Ministry of health of the Republic of Belarus
Educational institution
«Gomel State Medical University»

Department of general and clinical pharmacology

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METHODOLOGICAL RECOMMENDATIONS

for a practical lesson on the discipline "Clinical pharmacology"
with six-year students of the Faculty of Foreign Students,
studying at the specialty 1-79 01 01 "General medicine"

TOPIC 6**: « CLINICAL PHARMACOLOGY OF ANTIBACTERIAL, ANTIVIRAL,ANTIFUNGAL AND ANTIPROTOZOAL DRUGS. BASICS OF CARRYING OUT OF RATIONAL ANTIBIOTICOTHERAPY. PRINCIPLES OF TREATMENT OF ACUTE RESPIRATORY VIRAL INFECTIONS».**

Time: 7 hours

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LEARNING AND EDUCATIONAL GOALS, OBJECTIVES, AND MOTIVATION FOR MASTERING THE TOPIC

Antimicrobials are among the drugs whose efficacy is most obvious. The introduction of antibiotics into medical practice led to a decrease in mortality for the most severe and widespread infectious diseases (pneumonia, meningitis, endocarditis, tuberculosis, etc.) and to a decrease in the incidence of certain socially significant diseases, such as acute rheumatic fever.

The initial success of the first antibiotics, and the optimism associated with this fact and the subsequent prospects for developing new antimicrobial agents, enabled scientists and clinicians in the 1950's and 1960's to express the view that medicine had triumphed over germs and really eliminated infectious diseases as a significant factor in the social life of mankind. However, the situation was soon complicated by the appearance of resistant to antibiotics staphylococci and pneumococci, and later of gram-negative bacteria, and the problem has become particularly acute and dramatic in the last 5-10 years, when in medical institutions began to spread microorganisms resistant to many and sometimes all antibiotics. This situation has led experts to raise fears that a "post-antibiotic era" is approaching.

The main limitation to the effectiveness of antimicrobial drugs is the ability of microorganisms to develop resistance (resistance) to their action. This natural process is greatly accelerated by the unnecessary and excessive use of antimicrobials as a means of prevention in medicine, as a means of self-treatment by the general public, as a means of treatment and stimulation of animal and bird growth in agriculture. The threat of the emergence and spread of antibiotic resistance was immediately realized by the scientific community, however for many years the problem was solved by the development and implementation of new preparations, that overcome the known mechanisms of resistance.

The situation began to change for the worse in the mid-1990s, when, due to a number of economic reasons and fundamental biological obstacles, the development and implementation of new anti-microbial drugs in practical medicine slowed down, and the process of spreading resistance accelerated due to the growth of consumption of these drugs, primarily due to their affordability. The awareness of the resistance threat was reflected in the document "Global Strategy for Containment of Resistance", adopted by the World Health Organization in 2001. The document proposed specific measures to curb antimicrobial resistance at the state level, and it was recommended that the implementation of these measures should be considered as a priority for national health systems.

However, globally, these measures proved to be insufficient. The results of various epidemiological studies continue to document the growth and spread of resistant microorganisms both in and out of hospitals. This can be explained by the fact that the process of resistance formation is a multifactorial process, and many of its components are interrelated. It is known that the use of antibiotics is accompanied by selective pressure on pathogens, which leads to the growth of their resistance to the used antibiotics and reduces their effectiveness. Another phenomenon, much more global in its consequences, is the formation of resistance not only among the infectious microbes, but also among the saprophytic microflora, which are not etiologically significant. This phenomenon is called "collateral damage" of antibiotic therapy. It has been shown that the spread of antibiotic-resistant pathogens is

in direct dependence on the number of prescribed antibiotics and the breadth of their antimicrobial spectrum.

Globally, most antimicrobials are prescribed by primary care physicians, primarily for the treatment of acute respiratory infections. There for a determinant component of curbing antimicrobial resistance is a reasonable limitation of antibiotic use in outpatient practice and rationalization of their use. The set of measures necessary for this purpose is called antibiotic stewardship, the rationalization of antimicrobial agents used to improve their effectiveness and curb antimicrobial resistance.

In order to achieve the competent antibiotic therapy management, each qualified doctor, irrespective of his/her specialty, should possess knowledge not only about the etiopathogenesis of infectious diseases, diagnostic and differential-diagnostic search, algorithm of medical help, but also about clinical pharmacology of drugs used in treatment of infectious diseases, should correctly choose the antibacterial drug, the route of administration, the frequency of use and the duration of treatment, taking into account the dynamic.

Learning objective:

– Formation of scientific knowledge about the pharmacokinetics and pharmacodynamics of drugs on the topic of the class in order to master the rational and differentiated pharmacotherapy of various infectious diseases.

Educational purpose:

– to develop their value-personal, spiritual potential, to form the qualities of a patriot and citizen, ready for active participation in the economic, industrial, socio-cultural and public life of the country; to realize the social importance of their future professional activity, to learn to comply with academic and labor discipline, the norms of medical ethics and deontology.

Tasks:

As a result of the training session, the student should

know:

- Clinical and pharmacological classification of drugs used in the treatment of diseases on the topic of the lesson, their pharmacokinetic and pharmacodynamic features;
- Indications and contraindications for administration of drugs on the theme of the class, features of their use in different age groups and in various concomitant diseases; dosage regime of drugs and their interaction with other pharmacological groups;
- Principles of control over the effectiveness and safety of the medicines, possible side effects, ways to prevent and correct them;

be able to:

- Choose the most effective and safest medicines on the topic of the lesson, taking into account their basic pharmacokinetic and pharmacodynamic characteristics, possible side effects and drug interactions, on the one hand, the characteristics of the disease, age and gender of the patient, the presence of concomitant pathology and the degree of impairment of the basic functions of the body, on the other hand;
- To conduct objective control over the efficacy and safety of medications on the theme of the class, to analyze their pharmacokinetic parameters and on the basis of the received data to calculate single and course doses;

- determine the optimal route of administration of medicines on the subject of the class, prescribe them taking into account the time of day, intake and composition of food, predict, prevent and detect side effects of medicines, avoid lip- pragmasy and irrational combination of different medicines;

- prescribe medications on the topic of the class in the prescription;

- inform patients about the nature of action of the medicines on the topic of the class, the rules of their administration and possible side effects;

- Evaluate scientific information on the effectiveness of the studied drugs, work with reference and other literature on the topic of the lesson;

possess:

– ability and willingness to analyze the characteristics of absorption, distribution, biotransformation and excretion of drugs on the topic of the class;

– ability and readiness to rationally dose the medication on the topic of the class, including the choice of dosage form, routes of administration and dosing regime;

– skills to use medicines on the topic of the class in the treatment, rehabilitation and prevention of relevant diseases and pathological conditions, taking into account the main pharmacodynamic parameters;

– skills of search, analysis and synthesis of information on the use and effect of various medicines on the topic of the class.

Motivation for learning the topic:

The specifics of training doctors in this specialty determines the need for purposeful study of students' knowledge of pharmacokinetics and pharmaco-dynamics of drugs on the topic of the class and the ability to justify and conduct a rational differentiated pharmacotherapy of the corresponding diseases and pathological conditions.

MATERIAL EQUIPMENT

Reference and informational literature, charts, tables, presentations, patient case histories, package of regulatory documents, collection of medications.

CONTROL QUESTIONS FROM RELATED DISCIPLINES

- from biochemistry and physiology: physical properties and structure of cell membranes, transport of substances through biological membranes in norm and pathology;

- general and bioorganic chemistry: basics of chemical kinetics and catalysis, buffer solutions and systems, pH calculation;

- from biochemistry: kinetics of enzymatic reactions, Michaelis-Menten kinetics equation, the concept of enzyme inhibitors, types of enzyme inhibitors;

- from pathological physiology: cell damage, disorders of protein, fat, carbohydrate and mineral metabolism, disorders of local and general circulation, immunopathological processes, allergy, inflammation, infectious pathology;

- from microbiology, virology, immunology: microbial flora and viruses causing diseases in patients of various age categories, immune system, antigens, specific and non-specific protective factors of the organism;

- from Latin: basic rules for coordinating parts of speech and formulating prescriptions when prescribing medicines;

- from pharmacology: general questions of pharmacology, pharmacokinetics and pharmacodynamics of drugs, general prescription and prescription rules;

- infectious diseases: general issues of infectiology, intestinal infections and invasions, acute respiratory viral infections, viral hepatitis, transmissible infections, infectious diseases occurring with predominant lesions of the central nervous system.

CLASS DISCUSSION QUESTIONS

1. The peculiarities of the course of an infectious disease depending on the nature of the causative agent and the reactivity of the organism.

2. Classification, the concept of basic and reserve antibiotics. Penicillins, cephalosporins, cefamycins, beta-lactamase inhibitors. Monobactams, car-bape-nemes. Macrolides and azalides. Tetracyclines. Amphenicols. Aminoglycosides. Lincosamides and polymyxins. Glycopeptides, oxazolidinones and steroidal antibiotics (fusidic acid). Mechanism of action and antimicrobial spectrum of antibiotics of various classes, application for treatment and prophylaxis of infections. Complications of antibiotic therapy and their prevention.

3. Sulfonamides: classification, mechanism of action, antimicrobial spectrum, use, side effects. Quinolones and fluoroquinolones: classification, mechanism of action, antimicrobial spectrum, clinical pharmacology.

4. Nitrofurans, nitroimidazoles, oxyquinolines: classification, mechanism of action, antimicrobial spectrum, use, side effects.

5. Principles of combined antibiotic therapy. Control over efficacy and safety of treatment with antibacterial drugs.

6. Antiseptic and disinfectants, definition, classification, principle of action, application.

7. Classification of antiviral drugs. Clinical and pharmacological characteristics of anti-influenza drugs, anti-herpetic and antiretroviral drugs, interferons, immunobiological drugs. Principles of treatment of acute respiratory viral infections.

8. Modern principles of pharmacological therapy of the most common fungal and parasitic diseases.

9. Classification of antifungal drugs of local and systemic application.

10. Clinical pharmacology of the main groups of drugs used for the treatment of parasitic diseases.

PROCESS OF THE STUDY

Theoretical part:

Answers to theoretical questions about the topic of the class are presented in the appendix.

Practical part:

1) Take notes on theoretical material demonstrated by the teacher;

2) Develop methods of solving tasks and writing out prescriptions on the topic of the class.

Control of assimilation of the theme:

Conducted in the form of independent written work (the solution of practical tasks and prescriptions for individual assignments).

METHODOLOGICAL RECOMMENDATIONS ON THE ORGANIZATION AND REALIZATION OF CSR

The time which is allotted for independent work can be used by students for:

- Preparation for the practical classes;
- To write a textbook medical history;
- To prepare thematic reports, essays, presentations;
- abstracting of textbooks.

The main methods of organizing independent work:

- test tasks and practical tasks for self-monitoring and self-assessment;
- Writing a textbook medical history.

The list of SRW tasks:

- solving practical tasks from EMSC;
- Reading: solving practical tasks from EMCC; completing test tasks from EMCC;
- Writing an academic case history.

CDS control is carried out in the form of:

- evaluation of the oral answer to a question, report or solution of a problem in practical classes;
- individual interview;
- Checking of medical history.

METHODIC GUIDELINES FOR ORGANIZING AND CARRYING OUT THE USRS

Recommended forms of the USRS organization:

- writing a textbook medical history;
- Writing an essay on a given topic;
- report and multimedia presentation on a given topic.

List of tasks for the USRS:

Abstract/Multimedia Presentation Topics:

1. antibiotics and their prophylactic use in surgery.
2. Modern tactics of application of antimicrobial agents in treatment of the main diseases of the digestive system.
3. Antibiotics use in pregnancy, old age and childhood.

Forms of control over USRS realization:

- Verification of medical history;
- Examination and evaluation of the report on the assigned theme;
- check and evaluation of multimedia presentation on the given topic.

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CHEMOTHERAPEUTIC AGENTS. CONCEPT OF CHEMOTHERAPY [1-8].

Chemotherapeutic agents are medicinal substances suppressing the vital functions of pathogens of infectious diseases or tumor cells.

Antibiotics are medicinal substances of predominantly microbial origin, as well as their semisynthetic and synthetic analogues, which have the ability to suppress the viability of susceptible microorganisms.

Currently, 3 types of antibiotic treatment are used:

1. *Preventive treatment* - prescribing antibiotics for the prevention of infectious diseases (for example, for seasonal prevention of acute rheumatic fever or postoperative complications).

2. *Empirical or initial treatment* – administration of broad-spectrum antibiotics suppressing microorganisms associated with the given pathology without the results of bacterial culture and antibiotic susceptibility testing (eg, community-acquired pneumonia is most often caused by pneumococcus susceptible to aminopenicillins).

3. *Final treatment* – administration of narrow-spectrum antibiotics in accordance with the results of bacterial culture test (type of detected pathogens and its susceptibility to antibiotics).

Principles of rational chemotherapy.

The choice of the drug should be carried out taking into account:

1) Diagnosis (therapy can be empirical and etiotropic);
2) The spectrum of drugs activity (it is preferable to administer narrow-spectrum antibiotics);
3) The state of the patient's organism taking into account his age, pregnancy and concomitant diseases;
4) Toxicity of drugs, their side effects;
5) Localization of the infection (the substance should reach the focus of infection);
6) Route of administration (In severe cases, drugs are administered parenterally);
7) The possibility of combining drugs in order to enhance the pharmacological effect and prevention of the development of resistance of microorganisms to antibiotics;
8) Drugs cost.

When prescribing treatment adequate dose of the drug, frequency of its administration and duration of the course of antibiotic therapy should be chosen.

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PENICILLINS [1-8]

Classification	Natural	Semisynthetic			
		ß -lactamase-resistant	**Aminopenicillins**	**Antipseudomonal**	**Penicillinase-resistant**
Drugs	**Short acting:** 1. Benzylpenicillin sodium and potassium salts 2. Phenoxymethylpenicillin **Long-acting:** 3. Benzylpenicillin novocaine salt 4. Bicillin-1, bicillin-5	5. Oxacillin 6. Cloxacillin	7. Ampicillin 8. Amoxicillin	***Carboxypenicillins:*** 9. Carbenicillin 10. Ticarcillin ***Ureidopenicillins:*** 11. Piperacillin 12. Azlocillin	13. Amoxicillin / clavulanic acid (Augmentin) 14. Ampicillin / сульбактам (Unazine) 15. Ticarcillin / clavulanic acid (Timentin) 16. Piperacillin / Tazobactam
Mechanism of action	Suppress the synthesis of the bacterial cell wall (bactericidal action)				+ Inhibition of ß-lactamases due to sulbactam, clavulanate → Are active against PRSA
Spectrum of activity	1. Gr (+) cocci: non-penicillinase producing staphylococci: streptococci, pneumococci 2. Gr (-) cocci: meningococci 3. Gr (+) sticks: Listeria, causative agents of diphtheria, anthrax 4. Spirochetes, anaerobes	See natural penicillins + 5. Penicillinase-producing staphylococci (PRSA)	1. Gr (-) bacteria: E. coli, hemophilic rod, salmonella, shigella 2. Gr (+) cocci: non-penicillinase producing staphylococci, Streptococci (enterococcus), pneumococci 3. Gr (-) cocci: meningococci 4. Gr (+) sticks: listeria, exciters of diphtheria, anthrax 5. Spirochetes, anaerobes	Similar to Ampicillin, but + 1. Pseudomonas aeruginosa 2. Ampicillin-resistant Gr (-) m/o: Enterobacter, Proteus, Morganella 3. Gr (-) non-sporeforming anaerobes	The broadest spectrum of activity among all penicillins
Indications for use	1. Erysipelas, scarlet fever 2. Syphilis 3. Bacterial endocarditis 4. Anaerobic infections 5. Borreliosis, anthrax	1. Staphylococcal infections (infections of the skin and soft tissues, bones and joints, hospital pneumonia, etc.)	1. Urinary tract infection 2. Upper respiratory infection (Acute otitis media, acute sinusitis) 3. Lower respiratory infection (bronchitis, community-acquired pneumonia) 4. Эрадикация Helicobacter pylori (8)	1. Diseases caused by Pseudomonas aeruginosa (skin, abdominal organs, urinary and biliary tracts infections, etc.)	1. Severe infections of the respiratory and musculoskeletal system, urinary and biliary tracts and soft tissues. 2. Hospital-acquired infections
Side effects	Allergy, headache, nausea, vomiting, pseudomembranous colitis, pain in i/m administration, phlebitis in i/v administration				
Contraindications	Allergy, I semester of pregnancy (amoxicillin / clavulanic acid)				
Drug interactions	1. Anticoagulants, thrombolytics, NSAIDs, salicylates ↑ risk of bleeding. 2. ACE inhibitors, potassium-sparing diuretics, potassium-containing drugs ↑ risk of hyperkalemia (for benzylpenicillin potassium salt). 3. Aminoglycosides lead to mutual inactivation when mixed 4. Combination with oral combined contraceptives ↓ their effectiveness				

CEPHALOSPORINS [1-8]

Classification	I generation	II generation	III generation	IV generation	V generation
Drugs	*i/v i/m* 1. Cefazolin (Kefzol) *per os* 2. Cephalexin (Keflex) 3. Cefadroxil (Duricef)	*i/v i/m* 4. Cefuroxime (Ceftin) 5. Cefamandole (Mandol) *per os* 6. Cefaclor (Ceclor) 7. Cefuroxime (Zinacef)	*i/v i/m* 8. Cefotaxime (Claforan) 9. Ceftriaxone (Rocephin) 10. Cefoperazone (Cefobid) 11. Ceftazidime (Fortu) *per os* 12. Cefixime (Fixx) 13. Ceftibuten (Cedax)	*i/v i/m* 14. Cefepime (Maxi-pime) 15. Cefpirome (Cefrom)	*i/v i/m* 16. Ceftobiprole 17. Ceftaroline
Mechanism of action	Suppress the synthesis of the bacterial cell wall (bactericidal action)				
Spectrum of activity	1. Gr (+) cocci: streptococci, staphylococci 2. Gr (-) cocci and bacilli insig-nificantly	1. Gr (-) bacteria: hemophilic rod, Klebsiella, proteus 2. Gr (+) cocci: streptococci, staphylococci	1. Gy (-) bacteria (including polyre-re-sistant strains of enterobacteria) 2. Anaerobes (8,9) 3. Gr (+) cocci: strepto-, pneumococci (8.9) 4. Pseudomona (10, 11)	***See III generation***	1. MRSA (methicillin-resistant Staphylococcus aureus) 2. Penicillin-resistant strepto-cocci and enterococci
Indications	1. Perioperative chemopreven-tion 2. Strepto- and staphylococcal in-fections of the musculoskeletal system, skin, soft tissues	+ 3. Urinary tract infection 4. Respiratory infections (community-acquired pneumo-nia, acute sinusitis and otitis media)	1. Infections of the respiratory system (including, hospital pneumonia) 2. Urinary tract infection 3. Abdominal, pelvic infections	+ 4. Infections caused by hospital strains of Enterobacteria, staphy-lococci, Pneumococcus and Pseudomonas aeru-ginosa	1. Infections of the skin and soft tissues
Side effects	**Allergic reactions; hematological reactions: in rare cases - leukopenia, eosinophilia; disulfiram-like reaction with alcohol intake (5,10);** headache; nausea, vomiting; Super-infections caused by enterococci, MRSA; pain and thrombophlebitis in the site of injection				
Contraindications	Allergy				
NB!	1. Cephalosporins are resistant to bacterial beta-lactamases, BUT combination of cefoperazone + sulbactam (Beta-lactamase inhibitor) expands the spectrum of action up to resistant enterobacteria and akinetobacter; suppresses nesporogenous anaerobes → therapy of abdominal and pelvic infections. 2. Each subsequent generation is superior to the previous when comparing the spectrum of activity among the Gp (-) bacteria, but loses activity against Gr (+). AN EXCEPTION! IV generation (high activity against Gr +)				
Drug interactions	1. Alcohol-containing preparations, alcohol lead to a disulfiram-like reaction (10). 2. Anticoagulants, thrombolytics, NSAIDs, salicylates ↑ risk of bleeding. 3. Aminoglycosides, glycopeptides, loop diuretics and other nephrotoxic agents ↑ risk of nephrotoxicity				

CARBAPENEMS AND MONOBACTAMS [1-8]

Classification	Carbapenems	Monobactams
Drugs	1. Imipenem-cilastatin (Tienam) 3. Doripenem (Doriprex) 2. Meropenem (Meronem) 4. Ertapenem (Invanz)	3. Aztreonam
Mechanism of action	Suppress the synthesis of the bacterial cell wall (bactericidal action)	
Spectrum of activity	Record wide: 1. Gr (+) cocci: streptococci, staphylococci, pneumococci 2. Gr (-) cocci: neiesseria, gonococcus and meningococcus 3. Gr (-) bacteria: Listeria, Hemophilus rod, Proteus, Shigella, Salmonella, Escherichia coli, Klebsiella, Citrobacterium, Campylobacter, Pseudomonas aeruginosa, Serratia 4. Anaerobes: clostridia, fusobacteria, bacteroides	1. Gr (-) flora: gonococcus, meningococcus, Escherichia coli, Salmonella, Shigella, Klebsiella, Proteus, Citrobacterium, Pseudomonas aeruginosa.
Indications	Last resort antibiotic 1. Infections of the lower respiratory and urinary tracts, abdominal organs, skin, soft tissues 2. Meningitis 3. Sepsis * Including caused multidrug-resistant bacteria	*Last resort antibiotic (infections caused by resistant to other ß-lactam antibiotics and aminoglycosides strains of Gr (-) bacteria or in case of intolerance to aminoglycosides)* 1. Sepsis 2. Urinary tract infection (cystitis, pyelonephritis) 3. Hospital pneumonia, cystic fibrosis 4. Infections of the skin, musculoskeletal system
Side effects	1. Nausea, vomiting, diarrhea, abdominal pain 2. Thrombophlebitis at the injection site 3. Allergy 4. Pseudomembranous colitis (rarely)	1. Pain and swelling at the injection site (в/м), thrombophlebitis (в/в) 2. Nausea, vomiting, diarrhea, abdominal pain, pseudomembranous colitis 3. Hepatitis, jaundice
Contraindications	1. Hypersensitivity to carbapenems	1. Hypersensitivity in anamnesis
NB!	1. Carbapenems are resistant to most β-lactimases of m/o (but MRSA is resistant to carbapenems). 2. Cilastatin inhibits the enzyme dehydropeptidase I which destroys the imipenem in the renal tubules.	It is destroyed by ß-lactamases of many microbes.
Drug interactions	1. Extended-spectrum penicillins, aztreonam, cephalosporins, chloramphenicol when used together are antagonistic. 2. Ganciclovir has a high risk of generalized seizures (1)	1. Carbopenems when used together are characterized by antagonism. 2. It is forbidden to mix a solution of aztreonam with other drugs, both in the syringe and in the infusion system.

TETRACYCLINS AND MACROLIDES [1-8]

Classification	Tetracyclines		Macrolides	
	Natural	**Semisynthetic**	**Natural**	**Semisynthetic**
Drugs	1. Tetracycline	2. Metacyclin (rondomycin) 3. Doxycycline (vibramycin)	***14- membered:*** 4. Erythromycin 5. Oleandomycin ***16- membered:*** 6. Josamycin 7. Midekamycin (macropen)	***14-membered:*** 8. Roxithromycin (rulid) 9. Clarithromycin (clamed) ***15- membered:*** 10. Azithromycin (Sumamed) ***16- membered:*** 11. Midequamycin acetate
Mechanism of action	Suppress the synthesis of the protein of the microbial cells at the level of the ribosomes (bacteriostatic). In high doses bactericidal action (macrolides).			
Spectrum of activity	1. Gr (-) bacteria: plague, cholera, brucellosis, tularemia, hemophilic rod, E. coli, salmonella, shigella, Klebsiella 2. Gr (-) cocci: moraxella 3. Gr (+) bacteria: anthrax, listeria 4. Others: spirochaetes, rickettsia, chlamydia, mycoplasmas, protozoa (tropical malaria and amoebiasis)		1. Gr (+) cocci: strepto-, pneumo-, staphylococcus, enterococcus (including ß-lactamase-producing) 2. Intracellular pathogens (mycoplasmas, chlamydia, legionella) 3. Gr (+) sticks: listeria, pathogens of diphtheria 4. Gr (-) bacteria: causative agent of whooping cough, hemophilic rod, 5. Gr (-) cocci: gonococcus (10); Others: spirochetes	
Indications	1. Especially dangerous infections (plague, tularemia, anthrax) 2. Borreliosis (Lyme disease), rickettsiosis 3. Community-acquired pneumonia 4. STIs (non-gonococcal urethritis, chlamydial infection, syphilis) 5. Acne		1. Infections of the upper and lower respiratory tract (streptococcal tone-zillofaringitis, acute sinusitis, acute otitis media, community-acquired pneumonia, exacerbation of chronic bronchitis, whooping cough, diphtheria) 2. Chlamydiosis, ureaplasmosis, syphilis 3. Eradication of H. pylori (9)	
Side effects	1. Gastrointestinal disorders 2. Dysbacteriosis, superinfection 3. Violation of bone and dental tissue formation 4. Photosensibilization 5. Hepatotoxicity 6. Allergy		1. Gastrointestinal disorders Rarely: 2. Reversible hear impairment 3. Thrombophlebitis at the injection site 4. Superinfections 5. Allergy	
Contraindications	1. Age before 8 2. Pregnancy, lactation 3. Severe liver pathology		1. Hypersensitivity in anamnesis 2. Pregnancy (1-9) 3. Lactation (6-9)	
NB!	The majority of Gr (+) cocci: strepto-, pneumo-, staphylococcus and anaerobes (clostridia, actinomycetes) are resistant to tetracyclines		Azithromycin: prolonged T1 / 2 → is given once a day (0,5 g daily during 3 days or 0,5 g in the first day, 2nd -5th day –0,25 g daily). The bactericidal concentration in the focus of infectious inflammation is being maintained for 5-7 days after the last dose	

Drug interactions	1. Milk, antacids, preparations containing magnesium, calcium, iron, sequestrants of bile acids ↓ absorption of tetracyclines 2. For penicillins, cephalosporins, antagonism is characteristic. 3. Indirect anticoagulants ↑ bleeding risk. 4. Digoxin ↑ risk of glycoside intoxication. 5. Methotrexate, theophylline, lithium preparations ↑ risk of toxicity.	1. Benzodiazepines, cardiac glycosides ↑ action of macrolides. 2. Anticonvulsants, xanthines, glucocorticosteroids, antiarrhythmic drugs ↑ concentration of macrolides in blood serum and ↑ risk of their toxicity. 3. Ergot alkaloids pose a risk of limb ischemia, ergotism with peripheral necrosis (especially 4-10) 4. H1 receptor blockers (astemizole, terfenadine), cardiac glycosides ↑ risk of cardiotoxicity (increased Q-T interval, arrhythmia) 5. Statins (lovastatin, simvastatin) ↑ risk of rhabdomyolysis. 6. Indirect anticoagulants pose a risk of hypoprothrombinemia when used with clarithromycin

SYNTHETIC ANTIMICROBIAL AGENTS [1-8]

Amphenicols and aminoglycosides

Classification	Amfenicols	Aminoglycosides		
		I generation	II generation	III generation
Drugs	1. Chloramphenicol (Levomycetin)	1. Streptomycin 2. Neomycin 3. Kanamycin	4. Gentamicin 5. Tobramycin (tobrex) 6. Nethylmycin	7. Amikacin
Mechanism of action	It binds to the 50S-subunit of the bacterial ribosome → inhibits aminoacids integration into the polypeptide chain → inhibition of protein synthesis (mainly bacteriostatic action)	Attach to the 30S-subunit of the ribosome → disruption of their binding to transfer RNA → disturbance of protein synthesis of the microbial cell → cell death (bactericidal action)		
Spectrum of action	1. Gr (+) cocci: streptococci 2. Gr (-) cocci: Neisseria 3. Gr (-) sticks: escherichia, salmonella, Haemophilus influenzae 4. Intracellular parasites: rickettsia, chlamydia, mycoplasma	Susceptible: 1. Gr (-) intestinal bacteria: Salmonella, Shigella, Escherichia coli, Proteus, Klebsiella, Enterobacter, Serratia; 2. Mycobacterium tuberculosis (1,3,7); 3. Pseudomonas aeruginosa (4-7).	Moderate susceptible: 1. Gr (+) cocci: penicillins (including resistant to penicillin and some MRSA strains), streptococci (including enterococci); 2. Gr (-) cocci: meningococci, gonococci. Resistant: anaerobes and pneumococcus (are useless when community-acquired pneumonia)	
Indications	Topically: 1. Eye infections 2. Purulent inflammatory skin diseases Systemically – the 2nd line drug: Bacterial meningitis, brain abscess Intra-abdominal infections and infections of the pelvic organs Typhoid fever, plague, gas gangrene, rickettsiosis	1. Pseudomonas aeruginosa (4-7) 2. Sepsis 3. Infective endocarditis 4. Fever in patients with neutropenia 5. Nosocomial pneumonia 6. Intra-abdominal infections, pelvic organs infections 7. Specific therapy: plague (1), tularemia (1.4), brucellosis (1), tuberculosis (1,3,7) 8. Antibiotic prophylaxis: decontamination of the intestine before routine operations on the large intestine (inside) (2)		
Side effects	Hematotoxicity (dose-dependent reticulocytopenia, thrombocytopenia and anemia); "Gray syndrome of newborns" (vomiting, bloating, respiratory disorders, cyanosis, later vasomotor collapse, hypothermia, acidosis); gastrointestinal disorders (nausea, vomiting, diarrhea, superinfections)	Nephrotoxicity (significant increase or decrease in the amount of urine, a decrease in glomerular filtration, increased serum creatinine levels), ototoxicity (irreversible hearing loss!), vestibulotoxicity (dizziness, impaired coordination of movements, gait alteration), neuromuscular blockade (weakness of diaphragmatic and other respiratory muscles, respiratory paralysis), headache, drowsiness, paresthesia, seizures, allergic reactions (rare), local reactions (phlebitis, thrombophlebitis)		
Contraindications	Allergic reactions in the anamnesis, pregnancy and lactation period, newborns, blood diseases	Allergic reactions in the anamnesis, pregnancy (only for vital indications!), lactation period (2)		
NB!	It is extremely rare even with topical application may occur idiosyncrasy - aplastic anemia (100% lethality!). It is necessary to monitor 2 times a week the level of platelets and reticulocytes. «Gray syndrome of newborns" occurs at doses> 50 mg / kg due to a low rate of metabolism in the liver.	1. The risk of side effects increases with prolonged administration (more than 7-10 days), hypokalemia, dehydration, the use of large doses. If neuromuscular blockade occurs, calcium chloride should be introduced. 2. Dosing is done only on kg of body weight. The entire daily dose should be administered once a day (except for the treatment of newborns, endocarditis and meningitis). 3. Monitoring of kidney function (creatinine clearance).		

Drug interactions	1, Cytostatics ↑ depression of bone marrow hematopoiesis. 2. Oral antidiabetic drugs ↑ hypoglycemia 3. Macrolides, lincosamides, penicillins ↓ efficiency. 4. ↓ the effectiveness of combined oral contraceptives. 5. Indirect anticoagulants ↑ risk of bleeding. 6. Preparations of iron, folic acid, vitamin B12 ↓ the effect of amphenicol.	1. Loop diuretics, cisplatin ↑ ototoxicity. 2. Cephalosporins, penicillins inactivate aminoglycosides when mixed; show synergism with separate administration, but ↑ risk of nephrotoxicity (cephalosporins). 3. Digoxin ↓ the effectiveness of aminoglycosides. 4. Drugs for anesthesia, narcotic analgesics, non-depolarizing muscle relaxants, magnesium sulfate ↑ risk of neuromuscular blockade, oppression and respiratory arrest. 5. Antimiasthenic agents ↓ action of aminoglycosides.

LINCOSAMIDES AND POLYMIXINES [1-8]

Classification	Lincosamides		Polymyxin
	Natural	Semisynthetic	
Drugs	1. Lincomycin	2. Clindamycin (Dalacin)	1. Polymyxin B 2. Polymyxin M 3. Polymyxin E (colistat)
Mechanism of action	Suppress the synthesis of the microbial cells protein in the ribosomes (bacteriostatic action, in large doses - bactericidal action)		Violate the integrity of the cytoplasmic membrane of the microbial cell (bactericidal action)
Spectrum of action	1. Gr (+) cocci: staphylococci (except MRSA), streptococci, pneumococci 2. Anaerobes (but Cl. Difficile is resistant) 3. Protozoa: toxoplasma, pneumocysts, tropical malaria (2)		1. Gr (-) bacteria: E. coli, Salmonella, Shigella, Klebsiella, Enterobacteria, Pseudomonas aeruginosa. 2. Anaerobes: Fusobacteria and bacteroides are moderately sensitive
Indications	Drugs of last resort: 1. Streptococcal and staphylococcal infections 2. Infections caused by non-spore forming anaerobes: infections of the lower respiratory tract, skin and soft tissues, bones and joints, intra-abdominal infections and pelvic infections Locally: acne, bacterial vaginosis (2)		1. A drug of last resort for resistant pseudomonas infection; severe gram-negative infections caused by multidrug-resistant hospital strains (1.3); 2. Bacterial infections of the eyes, ear (locally) (1) 3. Local treatment of Pseudomonas aeruginosa (2)
Side effects	Allergic reactions, gastrointestinal disorders, pseudomembranous colitis, neutropenia, thrombocytopenia		Severe nephrotoxicity (increased serum creatinine and urea levels, development of acute tubular necrosis with pronounced proteinuria and hematuria), neurotoxicity (paresthesia, peripheral poly-neuropathies, impaired consciousness, hearing impairment, neuromuscular blockade with the threat of development of the respiratory muscles paralysis), hematotoxicity (thrombocytopenia), hypokalemia, hypocalcemia
Contraindications	Allergic reactions in the anamnesis, pregnancy and lactation, gastrointestinal disease in prior period (ulcerative colitis, antibiotic-associated enteritis or colitis)		Allergic reactions in the anamnesis, renal failure, myasthenia gravis, botulism, the use of neuromuscular blockers
NB!	Cross-resistance with macrolides is possible. Clindamycin is better than lincomycin since it has a wider indication for use and a high stable bioavailability when taken orally. In severe infections and sepsis should be combined with fluoroquinolones or aminoglycosides		Simultaneous administration of polymyxin with aminoglycosides increases its nephrotoxicity, and with neuromuscular blockers – neural-muscular transmission disturbance.
Drug interactions	1. Anesthetics, narcotic analgesics, non-depolarizing muscle relaxants, magnesium sulfate ↑ neuromuscular blockade, ↑ risk of oppression and respiratory arrest. 2. Adsorbent antidiarrheal drugs ↓ absorption of lincosamyls. 3. Macrolides, chloramphenicol ↓ action of lincosamides		1. Glycopeptides, loop diuretics, cisplatin ↑ risk of ototoxicity, nephrotoxicity. 2. Capreomycin, aminoglycosides ↑ risk of ototoxicity, nephrotoxicity, neuromuscular blockade. 3. Non-depolarizing muscle relaxants ↑ risk of neuromuscular blockade, respiratory depression.

GLYCOPEPTIDES, OXAZOLIDINONS AND FUZIDIC ACID [1-8]

Classification	Glycopeptides		Oxazolidinones	Antibiotics of different groups
	I generation	**II generation (lipoglycopeptides)**		
Drugs	1. Vancomycin 2. Teicoplanin	3. Telavancin 4. Dalbavancin	1. Linezolid (zivox)	1. Fusidic acid (fusidate)
Mechanism of action	Attache to peptidoglycans of bacterial cells → inhibition of bacterial cell wall synthesis (bactericidal action).		Suppress bacterial protein synthesis (bacteriostatic action)	
Spectrum of activity	1. Gr (+) cocci: staphylococci (including MRSA and MRSE), streptococci, pneumococci, enterococci, 2. Anaerobes: clostridia (including Cl. Difficile), listeria, corynebacteria		Gr (+) cocci: including PRSA, MRSA, vancomycin-resistant enterococci	1. Gr (+) cocci: staphylococci (S. aureus, including MRSA; S. Epidermidis, including MRSE) 2. Anaerobes: Clostridia (including Cl. Difficile)
Indications	*Systemic administration:* 1. Generalized infections caused by sensitive strains of bacteria 2. Prevention of postoperative complications *Oral administration:* 3. Pseudomembranous colitis (Cl. Difficile) 4. Staphylococcal enteritis		*Staphylococcal and pneumococcal infections resistant to other drugs:* *1.* Lower respiratory tract infections 2. Infections of the skin and soft tissues 3. Enterococcal infections caused by vancomycin-resistant strains of Enterococcus faecalis and faecium	*A drug of last resort:* 1. Staphylococcal infections (with allergy or resistance to β-lactam antibiotics) 2. Pseudomembranous colitis
Side effects	Allergic reactions, phlebitis, ototoxicity (tinnitus, hearing impairment), nephrotoxicity, neutropenia, thrombocytopenia, red neck syndrome (chest and neck hyperemia, nausea, hypotension)		Allergic reactions, gastrointestinal disorders, hepatotoxicity, reversible anemia, thrombocytopenia	Gastrointestinal disorders, in rare cases – violations of the liver function, jaundice
Contraindications	Allergic reactions in the anamnesis, pregnancy and lactation			
NB!	Vancomycin isn't administered i/m (tissue necrosis!); is administered IV slowly (in push administration the "red neck" syndrome develops due to the release of histamine from mast cells). Teykoplanin unlike vancomycin is more active against MRSA and enterococci, better tolerated, lasts longer (1 time per day), IM administration and IV push are allowed. II generation is characterized by broader activity and longer duration of action (administration once a day (3) or once a week. (4)		Has a high bioavailability (bioavailability is 100% even in oral administration)	It is non-toxic, but the resistance of microorganisms develops quickly.

Drug interactions	1. Aminoglycosides, capreomycin, polymyxins, amphotericin B, antitumor agents (carmustine, cisplatin, streptozocin), loop diuretics, salicylates, cyclosporine, paromomycin ↑ risk of ototoxicity and nephrotoxicity. 2. Drugs for anesthesia, non-depolarizing muscle relaxants ↑ risk of hypotension and neuromuscular blockade 3. H1 receptor blockers, phenothiazines, thioxanthenes mask the ototoxic effect of vancomycin (tinnitus, dizziness). 4. Dexamethasone ↓ penetration of vancomycin into the cerebrospinal fluid. 5. ↓ effect of digoxin. 6. ↓ increase the risk of bleeding during treatment with warfarin.	1. Dextrometharfan ↑ risk of developing serotonin syndrome (depression of consciousness, delirium, irritability, tremor, increased sweating, hyperpyrexia)	1. Hydrocortisone ↓ fusidic acid efficacy. 2. ↓ bactericidal effect of penicillins, cephalosporins.

SULPHANILAMIDE [1-8]

Classification	**For resorptive use (well absorbed in the digestive tract)**			**For topical administration**	**Combined drugs**
	Short-acting	**Long-acting**	**Ultra long-acting**		
Drugs	1. Streptocide 2. Sulfacaramide 3. Sulfadimezine	4. Sulfapyridazine 5. Sulfadimethoxin	6. Sulfalene	7. Sulfacil sodium (albucid) 8. Silver sulfadiazine (dermazin) 9. Phthalazole	10. Sulfamethoxazole / trimethoprim (co-trimoxazole, biseptol) 11. Sulfadoxine / pyrimethamine (fanzi-dar) 12. Sulfapyridine / 5-ASA
Mechanism of action	Being structural analogues of PABA (necessary for bacterial growth) competitively inhibit the enzyme dihydrofolate synthetase involved in the folic acid synthesis			+ The silver ion, when combined with DNA, accumulates on the surface of bacteria nucleus and inhibits their growth and division (8)	+ Trimethoprim and pyrimethamine block the enzyme dihydrofolate reductase
Spectrum of action	Highly susceptible pathogens: cocci (pneumococci, gonococci, meningococci, streptococci), intestinal bacteria (Escherichia coli, salmonella, vibrio cholerae), large viruses (trachoma, inguinal lymphogranulomatosis), chlamydia, causative agents of gas gangrene, diphtheria, etc. Moderately susceptible pathogens: staphylococci, enterococci, klebsiella, mycobacteria, actinomycetes, causative agents of leprosy, tularemia, leishmaniasis				1. Gr (+) cocci: staphylococci (including MRSA and PRSA), streptococci (except for β-hemolytic streptococcus A) 2. Gr (-) cocci: meningococci, morocelles 3. Gr (-) rods: E. coli, salmonella, Klebsiella, Haemophilus influenzae 4. Nocardia, pneumocysts, toxoplasm
Indications	1. Acute coccal infections (pneumonia, tonsillitis, bronchitis, sinusitis, otitis, cholecystitis, meningitis, etc.) (4-6,10) 2. Acute infections of the urinary and genital tract (cystitis, prostatitis, etc.) (2.10) 3. Eye infections (conjunctivitis, blepharitis, etc.) (7)			4. Burns and infected skin wounds (8) 5. Acute intestinal infections (dysentery, enteritis, colitis, etc.) (9), ulcerative colitis and Crohn's disease (12) 6. Treatment of trachoma, malaria, chlamydia, toxoplasmosis, actinomycosis, leprosy, etc.	
Side effects	Allergic reactions (dermatitis, Stevens-Johnson syndrome, etc.); violation of hematopoiesis (leukopenia, agranulocytosis, sulmmemoglobinemia, anemia); urinary disruption (crystalluria, hematuria, urinary retention); hepatotoxicity (hepatitis, in children jaundice due to insufficiency of glucuronyltransferase); neurotoxicity (dizziness, headache, depressive conditions); immunosuppression (10).				
Contraindications	Allergic reactions to sulfanilamides, furosemide, thiazide diuretics, carbonic anhydrase inhibitors, sulfonylurea preparations; do not use in children under 2 months, except for children of HIV-infected mothers; pregnancy; severe renal insufficiency; severe liver dysfunction; megaloblastic anemia associated with a deficiency of folic acid.				
NB!	In the acidic medium of urine sulphanilamides crystallize in the renal tubules, increased alkaline fluids are recommended. Alkaline medium promotes sulfonamides ionization and improves the drugs uptake by a microbial cell. Photosensitivity is provoked. Sulfanilamides increase effects of neuromuscular blockers and can cause respiratory muscles paralysis. In pregnant women, sulfonamides can affect the binding of bilirubin to protein and cause fetus hyperbilirubinemia. Drugs have a teratogenic effect, can cause hemolysis, jaundice of newborns, methemoglobinemia, congenital disorders of the nervous and cardiovascular systems. Within long-term treatment with sulfonamides, mandatory hematological monitoring is necessary.				

Drug interactions	1. Indirect anticoagulants, oral antidiabetic agents, methotrexate ↑ effects and toxic effects of these drugs. 2. Drugs that cause inhibition of bone marrow function ↑ leukopenic and thrombocytopenic effect. 3. ↓ the effectiveness of combined oral contraceptives. 4. ↓ bactericidal effect of penicillins.

QUINOLONES AND FLUOROQUINOLONES [1-8]

Classification	Non-fluorinated quinolones	Fluoroquinolones		
		I generation ("Gram-negative" mono-fluoroquinolones)	**II generation ("Respiratory" difluoro-quinolones)**	**III generation ("Respiratory-anti-anaerobic" trifluoroquinolones)**
Drugs	1. Nalidixic acid (nevigramon) 2. Oxolinic acid 3. Pipemidic acid (palin)	4. Norfloxacin 5. Ofloxacin 6. Pefloxacin 7. Ciprofloxacin	8. Levofloxacin 9. Sparfloxacin	10. Moxifloxacin 11. Gemifloxacin 12. Gatifloxacin
Mechanism of action	DNA gyrase is inhibited. Affect the RNA of bacteria and the synthesis of bacterial proteins, the stability of membranes and other life processes of bacterial cells (bactericidal action)			
Spectrum of action	Gr (-) bacteria: Escherichia coli, Shigella, Proteus	Gr (-) bacteria, S. aureus; Low activity against Streptococcus pneumoniae, Mycoplasma, Chlamydophila	Gr (-) bacteria, S. aureus + high activity against Streptococcus pneumoniae, Mycoplasma pneumoniae, Chlamydophila pneumoniae	The same + anaerobes, atypical pathogens
Indications	1. Urinary tract infections: acute cystitis, antiretroviral therapy for chronic forms of infection. Do not use for acute pyelonephritis. 2. Intestinal infections: shigellosis, bacterial enterocolitis (1).	1. Upper respiratory tract infections: sinusitis, especially caused by multiresistant strains, malignant external otitis media. Infections of the lower respiratory tract: exacerbation of chronic bronchitis, community-acquired and nosocomial pneumonia, legionellosis. 2. Intestinal infections: shigellosis, typhoid fever, generalized salmonellosis, iersiniosis, cholera. 3. Anthrax. 4. Intra-abdominal infections and infections of the pelvic organs. 5. Urinary tract infections: (cystitis, pyelonephritis). Prostatitis. Gonorrhea. 6. Infections of the skin, soft tissues, bones and joints. 7. Eye infections. 8. Sepsis. 9. Tuberculosis in combination therapy for drug-resistant tuberculosis (5,6).		
Side effects	Digestive disorders (heartburn, pain in the epigastric region, anorexia, nausea, vomiting, diarrhea); central nervous system disturbance (ototoxicity, drowsiness, insomnia, headache, dizziness, visual impairment, paresthesia, tremor, convulsions); allergic reactions (rash, itching, angioedema); photosensitization.			
Contraindications	Allergic reaction; deficiency of glucose-6-phosphate dehydrogenase; pregnancy.			
	+ Severe dysfunction of the liver and kidneys; severe cerebral atherosclerosis.	+ Childhood; lactation.		

NB!	Absorption of fluoroquinolones in the gastrointestinal tract (unlike non-fluorinated quinolones) is not disturbed by food, but it deteriorates sharply with the use of divalent calcium, iron, magnesium, aluminum, zinc cations. The combination of fluoroquinolones with theophylline, metronidazole, and NSAIDs can cause a convulsive reaction. Fluoroquinolones can increase the photosensitivity of tissues. In the course of treatment with fluoroquinolones and during 3 days after its termination, contact with UV-irradiation is excluded.
Drug interactions	1. ↑ anticoagulant effect of indirect anticoagulants. 2. Nonsteroidal anti-inflammatory drugs ↑ risk of seizures. 3. Oral antidiabetic agents, insulin ↑ risk of developing hypoglycemia or hyperglycemia. 4. Amiodarone, tricyclic antidepressants, astemizole, disopyramide, cisapride, erythromycin, pentamidine, phenothiazines, procainamide, quinidine, terfenadine and other drugs that increase the QT interval when used with sparfloxacin and moxifloxacin lead to a ↑ risk of intermittent cardiotoxia (cardiotoxin). 5. Dicrease the effectiveness of BCG vaccination. 6. Nitrofurantoin ↓ the effect of norfloxacin. 7. Xanthines (theophylline, aminophylline, caffeine) ↑ risk of xanthine toxicity (especially with ciprofloxacin). 8. Aluminum, calcium and magnesium-containing antacids, magnesium-containing laxatives, preparations of zinc, bismuth and iron ↓ the effect of fluoroquinolones when taken orally.

NITROFURANES, OXYCHINOLINES AND NITROIMIDASEZOLES [1-8]

Classification	Nitrofurans	Nitroimidazoles	Oxyquinolines
Drugs	1. Nitrofurantoin (furadonin) 2. Furazidine (furamag) 3. Nifuroxazide 4. Furazolidone 5. Nitrofural (furacilin)	6. Metronidazole (Trichopolum) 7. Tinidazole 8. Ornidazole	9. Nitroxoline
Mechanism of action	Being oxygen acceptors, they break the process of cellular respiration of bacteria, inhibit the biosynthesis of nucleic acids (depending on the concentration have a bacteriostatic or bactericidal effect)	Active reduced forms of drugs disrupt DNA replication and protein synthesis in a microbial cell; inhibit tissue respiration (bactericidal action)	Violate protein synthesis, form chelates, enhancing oxidative processes in the cytoplasm (bactericidal action)
Spectrum of activity	1. Gr (+) cocci: streptococci, enterococci, staphylococci). 2. Gr (-) bacteria: intestinal group. 3. Protozoa: Giardia, Trichomonas (4).	1. Anaerobic bacteria 2. Helicobacter 3. The simplest (Trichomonas, Giardia, Amoeba, Balantidia) 4. Gardnerella	1. Gr (+) and Gr (-) bacteria (staphylococci, enterobacteria, etc.) 2. The simplest (amoeba, lamblia, balantidia) 3. Pathogenic fungi (candida)
Indications	1. Infections of the lower sections of the urinary tract: acute cystitis, suppressive therapy of chronic infections (1, 2) 2. Preventive maintenance of infectious complications at urological operations, a cystoscopy, a catheterization of a bladder (1,2) 3. Intestinal infections: acute infectious diarrhea, enterocolitis (3) 4. Giardiasis, trichomoniasis (4) 5. Local washing of wounds and cavities (2,5)	*Systemically:* *1.* Anaerobic infections of different locations 2. Pseudomembranous colitis 3. Perioperative prophylaxis for intra-abdominal and gynecological interventions 4. Protozoal infections 5. Eradication of H. pylori in peptic ulcer disease *Topically:* vaginitis, bacterial vaginosis, rosacea, seborrheic dermatitis, perioral dermatitis.	Acute uncomplicated cystitis - treatment, prevention (as a drug of the II line)
Side effects	Allergic reactions (rash, eosinophilia, fever, arthralgia, myalgia, drug induced lupus erythematosus, rarely anaphylactic shock); disorders of the gastrointestinal function (nausea, vomiting, diarrhea), liver (transient increase in transaminase activity, cholestasis, hepatitis), lungs (pneumonitis, bronchospasm, cough, pain in the chest), nervous system (dizziness, headache, general weakness, drowsiness, peripheral polyneuropathies); hematological reactions (leukopenia, megaloblastic or hemolytic anemia).	Digestive disorders (bad taste in the mouth, abdominal pain, nausea, vomiting, diarrhea), CNS (headache, dizziness, impaired coordination of movements, impaired consciousness, seizures, in rare cases - epileptic seizures); allergic reactions (rash, itching); hematological reactions (leukopenia, neutropenia); topical reactions (phlebitis and thrombophlebitis after intravenous administration); cutaneous manifestations (photodermatitis).	Peripheral neuro- and myopathy, optic nerve damage, allergic reactions, abdominal pain and nausea.
Contraindications	Allergic reactions; renal failure (1,2); severe liver disease (4); deficiency of glucose-6-phosphate dehydrogenase; pregnancy - III trimester (1); newborn period.	Allergic reactions; organic diseases of the central nervous system with severe clinical manifestations; pregnancy (I trimester); lactation.	Diseases of the peripheral nervous system, liver; kidney failure; pregnancy, lactation; newborns.
NB!	Have disulfiram-like effect → can't be taken with alcohol. When taking nitrofurans tyrosine-contained products (cheese, cream, bananas) should be excluded from the diet due to the risk of increased blood pressure	The half-life of metronidazole is shorter than one of tinidazole and ornidazole, so it is prescribed 3 times a day, other drugs 1-2 times a day. They have a disulfiram-like effect (6, 7). May cause dark coloration of urine (6, 7).	During treatment with nitroxoline, saffron-yellow color of the tongue, urine and feces is possible.

Drug interactions	1. Alcohol-containing drugs, alcohol ↑ risk of developing a disulfiram-like reaction (with furazolidone). 2. Tricyclic antidepressants, MAO inhibitors, sympathomimetics ↑ risk of a sharp increase in blood pressure (with furazolidone). 3. Antacids, metoclopramide ↓ absorption of nitrofurans when taken orally. 4. ↓ serum phenytoin concentration. 5. ↓ the effectiveness of combined oral contraceptives.	1. Indirect anticoagulants ↑ effects of these drugs. 2. ↓ serum phenytoin concentration. 3. Alcohol-containing drugs, alcohol ↑ risk of developing a disulfiram-like reaction. 4. H2 receptor blockers (cimetidine) ↑ effectiveness of metronidazole. 5. Carbamazepine, lithium preparations ↑ risk of toxicity of these drugs. 6. Barbiturates (phenobarbital) ↓ the effectiveness of metronidazole. 7. Disulfiram ↑ risk of developing organic brain damage syndrome.	1.Nitrofurans ↑ risk of neurotoxic action. 2. Tetracyclines leads to a summation of effects. 3. Nystatin has a potentiation effect.

Antiviral drugs [1-8]

Antiviral drugs are medicines for the treatment and prevention of various viral diseases.

Classification	Anti-influenza agents	Antiherpetic, anticytomegalovirus agents	Antiretroviral agents	Agents for viral hepatitis
Drugs	1. Amantadine (Midantan) 2. Remantadine (Rimantadine) 3. Oseltamivir (Tamiflu) 4. Zanamivir (Relenza) 5. Arbidol	6. Acyclovir (Zovirax) 7. Valaciclovir (Valtrex) 8. Ganciclovir (Cymeven) 9. Idosukradin 10. Foscarnet	*NIRTs:* 11. Zidovudine (Retrovir) 12. Lamivudine (Zeffix) *NNIRTs* 13. Nevirapine (Viramune) *Protease inhibitors (PIs)* 14. Saquinavir (Invirase) 15. Indinavir (Crixivan)	16. Ribavirin *Interferons:* 17. Reaferon (Interferon- α2) 18. Intron-A (Interferon-α2b) *Interferon inductors:* 19. Cycloferon 20. Tylorone
Mechanism of action	1. Inhibit M2 proton channels of the influenza A virus (1, 2) and neuro-minidase of influenza A and B viruses → block viral replication (3, 4). 2. Prevents the fusion of viral lipid envelope with cell membranes, induces the synthesis of interferon (5).	1. Are phosphorylated in the infected cell with the formation of triphosphate derivatives → inhibit the synthesis of viral DNA-polymerase (6-8) 2. Violates the synthesis of nucleic acids (DNA), selectively depresses the replication of the herpes simplex virus (9) 3. Inhibits DNA polymerase and reverse transcriptase of HIV (10)	1. Inhibits the reverse transcriptase of viral DNA and selectively inhibits viral DNA replication (11,12) 2. Bind directly to reverse transcriptase of HIV → destruction of enzymatic catalytic center (13) 3. Inhibits proteases involved in the assembly of the viral virion at the exit from the affected cell (14, 15)	1. Inhibits synthesis of viral RNA and DNA (16) 2. Inhibit the synthesis of viral matrix RNA, suppress the synthesis of proteins of the viral envelope (17, 18) 3. Suppress the effect of tumor growth factors; destroy bacterial cells (17, 18) 4. Stimulate the synthesis of endogenous interferon in the body (19, 20)
Pharmacological effects	1. Antiviral, 2. Interferon-inducing (5,19,20), 3. Immunomodulating (5,17-20), 4. Antineoplastic (17,18), 5. Anti-inflammatory (19)			
Indications	1. Influenza A treatment (1-5,16) and prevention (5) 2. Influenza B treatment (3-5,16) 3. Herpes simplex virus type 1 and type 2 skin and mucosa infection (6-9), 4. Cytomegalovirus infection (6-8,10), shingles (6,7) 5. Acyclovir-resistant viral infections in AIDS patients (10)		1. Treatment of infection caused by HIV-1 and HIV-2 (11, 12, 14, 15); HIV-1 (13)	1. Chronical hepatitis C (16-20) 2. Viral infections caused by RSV- virus (16) 3. Acute viral hepatitis B (16-20) 4. Kaposi's sarcoma (17,18)
Side effects	1. Nausea, vomiting (1-3) 2. Headache, dizziness (1-3) *Relenza (Zanamivir) – very rarely*	1. Nausea, vomiting (6-8,10) 2. Headache (6-8) 3. Anemia, granulocytopenia (8,10) 4. Inflammation or edema of the eyelids (9) 5. Nephro-, neurotoxicity (10)	1. Leukopenia, anemia (11, 12) granulocytopenia (11, 12, 13) 2. Dyspeptic phenomena (11-15), a taste perversion (15) 3. Peripheral neuropathies, myalgia (11-14)	1. ↓ blood pressure (16,18) 2. Thyroid disfunction (16) 3. Leukemia and thrombocytopenia (16-18) 4. Flu-like condition 5. Allergic reactions
Contraindications	1. Diseases of the liver and kidneys (1-3) 2. Gastroduodenal ulcers (1) 3. Hypersensitivity to the drug	1. Hypersensitivity to the drug 2. Neutropenia, granulocytopenia, anemia (8)	1. Leukopenia, anemia (11, 12) 2. Chronic hepatitis and cirrhosis of liver, renal failure (11) 3. Hypersensitivity	1. Pronounced diseases of the liver and kidneys (16, 17) 2. Thyrotoxicosis (16) 3. Cardiac decompensation (17,18)
Drug interactions	1. Alcohol ↑ risk of toxic effects on the CNS.	1. ↑ risk of nephrotoxicity when used with other nephrotoxic drugs.	1. ↑ risk of toxic effects of drugs with neuro-, myelotoxicity.	1. ↑ risk of toxic effects of drugs with neuro-, myelo-, cardiotoxicity

Antifungal agents (antimycotics) [1-8]

Antifungal agents (antimycotics) — medicines that suppress the growth and reproduction of pathogenic fungi and arefor the prevention and treatment of mycoses.

Classification	Polyene antibiotics and others *	Azoles	Allylamines	Derivatives of undecylenic acid
Drugs	1. Amphotericin B (Fungizone) 2. Nystatin 3. Levorin 4. Mycoheptin 5. Griseofulvin *	*Imidazole derivatives:* 6. Clotrimazole (Kanesten) 7. Ketoconazole (Nizoral) 8. Miconazole (Dactarine) *Triazole derivatives:*9. Fluconazole (Diflucan) 10. Itraconazole (Orungal)	11. Terbinafine (Lamisil) 12. Naphthifin (Exoderyl)	13. Nitrofungin Neo 14. Undecine 15. MycoSeptin
Mechanism of action	1. Bind to ergosterol of the fungal membrane → ↑ its permeability → death of a fungal cell (1-4) 2. Inhibits the synthesis of nucleic acids → disrupts the reproduction of fungal cells (5)	Inhibition of the conversion of lanosterol to ergosterol (the main sterol of the cytoplasmic membrane of the fungal cells) → disruption of the formation of the fungal cell membrane	Inhibit the enzyme squalene epoxidase catalyzing (with the squalene cyclase) the conversion of squalene to lanosterol → ergosterol deficiency → squalene intracellular accumulation → death of the fungus	Bind to ergosterol fungal membrane → ↑ its permeability → death of a fungal cell
Pharmacological effects	1. Antimycotic effect: fungicidal action (1-4,6-12-15); fungistatic action (5-10,13-15), 3. antibacterial (3,6-10,12,13)			
Indications	1. Systemic mycoses: (blastomycosis, cryptococcosis, histoplasmosis, etc.) (1-4,7,9,10) 2. Candidomycosis (1-4,6,7,9,10) 3. Trichomoniasis (3.6) 4. Onychomycosis (5,7,10-12) 5. Dermatomycosis (trichophytosis, microsporia) (5-8,10-15) 6. Fungal eczema (13)			
Side effects	1. Nausea, vomiting 2. Dysfunction of the liver (1) 3. Impaired renal function (1.4) 4. Anemia, thrombocytopenia (1) 5. Candidiasis of the oral cavity (5)	1. Local reactions when applied to the skin (6,8) 2. Nausea, vomiting (7-10) 3. Arthralgia (7) 4. Dysfunction of the liver (7, 10) 5. Edema, dysmenorrhea (10)	1. Nausea, vomiting (11) 2. Neutropenia (11) 3. Local reactions when applied to the skin (12)	1. Topical reactions when applied to the skin (13, 14)
Contraindications	1. Diseases of the kidneys, liver (1,3-5) 2. Diseases of the hematopoietic system (1.5) 3. Diabetes mellitus (1,5)	1. Pregnancy, breast-feeding (6-9) 2. Dysfunction of the liver (7,8,10) 3. Herpetic fever (8) 4. Hypersensitivity to the drug	1. Severe renal and hepatic insufficiency (11) 2. Diseases of the blood (11) 3. Pregnancy, breast-feeding	1. Hypersensitivity to the drug 2. Acute inflammatory skin diseases (14,15)

Drug interactions	1. ↑ the risk of toxic effects of drugs with neuro-, myelo-, nephrocardiotoxicity	1.Statins ↑ risk of rhabdomyolysis. 2. Indirect anticoagulants ↑ risk of hypocoagulation. 3. Antacids, H2-blockers, PPIs, anticholinergics ↓ plasma azoles concentration.	1. Alcohol, hepatotoxic drugs ↑ risk of hepatotoxicity.	No onteractions