

MINISTRY OF HEALTH OF THE REPUBLIC OF BELARUS
EDUCATIONAL INSTITUTION
BELARUSIAN STATE MEDICAL UNIVERSITY

Контрольный
экземпляр

APPROVED
by First Vice-Rector, Professor
S.V. Gubkin
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MICROBIOLOGY

**Curriculum of higher educational institution
in the educational discipline for the specialty:**

1-79 01 08 «Pharmacy»

Minsk, BSMU 2018

Curriculum is made on the basis of the standard program «Microbiology», approved 29.08.2014, registration № TD-L.443/тип.

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RECOMMENDED FOR APPROVAL:

by the Department of microbiology, virology, immunology of the Educational Institution «Belarusian State Medical University»
(protocol N 11 of 24.04.2018);

by the Methodological Commission of preventive medicine disciplines of the Educational Institution «Belarusian State Medical University»
(protocol N 8 of 25.05.2018)

EXPLANATORY NOTE

In the system of pharmaceutical education the subject microbiology is included in the complex of general biological disciplines and comprises knowledge about general and special microbiology, virology and immunology.

In recent years, the role of microbiology in the preparation of pharmacists has increased significantly. The pharmacist should know and master the necessary methods for assessing the microbial contamination of medicinal raw materials and ready-made dosage forms, be able to monitor the correct storage of medicinal products. In this regard, special attention in the study of general microbiology is given to questions about phytopathogenic microorganisms and methods for determining the microbial contamination of medicinal products produced at pharmaceutical plants and pharmacies.

Bacteriological monitoring of compliance with the sanitary regime in pharmacies includes microbiological examination of the air of industrial premises, washings from equipment and hands of personnel engaged in the production of medicines. The pharmacist must correctly evaluate the reports of the microbiological laboratory that conducted the bacteriological control.

Modern serological reactions are highly sensitive and specific methods of drug compounds monitoring in serum and plasma are used. The development of methods for the of drug compounds analysis is associated with elucidating antibodies biosynthesis and their interaction with antigens.

The intensive development of microbiology leads to a considerable increase in the volume of the subject and a significant expansion of its content.

The program reflects the main changes in the subject that have occurred to date.

The aim of the discipline: promotion of students' knowledge and skills in the field of microbiology, immunology and virology, necessary for the preparation and subsequent practical activities of the pharmacist.

The tasks of the discipline are to develop students' academic competence in:

- properties of microorganisms - causative agents of human diseases;
- routes and mechanisms of infection transmission, spread, pathogenesis, clinical manifestations and laboratory diagnosis, prevention and treatment of infectious diseases;
- mechanisms of action of antimicrobial agents;
- methods for evaluation of microbial contamination of medicinal raw materials and ready-made dosage forms, for monitoring drugs sterility and correct storage of medicinal products;
- methods of sterilization, disinfection, asepsis, antisepsis and preservation necessary for the pharmacist;
- the structure and mechanisms of functioning of the human immune system, immunopathology mechanisms, methods of immunotherapy, chemotherapy, and prevention of infectious diseases.

Teaching and successful studying of microbiology, virology, immunology is carried out on the basis of the following disciplines:

Pharmaceutical Latin. Practical use grammar and word-formation principles. The meaning of Latin and Greek word elements and certain minimum of terminology in the Latin language.

Medical biology. Biological basis of life. Levels of organization: molecular-genetic, cellular, organismal, populational.

Cytobiology. Reproduction. Heredity and variability. Evolution. The person and biosphere. Biosphere functions in the development of nature and maintenance of dynamic balance. Biological aspects of the human ecology. Biological bases of parasitism of transmissible diseases. Parasitic forms in fauna. Protozoology. Biology of the protozoa.

Biological physics. Medical devices and the equipment used in microbiology. The microscope. The electron microscope. Special methods of microscopy. Concentration colourimetry. Nephelometry. Ultra-violet radiation and its application. Luminescence.

Human anatomy and physiology. The structure of the human body, systems, organs, tissues, sexual and age features of an organism. The organism and its protective systems. Main principles of formation and regulation of physiological functions. Blood, lymph, tissue liquid; leukocytes, functions of separate types of leukocytes; blood groups - agglutinogens, agglutinins; hemolysins; a Rhesus factor. Digestion - role of intestinae microflora. Endocrine glands; thymus, its role in immune reactions.

General and inorganic chemistry. Chemical elements and compounds. Chemical reactions.

Biological chemistry. Inorganic and organic chemical compounds.

Analytical chemistry. Elements of analytical chemistry, synthesis and transformation of useful chemical compounds.

Pharmaceutical botany. Plants as sources of medicinal raw materials. The structure of plant cells. Plants' tissues. Anatomy of the vegetative organs of plants.

Requirements for the student's knowledge upon termination of the discipline

The student should know:

- The place and role of microbes in biosphere, morphology, physiology, genetics, ecology, of bacteria, viruses, fungi, protozoa, basics of biotechnology and genetic engineering;
- the impact of environmental factors on microorganisms, sources of microbial contamination of medicinal raw materials and drugs, methods for microbiological control of drugs;
- general regularities of bacterial, viral, fungal and protozoan infections development, environmental factors promoting and discouraging infections, opportunistic pathogens and infections;
- human immune system, antigens, humoral and cellular immune response, immunopathogenesis of allergic, infectious-allergic, and autoimmune diseases, immunodeficiencies, principles of anti-infection immunity;
- microbiological and immunological methods for bacterial, viral, fungal and protozoan diseases, methods for immuno- and chemotherapy and prophylaxis of infections;

- methods for evaluation of drugs sterility

should be able:

- to perform analysis of drugs microbiological purity;
- to sample biological materials, to fill in forms for bacteriological, immunological and molecular-genetic studies and evaluate their results;
- to assess sensitivity of bacteria to antibiotics by disc- diffusion method;
- to carry out certain serological tests (agglutination test, passive agglutination test, complement fixation test, immunofluorescence test, ELISA) and PCR;

should master:

- techniques of microbiological smears preparations and staining them with simple methods and Gram method;
- techniques of immersion light microscopy with the results evaluation;
- differentiation of bacteria by morphological features;
- technique of biological material primary seeding on a nutrient medium for the isolation of pure cultures of bacteria;
- methods of disinfection of infectious materials, wastes and contaminated objects;
- technique of carrying out slide agglutination test and its evaluation.

Total number of hours for the study of the discipline is 210 academic hours. Classroom hours according to the types of studies: lectures - 40 hours, laboratory studies - 72 hours, student independent work (self-study) - 98 hours.

Current assessment is carried out according to the syllabus of the specialty in the form of a credit (4 semester), and examination (5 semester).

Form of higher education – full-time.

**ALLOCATION OF ACADEMIC TIME
ACCORDING TO SEMESTERS OF STUDY**

Code, name of the specialty	semester	Number of academic hours					Form of current assessment
		total	in-class	including		out-of-class self-studies	
				lectures	laboratory studies		
1-79 01 08 Pharmacy	4	90	60	22	38	30	credit
	5	120	52	18	34	68	examination
Total hours		210	112	40	72	98	

THEMATIC PLAN

Section (topic) name	Number of class hours	
	lectures	practical (laboratory or seminars)
1. General and sanitary microbiology	14	24
1.1. Microbiology as a science. The world of microbes	2	-
1.2. Morphology of microorganisms	-	4
1.3. Physiology of microorganisms	2	6
1.4. Genetics of microorganisms	2	2
1.5. Ecology of microorganisms. Infection	2	2
1.6. Microbiological basics of chemotherapy and antiseptics of bacterial infections	2	4
1.7. Sanitary microbiology. Microbiological examination of medicinal raw materials and drugs	4	6
2. Theoretical and applied medical immunology	8	14
2.1. Immunology. Immune system. Innate immunity	2	2
2.2. Antigens and antibodies	2	2
2.3. The immune response	2	2
2.4. Immunodiagnosis of infectious diseases	-	2
2.5. Immunopathology. Basics of clinical immunology. Immunoprophylaxis and immunotherapy of infectious diseases	2	6
3. Special medical microbiology	8	22
3.1. Causative agents of purulent inflammatory infections: Staphylococci, Streptococci, Pseudomonas, Proteus, Bacteroides. Nosocomial infections	2	-
3.2. Laboratory diagnosis of wound and purulent-inflammatory infections caused by Staphylococci, Streptococci, Pseudomonas, Proteus, Bacteroides, Clostridia	-	6
3.3. Causative agents of airborne infections: meningococci, Bordetella, Corynebacteria, Mycobacteria. Laboratory diagnosis of airborne infections	2	4
3.4. Enterobacteria. Escherichia, Salmonella, Shigella	2	-
3.5. Laboratory diagnosis of diseases caused by Escherichia, Salmonella, Shigella, Vibrio, Iersinia, Clostridia, Campylobacter, Helicobacter	-	4
3.6. Pathogens of sexually transmitted infections: Teponema, gonococci, Chlamydia, Mycoplasma. Laboratory diagnosis of sexually transmitted diseases	2	2
3.7. Laboratory diagnosis of bacterial zoonotic infections caused by Tularemia pathogens, Brucellae, plague Yersinia, Anthrax bacilli, Leptospira	-	2
3.8. Laboratory diagnosis of vector-borne infections caused by Borrelia, Rickettsia	-	1
3.9. Basics of medical mycology and protozoology	-	3
4. General and special medical virology	10	12
4.1. General Virology	2	2

Section (topic) name	Number of class hours	
	lectures	practical (laboratory or seminars)
4.2. Orthomyxoviruses. Paramyxoviruses. Coronaviruses. Laboratory diagnosis of viral respiratory infections caused by Orthomyxoviruses, Paramyxoviruses, Coronaviruses	2	2
4.3. Herpesvirus. Adenovirus. Togaviruses. Laboratory diagnosis of viral respiratory infections caused by Adenoviruses, Herpesviruses	2	2
4.4. Characteristics of the pathogen and laboratory diagnosis of intestinal, transmissible and contact viral infections caused by Picornaviruses, Reoviruses, Caliciviruses, Flaviviruses, Rhabdoviruses	2	2
4.5. Characteristics of the pathogens and laboratory diagnosis of viral infections caused by Hepadnaviruses, Retroviruses, Togaviruses. Prions and prion diseases	2	4
Total hours	40	72

EDUCATIONAL PROGRAM CONTENT

1. GENERAL AND SANITARY MICROBIOLOGY

1.1. Microbiology as a science. The world of microbes

Subject, problems, methods and place of microbiology in the systems of sciences. Microbiology as a complex of sciences about morphology, physiology, ecology, genetics and evolution of microorganisms. Classification of microbiological sciences: depending on object of research (the general microbiology, bacteriology, virology, mycology, protozoology), field of research or applied purposes (medical, sanitary, veterinary, technical, soil, sea, space).

Medical microbiology as a science about pathogenic microbes, etiology, pathogenesis, diagnosis, therapy and specific prophylaxis of diseases. Value of microbiology in the progress of medicine and in the practice of pharmacists. Communications of medical microbiology with biological, medical, hygienic and other sciences.

Microbiology history. Early knowledge about organisms invisible to the naked eye - contagium (I century BC - I century AC - Roman encyclopaedists; XVI century - D.Frakastoro; XVII century - A.Kirher).

The invention of a microscope and discovery of the world of microbes by A. Leeuwenhoek.

Pasteur period in the development of microbiology (second half of the XIX century). The works of L. Pasteur, R. Koch. Their importance for medical microbiology. Discovery of causative agents of the main infectious human diseases. Development of methods for their cultivation, differentiation and diagnosis.

Medical microbiology in the first half of the twentieth century. Study of pathogenic bacteria. Development of a chemotherapeutic direction in microbiology and

medicine (P. Ehrlich et al.). The discovery of antibiotics (A. Fleming and others).

The modern period in the development of medical microbiology (the second half of the twentieth and the beginning of the 21st century). The importance of scientific and technological progress and discoveries in the field of molecular biology and genetics for the further development of theoretical and applied medical microbiology.

The role of medical microbiology in the decrease of prevalence and elimination of infectious diseases. Systemic classification and nomenclature of bacteria. Classification of prokaryotes. Basic principles of bacterial systematization. Taxonomic categories: domain, kingdom, sub-kingdom, type, class, order, family, genus, species. Criteria of the species. Subspecies categories: biovar, serovar, phagovar, pathovar, morphovar. Population, strain, culture, clone. Binary nomenclature of bacteria.

1.2. Morphology of microorganisms

Morphology structure and chemical composition of bacteria.

The main forms and sizes of bacteria. Structures of the bacterial cell: nucleoid, cytoplasm, ribosomes, mesosomes, inclusions, cell wall, cytoplasmic membrane, periplasmic space, capsule, villi (pili), flagella. Their chemical composition and functional significance. Differences in the structure of gram-positive and gram-negative bacteria. Spores, their characteristics. Polymorphism of microorganisms. Protoplasts, spheroplasts and L-forms of bacteria.

Methods of bacteria morphology research.

Basic Methods for Investigating the Morphology of Bacteria

Microscopic examination of microorganisms: bright field and immersion microscopy; dark-field, phase-contrast and luminescent microscopy.

Methods of preparing native and fixed smears.

Simple and complex methods of smears staining. The methods of Gram, Tsil-Nielsen, Ozheszko, Neisser, Burri-Hins. Mechanisms of interaction of dyes with the cytoplasm and individual structures of a bacterial cell (tinctorial properties of bacteria). Electron microscopic methods for studying microorganisms. A microscopic method, steps, an estimation. Types of microscopic preparations. Techniques of fixed and native smears preparation. Main variants of light microscopy, dark-field, phase-contrast, luminescent. Techniques of light microscopy. Studying of microorganisms morphology in an electronic microscope. Tinctorial properties of microbes. Dyes. Simple and differential methods of fixed preparations staining. Techniques of staining by Gram, Ziehl-Neelsen, Neisser methods. Methods of alive microorganisms research.

Morphology of Actinomyces, Spirochetes, Rickettsia, Chlamidia, Mycoplasma. Main forms, ultrastructure, differences from true bacteria, methods of studying.

1.3. Physiology of microorganisms

Metabolism of bacteria. Constitutive and inducible-adaptive enzymes of bacteria. Practical use of biochemical activity of microorganisms in medical microbiology and in the microbiological industry (for the production of antibiotics, enzymes, vitamins, organic acids, fodder protein, etc.), genetic engineering. Nutrition of bacteria Sources of carbon, nitrogen and minerals. Growth factors. Autotrophs and heterotrophs. Mechanisms of transfer of nutrients into a bacterial cell. Biological oxidation in the metabolism of bacteria The main types of biological oxidation of

substrates in bacteria. Aerobes, anaerobes, facultative anaerobes, microaerophiles, general characteristics. Methods of cultivation of anaerobes.

Growth and reproduction of bacteria Phases of reproduction of the bacterial population in liquid and solid nutrient media; periodic and continuous cultivation; colonies of microorganisms; pigments.

Basic principles and methods of bacteria culturing. Bacteriological method of investigation Nutrient media and their classification. Methods for the isolation of pure cultures of aerobic and anaerobic bacteria. Temperature regime, concentration of hydrogen ions (pH) and oxidation-reduction potential. Features of cultivation of rickettsia, chlamydia, mycoplasmas. Methods for studying enzymatic activity and its use for identification of microorganisms.

1.4. Genetics of microorganisms

Structure of a genetic apparatus in bacteria. Nucleoid, plasmids. Genotype and phenotype. The organization of the operon. Modifications in bacteria. Mechanism and phenotypic manifestation. Mutations and mutagenesis. Spontaneous and induced, gene and chromosomal, direct and reverse mutations in bacteria and their characteristics. R-S dissociation. Genetic recombination in bacteria. Transformation, transduction and conjugation. Their mechanisms. Reparation. Principles of genetic mapping. Extrachromosomal factors of heredity. Definition and general characteristics. Plasmids of bacteria. Episomes. Conjugative and non-conjugative plasmids. Types of plasmids (F, R, Col, Ent, Hly, etc.) and their role in the determination of pathogenic features and drug resistance in bacteria. Transposable elements and transposons. IS sequences. Fundamentals of genetic engineering. The importance of mutations, recombinations and reparations in the evolution of microorganisms. Theoretical and practical significance of bacterial genetics for microbiology and medicine. Goals and tasks of genetic engineering. Practical use of genetic engineering in medical microbiology and biotechnology. Methods of genetic analysis (molecular hybridization, polymerase chain reaction, blotting, sequencing of nucleic acids, etc.). The importance of genetic methods in the laboratory diagnosis of infectious diseases. Genomics of microorganisms, its relationship with human genomics. Proteomics of microorganisms.

1.5. Ecology of microorganisms. Infection

Fundamentals of environmental microbiology. Distribution of microorganisms in the environment: air, soil, water. The concept of microbial biocenosis. Symbiotic and antagonistic interactions between a microorganism and other organisms: mutualism, commensalism, synergism, parasitism, antagonism. Microbiological aspects of environmental protection. Microorganisms and biosphere.

Sanitation-indicative bacteria, their characteristics Microflora of the human body. The role of the the human body microflora in normal physiological processes and pathology. Obligatory (resident) and facultative (transient) microorganisms. Formation of microbial biocenosis in different age periods. The microflora of the skin, oral cavity, gastrointestinal tract, respiratory tract, conjunctiva of the eye, genitourinary tract.

Dysbacteriosis. Factors provoking the dysbiosis development. Preparations for the treatment and prevention of dysbiosis.

The basics of infection. Definition of the concepts "infection (infectious process)", "infectious disease". Types of infectious processes and conditions for their development, the routes of the pathogen transmission. The role of the pathogen in infection. Evolution of microbial parasitism. Optional and obligate, extracellular and intracellular parasitism of bacteria, rickettsia, chlamydia, mycoplasmas, fungi and protozoa.

Pathogenicity and virulence of bacteria. Definition. Adhesion, colonization, penetration, invasion and aggression. Enzymes of pathogenicity. Substances that inhibit phagocytosis (capsular polysaccharides and peptides, proteins and lipopolysaccharides of cell walls). Measurement of virulence.

Toxigenicity and toxicity of bacteria. Protein toxins (exotoxins). Basic properties and mechanism of action. Endotoxins of bacteria. Chemical composition and basic properties. Differences from protein toxins.

Toxic substances of rickettsia, chlamydia, viruses. Genetic control and variability of factors of pathogenicity and toxigenicity in bacteria.

Infecting dose. Ways of microbes penetration into the body.

Distribution of bacteria and toxins in the body: bacteremia, septicemia, toxemia. Syndrome of systemic inflammatory response.

The dynamics of an infectious disease development. Periods in the development of an infectious disease. Forms of infection: exo- and endogenous, focal and generalized, mono- and mixed; secondary infection, reinfection, superinfection, relapse; acute, chronic, persistent infection, microbial carriage. The concept of wound, respiratory, intestinal, skin, urogenital infections; anthroponotic, zoonotic, natural focal infectious diseases; diseases transmitted by contact-household, airborne, transmissible, etc. routes.

The role of the macroorganism and the environment in the infectious process. The importance of social factors.

Biological method of investigation

Biological (experimental) method of research, evaluation. Laboratory animals. Methods of infection. Application for an isolation and identification of the pathogen, assessment of virulence, toxicity and toxigenicity of microbial cultures, immunogenicity, sterility and pyrogenicity of preparations.

1.6. Microbiological basics of chemotherapy and antiseptics of bacterial infections

Definition, characteristics of major groups of chemotherapeutic drugs

Sulfonamides. The mechanism of antibacterial action. Antibiotics. Definition and history of discovery. Producers of antibiotics. The main groups of antibiotics: beta-lactam compounds, carbapenems, monobactams, aminoglycosides, tetracyclines, levomycetin (chloramphenicol), macrolides, fluoroquinolones, lincosamides, polyene compounds, oxazolidinones (linezolid). Their antimicrobial spectra. Narrow and wide spectrum antibiotics.

Mechanisms of antimicrobial action of antibiotics

Inhibitors of cell wall synthesis, protein synthesis and nucleic acids in bacteria. Inhibitors of cytoplasmic membrane synthesis in bacteria and fungi.

Units of antimicrobial activity of antibiotics

Side effect of antibiotics.

Allergic and toxic reactions; dysbacteriosis, effect on the immune system, teratogenic effect.

Drug resistance of bacteria

The emergence and spread of drug resistance of bacteria as a biological and medical problem. Primary and acquired resistance of microorganisms to chemotherapeutic drugs. Their biochemical and genetic mechanisms. The role of plasmids. Selective action of antibiotics and other chemotherapeutic agents as selection factors for resistant individuals in the bacterial population. Approaches for prevention of the drug resistance of bacteria.

Methods for determining the resistance of bacteria to antibiotics.

Quantitative and qualitative determination of bacterial sensitivity to antibiotics. Evaluation of results and significance.

Diffusion method (paper disc method). E-test. Method of serial dilutions in a liquid nutrient medium. A method of serial dilutions in a solid nutrient medium. Accelerated methods for determining the sensitivity of bacteria to antibiotics.

Antiseptic, definition. Antiseptic compounds, requirements, origin, properties, groups, mechanisms of action on microbes. Types of antiseptics. Therapeutic antiseptics. Prophylactic antiseptics.

1.7. Sanitary microbiology. Microbiological examination of medicinal raw materials and drugs

The microflora of air, water, soil. Sanitary-bacteriological study of water, air.

The microflora of the air. Indicators of air health. Methods for evaluation: microbial number. Microflora of water, sources of its pollution. Indicators of the sanitary state of water. Determination of the water microbial number. Methods for the determination of total and thermotolerant coliform bacteria. The microflora of the soil, its health status.

Phytopathogenic bacteria. Microflora of medicinal raw materials and drugs.

The concept of epiphytic and phytopathogenic microorganisms. Rhizosphere, mycorrhiza, role for plants. Infectious diseases of plants caused by phytopathogenic microorganisms, their manifestation. Routes of infection of plants and ways of distribution of bacteria in the affected plants. Measures to combat bacterial diseases. Sources and causes of microbial contamination of medicinal plant raw materials and medicines. Signs of microbial spoilage of medicinal forms and measures of its prevention.

Determination of microbial contamination of medicinal plant material.

Determination of microbial contamination of drugs and ways to eliminate their antimicrobial effect. Determination of the sterility of injection solutions. Pyrogens.

2. THEORETICAL AND APPLIED MEDICAL IMMUNOLOGY

2.1. Immunology. Immune system. Innate immunity

The concept of immunity

Definition of the term "immunity". The main directions of modern immunology: immunology of infectious and noninfectious diseases, immunopathology, immunomorphology, immunochemistry.

The main structural and functional components of the immune system

Immunocompetent organs (central and peripheral): structure and function, changes in ontogenesis. Immunocompetent cells: types, morphology, markers (CD-antigens), identification and isolation. The main histocompatibility complex. The structure of the HLA system. Molecules of I, II class of histocompatibility. The biological significance of HLA molecules, a role in the recognition and elimination of antigen. Factors of intercellular interaction in the immune system (integrins, cytoadhesins, selectins). Cytokines.

Classification of immunity

Classification of immunity (by origin, direction of action, etc.). Local immunity.

Non clonal factors of an immune system

Protective functions of the skin, mucous membranes, connective tissue. Protective role of normal human microflora.

Factors of natural resistance of the body.

Non clonal factors of the humoral immunity

Acute phase proteins, lysozyme, lactoferrin and other innate humoral factors.

The complement system, the activation pathway. Biological functions of the complement system proteins.

Mononuclear phagocytes system

Phagocytosis. The main stages of phagocytosis and their characteristics. Opsonins and their role in phagocytosis. Immune and non-immune phagocytosis. Completed and incomplete phagocytosis.

System of granulocytes. Activation of neutrophils, bactericidal action.

System of antigen-presenting cells.

Dendritic cells, their role.

Methods for the immune status evaluation

Evaluation of the B-system of immunity: the content of B-lymphocytes in the blood (immunofluorescence, flow cytometry).

Determination of the cellular immunity (T-system) activity: T-lymphocytes blood count, blast-transformation reaction.

Determination of innate immunity humoral and cellular factors: serum and saliva lysozyme level, serum complement level, phagocytic activity of granulocytes and blood monocytes.

2.2. Antigens and antibodies

Definition of antigen, hapten, antigenicity, immunogenicity. The chemical nature of antigens and their determinant groups. Immunochemical specificity of antigens: species, group, type, organospecificity, heterogeneous antigens. Autoantigens.

Properties of antigens. Bacterial antigens: O, H, K, Vi, protective antigens. Antigenic mimicry. Human cell antigens: CD-antigens, main histocompatibility complex antigens.

Antibodies: definition, functions. Structure and functions of immunoglobulins. Classes of immunoglobulins, their main characteristics. Protective role of antibodies in acquired immunity. Place of formation and function of antibodies. Dynamics of antibody formation. Methods for determining the concentration of immunoglobulins. Mancini's reaction. Preparation and use of monoclonal antibodies.

2.3. The immune response

Antigen presenting cells

Antigen presenting cells characteristics. The system of pattern-recognition receptors: TLR, NOD-receptors. Interaction of the antigen-presenting cell with antigens: processing and presentation of the antigen. Activated macrophage and regulation of its functions. T-lymphocytes and their characteristics. Subpopulations of T cells (T helpers: Th1, Th2, Treg, cytotoxic T lymphocytes, memory T lymphocytes). The spectrum of produced cytokines. T-cell receptor, structure. The role of the T-cell receptor and costimulatory molecules (CD28; CD80, CD81, CD4, CD8), involved in the activation of T-lymphocytes (differentiation antigens, receptors of cytokines, hormones).

The concept of intercellular cooperation

Mediators of the immune response. Dynamics of the immune response.

Immunological tolerance

Genetic control of the immune response

2.4. Immunodiagnosis of infectious diseases

Antigen-antibody reactions (serological reactions).

General characteristics of the "antigen-antibody" reactions: specificity and sensitivity, reversibility, optimal ratio of ingredients. The mechanism of reaction, diagnostic value.

Agglutination reaction. The indirect (passive) hemagglutination test. Coombs reaction for the detection of incomplete antibodies. Diagnostic agglutinating serums (group and type-specific). Diagnosticums.

Precipitation reactions: ring precipitation, immunodiffusion in gel, immunoelectrophoresis.

Immunofluorescence reaction. The importance for express diagnosis of various diseases and the indication of microorganisms in the environment.

Reactions of immune lysis. Practical use of the hemolysis reaction. Complement fixation test, performance technique.

The reaction of toxin neutralization with antitoxin.

Immunoenzyme and radioimmunoassay. Immunoblotting.

2.5. Immunopathology. Basics of clinical immunology. Immunoprophylaxis and immunotherapy of infectious diseases

Allergy. Allergens. Classification of allergic and auto-allergic reactions

Hypersensitivity of immediate type (ITH). Types of ITH: anaphylactic, cytotoxic, immunocomplex, antireceptor. Immunopathological mechanisms.

Delayed type hypersensitivity of the (DTH). The role of DTH in antimicrobial

and antiviral immunity, transplant rejection and autoaggression. Skin allergic tests and their diagnostic value.

Prevention of allergic diseases in pharmaceutical production, in everyday life.

Autoimmune diseases

Classification of autoimmune diseases: organ-specific, unspecific and mixed autoimmune diseases.

Congenital and acquired immunodeficiency states

Primary and secondary immunodeficiencies. Approaches to diagnosis.

3. SPECIAL MEDICAL MICROBIOLOGY

3.1. Causative agents of purulent inflammatory infections: Staphylococci, Streptococci, Pseudomonas, Proteus, Bacteroides. Nosocomial infections

Staphylococci. Classification. Morphological, cultural and biochemical properties. Antigenic structure. Species of staphylococci, differentiating traits. Ecology. Resistance to environmental factors. Factors of pathogenicity and toxigenicity of staphylococci (surface structures, toxins, enzymes). The etiological and pathogenetic role of staphylococci in purulent-inflammatory processes. Staphylococcal sepsis. Staphylococcal hospital infection. Immunity. Prevention and treatment of staphylococcal infections.

Streptococci. Morphological, cultural, biochemical and antigenic features. Differentiation of hemolytic properties and antigenic structure. Ecology. Resistance. Pathogenic species. Pathogenicity factors and toxins. Role in pathology.

The etiological and pathogenetic role of Group A streptococci in respiratory infections, erysipelas, tonsillitis, scarlet fever, pyoderma, acute glomerulonephritis, rheumatism, dental diseases, sepsis, etc. Antibodies to toxins and enzymes of streptococci. Their role in immunity and diagnostic significance.

The etiological and pathogenetic role of streptococcus pneumonia in human pathology (pneumonia and other diseases). Immunity. Prevention and treatment of streptococcal infections.

Pseudomonads. Morphological, cultural and biochemical features. Ecology. Resistance. Pathogenicity for humans and localization in the patient's body. Pathogenicity factors. The role of *Pseudomonas aeruginosa* in nosocomial infections. Prevention, treatment.

Bacteroides. Their role in health and pathology.

Proteus, Providencia and Morganella. Classification. Species. Differentiating traits. The etiological and pathogenetic role of the proteus in purulent and mixed infections, food poisoning. The role in nosocomial infections. Prevention, treatment.

Principles of microbiological diagnosis of purulent-inflammatory infections.

3.2. Laboratory diagnosis of wound and purulent-inflammatory infections caused by Staphylococci, Streptococci, Pseudomonas, Proteus, Bacteroides, Clostridia

Staphylococci. Properties. Pathogenicity factors. The etiological and pathogenetic role of staphylococci in purulent-inflammatory processes, sepsis, nosocomial infections. Laboratory diagnosis, specific prevention and treatment of

staphylococcal infections.

Streptococci. Properties. Pathogenicity factors and toxins. Role in human pathology. Laboratory diagnosis, prevention and treatment of streptococcal infections.

Pseudomonas aeruginosa. Properties. Ecology. Pathogenicity factors. The role of *P.aeruginosa* in nosocomial infections. Laboratory diagnosis. Prevention, treatment.

Clostridia as the causative agents of wound anaerobic infection. Toxins and their characteristics. *C.perfringence* enterotoxin and its role in food poisoning. The role of *Clostridium* toxins and tissue decay products in the pathogenesis of wound infection. Microbial associations in wound anaerobic infection. Antitoxic immunity.

Laboratory diagnosis, specific prevention and therapy of wound anaerobic infection.

C.tetani. Tetanospasmin and tetanolysin, their pathogenetic effect. Tetanus in newborn infants. Antitoxic immunity. Laboratory diagnosis, specific prevention and tetanus therapy.

Bacteroides, fusobacteria, prevotella, porphyromonas. Their role in health and human pathology. Principles of microbiological diagnosis.

Proteus and Morganella. Classification. Species. Differentiating features. The etiological and pathogenetic role of the proteus in purulent and mixed infections and food poisoning. The role in nosocomial infections. Laboratory diagnosis. Prevention, treatment.

3.3. Causative agents of airborne infections: meningococci, Bordetella, Corynebacteria, Mycobacteria. Laboratory diagnosis of airborne infections

Meningococci. Morphological, tinctorial, cultural and biochemical features. Antigenic structure. Ecology. Resistance. Pathogenicity for humans and localization in the body. Intracellular parasitism. Pathogenicity factors.

Serological groups. Etiologic and pathogenetic role in epidemic cerebrospinal meningitis, meningococemia and nasopharyngitis. Meningococci carriage state. Immunity in meningococcal infections. Laboratory diagnosis, prevention, treatment.

Pathogen of whooping cough. Pathogens of parapertussis and bronchosepticosis. Morphological, cultural, biochemical and antigenic traits. Pathogenicity for humans and localization in the body. Ecology. Resistance. Pathogenicity factors and toxins. Pathogenesis and immunity. Laboratory diagnosis, prevention and treatment of pertussis.

Hemophilus. Properties. Pathogenicity factors. Pathogenesis and immunity. Laboratory diagnosis, specific prevention, therapy.

Legionella. Properties. Pathogenicity factors. Pathogenesis and immunity. Laboratory diagnosis, specific prevention, therapy.

The causative agent of Q-fever. Properties, methods of diagnosis, prevention and treatment.

The causative agent of diphtheria. Morphological, cultural and biochemical features. Biovars. Differentiation of the diphtheria causative agent from diphtheroides. Ecology. Resistance. Pathogenicity for humans and localization in the body. Pathogenicity factors. Diphtheria toxin, its properties. Mechanism of action. Genetic control of toxin formation. Anatoxin. Antitoxic immunity and its evaluation. *C.diphtheriae* carriage.

Laboratory diagnosis, prevention and treatment of diphtheria.

Mycobacteria pathogenic to humans. Pathogens of tuberculosis. Morphological, cultural, tinctorial and biochemical features. Peculiarities of cell wall chemical composition. Ecology. Resistance. Antigenic and allergenic properties. Pathogenicity for humans and localization in the body. Pathogenicity factors of *M.tuberculosis*. Tuberculin. Immunity and its features. Allergy. Laboratory diagnosis, specific prevention (BCG). Chemotherapy.

Pathogens of mycobacteriosis, their general characteristics, role in human pathology.

The causative agent of leprosy. Biological features. Pathogenicity for humans. Chemotherapy. Prophylaxis of leprosy.

3.4. Enterobacteria. Escherichia, Salmonella, Shigella

Systematics and general characteristics of enterobacteria. Morphological, cultural and biochemical features. Differential and diagnostic traits. Antigenic structure: O- and K-antigens, their chemical composition and connection with the cell wall; H-flagella antigens. Ecology of enterobacteria. Resistance. Pathogenicity factors and toxins. Localization in the body. Carriage.

Escherichia. E.coli, a physiological role in the human intestine and a sanitary-indicative value.

Serogroups of *Escherichia* and their role in the etiology of acute intestinal diseases (escherichiosis): children enteritis, dysentery-like diseases of children and adults, cholera-like diseases. Enterohemorrhagic *escherichia*, the causative agents of hemolytic-uremic syndrome. The etiological and pathogenetic role of *Escherichia* in infections of the urinary tract, appendicitis, cholecystitis and nosocomial infections. Immunity. Prevention, treatment.

Shigella. Classification of shigella. Etiological role in dysentery. Pathogenesis of the disease. Intracellular persistence of the pathogen. Prophylaxis and treatment of dysentery.

Salmonella. Properties. Serological classification of salmonella by Kaufman-White. Pathogenicity for humans and animals.

The causative agents of typhoid and paratyphoid fever. Pathogenesis of typhoid fever. *Salmonella*, the causative agents of acute gastroenteritis. Pathogenesis of diseases. *Salmonella*, the causative agent of nosocomial infections. Prevention and treatment.

3.5. Laboratory diagnosis of diseases caused by Escherichia, Salmonella, Shigella, Vibrio, Iersinia, Clostridia, Campylobacter, Helicobacter

Escherichia. Properties, physiological role and sanitary value.

Serogroups of *Escherichia* and their role in the etiology of acute intestinal diseases (escherichiosis): children enteritis, dysentery-like diseases of children and adults, cholera-like diseases. Enterohemorrhagic *escherichia*, the causative agents of hemolytic-uremic syndrome. The etiological and pathogenetic role of *Escherichia* in infections of the urinary tract, appendicitis, cholecystitis and nosocomial infections. Immunity. Laboratory diagnosis of escherichiosis. Prevention, treatment.

Shigella. Classification of shigella. Etiological role in dysentery. Pathogenesis of the disease. Intracellular persistence of the pathogen. Laboratory diagnosis of

dysentery. Chemotherapy.

Salmonella. Serological classification of salmonella by Kaufman-White. Pathogenicity for humans and animals.

The causative agents of typhoid and paratyphoid fever. Pathogenesis and immunology of typhoid fever.

Salmonella, the causative agents of acute gastroenteritis. Pathogenesis of diseases. Salmonella, the causative agent of nosocomial infections.

Laboratory diagnosis of typhoid and salmonellosis. Prevention and treatment.

Klebsiella. Classification. Klebsiella antigens. The etiological and pathogenetic role of Klebsiella in pneumonia, rhinoscleroma, ozaena and other diseases. The role in nosocomial infections. Laboratory diagnosis. Prevention, treatment.

Yersinia, the causative agents of pseudotuberculosis and enterocolitis. Morphological and physiological features. Pathogenicity for humans and rodents. Laboratory diagnosis of yersiniosis. Prevention, treatment.

C.botulinum. Toxins. Characteristics and pathogenetic action. Laboratory diagnosis, specific treatment and prevention of botulism.

V.cholera. Morphological, cultural and biochemical features. Antigenic structure, O- and H-antigens. *V.cholera* biovars. Serovars. Ecology. Resistance. Pathogenicity factors. Genetic control of pathogenicity factors. Enterotoxin (cholerogen), properties and mechanism of pathogenetic action. Pathogenesis and immunity in cholera.

Laboratory diagnosis, specific prevention, cholera therapy.

Campylobacter. Morphological, cultural and biochemical features. Ecology. Resistance. Pathogenicity factors. Pathogenesis and immunity in campylobacteriosis. Laboratory diagnosis, prevention and therapy of campylobacteriosis.

Helicobacter. Properties, role in the development of peptic ulcer of the stomach and duodenum. Laboratory diagnosis, prevention and treatment

3.6. Pathogens of sexually transmitted infections: Teponema, gonococci, Chlamydia, Mycoplasma. Laboratory diagnosis of sexually transmitted diseases

N.gonorrhoeae. Etiological and pathogenetic role in urethritis and blenorrhea in children. Prevention of blenorrhea in newborns. Immunity. Laboratory diagnosis of gonorrhoea. Prevention, treatment.

Treponema. The causative agent of syphilis. Properties. Pathogenesis and immunity. Laboratory diagnosis. Prevention and treatment.

Chlamydia. Morphological and biological features. Resistance. Obligatory intracellular parasitism. Pathogenicity factors of chlamydia. Pathogen of trachoma. Pathogenicity for humans. Properties. The causative agent of urogenital chlamydiosis. Role in the pathology of pregnancy and fetal damage. Material and methods for diagnosis. Prevention, treatment. Laboratory diagnosis of chlamydiosis.

Mycoplasma, causative agents of urogenital diseases. Role in the pathology of pregnancy and fetal damage. Laboratory diagnosis of mycoplasma infection. Prevention, treatment.

3.7. Laboratory diagnosis of bacterial zoonotic infections caused by Tularemia pathogens, Brucellae, plague Yersinia, Anthrax bacilli, Leptospira

The causative agent of anthrax. Morphological, cultural and biochemical

features. Ecology. Resistance to environmental factors. Pathogenicity for humans and animals, pathogenicity factors. Toxins. Properties and pathogenetic action. Laboratory diagnosis, specific treatment and prevention of anthrax.

The causative agents of brucellosis. Morphological, cultural, biochemical and antigenic properties. Brucella differentiation. Ecology. Resistance. Pathogenicity for humans and animals. Localization in the body. Pathogenicity factors. Pathogenesis and immunity in brucellosis.

Laboratory diagnosis, specific prevention and therapy.

The causative agent of the plague. Morphological and physiological features. Pathogenicity for humans and rodents. Localization in the body. Pathogenicity factors and toxins. Pathogenesis of plague. Immunity.

Laboratory diagnosis, specific prophylaxis and plague therapy.

The causative agent of tularemia. Morphological, cultural and biochemical features. Ecology. Resistance. Pathogenicity for humans and rodents. Localization in the body. Pathogenicity factors. Pathogenesis and immunity in tularemia. Methods of diagnosis, prevention and treatment of tularemia.

Leptospira. Serological groups and serovars of leptospira. Pathogenicity for humans, animals. Pathogenesis of leptospirosis. Immunity. Specific prevention. Laboratory diagnosis.

3.8. Laboratory diagnosis of vector-borne infections caused by *Borrelia*, *Rickettsia*

Borrelia. The causative agents of epidemic and endemic recurrent typhus. Their differentiation. Pathogenicity for humans. Pathogenesis and immunity. Laboratory diagnosis. Lyme disease, the properties of the pathogen, the transmission route. Pathogenesis. Clinical methods of diagnosis.

Rickettsia. Classification of rickettsia and rickettsiosis. The causative agents of typhus and Brill-Zinsser disease, endemic rickettsiosis.

Morphological and biological features. Ecology. Resistance. Hosts and vectors for the infection process. The intracellular parasitism of rickettsiae. Antigenic structure, toxic factors. Pathogenicity for humans. Immunity.

Laboratory diagnosis of rickettsiosis. Specific prevention and treatment.

3.9. Basics of medical mycology and protozoology

Systematic position and classification of fungi. Medically important fungi. Morphology. Biology. Sensitivity to environmental factors. Antigenic structure. Pathogenicity factors. Features of mycotic infection. Immunity in fungal diseases. Principles of mycological diagnosis.

Etiology, pathogenesis, immunity, methods of diagnosis of epidermophytosis, trichophytosis, microsporia, favus.

Mycosis caused by opportunistic fungi. Pathogenesis, immunity of diseases caused by candida, aspergillus, penicillium and other mold fungi. Hospital fungal infections. Diagnosis of candidomycosis.

Pneumocystis, general characteristic. Pneumocystis pneumonia as a complication of HIV infection.

General characteristics of protozoa. Pathogenic protozoa. Invasions, prevalence, classification. Pathogenicity factors of protozoa. Antigens of protozoa: characteristics,

classification. Features of natural and acquired antiparasitic immunity. Innate immunity. Humoral immune response. Cellular immune response.

Features of immunoprophylaxis, chemoprophylaxis and chemotherapy of protozoan invasions. Methods of laboratory diagnosis.

Etiology and laboratory diagnosis of malaria.

Etiology and laboratory diagnosis of toxoplasmosis.

Etiology and laboratory diagnosis of amoebiasis.

Etiology and laboratory diagnosis of giardiasis.

Etiology and laboratory diagnosis of cryptosporidiosis.

Etiology, pathogenesis, immunity, laboratory diagnosis of urogenital trichomoniasis. Associated infections with chlamydia, mycoplasma, gonococci.

4. GENERAL AND SPECIAL MEDICAL VIROLOGY

4.1. General virology

Classification and morphology of viruses. Viruses as an independent form of existence of organic matter. The main features that distinguish viruses from other forms of organic matter. Classification of viruses. Close to viruses infectious agents: prions, viroids.

The morphology of naked and enveloped virions. Features of vegetative and integrated (provirus) viruses. Chemical composition of viruses. Differences in structural organization and chemical composition between virions and bacterial cells.

Virus-specific enzymes in a virion and infected cell.

Propagation of viruses. Strict parasitism and cytotrophism of viruses and the factors that determine them. The stages of virus reproduction: adsorption, viropexis, deproteinization, the synthesis of early and late proteins, multiple replication of the genome, assembly of the virion, exit from the cell. Infectious, incomplete and defective viral particles. Abortive and lytic infection. Integrative infection. Virogenia.

Genetics of viruses. Genetic apparatus of viruses. Variants. Mechanisms for increasing the density of information. Modifications in viruses: phenotypic mixing, complementation. Mutations in viruses. Genetic recombinations in viruses. Recombination, genetic reactivation, hybridization. Genetic markers of virulence. Population variability in viruses, mechanisms, practical significance.

Ecology of viruses. Human and animal viruses. The sensitivity of viruses to physical and chemical factors of the environment.

Viruses of bacteria (bacteriophages). Morphology of phage particles. Chemical composition. Properties. Virulent and moderate phages and peculiarities of their interaction with bacteria. Lysogenic infection. Phage conversion. Defective phages. Use of phages for diagnosis, treatment and prevention of bacterial infections. Phagotyping of bacteria. Sanitary-indicative bacteriophages.

Viral diseases. Viruses as a cause of tumors and infectious diseases. Prevalence, main features of viral infections. Types of viral infections. The cytopathic and cytotoxic effects of viruses. Immunotropic, toleogenic, oncogenic, teratogenic effect of viruses. Persistence of viruses in the host. Pathogenesis of viral infections. Slow infections.

Antiviral immunity. Factors of natural immunity. Cell inactivity. Antiviral inhibitors. Natural killers. Mechanisms of antiviral activity of the complement system and phagocytic system. Viral interference. Interferonogens. Interferons, types, classes, properties, antiviral, antitumor, immunomodulating and radioprotective action.

Acquired immunity to viral infections. Mechanisms of neutralization of infectious activity of virions with antibodies. Cytotoxic effect of lymphocytes on virus-infected cells. Mechanisms of development of immunological failure, allergic and autoimmune lesions in viral infections.

Immunoprophylaxis and immunotherapy of viral infections

Chemotherapy and chemoprophylaxis of viral infections. Basic antiviral chemotherapy and mechanisms of their action. Antiviral antiseptics.

Virological methods of diagnosis. The study of the viruses morphology by electronic and immunoelectronic microscopy. Detection of viral inclusions and other tissue damage by the cytological method. Cell cultures. Methods for isolating, indicating and identifying viruses on a chicken embryo, cell cultures, laboratory animals. Serological method of viral infections diagnosis. The reaction of viral activity neutralization. Hemagglutination inhibition and hemadsorption inhibition test. The reaction of immunoprecipitation. CFT. Express diagnostic methods: immunofluorescence, enzymeimmunoassay and radioimmunoassay. Methods of molecular genetic analysis (molecular hybridization, PCR).

4.2. Orthomixoviruses. Paramyxoviruses. Coronaviruses. Laboratory diagnosis of viral respiratory infections caused by Orthomixoviruses, Paramyxoviruses, Coronaviruses

Orthomixoviruses. General characteristics and classification. Influenza viruses A and B, virion structure, properties, antigenic structure and serotypes, antigenic variability and its consequences, sensitivity to physical and chemical factors. Influenza virus C. Influenza, prevalence, pathogenesis, immunity, methods of virological diagnosis. Preparations for specific therapy, immuno- and chemoprophylaxis of influenza. Viruses of "bird" and "swine" flu.

Paramyxoviruses. General characteristics and classification. Parainfluenza viruses, structure, properties, serotypes. Pathogenesis, immunity, laboratory diagnosis of parainfluenza. The virus of epidemic parotitis, structure, properties. Pathogenesis, immunity, diagnosis, specific prevention of mumps. Pneumovirus, structure, properties, pathogenicity for humans.

Morbilliviruses. Measles virus, structure, properties. Measles, prevalence, pathogenesis, immunity, virologic diagnosis. Preparations for active and passive immunoprophylaxis of measles.

Coronaviruses. The causative agent of severe acute respiratory syndrome (SARS), the structure of the virion, properties. The prevalence of the disease, pathogenesis, immunity, virological diagnosis, prevention.

4.3. Herpesvirus. Adenovirus. Togaviruses. Laboratory diagnosis of viral respiratory infections caused by Adenoviruses, Herpesviruses

Herpesviruses. Characteristics. Classification. Structure of the virion. Cultivation. Resistance. Antigens.

Herpes simplex viruses: HSV-1 and HSV-2. Pathogenetic features of the

disease. Persistence. Immunity. Oncogeneity of herpesviruses.

Varicella-zoster virus. Intranuclear inclusions in infected cells. Antigens. Hemagglutinin. Pathogenetic features of the disease.

Cytomegalovirus, Epstein-Barr virus, herpesviruses 6, 7 and 8 types. Laboratory diagnosis of herpesvirus infections.

Adenovirus. Structure of the virion. Cultivation. Toxic effect. Resistance. Antigens. Adenovirus serotypes. Pathogenetic features of diseases. Persistence. Oncogenic types of adenoviruses. Laboratory diagnosis of adenoviral infections.

Togaviruses. Characteristics and classification.

4.4. Characteristics of the pathogen and laboratory diagnosis of intestinal, transmissible and contact viral infections caused by Picornaviruses, Reoviruses, Caliciviruses, Flaviviruses, Rhabdoviruses

Picornaviruses. General characteristics.

Enteroviruses: polioviruses, Coxsackie and ECHO. Properties.

Localization and spread of polioviruses in the human body. Immunity. Specific prevention and therapy.

Diseases caused by Coxsackie and ECHO viruses in humans.

Hepatavirus, hepatitis A virus. Properties. Resistance. Pathogenesis of hepatitis A. Specific prevention.

Laboratory diagnosis of diseases caused by picornaviruses.

Hepatitis E virus. Characteristics. Transmission routes. Laboratory diagnosis, prevention, treatment.

Reoviruses. Characteristics and classification. Role in human pathology.

Rotaviruses. Structure, cultivation, antigenic structure, resistance, epidemiology. Pathogenesis, immunity. Laboratory diagnosis. Specific prevention and treatment.

Flaviviruses. Characteristics and classification. Virus of tick-borne encephalitis, yellow fever, dengue fever.

Hepatitis C virus, properties, transmission routes, diagnostic methods.

Rabdoviruses. The rabies virus. Properties. Pathogenicity for humans and animals. Tropism to the nervous tissue. Pathogenetic features of the disease. Intracellular inclusions (Babesh-Negri bodies). Laboratory diagnosis, specific prevention of rabies.

4.5. Characteristics of the pathogen and laboratory diagnosis of viral infections caused by Hepadnaviruses, Retroviruses, Togaviruses. Prions and prion diseases

Hepadnaviruses. Hepatitis B virus. The virion structure. Antigens. Resistance of the virus. Pathogenesis of the disease. Persistence. The role of the virus in the onset of primary liver cancer. Immunity. Laboratory diagnosis, specific prevention.

Hepatitis D virus, properties, routes of transmission. Methods of diagnosis.

Retroviruses. General characteristics and classification of the family.

Human immunodeficiency viruses (HIV-1 and HIV-2). The structure of the virion. Stages of reproduction of the virus in T-lymphocytes. Sensitivity to physical and chemical factors. HIV infection. Prevalence. Routes of infection. Groups at increased risk of infection. Formation of immunodeficiency and its characteristics.

Diagnosis of AIDS and its complications. Etiotropic therapy. Primary and secondary prevention of AIDS and its complications. Protocols for the diagnosis and prevention of HIV infection.

Togaviruses. Characteristics and classification.

Rubiviruses. Rubella virus. Characteristics. Consequences of the disease in pregnant women.

Laboratory diagnosis. Specific prevention and treatment.

Prions. The history of the discovery. Properties. Pathogenesis, clinical manifestations and diagnosis of prion infections (Creutzfeldt-Jakob disease, Gerstmann-Strausler-Sheinker syndrome, fatal familial insomnia, Kuru disease, transmissible spongiform encephalopathy of cattle).

EDUCATIONAL DISCIPLINE CURRICULAR CHART

Section, topic #	Section (topic) name	number of hours		Self-studies	Equipment	Form of control
		lectures	laboratory			
4 th semester						
1	General and sanitary microbiology	14	24	20		
1.1	Microbiology as a science. The world of microbes	2	-			Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
1.2	Morphology of microorganisms	-	4		Light microscopes Microscope lumam Darkfield microscope Phase contrast microscope Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
1.3	Physiology of microorganisms	2	6		Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
				5		

Section, topic #	Section (topic) name	number of hours		Self studies	Equipment	Form of control
		lectures	laboratory			
1.4	Genetics of microorganisms	2	2	2	Light microscopes Equipment for pcr Sequencer Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
1.5	Ecology of microorganisms. Infection	2	2	2	Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
1.6	Microbiological bases of chemotherapy and antiseptics of bacterial infections	2	4	2	Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
1.7	Sanitary microbiology. Microbiological examination of medicinal raw materials and drugs	4	6	9	Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests Final test, Colloquium

Section, topic #	Section (topic) name	number of hours		Self-studies	Equipment	Form of control
		lectures	laboratory			
2.	Theoretical and applied immunology	8	14	10		
2.1	Immunology. Immune system. Innate immunity	2	2	1	Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
2.2	Antigens and antibodies	2	2	1	Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
2.3	The immune response	2	2		Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
2.4	Immuno diagnosis of infectious diseases	-	2	1	Light microscopes Thermostat Equipment for sterilization Spectrophotometer Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests

Section, topic #	Section (topic) name	number of hours		Self-studies	Equipment	Form of control
		lectures	laboratory			
2.5	Immunopathology. Basics of clinical immunology. Immunoprophylaxis and immunotherapy of infectious diseases	2	6	7	Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests Final test, Colloquium, Final test, Credit

5th semester

3	Special medical microbiology	8	22	44		
3.1	Causative agents of purulent inflammatory infections: Staphylococci, Streptococci, Pseudomonas, Proteus, Bacteroides. Nosocomial infections	2	-		Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
3.2	Laboratory diagnosis of wound and purulent-inflammatory infections caused by Staphylococci, Streptococci, Pseudomonas, Proteus, Bacteroides, Clostridia, Neisseria	-	6	10	Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
3.3	Causative agents of airborne infections: meningococci, Bordetella, Corynebacteria, Mycobacteria. Laboratory diagnosis of airborne infections	2	4	6	Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning,

Section, topic #	Section (topic) name	number of hours		Self-studies	Equipment	Form of control
		lectures	laboratory			
						Situational tasks and tests Electronic tests
3.4	Enterobacteria. Escherichia, Salmonella, Shigella	2	-		Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
3.5	Laboratory diagnosis of diseases caused by Escherichia, Salmonella, Shigella, Vibrio, Iersinia. Clostridia, Campylobacter, Helicobacter	-	4	6	Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
3.6	Pathogens of sexually transmitted infections: Teponema, gonococci, Chlamydia, Mycoplasma. Laboratory diagnosis of sexually transmitted diseases	2	2	2	Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
3.7	Laboratory diagnosis of bacterial zoonotic infections caused by tularemia pathogens, Brucellae, plague Yersinia, anthrax Bacilli, Leptospira	-	2	3	Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests

Section, topic #	Section (topic) name	number of hours		Self-studies	Equipment	Form of control
		lectures	laboratory			
3.8	Laboratory diagnosis of vector-borne infections caused by <i>Borrelia</i> , <i>Rickettsia</i>	-	1	3	Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
3.9	Basics of medical mycology and protozoology	-	3	13	Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests Final test, Colloquium
4	General and special virology	10	12	24		
4.1	General Virology	2	2	3	Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
4.2	Orthomyxoviruses. Paramyxoviruses. Coronaviruses. Laboratory diagnosis of viral respiratory infections caused by Orthomyxoviruses, Paramyxoviruses, Coronaviruses	2	2	3	Ovoscope Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests

Section, topic #	Section (topic) name	number of hours		Self-studies	Equipment	Form of control
		lectures	laboratory			
4.3	Herpesvirus. Adenovirus. Togaviruses. Laboratory diagnosis of viral respiratory infections caused by Adenoviruses, Herpesviruses	2	2	3	Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
4.4	Characteristics of the pathogen and laboratory diagnosis of intestinal, transmissible and contact viral infections caused by Picornaviruses, Reoviruses, Caliciviruses, Flaviviruses, Rhabdoviruses	2	2	3	Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests
4.5	Characteristics of the pathogen and laboratory diagnosis of viral infections caused by Hepadnaviruses, Retroviruses, Togaviruses. Prions and prion diseases	2	4	12	Light microscopes Thermostat Equipment for sterilization Computer class	Interview, Written accounts of laboratory work, Control questioning, Situational tasks and tests Electronic tests Final test, Colloquium, Examination

INFORMATION AND INSTRUCTIONAL UNIT

LITERATURE

basic (relevant):

1. Generalov, I.I. Medical microbiology, virology and immunology: lecture course for students of medical universities / I.I. Generalov. – Vitebsk: VSMU, 2016. – P.I. – 282 p.

additional:

2. Medical Microbiology / F.H. Kayser [at al.]. Thieme, Shtuttgart, New York, 2005. 725 p.

3. Ryan, K.J. Sherris medical microbiology. An introduction to infection diseases/ K. J. Ryan, C. G. Ray J. C. Sherris. 4th ed. McGraw-Hill Medical Publishing Division, 2010. 979 p.

4. Khaitov R.M. Immunology: textbook. - Moscow: GEOTAR-Media, 2008. - 256 p.

5. Murray, P. R. Medical microbiology/ P. R. Murray, K. S. Rosenthal, M. A. Pfaller. Elsevier Health Science, 2015. 789 p.

6. Instructional manual, approved by the Academic and Methodological Association in the Field of Medical Education.

7. Gillespere, S. H. Medical microbiology illustrated/ S. H. Gillespere. Butterworth-Heinemann, 2014

8. Paul W.E. Fundamental Immunology, 6th Edition, 2008 Lippincott Williams & Wilkins.-P.1555.

LIST OF AVAILABLE DIAGNOSTIC TOOLS

The following forms are used for competences assessment:

1. Oral form:
 - interviews;
 - colloquiums;
 - situational tasks and tests;
2. Written form:
 - control questioning;
 - final tests;
 - written accounts of laboratory work;
3. Oral-written form:
 - credits;
 - examinations.
4. Technical form:
 - electronic tests.

LIST OF PRACTICAL SKILLS

1. Prepare a smear from bullion culture of bacteria and stain by Gram method.
2. Prepare a smear from agar medium culture of bacteria and stain by Gram method.
3. Identify *Staphylococcus spp.*
4. Identify *Streptococcus spp.*
5. Identify *Neisseria gonorrhoeae*.
6. Identify *Escherichia coli*.
7. Identify a mixture of *Staphylococcus spp.* and *Escherichia coli*.
8. Identify a causative agent of anthrax – *Bacillus anthracis*.
9. Identify *Vibrio spp.*
10. Identify *Brucella spp.*
11. Identify *Candida spp.*
12. Identify capsule of *Klebsiella spp.* (negative contrasting)
13. Identify *Mycobacterium* in sputum (Ziehl–Neelsen stain stain)
14. Identify *Corynebacterium diphtheria* (Löffler stain).
15. Demonstrate inoculation technique on plated agar medium from slant media.
16. Demonstrate inoculation technique on slant agar medium from plated medium.
17. Demonstrate inoculation technique on slant medium from slant medium.
18. Register and assess the results antibiotic susceptibility testing by disc diffusion method.
19. Assess the results of agglutination reaction in tubes.
20. Assess the results of Complement fixation test.
21. Assess the results of Indirect (passive) agglutination test.
22. Assess the results of haemagglutination inhibition test.
23. Demonstrate the technique of slide agglutination testing.

LIST OF LECTURES

4th semestre:

1. A place, subject, problems, methods in microbiology. History of microbiology. Systematisation and the nomenclature of microorganisms.
2. Evolution of microbes. A metabolism and energy exchange in bacteria. Growth and reproduction of microbes.
3. Genetics of bacteria.
4. Ecology of microbes. Normal microflora of the human. Basics of infectology. Evolution of infectious diseases.
5. Microbiological bases of chemotherapy and antiseptics. Antibiotics.
6. Microphlora of plants. Phytopathogenic bacterias. Determination of microbial contamination of medicinal plant material.
7. Sanitary microbiology. The microflora of air, water, soil. Sanitary-bacteriological study of water, air. Microbiological examination of medicinal raw materials and drugs. Sterilisation.
8. Immunology. Immune system. Innate immunity. Antigen presenting cells.

9. Antigens. Antibodies. B-lymphocytes. T-lymphocytes.
10. Humoral immune response. The cellular immune response. Immunological tolerance.
11. Clinical immunology. Allergy. Antiinfection immunity. Immunoprophylaxis and immunotherapy.

5th semestre:

1. Special medical microbiology. Staphylococci. Streptococci. Proteus. Bacteroides. Nosocomial infections
2. Causative agents of airborne infections: meningococci, Bordetella, Corynebacteria, Mycobacteria.
3. Enterobacteria. Escherichia, Salmonella, Shigella.
4. Pathogens of sexually transmitted infections: Treponema, gonococci, Chlamydia, Mycoplasma. Laboratory diagnosis of sexually transmitted diseases.
5. The general virology.
6. Orthomyxoviruses. Paramyxoviruses. Coronaviruses.
7. Herpesvirus. Adenovirus. Togaviruses.
8. Characteristics of the pathogen and laboratory diagnosis of intestinal, transmissible and contact viral infections caused by Picornaviruses, Reoviruses, Caliciviruses, Flaviviruses, Rhabdoviruses.
9. Characteristics of the pathogen and laboratory diagnosis of viral infections caused by Hepadnaviruses, Retroviruses, Togaviruses. Prions and prion diseases.

LIST OF LABORATORY STUDIES

4th semestre:

1. A bacterioscopy method of investigation. Forms of bacteria. Methods of studying of bacteria morphology.
2. Structure of a bacterial cell.
3. Morphology of aktinomycetes, spirochetes, rickettsia, chlamidia, mycoplasma.
4. Antimicrobial means. Bacteriological (cultural) a method of investigation, 1st and 2nd steps.
5. Bacteriological method of investigation, 3rd step.
6. Genetics of microorganisms.
7. Ecology of microbes. Microflora of a human body. An infection.
8. Microbiological bases of chemotherapy and antiseptics of bacterial infections.
9. Drug resistance of bacteria Microbiological bases of antiseptics of bacterial infections.
10. The microflora of air, water, soil. Sanitary-bacteriological study of water, air
11. Phytopathogenic bacteria. Microflora of medicinal raw materials and drugs. Determination of microbial contamination of medicinal plant material.
12. A concluding session on section: «the General and sanitary microbiology».
13. Immunology. Innate immunity.
14. Antigens. B-lymphocytes. T-lymphocytes. Antibodies.
15. Humoral immune response. The cellular immune response.

- 16.A Serological method of investigation.
- 17.Clinical immunology.Allergy.
- 18.Immunoprophylaxis and immunotherapy.
- 19.A concluding session on section: "Immunology".

5th semestre:

- 1. Special medical microbiology. Laboratory diagnosis of wound and purulent-inflammatory infections caused by staphylococci, streptococci, neisseriae.
- 2. Laboratory diagnosis of wound and purulent-inflammatory infections caused by pseudomonas, proteus
- 3. Laboratory diagnosis of wound and purulent-inflammatory infections caused by bacteroides, clostridia.
- 4. Mycobacteria pathogenic to humans. Laboratory diagnosis of airborne infections caused by meningococci, Hemophils, Legionella.
- 5. Laboratory diagnosis of airborne infections caused by Bordetella, Corynebacteria
- 6. Laboratory diagnosis of diseases caused by Escherichia, Salmonella, Shigella/
- 7. Laboratory diagnosis of diseases caused by Vibrio, Iersinia. Clostridia, Campylobacter, Helicobacter.
- 8. Laboratory diagnosis of sexually transmitted diseases.
- 9. Laboratory diagnosis of bacterial zoonotic infections caused by tularemia pathogens, Brucellae, plague Yersinia, anthrax bacilli, Leptospira/
- 10.Pathogens of vector-borne infections caused by Borrelia, Rickettsia. Basics of medical mycology and protozoology/
- 11.A concluding session on section: «Special medical microbiology».
- 12.The general virology.
- 13.Laboratory diagnosis of viral respiratory infections caused by Orthomixoviruses, Paramyxoviruses, Coronaviruses/
- 14.Laboratory diagnosis of viral respiratory infections caused by Adenoviruses, Herpesviruses/
- 15.Laboratory diagnosis of intestinal, transmissible and contact viral infections caused by Picornaviruses, Reoviruses, Caliciviruses, Flaviviruses, Rhabdoviruses/
- 16.Laboratory diagnosis of viral infections caused by hepadnaviruses, retroviruses, togaviruses. Prions and prion diseases/
- 17.A concluding session on section: «the General and special medical virology».

**PROTOCOL OF APPROVAL THE MICROBIOLOGY CURRICULUM IN THE SPECIALTY 1-79 01 08
"PHARMACY" FOR THE MEDICAL FACULTY OF INTERNATIONAL STUDENTS**

Title of the discipline requiring approval	Department	Amendments to the curriculum of the academic discipline	Decision of the department, which designed the curriculum (date, protocol #)
Medical Biology	Department of Biology	Suggested changes to the curriculum	
Normal Physiology	Department of Normal Physiology	Suggested changes to the curriculum	
Organic Chemistry	Department of Biological Chemistry	Suggested changes to the curriculum	
Biological Chemistry	Department of Biological Chemistry	Suggested changes to the curriculum	
Pharmacology	Department of Pharmacology	Suggested changes to the curriculum	
Pathological Physiology	Department of Pathophysiology	Suggested changes to the curriculum	

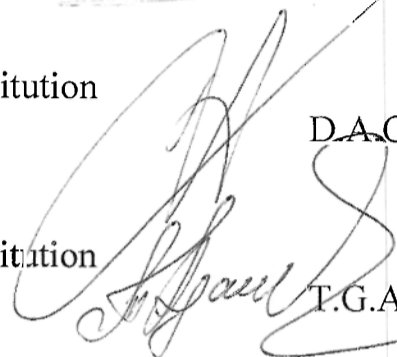
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T.G.Adamovich

Content and design of the program and accompanying documents meet the
specified requirements

Dean of the Medical Faculty of
International Students
01.06 2018



A.V.Haiduk

Methodologist of Educational Institution
«Belarusian State Medical University»
01.06 2018



S.A.Kharytonava

Head of the Foreign Languages Department
01.05 2018



M.N.Petrova

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