

Special virology

1. *Rotavirus*
2. *Enterovirus* *polio-, coxsackie, echo-viruses*
3. *Rhinovirus*
4. *Coronavirus*
5. *Hepatovirus* *HAV*
6. Arboviruses (overview – TBEV, dengue, WNV, yellow fever)
7. *Rubivirus* *Rubeola*
8. *Flavivirus* (especially TBEV, add yellow fever basic info) - overview
9. *Hepacivirus* *HCV*
10. HIV
11. *Respirovirus* *Parainfluenza* a *Rubulavirus* *Mumps*
12. *Morbillivirus*
13. *Pneumovirus* *RSV*
14. *Lyssavirus* *Rabies*
15. Influenzaviruses (especially A)
16. *Erythrovirus* *Parvovirus B-19*
17. *Papillomavirus* *HPV*
18. *Mastadenovirus* *Adenovirus*
19. *Simplexvirus* *HSV*
20. *Varicellovirus* *VZV* a *Orthopoxvirus*(smallpox)
21. *Cytomegalovirus* *CMV*
22. *Roseolovirus* *HHV-6*
23. *Lymphocryptovirus* *EBV*
24. *Orthohepadnavirus* *HBV*
25. Prions

Dear students, below you can find "a basic survival kit" for medical microbiology (and immunology) downloaded from www.studentconsult.com. The list is of course incomplete, but it might be useful as a starter for your exam preparation. Hope this helps.

Best regards,
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Medical Microbiology

The usual suspects

- Upper respiratory infections:
 - Pharyngitis/rhinitis:
 - Bacterial: *S. pyogenes*
 - Viral: Coronavirus, rhinovirus, adenovirus
 - Epiglottitis:

- Bacterial: *H. influenzae* (type B)
- Otitis externa:
 - Bacterial: *P. aeruginosa*
- Otitis media:
 - Bacterial: *S. pneumoniae*, *H. influenzae* (type B), *S. agalactiae* (in neonates), *Moraxella catarrhalis*
- Sinusitis:
 - Bacterial: *S. pneumoniae*, *H. influenzae* (type B), *Moraxella catarrhalis*
- Lower respiratory infections:
 - Community acquired pneumonia (CAP):
 - Bacterial: *M. pneumoniae*, *S. pneumoniae*, *H. influenzae*, *C. pneumoniae*, *L. pneumophila*, *M. catarrhalis*, *S. aureus*, *M. tuberculosis*, *C. psittaci*.
 - Viral: Influenza virus, respiratory syncytial virus (RSV)
 - Fungal: *C. immitis*, *H. capsulatum*, *B. dermatitidis*
 - Atypical pneumonia:
 - Bacterial: *M. pneumoniae*, *L. pneumophila*, *C. pneumoniae*.
 - Viral: Many causes, influenza,
 - Immunocompromised lung infections:
 - Bacterial: *M. tuberculosis*, *Nocardia*, *Actinomyces*, *Klebsiella*, *Pseudomonas*
 - Fungal: *Pneumocystis carinii* (prominent in HIV/AIDS)
 - Viral: Cytomegalovirus
- Urinary tract infections (UTI):
 - Uncomplicated UTI:
 - Bacterial: *E. coli*, *S. saprophyticus*
 - Complicated UTI:
 - Bacterial: *E. coli*, *E. faecalis*, *P. aeruginosa*, *P. mirabilis*, *K. pneumoniae*
 - Glomerulonephritis:
 - Bacterial: *S. pyogenes*-postinfectious sequelae or non-suppurative
 - Sexually transmitted infections:
 - Bacterial: *N. gonorrhoeae*, *C. trachomatis*, *Treponema pallidum*
 - Viral: Human papilloma virus (genital warts)
 - Parasitic: *Trichomonas vaginalis*
 - Pelvic inflammatory disease:
 - Bacterial: *N. gonorrhoeae*, *C. trachomatis*
- Skin and bone infections:
 - Cellulitis:
 - Bacterial: *S. pyogenes*, *P. aeruginosa*, *S. aureus*, *P. multocida* (animal bites)
 - Necrotizing fasciitis:
 - Bacterial: *S. pyogenes*, *C. perfringens*
 - Osteomyelitis:
 - Bacterial: *S. aureus*, *S. typhi* (sickle-cell patients), *P. multocida* (animal bites), *S. pyogenes*
 - Septic arthritis:
 - Bacterial: *N. gonorrhoeae* (if sexually active), *S. aureus*, *H. influenzae*
- Infectious diarrhea:
 - Watery diarrhea:
 - Bacterial: *V. cholerae*, *E. coli* (ETEC)
 - Viral: Rotavirus (especially in neonates), Norwalk virus
 - Parasitic: *Giardia*, *Cryptosporidium*
 - Bloody diarrhea:
 - Bacterial: *Salmonella*, *Shigella*, *C. jejuni*, *E. coli* (EHEC/EIEC), *Y. enterocolitica*
 - Parasitic: *Entamoeba histolytica*
- Cardiovascular infections:
 - Septic shock:
 - Bacterial: *E. coli*, *S. pyogenes*, *S. agalactiae* (neonates)
 - Native valves:
 - Bacterial: *S. mutans*, *S. intermedius*, *S. bovis*, *S. pyogenes* (non-suppurative, rheumatic fever), *E. faecalis*, *S. aureus* (IV drug users)
 - Prosthetic valves:
 - Bacterial: *S. epidermis* (acute); *S. mutans* (subacute), *S. intermedius* (subacute)

- Myocarditis:
 - Bacterial: *S. aureus*, *E. faecalis*, *C. diphtheriae*
 - Viral: Coxsackievirus type B
 - Protozoan: *T. cruzi*
- Nervous system infections:
 - Meningitis/encephalitis
 - Bacterial:
 - Neonatal: *S. agalactiae*, *L. monocytogenes*, *E. coli*
 - <6 years: *S. pneumoniae*, *N. meningitidis*, *H. influenzae* (type B) (in non-immunized)
 - Adult (6-60): *N. meningitidis*, *S. pneumoniae*
 - Aseptic:
 - Coxsackievirus, echovirus, mumps virus, poliovirus, arboviruses (EEE, West Nile, SLE, WEE, California, Japanese)
 - Fungal:
 - C. neoformans*

Bacteria

- Bacteria are first divided according to characteristics of their cell wall-gram positive, gram negative, and non-gram-staining.
 - Characteristics of gram-positive bacteria: stain color - purple; cell-wall peptidoglycan layer - thick; unique cell wall component - teichoic acid.
 - Characteristics of gram-negative bacteria: stain color - pink; cell-wall peptidoglycan layer - thin; unique cell wall component - endotoxin (lipopolysaccharide).
 - Characteristics of non-gram-staining bacteria: stain color: none; cell-wall peptidoglycan layer - variable; unique cell wall component - variable.
- Bacteria are also divided based on morphological features seen on microscopic examination. There are three major morphologies:
 - Cocci: round; can be arranged in clusters, chains, or pairs.
 - Bacilli (rods): rod shape.
 - Pleomorphic: variable shape.
- Bacteria can also be differentiated based on their need/affinity for oxygen. There are obligate aerobes (*P. aeruginosa*, *M. tuberculosis*, *Nocardia*, *bacilli*). There are obligate anaerobes (eg. *Clostridium*, *Bacteroides*, *Actinomyces*). Other bacteria have varying levels of tolerance for oxygen based on the presence of enzymes (catalase and superoxide dismutase) that protect them from oxidative damage.
- There are two primary methods by which bacteria attack the human body-endotoxin and exotoxin.
 - Characteristics of endotoxin: present primarily in the cell wall of gram-negative bacteria (*Lysteria monocytogenesis* the most important example of a *gram-positive* bacteria with endotoxin). Only toxic at high levels; results in fever and shock.
 - Characteristics of exotoxin: secreted by certain species of gram-positive and gram-negative bacteria. Toxic at low levels. Variable clinical effects (examples include botulism, tetanus, and anthrax).
- Endotoxin results in fever in the body by stimulating the release of IL-1 and TNF (pyrogens). Shock results from the release of NO and the activation of the complement cascade.
- Bacteria use various methods to increase their ability to infect humans. These methods include:
 - Capsule: the capsule is primary composed of polysaccharide (except *B. anthracis*, which is composed of D-glutamate). The capsule prevents phagocytosis by human macrophages and neutrophils.
 - Pilus/fimbria: pili and fimbriae help bacteria attach to cell surfaces (nasal mucosa, urethral epithelium, etc).
 - Spore: the spore form of some bacteria can survive heat, desiccation, and chemical exposure.
 - Flagellum: the flagellum gives the bacterium motility.

Viruses

- Viruses are organized based on the characteristics of their genetic material. They are first divided between **DNA and RNA**. They are further divided based on the presence of an **envelope**

(enveloped vs. naked); the structure of the genetic material (single stranded vs. double stranded, linear vs. circular); and the geometric structure of the capsid (icosahedral vs. helical).

- Viruses must infect a host cell to replicate. There are two cycles of viral replication-lytic and lysogenic. In the lytic cycle, the virus infects, replicates, and subsequently bursts the host cell to release the new viruses. In the lysogenic cycle, the virus infects and incorporates into the host cell's DNA; at that point the virus may lay dormant, express slowly, or progress to the lytic cycle.
- Vaccinations play an important role in virus preventions. Vaccines stimulate the immune system to 'be prepared' in the event of an infection by a certain virus. There are three types of vaccines: 1) Live attenuated vaccines are weakened fractions of the actual virus. They stimulate cell-mediated and humoral immunity and include the measles, mumps, rubella, Sabin polio, and varicella vaccinations. 2) Killed vaccines are (aptly named) dead and non-infective. They induce only humoral immunity and include the influenza, hepatitis A, and Salk polio vaccines. 3) In subunit vaccines. part of the organism is used as the immunogenic component. There are several types: a) toxoids - inactivated toxins (tetanus vaccine); b) polysaccharide or conjugate vaccines - composed of capsular material with or without an immunogenic protein coupled to it (HiB vaccine); c) recombinant subunit - recombinant engineered protein used at the immunogen (hepatitis surface Ag B is what constitutes the HBV vaccine).
- Hepatitis is an important viral illness. There are five important hepatitis-causing viruses: A, B, C, D, and E. The characteristics of each are as follows:
 - Hepatitis A: RNA picornavirus. Transmitted by the fecal-oral route. Usually asymptomatic. No chronic or carrier state.
 - Hepatitis B: DNA hepadnavirus. Transmitted parenterally and sexually. Can be acute, chronic, or carrier state.
 - Hepatitis C: RNA flavivirus. Transmitted parenterally and sexually. Most commonly chronic.
 - Hepatitis D: Defective virus. Transmitted parenterally and sexually. Cannot be expressed without concurrent HBV infection.
 - Hepatitis E: RNA calicivirus. Transmitted by the fecal-oral route. Usually acute. No carrier state. Can be fatal in pregnant women.

Fungi

- Several fungi are endemic in specific geographical areas. Fungal infections are often asymptomatic, but they can be clinically significant, especially in immunocompromised patients. Common fungi include:
 - Histoplasmosis: endemic to the Mississippi and Ohio River valleys (US).
 - Coccidioidomycosis: endemic to the Southwestern US.
 - Blastomycosis: endemic east of the Mississippi River and in Central America.
 - Paracoccidioidomycosis: endemic to Latin America.
- Opportunistic fungal infections are common in immunocompromised patients (HIV, corticosteroid therapy, chemotherapy). Common pathogens include:
 - Candida albicans*: can cause oral thrush or systemic infection.
 - Pneumocystis carinii*: common cause of pneumonia.
 - Cryptococcus neoformans*: can cause meningitis.

Parasites

- Parasites include protozoa and helminths (worms).
- Clinically significant protozoa:
 - Entamoeba histolytica*: can cause dysentery and liver abscesses.
 - Giardia lamblia*: causes watery diarrhea. Common in the wilderness.
 - Cryptosporidium*: causes watery diarrhea. Causes severe diarrhea in AIDS patients.
 - Plasmodium*: causes malaria.
 - Trichomonas vaginalis*: common cause of vaginitis. Foul-smelling.
- There are three classes of helminths:
 - Cestodes (tapeworms)
 - Trematodes (flukes)
 - Nematodes (roundworms)

Immunology

- There are two types of T cells. Tc cells (cytotoxic cells) are the executors of the cell-mediated arm of the acquired immune system. Th cells (helper cells) are the coordinators of the acquired immune system. They decide whether to attack an invader with a predominantly cell-mediated or humoral (antibody-mediated) attack.
- There are two types of T-helper cells: Th1 cells stimulate the cell-mediated arm of the acquired immune system by secreting IL-2 and λ -interferon, which stimulate the action of macrophages and Tc cells. Th2 cells stimulate the humoral (antibody-mediated) arm of the acquired immune system by secreting IL-4 and IL-5, which stimulate B cells to make antibodies.
- There are two types of major histocompatibility complexes (MHC). These complexes are responsible for presenting antigens to Th cells and allowing the immune system to identify 'self'.
 - MHC I are present on all nucleated cells in the body. They present antigens (from the RER) from all translated proteins in the cell. The antigens are present on the cell surface and help identify cells that are infected with viruses. Tc cells bind to MHC I antigens and destroy infected cells.
 - MHC II are present on the surface of antigen-presenting cells (macrophages and dendritic cells). They present antigens from ingested (phagocytosed) bacteria and viral particles. Th cells bind to MHC II antigens and induce a cell-mediated or humoral response.
- There are five major types of immunoglobulins (antibodies) produced by the humoral immune system.
 - IgM: The first antibody produced in response to an antigen. Fixes complement. Does not cross the placenta.
 - IgG: The primary antibody in the secondary response (second-exposure). Opsonizes (coats) bacteria, fixes complement, thereby destroying the bacteria. Crosses the placenta.
 - IgA: Found in mucosal secretions (upper respiratory tract, genitourinary tract). Engages pathogens outside the body. Aggregated form activates the alternative pathway of complement activation only.
 - IgE: Mediates Type I hypersensitivity reaction by binding to antigens and the surface of mast cells and basophils, stimulating the release of histamine. Levels often elevated in helminth infections.
 - IgD: Membrane IgD is part of the functional B cell receptor on mature B cells.
- There are several disorders of the immune system—both deficiencies and hypersensitivity reactions (autoimmune disease):
 - Antibody mediated: Systemic lupus erythematosus, polyarteritis nodosa, poststreptococcal glomerulonephritis, serum sickness
 - T-cell mediated: Type I diabetes mellitus, rheumatoid arthritis, MS, peripheral neuritis
- There are four types of hypersensitivity reactions:
 - Type I hypersensitivity reaction: This reaction, which results from IgE-mediated release of inflammatory molecules such as histamine from mast cells and basophils, can manifest as an asthma attack, a local wheal-and-flare, or anaphylaxis.
 - Type 2 hypersensitivity reaction: This reaction, which is antibody and complement mediated, is cytotoxic in nature and occurs in autoimmune hemolytic anemia, Graves' disease, and myasthenia gravis.
 - Type 3 hypersensitivity reaction: This reaction, which is caused by immune complex deposition and subsequent complement activation, may be a complication of IV administration of antigenic medications (penicillin).
 - Type 4 (delayed-type) hypersensitivity reaction: This reaction, which is cell mediated, results in a delayed (24 to 48 hour) response. It is mediated by T cells. Examples include transplant rejection, TB skin test, and contact dermatitis (poison ivy).