

MICROBIOLOGY – EXAM QUESTIONS

1. MICROSCOPY

1. Describe a principle of Gram stain.
2. Give an examples and principles of other stain methods used in microbiology.
3. Which of the following organisms have mycolic acids in their cell walls:
Staphylococcus, *Nocardia*, *Mycobacterium*, and *Klebsiella*?

2. BACTERIAL CELL

1. The structure of bacterial cells, the shape and size of bacteria
2. Basic genetics of bacteria.
3. What are the principal properties of a plasmid?

3. BACTERIAL CELL WALL

1. Describe bacterial cell wall
2. Which antibiotics affects peptidoglycan synthesis?

4. THE OUTER STRUCTURES OF BACTERIA

1. Name and describe the outer structures of bacteria.
2. Give an examples of motile species.
3. What is the difference between capsule and glycocalyx? Give an examples of encapsulated bacteria.

5. TOXINS

1. Endotoxin, exotoxin superantigens. What is the difference between them?
2. Give an examples of diseases primarily caused by effect of toxin.
3. Briefly explain mechanism of action of toxins.

6. VIRUS – STRUCTURE AND LIVING CYCLE

1. Describe the structure and classification of viruses
2. What is the difference in growth cycle between RNA and DNA viruses?

7. VIRUS AND HOST ORGANISM

1. The course of infection in macroorganism, types of infection.
2. Describe a methods for detection of viral infections.

8. FUNGI

1. How do fungi differ from bacteria (size, nucleus, cytosol, plasma membrane, cell wall, physiology, generation time)?
2. What is the difference between a yeast and a mould?
3. Fungi of medical importance.

9. PARASITES

1. Taxonomy and classification of parasites.
2. Which methods are used for detection and identification of parasites?
3. Arthropods of medical importance

10. PATHOGENICITY

1. What is the distinction between colonization and disease?
2. Which mechanisms of virulence you know?
3. Give examples of strict pathogens and opportunistic pathogens.

11. ANTIBIOTICS

1. Describe the mechanism of action of antibiotics.
2. Name the three mechanisms bacteria use to become resistant to β -lactam antibiotics.
3. What is the mechanism responsible for oxacillin resistance in *Staphylococcus*? Cefotaxime resistance in *Escherichia*? Penicillin resistance in *Str. pneumoniae*?

12. MICROBIOLOGY DIAGNOSTICS

1. What is the most important factor that influences the recovery of microorganisms in blood collected from patients with sepsis?
2. What types of cultivation media do you know? Give examples of media and their application.
3. What criteria should be used to assess the quality of a lower respiratory tract specimen?
4. What methods are used to detect the three most common bacteria that cause sexually transmitted diseases?

13. CASE STUDY

An 18-year-old man fell on his knee while playing basketball. The knee was swollen and remained painful the next day, so he was taken to the local emergency department. Clear fluid was aspirated from the knee, and the physician prescribed symptomatic treatment. Two days later, the swelling returned, the pain increased, and erythema developed over the knee. Because the patient also felt systemically ill and had an oral temperature of 38.8°C, he returned to the emergency department. Aspiration of the knee yielded cloudy fluid, and cultures of the fluid and blood were positive for *Staphylococcus aureus*.

1. Name two possible sources of this organism.
2. Staphylococci cause a variety of diseases, including cutaneous infections, endocarditis, food poisoning, SSSS, and TSS. How do the clinical symptoms of these diseases differ from the infection in this patient? Which of these diseases are intoxications?
3. What toxins have been implicated in staphylococcal diseases? Which staphylococcal enzymes have been proposed as virulence factors?
4. Which structures in the staphylococcal cell and which toxins protect the bacterium from phagocytosis?
5. What is the antibiotic of choice for treating staphylococcal infections?

14. CASE STUDY

A 62-year-old man with a history of chronic obstructive pulmonary disease (COPD) came to the emergency department because of a fever of 40 °C, chills, nausea, vomiting, and hypotension. The patient also produced tenacious, yellowish sputum that had increased in quantity over the preceding 3 days. His respiratory rate was 18 breaths/min, and his blood pressure was 94/52 mmHg. Chest radiographic examination showed extensive infiltrates in the left lower lung that involved both the lower lobe and the lingula. Multiple blood cultures and culture of the sputum yielded *Streptococcus pneumoniae*.

1. What predisposing condition made this patient more susceptible to pneumonia and bacteremia caused by *S. pneumoniae*? What other populations of patients are susceptible to these infections? What other infections does this organism cause, and what populations are most susceptible?
2. What infections are caused by *S. pyogenes*, *S. agalactiae*, and viridans streptococci?
3. What are the major virulence factors of *S. pneumoniae*, and *S. pyogenes*?
4. Which two nonsuppurative diseases can develop after localized *S. pyogenes* disease?
5. What is the antibiotic of choice for treating pneumococcal infections?
6. Is there a specific prevention of pneumococcal infections?

15. CASE STUDY

A 35-year-old man with a history of intravenous drug use entered the local health clinic with complaints of a dry, persistent cough; fever; malaise; and anorexia. Over the preceding 4 weeks, he had lost 15 pounds and experienced chills and sweats. A chest radiograph revealed patchy infiltrates throughout the lung fields. Because the patient had a nonproductive cough, sputum was induced and submitted for bacterial, fungal, and mycobacterial cultures. Blood cultures and serologic tests for HIV infection were performed. The patient was found to be HIV

positive. The results of all cultures were negative after 2 days of incubation; however, cultures were positive for *M. tuberculosis* after four weeks of incubation.

1. What is unique about the cell wall of mycobacteria, and what biologic effects can be attributed to the cell wall structure?
2. Which methods are used to diagnose TBC?
3. Why is *Mycobacterium tuberculosis* more virulent in patients with HIV infection than in nonHIV-infected patients?
4. Which antitubercotics are used for therapy and why do mycobacterial infections have to be treated with multiple drugs for 6 months or more?
5. Is there a specific prevention of TBC?

16. CASE STUDY

A 22-year-old female schoolteacher was brought to the emergency room after a 2-day history of headache and fever. On the day of admission the patient was confused and highly agitated. Purpuric skin lesions were present on her trunk and arms. Gram stain of CSF showed many gram-negative diplococci, and the same organisms were isolated from blood and CSF.

1. What is the most likely organism responsible for this fulminant disease?
2. Describe the cultivation conditions necessary for the identification of this species.
3. What is the epidemiology of this disease?
4. Which treatment (antibiotic) should be administered?
5. What virulence factors have been associated with this species?
6. Is there any prophylaxis available?

17. CASE STUDY

A 25-year-old, previously healthy woman came to the emergency room for the evaluation of bloody diarrhea and diffuse abdominal pain of 24 hours' duration. She complained of nausea and had vomited twice. She reported no history of inflammatory bowel disease, previous diarrhea, or contact with other people with diarrhea. The symptoms began 24 hours after she had eaten an undercooked hamburger at a local fast food restaurant. Rectal examination revealed watery stool with gross blood. Sigmoidoscopy showed diffuse mucosal erythema and petechiae with a modest exudation but no ulceration or pseudomembranes.

1. Name four genera of *Enterobacterales* (previously *Enterobacteriaceae*) that can cause gastrointestinal disease. Name two genera that can cause hemorrhagic colitis.
2. What virulence factor mediates this disease?
3. Name the five groups of *Escherichia coli* that can cause gastroenteritis. What is characteristic of each group of organisms?
4. Differentiate between disease caused by *S. Typhi* and that caused by *Shigella*.
5. Describe the epidemiology of the two forms of disease caused by *Yersinia pestis*.

18. CASE STUDY

A 57-year-old man was hospitalized in New York with a 2-day history of severe, watery diarrhea. The illness had begun 1 day after his return from Ecuador. The patient was dehydrated and suffering from an electrolyte imbalance (acidosis, hypokalemia). The patient made an uneventful recovery after fluid and electrolyte replacement was instituted to

compensate for the losses resulting from the watery diarrhea. Stool cultures were positive for *Vibrio cholerae*.

1. What are the characteristic clinical symptoms of cholera?
2. What is the most important virulence factor in this disease? What other virulence factors have been described? What are the modes of their action?
3. How did this patient acquire this infection? How does this situation differ from the acquisition of infections caused by *V. parahaemolyticus* or *V. vulnificus*?
4. How can cholera be controlled in areas where infection is endemic?

19. CASE STUDY

A mother and her 4-year-old son came to the local emergency room with a 1-day history of diarrhea and abdominal cramping. Both patients had low-grade fevers, and blood was grossly evident in the child's stool specimen. The symptoms had developed 18 hours after the patients had consumed a dinner consisting of mixed green salad, chicken, corn, bread, and apple pie. *Campylobacter jejuni* was isolated from stool specimens of both the mother and the child.

1. Which food that they consumed is most likely responsible for these infections? What measures should be used to prevent these infections?
2. Name three *Campylobacter* species that have been associated with gastroenteritis. Name the species of *Campylobacter* that is most commonly associated with septicemia.
3. What is the mechanism of pathogenicity of *Campylobacter jejuni*?
4. What diseases have been associated with *Helicobacter pylori*, how do we prove *Helicobacter* infection?

20. CASE STUDY

The patient with craniocerebral injury was long-term hospitalized in the ICU. The patient was repeatedly treated with antibiotics. Artificial lung ventilation had to be initiated because of deterioration of respiratory parameters. The patient was febrile, and purulent secretion was aspirated from endotracheal tube. In endotracheal aspirate, *Pseudomonas aeruginosa* was cultivated.

1. What factors put this man at increased risk for infection with *P. aeruginosa*?
2. What virulence factors possessed by the organism make it a particularly serious pathogen? What are the biologic effects of these factors?
3. What is the epidemiology of *P. aeruginosa*? Give examples of other infections it causes.
4. What three mechanisms are responsible for the antibiotic resistance found in *P. aeruginosa*?
5. What diseases are caused by *B. cepacia* complex? *S. maltophilia*? *A. baumannii*? *M. catarrhalis*? List the basic characteristics of these bacteria, including susceptibility to antibiotics.

21. CASE STUDY

A 78-year-old man confined to a nursing home awoke with a severe headache and stiff neck. Because he had a high fever and signs of meningitis, the nursing home staff took him to a local

emergency department. The CSF specimen was cloudy. Analysis revealed 400 white blood cells per mm³ (95% polymorphonuclear neutrophils), a protein concentration of 75 mg/dl, and a glucose concentration of 20 mg/dl. Small gram-negative rods were seen on Gram stain of the CSF, and cultures of CSF and blood were positive for *Haemophilus influenzae*.

1. Discuss the epidemiology of *H. influenzae* meningitis, and compare it with the epidemiology of meningitis caused by *Streptococcus pneumoniae* and by *Neisseria meningitidis*.
2. Compare the biology of the *H. influenzae* strain that is likely to be the cause of this patient's disease with that of the strains that historically caused pediatric diseases (prior to vaccination).
3. What other diseases does this organism cause? What other *Haemophilus* species cause disease, and what are the diseases?
4. Why is chocolate agar needed for the isolation of *Haemophilus* organisms?

22. CASE STUDY

A 5-year-old girl was brought to the local public health clinic because of a severe, intractable cough. During the previous 10 days, she had a persistent cold that had worsened. The cough developed the previous day and was so severe that vomiting frequently followed it. The child appeared exhausted from the coughing episodes. A blood cell count showed a marked leukocytosis with a predominance of lymphocytes. The examining physician suspected that the child had pertussis.

1. What laboratory tests can be performed to confirm the physician's clinical diagnosis? What specimens should be collected, and how should they be submitted to the laboratory?
2. What virulence factors are produced by *B. pertussis*, and what are their biologic effects?
3. What is the natural progression and prognosis for this disease? Who is most at risk of this disease?
4. How can it be prevented?

23. CASE STUDY

A 73-year-old man was admitted to the hospital because of breathing difficulties, chest pain, chills, and fever of several days' duration. He had been well until 1 week before admission, when he noted the onset of a persistent headache and a productive cough. The patient smoked two packs of cigarettes a day for more than 50 years and drank a six-pack of beer daily; he also had a history of bronchitis. Physical examination results revealed an elderly man in severe respiratory distress with a temperature of 39 °C, pulse of 120 beats/minute, respiratory rate of 36 breaths/minute, and blood pressure of 145 / 95 mm Hg. Chest radiograph revealed an infiltrate in the middle and lower lobes of the right lung. The white blood cell count was 14,000 cells/mm³ (80% polymorphonuclear neutrophils). Gram stain of the sputum showed neutrophils but no bacteria, and routine bacterial cultures of sputum and blood were negative for organisms. Infection with *Legionella pneumophila* was suspected.

1. What laboratory tests can be used to confirm this diagnosis? Why were the routine culture and Gram-stained specimen negative for *Legionella* organisms?

2. How are *Legionella* species able to survive phagocytosis by the alveolar macrophages?
3. What environmental factors are implicated in the spread of *Legionella* infections? How can this risk be eliminated or minimized?
4. Which antibiotics are used for treatment?

24. CASE STUDY

A 61-year-old woman with left-sided face pain came to the emergency department of a local hospital. She was unable to open her mouth because of facial muscle spasms and had been unable to eat for 4 days because of severe pain in her jaw. Her attending physician had noted trismus and risus sardonicus. The patient reported that 1 week before presentation, she had incurred a puncture wound to her toe while walking in her garden. She had cleaned the wound and removed small pieces of wood from it, but she had not sought medical attention. Although she had received tetanus immunizations as a child, she had not had a booster vaccination since she was 15 years old. The presumptive diagnosis of tetanus was made.

1. How should this diagnosis be confirmed?
2. What is the recommended procedure for treating this patient? Should management wait until the laboratory results are available? What is the long-term prognosis for this patient?
3. Compare the mode of action of the toxins produced by *C. tetani* and *C. botulinum*.
4. What virulence factors are produced by *C. perfringens*?
4. *C. perfringens* causes what diseases?
5. *C. difficile* causes what diseases? Why is it difficult to manage infections caused by this organism?

25. CASE STUDY

A 65-year-old man entered the emergency department of a local hospital. He appeared to be acutely ill, with abdominal tenderness and a temperature of 40°C. The patient was taken to surgery because appendicitis was suspected. A ruptured appendix surrounded by approximately 20 ml of foul-smelling pus was found at laparotomy. The pus was drained and submitted for aerobic and anaerobic bacterial culture analysis. Postoperatively, the patient was started on antibiotic therapy. Gram stain of the specimen revealed a polymicrobial mixture of organisms, and culture was positive for *Bacteroides fragilis*, *Escherichia coli*, and *Enterococcus faecalis*.

1. Which organism or organisms are responsible for causing the abscess formation? What virulence factors are responsible for causing abscess formation?
2. *B. fragilis* causes infections at what other body sites?
3. What antibiotics should be selected to manage this polymicrobial infection?
4. Which enterobacteria can mimic appendicitis and why?
5. What other anaerobic gram-negative rods are important causes of human disease?

26. CASE STUDY

An 18-year-old woman complained of knee pain that started 2 weeks previously. Three months earlier, soon after vacationing in Connecticut, she noticed a circular area of redness on her lower leg; it was approximately 10 cm in diameter. During the next 2 weeks, the area enlarged

and the border became more clearly demarcated; however, the rash gradually disappeared. A few days after the rash disappeared, the woman experienced the onset of headaches, an inability to concentrate, and nausea. These symptoms also gradually abated. The pain in her knee developed approximately 1 month after these symptoms disappeared. On examination of the knee, mild tenderness and pain were elicited. A small amount of serous fluid was aspirated from the joint, and it had an elevated white blood cell count. Antibodies to *Borrelia burgdorferi* were present in the patient's serum (titers of 1:32 and 1:1024 for IgM and IgG, respectively), the results have been confirmed by Western blotting.

1. What are the initial and late manifestations of Lyme disease?
2. What are the limitations of the following diagnostic tests for Lyme disease: microscopy, culture, and serology? How do these compare with the diagnostic tests for other relapsing fevers?
3. Name two examples each of nontreponemal and treponemal tests for syphilis. What reactions to those tests would you expect in patients with primary, secondary, and late syphilis?
4. What are the reservoir and vectors for syphilis, epidemic and endemic relapsing fever, Lyme disease, and leptospirosis?
5. What diagnostic tests can be used for the diagnosis of leptospirosis?

27. CASE STUDY

Increased lethargy, headache, cough, a low-grade fever, and chills and sweats at night developed in a 21-year-old university student. When she was seen at the student health center, she had a nonproductive cough and shortness of breath on exertion. Her pulse rate was 95 beats/min, and her respiratory rate was 28 breaths/min. Her pharynx was erythematous; scattered rhonchi and rales but no consolidation were noted on auscultation. Results of a chest radiograph showed patchy infiltrates. A Gram stain of sputum revealed many white blood cells but no organisms. The antibody titer for a *Mycoplasma* complement fixation test performed on a specimen collected at admission was 1:8; the titer for a specimen collected a week later was 1:32.

1. How do *Mycoplasma* species differ from other bacteria?
2. Describe the epidemiology of *M. pneumoniae* infections. What aspects of this case are characteristic of such infections?
3. What other mycoplasmas cause human disease? What diseases do they cause?
4. What antibiotics are recommended in the treatment of mycoplasma pneumonia?

28. CASE STUDY

A 22-year-old man came to the emergency department with a history of urethral pain and purulent discharge that developed after he had sexual contact with a prostitute. Gram stain of the discharge revealed abundant gram-negative diplococci resembling *Neisseria gonorrhoeae*. The patient was treated with ceftriaxon and sent home. Two days later, the patient returned to the emergency room with a complaint of persistent, watery urethral discharge. Abundant white blood cells but no organisms were observed on Gram stain of the discharge. Culture of the discharge was negative for *N. gonorrhoeae* but PCR was positive for *C. trachomatis*.

1. Why is ceftriaxon ineffective against *Chlamydia*? What antibiotic can be used to treat this patient?

2. Describe the growth cycle of *Chlamydia*. What structural features make the EBs and RBs well suited for their environment?
3. What are the possible complications of gonorrhea and urogenital chlamydia infection?
4. Describe the differences among the three species in the family *Chlamydiaceae* that cause human disease.
5. *C. trachomatis*, *C. pneumoniae*, and *C. psittaci* each cause respiratory tract infections. Describe the patient population most commonly infected and the epidemiology of these infections.

29. CASE STUDY

A 68-year-old man comes to the dermatology clinic with a painful skin ulcer in the area of the left lower leg. A smear from the defect was performed on the day of admission. In the laboratory examinations, a slight elevation of CRP was found, leukocytes were normal. The patient is partially immobile, lives in the household with a dog. Culture showed a massive presence of gram-positive club-shaped rods, the bacterium was identified by MALDI-TOF MS as *Corynebacterium ulcerans*.

1. What other tests should be performed if this bacteria is found?
2. What was the likely source of infection in the patient?
3. Describe the clinical symptoms of other forms of diphtheria.
4. What is the main virulence factor of *C. diphtheriae*? What is the mechanism of its action?
5. How do we treat the disease and can the disease be prevented?

30. CASE STUDY

The patient, a 40-year-old man with diabetes and hypertension, is undergoing dialysis for renal failure. During dialysis he developed fever and chills. Two months prior to this episode, he had been treated with ampicillin and gentamicin for group B streptococcal endocarditis. Ampicillin- and gentamicin-resistant *Enterococcus faecium* was isolated from blood cultures obtained during hemodialysis. Echocardiography showed vegetations on the mitral and tricuspid valves.

1. What risk factors contributed to the disease caused by this bacterium?
2. What other species of enterococci caused human infections?
3. What was the likely source of infection?
4. Name other agents that are associated with endocarditis.
5. Which antibiotics can be used to treat this patient?

31. CASE STUDY

A 73-year-old man with refractory rheumatoid arthritis was brought to a local hospital by his family because he had impaired consciousness and a three-day history of headache, nausea, and vomiting. At the time, he was taking infliximab, methotrexate, and prednisone to treat rheumatoid arthritis. On physical examination, the patient had a stiff neck and was febrile, with a pulse of 92 bpm and a blood pressure of 179/72 mm Hg. Because meningitis was suspected, blood and cerebrospinal fluid (CSF) were collected for culture. Gram stain of cerebrospinal fluid was negative, but both blood and cerebrospinal fluid showed *Listeria monocytogenes*.

1. What is the mechanism of pathogenesis of *Listeria monocytogenes*?

2. What antibiotics do we use in therapy? Is this bacteria primarily resistant to any antibiotics?
3. Which patients are most susceptible to listeria infections and how are these infections acquired?
4. Which other gram-positive pleomorphic rods cause localized skin infections in humans?

32. CASE STUDY

A 27-year-old man came to the hospital with persistent fever and shortness of breath. During the following week, he developed severe substernal chest pain and a pericardial friction murmur. Echocardiography revealed a small effusion. Due to the patient's age and the suspicion of an opportunistic infection, the patient was tested for HIV. This infection was confirmed, it was even determined that it was already a developed AIDS disease. The patient left the hospital against the doctor's advice, but returned a week later with a persistent cough, fever, and pain in the chest and left arm. A diagnostic-therapeutic pericardiocentesis was performed and 220 ml of fluid was aspirated. Tuberculous pericarditis was suspected and appropriate antimycobacterial treatment (a combination of isoniazid, rifampicin, pyrazinamide and streptomycin) was initiated. However, over the next 3 weeks, the patient developed progressive heart failure and died. *M. avium* was found in pericardial fluid, autopsy cultures of the pericardium, spleen, liver, adrenal glands, kidneys, small intestine, lymph nodes, and pituitary gland.

1. What morphological and growth characteristics help us distinguish the most common mycobacterial species?
2. Why did the patient's condition not improve and eventually die despite intensive antimycobacterial treatment?
3. What other mycobacteria do you know? What is their clinical manifestation?
4. *Nocardia* show a certain similarity with mycobacteria. How are they similar and how are they different? What diseases do they cause, and what is their therapy?

33. CASE STUDY

A woman brings her husband to the emergency room, saying that he is vomiting, has a fever and has a headache. The patient (58-year-old man) has a fever of 40 °C, during the examination he complains of photophobia, severe headache and fatigue. He states that he had the flu about a week ago (his joints hurt, his head hurt, and he was tired). He and his wife spend the summer at a cottage in southern Bohemia, and he was repeatedly bitten by ticks. The doctor suspects an infection with the tick-borne encephalitis virus.

1. What tests will we do to confirm this infection?
2. What is the treatment of this disease, what are the possible consequences, do we have the possibility of prevention?
3. This virus belongs to the Flavivirus group. What other representatives from this group do you know? What diseases do they cause? How are they transmitted?
4. Arthropods also transmit other pathogens, including *Rickettsia* and *Coxiella*. What is the pathogenesis of these organisms? What diseases are caused by *R. prowazekii*, *R. rickettsii*, *R. akari*, *R. typhi*, *C. burnetii*?

34. CASE STUDY

Within three hours after a dinner at an Asian restaurant, all members of the family developed symptoms of food poisoning, accompanied by abdominal pain, nausea and vomiting. All patients had spontaneous remission within 1 day.

1. Which agents can be the cause of this disease?
2. *Bacillus anthracis* and *Bacillus cereus* cause disease using specific toxins. Describe their mechanism of action.
3. *Bacillus cereus* causes other serious disease. Which one?
4. Which of these two above mentioned species is resistant to penicillin?
5. What forms of anthrax do you know?

35. CASE STUDY

A 63-year-old man was bitten by outdoor living cat. He initially presented with pain and localized swelling of his thumb 5 days after the bite. Oral amoxicillin/clavulanic acid were prescribed, but the patient's condition worsened, with increased local pain, swelling and erythema at the wound site, and systemic signs (fever, malaise, vomiting). Incision of the wound was performed, but no abscess was found, culture of the wound was positive for a light growth of coagulase-negative staphylococci. Intravenous penicillins were prescribed, but the patient continued to deteriorate, with the development of tender axillary lymphadenopathy and pulmonary symptoms. A chest radiograph revealed pneumonic infiltrates in the right middle and lower lobes of the lung. After 3 days of incubation, tiny colonies of faintly staining gram-negative coccobacilli were observed on the original wound culture. The organism was referred to national reference laboratory, where it was identified as *Francisella tularensis*.

1. What is the most common source of human infection with *Francisella*, *Brucella* and *Bartonella*?
2. In which organs of animal hosts do *Brucella* preferentially concentrate and why?
3. What bacteria can cause disease after a dog or cat bite?
4. What characteristics are common to the genera *Francisella*, *Brucella*, and *Bartonella*?
5. Why was amoxicillin therapy unsuccessful?

36. CASE STUDY

A 19-year-old woman was treated with co-trimoxazole for acute cystitis. After 3 days of therapy she comes to emergency for worsening her symptoms. She has got strong pain in left lumbar area, fever with shivers and chills. She noticed smell of urine. Biochemical examination of urine shows leucocyturia, and bacteriuria. Urine, and hemocultivation were positive for *Escherichia coli*.

1. What were the risk factors for pyelonephritis development?
2. Which virulence factors of *E. coli* are associated with UTI?
3. Was co-trimoxazole treatment chosen correctly?
4. Explain the term significant bacteriuria.
5. Which other enterobacteria are associated with UTI? Which of their characteristics are associated with development of UTI?

37. CASE STUDY

A 69-year-old man with a pus-draining abscess on the left jaw has a 5-month history of a slowly developing lesion following a dental procedure. There are small yellowish particles in the pus. Gram stain of the abscess material revealed slender gram-positive branched rods. Cultivation was carried out aerobically and anaerobically. Anaerobic culture was positive after 2 weeks.

1. Which anaerobic bacteria is the likely cause of the infection and why?
2. What forms of actinomycosis do you know?
3. What is the treatment for this disease?
4. Which bacteria cause granulomatous inflammation?

38. CASE STUDY

A 25-year-old carpenter notices the appearance of several hyperkeratotic papules (warts) on the palm side of his index finger. They do not change in size and cause him only minimal discomfort. After a year, they spontaneously disappear.

1. Will this virus infection spread to other body sites?
2. After its disappearance, is the infection likely to be completely resolved or to persist in the host?
3. What viral, cellular, and host conditions regulate the replication of this virus and other HPVs?
4. How would the papillomavirus type causing this infection be identified?
5. Is it likely that this type of HPV is associated with human cancer? If not, which types are associated with cancers, and which cancers are they?

39. CASE STUDY

A 7-year-old boy attending summer camp complains of sore throat, headache, cough, red eyes, and tiredness and is sent to the infirmary. His temperature is 40°C. Within hours, other campers and counselors visit the infirmary with similar symptoms. Symptoms last for 5 to 7 days. All the patients have gone swimming in the camp pond. More than 50% of the people in the camp complain of symptoms similar to those in the initial case. The Public Health Department identifies the agent as adenovirus serotype 3.

1. Toward which adenovirus syndrome do the symptoms point?
2. An outbreak as large as this indicates a common source of infection. What was the most likely source or sources? What were the most likely routes by which the virus was spread?
3. What physical properties of the virus facilitate its transmission?
4. What sample or samples would have been used by the Public Health Department to identify the infectious agent, and what tests would be required to diagnose the infection?

40. CASE STUDY

A 2-year-old child with fever for 2 days has not been eating and has been crying often. On examination the physician notes that the mucous membranes of the mouth are covered with numerous shallow, pale ulcerations. A few red papules and blisters are also observed around

the border of the lips. The symptoms worsen over the next 5 days and then slowly resolve, with complete healing after 2 weeks.

1. The physician suspects that this is an HSV infection. How would the diagnosis be confirmed?
2. How could you determine whether this infection was caused by HSV-1 or HSV-2? 3. HSV escapes complete immune resolution by causing latent and recurrent infections. What was the site of latency in this child, and what might promote future recurrences?
3. What were the most probable means by which the child was infected with HSV?
4. Which antiviral drugs are available for the treatment of HSV infections? What are their targets? Were they indicated for this child? Why or why not?

41. CASE STUDY

A 17-year-old high school student has had low-grade fever and malaise for several days, followed by sore throat, swollen cervical lymph nodes, and increasing fatigue. The patient also notes some discomfort in the left upper quadrant of the abdomen. The sore throat, lymphadenopathy, and fever gradually resolve over the next 2 weeks, but the patient's full energy level does not return for another 6 weeks.

1. What laboratory tests would confirm the diagnosis of EBV-induced infectious mononucleosis and distinguish it from CMV infection?
2. To what characteristic diagnostic feature of the disease does mononucleosis refer?
3. What causes the swollen glands and fatigue?
4. Who is at greatest risk for a serious outcome of an EBV infection? What is the outcome? Why?

42. CASE STUDY

An 18-year-old college freshman complained of a cough, runny nose, and conjunctivitis. The physician in the campus health center noticed small white lesions inside the patient's mouth. The next day, a confluent red rash covered his face and neck.

1. What clinical characteristics of this case were diagnostic for measles?
2. Are any laboratory tests readily available to confirm the diagnosis? If so, what are they?
3. Is there a possible treatment for this patient?
4. When was this patient contagious?
5. Provide several possible reasons for this person's susceptibility to measles at 18 years of age.

43. CASE STUDY

In late December, a 22-year-old man suddenly experienced headache, myalgia, malaise, dry cough, and fever. He basically felt lousy. After a couple of days, he had a sore throat, his cough had worsened, he started to feel nauseated, and he began vomiting. Several of his family members had experienced similar symptoms during the previous 2 weeks.

1. In addition to influenza, what other agents could cause similar symptoms (differential diagnosis)?

2. How would the diagnosis of influenza be confirmed?
3. Is there any antiviral therapy for influenza?
4. When was the patient contagious, and how was the virus transmitted?
5. Why is influenza so difficult to control even when there is a national vaccination program?

44. CASE STUDY

An 11-year-old boy was brought to a hospital in California after falling; his bruises were treated and he was released. The following day he refused to drink water with his medicine, and he became more anxious. That night he began to act up and hallucinate. He also was salivating and had difficulty breathing. Two days later, he had a fever of 40.8°C (105.4°F) and experienced two episodes of cardiac arrest. Although rabies was suspected, no remarkable data were obtained from a computed tomographic image of the brain or cerebrospinal fluid analysis. A skin biopsy from the nape of the neck was negative for viral antigen on day 3 but was positive for rabies on day 7. The patient's condition continued to deteriorate, and he died 11 days later. When the parents were questioned, it was learned that the boy had been bitten on the finger by a dog 6 months earlier while on a trip to India.

1. What clinical features of this case suggested rabies?
2. Why does rabies have such a long incubation period?
3. What treatment should have been given immediately after the dog bite? What treatment should be given as soon as the diagnosis was suspected?
4. How do the clinical aspects of rabies differ from those of other neurologic viral diseases?

45. CASE STUDY

A 28-year-old man had several complaints. He had a bad case of thrush (oral candidiasis) and lowgrade fever, had serious bouts of diarrhea, had lost 20 pounds in the past year without dieting, and, most seriously, complained of difficulty breathing. His lungs showed a bilateral infiltrate on radiographic examination, characteristic of *P. carinii* pneumonia. A stool sample was positive for *Giardia* organisms. He was a heroin addict and admitted to sharing needles.

1. What laboratory tests should have been done to support and confirm a diagnosis of HIV infection and AIDS? What is the structure of HIV virus and which antigens are important for detection of HIV?
2. How did this man acquire the HIV infection? What are other high-risk behaviors for HIV infection?
3. What was the immunologic basis for the increased susceptibility of this patient to opportunistic infections?
4. Which other pathogens are part of typical HIV/AIDS-related diseases?

46. CASE STUDY

A 55-year-old man (patient A) was admitted to the hospital with fatigue, nausea, and abdominal discomfort. He had a slight fever, his urine was dark yellow, and his abdomen was distended and tender. He had returned from a trip to Thailand within the previous month. A 28-year-old woman (patient B) was admitted to the hospital complaining of vomiting, abdominal discomfort, nausea, anorexia, dark urine, and jaundice. She admitted frequent unprotected sexual

contacts. A 25-year-old intravenous drug abuser (patient C) was admitted with fatigue, jaundice, nausea, and abdominal discomfort.

1. What clinical or epidemiologic clues would have assisted in the diagnosis of hepatitis A, B, and C?
2. What laboratory tests would have been helpful in distinguishing the different hepatitis infections?
3. What was the most likely means of viral acquisition in each case?
4. What personal and public health precautions should have been taken to prevent the transmission of virus in each case?
5. Which of the patients was susceptible to chronic disease?
6. What laboratory tests distinguish acute from chronic HBV disease?
7. How can HBV disease be prevented? Treated?

47. CASE STUDY

A mother comes to the emergency department with a 13-month-old daughter who has had watery diarrhea for the 2nd day, is vomiting, and has a fever of 38.3°C. The little girl looks apathetic, she is hospitalized for dehydration. Examining a stool sample will show *Rotavirus*.

1. How are rotaviruses transmitted?
2. What is the mechanism of diarrhea in rotavirus infection?
3. What age group is most at risk of rotavirus infection? Do we have the possibility of prevention?
4. What other viruses cause diarrheal diseases? List their basic characteristics.

48. CASE STUDY

A mother presented with a two-year-old boy for 2 days of loss of appetite and sudden onset of fever at night. The previous morning his mother had noticed two papules; one on the palm of the hand and one on the sole of the foot, which made the boy very itchy. Subsequently, he developed severe leg pain and difficulty eating. During the examination, the boy was febrile (38.5°C). He already had many papules on his palms and soles. He also had several papules on his trunk and DKK. In his mouth, he had numerous reddish macules approximately 2 mm in diameter on the hard palate. Based on clinical symptoms, the case was diagnosed as hand-foot-mouth disease.

1. What virus causes this disease? What do you know about him? Do we have a specific therapy?
2. List at least 2 other viruses from the *Picornaviridae* family and describe the course of the disease, the possibility of therapy/prevention
3. What other viruses from the *Paramyxoviridae* family cause disease in humans? Describe the structure of a virus and its basic characteristics?
4. How do paramyxoviruses differ from orthomyxoviruses?

49. CASE STUDY

A 26-year-old woman in the 7th month of pregnancy comes to the clinic with a rash and fever. The measured temperature is 38.8 °C, and patient had polymorphic multiphasic vesiculopustulous exanthema all over the body, including the scalp.

1. What disease do we suspect?
2. Is this disease preventable? What therapy do we choose?
3. What are the possible complications of this disease?
4. Which viruses cause exanthematic infections especially in children? List their basic characteristics.
5. How does *Toxoplasma gondii* infection manifest itself? For which patients is this infection dangerous?

50. CASE STUDY

Patient (male – 28 years) travelling repeatedly to the tropic countries. In January he travelled to Mali, and did not take antimalarial prophylaxis. He was repeatedly bitten by mosquitoes, headache appeared on 7 days after the biggest bite, day 2 fever with chills and subsequent sweating. What was the differential diagnosis of infectious agents in this patient? What was the most likely etiologic agent?

1. What tests would have been done to confirm the diagnosis?
2. What aspects of the medical history might suggest a risk for infection with this agent?
3. Describe the life cycle of plasmodia. Which species are clinically significant?
4. What were the therapeutic options and the likelihood that therapy would be successful?

51. CASE STUDY

A 75-year-old man presented to a local hospital complaining of headache, fever, and right arm myoclonic seizures. He had mild leukocytosis, but no evidence of intracranial hemorrhage or other obvious abnormalities. Due to the sudden onset of convulsions and weakness of the right limbs, he was hospitalized in the neurological ICU with a suspected CNS infection. In the laboratory, he had a leukocytosis of 12,190/ μ l and a CRP of 28.5 mg/l. The serological result for HIV was negative. Blood cultures for bacteria and fungi were negative. CT showed diffuse brain edema, subarachnoid and intraventricular hemorrhage. A slightly cloudy cerebrospinal fluid was obtained from a lumbar puncture with a glycorrhagia of 0.22 mmol/l, a proteinorahia of 9.5g/l and a leukocyte count of 560/ μ l (of which 90% were neutrophils). Microscopic examination of the cerebrospinal fluid revealed numerous trophozoites approximately 10-25 μ m in size that moved rapidly and directionally by means of pseudopodia. The cytoplasm of the trophozoites contained abundant granular vacuoles. The amoeba was identified as *Naegleria fowleri*. Despite intensive therapy, the patient died 6 days after admission.

1. In what environment did the *Naegleria* infection probably occur? What is the treatment?
2. What other free-living amoebae do you know?
3. What other disease is associated with amoebas? What are the complications of this disease?
4. What is the laboratory diagnosis of amoeba?

52. CASE STUDY

A previously healthy, 37-year-old man originally from Saudi Arabia presented to the clinic with a 6-week history of skin lesions on the nose, ear, arm, and fingers. A skin biopsy was performed and, together with pus from the wound, sent to the reference laboratory for culture for suspected cutaneous form of tuberculosis. Physical examination revealed painless

erythematous papules and nodules with overlying scales and crusts, some of which had central ulcerations. Tuberculosis was not proven, and due to the patient's recent stay in Saudi Arabia, a cutaneous form of leishmaniasis was suspected. A smear from the manifestations revealed large macrophages containing abundant intracellular Leishman-Donovan bodies (amastigotes); some were loosely deposited in the dermis without any granuloma tissue culture and PCR confirmed that the infection was caused by *Leishmania tropica*.

1. What is the life cycle of *Leishmania*? What other species do you know?
2. Can leishmania infection manifest itself in other ways than skin lesions?
3. Which other clinically significant parasite belongs to flagellates? What diseases does it cause and how is it transmitted?
4. Other parasites manifesting as skin lesions or lymphedema are flukes, filaria and *Dracunculus medinensis*. How are they transmitted and what is their life cycle? How is it treated?

53. CASE STUDY

A 3-year-old girl was admitted to hospital with 3 days of worsening diffuse abdominal pain, anorexia, vomiting, and diarrhea associated with the presence of worms in the past 24 hours. The family lives on a farm without sewage, the previous day they took an unspecified anthelmintic, after which the symptoms intensified. On physical examination, she was irritable, dehydrated, had tachycardia, and the abdomen was painful to palpation with absent peristalsis. In the laboratory, she had 10,300/μl leukocytes with 10% eosinophilia. For signs of obstructive ileus, an enterotomy was performed and the worms were removed. The worm was identified as *Ascaris lumbricoides*.

1. What is the life cycle of *A. lumbricoides*? What is the therapy? Is this disease common in the world?
2. Worms from the genus *Toxokara* are also referred to as roundworms. How does their strategy differ from ascar?
3. Another worm that is parasitic on humans is *Enterobius vermicularis*. What do you know about him?
4. Among the Nematoda belong also *Trichinella spiralis*. How can a person become infected? How does the disease manifest itself?
5. Cestoda or tapeworms are also parasites of mammals. What is their life strategy?

54. CASE STUDY

A 42-year-old laborer living in a dormitory comes to the skin clinic for several weeks of exanthema and severe itching that worsens at night. Roommates also have similar problems. A diagnosis of scabies was made based on clinical symptoms.

1. Do we have the possibility to confirm the presence of scabies as the causative agent of the disease somehow diagnostically, or how?
2. What is the therapy? What is the method of transmission? Is this infection common?
3. Other fungal infections can also appear on the skin. Give examples and options for therapy?

55. CASE STUDY

A 27-year-old hemato-oncology patient came to the hospital with acute nonspecific symptoms of fatigue, mild productive cough, and fever with chills, without hemoptysis or chest pain. The patient is on immunosuppression after an allogeneic bone marrow transplant for ALL (acute lymphoblastic leukemia). X-ray examination revealed the presence of a thick-walled cavitary mass in the right lung apex with centrilobular nodules consistent with aspergilloma along with patchy milk-glass opacities surrounding the alveolar infiltrate, this is referred to as the "Halo sign" in invasive aspergillosis. Bronchoscopy with bronchoalveolar lavage revealed dark fluid with suspended black particles, and fluid analysis showed high titers of aspergillus. Microbiological culture showed *Aspergillus fumigatus*. Immunosuppression was stopped and antifungal therapy started. Unfortunately, the patient died 16 days after admission due to the progression of the condition.

1. What other agents of systemic fungal diseases do you know? How can they be diagnosed?
2. Which micromycetes are referred to as dimorphic? Which organs are most often affected?
3. What is the systemic therapy of mycoses? Describe the mechanism of action of polyenes, azoles and echinocandins.