Canadian College of Microbiologists | Collège Canadien des Microbiologistes

Canadian College of Microbiologists

Syllabus for Examination Preparation for Fellows in Clinical Microbiology (FCCM)

This syllabus has been prepared as a study guide for the written and oral components of the FCCM examination. Numerous study topics, practice questions, and references are listed in this document; however, this is not an exhaustive list and any relevant topic in clinical microbiology may be included in the final exam.

The content breakdown of the written exam is: 40 – 50% bacteriology, 15 – 20% virology, 10 – 15% mycology, 10 – 15% parasitology, 10 – 15% other (public health, infection control, immunology, etc.). The oral exam consists of three cases and evaluates six different content areas in each case: 1) Diagnostic systems and interpretation of laboratory data, 2) Laboratory quality control, 3) Hospital infection prevention and control, 4) Laboratory management and regulation, 5) Laboratory biosafety and 6) Public health and epidemiology.

Core Competencies Evaluated in the Examination Process

Scientific and Laboratory Basis of Microbiology

The candidates should be able to:

1. Discuss the various bacterial, viral, fungal, and parasite pathogens in terms of their physiology, genetics, molecular biology, and pathogenesis.
2. Describe the epidemiology of infections caused by these infectious agents.
3. Describe the elements of the immune system that related to microbial defenses, the tests required to evaluate immune function, and be able to differentiate tests of acute infection and immunity.
4. List the significant normal human microflora.
5. Establish a differential diagnosis based on a clinical case presentation.
6. Describe the clinical criteria for the submission of specimens for microbiologic examination.
7. Discuss the procedures relevant to the collection, transport, storage, and processing of clinical specimens (pre-analytical, analytical, post-analytical).
8. Discuss the appropriate methods for the examination of microbiology specimens and for the presumptive and definitive identification of microbial pathogens.
9. Describe the principles and performance details of commonly used and novel assay systems.
10. Describe the nature and activity of antimicrobial agents in general use, their associated toxicities and their mechanisms of resistance. Additionally, candidates should be able to identify the intrinsic resistance patterns for microorganisms with predictable patterns.
11. Discuss the laboratory principles for testing antimicrobial activity.
12. Discuss the empiric management of clinical cases and know the first-line antimicrobial agents recommended for common pathogens.

Quality Management and Biosafety

The candidates should be able to:

1. Discuss quality management principles including quality management systems, assay evaluations of qualitative and quantitative systems (including verification and validation principles and determinations of sensitivity, specificity, positive and negative predictive values, etc.), and staffing practices.
2. Explain quality assurance and quality control principles applicable to each division of the microbiology laboratory.
3. Discuss the 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, usage estimate, and test planning.
5. Interpret the results of the microbiology testing to the clinician.
6. Discuss the laboratory principles of disinfection and sterilization.
7. Discuss WHMIS, biosafety cabinets, universal precautions, and spill clean-up procedures.
8. Describe licensure and accreditation requirements for laboratories.
9. Describe the contents of the Human Pathogens and Toxins Act (HPTA).

Hospital Infection Prevention and 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 risks of and follow-up required for laboratory-acquired infections.
3. Discuss the structure and functions of a hospital infection control program.
4. Describe the infection control isolation procedures appropriate to specific disease entities.
5. Describe an approach to outbreak management, including knowledge of epidemiology, incubation periods, seroprevalence, transmissibility, control measures, and analytical tools.
6. Discuss the principles, performance, and limitations of non-molecular and molecular epidemiological methods.

Public Health and Epidemiology

The candidates should be able to:

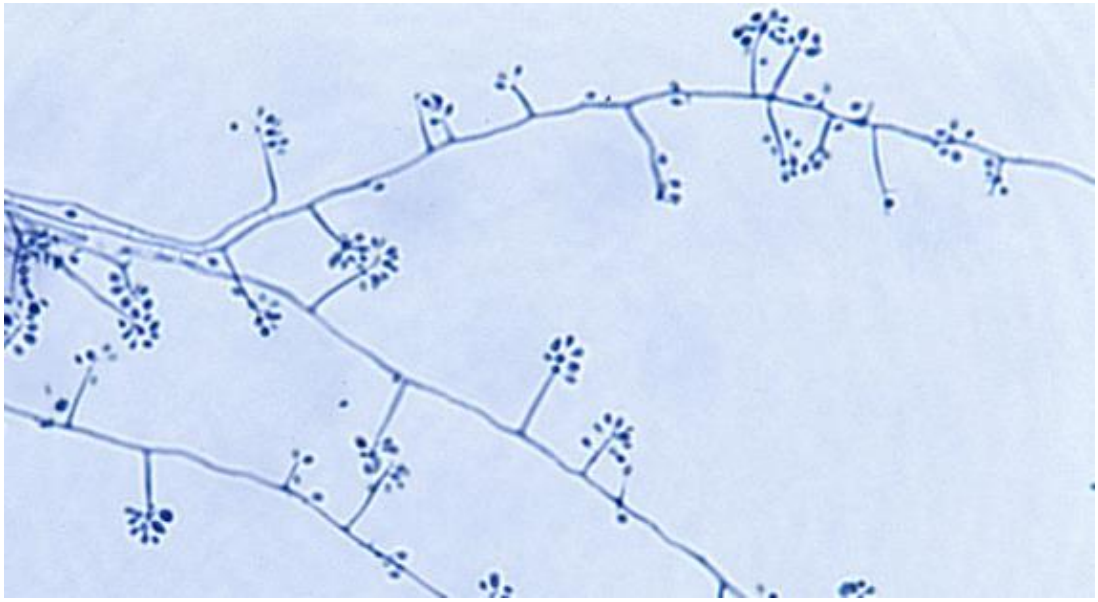
1. Discuss the principles of passive and active immunization in the prevention of infectious diseases.
2. Describe standard vaccines and vaccination programs implemented in Canada.
3. Discuss the public health applications of the information generated by the microbiology laboratory.
4. Describe the rationale used for Reportable/Notifiable disease assignment.

Sample Written Exam Questions

1. A female baby is born at 38.5 weeks gestation with a rash, low birthweight, hepatosplenomegaly, and bilateral cataracts. The infant's presentation is thought to be a result of a maternal infection acquired while the baby was *in utero*. What is the most likely infection to have caused this clinical presentation?

   a) Cytomegalovirus
   b) Group B streptococcus
   c) Rubella virus
   d) *Toxoplasma gondii*
   e) *Treponema pallidum*

2. A slowly developing, ulcerating skin lesion occurs in a horticultural worker and yields on culture a dimorphic fungus but no pathogenic bacteria. Based on the image of the lactophenol prep portrayed below, the causal organism is likely to be:



   a) *Blastomyces dermatitidis*
   b) *Histoplasma capsulatum*
   c) *Coccidioides immitis*
   d) *Sporothrix schenckii*
   e) *Paracoccidioides brasiliensis*

3. Identify the causative agent most likely associated with the clinical clues:
   70 year old with chronic obstructive lung disease, acute onset of cough and fever of 41°C, pulse 90/min, sputum which shows PMNs and mononuclear cells but no bacteria by Gram stain.

   a) *Streptococcus pneumoniae*
   b) *Mycoplasma pneumoniae*
   c) *Haemophilus influenzae*
   d) *Legionella pneumophila*
   e) *Staphylococcus aureus*

4. In population approaches to the control of infectious diseases, the concept of "herd immunity" is important. The concept of herd immunity in the context of prevention of infectious diseases means:

   a) That virtually 100% of the population has been immunized and therefore further transmission of an infectious agent cannot occur.
   b) If a high level of immunization is maintained in the community, ongoing transmission cannot occur and non-immunized individuals are protected by immunization of other members.
   c) Selected geographical areas are targeted for high level immunization without attempting to fully immunize the entire population.
   d) If a large number of members of the population can be immunized, then the adverse effect rate on a proportional basis will be lower.
   e) It is important to allow some naturally occurring infections to ensure adequate numbers within the herd have some immunity.

5. Resistance to ampicillin dependent on a β-lactamase enzyme whose synthesis is directed by a plasmid-borne gene has been observed only in:

   a) *Streptococcus pyogenes*
   b) *Streptococcus agalactiae*
   c) *Brucella melitensis*
   d) *Bordetella pertussis*
   e) *Haemophilus influenzae*

6. Which of the following statements is FALSE:

   a) *Toxocara canis* causes visceral larva migrans in man.
   b) Dog hookworms cause cutaneous larva migrans in man.
   c) *Ascaris lumbricoides* is acquired by ingesting the parasite's eggs.
   d) *Necator americanus* is acquired when larvae penetrate the skin.
   e) Trichinosis is acquired by ingesting infected poultry.

7. The CAMP test:

   a) Requires use of only bovine blood and incubation under anaerobic conditions
   b) Is easily applicable in small laboratories to definitely identify *Streptococcus agalactiae*
   c) Reaction depends on enhancement of *Streptococcus* Group B β-hemolysin by staphylococcal CAMP factor to produce an area of increased hemolysis
   d) Reaction depends on the enhancement of staphylococci β-hemolysin by *Streptococcus* Group B CAMP factor to produce an area of increased hemolysis
   e) Is useful to differentiate *S. aureus* from Group A streptococci

Correct responses: 1) C, 2) D, 3) D, 4) B, 5) E, 6) E, 7) D

Sample Oral Exam Questions

Please note, the oral exam question has been abbreviated but is reflective of the exam process.

Case:

A 20 month old female presents to the emergency department of a large tertiary care hospital. The child appears to be irritable and lethargic. The mother states that the child had woken up in the morning with a fever of 39.5°C. After a dose of children's Tylenol, the fever had abated; however, after lunch, the child began crying and vomited the lunch.
Upon physical exam, the child was noted to have a petechial rash covering her body and a stiff neck.
The family sharing a home with this child consisted of mom, dad, and 2 siblings who attended elementary school. None of the other family members displayed any illness.

Part I: Diagnostic Systems and Interpretation:

Q: What is your differential diagnosis? What specimens should be collected for processing by the microbiology laboratory?

Q: How should CSF be processed in the laboratory? What testing is performed?

Q: What are the appropriate growth conditions for this organism? What biochemical tests are used to identify this organism?

Q: What is the recommended treatment for *N. meningitidis*?

Q: Are penicillin-resistant strains frequently reported and what impact do these strains have on therapeutic options?

Part II: Laboratory QC

Q: What parameters should be monitored as part of the QC program for blood cultures? Please indicate 3 parameters.

Q: Over the past 3 months, the lab has recorded a contamination rate of 8%. What actions should you take to investigate and rectify this issue?

Part III: Infection Control

Q: Invasive *N. meningitidis* cases require which level of infection control precautions and what specific measures are implemented as part of that precaution level?

Q: The casualty officer in the Emergency Department phones you because the Emergency Department staff are concerned about risks. How do you respond? Do the staff require prophylaxis?

Part IV: Laboratory Management and Regulation

Q: What programs and practices are utilized in your laboratory to ensure the quality of the results generated by the technologists?

Q: Knowing that PCR assays for *N. meningitidis* are not standardized in Canada, how would establish an External Proficiency Testing Program for this assay?

Q: Describe the activities to which the Human Pathogens and Toxins Act applies?

Part V: Laboratory Safety

Q: In regards to laboratory safety measures, how should positive blood culture bottles be processed?

Q: Can you please describe the different classes of biological safety cabinets available, indicating their key features?

Part VI: Public Health & Epidemiology

Q: Are all laboratory isolations of *N. meningitidis* reportable in Canada?

Q: What is the epidemiology of invasive meningococcal disease in Canada?

Recommended References

Cases in Medical Microbiology and Infectious Diseases. ASM Press, Washington, D.C.

Cases in Human Parasitology. ASM Press, Washington, D.C.

Control of Communicable Diseases Manual. American Public Health Association Press, Washington, D.C.

Medically Important Fungi: A Guide to Identification. ASM Press, Washington , D.C.

Principles and Practice of Infectious Diseases. Churchill Livingstone Elsevier, Philadelphia, PA.

Manual of Clinical Microbiology. ASM Press, Washington, D.C.

Red Book: Report of the Committee on Infectious Diseases. American Academy of Pediatrics, Elk Grove, Ill.

Cumitechs. ASM Press, Washington, D.C.

Clinical Laboratory Standards Institute documents, including but not limited to:

- M100 Performance Standards for Antimicrobial Susceptibility Testing
- M02 Performance Standards for Antimicrobial Disk Susceptibility Tests
- M07 Methods for Dilution Antimicrobial Susceptibility Tests for Bacteria That Grow Aerobically
- M11 Methods for Antimicrobial Susceptibility Testing of Anaerobic Bacteria
- M45 Methods for Antimicrobial Dilution and Disk Susceptibility Testing of Infrequently Isolated or Fastidious Bacteria
- M24 Susceptibility Testing of Mycobacteria, Nocardiae, and Other Aerobic Actinomycetes
- M27S Reference Method for Broth Dilution Antifungal Susceptibility Testing of Yeasts
- M38 Reference Method for Broth Dilution Antifungal Susceptibility Testing of Filamentous Fungi
- M59 Epidemiological Cutoff Values for Antifungal Susceptibility Testing
- M39 Analysis and Presentation of Cumulative Antimicrobial Susceptibility Test Data
- GP31 Laboratory Instrument Implementation, Verification, and Maintenance
- M52 Verification of Commercial Microbial Identification and Antimicrobial Susceptibility Testing Systems
- M58 Methods for the Identification of Cultured Microorganisms Using Matrix-Assisted Laser Desorption/Ionization Time-of-Flight Mass Spectrometry
- MM03 Molecular Diagnostic Methods for Infectious Diseases
- MM09 Nucleic Acid Sequencing Methods in Diagnostic Laboratory Medicine

Human Pathogens and Toxins Act (HPTA)