

## **CLINICAL MICROBIOLOGY: Rotation Director: Kenneth H. Rand, M.D., Professor**

**1. Description of the rotation:** Organization of Rotation: The resident spends a variable, but adequate length of time in each of the following sections: plating urines, wounds, respiratory, bloods, mycology, mycobacteriology, and virology. The technologists in these areas are the primary instructors. There will be a lecture/seminar 3-4 times/week from 1:30 - 3:00 pm. These seminars will be given by the medical director and 3-4 topics will be assigned to each resident. The resident should read the pertinent literature (lab manual, ASM manual, journal articles as indicated). As appropriate to the individual case or consultation under review, the ethical, socioeconomic, medicolegal, and cost-containment issues are reviewed and discussed. As well, research design, statistics, and critical review of the literature are discussed. By use of the literature, Medline, and textbooks, the resident is trained to become a lifelong learner.

**2. Goals of the rotation:** The resident, after completing their rotation in the Clinical Microbiology Laboratory should be able to function as a reasonably competent Medical Director of a Clinical Microbiology Laboratory. The resident should be able to advise and direct the medical and/or supporting staff of his hospital in the selection of the proper laboratory examinations for the diagnosis and management of infectious disease. This includes the proper collection and transport of clinical specimens for laboratory examination. The resident should be knowledgeable and reasonably proficient in the performance of the necessary methods and procedures to: 1) Set-up the various clinical specimens in culture to isolate bacteria, mycobacteria, and fungi 2) Direct microscopic examination of the various clinical specimens 3) Identify the medically important bacteria, mycobacteria and fungi 4) Perform qualitative and quantitative antibiotic sensitivity testing of bacteria 5) Perform and evaluate the various components of the quality control program 6) Recognize the need to consider efficiency and cost-containment in laboratory direction 7) Recognize that laboratory direction is a lifelong process of applying new information and methodology. The resident should be capable of interpreting the results of a cultural or microscopic examination and be able to discuss the significance of the results intelligently with the patient's physician.

**3. Duration of the rotation:** Four weeks will be spent for the rotation in the didactic clinical microbiology. It is expected that the resident will elect/select a rotation in microbiology in their senior years. The rotation includes mycology and parasitology and virology. The rotation consists of an introductory 1 month block of time and one subsequent 1 month "elective" segment.

**4. Duties and responsibilities of residents:** A daily schedule is approximately as follows: 8:30 - 11:30 PM: Hands on work-up and interpretation of cultures under the direction of technologists; 4 weeks will be spent in Microbiology, (2 weeks in the bacteriology section on bench rotations in urines, wounds, respiratory and blood, CSF, stool), 1 weeks in Mycology, Mycobacteriology and Parasitology and 1 week in Virology. 1:30 - 3:00 PM: Lecture series preparation and reading of direct smears. Inoculation of specimens. Work-up of anaerobic cultures. Performing disk sensitivity tests. Literature study. The schedule is somewhat different for the rotations in mycology, mycobacteriology, parasitology and virology. Attend Infectious Disease Case Conference and rounds and Hospital Infection Control Committee meeting. Conferences: Infectious Disease Conference with adult and pediatric infectious disease (weekly), Tuesday, 8:30 room R2-133 in the ARB. Reading assignments: A variety of books (Microbiology, Infectious Diseases, Diagnostic Microbiology) are available in the laboratory or Dr. Rand's office. There are copies of several pertinent specialty journals available, as well as selections of reprints of various subject matters. Research: There is no requirement for a research project. Opportunities to do a project exist, if desired by the resident.

**5. Teaching staff:** Kenneth Rand, M.D.

**6. i. Resident Supervision:** The resident is supervised by Dr. Rand and the senior medical technology staff in microbiology. Calls are discussed and reviewed during call report (daily as needed and at Monday 7:30 CP conference).

**ii. Resident Evaluation:** Written monthly evaluation.  
Revised 7-2003

### **Core Competencies in Microbiology**

Through a combination of lectures and hands on bench top experience the pathology residents will achieve core competencies in Microbiology and gain an in depth understanding of the principles and practice of Clinical Microbiology.

**a. Patient Care:** The resident will learn importance of the clinical microbiology laboratory in the diagnosis and management of patients with infectious diseases. The resident will learn critical aspects of specimen acquisition, transport, handling in the laboratory and relationship between results and their application to individual patients. Through Infectious Diseases conferences and rounds, they will understand the entirety of the process of patient management and the role of the laboratory in this process.

**b. Medical knowledge:** In the introductory section, the principles of laboratory safety are illustrated and examined in detail. The basis of bacterial taxonomy and classification is discussed, along with the basic principles of microbial pathogenesis. Other topics include an understanding of normal flora, specimen collection and transport, set up and processing of cultures, the importance of using differential and selective media, quality control and quality assurance. The lecture on blood culture methods includes the collection of blood cultures, identification of contamination, recommendations for the appropriate volume and number of blood cultures in different clinical settings, and a description of each of the major automated blood cultures methodologies, e.g. Bactec, ESP, Organon-Technika, etc The residents then study the classification and identification of the Enterobacteriaceae in detail, developing an understanding of the common biochemical test methodologies, such as TSIs, KIAs, use of selective media for enteric pathogens, oxidase test, ImVIC, and the classic identification methods such as API, numeric coding systems, as well as the semi-automated MicroScan and Vitek methodologies. Clinical correlation is provided for each of the most important species. The identification and clinical significance of the non-fermenting gram negatives such as Pseudomonas, Acinetobacter, Bordetella, Moraxella, Neisseria and Hemophilus is discussed in detail, including the principles of oxidative and fermentative metabolism, carbohydrate utilization for Neisseria, X and V factors for Hemophilus. The clinical importance and classic methods for the identification of the curved gram negative rods, Helicobacter and Vibrio, are discussed in detail including the available specialized media and importance of growth conditions for isolation, use of urease, growth in high salt, for preliminary identification of these organisms. The identification and classification of the Staphylococci includes detailed descriptions of the methodologies for coagulase testing, methicillin resistance testing, and other helpful test. Identification of the Streptococci includes an understanding principles of alpha, beta and gamma hemolysis, Lancefield classification, etc and of enterococcal identification including Bile-Esculin, salt tolerance, as well as the genetics of Vancomycin resistance. Other lecture topics include detailed classification and biochemical identification of the gram positive rods, including a discussion of Anthrax and its potential importance in Bioterrorism. Individual lectures are provided covering the clinical importance, classification and identification of the anaerobes, Legionella, Rickettsia, Mycoplasma, Ureaplasma, Ehrlichia, Bartonella, Spirochetes including Lyme disease and Syphilis. Serologic methods of diagnosis are discussed in detail for Syphilis and Lyme disease.

The discussion of antimicrobial susceptibility testing includes methods and principles of disk diffusion, e-test, broth dilution, microtiter broth dilution, time-kill as well as antibiotic synergy. The residents get a substantial understanding of the criteria for the selection of breakpoints for susceptibility and the correlation between different methods. Residents will understand the

essential mechanisms of bacterial resistance such as ESBLs, vancomycin resistance in enterococci and methicillin resistance in *Staphylococcus aureus*.

Separate lectures describe the identification and clinical correlation of the mycobacteria including the principles of sputum decontamination, use of Bactec and LJ media, and the application of molecular methods to the identification of tuberculosis and MAI. Identification of the yeasts includes *Candida* species, and Cryptococci including Cryptococcal serology. Separate lectures are provided for the identification of the filamentous fungi including *Aspergillus*, Mucorales, agents of Phaeohyphomycosis, Chromomycosis and the dermatophytes. A separate lecture with detailed clinical correlation is provided on the identification of the dimorphic fungi, Coccidioidomycosis, Histoplasmosis and Blastomycosis and includes the use of antigen detection, serologic methods, skin testing, etc.

The virology lecture section includes detailed clinical descriptions and discussion of the serologic, molecular and cultural methodologies for the detection and identification of Epstein Barr Virus, Herpes Simplex Virus I and II, Varicella, HHV-6, and Cytomegalovirus including shell vial technique, CMV antigenemia testing, and quantitative PCR. Respiratory virus identification and detection includes RSV, Influenza A and B, Parainfluenza, Adenovirus and Rhinovirus. Separate lectures are given on the clinical aspects and laboratory diagnosis and management of HIV, and the hepatitis viruses A, B, C, D and G. Detailed discussion of the molecular methodologies for these agents are discussed.

**c. Practice-Based Learning:** The resident will develop a systematic approach to the investigation and evaluation of clinically relevant testing and how to make appropriate decisions resulting in improved patient care. This involves the integration of individual clinical expertise with the best available external clinical evidence from systematic research. To attain the above goals, the resident is expected to:

Proactively seek examples of abnormal, interesting, and unusual laboratory findings and correlate these data with clinical diagnoses and disease states via chart review and contact with clinicians.

**d. Communication:** The resident will learn how to be effective when exchanging information with other health care professionals. Residents will be expected to become competent in both written and oral communication with clinical staff, knowledgeable about issues such appropriate test selection, reasonableness of requests for esoteric tests, importance of cost effective utilization of laboratory resources. Residents will interact with the medical staff in Infectious diseases and hospital staff in Infection control through attendance in case conferences and committee meetings.

**e. Professionalism:** The resident will be expected to show a commitment to ethical principles when carrying out professional responsibilities. He/she will exhibit behavior appropriate to their activities related to the clinical microbiology rotation. Specifically, the resident will be expected to maintain strict patient confidentiality with respect to all clinical and personal information: diagnosis, prognosis, test results, etc. The resident will be expected to demonstrate compassion and empathy for patients, respectful behavior toward all health care professionals regardless of status, behave appropriately when involved in stressful/emotional situations by maintaining self-control and attempting to defuse the situation. The resident is expected to respond to pager and telephone calls promptly and courteously, regularly and punctually attend conferences, meetings, assigned rotations, and other obligations, and contribute whenever possible. The resident must develop a commitment to ongoing professional and personal development by keeping abreast of developments in the medical literature.

**f. Systems-Based Practice:** The resident will become aware of and responsive to the larger context and system of health care. The resident will be able to demonstrate an understanding of the role of the clinical laboratory in the health care delivery system and the importance of reliable, cost effective, and timely laboratory data in clinical decision-making. The resident will be able to demonstrate awareness of the integral role of the microbiology laboratory in public health and epidemiology, including statutory requirements for laboratory-based reportable diseases,

demonstrate the ability to work effectively with clinicians and other health care professionals to achieve high quality and cost effective care. The resident will understand and become familiar with different models for health care delivery and their impact on laboratory reimbursement. Residents will demonstrate a knowledge of methods for laboratory cost analysis and accounting and cost containment measures. Residents will develop an understanding of the importance of the budget preparation and tracking process.

### **Resident Responsibilities for Upper Level Microbiology Rotations**

1. Residents are expected to arrange in advance a +1 hour meeting with Dr. Rand 2 - 3 times/week to discuss educational, clinically important and/or interesting cases and issues that arise from the microbiology laboratory.
2. Residents will compile 2 - 4 cases each meeting for discussion. Cases may be obtained from positive blood or sterile body fluid cultures, positive Tb, fungal or viral cultures, unusual or difficult to identify isolates from any source and positive syphilis (or other interesting) serology tests from the previous day (or weekend if on a Monday).
3. Residents will attend the case presentation portion of adult or pediatric Infectious Diseases rounds to provide Microbiology support for questions that may arise. Clinically important, educational cases may be obtained from this source for discussion with Dr. Rand.
4. Residents will be expected to know all relevant laboratory and clinical background information for the cases to be discussed with Dr. Rand.
5. Based on the case discussions, literature assignments will be assigned for questions that arise.
6. Residents are expected to obtain information from the clinicians taking care of the patient when needed and to convey suggestions to them for the management of their patients.
7. Residents are encouraged to pursue publication of interesting cases, or carry out small laboratory studies relevant to questions that arise from these discussions.
8. Resident should attend the Infectious Diseases clinical conference, which meets at 8:30 AM on the 1st, 2nd and 4th Tuesdays in R2 -133 - recommend calling 2-4059 to make sure it isn't cancelled.

Because the upper level rotation learning is case based, and involves resident interaction with the clinical infectious disease fellows and attendings, the experience encompasses the elements of Patient Care, Medical Knowledge, Practice Based Learning and Communication. Dr. Rand emphasizes the areas of Professionalism and Systems-Based Practice the one-on-one case-based teaching sessions.

### **Core Curriculum for Clinical Microbiology**

Through a combination of lectures and hands on bench top experience the pathology residents will gain an in depth understanding of the principles and practice of Clinical Microbiology.

In the introductory section, the principles of laboratory safety are illustrated and examined in detail. The basis of bacterial taxonomy and classification is discussed, along with the basic principles of microbial pathogenesis. Other topics include an understanding of normal flora, specimen collection and transport, set up and processing of cultures, the importance of using differential and selective media, quality control and quality assurance. The lecture on blood culture methods includes the collection of blood cultures, identification of contamination, recommendations for the appropriate volume and number of blood cultures in different clinical settings, and a description of each of the major automated blood cultures methodologies, e.g.

Bactec, ESP, Organon-Technika, etc The residents then study the classification and identification of the Enterobacteriaceae in detail, developing an understanding of the common biochemical test methodologies, such as TSIs, KIAs, use of selective media for enteric pathogens, oxidase test, ImVIC, and the classic identification methods such as API, numeric coding systems, as well as the semi-automated Microscan and Vitek methodologies. Clinical correlation is provided for each of the most important species. The identification and clinical significance of the non-fermenting gram negatives such as Pseudomonas, Acinetobacter, Bordetella, Moraxella, Neisseria and Hemophilus is discussed in detail, including the principles of oxidative and fermentative metabolism, carbohydrate utilization for Neisseria, X and V factors for Hemophilus. The clinical importance and classic methods for the identification of the curved gram negative rods, Helicobacter and Vibrio, are discussed in detail including the available specialized media and importance of growth conditions for isolation, use of urease, growth in high salt, for preliminary identification of these organisms.

The identification and classification of the Staphylococci includes detailed descriptions of the methodologies for coagulase testing, methicillin resistance testing, and other helpful tests. Identification of the Streptococci includes an understanding of principles of alpha, beta and gamma hemolysis, Lancefield classification, etc and of enterococcal identification including Bile-Esculin, salt tolerance, as well as the genetics of Vancomycin resistance. Other lecture topics include detailed classification and biochemical identification of the gram positive rods, including a discussion of Anthrax and its potential importance in Bioterrorism. Individual lectures are provided covering the clinical importance, classification and identification of the anaerobes, Legionella, Rickettsia, Mycoplasma, Ureaplasma, Ehrlichia, Bartonella, Spirochetes including Lyme disease and Syphilis. Serologic methods of diagnosis are discussed in detail for Syphilis and Lyme disease.

The discussion of antimicrobial susceptibility testing includes methods and principles of disk diffusion, e-test, broth dilution, microtiter broth dilution, time-kill as well as antibiotic synergy. The residents get a substantial understanding of the criteria for the selection of breakpoints for susceptibility and the correlation between different methods. Separate lectures describe the identification and clinical correlation of the mycobacteria including the principles of sputum decontamination, use of Bactec and LJ media, and the application of molecular methods to the identification of tuberculosis and MAI. Identification of the yeasts includes Candida species, and Cryptococci including Cryptococcal serology. Separate lectures are provided for the identification of the filamentous fungi including Aspergillus, Mucorales, agents of Phaeohyphomycosis, Chromomycosis and the dermatophytes. A separate lecture with detailed clinical correlation is provided on the identification of the dimorphic fungi, Coccidioidomycosis, Histoplasmosis and Blastomycosis and includes the use of antigen detection, serologic methods, skin testing, etc.

The virology lecture section includes detailed clinical descriptions and discussion of the serologic, molecular and cultural methodologies for the detection and identification of Epstein Barr Virus, Herpes Simplex Virus I and II, Varicella, HHV-6, and Cytomegalovirus including shell vial technique, CMV antigenemia testing, and quantitative PCR. Respiratory virus identification and detection includes RSV, Influenza A and B, Parainfluenza, Adenovirus and Rhinovirus. Separate lectures are given on the clinical aspects and laboratory diagnosis and management of HIV, and the hepatitis viruses A, B, C, D and G. Detailed discussion of the molecular methodologies for these agents will be given in the Molecular Pathology starting in the summer 2000, but were covered in the Microbiology section previously.