1. Perform biochemical, confirmatory, and rapid identification tests for bacteria.
2. Explain the principles and mechanisms of action behind each type of bacterial identification test.
3. Interpret the results of bacterial testing, including positive and negative reactions, and correlate them with bacterial characteristics and identification.
4. Utilize disk diffusion tests to assess bacterial susceptibility to antimicrobial agents.
5. Select and perform secondary testing to further characterize and identify bacterial isolates.
6. Explain the principles and applications of commercial bacterial identification systems.
7. Describe the basic concepts of serological identification methods and their role in microbial diagnostics.
8. Utilize established algorithms and databases to accurately identify bacterial isolates.
9. Quantify bacterial growth using semi-quantitative terms.

Course Outcome(s):

J. Perform, interpret, and report antimicrobial susceptibility testing results.

Objective(s):

1. Apply standardized procedures and quality control measures for antimicrobial susceptibility testing.
2. Perform and interpret disk diffusion (Kirby-Bauer) and E-test methods for antimicrobial susceptibility testing.
3. Discuss the importance of beta-lactamase detection and the principles of testing.
4. Discuss micro-broth dilution and automated systems to determine and interpret minimum inhibitory concentrations of antimicrobial agents.
5. Understand and apply CLSI guidelines for antimicrobial susceptibility testing.
6. Interpret antimicrobial susceptibility testing results, recognize unusual profiles, and predict resistance mechanisms.
7. Report antimicrobial susceptibility testing data accurately, utilizing cascade and selective reporting strategies.
8. Explain the mode of action, spectrum of activity, and common mechanisms of bacterial resistance to antimicrobial agents.

Course Outcome(s):

K. Describe the unique characteristics of mycobacteria, their identification methods, clinical significance, transmission routes, and the associated clinical infections.

Objective(s):

1. Describe the unique characteristics of mycobacteria, including cell wall structure, growth rate, and acid-fast staining properties.
2. Explain and apply various identification methods for mycobacteria biochemical tests and molecular diagnostics using algorithms and databases incorporating phenotypic and genotypic characteristics.
3. Explain the purpose of decontamination in mycobacterial specimen processing and demonstrate the ability to select appropriate decontamination methods to facilitate accurate microscopic examination.
4. Describe the key characteristics, clinical significance, transmission routes, and associated clinical infections of the Mycobacterium tuberculosis complex, M. avium complex, and other clinically relevant mycobacteria.

Course Outcome(s):

L. Discuss safety precautions and proper procedures for handling, collecting, transporting, and processing mycobacterial specimens.

Objective(s):

1. Summarize safety precautions and proper procedures for handling, collecting, transporting, and processing mycobacterial specimens from various body sites, differentiating between contaminated and non-contaminated specimens.
2. Identify potential sources of error in mycobacterial specimen processing and apply appropriate quality assurance measures.

Course Outcome(s):

M. Discuss the preparation, staining, and screening of mycobacterial smears, interpret acid-fast staining results, select and inoculate culture media, and accurately report findings.

Objective(s):

1. Describe and perform the preparation, staining, and screening procedures for mycobacterial smears, including quality control.
2. Perform and interpret acid-fast staining using either fuchsin and fluorochrome methods, evaluating stained smears microscopically and reporting results accurately, including the identification of potential false positives and artifacts.
3. Select appropriate culture media for different types of mycobacterial specimens and optimize incubation conditions (temperature, atmosphere, duration) to support mycobacterial growth.
4. Describe the expected turnaround times for mycobacterial smear and culture results, explaining factors that can influence these timelines.
5. Discuss the reporting of mycobacterial culture and susceptibility results, correlating laboratory findings with clinical information and the need to promptly notify public health authorities of positive findings.

Course Outcome(s):

N. Describe the characteristics, classification, reproduction, growth requirements, and morphological structures of fungi.

Objective(s):

1. Describe the fundamental characteristics of fungi, differentiating them from other microorganisms.
2. Explain the principles of fungal classification and taxonomy.
3. Describe the structure and function of eukaryotic cells in fungi.
4. Differentiate between sexual and asexual reproduction in fungi.
5. Identify the growth requirements for different types of fungi.
6. Recognize and describe the various morphological structures of fungi.

Course Outcome(s):

O. Perform, interpret, and correlate laboratory findings with clinical information to diagnose and assess the clinical significance of fungal infections.

Objective(s):

1. Describe proper collection, transport, and storage procedures for fungal specimens.
2. Assess the acceptability of fungal specimens for culture and direct examination.
3. Select and explain the purpose of appropriate media for culturing fungal specimens.
4. Inoculate various media with fungal specimens using appropriate techniques.
5. Optimize incubation conditions for fungal cultures.
6. Differentiate common yeasts and molds on direct microscopic smears and routine mycology media.
7. Perform and interpret microscopic examinations of fungi using various techniques.
8. Correlate patient history, clinical symptoms, and laboratory findings to identify fungal pathogens and assess their clinical significance.
9. Describe different test methodologies for fungal identification, including rapid and traditional testing methods.
10. Utilize databases and materials to aid in the identification of fungal isolates.

Course Outcome(s):

P. Recognize and describe structures of different parasite stages to classify and differentiate major categories of parasites and explain their clinical significance.

Objective(s):

1. Classify and differentiate between the major categories of parasites (nematodes, cestodes, trematodes, and protozoans) based on their morphology, life cycle, and clinical significance.
2. Describe and recognize the characteristic structures of different parasite stages (adults, larvae, ova, cysts, trophozoites).

Course Outcome(s):

Q. Evaluate, collect, process, and examine parasitic specimens using appropriate techniques to accurately identify and differentiate parasites.

Objective(s):

1. Evaluate the acceptability of specimens for parasitic identification.
2. Describe appropriate procedures for collecting, handling, and preserving specimens for parasitic examination.
3. Identify common preservatives used for parasitic specimens and explain their purpose and limitations.
4. Perform macroscopic examination of specimens and describe the process of direct microscopic examination for parasite detection.
5. Select, perform, and interpret appropriate concentration methods, stains, and immunoassays for parasitic identification.
6. Identify and differentiate various parasites based on their morphology and diagnostic stages in different specimen types.
7. Utilize clinical information to select appropriate diagnostic tests and interpret laboratory findings in the context of parasitic infections.
8. Differentiate between parasites and artifacts commonly found in clinical specimens.

Course Outcome(s):

R. Describe the fundamental structure, classification, and replication of viruses, and associate
specific viral agents with their corresponding diseases, pathological manifestations, and routes of transmission.

Objective(s):

1. Describe the basic structure and components of viruses.
2. Explain the criteria used for classifying viruses and provide examples of viruses that infect animals, plants, and bacteria.
3. Associate specific viral agents with their corresponding diseases or pathological manifestations and routes of transmission.
4. Describe appropriate methods for collecting and processing specimens for viral studies, considering factors such as specimen type, collection devices, safety precautions, transport media, temperature, and time.
5. Select appropriate storage and shipment methods for viral specimens, ensuring proper labeling and documentation.
6. Utilize specimen processing algorithms to guide the handling and analysis of specimens based on the suspected viral agent and other relevant factors.
7. Describe the principles, limitations, and applications of various laboratory procedures used for the detection of viral agents and particles, including quality control and troubleshooting strategies.
8. Perform and interpret results of direct detection methods, immunodiagnostic assays, molecular methods, cell culture, and serology for viral diagnosis.

Course Outcome(s):

S. Discuss quality management principles in the clinical microbiology laboratory.

Objective(s):

1. Demonstrate adherence to established policies and procedures in the clinical microbiology laboratory.
2. Perform and interpret quality control (QC) procedures for various laboratory tests and equipment.
3. Identify, document, and report errors in laboratory procedures and results, and participate in corrective action planning.
4. Participate in quality management activities, including data collection and analysis.
5. Assist in the education and training of laboratory personnel and healthcare providers.
6. Engage in continuing education to maintain knowledge and skills in clinical microbiology.

Methods of Evaluation:

1. Discussion Boards
2. Homework assignments
3. Case studies
4. Exams
5. Quizzes
6. Lab practical exams
7. Individual projects
8. Class participation

Course Content Outline:

1. Fundamentals
    a. Microorganisms
        i. Bacteria
        ii. Yeasts, molds
        iii. Viruses
        iv. Parasites
        v. Prions
    b. Classification
        i. Taxonomy
        ii. Nomenclature
        iii. Identification
    c. Phenotypic characterization
        i. Growth
        ii. Reproduction
        iii. Metabolism
        iv. Nutrition
    d. Stains
        i. Gram's
        ii. Acid-fastness
        iii. Morphologies of bacteria
            1. Cocci
                a. Chains
                b. Clusters
                c. Tetrads
                d. Pairs
            2. Diplococci
            3. Coccobacilli
            4. Bacilli/Rods
            5. Lancet
            6. Fusiform
            7. Pleomorphic
            8. Branching
            9. Palisading
            10. Endospores
            11. Capsules
            12. Flagella
            13. Spirochetes
            14. Intra- and extra-cellular
    e. Healthcare
        i. Hospitals
            1. Pathogen identification
            2. Susceptibility testing
            3. Infection control
        ii. Public health

1. County
2. State
3. National

iii. Surveillance of infectious diseases
1. Environmental samples
2. Personnel specimens
3. Patient specimens
4. Epidemiologic analysis
5. Phenotypic techniques
6. Genotypic techniques
7. Reporting
8. Centers for Disease Control
9. Bioterrorism agents
10. Emerging infections

2. Safety
a. Decontamination
b. Disinfection
c. Sterilization
d. Precautions
i. Standard Precautions
1. Handwashing
2. Protective clothing/devices

ii. Engineering controls
1. HEPA filtration
2. Ultraviolet germicidal irradiation
3. Negative pressure room

iii. Health care facilities
1. Emergency care
2. Respirator use

iv. Sharps
v. Biological safety cabinets
1. Classification
2. Requirements

vi. Emergency aid
1. First aid
2. Eye wash
3. Showers

vii. Immunizations
viii. Employee health services

e. Aerosolization
i. Containment procedures
ii. Centrifuge safety

f. Infectious waste
i. Definition
ii. Environmental Protection Agency
iii. State regulations

g. Hazards of chemicals
i. Safety data sheets (SDS)
ii. Storage
iii. Labeling
iv. Health hazards
v. Environmental hazards

h. Biohazard materials
i. Identification of infectious materials
ii. Special handling
iii. Autoclaves
iv. Waste

3. Specimen collection and processing

a. Properly identify specimen type
    i. CSF
    ii. Blood and bone marrow
    iii. Pleural
    iv. Synovial
    v. Peritoneal
    vi. Pericardial
    vii. Amniotic
    viii. Gastric
    ix. Genital
    x. Eye/ear/ throat
    xi. Nasopharynx/sinuses
    xii. Sputum/Bronchial Tissue, skin, and bone
    xiii. Catheter tips
    xiv. Urine
        1. Catheterized
        2. Clean voided midstream
        3. Suprapubic
    xv. Wound
        1. Abscess aspiration/purulent material
        2. Surgical
        3. Soft tissue
    xvi. Gastrointestinal
    xvii. Autopsy
b. Acceptability of specimens
    i. Body site
    ii. Site preparation
    iii. Collection method
        1. Aseptic technique
        2. Sampling device
    iv. Transport media
        1. Container type
        2. Preservatives
    v. Temperature
    vi. Time
        1. Collection time
        2. Time in transit
    vii. Atmosphere
    viii. Patient therapy
    ix. Quantity
    x. Contamination
    xi. Spillage
c. Lab Storage
    i. Suspected organism
    ii. Temperature
    iii. Atmosphere
    iv. Length of time
    v. Preservative
d. Provide proper accession of specimens
    i. Labeling
    ii. Batching
    iii. Routing

4. Bacterial Culture
a. Direct Smears
    i. Stain smear
    ii. Wet mounts
        1. Saline
        2. Iodine

3. KOH
4. Methylene Blue

iii. Gram
iv. Spore
v. Acid-fast
1. Ziehl-Neelsen
2. Kinyon
3. Modified Kinyons

vi. Fluorescent
1. Acridine orange
2. Auramine-rhodamine
3. Calcofluor white
4. Fluorescein conjugated

vii. Microscopic evaluation
1. Bacteria
a. Structures
b. Capsule
c. Spores
2. Yeasts and hyphal elements
3. White and red cells
4. Epithelial cells
a. Inclusions
b. Clue cells
5. Artifacts and background material
6. Sputum
a. Berrett's criteria
7. Quantitate organisms and cells

b. Inoculation preparation
i. Centrifugation
ii. Homogenization

c. Inoculation
i. Order of media
ii. Quantitative
iii. Semi-quantitative
iv. Swab
v. Loop sterilization
1. Reusable metal
2. Plastic
3. Calibrated

vi. Isolation
vii. Stab
viii. Pipette
ix. Automated plater
x. Growth media
1. Primary media
a. Enriched
b. Selective
i. Differential
ii. Enrichment
c. Nutrient
2. Media additives
a. Nutrients
b. Supplements
c. Antibiotics
d. pH
e. Environment
3. Special isolation media
a. Uncommon organisms
b. Enrichment media

c. Buffered charcoal yeast extract
d. Stool selective media
e. Corynebacterium selective media

d. Incubation
   i. Atmospheric
      1. Aerobic-ambient
      2. Capnophilic (3-5%,5-10%, microaerophilic)
      3. Anaerobic
   ii. Temperature
      1. 4°C
      2. 25°C
      3. 30°C
      4. 35°C
      5. 42°C
   iii. Humidity
   iv. Length of incubation
e. Colony morphologies
   i. Visual characteristics
      1. Size
      2. Shape
         a. Elevation
         b. Form
         c. Margin
            i. Umbilicated
            ii. Swarming, etc.
         d. Surface appearance
            i. Mucoid
            ii. Transparent
            iii. Opaque, etc.
         e. Pigmentation
         f. Changes in media
            i. Hemolysis
            ii. Pitting
            iii. Fermentation, etc.
   ii. Growth characteristics
      1. Blood Agar media
         a. Hemolysis
         b. Double beta
         c. Subtle or narrow zone
      2. Selective Gram Negative media
         a. Fermenter vs. non-fermenter
         b. Detection of H2S
         c. Lysine decarboxylation
      3. Chocolate media
      4. Modified Thayer Martin (MTM)
      5. Campy-blood agar (BA)
         a. Cefoperazone
         b. Vancomycin
         c. Amphotericin B (CVA)
      6. Colistin-nalidixic acid (CNA) blood agar
         a. Phenylethyl alcohol (PEA)
         b. Mannitol salt agar (MSA)
      7. Anaerobic media
         a. Anaerobic blood agar
         b. Kanamycin-vancomycin laked (KVL)
      8. Other media
         a. Group B selective broths
         b. Routine enrichment broths

        c. Mueller-Hinton
        d. Chromogenic agar
5. Bacterial Identification
    a. Principles
        i. Limitations
        ii. Sources of errors
        iii. Troubleshooting
        iv. Sensitivity and specificity
        v. Environmental requirements
    b. Identification tests
        i. Catalase
        ii. Oxidase/DMSO modified
        iii. Coagulase
        iv. TSI and KIA slants
        v. Methyl Red
        vi. Phenylalanine deaminase
        vii. Amino acid
        viii. Acid production
        ix. Fermentation
        x. Oxidation
        xi. Indole
            1. Tube
            2. Spot
        xii. Porphyrin
        xiii. Pyrrolidinyl arylamidase
        xiv. Salt tolerance
        xv. Esculin hydrolysis
            1. Rapid
            2. Bile esculin slant
        xvi. Hippurate hydrolysis
        xvii. H2S production
        xviii. Nitrate reduction
        xix. Citrate utilization
        xx. Urease
        xxi. Butyrate esterase
        xxii. Voges-Proskauer
        xxiii. Bile solubility
        xxiv. X and V growth factors
    c. Disk identification tests
        i. Novobiocin
        ii. Optochin
        iii. Special potency disks
        iv. Bacitracin
        v. Beta-lactamase
        vi. Colistin
        vii. Kanamycin
        viii. Vancomycin
    d. Other testing
        i. Satellitism
        ii. Staphylococcus aureus streak
        iii. Motility
        iv. Aerotolerance
        v. Colony fluorescence
    e. Commercial identification systems
        i. Non-automated
            1. Miniaturized
            2. Rapid
        ii. Automated

1. Nucleic acid detection
2. Nonamplified
3. Maldi-TOF

f. Serological identification
   i. Coagglutination
   ii. Latex agglutination
   iii. Urine antigen detection
   iv. Toxin detection
   v. Immunofluorescent assays
      1. Direct-DFA
      2. Indirect-IFA
   vi. Enzyme linked immunoabsorbent assay
   vii. Serotype

g. Algorithms and databases
   i. Analog
   ii. Digital

h. Bacteria to describe
   i. Staphylococci
      1. Staphylococcus epidermidis
      2. Staphylococcus lugdunensis
   ii. Enterobacteriaceae
      1. Providencia spp.
      2. Morganella morganii
   iii. Other facultative Gram-negative rods
      1. Helicobacter spp.
   iv. HACEK and other fastidious Gram-negative rods
      1. Aggregatibacter aphrophilus
      2. Aggregatibacter actinomycetemcomitans
      3. Cardiobacterium hominis
      4. Eikinella corrodens
      5. Kingella spp.
   v. Other Gram-negative coccobacilli
      1. Bordetella spp.
      2. Francisella tularensis
      3. Haemophilus influenzae
         a. Serotypes b and non-b
         b. Biovar aegyptius
      4. Legionella pneumophila
   vi. Aerobic Gram-positive rods
      1. Gardnerella vaginalis
      2. Corynebacterium diphtheriae
      3. Listeria monocytogenes
      4. Bacillus anthracis
      5. Clostridium perfringens
      6. Clostridium difficile
      7. Propionibacterium acnes
   vii. Aerobic Gram-positive cocci
      1. Peptostreptococcus spp.
   viii. Aerobic Gram-negative rods and cocci
      1. Bacteroides fragilis group
      2. Bacteroides spp.
      3. Fusobacterium spp.
      4. Prevotella spp.
      5. Veillonella spp.

i. Bacteria to describe and identify
   i. Staphylococci
      1. Staphylococcus saprophyticus
      2. Other coagulase-negative Staphylococci
   ii. Micrococcus spp.

iii. Streptococci
1. Alpha and non-hemolytic Streptococci
iv. fastidious Gram-negative coccobacilli
1. Other Haemophilus spp.
2. Pasteurella multocida
v. Aerobic Gram-positive rods
1. Other Corynebacterium species
2. Bacillus cereus
3. Other Bacillus sp.

j. Bacteria to describe, identify, and explain clinical significance
i. Staphylococci
1. Staphylococcus aureus
2. Methicillin-resistant Staphylococcus aureus (MRSA)
3. Vancomycin-intermediate S. aureus (VISA)
4. Vancomycin-resistant S. aureus (VRSA)
ii. Streptococci
1. Streptococcus pyogenes (Group A)
2. Streptococcus agalactiae (Group B)
3. Other beta-hemolytic Streptococci
4. Streptococcus pneumoniae
5. Viridans streptococci
6. Vancomycin-resistant Enterococci (VRE)
iii. Enterococcus
1. Enterococcus faecalis
2. Enterococcus faecium
iv. Group D Streptococcus
v. Aerobic Gram-negative cocci
1. Neisseria gonorrhoeae
2. Neisseria meningitidis
3. Moraxella catarrhalis
vi. Enterobacteriaceae
1. Escherichia coli
a. Enterohemorrhagic E. coli due to Shiga toxin
b. Other diarrheagenic E. coli
2. Shigella sp.
3. Klebsiella sp.
a. K. pneumoniae
b. K. oxytoca
4. Enterobacter sp.
a. E. aerogenes
b. E. cloacae
5. Serratia sp.
6. Citrobacter sp.
7. Salmonella spp.
8. Proteus sp.
a. P. mirabilis
b. P. vulgaris
9. Yersinia enterocolitica
vii. Other facultative Gram negative rods
1. Vibrio cholera
2. Aeromonas sp.
3. Campylobacter jejuni
viii. Glucose non-fermenting Gram-negative rods
1. Pseudomonas aeruginosa
2. Stenotrophomonas maltophilia

6. Antimicrobial
a. Testing
i. Principles
ii. Limitations

iii. Sources of errors
iv. Troubleshooting
v. Sensitivity and specificity
vi. Quality control

b. Disk diffusion and gradient method
i. Media
ii. Inoculum
iii. Incubation
iv. Potency
v. Storage
vi. Reading
vii. Interpretation
1. Qualitative
2. Quantitative
viii. Reporting

c. Beta-lactamase
i. Species
ii. Testing
iii. Induced Beta-lactamase

d. Minimum inhibitory concentration
i. Micro-broth
ii. Automated systems
iii. Inoculum
iv. Incubation
v. Reading
vi. Interpretation
vii. Reporting
viii. Supplements and special techniques
ix. Error detection
x. Troubleshooting

e. Susceptibility testing
i. Oxacillin resistance
1. Staphylococcus spp.
ii. Inducible clindamycin resistance
1. Staphylococcus
2. beta-hemolytic Streptococcus spp.
3. Streptococcus pneumoniae
iii. Vancomycin resistance
1. Staphylococcus and Enterococcus spp.
iv. High level aminoglycoside resistance
1. Enterococcus spp.
v. Penicillin resistance
1. Streptococcus pneumonioe
vi. Extended spectrum beta-lactamases (ESBL)
1. Enterobacteriaceae
vii. ampC enzymes
1. Gram-negative rods
viii. Carbapenemase resistant
1. Enterobacteriaceae (CRE)
ix. Special resistance detection
x. Unusual antimicrobial profiles
xi. Predictor antimicrobial agents
xii. Multidrug-resistant organisms (MORO)
xiii. Interpret results according to set guidelines
1. Qualitative
2. Quantitative

f. Modes of action
i. Cell wall
ii. Cell membrane

iii. Protein synthesis
iv. Nucleic acid
v. Folic acid
vi. ATP
vii. Spectrum of activity

7. Mycobacteria
   a. Characteristics
      i. Acid-fastness
      ii. Growth requirements
      iii. Rate of growth
      iv. Atmosphere requirements
      v. Temperature
   b. Identification of isolates
      i. Acid-fastness
      ii. Temperature for growth
      iii. Rate of growth
      iv. Colony morphology
      v. Pigment
      vi. Biochemical testing
      vii. Molecular diagnostics
   c. Digestion and decontamination
      i. Liquefication
      ii. Decontamination
      iii. Centrifugation
   d. Clinically significant Mycobacteria spp.
      i. Mycobacterium tuberculosis complex
      ii. M. tuberculosis
      iii. Mycobacterium avium-intracellulare complex
   e. Infection
      i. Routes of transmission
      ii. Signs and symptoms
   f. Safety requirements
      i. Biological safety level
      ii. Personal protective equipment
      iii. Equipment
      iv. Negative pressure facility
      v. Employee testing
      vi. BCG vaccine
      vii. Processing procedures
         1. Contaminated specimens
         2. Non-contaminated specimens
   g. Specimen collection and transportation
      i. Pulmonary sites
      ii. Sputum, expectorated and induced
      iii. Bronchial alveolar lavage (BAL), bronchoscopy, etc.
   h. Extrapulmonary sites
      i. Non-contaminated
      ii. Contaminated
8. Staining
   a. Smear preparation
   b. Principles
   c. Reagents
      i. Fuchsin
         1. Ziehl-Neelsen
         2. Kinyoun
      ii. Fluorochrome
         1. Auramine O
         2. Auramine-rhodamine
   d. Quality control

e. Limitations
f. Sources of errors
g. Troubleshooting

9. Microscopic
    a. Evaluation
        i. Magnification
        ii. Scanning pattern
        iii. Organism morphology
    b. Interpretation
    c. Sources of false positives
    d. Artifacts, debris, background
    e. Reporting scheme
10. Cultures
    a. Media
        i. Primary cultures
            1. Egg-based
            2. Agar-based
            3. Liquid based
        ii. Commercial systems
    b. Incubation
        i. Temperature
            1. 35 °C vs. 31°C
            2. 25-33° C
        ii. Atmosphere
    c. Reading schedule
11. Result reporting
    a. Turnaround time
    b. Direct smear
    c. Culture
    d. Susceptibility results
12. Mycology
    a. Describe characteristics of fungi
        i. Classification
        ii. Taxonomy
        iii. Eukaryotic cells
        iv. Reproduction
        v. Growth requirements
        vi. Morphologic structures
    b. Specimens
    c. Collection methods
    d. Transportation
    e. Storage
    f. Culture media
        i. Primary isolation media
        ii. Without antibacterial or antifungal agents
        iii. With antibacterial agents
        iv. Dermatophyte test medium (DTM)
        v. Mycosel or mycobiotic agar
        vi. Selective and differential for yeast
    g. Inoculate preparation
        i. Aspirates
        ii. Tissue
        iii. Bone
        iv. Blood
        v. Bone marrow
        vi. CSF
        vii. Body fluids
        viii. Respiratory specimens

- ix. Urine
- x. Hair, skin, nails

h. Incubation
- i. Temperature
- ii. Length
- iii. Schedule

i. Direct microscopic smears
- i. KOH
- ii. India ink
- iii. Gram stain

j. Microscopic testing
- i. Germ tube
- ii. Cornmeal/rice
- iii. Scotch tape preparation with LPCB
- iv. Culture slides

k. Organisms
- i. Yeasts
  1. Candida
     a. C. abicans
     b. C. glabrata
     c. C. tropica/is
     d. Other Candida sp.
  2. Cryptococcus
     a. C. neoformans
     b. Other Cryptococcus sp.
  3. Trichosporon sp.
  4. Geotrichum sp.
  5. Malassezia spp., ie M.furfur
- ii. Dimorphic moulds
  1. Blastomyces dermatitidis
  2. Coccidioides spp., ie C. immitis
  3. Histoplasma capsulatum
  4. Sporothrix schenckii
  5. Paracoccidioides braziliensis
- iii. Brightly colored/hyaline moulds
  1. Aspergillus spp.
     a. A.fumigatus
     b. A.flavis
     c. niger
     d. Other A. sp.
  2. Penicillum sp.
  3. Fusarium spp.
- iv. Dermatophytes
  1. Microsporum spp.
  2. Trichophyton spp.
  3. Epidermophytonfloccosum
- v. Zygomycetes
  1. Rhizopus spp.
  2. Mucor spp.
  3. Lichtheimia spp. (formerly Absidia spp.)
- vi. Other fungi
  1. Pneumocystis jiroveci

l. Testing methods
- i. Assimilation/fermentation
- ii. Temperature tolerance
- iii. Mould/yeast conversion
- iv. Wood's lamp fluorescence
- v. In-vitro hair perforation
- vi. Antigen detection methods

vii. Commercial methods
viii. Molecular methods
m. Databases and reference materials

13. Parasites
a. Characteristics of categories
i. Nematodes
ii. Tissues
iii. Intestinal
iv. Cestodes
v. Trematodes
vi. Protozoan
vii. Amebae
viii. Flagellates
ix. Sporozoa
x. Plasmodium spp.
xi. Coccidia
xii. Ciliates
b. Specimen Collection and Handling
i. Acceptability
1. Collection time/receipt time
2. Specimen storage
3. Number of specimens
4. Presence of interfering or contaminating substances Preservatives for parasitic specimen
a. Polyvinyl alcohol (PVA)
b. 10% Formalin
c. Schaudinn solution
d. Sodium acetate-acetic acid-formalin (SAF)
e. Less toxic single-tube systems
f. Rejection criteria
c. Examination
i. Thick smears
ii. Thin smears
iii. Macroscopic
iv. Color
v. Presence of blood or mucous
vi. Consistency
vii. Organism components
d. Direct microscopic
i. Size
ii. Wet mounts
1. Saline
2. Iodine
e. Concentration methods
i. Principles
ii. Limitations
iii. Sources of errors
iv. Troubleshooting
v. Sensitivity and specificity
vi. Quality control
f. Permanent stained smears
i. Trichrome/modified trichrome
ii. Iron-hematoxylin
iii. Modified Kinyons (acid-fast)
iv. Calcofluor white
v. Auromine O
g. Other tests
i. Immunoassays
ii. Nucleic acid assays

h. Organisms
i. Nematodes
    i. Intestinal
        1. Ascaris lumbricoides
        2. Strongyloides stercoralis
        3. Hookworm
            a. Necator spp.
            b. Ancyclostoma spp.
        4. Trichuris trichiura
        5. Enterobius vermicularis
    ii. Blood and tissue
        1. Trichinella spiralis
        2. Wuchereria boncrofti
        3. Brugia molayi
        4. Loa loo
        5. Mansonella Onchocerca volvulus
        6. Dracunculus medinensis
j. Cestodes
    i. Toenia solium
    ii. Taenia saginata
    iii. Echinococcus granulosus
    iv. Diphyllobothrium latum
    v. Hymenolopis nano
    vi. Hymenolopis diminuta
k. Trematodes
    i. Paragonlmus westermani
    ii. Fasciolopsis buski
    iii. Fasciala hepatica
    iv. Clonorchis sinensis
    v. Schistosoma mansoni
    vi. Schistosoma haematobium
    vii. Schistosoma japonicum
l. Protozoa
    i. Amoeba
        1. Entamoeba histolytica
        2. Entamoeba dispar
        3. Entamoeba coli
        4. Other Entamoeba sp.
        5. Lodamoeba biltschlii
        6. Endolimax nano
        7. Acanthamoeba sp.
        8. Naegleria fowleri
        9. Blastocystis hominis
    ii. Flagellates
        1. Giardia lamblia/intestinalis
        2. Trichomonas vaginalis
        3. Dientamoeba lragilis
    iii. Trypanosoma spp.
    iv. Leishmania spp.
    v. Sporozoa
        1. Plasmodium spp.
        2. Babesia spp.
        3. Cryptosporidium parvum
    vi. Ciliates
        1. Balantidium coli
m. Identification
    i. Diagnostic stage
    ii. Life cycle

iii. Specimen of choice
iv. Detection methods

n. Artifacts
i. White and red blood cells
ii. Epithelial cells
iii. Pollen granules
iv. Vegetable fibers and cells
v. Yeast cells
vi. Charcot-Leyden crystals
vii. Fungal spores
viii. Diatoms
ix. Hair

o. Other specimens
i. Cellophane tape/vaspar paddle preparation for Enterobius vermicularis
ii. Wet mount/culture for Trichomonas species
iii. Duodenal capsule or string technique
iv. Thick and thin blood films
v. Bone marrow and body fluids
vi. Urine
vii. Lower respiratory
viii. Biopsy

14. Viruses
a. Structure
b. Replication
c. Classifications
d. Pathology
i. Hepatitis viruses
ii. Simplex virus, Herpesvirus 1 and 2
iii. Cytomegalovirus (CMV)
iv. Varicella-Zoster (VZV)
v. Influenza virus A
1. Avian influenza (H5N1, H7N1)
2. Swine influenza (H1N1)
vi. Influenza virus B
vii. Respiratory syncytial virus (RSV)

15. Laboratory testing
a. Principles
b. Limitations
c. Sources of errors
d. Troubleshooting
e. Sensitivity and specificity
f. Quality control
g. Direct detection methods
h. Immunodiagnostic
i. Direct and indirect immunofluorescent
ii. Antibody methods
iii. Enzyme immunoassay methods (EIA)(ELISA)
i. Molecular methods
j. Cell culture systems
k. Serology

16. Quality Management
a. Quality assurance
b. Quality control
c. Pre-analytical
i. Specimen collection
ii. Specimen transport
d. Analytical

i. Standard operating procedures
ii. Accurate performance of manual testing

e. Post-analytical
i. Result entry
ii. Accurate reporting

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