

# **SPECIAL AND CLINICAL MICROBIOLOGY**

## **Laboratory workbook**

Student name \_\_\_\_\_

Faculty \_\_\_\_\_

Group \_\_\_\_\_

Minsk BSMU 2021

МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ  
БЕЛОРУССКИЙ ГОСУДАРСТВЕННЫЙ МЕДИЦИНСКИЙ УНИВЕРСИТЕТ  
КАФЕДРА МИКРОБИОЛОГИИ, ВИРУСОЛОГИИ, ИММУНОЛОГИИ

# ЧАСТНАЯ И КЛИНИЧЕСКАЯ МИКРОБИОЛОГИЯ

## SPECIAL AND CLINICAL MICROBIOLOGY

Лабораторный практикум

*6-е издание*



Минск БГМУ 2021

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Ч-25

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Содержит информацию для подготовки к практическим занятиям по разделам  
частной и клинической микробиологии. Приведены схемы, алгоритмы, справочные  
сведения, методики выполнения лабораторных работ. Первое издание вышло  
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**The subject to study:**

Staphylococci, systematics, general characteristics. Methods of microbiological diagnostics of staphylococcal infections. The material for the research depending on the form of the infection. Scheme of pure culture isolation (from pus, mucus, blood, etc.). Identification methods, phage typing. Specific prevention and treatment of staphylococcal infections.

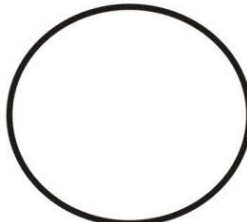


Streptococci. Systematics. Pyogenic streptococci. Pneumococci. General characteristics. Antigenic structure. Acute and chronic diseases, pathogenesis, immunity. Specific antibodies to streptococcal antigens, diagnostic value. Methods for streptococcal infections diagnosis. Bacteriological method, study design. Material for studies depending on the form of the infection, the rules and methods for taking material. Principles of therapy and prevention pro-streptococcal infections.

Neisseria. Systematics, general characteristics.

Characteristics of the causative agent, mechanisms of pathogenesis, immunity, methods of microbiological diagnosis of acute and chronic gonorrhea.

Characteristics of the causative agent, mechanisms of pathogenesis, immunity, diagnosis and prevention of meningococcal infection-howl. sources:

**Laboratory work**

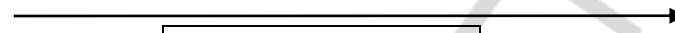
Tasks	Methods, results																		
<p>1. Microbiological diagnostics of staphylococcal infection, Step 2</p> <p>a) macro- and microscopic examination of the colonies on YSA;</p> <p>b) plasmacoagulase test.</p>	<div style="display: flex; align-items: center; justify-content: space-around;"> <div style="text-align: center;">  <p>Smear _____</p> <p>Stain _____</p> </div> <div style="text-align: center;">  <p>MSA (YSA)</p> </div> <div style="text-align: center;">  </div> </div> <div style="text-align: center; margin-top: 10px;"> <p>Stabilized rabbit plasma, 37 °C, 2–4–24 h.</p> </div> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Feature</th> <th>Staphylococcal colonies</th> </tr> </thead> <tbody> <tr><td>Shape</td><td></td></tr> <tr><td>Size</td><td></td></tr> <tr><td>Surface</td><td></td></tr> <tr><td>Edge</td><td></td></tr> <tr><td>Color</td><td></td></tr> <tr><td>Cionsistency</td><td></td></tr> <tr><td>Transparency</td><td></td></tr> <tr><td>Lecithinase</td><td></td></tr> </tbody> </table> <p><b>Conclusion:</b> according to morphological, cultural and biochemical properties unknown bacterium is identified as</p>	Feature	Staphylococcal colonies	Shape		Size		Surface		Edge		Color		Cionsistency		Transparency		Lecithinase	
Feature	Staphylococcal colonies																		
Shape																			
Size																			
Surface																			
Edge																			
Color																			
Cionsistency																			
Transparency																			
Lecithinase																			

2. Microbiological diagnostics of streptococcal infection, Step 3:  
 a) a description of Streptococci growth in serum broth;  
 b) determining the morphology of streptococci, Gram staining;  
 c) determination of streptococcus serogroup by ring precipitation test.

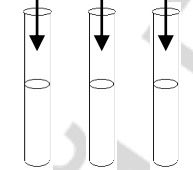


Serum  
broth

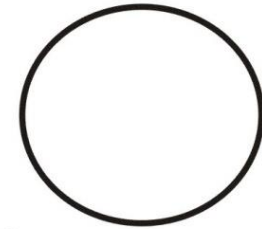
Colonies characteristics \_\_\_\_\_



Cell wall antigens extract



Ring precipitation test



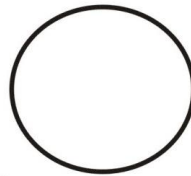
Smear \_\_\_\_\_

Stain \_\_\_\_\_

Conclusion: according to morphological, cultural and biochemical properties unknown bacterium is identified as \_\_\_\_\_

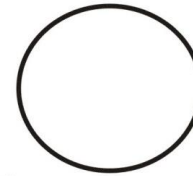
Demonstration.

1. Staphylococcus aureus in pus, Gram staining.
2. Streptococcus pneumoniae, pure culture, Gram staining.
3. Streptococcus pneumoniae, white mice, Gram staining.
4. Gonococcus in pus, Gram staining.
5. Meningococcus in cerebrospinal fluid, methylene blue.
6. The growth of staphylococci on YSA, blood agar, broth.
7. The growth of streptococci on blood agar and broth.
8. Plasmacoagulase test
9. Anaerobic mannitol fermentation.
10. Phage typing of staphylococci.



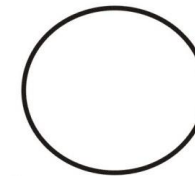
Smear \_\_\_\_\_

Stain \_\_\_\_\_



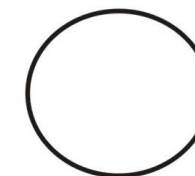
Smear \_\_\_\_\_

Stain \_\_\_\_\_



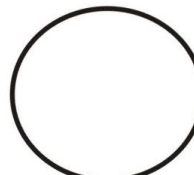
Smear \_\_\_\_\_

Stain \_\_\_\_\_



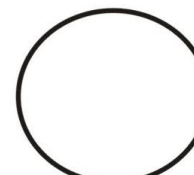
Smear \_\_\_\_\_

Stain \_\_\_\_\_



Smear \_\_\_\_\_

Stain \_\_\_\_\_



Smear \_\_\_\_\_

Stain \_\_\_\_\_

Signature of the tutor \_\_\_\_\_

**Complementary materials to class 5.**

<i>Staphylococcus</i> genus characteristics		Bacteriological diagnostics of staphylococcal infection					
Main pathogenic species		<b>Material for investigation</b>			<b>Staphylococcal infections</b>		
Morphology (size, shape, relative positions of cells)							
Spores development							
Capsule							
Flagella (motility)							
Gram staining		<b>Media for pure culture isolation</b>					
Catalase activity							
Main pathogenicity factors							
		<b>Medium for pure culture accumulation</b>					
<b>Methods for staphylococcal infection diagnostics</b>		<b>Staphylococcus indentification</b>					
<b>Method</b>	<b>Usage (+/-)</b>	<b>Species</b>	Plasmacoagulation test	Anaerobic mannitol fermentation	DNA-se	Lecithinase	Protein-A
Microscopic		<i>S. aureus</i>					
Cultural		<i>S. epidermidis</i>					
Biological		<i>S. saprophyticus</i>					
Serological							
Allergic							
Molecular-genetic							

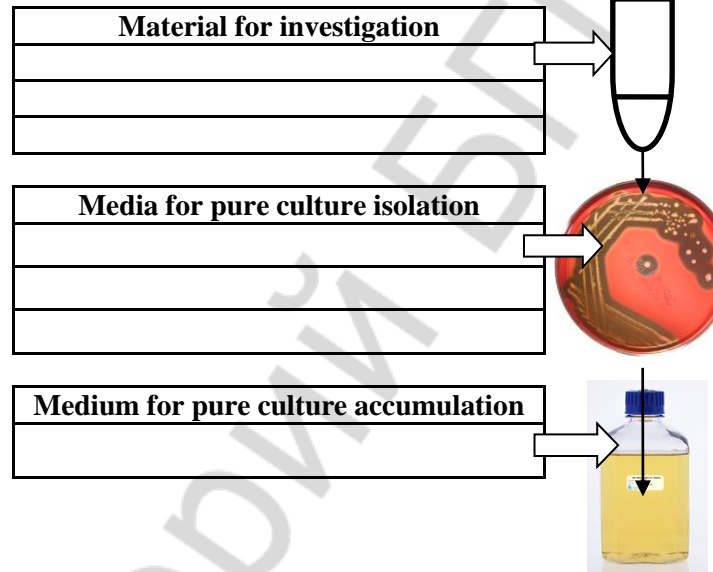
**Streptococcus genus characteristics**

Main pathogenic species	<i>S. pyogenes</i>	<i>S. pneumoniae</i>
Morphology		
Spores development		
Capsule		
Flagella (motility)		
Gram staining		
Group antigen		
Type-specific antigen (M-protein)		
Capsule polysaccharide		
Catalase activity		

**Methods for streptococcal infections diagnostics**

Methods	Usage (+/-)	
	<i>S. pyogenes</i>	<i>S. pneumoniae</i>
Microscopic		
Cultural		
Biological		
Serological		
Allergic		
Molecular-genetic		

**Bacteriological diagnostics of streptococcal infection**



<i>S. pyogenes</i> infections
<i>S. pneumoniae</i> infection
<b>Other important Str. species</b>

**Streptococci identification**

Str. species	Growth in nutrition broth	Hemolysis ( $\alpha, \beta, \gamma$ )	Precipitation on nest	Capsule swelling test	Inulin fermentation	Optochin test	Bile test
<i>S. pyogenes</i>							
<i>S. pneumoniae</i>							
<i>E. faecalis</i>							

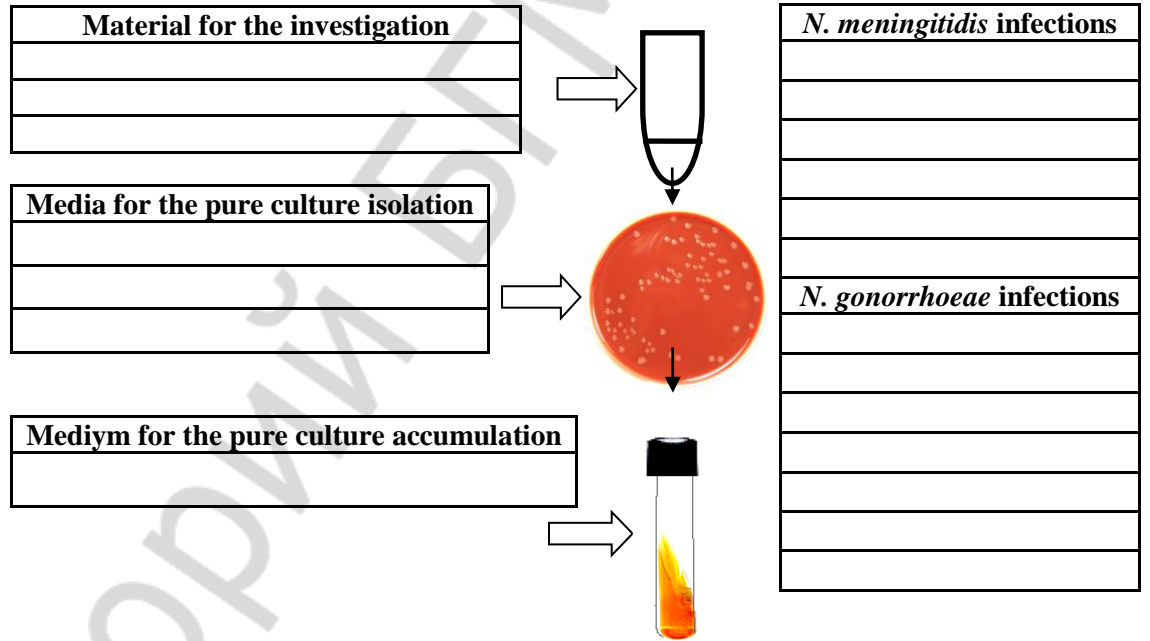
**Neisseria genus characteristics**

Features	<i>N. meningitidis</i>	<i>N. gonorrhoeae</i>
Morphology (size, shape, relative positions of cells)		
Spores development		
Capsule		
Flagella (motility)		
Gram staining		
Oxidase activity		
Pathogenicity factors		

**Methods for neisserial infections diagnostics**

Methods	Usage (+/-)	
	<i>N. meningitidis</i>	<i>N. gonorrhoeae</i>
Microscopic		
Cultural		
Biological		
Serological		
Allergic		
Molecular-genetic		

**Bacteriological method for the Neisseria infections diagnostics**



**Neisseria differentiation**

Species	Growth on nutrition agar	Growth at 20 °C	Colonies color	Fermentation		
				Glucose	Maltose	
<i>N. meningitidis</i>						
<i>N. gonorrhoeae</i>						
Opportunistic species						



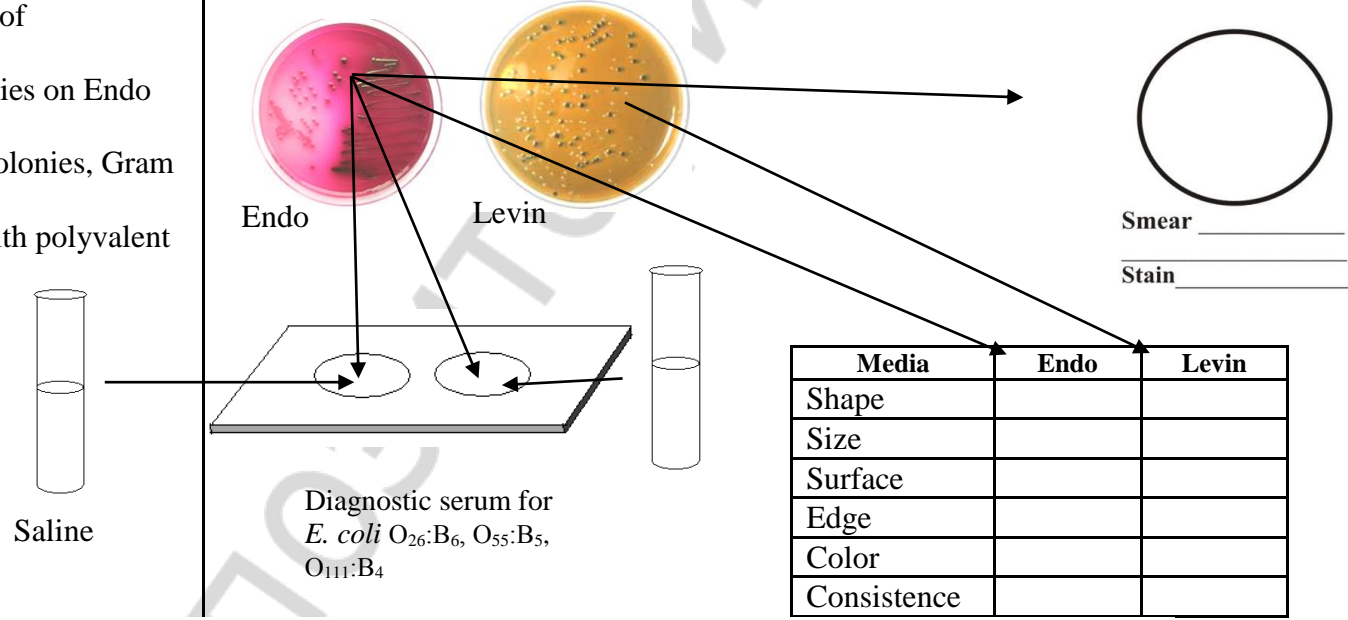
**Questions to study:** General characteristics of Enterobacteriaceae family. Differences between genera. General principles of diagnostics of acute enteric infections caused by pathogenic enterobacteria. Differential diagnostic media, composition, principle of work.

Escherichia, systematic position, general characteristics. The biological role of Escherichia coli. Molecular mechanisms of escherichiosis pathogenesis. Enteropathogenic, enterotoxigenic, enteroinvasive and enterohaemorrhagic Escherichia coli. Escherichiosis diagnostics. Antibiotic treatment.

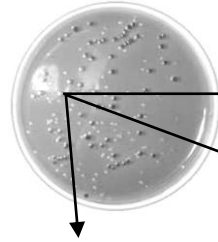
Salmonella, classification and general characteristics. Serological classification of Salmonella. Identification of Salmonella. Molecular biological typing.

Causative agents of typhoid and paratyphoid. The pathogenesis of typhoid. Microbiological diagnostics of typhoid fever, depending on the stage of pathogenesis.

**Laboratory work**

Task	Methods, results																					
<p>1. Bacteriological diagnostics of escherichiosis, 2-nd step:</p> <p>a) exploring of <i>E. coli</i> colonies on Endo and Levin media;</p> <p>б) slides preparation from colonies, Gram staining;</p> <p>в) slide agglutination test with polyvalent diagnostic OK-serum.</p>	 <p style="text-align: center;">Endo      Levin</p> <p style="text-align: center;">Smear _____</p> <p style="text-align: center;">Stain _____</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Media</th> <th>Endo</th> <th>Levin</th> </tr> </thead> <tbody> <tr> <td>Shape</td> <td></td> <td></td> </tr> <tr> <td>Size</td> <td></td> <td></td> </tr> <tr> <td>Surface</td> <td></td> <td></td> </tr> <tr> <td>Edge</td> <td></td> <td></td> </tr> <tr> <td>Color</td> <td></td> <td></td> </tr> <tr> <td>Consistence</td> <td></td> <td></td> </tr> </tbody> </table> <p style="text-align: center;">Diagnostic serum for <i>E. coli</i> O<sub>26</sub>:B<sub>6</sub>, O<sub>55</sub>:B<sub>5</sub>, O<sub>111</sub>:B<sub>4</sub></p> <p style="text-align: center;">Saline</p>	Media	Endo	Levin	Shape			Size			Surface			Edge			Color			Consistence		
Media	Endo	Levin																				
Shape																						
Size																						
Surface																						
Edge																						
Color																						
Consistence																						
<p>Conclusion: according to morphological, cultural and biochemical properties unknown bacterium is identified as _____</p>																						

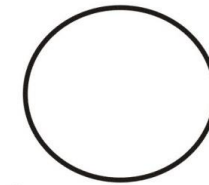
2. Bacteriological diagnostics of typhoid:  
 2-nd step of coproculture isolation:  
 a) describe colonies on Levin medium;  
 b) prepare slide from colonies, Gram staining;  
 c) inoculate Kligler medium.



Levin medium



TSI (Kligler) medium



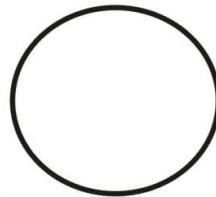
Smear \_\_\_\_\_

Stain \_\_\_\_\_

Feature	Levin medium
Shape	
Size	
Surface	
Edge	
Color	
Consistence	

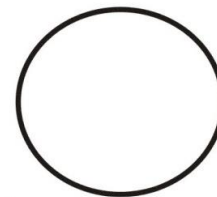
Demonstration.

1. Clean media: Endo, Levin Ploskirev, bismuth sulfite agar, Rapoport, magnesium, Kliglera.
2. The same media with the growth of E. coli, Salmonella, Shigella.
3. Biochemical Activity of E. coli and Salmonella.
4. Dendrograms of Salmonella molecular typing.
5. Tube agglutination test with killed E. coli culture.
6. The morphology of E. coli, Salmonella, Shigella (Gram staining).



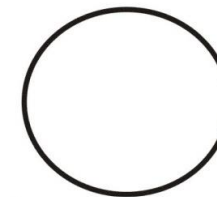
Smear \_\_\_\_\_

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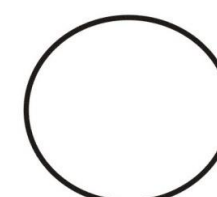
Smear \_\_\_\_\_

Stain \_\_\_\_\_



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Stain \_\_\_\_\_



Smear \_\_\_\_\_

Stain \_\_\_\_\_

Teacher signature \_\_\_\_\_

Complementary materials to class 2.

<i>Enterobacteriaceae</i> genera of medical importance		

General characteristics of *Enterobacteriaceae* family

Characteristics	<i>Enterobacteriaceae</i>
Morphology	
Spores development	
Capsule	
Flagella (motility)	
Gram staining	
Antigens	
Exotoxins	
Endotoxins	

*Escherichia coli* characteristics

Characteristics	<i>Escherichia coli</i>
Morphology	
Spores development	
Capsule	
Flagella (motility)	
Gram staining	
Antigens	
Number of serovars	
<i>E. coli</i> classification according to pathogenicity factors	1. 2. 3. 4.
Diseases caused by <i>E. coli</i>	

Methods for diagnostics of escherichiosis and salmonellosis

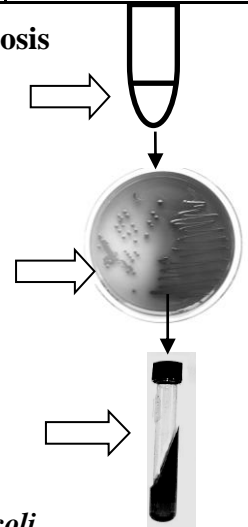
Methods	Usage (+/-)	
	<i>Escherichiosis</i>	<i>Typhoid and paratyphoid</i>
Microscopic		
Cultural		
Biological		
Serological		
Allergic		
Molecular-genetic		

Bacteriological diagnostics of escherichiosis

Material for the investigation

Media for pure culture isolation

Medium for the pure culture accumulation



Biological properties *E. coli*, as normal microflora representatives

Positive	Negative

**Characteristics of certain species from *Escherichia* and *Salmonella* genera**

Species	Fermentation					Indol production	H <sub>2</sub> S production	Catalase activity	Antigenic formula (O, H, K)
	Glucose	Lactose	Mannitol	Maltose	Saccharose				
<i>E. coli</i>									
<i>S. typhi</i>									
<i>S. paratyphi A</i>									
<i>S. schottmuelleri</i>									
<i>S. typhimurium</i>									

**Methods of microbiological typhoid diagnostics depending on the pathogenesis phase**




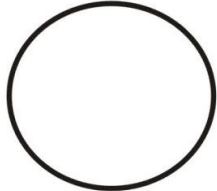
Pathogenesis phase		Bacteriological method				Serological method	
		Hemoculture	Urinoculture	Coproculture	Bileculture	Vidal test	BPAT with Vi-Ag
Incubation period							
Prodromal period							
midst of illness	Bacteremia and intoxication						
	Parenchymal diffusion						
	Allergic-secretory						
Reconvalescence							
Bacteria carrier state							

**The list of questions to study:** Characteristics of immunity in typhoid and paratyphoid fever. Serological diagnosis of typhoid and paratyphoid fever. Formulation and analysis of Vidal reaction. Methods for distinguishing infection, anamnestic and postvaccinal titer. Diagnosis of bacteria carrier state in typhoid fever.

Salmonella - causative agents of acute gastroenteritis. Salmonella phage typing and indication.

Shigella. Causative agents of dysentery, classification, general characteristics. Molecular mechanisms of pathogenesis, immunity, methods of laboratory diagnosis of acute and chronic dysentery. Approaches to the prevention of dysentery. Antibiotic treatment.

**Laboratory work**

Task	Methods, results
<ol style="list-style-type: none"> <li>1. Microbiological diagnostics of typhoid fever: 3-rd step.</li> <li>2. a) Describe the growth on the Kligler medium;</li> <li>3. b) prepare the slide from the colonies, Gram staining;</li> <li>4. a) check the culture for motility and indol production;</li> <li>5. d) determination of the antigenic structure of the culture isolated in slide agglutination test.</li> </ol>	<p>Biochemical properties assessment:                      Lactose _____                      Glucose _____                      H<sub>2</sub>S production _____</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>Motility test</p> <p>_____</p> <p>_____</p> </div> <div style="text-align: center;">  <p>Indol production test</p> <p>_____</p> <p>_____</p> </div> <div style="text-align: center;">  </div> <div style="text-align: center;">  <p>Smear _____</p> <p>Stain _____</p> </div> </div>

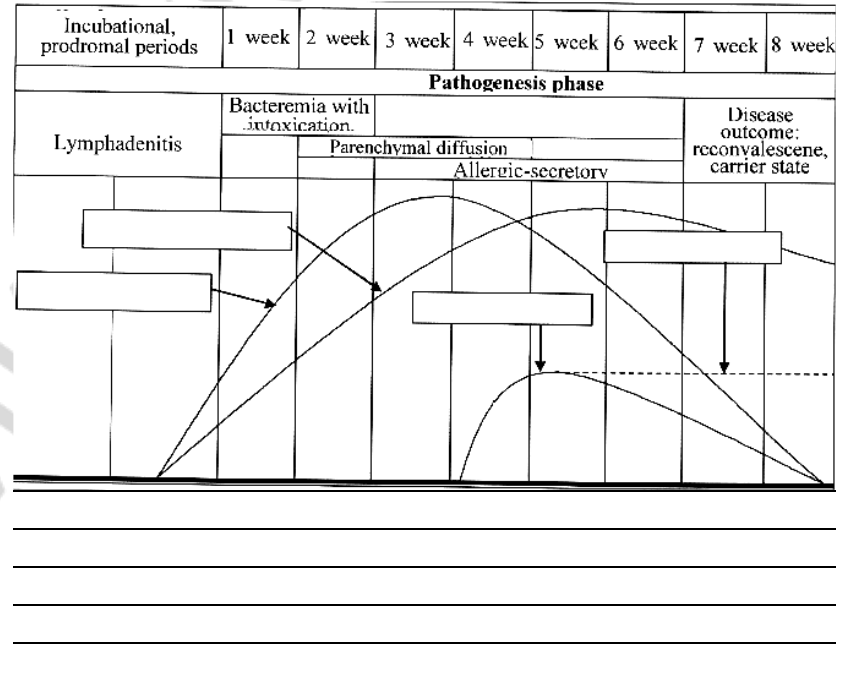
2. Assessment of Vidal test

**Vidal agglutination test (AT)**

Diagnosticum	1:50	1:100	1:200	1:400	1:800	AC	SC
O9							
Hd							
A (OH)							
B (OH)							

Conclusion: \_\_\_\_\_  
 (Diagnostic titer \_\_\_\_\_).

**Immunoglobulines dynamics in typhoid fever**



**Demonstration**

1. Shigella growth on differential-diagnostic media
2. Shigella and Salmonella growth on Kligler medium.
3. Biochemical activity of enterobacteria.
4. Salmonella phage-typing.
5. Vi-passive hemagglutination test
6. Preparations for the specific prophylaxis of typhoid and paratyphoid fever.

**Passive Vi – hemagglutination test**

1/10	1/20	1/40	1/80	1/160	1/320	1/640	SC	AC

Conclusion: \_\_\_\_\_  
 (Diagnostic titer \_\_\_\_\_).

Signature of the tutor \_\_\_\_\_

Supporting materials to class 3.

Shigella classification			
Shigella species	Serovariants number		

**Cultural method for the shigellosis diagnostics**

Materials for the research	

Media for the pure culture isolation	

Medium for the pure culture accumulation	

**Shigella**      **Salmonella**

Abscesses in mucosa      Lymph. nodes

Blood

**Shigellosis and salmonellosis pathogenesis**

Feature	S. sonnei	S. flexneri	S. dysenteriae
Glucose (A+G)			
Lactose			
Mannitol			
Serogroup			

Main salmonellosis pathogens	

**Bacteriological method for salmonellosis diagnostics**

Material for the research	

Medium for the material enrichment	

Medium for pure culture isolation	

Medium for pure culture accumulation	

Methods for salmonella identification	

**Class № 4. Microbiological diagnostics of diseases caused by Klebsiella, Iersinia, Campylobacter and pseudomonada.**

**Methods for food poisoning diagnostics**

Data \_\_\_\_\_.

**List of questions to study:** Klebsiella, classification and general characteristics, main diseases caused. Pathogenesis, immunity, methods of microbiological diagnosis of acute and chronic klebsiellosis.

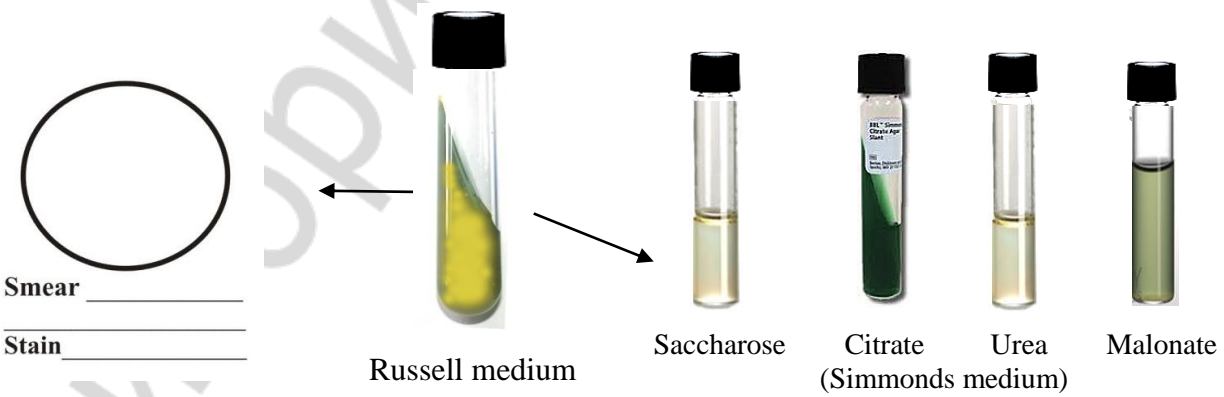
The causative agent of intestinal yersiniosis, general characteristics. Pathogenesis, immunity, methods of microbiological diagnostics.

Campylobacter, general characteristics, role in human pathology. Mechanisms of pathogenesis. Diagnosis of campylobacteriosis. Helicobacter.

Pseudomonas aeruginosa, general characteristics, pathogenicity factors, role in human pathology. Methods of microbiological diagnostics Pseudomonas infection.

Classification, etiology of food poisoning. Principles of microbiological diagnostics.

**Laboratory work**

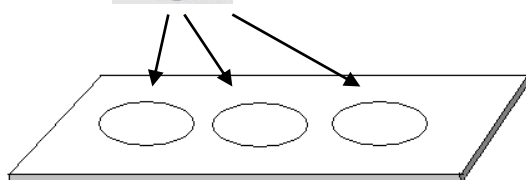
Tasks	Methods, results																												
<p>1. Independent work "Microbiological klebsiellosis diagnostics":</p> <p>A. Examine the growth of Klebsiella on differential-diagnostic media.</p> <p>B. Determine the capsule presence.</p> <p>C. Determine the biochemical properties of Klebsiella.</p> <p>D. Perform slide agglutination test with anti-capsule diagnostic sera and determine the K-antigen.</p> <p>E. Determine the titer of CFT for serological diagnosis of scleroma.</p>	 <p style="text-align: center;"><b>Klebsiella characteristics</b></p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Biochemical properties</th> <th style="text-align: center;"><i>K. pneumoniae</i> <i>s. rhinoscleromatis</i></th> <th style="text-align: center;"><i>K. pneumoniae</i> <i>s. ozaenae</i></th> <th style="text-align: center;"><i>K. pneumoniae</i> <i>s. pneumoniae</i></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><b>Glucose (A+G)</b></td> <td style="text-align: center;">-</td> <td style="text-align: center;">+/-</td> <td style="text-align: center;">+</td> </tr> <tr> <td style="text-align: center;"><b>Lactose</b></td> <td style="text-align: center;">-</td> <td style="text-align: center;">+/-</td> <td style="text-align: center;">+</td> </tr> <tr> <td style="text-align: center;"><b>Saccharose (4th day)</b></td> <td style="text-align: center;">-</td> <td style="text-align: center;">+/-</td> <td style="text-align: center;">+</td> </tr> <tr> <td style="text-align: center;"><b>Citrate</b></td> <td style="text-align: center;">-</td> <td style="text-align: center;">+/-</td> <td style="text-align: center;">+</td> </tr> <tr> <td style="text-align: center;"><b>Urea</b></td> <td style="text-align: center;">-</td> <td style="text-align: center;">-/+</td> <td style="text-align: center;">+</td> </tr> <tr> <td style="text-align: center;"><b>Malonate</b></td> <td style="text-align: center;">+</td> <td style="text-align: center;">-</td> <td style="text-align: center;">+</td> </tr> </tbody> </table>	Biochemical properties	<i>K. pneumoniae</i> <i>s. rhinoscleromatis</i>	<i>K. pneumoniae</i> <i>s. ozaenae</i>	<i>K. pneumoniae</i> <i>s. pneumoniae</i>	<b>Glucose (A+G)</b>	-	+/-	+	<b>Lactose</b>	-	+/-	+	<b>Saccharose (4th day)</b>	-	+/-	+	<b>Citrate</b>	-	+/-	+	<b>Urea</b>	-	-/+	+	<b>Malonate</b>	+	-	+
Biochemical properties	<i>K. pneumoniae</i> <i>s. rhinoscleromatis</i>	<i>K. pneumoniae</i> <i>s. ozaenae</i>	<i>K. pneumoniae</i> <i>s. pneumoniae</i>																										
<b>Glucose (A+G)</b>	-	+/-	+																										
<b>Lactose</b>	-	+/-	+																										
<b>Saccharose (4th day)</b>	-	+/-	+																										
<b>Citrate</b>	-	+/-	+																										
<b>Urea</b>	-	-/+	+																										
<b>Malonate</b>	+	-	+																										



**Slide agglutination test with anti-capsule serum**



Pure culture

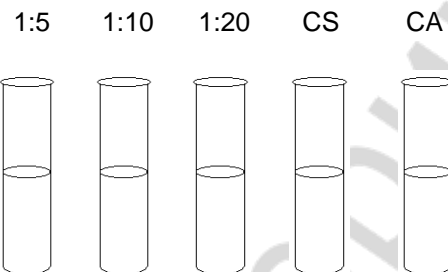


K3      K4      Saline sol.

Conclusion: \_\_\_\_\_

**Complement fixation test**

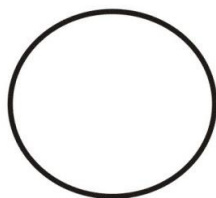
Variant	Serum dilutions			CS	CA	Result
	1:5	1:10	1:20			
1	++++	++++	++++	-	-	Very positive
2	++++	++++	-	-	-	Positive
3	+++	-	-	-	-	Weak positive
4	-	-	-	-	-	Negative



Conclusion: \_\_\_\_\_

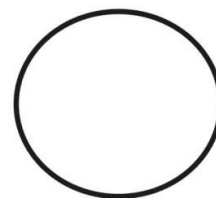
**Demonstration.**

1. Klebsiella growth on differential diagnostic media.
2. Klebsiella scleroma capsule (Hins-Burri staining).
3. Pseudomonas aeruginosa, pure culture, Gram staining.
4. Oxidase test.



Smear \_\_\_\_\_

Stain \_\_\_\_\_



Smear \_\_\_\_\_

Stain \_\_\_\_\_

Signature of the tutor \_\_\_\_\_

## Additional materials for class 4

Causative agents	Disease	Materials for bacteriological diagnostics
<i>K. pneumoniae s. rhinoscleromatis</i>		
<i>K. pneumoniae s. ozaenae</i>		
<i>K. pneumoniae s. pneumoniae</i>		
<i>Y. enterocolitica</i>		
<i>C. jejuni</i>		
<i>H. pylori</i>		
<i>P. aeruginosa</i>		

Methods of laboratory diagnostics				
Method	Usage (+/-)			
	Klebsiella	Campylobacter	Yersinia	Pseudomonas aeruginosa
Microscopic				
Cultural				
Biological				
Serological				
Allergic				
Molecular-genetic				

Diagnosis of bacterial food poisoning	
<p><b>Food poisoning</b> - acute systemic diseases resulting from ingestion of food, massively contaminated with microorganisms or microbial exotoxins. Food poisoning is divided into bacterial foodborne diseases and food poisoning (toxicosis), as well as poisoning of mixed etiology.</p>	
<p><b>Foodborne diseases (FBD):</b> FBDs result from ingestion of products massively colonized by certain bacteria. Pathogens: opportunistic members of the family Enterobacteriaceae - <i>E. coli</i>, <i>Proteus</i> (<i>P. vulgaris</i>, <i>P. mirabilis</i>), <i>Morganella morganii</i>, <i>Citrobacter</i>, <i>Enterobacter</i>, <i>Hafnia</i>, <i>Klebsiella pneumoniae</i>; Sem. <i>Vibrionaceae</i> - <i>V. parahaemolyticus</i>; Sem. <i>Bacillaceae</i> - <i>B. cereus</i>, <i>C. perfringens</i> serovar A; Sem. <i>Streptococcaceae</i> - <i>S. faecalis</i>; Sem. <i>Pseudomonadaceae</i> - <i>P. aeruginosa</i>, and others.</p>	<p><b>Microbial food toxicosis (intoxication):</b> acute illness arising from eating food, which contains a large amount of exotoxin (as a result of massive reproduction of microbes). These include botulism, toxicosis caused by staphylococcal enterotoxin, toxins from microscopic fungi and others.</p>
<p><b>Pathogenesis.</b> Pathogen replicates in the intestine, penetrates into lymphoid tissue, where it is killed with the release of endotoxin, which causes damage to the intramural bowel NS, CNS and blood vessels. Bacteria cause inflammation of the intestinal wall.</p>	<p><b>Pathogenesis</b> is based on the microbial exotoxin, which is not destroyed by food processing, digestive enzymes and acidic stomach contents.</p>
<p><b>Materials for the research:</b> vomit, stomach washings, feces, urine, blood, sectional material (in the case of death), the remains of the suspected food, raw and semi-finished products used, daily samples of food, swabs and scrapings from kitchen utensils.</p>	
<p><b>Lab. diagnosis:</b> isolation of obligate pathogenic or opportunistic enterobacteria and <i>Vibrio</i>, staphylococci and their toxins, streptococci, bacillus, as well as (if indicated) - botulism pathogens and toxins.</p>	
<p>To evaluate the etiologic role of opportunistic bacteria (OB) certain criteria are used.</p>	
<p>Main criterion is quantitative: Etiologically significant number of OM is <math>10^5</math>-<math>10^6</math> or more CFU per 1g of material. The diagnosis is more reliable while simultaneously detecting same germs or toxins in suspected food. Other criteria are: repeated isolation of same germs from the material of the patient, the identity of the pathogen strains (serovars and phage-vars) in a large number of patients in group food poisoning, as well as the increase in antibody titer in the dynamics of the disease.</p>	

**List of questions to study:**

Corynebacterium diphtheria. Systematics, general characteristics of the pathogen. Types of Corynebacterium diphtheria, their distinctive features. Diphtheria toxin and antitoxic serum. The pathogenesis of diphtheria. Methods of microbiological and molecular biological diagnosis of diphtheria. Principles of therapy and prevention of diphtheria. Determination of the effectiveness of post-vaccinal immunity.

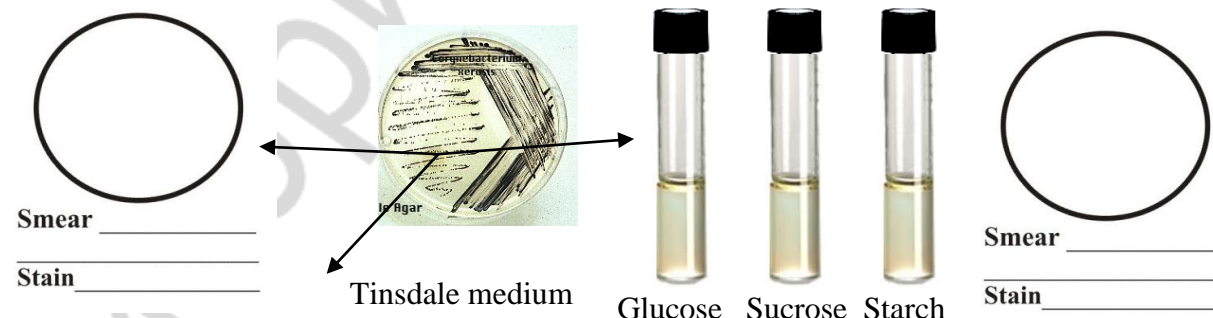
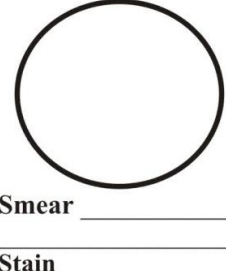
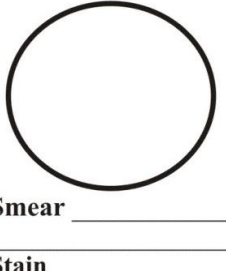
Bordetella pertussis. Characteristics of the pathogen, pathogenicity factors. Differentiation with parapertussis agent. The pathogenesis of pertussis, immunity, diagnostics. Principles of therapy and prevention of pertussis.

Haemophilus, general characteristics, role in human pathology.

Legionella, general characteristics, role in human pathology.

Listeria, general characteristics, role in human pathology.

**Laboratory work**

Tasks	Methods. results														
<p>1. Bacteriological diagnosis of diphtheria, 2nd step:</p> <p>a) Describe the colonies Corynebacterium on potassium tellurite serum agar</p> <p>b) Seed bacteria from typical colonies onto Hiss media (glucose, sucrose, starch).</p>	 <p style="text-align: center;">Tinsdale medium      Glucose    Sucrose    Starch</p>														
<p>Demonstration.</p> <p>1. Corynebacterium diphtheria stained by:</p> <p>a) Neisser; b) Leffler.</p> <p>2. Test for Corynebacterium diphtheria toxigenicity.</p> <p>3. Preparations for specific prevention and treatment of diphtheria and pertussis.</p> <p>4. Growth of Bordetella pertussis and parapertussis on CCA, NA with tyrosine, urease test.</p> <p>5. Bordetella pertussis, Gram staining</p> <p>6. Assessment of antidiphtheria immunity intensity</p>	<table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 20px;"> <thead> <tr> <th style="width: 20%;">Feature</th> <th>Colonies on serum tellurite agar</th> </tr> </thead> <tbody> <tr><td>Shape</td><td></td></tr> <tr><td>Size</td><td></td></tr> <tr><td>Surface</td><td></td></tr> <tr><td>Edge</td><td></td></tr> <tr><td>Color</td><td></td></tr> <tr><td>Consistency</td><td></td></tr> </tbody> </table> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Smear _____ Stain _____</p> </div> <div style="text-align: center;">  <p>Smear _____ Stain _____</p> </div> </div>	Feature	Colonies on serum tellurite agar	Shape		Size		Surface		Edge		Color		Consistency	
Feature	Colonies on serum tellurite agar														
Shape															
Size															
Surface															
Edge															
Color															
Consistency															

Signature of the tutor \_\_\_\_\_

**Additional materials and independent work for Class № 5.**

<b>Corynebacterium characteristics</b>		<b>Bordetella pertussis characteristics</b>	
<b>Properties</b>	<i>C. diphtheriae</i>	<b>Properties</b>	<i>B. pertussis</i>
Morphology (size, shape, relative positions of cells)		Morphology (size, shape, relative positions of cells)	
Spores development		Spores development	
Capsule		Capsule	
Flagella (motility)		Flagella (motility)	
Gram staining		Gram staining	
Pathogenicity factors			
<b>Medically important corynebacteria</b>		<b>Bordetella differentiation</b>	
<b>Species</b>	<b>Diseases</b>	<b>Feature</b>	<i>B. pertussis</i>
<i>C. diphtheriae</i>	Diphtheria		
<i>C. ulcerans</i> , <i>C. minutissimum</i> , <i>C. xerosis</i> , <i>C. pseudodiphtheriticum</i>	Opportunistic infections		
<b><i>C. diphtheriae</i> pathogenicity factors</b>		<b><i>B. pertussis</i> pathogenicity factors</b>	
<b>Pathogenicity factors</b>	<b>Biological effect</b>	<b>Pathogenicity factors</b>	<b>Biological effect</b>
Protein exotoxin (includes A and B subunits)	Protein synthesis arrest, specific damage of the myocardium, adrenal glands and nerve ganglia	Filamentous hemagglutinin	Binds cell membrane glycolipid of ciliated airway epithelium, binds surface R3 - glycoprotein receptor and initiates phagocytosis
Glycolipid (6-6'-diester-trehalose)	Phagocytosis impairment	Pertussis toxin (Pertussin)	S1 Pertussin subunit ribosylates membrane protein Gi; toxin inhibits the activity of phagocytes and monocyte migration. S2 - subunit binds to the respiratory tract cell surface glycolipid; S3 - subunit binds to phagocytes surface gangliosides
Hyaluronidase	Permeability of tissues violation	Pili	Adhesion to the ciliated epithelium of the respiratory tract
Neuraminidase		Pertactin	Adhesion to the ciliated epithelium of the respiratory tract
		Adenylate cyclase	Suppresses killing- activity of phagocytes and monocytes migration
		Dermatonekrotoksin	Damages the skin and is lethal to laboratory animals
		Tracheal toxin	peptidoglycan fragment - destroys ciliated cells of the respiratory tract; stimulates interleukin-1 secretion (fever)
		Endotoxin (LPS)	Activates complement and stimulate the production of cytokines
<b>Laboratory diagnostics and specific prophylaxis of diphtheria</b>		<b>Laboratory diagnostics and specific prophylaxis of pertussis</b>	
<b>Method</b>	<b>Properties</b>	<b>Method</b>	<b>Properties</b>
Microscopic		Bacteriological	
Cultural		Serological	
Molecular-genetic		Specific prophylaxis	
Specific prophylaxis			

<b>Haemophilus genus representatives and respective diseases</b>	
Species	Diseases
<i>H. influenzae</i>	
<i>H. ducreyi</i>	
<i>H. aphrophilus</i> , <i>H. parainfluenzae</i> , <i>H. haemolyticus</i> , <i>H. parahaemolyticus</i> u <i>dp.</i>	

<b>Haemophilus genus characteristics</b>	
Properties	<i>H. influenzae</i>
Morphology	
Spores development	
Capsule	
Flagella (motility)	
Gram staining	
Antigens	

<b><i>H. influenzae</i> pathogenicity factors</b>	
Pathogenicity factors	Biological effect
Polysaccharide capsule	Inhibition of phagocytosis
Pili and other adhesins	Attaching to epithelial cells
Lipopolysaccharide and glycopeptide	Epithelium surface and cilia damage
Ig A protease	Suppression of local immunity

<b>Laboratory diagnostics and specific prophylaxis of infections caused by <i>Haemophilus</i></b>	
Method	Properties
Microscopic	
Cultural	
Serological	
Specific prophylaxis	

<b>Legionella characteristics</b>	
Properties	<i>Legionella pneumophila</i>
Morphology (size, shape, relative positions of cells)	
Spores development	
Capsule	
Flagella (motility)	
Gram staining	

<b><i>Legionella pneumophila</i> pathogenicity factors</b>	
Pathogenicity factors	Biological effect
1. Optional intracellular parasitism	
Toxin (peptide)	inhibiting the "oxidative burst" during phagocytosis
Catalase	inactivation of toxic metabolites during macrophage activation
Factors of unknown nature	inhibit fusion of phagosomes and lysosomes, electron transport
2. Production of toxins, enzymes	
Labile exotoxin (Cytotoxin and hemolysin)	dysfunction or cell lysis
Endotoxin	dysfunction or cell lysis
Proteolytic enzymes: phosphatase, lipase, nuclease	degradation of host cells
3. Suppression of the expression of MHC class II molecules on macrophages, violation of Ag-presenting functions - the suppression of cellular immune response	

<b>Laboratory diagnostics and specific prophylaxis of legionellosis</b>	
Method	Properties
Microscopic	
Cultural	
Serological	
Molecular-genetic	
Specific prophylaxis	

### Listeria characteristics

Properties	<i>L. monocytogenes</i>
Morphology (size, shape, relative positions of cells)	
Spores development	
Capsule	
Flagella (motility)	
Gram staining	

### Listeria pathogenicity factors

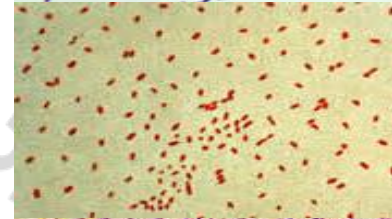
Pathogenicity factors	Biological effect
Endotoxin	Toxic effects -
Internalin - membrane protein	Listeria entry into macrophages and endothelial cells, (from phagosome into the cytoplasm)
listeriolysin O	Hemolysin, cause phagolysosomes membrane disruption
Phospholipase	Membrane damage and penetration into the cell

### Laboratory diagnostics and specific prophylaxis of listeriosis

Method	Properties
Microscopic	
Cultural	
Serological	
Molecular-genetic	
Specific prophylaxis	



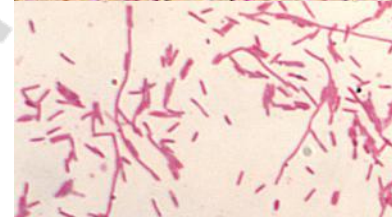
*C. diphtheriae*



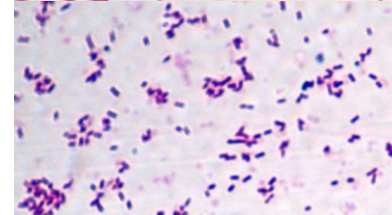
*B. pertussis*



*H. influenzae*



*L. pneumophila*



*L. monocytogenes*

**Class № 6. Methods of microbiological diagnosis of diseases caused by mycobacteria and actinomycetes.**

**Methods of microbiological diagnostics anaerobic infections**

**Data** \_\_\_\_\_

**The list of questions to study:**

Actinomycetes, systematic position, general characteristics, role in human pathology.

Mycobacteria classification. TB germs, general characteristics. Pathogenesis, immunity, methods of microbiological diagnostics, principles of treatment and prevention of tuberculosis. Mantoux test.

The causative agent of leprosy, general characteristics, role in human pathology.

Mycobacteriosis. Nocardia.

Anaerobes, classification, general characteristics. Causative agents of gas gangrene, tetanus, botulism. Systematics and general characteristics.

Exotoxins. properties Principles of therapy and prevention of anaerobic infections.

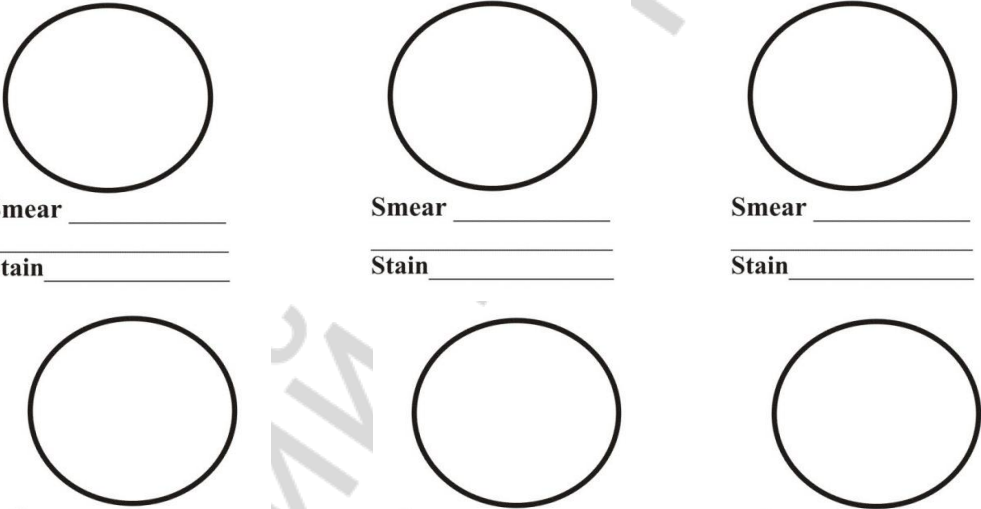
Clostridial gastroenteritis. Clostridium difitsile role in human pathology.

Nonspore anaerobes. Bacteroides. Peptococci. General characteristics, pathogenicity factors, role in human pathology.

General principles and methods for anaerobic infections diagnosis. Molecular biological diagnostics - PCR.

**Laboratory work**

Tasks	Methods, results																																								
1. The assessment of enzymatic activity of corynobacteria, identification	<p style="text-align: center;"><b>Biochemical properties of certain corynobacteria</b></p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th data-bbox="1173 879 1397 943" rowspan="2">Corynobacteria spp.</th> <th colspan="5" data-bbox="1397 879 1973 911">Enzymatic activity</th> <th data-bbox="1973 879 2103 943" rowspan="2">Nitrate reduction</th> </tr> <tr> <th data-bbox="1397 911 1514 943">Glucose</th> <th data-bbox="1514 911 1630 943">Sucrose</th> <th data-bbox="1630 911 1724 943">Starch</th> <th data-bbox="1724 911 1868 943">Cysteinase</th> <th data-bbox="1868 911 1973 943">Urease</th> </tr> </thead> <tbody> <tr> <td data-bbox="1173 943 1397 1042"><i>C. diphtheriae gravis mitis</i></td> <td data-bbox="1397 943 1514 1042">+</td> <td data-bbox="1514 943 1630 1042">-</td> <td data-bbox="1630 943 1724 1042">+</td> <td data-bbox="1724 943 1868 1042"></td> <td data-bbox="1868 943 1973 1042"></td> <td data-bbox="1973 943 2103 1042">+</td> </tr> <tr> <td data-bbox="1173 1042 1397 1198"><i>C. pseudodiphtheriae (hofmani)</i></td> <td data-bbox="1397 1042 1514 1198">-</td> <td data-bbox="1514 1042 1630 1198">-</td> <td data-bbox="1630 1042 1724 1198">-</td> <td data-bbox="1724 1042 1868 1198">-</td> <td data-bbox="1868 1042 1973 1198">+</td> <td data-bbox="1973 1042 2103 1198">+</td> </tr> <tr> <td data-bbox="1173 1198 1397 1230"><i>C. xerosis</i></td> <td data-bbox="1397 1198 1514 1230">+</td> <td data-bbox="1514 1198 1630 1230">+</td> <td data-bbox="1630 1198 1724 1230">-</td> <td data-bbox="1724 1198 1868 1230">-</td> <td data-bbox="1868 1198 1973 1230">+</td> <td data-bbox="1973 1198 2103 1230">+</td> </tr> <tr> <td data-bbox="1173 1230 1397 1262"><i>C. ulcerans</i></td> <td data-bbox="1397 1230 1514 1262">+</td> <td data-bbox="1514 1230 1630 1262">-</td> <td data-bbox="1630 1230 1724 1262">+</td> <td data-bbox="1724 1230 1868 1262">+</td> <td data-bbox="1868 1230 1973 1262">+</td> <td data-bbox="1973 1230 2103 1262">-</td> </tr> </tbody> </table> <p style="margin-top: 20px;">Conclusion: according to morphological, cultural and biochemical properties unknown bacterium is identified as _____</p>	Corynobacteria spp.	Enzymatic activity					Nitrate reduction	Glucose	Sucrose	Starch	Cysteinase	Urease	<i>C. diphtheriae gravis mitis</i>	+	-	+			+	<i>C. pseudodiphtheriae (hofmani)</i>	-	-	-	-	+	+	<i>C. xerosis</i>	+	+	-	-	+	+	<i>C. ulcerans</i>	+	-	+	+	+	-
Corynobacteria spp.	Enzymatic activity					Nitrate reduction																																			
	Glucose	Sucrose	Starch	Cysteinase	Urease																																				
<i>C. diphtheriae gravis mitis</i>	+	-	+			+																																			
<i>C. pseudodiphtheriae (hofmani)</i>	-	-	-	-	+	+																																			
<i>C. xerosis</i>	+	+	-	-	+	+																																			
<i>C. ulcerans</i>	+	-	+	+	+	-																																			

2. Microscopy of ready smear of tuberculosis patient sputum, Ziehl-Neelsen staining.						
<b>Demonstration.</b> 1. Mycobacteria growth on nutrient media. 2. Flotation method 3. Determination of M. tuberculosis drug resistance 4. Cord factor of M. tuberculosis, Ziehl-Neelsen staining. 5. Actinomycetes, pure culture, Gram staining. 6. M. leprae, Ziehl-Neelsen staining. 7. M. tuberculosis in sputum, Ziehl-Neelsen staining. 8. Anaerobes growth on nutrient media. 9. Clostridium, Gram staining. 10. Bacteroides, Gram staining.	Smear _____	Smear _____	Smear _____	Stain _____	Stain _____	Stain _____
	Smear _____	Smear _____	Smear _____	Stain _____	Stain _____	Stain _____

Signature of the tutor \_\_\_\_\_

**Materials for independent work for class № 6**

Actinomyces characteristics		Microbiological diagnostics and specific prophylaxis of actinomycosis	
Characteristics	<i>Actinomyces israelii</i>	Method	Description
Morphology (size, shape, relative positions of cells)		Microscopic	
Spores development		Cultural	
Capsule		Specific prophylaxis	
Flagella (motility)			
Gram staining			
Pathogenicity factors			



### Classification of medically important culturable mycobacteria

Slowly growing			Fast growing	
Tuberculosis agents	Non chromogenic	Chromogenic	Non chromogenic	Chromogenic
<i>M. tuberculosis</i> <i>M. bovis</i> <i>M. africanum</i>	<i>M. avium complex</i> <i>M. xenopi</i> <i>M. haemophilum et al.</i>	<i>M. kansasii</i> <i>M. marinum</i> <i>M. simae et al.</i>	<i>M. fortuitum</i> <i>M. chelonae</i> <i>M. smegmatis et al.</i>	<i>M. phlei</i> <i>M. vaccae</i>

### Myobacteria characteristics

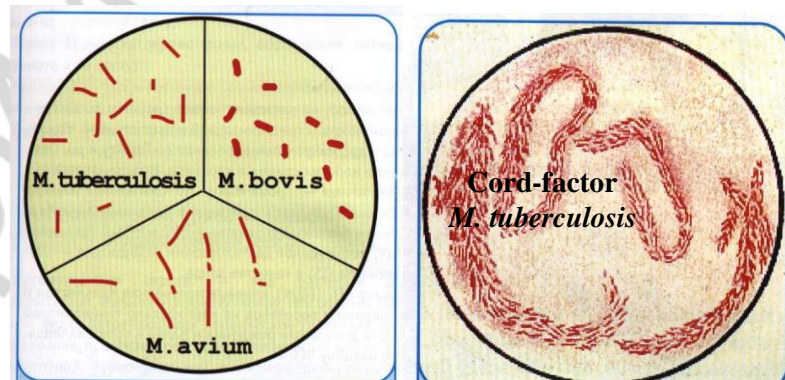
Characteristics	<i>M. tuberculosis</i>	<i>M. leprae</i>
Morphology (size, shape, relative positions of cells)		
Spores development		
Capsule		
Flagella (motility)		
Gram staining		
Pathogenicity factors		

### *M. tuberculosis* pathogenicity factors

Pathogenicity factors	Biological effects
Cord-factor (trehalose-6,6-dimycolate)	
Sulphatides (sulfur-containing glycolipids)	
Antigens	

### Microbiological diagnostics and specific prophylaxis of tuberculosis

Methods	Remarks
Microscopic	
Cultural	
Serological	
Biological	
Molecular-genetic	
Allergic	
Specific prophylaxis	



### Microbiological diagnostics and specific prophylaxis of leprosy

Methods	Remarks
Microscopic	
Allergic	
Biological	
Specific prophylaxis	

Ecological group of anaerobic bacteria			Clostridia characteristics			
Gram-negative nonsporeing rods		Diseases induced	Characteristics	<i>C. perfringens</i>	<i>C. tetani</i>	<i>C. botulinum</i>
<i>Bacteroides species</i>			Morphology (size, shape, relative positions of cells)			
<i>Fusobacterium species</i>			Spores development			
<i>Leptotrichia bucalis</i>			Capsule			
<i>Prevotella species</i>			Flagella (motility)			
<i>Porphyromonas species</i>			Gram staining			
<i>Bilophila wadsworthia</i>			Pathogenicity factors			
Grampositive spore forming rods						
Clostridia	<i>Clostridium tetani</i>	Tetanus (Lockjaw)	<b><i>Clostridium perfringens</i> pathogenicity factors</b>			
	<i>Clostridium perfringens, C. novyi, C. ramosum, C. histolyticum, C. septicum</i>	Gas gangrene, necrotizing enteritis				
	<i>Clostridium botulinum</i>	Botulism	Main toxins	Pathogenicity factors	Biological effects	
	<i>Clostridium difficile</i>	Pseudomembranous colitis, antibiotic-associated diarrhea		alpha-toxin (Lecithinase)	cleaves lecithin in cell membranes; increases vascular permeability destroying erythrocytes; necrotizing activity	
Gramnegative cocci			Main toxins	beta-toxin	necrotizing activity; induction of hypertension as a result of formation of catecholamines	
<i>Veillonella</i>	Septic infections	epsilon toxin		increases vascular permeability of the gastrointestinal tract		
Grampositive cocci				Iota toxin	necrotizing activity and increased vascular permeability	
<i>Enterococcus species</i>	Septic infections			enterotoxin	violates the permeability of the mucosa of the small intestine	
<i>Peptococcus species</i>						
<i>Peptostreptococcus spp.</i>						
<b><i>Bacteroides</i> pathogenicity factors</b>			Minor toxin	delta-toxin	hemolysis	
Pathogenicity factors		Biological effect		theta toxin	hemolysis, cytolysis	
toxins	endotoxin	general toxic effect		kappa toxin	collagenase, gelatinase, necrotizing activity	
	leukocidin	damages leukocytes		lambda-toxin	protease	
enzymes	collagenase	destroys the collagen fibers of the connective tissue (spread of purulent process)		mu-toxin	hyaluronidase: increases the permeability of tissues	
	DNase, heparinase	cause intravascular blood clotting		nu-toxin	DNase; hemolytic, necrotizing activity	
	fibrinolysin	dissolves blood clots		neuraminidase	damages gangliosides cell receptor, promotes thrombosis in capillaries	

	beta-lactamase	destroys the beta-lactam antibiotics
surface cell structure	pili	adhesion to the substrate
	capsule	protects the bacteria from phagocytosis
Metabolites	fatty acid	inhibit the chemotaxis and cytotoxicity of leukocyte

#### Microbiological diagnostics of septic infections caused by bacteroides

Method	Remarks
Microscopic	
Cultural	
Serological	
Molecular-genetic	

#### Microbiological diagnostics and specific prophylaxis of gas gangrene

Method	Remarks
Microscopic	
Cultural	
Biological	
Specific prophylaxis	

#### *Clostridium tetani* pathogenicity factors

Pathogenicity factors	Biological effects
Tetanus toxin	

#### Microbiological diagnostics and specific prophylaxis of tetanus

Methods	Remarks
Microscopic	
Biological	
Cultural	
Specific prophylaxis	

#### *Clostridium botulinum* pathogenicity factors

Pathogenicity factors	Biological effects
Botulinum exotoxin	Blocks the transmission of nerve impulses in the peripheral cholinergic synapses, providing neurotoxic effects (lethal dose for humans is about 0.3 g)

#### Microbiological diagnostics and specific prophylaxis of botulism

Methods	Remarks
Serological	
Biological	
Cultural	
Specific prophylaxis	Botulinum toxoids A, B, E, are used according to indications. For urgent passive prophylaxis specific antitoxic serum is used.

**The list of questions to study:**

Classification and general characteristics of the especially dangerous infections. Demands to collection and transportation of biological material. Principles of diagnostics.

Vibrio cholerae, the systematic position. Classification and general characteristics, pathogenicity factors. Biovars. Differentiation from non-cholera vibrio. Pathogenesis of cholera. Methods of microbiological diagnostics. Rapid methods. Principles of treatment and prevention.

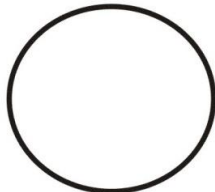
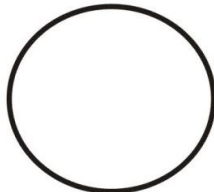
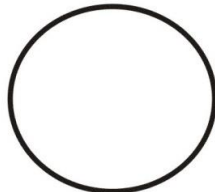
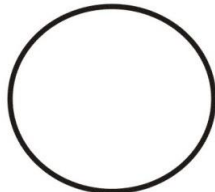
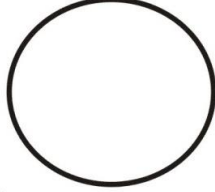
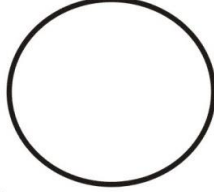
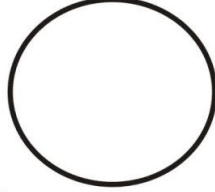
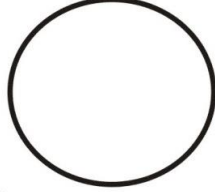
The causative agent of plague, systematic position, characteristics, pathogenicity factors. Differences from other Yersinia. Pathogenesis, principles of treatment and prevention of plague.

The causative agent of tularemia, systematics, general characteristics. Pathogenesis, principles of treatment and prevention.

Causative agents of brucellosis. Systematics and general characteristics, pathogenicity factors, pathogenesis. Microbiological diagnosis of brucellosis. Principles of treatment and prevention.

Anthrax. Systematics and general characteristics, pathogenicity factors. Differences from non-pathogenic bacilli. Pathogenesis. Microbiological diagnosis of anthrax. Principles of treatment and prevention.

**Laboratory work**

Tasks	Methods, results			
<p><b>Demonstration.</b></p> <ol style="list-style-type: none"> <li>Growth of vibrio cholera on alkaline agar, TCBS, peptone water.</li> <li>Phage lysability of vibrio cholera classica and El Tor.</li> <li>Tube agglutination test.</li> <li>Biochemical properties of V. cholerae.</li> <li>Mobility of Vibrio spp.</li> <li>V.cholera, pure culture, Gram staining.</li> <li>I.pestis in the organs, Leffler staining.</li> <li>The causative agent of tularemia (pure culture), Gram staining.</li> <li>Preparations for specific prophylaxis of especially dangerous infections.</li> <li>The causative agent of brucellosis, Gram staining.</li> <li>The growth of Bacillus spp. on nutrient media.</li> <li>B.anthraxis in organs, Gram staining.</li> <li>B.anthraxis, pure culture, Gram staining.</li> <li>B.anthraxis spores, Ozheshko staining.</li> </ol>	 Smear _____ Stain _____	 Smear _____ Stain _____	 Smear _____ Stain _____	 Smear _____ Stain _____
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	Signature of the tutor _____			

**Additional materials for independent study for class №7**

***V. cholera* characteristics**

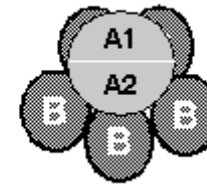
Characteristics	<i>Vibrio cholerae</i>
Morphology (size, shape, relative positions of cells)	
Spores development	
Capsule	
Flagella (motility)	
Gram staining	
Pathogenicity factors	

***Vibrio cholerae* pathogenicity factors**

Pathogenicity factors	Biological effects
Exotoxin (cholera toxin)	Violation of water-salt metabolism, the cytotoxic effect on the epithelium of the small intestine
Endotoxin	Inhibition of phagocytosis, drop in blood pressure; infectious-toxic shock
Pili	Adhesion to mucosal cells
Fibrinolysin hyaluronidase	Enzymes invasion (aggression)

**Microbiological diagnostics and specific prophylaxis of cholera**

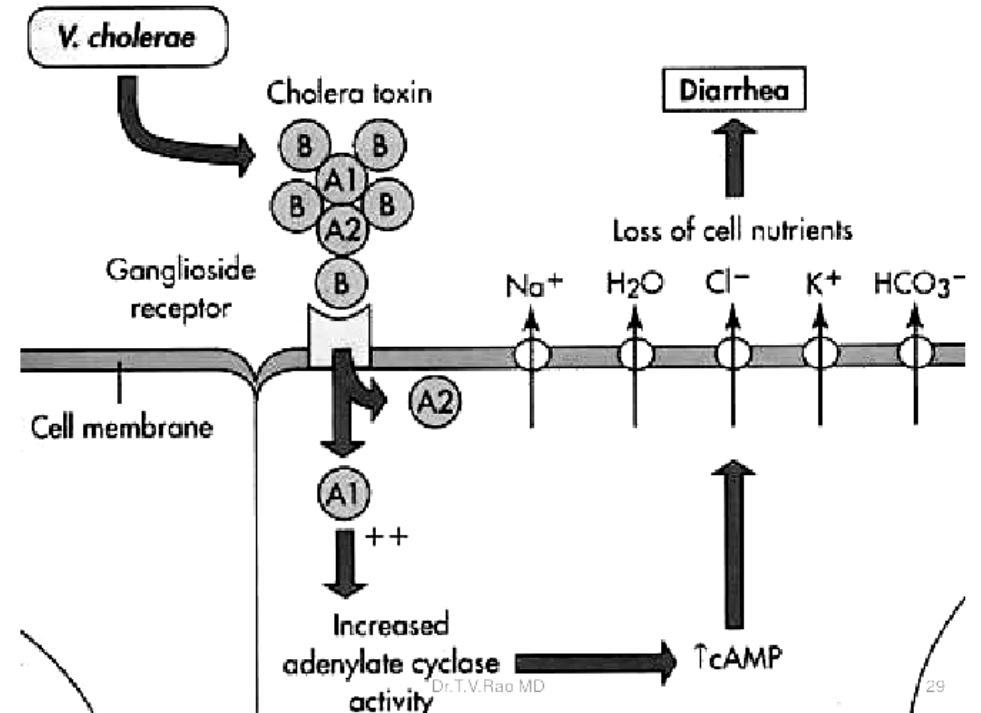
Method	Remarks
Microscopic	
Cultural	
Serological	
Molecular-genetic	
Specific prophylaxis	



**CHOLERA TOXIN**

5 B Subunits (Delivery)  
1 A Subunit (Enzyme)

**Mechanism of Action of Cholera Toxin**



***I. pestis* characteristics**

Characteristics	<i>Yersinia pestis</i>
Morphology (size, shape, relative positions of cells)	
Spores development	
Capsule	
Flagella (motility)	
Gram staining	
Pathogenicity factors	

***Y. pestis* pathogenicity factors**

Pathogenicity factors	Biological effects
Capsular Ag, F1-Ag, fraction 1)	protection against the absorption of phagocytes, non-toxic, the immunogen
Plasminogen activator - protease	activates lysis of fibrin clots, and inactivates C5a
V/W(Vi)-Ag	Includes protein (V-phase) and LPS (W-phase); exhibits antiphagocytic properties, promotes intracellular bacterial growth
Murine toxin	adrenergic receptor antagonist, proteinaceous substance, localizes intracellularly
Bacteriocins (pestitsiny)	Immunogenic properties

**Microbiological diagnostics and specific prophylaxis of plague**

Method	Remarks
Microscopic	
Cultural	
Molecular-genetic	
Biological	
Specific prophylaxis	

***F. tularensis* characteristics**

Characteristics	<i>Francisella tularensis</i>
Morphology (size, shape, relative positions of cells)	
Spores development	
Capsule	
Flagella (motility)	
Gram staining	
Pathogenicity factors	

***F. tularensis* pathogenicity factors**

Pathogenicity factors	Biological effects
Intracellular parasitism	Inhibition of phagocytes lysosomal function,
Capsule	Protection from phagocytosis
Endotoxin	Less active than other Gram-negative rods endotoxin (e.g., <i>E. coli</i> )

**Microbiological diagnostics and specific prophylaxis of tularemia**

Method	Remarks
Microscopic	
Cultural	
Serological	
Molecular-genetic	
Allergic	
Biological	
Specific prophylaxis	

Brucellosis agents characteristics		Anthrax pathogen characteristics	
<b>Characteristics</b>	<i>Brucella spp.</i>	<b>Characteristics</b>	<i>B. anthracis</i>
Morphology (size, shape, relative positions of cells)		Morphology (size, shape, relative positions of cells)	
Spores development		Spores development	
Capsule		Capsule	
Flagella (motility)		Flagella (motility)	
Gram staining		Gram staining	
Pathogenicity factors		Pathogenicity factors	
<b>Brucella pathogenicity factors</b>		<b>Bacillus anthracis pathogenicity factors</b>	
<b>Pathogenicity factors</b>	<b>Biological effects</b>	<b>Pathogenicity factors</b>	<b>Biological effects</b>
Endotoxin	Systemic toxic effect	Protein exotoxin (synthesis is controlled plasmid)	Exotoxin contains three factors: <b>lethal factor</b> - the cytotoxic effect, pulmonary edema, <b>protective Ag</b> - interacts with cell membranes mediates the activity of others. components, edematous factor - the increase in the concentration of cAMP, the development of edema
Hyaluronidase	Breaks down hyaluronic acid	Capsule	Antiphagocytic activity
Outer Membrane Proteins	Adhesion		
<b>Microbiological diagnostics and prophylaxis of brucellosis</b>		<b>Microbiological diagnostics and specific prophylaxis of anthrax</b>	
<b>Method</b>	<b>Remarks</b>	<b>Method</b>	<b>Remarks</b>
Microscopic		Microscopic	
Cultural		Cultural	
Serological		Serological	
Allergic		Allergic	
Molecular-genetic		Molecular-genetic	
Biological		Biological	
Specific prophylaxis		Specific prophylaxis	

**List of questions to study:**

Spirochetes, classification, general characteristics.

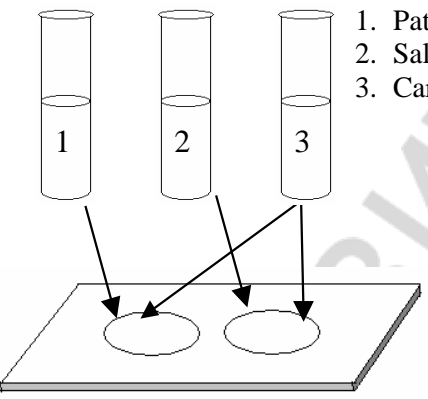
Treponema. Systematics and general characteristics. Pathogenesis and immunity in syphilis. Material for the study. Methods of microbiological diagnosis of syphilis. Principles of therapy and prevention of syphilis.

Fusospirochetosis pathogens

Leptospira. Systematics and general characteristics. Pathogenesis, methods of microbiological diagnostics, principles of treatment and prevention of leptospirosis.

Borrelia. Systematics and general characteristics. Pathogenesis and methods of microbiological diagnosis of relapsing fever. The causative agent of Lyme borreliosis, principles of treatment and prevention.

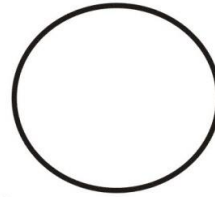
**Laboratory work**

Tasks	Methods, results
<p>1. Perform the slide microprecipitation reaction (VDRL) for the syphilis serodiagnosis.</p> <p>2. Assess ELISA (Wasserman test) for the syphilis diagnostics.</p>	<p><b>Slide microprecipitation test</b></p>  <p>1. Patient serum 1:20 2. Saline sol. 3. Cardiolipin Ag</p> <p>Conclusion: _____</p>



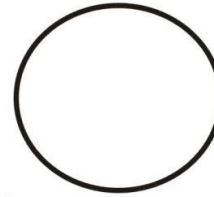
**Demonstration.**

1. Leptospire, dark field microscopy.
2. Borrelia in blood, Romanovsky-Giemsa staining.
3. Wasserman test (ELISA).
4. Treponema in dental plaque, Gram staining.
5. Treponema pallidum, pure culture, Romanovsky-Giemsa staining.



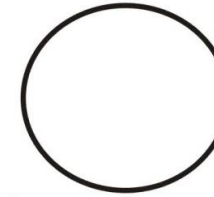
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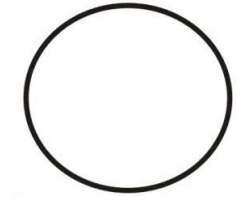
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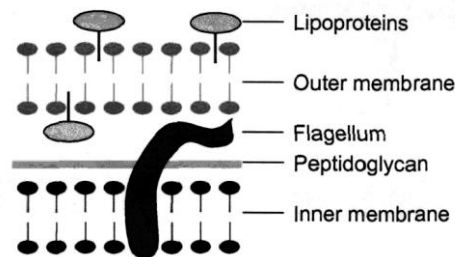
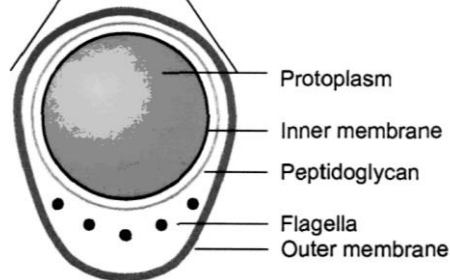
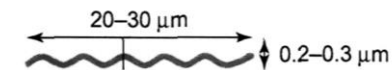
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**Additional materials for independent study for class № 7.**

**Spirochetes structure**



**Pathogenic spirochetes characteristics**

Features		Spirochetes genera		
		<i>Treponema</i>	<i>Borrelia</i>	<i>Leptospira</i>
Size	Length	5-20	3-20	7-14
	Width	0,09-0,5	0,2-0,5	0,1-0,15
Helixes number		8-12	2-8	12-24
Helix shape		Uniform, correct,	Uneven, different size	Uniform, correct secondary curls
Romanovsky-Giemsa staining		Pink	Blue Purple	Pink, Red

Diseases caused by treponema					Pathogenesis of syphilis		
Treponema spp.	Disease	Morbidity (countries, continents)			Disease stage	Period	Main pathogenetic mechanisms
<i>T. pallidum</i> , subspecies <i>pallidum</i>					Primary		
<i>T. pallidum</i> , subspecies <i>bedjel</i> (endemicum)					Secondary		
<i>T. pallidum</i> , subspecies <i>pertenue</i>					Tertiary		
<i>T. carateum</i>							
Opportunistic or saprophytic: <i>T. vincentii</i> , <i>T. refringens</i> , <i>T. denticola</i> , <i>T. minutum</i> , <i>T. scoliodontum</i>							
Methods for spirochetosis diagnostics					<b>Serological diagnosis of syphilis:</b>		
Methods	Method usage (+/-)					CFT (Wasserman) with treponemal and cardiolipin antigens in primary syphilis becomes positive in the 6th week of the disease in 25-50% of patients, in 7-8 weeks - 75-90%. In secondary syphilis it is positive in 98-100% cases. In tertiary syphilis CFT is positive in only 60-70% patients. CFT for syphilis diagnostics has unsatisfactory sensitivity and specificity and is replaced now by ELISA.	
	Syphilis	Epidemic relapsing fever	Endemic relapsing fever	Lyme disease	Lepto-spirosis	ELISA is the common used technics for syphilis diagnostics.	
Microscopic						Confirmatory tests:	
Cultural						– treponema immobilization test is rather specific, but time and labor consuming, subjective, requires treponema culture;	
Serological						– immunofluorescence (IF) with serum from patients.	
Allergic						Screening tests: slide microprecipitation test, ELISA	
Molecular-genetic							
Biological							
<b>Laboratory diagnosis of Lyme disease (Lyme borreliosis):</b>							
Microscopic method: dark-field microscopy (scrapings of skin lesions, plasma pellet, CSF, urine), microscopy of smears, impregnated with silver, IFT, and electron microscopy.							
Cultural method: <i>B. burgdorferi</i> isolation is possible in 80% cases from skin lesions (1stage) on special nutrient media.							
Molecular genetic methods: PCR allows the identification of the pathogen's DNA in the samples of the skin, blood, cerebrospinal fluid.							
Serological: ELISA, indirect IFT, Western blot. Sometimes there are false-positive results due to cross-reactions among patients with syphilis, mononucleosis, rheumatoid arthritis and others.							

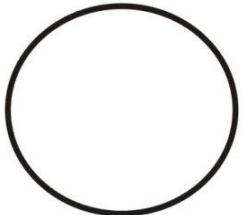
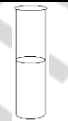
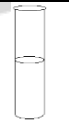
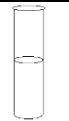
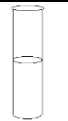

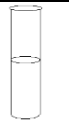
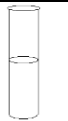
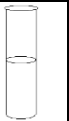


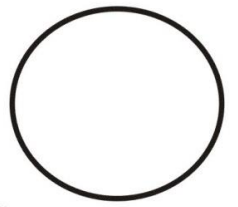
















**List of questions to study:**

Rickettsiae, systematic position, classification, general characteristics, role in human pathology. Rickettsia typhi, pathogenesis, immunity and methods of microbiological diagnostics. Other pathogenic rickettsia.

Chlamydia, general characteristics, role in human pathology. Pathogens of psittacosis, trachoma, respiratory and urogenital chlamydiosis. Methods of microbiological diagnosis of chlamydiosis. PCR in chlamydiosis diagnostics.

Mycoplasma, general characteristics, role in human pathology. Methods of microbiological diagnostics of mycoplasmoses.

**Laboratory work**

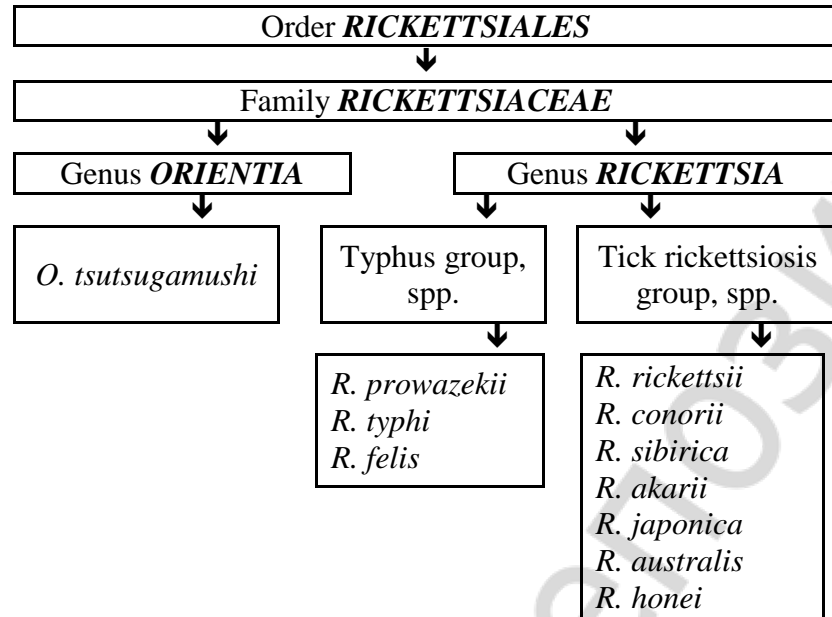
Tasks	Methods, results										
<p>1. Perform CFT for the typhus diagnostics</p> <div style="text-align: center;">  <p>Smear _____</p> <p>Stain _____</p> </div>	Reagents	1	2	3	4	5	6	7	SC	DC	Hemolytic system
	Saline sol.	1:5	1:10	1:20	1:40	1:80	1:160	1:320	0,5	0,5	4 ml 3% erythrocytes suspension + 4 ml hemolytic serum
	Serum of the patient	-	0,5	-	-	-	-	-	0,5	-	
	Diagnosticum	0,5	0,5	0,5	0,5	0,5	0,5	0,5	-	0,5	
	Complement	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	
	Incubation 30 minut at 37° C										
	Hemolytic system										
	Incubation for 30' at 37 °C										
	Assessment										
	Conclusion:										
<p><b>Demonstration.</b></p> <p>1. Passive blood agglutination test for differential diagnostics of epidemic and residual typhus</p> <p>2. Chlamydia spp. in cell culture, Romanovsky-Giemsa staining.</p> <p>3. R. prowazeki, pure culture, Zdrodovski staining.</p>	1/10	1/20	1/40	1/80	1/160	1/320	1/640	SC	DC	<div style="text-align: center;">  <p>Smear _____</p> <p>Stain _____</p> </div>	
											
											
Conclusion: _____											

Signature of the tutor \_\_\_\_\_

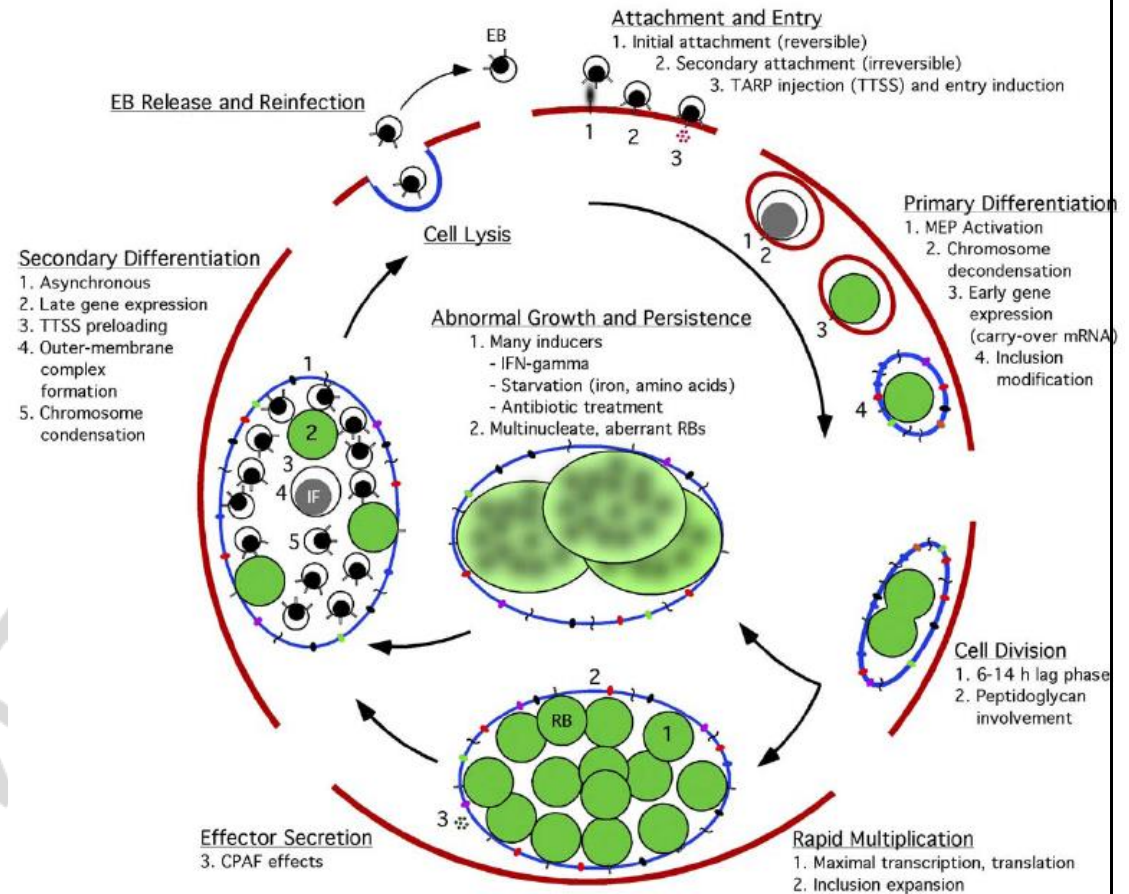
**Additional materials for independent work wor class № 8**

**Actual classification of Rickettsia:**

On the basis of a molecular genetic studies (genome sequencing, PCR) classification of microorganisms belonging to the order Rickettsiales has undergone significant changes. The genus *Coxiella* with *C. burnetti* was excluded from the family and added in the order Legionellales, family Coxiellaceae. Genus *Rochalimaea* was removed, and its representatives - *R. quintana* (Trench fever) and *R. henselae* (cat scratch disease) were included in the family Bartonellaceae, genus *Bartonella*. The family Rickettsiaceae now include three genera: *Rickettsia*, *Orientia*, *Wolbachia*. The medical importance of the latter genus is still unclear.



**The scheme of intracellular Chlamydia cycle**



### Laboratory diagnostics of diseases caused by Rickettsia, Chlamydia and Mycoplasma

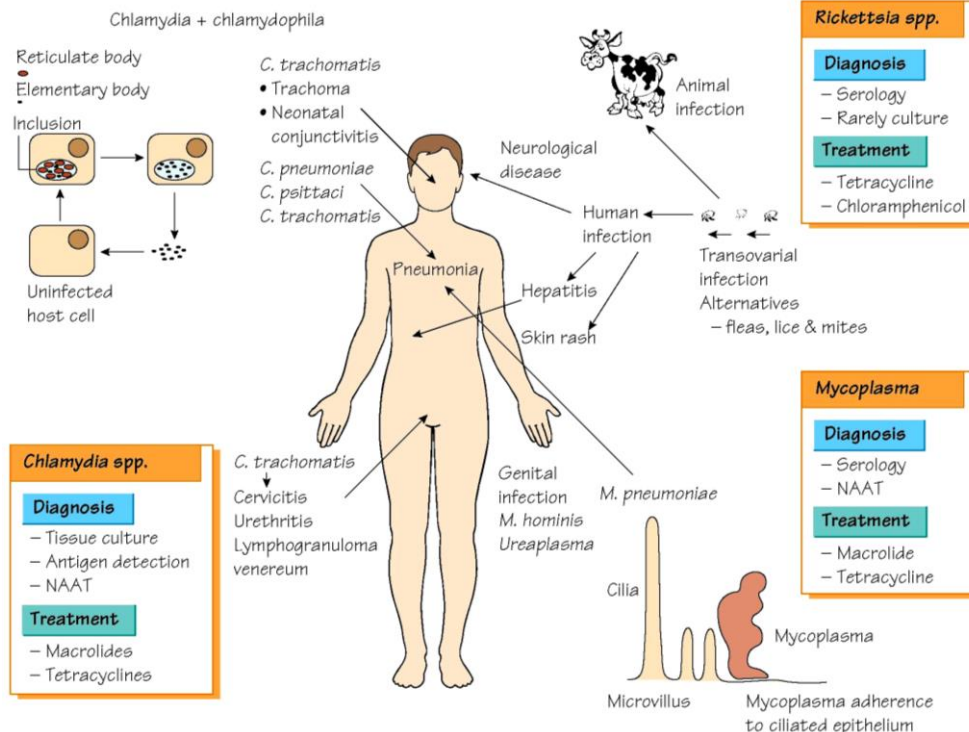
Method	Method usage		
	rickettsiosis	chlamydiosis	mycoplasmosis
Microscopic			
Cultural	Nutrition media		
	Chicken embryo		
	Cell culture		
	Lab animals		
Biological			
Serological			
Allergic			
Molecular-genetic			

### Chlamydiosis characteristics

Disease	Pathogen	Source	Transmission
Trachoma			
Urogenital chlamydiosis			
Veneral lymphogranulomas			
Psittacosis			
Pharyngitis, sinusitis, bronchitis, pneumonia			

### Mycoplasma and mycoplasmosis characteristics

Properties	<i>Mycoplasma spp</i>
	Size
Cell wall, peptidoglican	
Gram staining	
Capsule	
Flagella	
Spore	
Resistance in environment	
Cultural properties	
Reproduction	
Parasitism peculiarities	
Source of infection	
Transmission mechanisms	
Immunity	



1. Staphylococci, general characteristics. Role in human pathology. Pathogenicity factors and mechanisms of pathogenesis of staphylococcal infections. Microbiological diagnosis. Principles of treatment and prevention of staphylococcal infections.
2. Streptococci, classification. General characteristics. Pathogenicity factors. Antigenic structure. Pathogenesis, immunity, microbiological diagnosis, principles of treatment and prevention of streptococcal infections.
3. Classification of Neisseria. Meningococcus, general characteristics. Meningococcal infections, mechanisms of pathogenesis, immunity, methods of diagnosis, prevention.
4. Gonococci, general characteristics. Mechanisms of pathogenesis and immunity. Microbiological diagnosis of acute and chronic gonorrhoea.
5. General characteristics of the family Enterobacteriaceae.
6. General Principles of bacteriological diagnosis of acute intestinal infections (AII). The nutrient medium for enterobacteria. Classification principles of application.
7. Materials for researches in AII diagnostics.
9. E. coli, common characteristic. The biological role of Escherichia coli. Diseases caused by Escherichia.
10. Salmonella. General characteristics. Members of the genus. Serological classification by Kaufmann-White. Molecular biological typing.
11. Pathogens of typhoid, paratyphoid A and B, general characteristic. Phage typing. Vi-antigen and its value.
12. Pathogenesis and methods of microbiological diagnosis of typhoid and paratyphoid.
13. Immunity in typhoid fever. Serological diagnosis of typhoid and paratyphoid. Specific prophylaxis.
14. The etiology of food poisoning and intoxication of bacterial origin. Materials and methods of diagnosis.
15. Salmonellosis. Characteristics of pathogens and diagnostic methods. Nosocomial salmonellosis.
16. Shigella. Classification. Characteristics. Pathogenesis, immunity. Methods of microbiological diagnostics of acute and chronic dysentery.
17. Klebsiella. Classification, general characteristics. Pathogenesis, immunity, methods of microbiological diagnostics of klebsiellosis.
18. Pseudomonas aeruginosa, general characteristics, pathogenicity factors. Role in human pathology.
19. Pathogens of intestinal yersiniosis, general characteristics. Pathogenesis. Methods of diagnosis of yersiniosis.
20. C. diphtheria, general characteristics. Differences from non-pathogenic corynebacteria. Mechanisms of pathogenesis and microbiological diagnosis of diphtheria.
21. Diphtheria toxin and its properties. Toxoid. Immunity in diphtheria and its character. Determination of antitoxic immunity. Principles of therapy and prevention of diphtheria.
22. The causative agent of whooping cough, general characteristics. Differentiation with paraptussis agent. Pathogenesis, immunity. Microbiological diagnosis, principles of treatment and prevention of pertussis.
23. General characteristics of the causative agents of tuberculosis. Pathogenesis, immunity, diagnosis and specific prevention of tuberculosis. Mycobacteriosis.
24. The causative agent of leprosy. Characteristic, pathogenesis, immunity.

25. Particularly dangerous infections. classification mode, Basic rules of sampling, sending and transportation of infectious material General principles of diagnosis TELO.
26. V. cholera. Systematics. General characteristics. Differentiation of biovars. Pathogenesis, immunity, principles of treatment and prevention. Methods of microbiological diagnostics.
27. The causative agent of plague, a general characteristic. The pathogenesis of plague. Immunity, the principles of therapy and prevention of plague.
28. B. anthracis characteristic. Pathogenesis, immunity, principles of treatment and prophylaxis of anthrax.
29. The causative agent of tularemia, general characteristic. Pathogenesis, immunity, principles of treatment and prophylaxis of tularemia.
30. Pathogens of brucellosis, a general characteristic. Differentiation of Brucella species. Pathogenesis, immunity, principles of treatment and prevention of brucellosis.
- 31 Spirillae family. Campylobacter, characteristics, role in human pathology. Helicobacter.
32. Classification and general characteristics of anaerobes. Clostridia. Bacteroides, Peptococci and other nonspore anaerobes. Pathogenicity factors. Role in human pathology.
33. The causative agent of tetanus, general characteristics. Pathogenesis, immunity, principles of treatment and prevention of tetanus.

34. Gas gangrene pathogens, general characteristics. Pathogenesis, principles of treatment and prevention of gas gangrene.
35. The causative agent of botulism, general characteristic. Pathogenesis, principles of botulism prevention and therapy. Clostridial gastroenteritis.
36. Methods of diagnosis of anaerobic infections.
37. Classification and general characteristics of spirochetes.
38. Classification of treponemes and treponemal diseases. Characteristics of syphilis causative agent. Pathogenesis, immunity, diagnostic tests for syphilis.
39. Leptospire. General characteristics. The pathogenesis of leptospirosis, immunity, specific prevention. Microbiological diagnosis of leptospirosis.
40. Borrelia, general characteristics. Recurrent fever pathogenesis, immunity. Microbiological diagnosis. The causative agent of Lyme borreliosis.
41. Systematic position and characterization of Rickettsia. Pathogenesis, immunity, methods of diagnosis of typhus.
42. Characteristics of chlamydia. Causative agents of trachoma, psittacosis, respiratory and urogenital chlamydiosis. Pathogenesis and methods of diagnosis of chlamydia.
43. General characteristics of mycoplasma, pathogenicity factors, role in human pathology. Methods of mycoplasmosis diagnosis.

Practical skills:

1. Determine the morphology of Staphylococcus, pure culture, Gram stain.
2. Determine the morphology of streptococcus, pure culture, Gram stain.
3. Determine the morphology of gonococci in pus, Gram stain.
4. Determine the morphology of enterobacteria, pure culture, Gram stain.
5. Determine the morphology of the mixture of S.aureus and Escherichia coli, Gram stain.
6. Determine the morphology of B.anthraxis, pure culture, Gram stain.

7. Determine the morphology vibrio, pure culture, Gram stain.
8. Determine the morphology of Brucella, a pure culture, Gram stain.
9. Determine the morphology corynebacteria, pure culture, Leffler stain.
10. Determine the morphology of Klebsiella, pure culture, Hins-Burri stain.
11. Determine the morphology of mycobacteria in sputum, Ziehl-Neelsen stain.
12. Determine the biochemical properties of enterobacteria on Kligler iron agar medium.

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РЕПОЗИТОРИЙ БГМУ



**List of questions to study:**

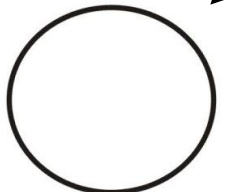
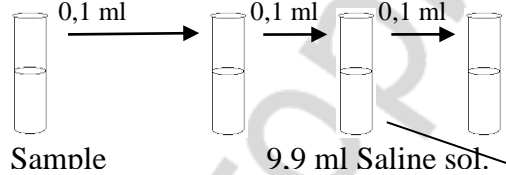
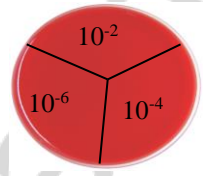
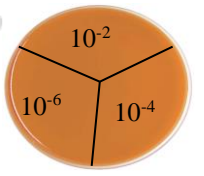
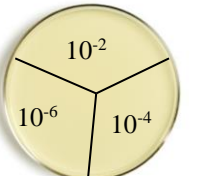

Clinical Microbiology: definition, objectives. Opportunistic microbes (OPM). Epidemiology, pathogenesis, diagnosis of diseases caused by UPM. Criteria of etiological significance.

Clinical forms and the etiology of septic infections of the skin and subcutaneous tissue. Methods of microbiological diagnostics.

Bacteriological method. Material for the research (pus, exudate), rules and methods of sampling. Criteria for assessment of the etiological significance of isolated microorganisms. Susceptibility to antibiotics.

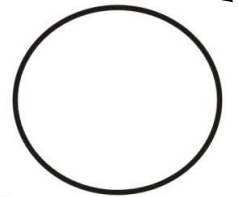
Bacteremia. Sepsis. Pyosepticemia. Etiology, definitions. Methods of microbiological diagnosis of sepsis. Bacteriological method. Rules and methods of blood collection for the research, peculiarities of pathogen isolation and results interpretation Susceptibility to antibiotics testing.

**Laboratory work**

Tasks	Methods, results
<p>1. Independent work “Research of the sample from the burnt wound”.</p> <p>a) Make serial dilution of the sample 1:100; 1:10000; 1:1000000)</p> <p>b) Streak respective sectors on nutrient media</p> <p>2. Research of the blood sample from the patient with suspected sepsis.</p> <div style="text-align: center;">  <p>Smear _____</p> <p>Stain _____</p> </div>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p><b>Exsudate sample research (Ist step)</b></p>  <p>Sample → 0,1 ml → 9.9 ml Saline sol. → 0,1 ml → 0,1 ml</p> <p>Streak respective sector with 0,05 ml (1 drop)</p> <div style="display: flex; justify-content: center; gap: 20px;"> <div style="text-align: center;">  <p>Blood aga</p> </div> <div style="text-align: center;">  <p>Levin media</p> </div> <div style="text-align: center;">  <p>Nutrient agar with furaginum</p> </div> </div> </div> <div style="text-align: center; margin-top: 20px;"> <p><b>Blood sample research (Ist step)</b></p>  <p>Blood, 10 ml → Biphasic (enrichment) media, 37 °C</p> </div> </div>

3. Research of the sample from the bronchi washings:

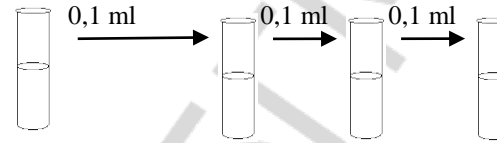
- a) Prepare the slide from the material, Gram staining;
- b) perform quantitative seeding of the material on selective media.



Smear \_\_\_\_\_

Stain \_\_\_\_\_

**Bronchi washings sample research (1st step)**



Streak respective sector with 0,05 ml (1 drop)

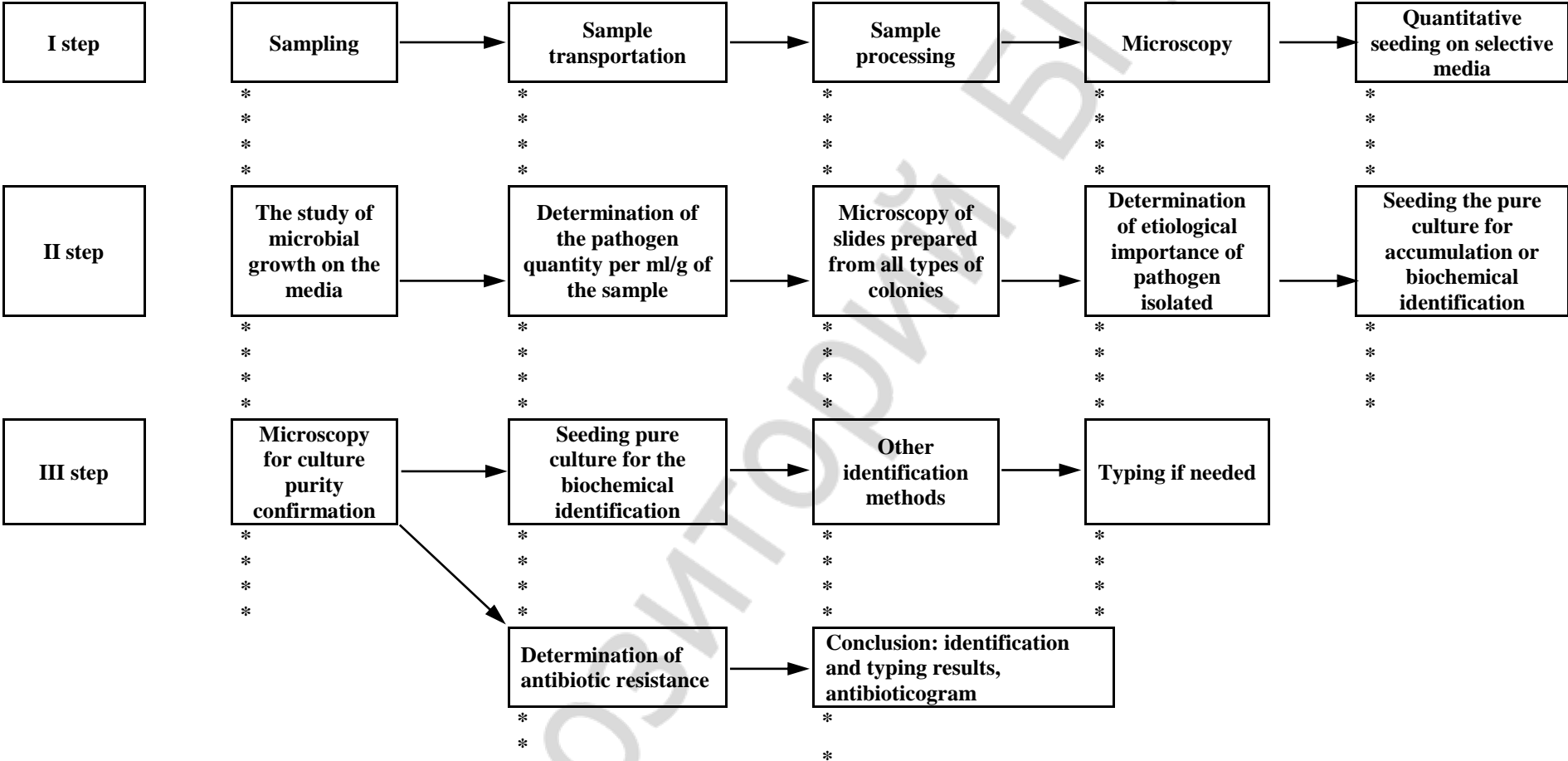
Blood agar      Levin media      Nutrient agar with lactose and bromothymol blue

Signature of the tutor \_\_\_\_\_

**Additional materials for independent work for class № 10.**

Criteria of etiological importance off opportunistic pathogens	Etiology (main pathogens) of purulent infection of the skin
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	
7.	
8.	
9.	
10.	

**The scheme of the microbiological diagnostics of purulent-septic infections**



**Class № 11. Clinical microbiology. Microbiological diagnostics of purulent infections of urinary tract. Hospital-acquired infection.**

Date \_\_\_\_\_

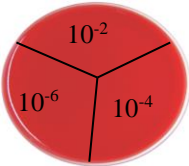
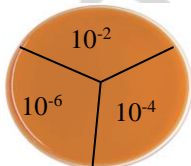
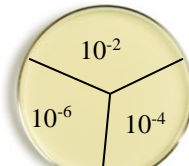

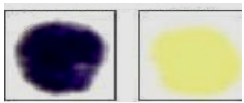
**The list of questions to study:**

Clinical forms and etiology of septic-purulent (opportunistic) infections of the bronchi and lungs. Methods of microbiological diagnostics. Material for the research, rules and methods of sampling. Bacteriological method. Criteria for assessing the etiological role of isolated bacteria. Susceptibility to antibiotics.

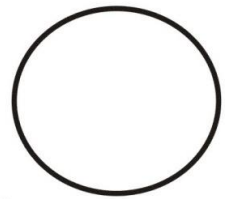
Etiology and clinical forms of septic-purulent (opportunistic) infections of the urogenital tract. Methods of microbiological diagnostics. Material for the study, rules and methods of sampling. Urine culture. Criteria for assessing the etiological role of isolated microbes. Susceptibility to antibiotics. Antibioticogramm.

Nosocomial infections. Pathogens. Principles of microbiological diagnosis. Prevention.

**Laboratory work**

Tasks	Methods, results
<p>1. Independent work: "Research of the sample from the burnt wound"</p>	<p style="text-align: center;"><b>Exsudate sample research (IIst step)</b></p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>Blood agar</p> </div> <div style="text-align: center;">  <p>Levin media</p> </div> <div style="text-align: center;">  <p>Nutrient agar with furaginum</p> </div> <div style="text-align: center;">  <p><i>p</i>-Phenylenediamine (PPD)</p> </div> <div style="text-align: center;">  <p>Oxidase test</p> </div> </div> <p>Colonies characteristics:</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>Calculation of bacteria quality per ml/g of the sample:  <math>N \text{ (CFU/ml)} = n \times 20 \times 10^x</math>,  <math>n</math> – colonies quantity in respective sector, 20 – conversion factor for 1 ml,  <math>10^x</math> – the degree of the sample dilution.</p> <p>N = _____ CFU/ml</p> <p style="text-align: right;">Smear _____          Stain _____</p> <p style="text-align: center;">Conclusion _____</p>

2. Research of the blood sample from the patient with suspected sepsis.



Smear \_\_\_\_\_

Stain \_\_\_\_\_

**Research of the blood sample (II step)**



Blood culture



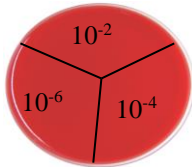
Blood agar



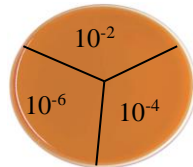
Yolk-salt agar

3. Research of the sample from the bronchi washings

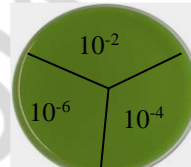
**Bronchi washings sample research (II st step)**



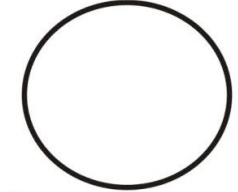
Blood agar



Levin media



Nutrient agar with lactose and bromothymol blue



Smear \_\_\_\_\_

Stain \_\_\_\_\_

Colonies characteristics:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Calculation of bacteria quality per ml/g of the sample:

$$N \text{ (CFU/ml)} = n \times 20 \times 10^x,$$

n – colonies quantity in respective sector,

20 – conversion factor for 1 ml,

$10^x$  – the degree of the sample dilution.

N = \_\_\_\_\_ CFU/ml

Conclusion \_\_\_\_\_



Russell medium

**Demonstration.**

1. *P. aeruginosa* growth on nutrient medium with furaginum (quantitative inoculation)
2. *Klebsiella* growth on medium with lactose and bromothimol blue (quantitative inoculation).

Signature of the tutor \_\_\_\_\_

<b>Additional materials for independent work for the class № 10</b>	
<b>Etiology (main pathogens) of respiratory septic-purulent diseases</b>	
1.	
2.	
3.	
4.	
5.	
<b>Etiology (main pathogens) of urogenital septic-purulent diseases</b>	
1.	
2.	
3.	
4.	
5.	

Hospital acquired infections (HAI, nosocomial infections) - any clinically recognizable infection contracted by patient due to residence or receiving various types of inpatient and outpatient medical care, the delivery of emergency medical services both in health care organizations and at home, as well as infectious disease contracted by medical staff as a result of professional activity, regardless of time of symptoms onset.

Nosocomial infections should be distinguished (introduced) from cases of infectious diseases registered in the delivery of health care in inpatient, outpatient medical institutions, or at home. Their main features are: the absence of a causal connection with the performance of therapeutic and diagnostic procedures and manipulations; acquisition of infection within the minimum incubation period before seeking medical help.

<b>Etiology (main pathogens) of nosocomial infections</b>	
1.	
2.	
3.	
4.	
5.	

**CLASSIFICATION of HAI**

HAI etiology includes bacteria; viruses; fungi; protozoa and metazoa. By source of infection HAI can be exogenous; endogenous and auto-infection.

Depending on the profile of medical care nosocomial infections are divided into: surgical infection, obstetric infections; neonatal infections; other infections.

Depending on the entrance gate and localization of infection nosocomial infections are divided into: surgical wound infections; burn wound infection; infections of skin and soft tissue; primary bloodstream infections; sepsis; cardiovascular system infection; bone and joint infections; eye infection; ear infections; infection of the nose, throat, mouth and upper respiratory tract; lower respiratory tract infections; pneumonia; infections of the central nervous system; urinary tract infections; infections of the reproductive system; infections of the gastrointestinal tract.

Depending on the type of pathogen nosocomial infections are divided into: caused by obligate pathogens and opportunistic pathogens.

Depending on the spread in the organism HAI can be divided into: localized; generalized and systemic infections.

Depending on the course character nosocomial infections are divided into: acute; subacute and chronic.

By severity nosocomial infections are divided into: pathogen caring; mild; moderate and severe form.

Depending on the mechanisms, ways and factors of transmission of nosocomial infections are divided into: aerosol; contact (direct and indirect); parenteral; fecal-oral (food and water).

**The list of questions to study:**

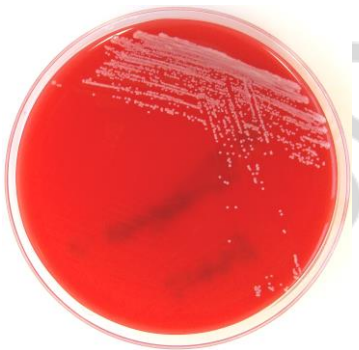
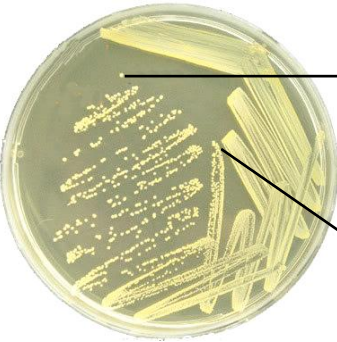

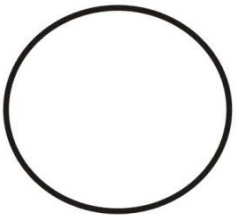
General characteristics and classification of protozoa. Pathogenic representatives. Laboratory diagnosis of malaria, toxoplasmosis, amebiasis, giardiasis, trichomoniasis.

The causative agent of cryptosporidiosis.


Classification and general characteristics of fungi. Pathogens of ringworm, keratomycosis, deep mycoses. Candidiasis and conditions which promote its development. General principles of fungal infections diagnostics.

Pathogen of pneumocystosis.

**Laboratory work**

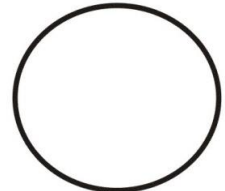
Tasks	Methods, results
<p>1. Research of the blood sample from the patient with suspected sepsis.</p> <p>2. Research of the sample from the bronchi washings</p>	<p style="text-align: center;"><b>Blood sample research (III step)</b></p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>Blood agar</p> </div> <div style="text-align: center;">  <p>YSA</p> </div> <div style="text-align: center;">  </div> <div style="text-align: center;">  <p>Smear _____</p> <p>Stain _____</p> </div> </div> <p style="text-align: right;"><b>Coagulase test</b> Stabilized rabbit plasm: 37 °C – 2, 4, 24 h</p> <p>Colonies characteristics: _____ _____ _____</p> <p><b>Conclusion:</b> _____</p>

**Research of bronchial washings sample (III syep)**



Russell medium

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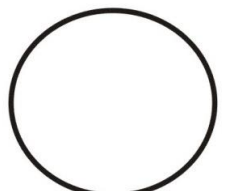
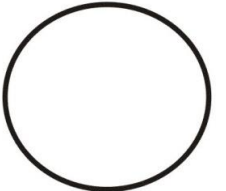
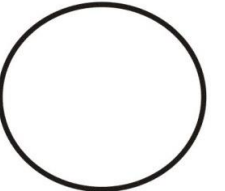
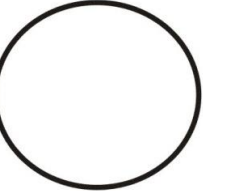
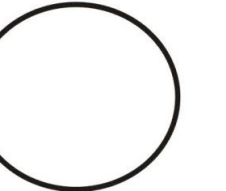
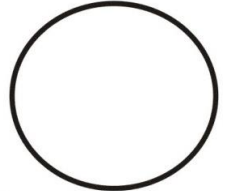
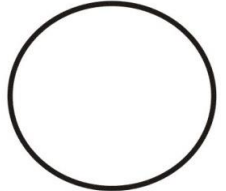
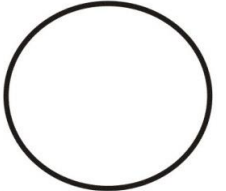
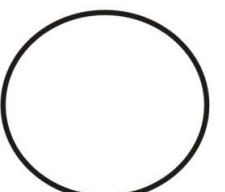


Fermentation:  
Lactose \_\_\_\_\_  
Glucose \_\_\_\_\_

Smear \_\_\_\_\_  
Stain \_\_\_\_\_

**Conclusion** \_\_\_\_\_

- Demonstration.**
1. Pathogenic protozoa.
  2. Candida, Gram stain.
  3. Candida growth on Saburo medium

				
Smear _____	Smear _____	Smear _____	Smear _____	Smear _____
Stain _____	Stain _____	Stain _____	Stain _____	Stain _____
				
Smear _____	Smear _____	Smear _____	Smear _____	
Stain _____	Stain _____	Stain _____	Stain _____	

Signature of the tutor \_\_\_\_\_



## Additional materials for independent study for the class № 12.

### DIAGNOSTICS OF MYCOSIS

Microscopic method. High diagnostic value of the method caused by significant differences in fungal morphology, simplicity and speed of the research. The result can be obtained within 1-2 hours. Microscopy can be conducted in native preparations without staining. For visualization of the pathogen in the biological material which is poorly transparent (hair, skin, nails, etc.) it should be processed with 10-20% alkaline (KOH), which dissolves keratin and has no effect on the morphology of the fungal cells. Fixed smears may be stained by Gram (fungi are Gram-positive), Romanovsky-Giemsa, special techniques. Dimorphic fungi in biological material are in the form of yeast. Microscopy of histological preparations is also possible.

Serological method:

Immunofluorescence is sensitive, specific and rapid method based on the identification of fungal Ag in biological materials.

PHAT, latex agglutination, PT, CFT, ELISA are used to detect fungal antigens and antibodies in blood, CSF, urine. Serological reactions not always highly specific, but produce results earlier than culture method.

Culture (mycological) method. Most pathogenic fungi are mesophiles (20-45 °C) and not demanding for the nutrient medium. Optimal pH ranges from 4.0 to 6.5. Growing time depends on the kind of fungus and can be from several weeks to 2-3 days. The most frequently used medium is Saburo agar (peptone agar with glucose or maltose). The acidity of the medium and high carbohydrate content inhibits the growth of bacteria. Dimorphic fungi (pathogens caused subcutaneous and deep mycoses) grow in the mycelial form at 20-25 °C. The identification of a pure culture is carried out by morphological and biochemical characteristics.

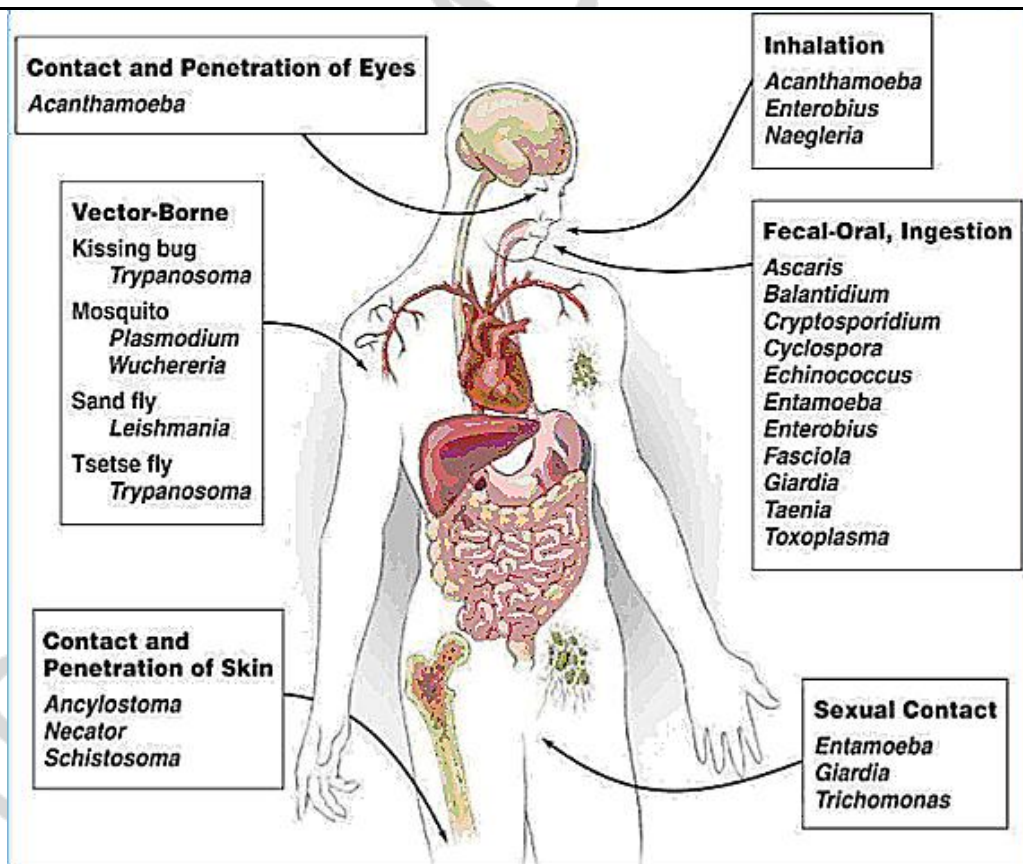
Allergic method. Skin tests are performed with fungal allergens (eg. Candide). Method is not very specific because of the group antigens presence.

Biological method. Bioassays in laboratory animals allow us to estimate the virulence of the pathogen, get in tissue culture of the fungus (usually in a form of yeast).

Molecular genetic methods. PCR and molecular hybridization are used. Among advantages - very high sensitivity and specificity, relative safety and short time needed for results.

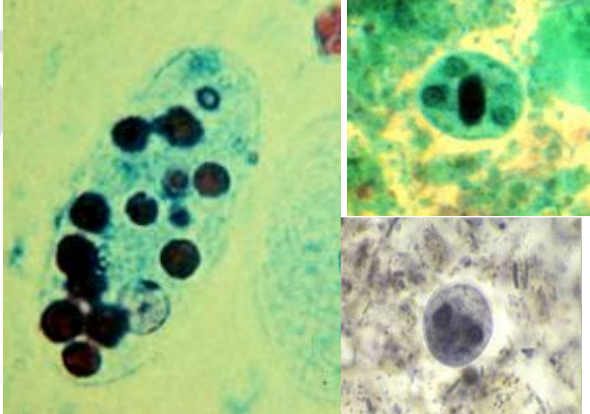
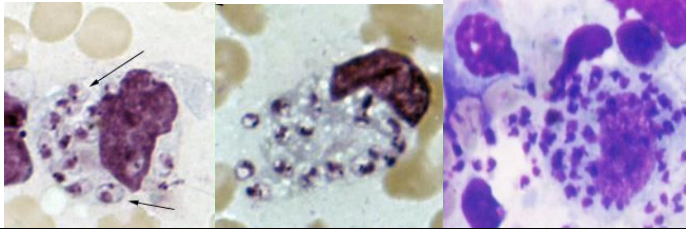
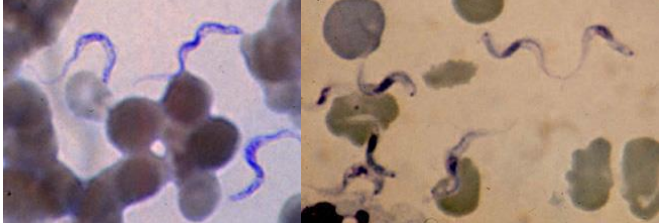

### The comparison of eu- and prokaryotic cell

Main characteristics	Prokaryotic cell	Eukaryotic cell
Cell size	Average 0,2-2,0 mkm	
Nucleus	Does not have a true nucleus. Nucleoid, is not separated from the cytoplasm by a membrane	
Chromosomes	Ring-like	
Number of chromosomes per cell	Usually one	
Mitochondria	No	
Endoplasmatic reticulum	No	
Ribosomes location	Dispersed in cytoplasm	
Sedimentation constant	70S	
Teichoic asides in cell wall	Gram positive bacteria	
Peptidoglycane in cell wall	All bacteria with exception of mycoplasm	
Endospores	Some has	
Division of cell	Binary (mitosis)	
Gametes, zygotes	No	



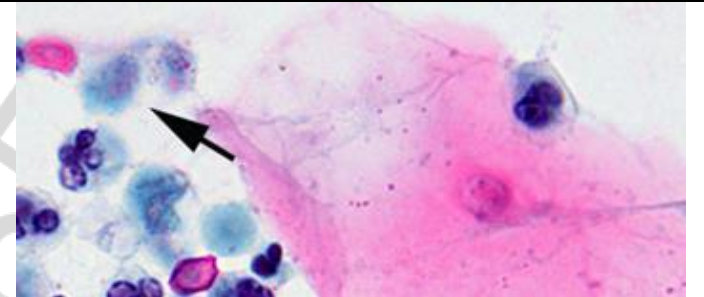
Main routs of pathogenic parasites invasion

Protozoa belong to the domain – *EUKARYA*, kingdom – *ANIMALIA*, subkingdom– *PROTOZOA*, which includes 7 types,  
 Four types of medical importance are showed in the table

Taxons	Representatives	Disease	Morphology
<p><b>TYPE</b>  <b><u>SARCOMASTIGOPHORA</u></b>            subtype <i>Sarcodina</i></p>	<p><b><u>AMOEBAE</u></b>  <i>Entamoeba histolytica</i></p>	<p>Amebiasis</p>	
	<p>Naegleria, acanthamoeba, hartmanella</p>	<p>Amoebic meningoencephalitis, keratitis</p>	
<p>subtype <i>Mastigophora</i></p>	<p><b><u>LEISHMANIA</u></b>  <i>Leishmania species</i></p>	<p>Leishmaniasis</p>	
	<p><b><u>TRYPANOSOMES</u></b>  <i>Trypanosoma gambiense</i>,  <i>Trypanosoma rodesiense</i>  <i>Trypanosoma cruzi</i></p>	<p>African trypanosomiasis (sleeping disease)            Chagas disease (American trypanosomiasis)</p>	
	<p><b><u>GIARDIA:</u></b>  <i>Lambliia intestinalis</i>  <i>(Giardia lamblia)</i></p>	<p>Diarrhea, malabsorption syndrome</p>	

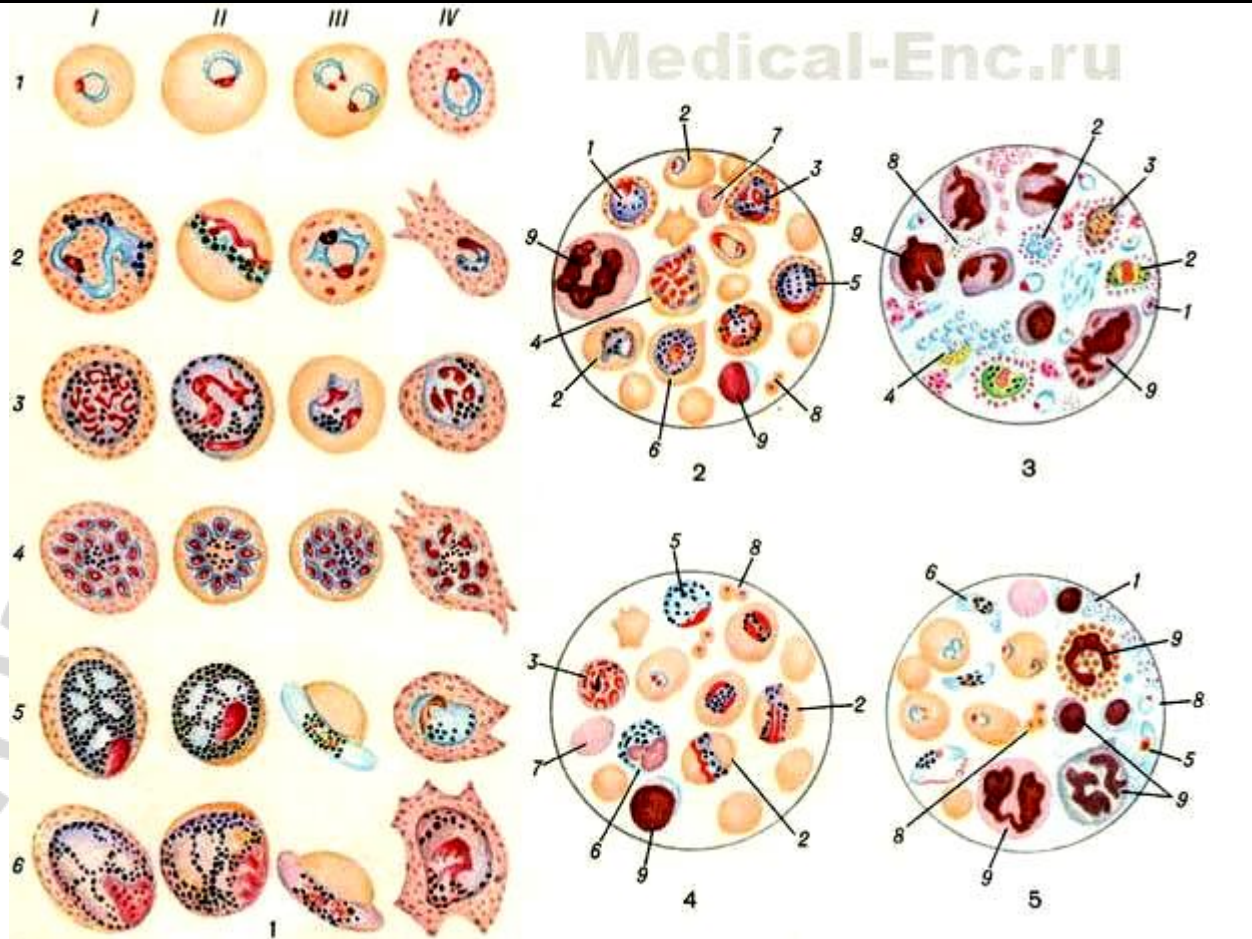
**Trichomonas**  
*Trichomonas vaginalis*


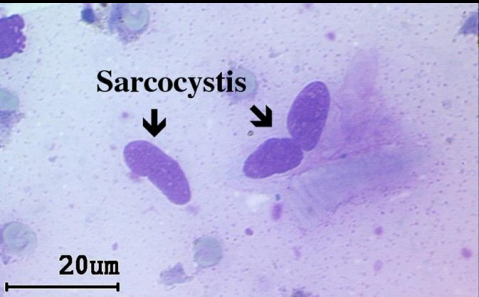
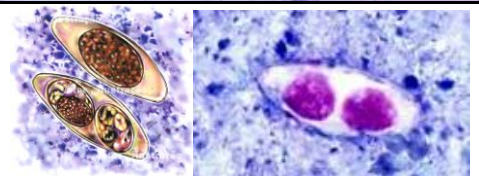
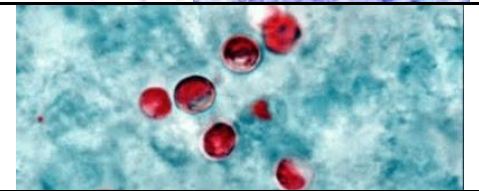
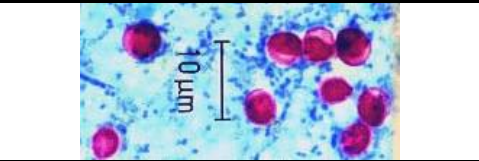

*Trichomonas vaginalis*  
vaginitis, urethritis, prostatitis


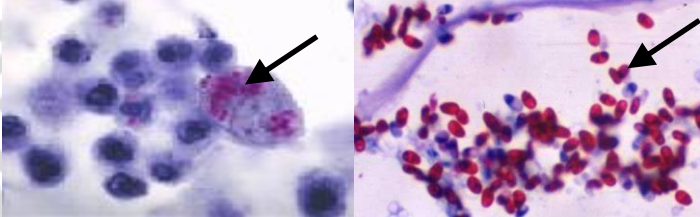
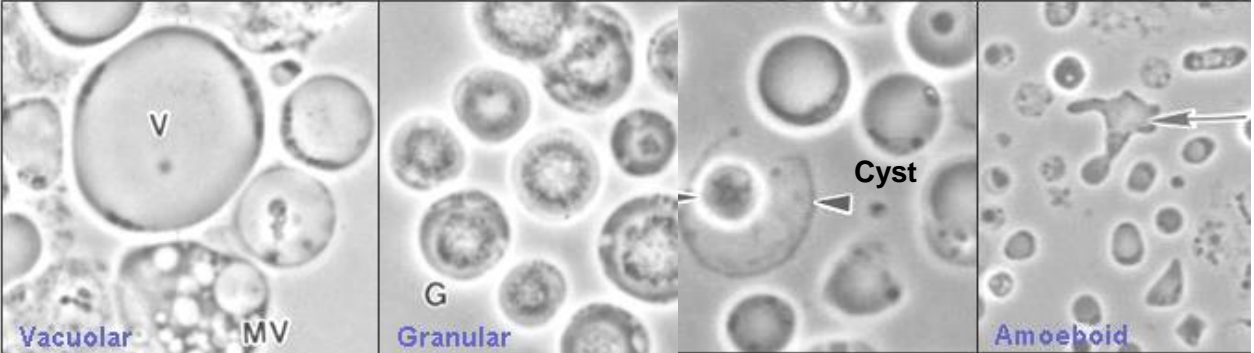


**TYPE -**  
**APICOMPLEXA**  
class - Sporozoa

**PLASMODIUM**  
**MALARIA:**  
*Plasmodium vivax*  
*Plasmodium ovale*  
*Plasmodium malariae*  
*Plasmodium falciparum*



	<p><b><u>TOXOPLASMA:</u></b> <i>Toxoplasma gondii</i></p>	Toxoplasmosis	
	<p><b><u>SARCOCYST:</u></b> <i>Sarcocystis species</i></p>	Sarcocystosis	
	<p><b><u>ISOSPORA:</u></b> <i>Isospora species</i></p>	Diarrhea	
	<p><b><u>CRYPTOSPORIDIUM:</u></b> <i>Cryptosporidium species</i></p>	Diarrhea	
	<p><b><u>CYCLOSPORA:</u></b> <i>Cyclospora cauetanensis</i></p>	Diarrhea	
	<p><b><u>BABESIA:</u></b> <i>Babesia species</i></p>	Babesiosis	

<p><b><u>TYPE – CILIOPHORA</u></b> class <i>Kinetofragminophorea</i></p>	<p><b><u>BALANTIDIUM:</u></b> <i>Balantidium coli</i></p>	<p>Balantidiasis</p>	
<p><b><u>TYPE – MICROSPORA</u></b> class <i>Microsporea</i></p>	<p><b><u>MICROSPORIDIA:</u></b> <i>Encephalitozoon species</i> <i>Enterocytozoon species</i></p>	<p>Microsporidiasis</p>	
	<p><b><u>BLASTOCYST:</u></b> <i>Blastocystis hominis</i></p>		

## MICROBIOLOGICAL DIAGNOSTICS OF PROTOZOAN INVASIONS

<p><b><u>AMEBIASIS</u></b> <b>Microscopic method.</b> Materials: samples of faeces or exudates from abscesses. Smears are stained with iodine solution or hematoxylin. Tissue forms with phagocytized erythrocytes or quad cysts. can be identified. In native specimens characteristic motile vegetative forms can be noted. IF may be used for the identification of pathogen</p> <p><b>Serological method:</b> PHA test, ELISA, CFT, and other tests may be used. The highest antibody titer can be detected in extraintestinal amebiasis.</p> <p>Some non-pathogenic amoeba are morphologically identical to Entamoeba histolytica. The differentiation is based on the enzymatic, immunological and molecular genetic analysis.</p>	<p><b><u>LEISHMANIASIS</u></b></p> <p><b>Microscopic method.</b> Materials: skin lesions (bumps, ulcers), bone marrow. Smears are stained by Romanovsky-Giemsa method. The detection of amastigote (nucleus and kinetoplasts are of red-purple color and cytoplasm is bluish) is of importance. IFT is also used.</p> <p><b>Cultural method.</b> Leishmania can be cultured on blood agar.</p> <p><b>Biological method.</b> Infection of mice or hamsters is possible.</p> <p><b>Serological method.</b> Specific antibodies may be detected by CFT, passive hemagglutination or ELISA.</p> <p><b>Allergic method.</b> Skin test with leishmania Ags may be used.</p>
<p><b><u>TRYPANOSOMES</u></b></p> <p><b>Microscopic method.</b> Materials: samples of blood, punctate from cervical lymphatic nodes, cerebrospinal fluid. Smears are stained by Romanovsky-Giemsa method.</p> <p><b>Cultural method.</b> Trypanosomes can be cultured on a nutrient medium with blood as well as in white mice or rats.</p> <p><b>Serological method.</b> The determination of specific IgM by ELISA is used.</p>	<p><b><u>GIARDIASIS</u></b></p> <p>Microscopic method. Materials: feces, duodenal secretion. In smears cysts or vegetative forms, can be detected. Iodine staining is usually used. IFT is also applicable.</p> <p>Cultural method. Giardia can be cultured nutrient media.</p> <p>Serological method. Specific antibody titers are higher in symptomatic giardiasis.</p>
<p><b><u>TRICHOMONIASIS</u></b></p> <p><b>Microscopic method.</b> Materials: samples from urethral discharge, prostatic secretions or urine sediment are studied. Smears are stained by Romanovsky-Giemsa (trophozoite nucleus is violet-ruby, cytoplasm - blue and blefaroplast, flagella and aksostil - pink-red), methylene blue. IF is also used.</p> <p><b>Cultural method.</b> In chronic trichomoniasis pathogen can be cultured on nutrient media with protein. The method gives good results when confirmation of convalescence is needed.</p>	<p><b><u>MALARIA</u></b></p> <p><b>Microscopic method.</b> Smears of blood are stained by Romanovsky-Giemsa method. Various forms of pathogen can be identified (red nucleus, blue cytoplasm).</p> <p>Differentiation of species is carried out by morphological features of parasites and parasitized erythrocytes.</p> <p><b>Serological method.</b> Specific antibodies are detected by ELISA. IFT is applicable for diagnostics. <b>Molecular genetic method.</b> PCR.</p>
<p><b><u>TOXOPLASMOSIS</u></b> <b>Microscopic method.</b> Materials: biopsy, samples of body fluids (blood, cerebrospinal fluid, lymph node puncture, etc.). Smears are stained by Romanovsky-Giemsa method. Toxoplasma Ags may be detected by IF test.</p> <p><b>Cultural method.</b> Cultivation of Toxoplasma is possible in cell cultures and chicken embryo.</p> <p><b>Serological method.</b> Detection of specific IgM indicates the early stages of the disease. IgG peaks at 4-8 week of disease. ELISA is widely used.</p> <p><b>Biological method.</b> Mice are infected in the abdominal cavity or intracranially. They usually succumb 7-10 days after infection. The pathogen is identified microscopically or by serological method.</p>	<p><b><u>BALANTIDIASIS</u></b></p> <p>Microscopic method. Microscopy of smears from feces under low magnification allows to reveal large motile balantidiums.</p> <p>Cultural method. Possible, but rarely used</p>

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