МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ РОССИЙСКОЙ ФЕДЕРАЦИИ,
МИНИСТЕРСТВО НАУКИ, ВЫСШЕГО ОБРАЗОВАНИЯ И ИННОВАЦИЙ
КЫРГЫЗСКОЙ РЕСПУБЛИКИ

МОО ВО Кыргызско-Российский Славянский университет
имени первого Президента Российской Федерации Б.Н. Ельцина

УТВЕРЖДАЮ
Директор ИКМиБТ
_____ Абилова СС.
04.11 2026 г.

ПРОФЕССИОНАЛЬНЫЙ ЦИКЛ
Клиническая фармакология

рабочая программа дисциплины (модуля)

Разработано **Базисной и клинической фармакологии, химии и биохимии**

Учебный план 310501_26_1 лд ин.plx
560001 Лечебное дело (Для иностранных студентов)

Квалификация **врач**

Форма обучения **очная**

Общая трудоемкость **3 ЗЕТ**

Часов по учебному плану 90

в том числе:

аудиторные занятия 48

самостоятельная работа 41,7

Виды контроля в семестрах:

зачет 7

Распределение часов дисциплины по семестрам

Семестр (<Курс>.<Семестр на курсе>)	**7 (4.1)**		Итого	
Недель	17			
Вид занятий	УП	РП	УП	РП
Лекции	16	16	16	16
Практические	32	32	32	32
Контактная работа в период теоретического обучения	0,3	0,3	0,3	0,3
В том числе инт.	4	4	4	4
Итого ауд.	48	48	48	48
Контактная работа	48,3	48,3	48,3	48,3
Сам. работа	41,7	41,7	41,7	41,7
Итого	90	90	90	90

Программу составил(и):
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Approved by the HEP: Zhamankulova M.K.

Рабочая программа дисциплины
Клиническая фармакология

разработана в соответствии с ФГОС 3++:
Федеральный государственный образовательный стандарт высшего образования - специалитет по специальности 560001 Лечебное дело (Для иностранных студентов) (приказ Минобрнауки России от г. №)

составлена на основании учебного плана:

560001 Лечебное дело (Для иностранных студентов)

утвержденного учёным советом вуза от 26.06.2026 протокол № 11.

Рабочая программа одобрена на заседании department of basic and clinical pharmacology, chemistry and biochemistry

Протокол от 28.08.2026 г. № 1
Срок действия программы: 2026-203 уч.г.
Руководитель подразделения: Зурдинова Аида Аширалиевна

ЛИСТ РЕГИСТРАЦИИ ИЗМЕНЕНИЙ
к рабочей программе дисциплины (модуля)

Клиническая фармакология

наименование дисциплины

№ п/п	Основание внесения изменения	Раздел/ пункт	Содержание изменения
1.			
2.			
3.			
4.			
5.			

1. ЦЕЛИ ОСВОЕНИЯ ДИСЦИПЛИНЫ	
1.1	The aim of studying Clinical Pharmacology is to develop students' knowledge and practical skills in the rational, evidence-based and safe use of medicines, including the principles of individualized pharmacotherapy, selection and optimization of drug treatment, evaluation of therapeutic efficacy and safety, prevention and management of adverse drug reactions, and identification of clinically significant drug interactions. The discipline aims to prepare future physicians to make scientifically justified decisions regarding pharmacotherapy, taking into account the patient's age, clinical condition, comorbidities, renal and hepatic function, and individual characteristics, in accordance with current clinical guidelines and evidence-based medicine principles.

2. МЕСТО ДИСЦИПЛИНЫ В СТРУКТУРЕ ООП	
Цикл (раздел) ООП:	Б1.О.03
2.1	**Требования к предварительной подготовке обучающегося:**
2.1.1	Биохимия (Профессиональный цикл)
2.1.2	Фармакология (Профессиональный цикл)
2.1.3	Эндокринология (Профессиональный цикл)
2.1.4	Б1.В.ДВ.03.01. Основы неотложной помощи
2.1.5	Патофизиология, клиническая патофизиология (Профессиональный цикл)
2.2	**Дисциплины и практики, для которых освоение данной дисциплины (модуля) необходимо как предшествующее:**
2.2.1	Семейная медицина (Профессиональный цикл)
2.2.2	Доказательная медицина (Профессиональный цикл)
2.2.3	Б1.В.ДВ.09.01. Стандарты диагностики

3. КОМПЕТЕНЦИИ ОБУЧАЮЩЕГОСЯ, ФОРМИРУЕМЫЕ В РЕЗУЛЬТАТЕ ОСВОЕНИЯ ДИСЦИПЛИНЫ (МОДУЛЯ)

В результате освоения дисциплины обучающийся должен

3.1	**Знать:**
3.1.1	The objectives, scope and main principles of clinical pharmacology and its role in clinical practice.
3.1.2	The principles of evidence-based medicine and their application in pharmacotherapy.
3.1.3	The basic concepts of pharmacokinetics and pharmacodynamics and their clinical significance.
3.1.4	The processes of drug absorption, distribution, metabolism and excretion (ADME).
3.1.5	The principles of selecting medicines based on clinical indications, efficacy, safety and cost-effectiveness.
3.1.6	The mechanisms of action, therapeutic effects, indications and contraindications of major pharmacological groups.
3.1.7	The principles of individualized pharmacotherapy, taking into account age, body weight, comorbidities and individual patient characteristics.
3.1.8	The influence of renal and hepatic impairment on drug pharmacokinetics and the principles of dose adjustment.
3.1.9	The mechanisms and clinical significance of pharmacokinetic and pharmacodynamic drug interactions.
3.1.10	The classification, mechanisms, clinical manifestations and prevention of adverse drug reactions.
3.1.11	The principles of therapeutic drug monitoring (TDM) and its clinical applications.
3.1.12	The principles of rational prescribing and safe use of medicines.
3.1.13	The features of pharmacotherapy in children, older adults, pregnant and breastfeeding women.
3.1.14	The principles of pharmacotherapy in patients with cardiovascular, respiratory, gastrointestinal, endocrine, neurological and infectious diseases.
3.1.15	The principles of antimicrobial stewardship and prevention of antimicrobial resistance.
3.1.16	The principles of pharmacovigilance and reporting of adverse drug reactions.
3.1.17	The principles of deprescribing, prevention of polypharmacy and identification of potentially inappropriate medications.
3.1.18	The role of clinical guidelines, drug formularies and essential medicines lists in rational pharmacotherapy.
3.2	**Уметь:**
3.2.1	Analyze a patient's clinical condition and identify the need for pharmacological treatment.
3.2.2	Select appropriate medicines based on clinical guidelines and evidence-based medicine.
3.2.3	Justify the choice of a medicine according to its efficacy, safety, suitability and cost-effectiveness.
3.2.4	Develop an individualized pharmacotherapy plan considering the patient's age, weight, clinical condition and comorbidities.
3.2.5	Evaluate the appropriateness of prescribed medicines and identify potential prescribing problems.

3.2.6	Calculate individual doses and dosing intervals according to clinical and pharmacokinetic parameters.
3.2.7	Adjust drug doses in patients with renal and hepatic impairment.
3.2.8	Identify clinically significant pharmacokinetic and pharmacodynamic drug interactions.
3.2.9	Recognize, assess and manage common adverse drug reactions.
3.2.10	Interpret laboratory and clinical parameters relevant to the evaluation of drug efficacy and safety.
3.2.11	Apply therapeutic drug monitoring principles when indicated.
3.2.12	Assess the efficacy and safety of ongoing pharmacotherapy and identify the need for its modification.
3.2.13	Identify inappropriate polypharmacy and assess opportunities for deprescribing.
3.2.14	Use reliable clinical pharmacology databases, official prescribing information and scientific publications.
3.2.15	Provide recommendations on the safe use of medicines and improve patient adherence to pharmacotherapy.
3.3	**Владеть:**
3.3.1	Conducting a clinical pharmacological assessment of a patient's medication regimen.
3.3.2	Selecting and justifying rational pharmacotherapy based on the patient's clinical characteristics and current clinical guidelines.
3.3.3	Preparing individualized medication regimens, including dose, route, frequency and duration of administration.
3.3.4	Evaluating the benefit-risk profile of prescribed medicines.
3.3.5	Identifying and preventing clinically significant drug interactions.
3.3.6	Recognizing, documenting and reporting adverse drug reactions.
3.3.7	Interpreting laboratory findings and therapeutic drug monitoring results relevant to pharmacotherapy.
3.3.8	Assessing the effectiveness and safety of prescribed treatment and recommending appropriate modifications.
3.3.9	Applying pharmacological principles in patients with multiple comorbidities and polypharmacy.
3.3.10	Implementing principles of antimicrobial stewardship and rational antibiotic use.
3.3.11	Conducting medication review and identifying opportunities for deprescribing.
3.3.12	Applying evidence-based medicine principles when making pharmacotherapeutic decisions.
3.3.13	Communicating recommendations concerning rational and safe medicine use to patients and healthcare professionals.

4. СТРУКТУРА И СОДЕРЖАНИЕ ДИСЦИПЛИНЫ (МОДУЛЯ)

Код занятия	Наименование разделов и тем /вид занятия/	Семестр / Курс	Часов	Компетен-ции	Литература	Инте ракт.	Пр. подг.	Примечание
	Раздел 1. Basic clinical pharmacology							
1.1	Intriduction to clinical pharmacology. Types of pharmacotherapy /Лек/	7	2		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			
1.2	Clinical pharmacodinamics and pharmacokinetics /Лек/	7	2		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			
1.3	Adverse drugs reactions. Pharmacovigilance /Лек/	7	2		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			
1.4	Interaction medicines. Drug-drug interaction /Лек/	7	2		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			

1.5	Clinical pharmacodynamics and pharmacokinetics /Пр/	7	3		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6	1		Objective: To develop the ability to interpret the clinical significance of pharmacokinetic parameters and apply them when selecting a dosing regimen. Key topics: routes of administration, bioavailability, distribution, protein binding, metabolism, CYP3A4/ CYP2D6/ CYP2C9/ CYP2C19, enzyme induction and inhibition, elimination, clearance, volume of distribution, half-life, and steady-state concentration. Practical exercises: calculation of loading and maintenance doses; analysis of concentration-time relationships; assessment of the impact of changes in clearance. Assessment: a calculation problem, a clinical case study, and an oral examination. Independent study: create pharmacokinetic profiles for five drugs.

1.6	Adverse drugs reactions. Pharmacovigilance /Пр/	7	3		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			Objective: To learn how to identify, classify, prevent, and manage adverse drug reactions (ADRs). Key topics: classification of ADRs (by type, complications, and outcomes), allergic and pseudo-allergic reactions, drug dependence, withdrawal syndrome, and overdose. Practical exercise: identifying the suspected drug, establishing a temporal relationship, assessing severity, and considering potential alternative causes.

1.7	Interaction of medicines. Assesment of drugs interaction / Пр/	7	3		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6	1		Objective: To learn how to identify clinically significant drug interactions. Key topics: Interactions affecting absorption, distribution, metabolism, and excretion; pharmacodynamic interactions; synergism and antagonism; the influence of food, alcohol, herbal preparations, and tobacco smoke. Practical exercise: Conducting a medication review for a patient and searching for potential interactions using reference databases. Assessment: A table of interactions plus a clinical case study. Independent study: Compile 10 examples of clinically significant drug interactions, including their mechanisms and recommended management strategies.

1.8	Rational use medicines. Principles of RUMs /Пр/	7	3		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			Objective: To master the algorithm for the rational selection of drug therapy. Key topics: treatment goals; personal drug class; specific drug choice; efficacy, safety, acceptability, and cost; prescription writing; patient information, instruction, and warnings; monitoring. Practical assignment: Solve a clinical case, compare three drug classes, select an appropriate class and specific medication, and prepare a prescription and a monitoring plan. Assessment: Written justification for the choice, followed by an oral defense. Independent student work: A comparative table of three drugs from the same therapeutic class.
1.9	Independent study assignment for the "General Clinical Pharmacology" section /Ср/	7	15		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			
	Раздел 2. Special Clinical Pharmacology							
2.1	Clinical pharmacology of drugs used for arterial hypertension and principles of the rational use of antihypertensive agents /Лек/	7	2		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			
2.2	Clinical pharmacology of medications used for diabetes mellitus and thyroid disorders / Лек/	7	2		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			

2.3	Clinical pharmacology of antibacterial agents. Principles of antibiotic therapy. Antibiotic resistance. /Лек/	7	2		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			
2.4	Clinical pharmacology of antineoplastic agents. Principles of chemotherapy for oncological diseases /Лек/	7	2		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			
2.5	Clinical pharmacology of antihypertensive agents /Пр/	7	3		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			Objective: To develop skills in individualizing therapy for patients with arterial hypertension (AH). Study: Antihypertensive agents; clinically significant contraindications and drug interactions. Practice: Define the therapeutic goal, select an appropriate drug class and specific agent, and establish parameters for efficacy and safety. Assessment: Case-based problem. Independent study: Prepare a clinical-pharmacological profile for one specific drug.

2.6	Clinical pharmacology of medications for ischemic heart disease (IHD) /Пр/	7	3		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			Objective: To develop skills in tailoring therapy for patients with ischemic heart disease (IHD). Study: Antianginal, antiplatelet, anticoagulant, and lipid-lowering agents; clinically significant contraindications and drug interactions. Practice: Define the therapeutic goal, select the appropriate drug class and specific agent, and establish parameters for efficacy and safety. Assessment: Case-based problem. Independent study: Prepare a clinical-pharmacological profile for one specific drug.

2.7	Session 7. Clinical pharmacology of drugs used for bronchobstructive syndrome /Пр/	7	3		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			Objective: To develop skills in personalizing therapy for patients with asthma and COPD. Study: Bronchodilators, inhaled corticosteroids (ICS), antileukotriene agents, and membrane stabilizers; clinically significant contraindications and drug interactions. Practice: Define the treatment goal, select the appropriate drug class and specific medication, and establish parameters for efficacy and safety. Assessment: Case-based problem. Independent study: Prepare a clinical-pharmacological profile for one specific medication.

2.8	Clinical pharmacology of medications for diabetes mellitus and thyroid disorders /Пр/	7	2		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			Objective: To individualize therapy for diabetes mellitus and thyroid disorders. Study topics: Major drug classes, risk of hypoglycemia, considerations for impaired renal function, and drug interactions. Practical component: Case studies involving treatment inefficacy, recurrent hypoglycemia, and hypo- or hyperthyroidism. Assessment: Clinical case review. Independent study: Develop a plan for monitoring treatment efficacy and safety.

2.9	Anti-inflammatory and anti-allergic agents. DMARDs /Пр/	7	2		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			Objective: To develop skills in selecting anti-inflammatory and anti-allergic therapy. Topics to study: NSAIDs, glucocorticosteroids, anti-allergic drugs, and disease-modifying antirheumatic drugs (DMARDs). Practical application: Assessment of gastrointestinal, renal, cardiovascular, and infectious risks. Assessment: Case study. Independent student work: Compare the safety profiles of two NSAIDs in a specific clinical scenario.

2.10	Clinical pharmacology of antibacterial agents /Пр/	7	2		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			Objective: To develop skills in rational antibiotic therapy. Topics to study: indications, likely causative pathogens, site of infection, severity, microbiology, dosing, duration of therapy, de-escalation, and antibiotic resistance. Practical application: Selecting an antibiotic based on clinical and microbiological case studies. Assessment: A clinical case scenario plus a dosage calculation. Independent study: Create a comparative profile of five antibiotics.

2.11	Protection of the Protocol /Пр/	7	2		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			Objective: To demonstrate a comprehensive clinical-pharmacological analysis of an assigned patient. Required components: Patient profile; diagnosis; examination findings; allergy and medication history; analysis of current therapy; treatment goals; selection of a therapeutic class (P-group) and a specific drug (P-drug); comparative tables; prescription; patient information, instruction, and warnings; and monitoring plan. Assessment method: Defense of the clinical protocol, a presentation, and a Q&A session. Evaluation criteria: Logical consistency of clinical decision-making, justification of treatment choices, and the ability to defend the chosen pharmacotherapy.
2.12	OSCE (10 станций) /Пр/	7	3		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6	2		Assessment of acquired skills across 10 stations
2.13	Contact work /КрТО/	7	0,3		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			

2.14	Independent study assignment for the section "Special Clinical Pharmacology" /Ср/	7	26,7		Л1.1 Л1.2 Л1.3 Л1.4 Л1.5 Э1 Э2 Э3 Э4 Э5 Э6			

5. ФОНД ОЦЕНОЧНЫХ СРЕДСТВ

5.1. Контрольные вопросы и задания

1. REVIEW QUESTIONS FOR ONGOING ASSESSMENT

Section 1. General Principles of Clinical Pharmacology
Definition, objectives and scope of clinical pharmacology.
The role of clinical pharmacology in modern medical practice.
Differences between pharmacology and clinical pharmacology.
Principles of evidence-based pharmacotherapy.
The concept of rational medicine use.
Essential medicines and their role in healthcare.
Clinical guidelines and their application in pharmacotherapy.
Principles of selecting medicines according to efficacy, safety and cost-effectiveness.
Individualized pharmacotherapy and personalized medicine.
The concept of the benefit-risk ratio in drug therapy.

Section 2. Clinical Pharmacokinetics
Clinical significance of absorption, distribution, metabolism and excretion (ADME).
Bioavailability and bioequivalence.
Volume of distribution and its clinical significance.
Drug clearance and its clinical application.
Elimination half-life and dosing intervals.
First-order and zero-order elimination kinetics.
Steady-state drug concentration.
Loading dose and maintenance dose.
Factors affecting drug metabolism.
Clinical significance of hepatic and renal impairment.
Dose adjustment in patients with chronic kidney disease.
Drug dosing in patients with liver dysfunction.
Pharmacokinetic changes in older adults.
Pharmacokinetic characteristics in children.
Therapeutic drug monitoring: indications and interpretation.

Section 3. Clinical Pharmacodynamics
Drug receptors and mechanisms of action.
Agonists, antagonists and partial agonists.
Dose-response relationships.
Therapeutic index and therapeutic window.
Potency and efficacy of medicines.
Receptor sensitivity and drug tolerance.
Pharmacodynamic variability among patients.
Pharmacogenetics and pharmacogenomics.
Clinical significance of cytochrome P450 enzymes.
Genetic polymorphisms affecting drug response.

Section 4. Adverse Drug Reactions and Drug Interactions
Classification of adverse drug reactions.
Dose-dependent and dose-independent adverse reactions.
Allergic and pseudoallergic drug reactions.
Risk factors for adverse drug reactions.
Prevention and management of adverse drug reactions.
Pharmacovigilance and adverse reaction reporting.
Pharmacokinetic drug interactions.
Pharmacodynamic drug interactions.
Clinically significant drug-drug interactions.
Drug-food and drug-alcohol interactions.
Medication errors and their prevention.
Drug-induced liver injury.
Drug-induced nephrotoxicity.
QT interval prolongation and drug-induced arrhythmias.

Assessment of medication safety.

Section 5. Clinical Pharmacology of Cardiovascular Medicines
Clinical pharmacology of antihypertensive medicines.
ACE inhibitors and angiotensin receptor blockers.
Beta-blockers: clinical applications and safety.
Calcium channel blockers.
Diuretics and their clinical use.
Clinical pharmacology of medicines used in chronic heart failure.
Pharmacotherapy of ischemic heart disease.
Clinical pharmacology of antiarrhythmic medicines.
Anticoagulants and antiplatelet agents.
Clinical pharmacology of lipid-lowering medicines.
Monitoring the efficacy and safety of cardiovascular pharmacotherapy.

Section 6. Clinical Pharmacology of Medicines Used in Respiratory and Gastrointestinal Diseases
Clinical pharmacology of bronchodilators.
Inhaled corticosteroids and their clinical use.
Pharmacotherapy of bronchial asthma.
Pharmacotherapy of chronic obstructive pulmonary disease.
Clinical pharmacology of proton pump inhibitors.
H2-receptor antagonists.
Pharmacotherapy of peptic ulcer disease.
Clinical pharmacology of antiemetic medicines.
Clinical pharmacology of laxatives and antidiarrheal agents.

Section 7. Clinical Pharmacology of Endocrine and Metabolic Medicines
Clinical pharmacology of insulin preparations.
Oral and injectable glucose-lowering medicines.
Pharmacotherapy of type 2 diabetes mellitus.
Clinical pharmacology of glucocorticoids.
Thyroid hormones and antithyroid medicines.
Pharmacotherapy of osteoporosis.
Clinical pharmacology of lipid-lowering medicines in patients with metabolic disorders.
Section 8. Clinical Pharmacology of Antimicrobial Medicines
Principles of rational antimicrobial therapy.
Clinical pharmacology of beta-lactam antibiotics.
Clinical pharmacology of macrolides.
Clinical pharmacology of aminoglycosides.
Clinical pharmacology of fluoroquinolones.
Clinical pharmacology of glycopeptide antibiotics.
Pharmacotherapy of tuberculosis.
Clinical pharmacology of antifungal medicines.
Clinical pharmacology of antiviral medicines.
Antimicrobial resistance and its clinical significance.
Principles of antimicrobial stewardship.
Antibiotic dosing in renal impairment.
Monitoring the efficacy and safety of antimicrobial therapy.

Section 9. Special Populations and Individualized Pharmacotherapy
Pharmacotherapy in children.
Pharmacotherapy during pregnancy.
Pharmacotherapy during breastfeeding.
Pharmacotherapy in older adults.
Drug treatment in patients with chronic kidney disease.
Drug treatment in patients with hepatic impairment.
Pharmacotherapy in patients with multiple comorbidities.
Polypharmacy and its clinical consequences.
Medication review and deprescribing.
Medication adherence and strategies to improve treatment outcomes.

2. MULTIPLE-CHOICE QUESTIONS (MCQs)
Choose one correct answer.
Which pharmacokinetic parameter describes the rate at which a drug is removed from plasma in relation to its concentration?
A. Bioavailability
B. Clearance
C. Volume of distribution
D. Protein binding

Which parameter is most important for determining the time required to reach steady-state concentration during repeated administration of a drug with linear pharmacokinetics?
A. Bioavailability
B. Elimination half-life
C. Peak concentration
D. Absorption rate

Which drug is commonly associated with a risk of hyperkalemia?
A. Amlodipine
B. Enalapril
C. Furosemide
D. Hydrochlorothiazide

Which laboratory test is routinely used to monitor warfarin therapy?
A. Activated partial thromboplastin time
B. International normalized ratio
C. Serum creatinine
D. Platelet count

Which drug class inhibits the renin-angiotensin-aldosterone system by blocking angiotensin II receptors?
A. ACE inhibitors
B. Angiotensin receptor blockers
C. Beta-blockers
D. Calcium channel blockers

Which medicine is associated with a risk of ototoxicity and nephrotoxicity?
A. Amoxicillin
B. Gentamicin
C. Azithromycin
D. Doxycycline

Which drug is used to reverse the anticoagulant effect of unfractionated heparin?
A. Vitamin K
B. Protamine sulfate
C. Naloxone
D. Flumazenil

Which medicine is a proton pump inhibitor?
A. Famotidine
B. Omeprazole
C. Metoclopramide
D. Sucralfate

Which pharmacokinetic process is most directly affected by severe hepatic impairment?
A. Drug absorption
B. Drug metabolism
C. Renal excretion
D. Gastrointestinal motility

Which of the following is a major principle of antimicrobial stewardship?
A. Prescribing antibiotics for all viral infections
B. Using broad-spectrum antibiotics routinely
C. Selecting antibiotics according to clinical indication and microbiological evidence
D. Continuing antibiotics indefinitely after symptom resolution

Which medicine is a direct oral anticoagulant that inhibits factor Xa?
A. Warfarin
B. Apixaban
C. Clopidogrel
D. Aspirin

Which drug class is associated with an increased risk of hypoglycemia?
A. Insulin preparations
B. ACE inhibitors
C. Proton pump inhibitors
D. Calcium channel blockers

Which factor may increase the risk of drug accumulation in older adults?
A. Increased glomerular filtration
B. Reduced renal clearance
C. Increased hepatic blood flow
D. Increased lean body mass

What is the main purpose of therapeutic drug monitoring?
A. To identify the medicine's trade name
B. To measure drug concentrations when clinically indicated and support dose individualization
C. To determine the tablet color
D. To replace clinical assessment

Which adverse effect is characteristic of ACE inhibitors?
A. Persistent dry cough
B. Ototoxicity
C. Severe hypoglycemia
D. Gingival hyperplasia

3. SITUATIONAL CLINICAL-PHARMACOLOGICAL TASKS
Case 1. Hypertension and Renal Function
A 67-year-old patient with arterial hypertension and chronic kidney disease is receiving enalapril. During follow-up, serum creatinine and potassium levels increase.
Questions:
Explain the pharmacological mechanism of enalapril.
What is the clinical significance of increased serum potassium?
Which laboratory parameters should be monitored?
What factors should be considered when deciding whether to continue or modify therapy?

Case 2. Warfarin and Drug Interaction
A 72-year-old patient receiving warfarin for atrial fibrillation starts taking an antibiotic. Several days later, the INR increases significantly.
Questions:
Explain possible mechanisms of the interaction.
What are the potential clinical consequences?
Which factors should be assessed?
What monitoring and management measures are required?

Case 3. Diabetes Mellitus and Hypoglycemia
A 58-year-old patient with type 2 diabetes mellitus receiving insulin develops sweating, tremor, palpitations and confusion.
Questions:
Identify the suspected adverse drug reaction.
Explain the mechanism of this reaction.
What factors could have contributed to its development?
Describe the principles of immediate management and prevention.

Case 4. Antibiotic-Associated Nephrotoxicity
A patient receiving gentamicin for a severe bacterial infection develops an increase in serum creatinine.
Questions:
Explain the mechanism of gentamicin-induced nephrotoxicity.
Which pharmacokinetic parameters are important for dose individualization?
What laboratory and clinical parameters should be monitored?
What is the role of therapeutic drug monitoring?

Case 5. Polypharmacy in an Older Adult
A 79-year-old patient takes eight medicines for hypertension, diabetes, ischemic heart disease and osteoarthritis. The patient reports dizziness and weakness.
Questions:
Define polypharmacy.
Identify potential medication-related problems.
Explain how drug interactions may contribute to the symptoms.
Describe the principles of medication review.
What is deprescribing and when may it be considered?

Case 6. Chronic Heart Failure
A 64-year-old patient with heart failure with reduced ejection fraction is prescribed an ACE inhibitor, beta-blocker, mineralocorticoid receptor antagonist and diuretic.
Questions:
Explain the pharmacological rationale for combining these medicines.

Describe the mechanisms of action of each drug group.
Which clinical and laboratory parameters should be monitored?
Identify potential adverse effects and interactions.

Case 7. Pharmacotherapy During Pregnancy
A pregnant patient asks whether she can continue taking a medicine prescribed before pregnancy.
Questions:
What factors should be considered when evaluating medicine use during pregnancy?
Explain the importance of gestational age.
What is the benefit-risk assessment?
Which reliable sources should be used to evaluate medicine safety?

Case 8. Drug-Induced Liver Injury
A patient receiving several medicines develops increased ALT and AST levels.
Questions:
Define drug-induced liver injury.
Identify medicines that may cause hepatotoxicity.
What clinical and laboratory parameters should be assessed?
How should suspected drug-induced liver injury be evaluated?

Case 9. Antimicrobial Stewardship
A patient with an acute viral respiratory infection requests antibiotics.
Questions:
Explain why antibiotics are not indicated for uncomplicated viral infections.
Describe the risks of unnecessary antibiotic use.
Explain the concept of antimicrobial resistance.
Describe the principles of responsible antibiotic prescribing.

Case 10. Therapeutic Drug Monitoring
A patient after organ transplantation receives tacrolimus. The measured trough concentration is outside the intended therapeutic range.
Questions:
Explain the mechanism of action of tacrolimus.
Why is therapeutic drug monitoring necessary?
Which factors may influence tacrolimus concentrations?
What is the role of renal function and drug interactions?
What precautions should be considered before changing the dose?

4. DOSE CALCULATION AND PHARMACOKINETIC TASKS
All numerical examples are educational. They are not universal clinical prescribing recommendations.
A patient weighing 70 kg is prescribed an educational dose of 5 mg/kg. Calculate the total dose in milligrams.
A medicine has a concentration of 25 mg/mL. Calculate the volume required to administer 100 mg.
A medicine is prescribed at 250 mg three times daily. Calculate the total daily dose.
A patient receives 500 mg of a medicine every 12 hours. Calculate the total daily dose.
A solution contains 2 g of medicine in 100 mL. Calculate its concentration in mg/mL.
Calculate the loading dose if the target plasma concentration is 10 mg/L, the volume of distribution is 40 L and bioavailability is 100%.
Calculate the maintenance dose rate if clearance is 5 L/hour and the target average steady-state concentration is 2 mg/L.
A medicine has an elimination half-life of 8 hours. Estimate the percentage of the initial amount remaining after 24 hours, assuming first-order elimination.
Calculate the creatinine clearance using the Cockcroft–Gault equation for an illustrative adult patient using the supplied age, weight, serum creatinine and sex coefficient.
A patient receives a medicine by infusion at 50 mg/hour for 6 hours. Calculate the total administered dose.
A patient receives 750 mg of a medicine per day in three equal doses. Calculate the dose per administration.
A medicine has a bioavailability of 50%. Calculate the oral dose needed to provide the same systemic exposure as a 100 mg intravenous dose, assuming linear pharmacokinetics.
A medicine has a volume of distribution of 30 L and a plasma concentration of 4 mg/L. Estimate the amount of drug in the body using the simplified relationship.
A medicine has a clearance of 4 L/hour and a volume of distribution of 40 L. Calculate its elimination half-life using the first-order approximation.
A patient receives 1.5 g of a medicine in 24 hours. Convert the total daily dose into milligrams.

5. PRACTICAL TASKS FOR ONGOING ASSESSMENT
Students should be able to complete the following practical assignments:
Conduct a clinical pharmacological assessment of a prescribed medication regimen.
Identify the pharmacological group and mechanism of action of a selected medicine.
Compare two medicines according to efficacy, safety and pharmacokinetic properties.
Identify potential drug-drug interactions in a medication list.
Evaluate the appropriateness of a prescribed dose.
Identify contraindications and precautions for a selected medicine.

Interpret a basic laboratory profile relevant to drug safety.
Identify potential adverse drug reactions based on a clinical scenario.
Explain indications for therapeutic drug monitoring.
Interpret an illustrative therapeutic drug monitoring result.
Identify potential medication-related problems in an older adult.
Conduct a structured medication review.
Identify opportunities for deprescribing.
Evaluate the appropriateness of antibiotic therapy.
Develop a monitoring plan for a selected pharmacological treatment.
Identify possible causes of treatment failure.
Assess medication adherence and barriers to adherence.
Identify potential drug-induced renal or hepatic injury.
Use official prescribing information to assess the safety of a medicine.
Prepare a patient-oriented explanation of safe medicine use.

6. PRESCRIPTION AND PHARMACOTHERAPY TASKS
For each of the following medicines, students should identify the INN, pharmacological group, mechanism of action, clinical indications, contraindications, adverse reactions and important interactions.
Enalapril.
Losartan.
Amlodipine.
Bisoprolol.
Furosemide.
Spironolactone.
Atorvastatin.
Acetylsalicylic acid.
Apixaban.
Metformin.
Insulin glargine.
Empagliflozin.
Omeprazole.
Salbutamol.
Budesonide.
Amoxicillin.
Ceftriaxone.
Azithromycin.
Gentamicin.
Tacrolimus.

Students should also demonstrate the ability to prepare an educational prescription or medication order, including the dosage form, strength, dose, route, frequency and duration, where applicable.

7. EXAMINATION QUESTIONS FOR INTERIM ASSESSMENT
Define clinical pharmacology and explain its importance in medical practice.
Describe the principles of evidence-based pharmacotherapy.
Explain the clinical significance of pharmacokinetic parameters.
Discuss drug absorption and bioavailability.
Explain volume of distribution and clearance.
Describe elimination half-life and steady-state concentration.
Explain the principles of loading and maintenance doses.
Discuss pharmacokinetic changes in renal impairment.
Describe the principles of dose adjustment in hepatic impairment.
Explain therapeutic drug monitoring and its clinical applications.
Describe drug receptors and mechanisms of pharmacodynamic action.
Explain the clinical significance of pharmacogenetics.
Discuss the classification and prevention of adverse drug reactions.
Explain pharmacokinetic and pharmacodynamic drug interactions.
Describe the principles of pharmacovigilance.
Discuss the clinical pharmacology of ACE inhibitors.
Explain the clinical use and safety of beta-blockers.
Describe the pharmacological treatment of chronic heart failure.
Discuss the clinical pharmacology of anticoagulants.
Explain the principles of monitoring anticoagulant therapy.
Describe the clinical pharmacology of lipid-lowering medicines.
Discuss the pharmacological treatment of bronchial asthma.
Explain the clinical pharmacology of proton pump inhibitors.
Describe the principles of pharmacotherapy in type 2 diabetes mellitus.
Discuss the clinical pharmacology of insulin.

Explain the pharmacological effects and adverse reactions of glucocorticoids.
Describe the principles of rational antimicrobial therapy.
Discuss the clinical pharmacology of beta-lactam antibiotics.
Explain antimicrobial resistance and antimicrobial stewardship.
Discuss the principles of antibiotic dose adjustment in renal impairment.
Describe the principles of pharmacotherapy in older adults.
Explain the risks associated with polypharmacy.
Discuss medication review and deprescribing.
Describe the principles of pharmacotherapy during pregnancy.
Explain the principles of pharmacotherapy in children.
Discuss the prevention and management of drug-induced liver injury.
Explain the principles of individualized pharmacotherapy.
Discuss the clinical assessment of medication adherence.
Explain the role of clinical guidelines and essential medicines lists.
Describe the principles of rational and safe prescribing.

8. SAMPLE EXAMINATION TICKETS
Examination Ticket No. 1
Clinical pharmacology: objectives, scope and principles.
Pharmacokinetic parameters and their clinical significance.
Practical task: calculate a loading dose using the volume of distribution and target concentration.

Examination Ticket No. 2
Pharmacodynamics: receptors, agonists and antagonists.
Adverse drug reactions and pharmacovigilance.
Situational task: identify a suspected adverse drug reaction and propose a monitoring strategy.

Examination Ticket No. 3
Clinical pharmacology of ACE inhibitors and angiotensin receptor blockers.
Drug interactions involving anticoagulants.
Situational task: assess an increased INR in a patient receiving warfarin.

Examination Ticket No. 4
Therapeutic drug monitoring: principles and clinical applications.
Clinical pharmacology of aminoglycosides.
Situational task: evaluate nephrotoxicity in a patient receiving gentamicin.

Examination Ticket No. 5
Rational antimicrobial therapy and antimicrobial stewardship.
Clinical pharmacology of insulin and glucose-lowering medicines.
Practical task: identify the risks of hypoglycemia and develop a monitoring plan.

Examination Ticket No. 6
Individualized pharmacotherapy in older adults.
Polypharmacy and deprescribing.
Situational task: conduct a medication review in an older patient with multiple comorbidities.

Examination Ticket No. 7
Clinical pharmacology of medicines used in chronic heart failure.
Pharmacokinetic changes in renal impairment.
Practical task: identify the parameters required for dose individualization.

Examination Ticket No. 8
Pharmacogenetics and personalized medicine.
Clinical pharmacology of immunosuppressants.
Situational task: interpret an illustrative tacrolimus concentration and identify possible influencing factors.

9. ASSESSMENT CRITERIA
9.1. Assessment of theoretical knowledge
Excellent (90–100 points):
Demonstrates comprehensive knowledge of clinical pharmacology.
Correctly explains pharmacokinetic and pharmacodynamic mechanisms.
Justifies pharmacotherapeutic decisions using evidence-based principles.
Identifies adverse reactions and clinically significant drug interactions.

Good (75–89 points):
Demonstrates good knowledge of the discipline.
Correctly explains most pharmacological mechanisms.

Makes minor errors that do not substantially affect the overall assessment.

Satisfactory (60–74 points):
Demonstrates basic knowledge of the main topics.
Has partial understanding of pharmacokinetic and pharmacodynamic principles.
Requires guidance when solving clinical pharmacological problems.

Unsatisfactory (below 60 points):
Demonstrates insufficient knowledge.
Cannot adequately explain the main pharmacological mechanisms.
Makes significant errors in dose calculations or assessment of medication safety.

9.2. Assessment of practical skills
The following criteria should be considered:
Accuracy of pharmacological assessment.
Appropriateness of medicine selection.
Correctness of dose calculations.
Recognition of contraindications and drug interactions.
Identification of adverse drug reactions.
Ability to interpret relevant clinical and laboratory parameters.
Justification of pharmacotherapeutic recommendations.
Application of evidence-based medicine principles.

10. RECOMMENDED FORMS OF INTERIM ASSESSMENT
Interim assessment may include:
Written examination;
Oral examination;
Multiple-choice testing;
Clinical pharmacological case analysis;
Dose calculation tasks;
Medication review;
Assessment of therapeutic drug monitoring results;
Integrated practical examination.

The final assessment should evaluate not only theoretical knowledge but also the student's ability to make safe, evidence-based and individualized pharmacotherapeutic decisions.

5.2. Темы курсовых работ (проектов)

ТЕМЫ РЕФЕРАТОВ
• Значение хронофармакологии для эффективности фармакотерапии
• Значение фармакогенетики и фармакогеномики для клинициста
• Фармаконадзор. Редкие побочные реакции
• Современная антигипертензивная терапия и место фармакоэкономических исследований
• Современная терапия бронхиальной астмы и фармакоэкономический анализ
• Антиагрегантная терапия и ее последствия
• Лекарственные средства при сахарном диабете. Мониторинг лечения
• Противовирусная терапия: современные тенденции

5.3. Фонд оценочных средств

1. General Provisions
The Fund of Assessment Tools is designed to evaluate students' knowledge, skills and practical competencies acquired during the study of Clinical Pharmacology.
The main objectives are to assess students' ability to:
- Apply pharmacokinetic and pharmacodynamic principles in clinical practice.
- Select medicines based on evidence-based medicine and clinical guidelines.
- Develop individualized pharmacotherapy regimens.
- Calculate and adjust drug doses.
- Identify clinically significant drug interactions.
- Recognize and assess adverse drug reactions.
- Interpret therapeutic drug monitoring results.
- Evaluate the efficacy and safety of pharmacotherapy.
- Apply principles of rational prescribing, pharmacovigilance and deprescribing.

2. Expected Learning Outcomes
2.1. Knowledge – Students should know:
1. Principles and objectives of clinical pharmacology.
2. Clinical significance of pharmacokinetics and pharmacodynamics.
3. Mechanisms of action and clinical applications of major pharmacological groups.
4. Principles of evidence-based pharmacotherapy.

5. Factors influencing individual drug response.
6. Pharmacokinetic changes in renal and hepatic impairment.
7. Mechanisms and clinical significance of drug interactions.
8. Classification and prevention of adverse drug reactions.
9. Principles of therapeutic drug monitoring.
10. Principles of rational prescribing and individualized pharmacotherapy.
11. Pharmacotherapy in children, older adults and pregnant women.
12. Principles of antimicrobial stewardship and pharmacovigilance.
13. Polypharmacy, medication review and deprescribing.

2.2. Skills – Students should be able to:

1. Select medicines according to clinical indications and current guidelines.
2. Justify the choice of medicines based on efficacy, safety and cost-effectiveness.
3. Calculate individual doses and dosing intervals.
4. Adjust doses according to renal and hepatic function.
5. Identify contraindications and clinically significant drug interactions.
6. Recognize and assess adverse drug reactions.
7. Interpret relevant laboratory and clinical parameters.
8. Apply therapeutic drug monitoring principles.
9. Evaluate the efficacy and safety of pharmacotherapy.
10. Identify inappropriate polypharmacy and medication-related problems.
11. Use reliable clinical pharmacology databases and scientific literature.

2.3. Practical Competencies – Students should be proficient in:

1. Conducting clinical pharmacological assessment of medication regimens.
2. Developing individualized pharmacotherapy plans.
3. Calculating and adjusting drug doses.
4. Evaluating the benefit-risk profile of medicines.
5. Identifying and preventing adverse drug reactions and interactions.
6. Interpreting therapeutic drug monitoring results.
7. Conducting medication reviews.
8. Applying antimicrobial stewardship principles.
9. Justifying pharmacotherapeutic decisions using evidence-based medicine.

3. Structure of Assessment Tools

Assessment tool	Number	Assessment stage
Review questions	- 100	Ongoing
Multiple-choice questions	- 50	Ongoing/interim
Situational clinical-pharmacological tasks	- 20	Ongoing/interim
Dose calculation tasks	- 20	Ongoing
Drug interaction analysis tasks	- 10	Ongoing
Medication review tasks	-10	Ongoing
Practical pharmacotherapy assignments	- 20	Ongoing/interim
Examination questions	- 40	Interim
Examination tickets	- 20	Interim

The following sections provide the assessment materials and sample tasks.

4. Multiple-Choice Questions (MCQs)

Choose one correct answer.

Section I. Clinical Pharmacokinetics and Pharmacodynamics

1. Which pharmacokinetic parameter describes the volume of plasma cleared of a drug per unit of time?
A. Bioavailability
B. Clearance
C. Half-life
D. Volume of distribution

2. Which parameter determines the time required to reach steady state during repeated administration of a drug with linear pharmacokinetics?
A. Absorption rate
B. Elimination half-life
C. Peak concentration
D. Bioavailability

3. What is the main purpose of a loading dose?
A. To prevent drug interactions
B. To achieve the target plasma concentration rapidly
C. To reduce drug metabolism
D. To increase renal excretion

4. Which organ is primarily responsible for the metabolism of most medicines?
A. Heart
B. Liver
C. Spleen

D. Pancreas
5. What does a narrow therapeutic index indicate?
A. A wide margin between effective and toxic doses
B. A small margin between effective and toxic concentrations
C. Absence of adverse reactions
D. Complete predictability of drug response
6. Which enzyme system is important in the metabolism of many medicines?
A. Cytochrome P450
B. Acetylcholinesterase
C. Cyclooxygenase
D. Carbonic anhydrase
7. What is pharmacogenetics primarily concerned with?
A. Drug prices
B. Genetic variations affecting drug response
C. Drug packaging
D. Pharmaceutical manufacturing
8. Which statement best describes a competitive receptor antagonist?
A. It activates the receptor irreversibly
B. It competes with an agonist for receptor binding
C. It increases receptor synthesis
D. It permanently increases receptor sensitivity
Section II. Cardiovascular Pharmacotherapy
9. Which adverse effect is characteristic of ACE inhibitors?
A. Dry cough
B. Ototoxicity
C. Hypoglycemia
D. Gingival hyperplasia
10. Which electrolyte abnormality may occur with spironolactone?
A. Hypokalemia
B. Hyperkalemia
C. Hypercalcemia
D. Hypernatremia
11. Which laboratory parameter is routinely used to monitor warfarin therapy?
A. INR
B. Serum glucose
C. Serum sodium
D. Hemoglobin A1c
12. Which drug is a direct factor Xa inhibitor?
A. Warfarin
B. Apixaban
C. Aspirin
D. Clopidogrel
13. Which drug class is commonly used to reduce LDL cholesterol?
A. Statins
B. Antihistamines
C. Antacids
D. Beta-2 agonists
14. Which parameter should be monitored in patients receiving loop diuretics?
A. Electrolytes and renal function
B. Visual acuity only
C. Serum amylase only
D. Thyroid antibodies only
15. Which drug reverses the anticoagulant effect of unfractionated heparin?
A. Vitamin K
B. Protamine sulfate
C. Naloxone
D. Flumazenil
Section III. Endocrine and Respiratory Pharmacotherapy
16. Which medicine is associated with an increased risk of hypoglycemia?
A. Insulin
B. Amlodipine
C. Omeprazole
D. Loratadine
17. Which class of medicines improves glycemic control by increasing urinary glucose excretion?
A. SGLT2 inhibitors
B. ACE inhibitors
C. Beta-blockers
D. Proton pump inhibitors

18. Which adverse effect may occur with prolonged systemic glucocorticoid therapy?
A. Osteoporosis
B. Hypoglycemia in all patients
C. Severe bradycardia in all patients
D. Ototoxicity
19. Which medicine is a short-acting beta-2 agonist?
A. Salbutamol
B. Budesonide
C. Montelukast
D. Tiotropium
20. Which medicine belongs to the proton pump inhibitor group?
A. Famotidine
B. Omeprazole
C. Metoclopramide
D. Sucralfate
Section IV. Antimicrobial Pharmacotherapy
21. Which antibiotic class inhibits bacterial cell wall synthesis?
A. Beta-lactams
B. Macrolides
C. Tetracyclines
D. Aminoglycosides
22. Which antibiotic class acts on the 50S ribosomal subunit?
A. Macrolides
B. Fluoroquinolones
C. Beta-lactams
D. Glycopeptides
23. Which adverse reactions are particularly associated with aminoglycosides?
A. Nephrotoxicity and ototoxicity
B. Hypoglycemia and hypercalcemia
C. Gingival hyperplasia and constipation
D. Dry cough and angioedema
24. What is the main principle of antimicrobial stewardship?
A. Routine use of broad-spectrum antibiotics
B. Appropriate antimicrobial selection and duration
C. Antibiotic treatment of all viral infections
D. Avoidance of microbiological investigations in all cases
25. Which factor is particularly important when adjusting aminoglycoside doses?
A. Renal function
B. Hair color
C. Blood group
D. Visual acuity
26. Which medicine is an antifungal agent?
A. Fluconazole
B. Amoxicillin
C. Acyclovir
D. Oseltamivir
27. Which mechanism contributes to bacterial resistance to beta-lactam antibiotics?
A. Beta-lactamase production
B. Increased insulin secretion
C. Inhibition of human DNA synthesis
D. Increased gastric acid production
Section V. Adverse Reactions and Drug Interactions
28. Which combination may increase the risk of bleeding?
A. Warfarin and ibuprofen
B. Paracetamol and saline
C. Amoxicillin and loratadine
D. Metformin and calcium carbonate
29. Which combination may increase the risk of hyperkalemia?
A. Enalapril and spironolactone
B. Amlodipine and omeprazole
C. Salbutamol and loratadine
D. Paracetamol and amoxicillin
30. Which adverse reaction is associated with ACE inhibitor use?
A. Angioedema
B. Ototoxicity
C. Retinal detachment
D. Severe hypocalcemia
31. What is the main purpose of pharmacovigilance?

A. Monitoring and prevention of adverse drug reactions
B. Determining medicine prices
C. Advertising pharmaceutical products
D. Replacing clinical trials
32. Which parameter is important when evaluating possible drug-induced liver injury?
A. ALT and AST
B. Serum sodium only
C. Platelet count only
D. Blood group
33. Which medicine may increase the risk of QT interval prolongation?
A. Selected macrolide antibiotics
B. Oral rehydration solution
C. Normal saline
D. Topical emollients
Section VI. Special Populations and Individualized Pharmacotherapy
34. Why may drug doses need adjustment in chronic kidney disease?
A. Reduced renal clearance may cause drug accumulation
B. Renal impairment always increases drug absorption
C. All medicines are metabolized exclusively by the kidneys
D. Kidney disease eliminates drug interactions
35. Which factor is particularly important when prescribing medicines to children?
A. Body weight and age
B. Hair color
C. Blood group only
D. Height alone
36. What is polypharmacy?
A. Use of multiple medicines by one patient
B. Use of one medicine in several dosage forms
C. Use of medicines only in hospitals
D. Administration of medicines by injection
37. What is deprescribing?
A. Systematic reduction or discontinuation of medicines when clinically appropriate
B. Increasing all doses simultaneously
C. Replacing generic medicines with branded medicines
D. Prescribing additional medicines without review
38. What should be considered before prescribing a medicine during pregnancy?
A. Benefit-risk assessment for the mother and fetus
B. The medicine's color
C. The manufacturer's advertising
D. The medicine's packaging size only
Section VII. Therapeutic Drug Monitoring and Rational Prescribing
39. Which medicine commonly requires therapeutic drug monitoring after transplantation?
A. Tacrolimus
B. Paracetamol
C. Loratadine
D. Amoxicillin
40. What should be considered when interpreting a tacrolimus concentration?
A. Sampling time and concomitant medicines
B. Hair color and height only
C. Blood group only
D. The tablet packaging color
41. What is medication adherence?
A. The extent to which a patient follows an agreed treatment regimen
B. The number of medicines available in a pharmacy
C. The cost of a prescription
D. The number of laboratory tests performed
42. What is the primary purpose of medication reconciliation?
A. Comparing medication information across transitions of care
B. Increasing the number of prescribed medicines
C. Replacing all medicines with generics
D. Avoiding patient interviews
43. Which source is most appropriate for checking official prescribing information?
A. Approved product information
B. Unverified social media posts
C. Commercial advertisements
D. Anonymous online comments
44. What should be assessed when a medicine appears ineffective?
A. Diagnosis, adherence, dose, interactions and treatment duration

B. Packaging color only
C. Manufacturer's advertising budget
D. Tablet shape only
45. What is the purpose of a clinical medication review?
A. To identify and resolve medication-related problems
B. To increase the number of medicines
C. To replace all laboratory tests
D. To eliminate all long-term therapy
46. Which factor may reduce medication adherence?
A. Complex dosing regimens
B. Clear patient instructions
C. Appropriate follow-up
D. Shared decision-making
47. What is the main aim of individualized pharmacotherapy?
A. Tailoring treatment to patient-specific characteristics
B. Prescribing identical doses to all patients
C. Avoiding all laboratory monitoring
D. Using only the newest medicines
48. Which measure is important when assessing the safety of anticoagulant treatment?
A. Evaluation of bleeding risk
B. Routine assessment of hair growth
C. Measurement of visual acuity only
D. Assessment of body temperature only
49. What should be considered when using medicines with a narrow therapeutic index?
A. Close monitoring and careful dose individualization
B. Unrestricted dose escalation
C. No need for follow-up
D. Identical dosing in all patients
50. What is the main objective of rational pharmacotherapy?
A. Achieving the best possible therapeutic outcome with acceptable risk
B. Prescribing the largest number of medicines
C. Always selecting the most expensive medicine
D. Avoiding treatment monitoring
Answer Key

Questions	Correct answers
1–10	B, B, B, B, B, A, B, B, A, B
11–20	A, B, A, A, B, A, A, A, A, B
21–30	A, A, A, B, A, A, A, A, A, A
31–40	A, A, A, A, A, A, A, A, A, A
41–50	A, A, A, A, A, A, A, A, A, A

5. Situational Clinical-Pharmacological Tasks
Case 1. Drug-Induced Hyperkalemia
A 68-year-old patient with hypertension and chronic kidney disease receives enalapril and spironolactone. Laboratory tests reveal increased serum potassium.
Questions:
1. Explain the mechanisms of action of both medicines.
2. Identify the potential drug interaction.
3. Explain the risk of hyperkalemia.
4. Which clinical and laboratory parameters should be monitored?
5. What pharmacotherapeutic decisions should be considered?
Expected answer: Both medicines inhibit components of the renin-angiotensin-aldosterone system and may increase potassium concentrations. Renal function, potassium levels, clinical condition and indications for both medicines require reassessment. Treatment modification should be individualized.
Case 2. Increased INR During Antibiotic Treatment
A patient receiving warfarin for atrial fibrillation starts antibiotic treatment. Several days later, INR increases significantly.
Questions:
1. Identify possible mechanisms of the interaction.
2. What are the potential consequences?
3. Which clinical parameters should be assessed?
4. What monitoring and management measures are appropriate?
Expected answer: Some antibiotics may alter warfarin metabolism, vitamin K availability or intestinal flora. The patient may develop an increased bleeding risk. INR and clinical signs of bleeding should be assessed promptly.
Case 3. Hypoglycemia During Insulin Treatment
A patient with type 2 diabetes develops sweating, tremor, palpitations and confusion after receiving insulin.
Questions:
1. Identify the suspected adverse drug reaction.
2. Explain its pharmacological mechanism.

3. Identify potential contributing factors.
4. Describe the principles of immediate management and prevention.

Expected answer: Suspected insulin-induced hypoglycemia. Blood glucose should be checked promptly where feasible, and treatment should follow the patient's clinical condition and established hypoglycemia protocols.

Case 4. Aminoglycoside-Associated Nephrotoxicity

A patient receiving gentamicin develops an increase in serum creatinine.

Questions:

1. Explain the mechanism of nephrotoxicity.
2. What pharmacokinetic parameters influence gentamicin dosing?
3. Which monitoring procedures are required?
4. What is the role of therapeutic drug monitoring?

Expected answer: Gentamicin may accumulate in renal tubular cells and cause nephrotoxicity. Renal function, dosing interval, treatment duration and drug concentrations should be considered.

Case 5. Polypharmacy in an Older Adult

A 78-year-old patient takes eight medicines for cardiovascular disease, diabetes and osteoarthritis. The patient reports dizziness and weakness.

Questions:

1. Define polypharmacy.
2. Identify possible medication-related problems.
3. Explain the role of drug interactions.
4. Describe the medication review process.
5. What is deprescribing?

Expected answer: A structured medication review should assess indications, doses, interactions, adverse effects, adherence and treatment burden. Deprescribing may be considered when a medicine's potential harms exceed its expected benefits.

Case 6. Tacrolimus Monitoring

A patient after kidney transplantation receives tacrolimus. The trough concentration is above the intended therapeutic range.

Questions:

1. Explain the mechanism of action of tacrolimus.
2. Why is therapeutic drug monitoring important?
3. Which medicines may alter tacrolimus concentrations?
4. What factors should be considered before changing the dose?

Expected answer: Tacrolimus inhibits calcineurin and suppresses T-cell activation. Its concentration may be influenced by CYP3A4/CYP3A5 interactions, adherence, sampling time, hepatic function and other patient factors. Dose changes require specialist assessment.

Case 7. ACE Inhibitor-Associated Cough

A patient receiving enalapril develops a persistent dry cough.

Questions:

1. Explain the mechanism of this adverse reaction.
2. Identify the pharmacological group.
3. What alternative treatment class may be considered?
4. What clinical factors should be evaluated?

Expected answer: ACE inhibition reduces bradykinin degradation. An angiotensin receptor blocker may be considered if clinically appropriate.

Case 8. Antimicrobial Stewardship

A patient with an uncomplicated viral respiratory infection requests antibiotics.

Questions:

1. Explain why antibiotics are not indicated for uncomplicated viral infections.
2. Describe the risks of unnecessary antibiotic use.
3. Explain antimicrobial resistance.
4. Identify the principles of responsible antibiotic prescribing.

Expected answer: Antibiotics act against susceptible bacteria and do not treat viral infections. Unnecessary use contributes to resistance and adverse reactions.

Case 9. Drug-Induced Liver Injury

A patient receiving multiple medicines develops increased ALT and AST.

Questions:

1. Define drug-induced liver injury.
2. Identify possible pharmacological causes.
3. What additional laboratory parameters are relevant?
4. How should the medication regimen be assessed?

Expected answer: Assess the timing of drug exposure, liver biochemical profile, bilirubin, clinical symptoms, alternative causes and potentially hepatotoxic medicines. Suspected serious injury requires prompt clinical evaluation.

Case 10. Treatment Failure

A patient with hypertension remains above the target blood pressure despite receiving several medicines.

Questions:

1. Identify possible causes of apparent treatment failure.
2. Explain the importance of medication adherence.
3. What interactions or secondary causes should be considered?
4. Which monitoring and reassessment measures are appropriate?

Expected answer: Consider adherence, measurement accuracy, dose adequacy, treatment duration, drug interactions, lifestyle factors and secondary hypertension before modifying therapy.

6. Dose Calculation Tasks

All numerical examples are educational and are not universal prescribing recommendations.

1. Calculate a dose of 5 mg/kg for a patient weighing 60 kg.
2. A solution contains 25 mg/mL. Calculate the volume required for a 100 mg dose.
3. Calculate the daily dose if 250 mg is administered three times daily.
4. A patient receives 500 mg every 12 hours. Calculate the total daily dose.
5. A solution contains 2 g in 100 mL. Calculate its concentration in mg/mL.
6. Calculate the loading dose for a target concentration of 5 mg/L, volume of distribution of 40 L and bioavailability of 100%.
7. Calculate the maintenance dose rate when clearance is 4 L/hour and the target concentration is 2 mg/L.
8. A medicine has a half-life of 8 hours. Calculate the approximate percentage remaining after 24 hours, assuming first-order elimination.
9. Calculate an infusion rate of 500 mL over 4 hours in mL/hour.
10. Calculate the oral dose required to provide systemic exposure equivalent to 100 mg intravenously when oral bioavailability is 50%, assuming linear pharmacokinetics.

7. Drug Interaction Analysis Tasks

For each combination, identify the possible interaction mechanism, clinical risk and appropriate monitoring.

No.	Drug combination	Main safety issue
1	Warfarin + ibuprofen	Increased bleeding risk
2	Enalapril + spironolactone	Hyperkalemia
3	Gentamicin + furosemide	Increased ototoxicity risk
4	Clarithromycin + simvastatin	Increased statin exposure and myopathy risk
5	Metformin + iodinated contrast media	Risk of complications if acute kidney injury develops
6	Opioids + benzodiazepines	Sedation and respiratory depression
7	Tacrolimus + clarithromycin	Increased tacrolimus exposure
8	NSAIDs + ACE inhibitors + diuretics	Increased acute kidney injury risk
9	Multiple QT-prolonging medicines	Increased risk of arrhythmia
10	Insulin + sulfonylurea	Increased hypoglycemia risk

8. Medication Review Tasks

Students should analyze hypothetical medication regimens and identify:

1. Medicines without a documented indication.
2. Potentially inappropriate medicines.
3. Duplicate pharmacological therapy.
4. Clinically significant drug interactions.
5. Doses requiring adjustment.
6. Medicines associated with increased fall risk.
7. Medicines that may cause renal or hepatic injury.
8. Potential adherence problems.
9. Opportunities for deprescribing.
10. Required clinical and laboratory monitoring.

Expected output: A structured medication review report containing identified problems, pharmacological justification, proposed actions and a follow-up monitoring plan.

9. Practical Assessment Tasks

Students should demonstrate the ability to:

1. Prepare a clinical pharmacological profile of a medicine.
2. Compare medicines from the same pharmacological group.
3. Select an appropriate medicine using clinical guidelines.
4. Justify a pharmacotherapy regimen.
5. Calculate an individualized dose.
6. Adjust a dosing regimen according to renal function.
7. Identify contraindications and interactions.
8. Interpret an adverse drug reaction.
9. Interpret therapeutic drug monitoring results.
10. Evaluate a medication list.
11. Identify polypharmacy-related risks.
12. Develop a medication monitoring plan.
13. Assess treatment adherence.
14. Apply antimicrobial stewardship principles.
15. Analyze potential drug-induced liver injury.
16. Assess possible drug-induced nephrotoxicity.
17. Evaluate treatment failure.
18. Use official prescribing information.
19. Prepare an educational medication order.

20. Explain medication safety recommendations to a patient.

10. Examination Questions for Interim Assessment

1. Definition, objectives and scope of clinical pharmacology.
2. Principles of evidence-based pharmacotherapy.
3. Clinical significance of pharmacokinetics.
4. Pharmacokinetic parameters and their clinical application.
5. Loading and maintenance doses.
6. Pharmacokinetic changes in renal impairment.
7. Pharmacokinetic changes in hepatic impairment.
8. Therapeutic drug monitoring.
9. Clinical pharmacodynamics.
10. Pharmacogenetics and individualized pharmacotherapy.
11. Classification and prevention of adverse drug reactions.
12. Pharmacokinetic drug interactions.
13. Pharmacodynamic drug interactions.
14. Principles of pharmacovigilance.
15. Clinical pharmacology of ACE inhibitors.
16. Clinical pharmacology of beta-blockers.
17. Pharmacotherapy of chronic heart failure.
18. Clinical pharmacology of anticoagulants.
19. Monitoring anticoagulant treatment.
20. Clinical pharmacology of lipid-lowering medicines.
21. Pharmacotherapy of bronchial asthma.
22. Clinical pharmacology of proton pump inhibitors.
23. Pharmacotherapy of type 2 diabetes mellitus.
24. Clinical pharmacology of insulin.
25. Clinical pharmacology of glucocorticoids.
26. Rational antimicrobial therapy.
27. Clinical pharmacology of beta-lactam antibiotics.
28. Clinical pharmacology of aminoglycosides.
29. Antimicrobial resistance and stewardship.
30. Dose adjustment in renal impairment.
31. Pharmacotherapy in older adults.
32. Pharmacotherapy during pregnancy.
33. Pharmacotherapy in children.
34. Polypharmacy and its clinical consequences.
35. Medication review and deprescribing.
36. Drug-induced liver injury.
37. Drug-induced nephrotoxicity.
38. Clinical interpretation of therapeutic drug monitoring.
39. Medication adherence and treatment outcomes.
40. Principles of rational and safe prescribing.

11. Sample Examination Tickets

Examination Ticket No. 1

1. Clinical pharmacology: objectives and principles.
2. Clinical pharmacokinetics and its application.
3. Practical task: calculate a loading dose.

Examination Ticket No. 2

1. Clinical pharmacodynamics.
2. Adverse drug reactions and pharmacovigilance.
3. Situational task: assess a suspected adverse drug reaction.

Examination Ticket No. 3

1. Clinical pharmacology of ACE inhibitors and ARBs.
2. Drug interactions involving anticoagulants.
3. Situational task: evaluate an increased INR in a patient receiving warfarin.

Examination Ticket No. 4

1. Therapeutic drug monitoring.
2. Clinical pharmacology of aminoglycosides.
3. Situational task: evaluate possible gentamicin-associated nephrotoxicity.

Examination Ticket No. 5

1. Rational antimicrobial therapy.
2. Clinical pharmacology of insulin and glucose-lowering medicines.
3. Practical task: identify and assess hypoglycemia risk.

Examination Ticket No. 6

1. Individualized pharmacotherapy in older adults.
2. Polypharmacy and deprescribing.

3. Practical task: perform a medication review.

Examination Ticket No. 7

1. Clinical pharmacology of medicines used in chronic heart failure.
2. Pharmacokinetic changes in renal impairment.
3. Practical task: identify parameters required for dose adjustment.

Examination Ticket No. 8

1. Pharmacogenetics and personalized medicine.
2. Clinical pharmacology of immunosuppressants.
3. Situational task: assess an elevated tacrolimus concentration.

Examination Ticket No. 9

1. Clinical pharmacology of lipid-lowering medicines.
2. Drug-induced liver injury.
3. Practical task: develop a medication safety monitoring plan.

Examination Ticket No. 10

1. Clinical pharmacology of anticoagulants.
2. Drug interactions and bleeding risk.
3. Situational task: evaluate a patient receiving warfarin and an NSAID.

12. Assessment Criteria

12.1. Theoretical knowledge

Score	Grade	Assessment criteria
90–100	Excellent	Comprehensive knowledge; correct pharmacological reasoning; evidence-based justification
75–89	Good	Good knowledge; minor errors that do not affect the main conclusions
60–74	Satisfactory	Basic knowledge; partial understanding; requires guidance in complex cases
Below 60	Unsatisfactory	Insufficient knowledge; significant errors in pharmacotherapy and medication safety

12.2. Practical skills

The following criteria should be evaluated:

- Accuracy of pharmacological assessment;
- Appropriateness of medicine selection;
- Correctness of dose calculations;
- Identification of contraindications;
- Recognition of clinically significant drug interactions;
- Assessment of adverse drug reactions;
- Interpretation of clinical and laboratory parameters;
- Ability to justify pharmacotherapeutic decisions;
- Application of evidence-based medicine;
- Development of appropriate monitoring plans.

12.3. Assessment of situational tasks

Criterion	Maximum points
Identification of the main medication-related problem	2
Correct pharmacological explanation	2
Identification of risks and interactions	2
Appropriate monitoring recommendations	2
Scientific justification of the proposed approach	2
Total	10

13. Matrix of Assessment Tools and Learning Outcomes

Assessment tool	Knowledge		Skills	Practical competencies
Review questions	✓			
MCQs	✓	✓		
Situational tasks	✓	✓	✓	
Dose calculations	✓	✓	✓	
Drug interaction analysis		✓	✓	✓
Medication review	✓	✓	✓	
Practical assignments	✓	✓	✓	
Examination	✓	✓	✓	

14. Methodological Recommendations for Examiners

Assessment should focus on the student's ability to apply clinical pharmacology principles to individual patients.

The examiner should evaluate whether the student can:

1. Explain the clinical rationale for selecting a medicine.
2. Justify an individualized dosing regimen.
3. Identify clinically significant interactions.
4. Recognize adverse drug reactions.
5. Interpret relevant laboratory and pharmacokinetic parameters.
6. Evaluate the efficacy and safety of treatment.
7. Propose appropriate monitoring measures.

8. Apply evidence-based medicine principles.
Particular attention should be paid to medication safety. Errors involving potentially dangerous dose calculations, failure to recognize major contraindications or inability to identify serious adverse drug reactions should be considered significant deficiencies.

15. Final Provisions
The Fund of Assessment Tools is intended for systematic evaluation of students' knowledge and practical competencies throughout the study of Clinical Pharmacology.
The assessment materials may be supplemented and updated according to changes in clinical guidelines, pharmacological evidence, national regulations and the educational programme.
All calculation exercises and situational cases are educational. Actual prescribing decisions must comply with current clinical guidelines, approved prescribing information, individual patient characteristics and applicable national regulations.
16. Recommended grading system
For the course syllabus (RPD), the following point distribution model can be used:
Ongoing assessment: tests and oral questioning - 20%
Clinical pharmacological cases - 25%
Independent student work - 5%
Dose calculations and practical assignments - 10%
Interim assessment (examination) - 30%
Total - 100%

5.4. Перечень видов оценочных средств

Коллоквиум по разделу "Общая клиническая фармакология"
Коллоквиум по разделу "Частная клиническая фармакология"
Протокол по оценке использования лекарственных средств у курируемого больного
Реферат
Ситуационные задачи
Тесты
Личный формуляр студента
ОСКЭ (10 станций)

6. УЧЕБНО-МЕТОДИЧЕСКОЕ И ИНФОРМАЦИОННОЕ ОБЕСПЕЧЕНИЕ ДИСЦИПЛИНЫ (МОДУЛЯ)

6.1. Рекомендуемая литература

6.1.1. Основная литература

	Авторы, составители	Заглавие	Издательство, год
Л1.1	Кукес В.Г., Стародубцев А.К.	Клиническая фармакология и фармакотерапия: учебник для вузов	М.: ГЭОТАР-МЕД 2004
Л1.2	Бегг Э.	Клиническая фармакология: учебное пособие	М.: БИНОМ. Лаборатория знаний 2004
Л1.3	Ортенберг Э.А.	Клиническая фармакология: учебное пособие	Ростов н/Д: Феникс 2006
Л1.4	Лоуренс Д.Р., Беннетт П.Н., Браун М.Дж.	Клиническая фармакология: учебное пособие	
Л1.5	Михайлов И.Б.	Клиническая фармакология: учебное пособие	

6.2. Перечень ресурсов информационно-телекоммуникационной сети "Интернет"

Э1	Государственный реестр лекарственных средств РФ	https://grls.minzdrav.gov.ru/Default.aspx
Э2	Американская база по ЛС	www.drugs.com
Э3	MEDSCAPE	www.medscape.com
Э4	Interactive clinical pharmacology	www.icp.org.nz
Э5	Государственный реестр Кыргызской Республики	https://dlsmi.kg/ru/ndb_reestr/
Э6	NICE	www.nice.org

6.3. Перечень информационных и образовательных технологий

6.3.1 Компетентностно-ориентированные образовательные технологии

6.3.1.1	The study of the discipline includes:
6.3.1.2	• lectures;
6.3.1.3	• practical sessions;
6.3.1.4	• independent study;
6.3.1.5	• clinical case reviews;
6.3.1.6	• solving clinical scenarios;

6.3.1.7	•	working with clinical guidelines;
6.3.1.8	•	testing;
6.3.1.9	•	performing practical skills;
6.3.1.10	•	preparing individual assignments;
6.3.1.11	•	OSCE (Objective Structured Clinical Examination)

6.3.2 Перечень информационных справочных систем и программного обеспечения

6.3.2.1	https://grls.minzdrav.gov.ru/Default.aspx
6.3.2.2	www.drugs.com
6.3.2.3	www.icp.org.nz
6.3.2.4	www.nice.org
6.3.2.5	www.antibiotic.ru
6.3.2.6	www.medscape.com

7. МАТЕРИАЛЬНО-ТЕХНИЧЕСКОЕ ОБЕСПЕЧЕНИЕ ДИСЦИПЛИНЫ (МОДУЛЯ)

7.1	For lecture-based instruction, there are two lecture halls equipped with demonstration gear, including computers, multimedia equipment, and visual teaching aids (such as thematic presentations aligned with the course syllabus).
7.2	For practical sessions, there are six classrooms furnished with specialized furniture, visual displays covering all course topics, whiteboards, and display cases containing various medicinal products. These rooms are also equipped with technical resources, including Wi-Fi, computers, and multimedia systems.
7.3	To support student learning, the department maintains a library containing drug reference books, formularies, manuals, textbooks, and various teaching and methodological guides. Additionally, the department features thematic visual displays and provides access to printers, photocopiers, and scanners.
7.4	To facilitate the study of the discipline, the department utilizes hands-on demonstration materials—such as trays containing various types of medicinal preparations (solid, semi-solid, and liquid dosage forms)—as well as prescription-writing exercises, official prescription forms, sets of assessment tasks, and colloquia covering all sections of the course. Students are also provided with a list of medicinal products to be included in their personal formulary.

8. МЕТОДИЧЕСКИЕ УКАЗАНИЯ ДЛЯ ОБУЧАЮЩИХСЯ ПО ОСВОЕНИЮ ДИСЦИПЛИНЫ (МОДУЛЯ)

1. GENERAL PROVISIONS

Clinical Pharmacology is a medical discipline that studies the effects of medicines in humans, their clinical applications, efficacy, safety, pharmacokinetic and pharmacodynamic properties, drug interactions and principles of individualized pharmacotherapy.

Clinical Pharmacology provides the scientific basis for rational prescribing and safe use of medicines in clinical practice. It enables future physicians to select appropriate medicines, determine optimal dosing regimens, evaluate treatment outcomes, identify adverse drug reactions and prevent medication-related problems.

These methodological guidelines are intended to support students in mastering theoretical knowledge, developing practical skills and acquiring competencies necessary for evidence-based and individualized pharmacotherapy.

The guidelines provide recommendations for:

Preparation for lectures and practical classes;

Independent study of theoretical material;

Analysis of clinical pharmacological situations;

Selection and evaluation of medicines;

Dose calculation and dose adjustment;

Assessment of drug interactions and adverse reactions;

Therapeutic drug monitoring;

Preparation for ongoing and interim assessment.

2. AIM AND OBJECTIVES OF STUDYING THE DISCIPLINE

2.1. Aim

The aim of studying Clinical Pharmacology is to develop students' knowledge and practical skills in the rational, evidence-based and safe use of medicines, including individualized selection of pharmacotherapy, optimization of dosing regimens, evaluation of therapeutic efficacy and safety, prevention and management of adverse drug reactions, and identification of clinically significant drug interactions.

2.2. Objectives

Students should:

Understand the principles and objectives of clinical pharmacology.

Master the clinical application of pharmacokinetic and pharmacodynamic concepts.

Develop the ability to select medicines according to evidence-based clinical recommendations.

Understand the principles of individualized pharmacotherapy.

Learn to calculate and adjust drug doses according to patient-specific characteristics.

Identify and assess clinically significant drug interactions.

Recognize, prevent and evaluate adverse drug reactions.

Master the principles of therapeutic drug monitoring.
Develop skills in assessing the efficacy and safety of pharmacotherapy.
Understand the principles of rational prescribing and antimicrobial stewardship.
Identify inappropriate polypharmacy and opportunities for deprescribing.
Develop the ability to use clinical pharmacology databases and scientific literature.

3. ORGANIZATION OF THE EDUCATIONAL PROCESS
The discipline is studied through lectures, practical classes, independent student work and assessment activities.
The educational process includes:
Lectures on the theoretical foundations of clinical pharmacology;
Practical classes focused on clinical application of pharmacological knowledge;
Analysis of clinical pharmacological cases;
Individual and group assignments;
Medication review exercises;
Dose calculation tasks;
Interpretation of laboratory and therapeutic drug monitoring results;
Preparation for ongoing and interim assessment.
Students are expected to attend classes regularly, complete assigned tasks on time and actively participate in discussions and practical activities.

The study of each topic should follow three stages:
Stage 1. Theoretical preparation: study lecture materials, recommended textbooks and clinical guidelines.
Stage 2. Practical application: analyze medicines, solve clinical pharmacological cases, perform calculations and assess medication safety.
Stage 3. Self-assessment: answer review questions, complete tests and evaluate the results of independent work.

4. METHODOLOGY FOR STUDYING THEORETICAL MATERIAL
When studying clinical pharmacology, students should focus on understanding how medicines work in patients and how patient-specific characteristics influence treatment outcomes.
For each medicine or pharmacological group, students should study the following aspects:
International Nonproprietary Name (INN).
Pharmacological group.
Mechanism of action.
Pharmacokinetic characteristics.
Pharmacodynamic effects.
Clinical indications.
Contraindications and precautions.
Adverse drug reactions.
Clinically significant drug interactions.
Dosage forms and routes of administration.
Dose adjustment in specific patient populations.
Parameters for monitoring efficacy and safety.
Place in current clinical guidelines.
Evidence supporting its clinical use.
Students should pay particular attention to the relationship between pharmacological properties, clinical efficacy and potential risks.

5. METHODOLOGICAL GUIDELINES FOR STUDYING CLINICAL PHARMACOKINETICS
Clinical pharmacokinetics is essential for individualizing drug dosage and optimizing therapeutic outcomes.
Students should study:
Drug absorption and bioavailability;
Drug distribution and volume of distribution;
Plasma protein binding;
Drug metabolism and cytochrome P450 enzymes;
Renal and biliary drug excretion;
Clearance;
Elimination half-life;
Steady-state concentration;
Loading and maintenance doses;
Therapeutic drug monitoring.
Practical recommendations
When analyzing the pharmacokinetics of a medicine, students should be able to:
Explain how the medicine is absorbed and distributed.
Identify the main metabolic pathways.
Determine the major route of elimination.
Explain the clinical significance of half-life and clearance.
Identify factors that may cause drug accumulation.
Understand the need for dose adjustment in renal or hepatic impairment.
Interpret drug concentration measurements when therapeutic drug monitoring is indicated.

Special attention should be paid to medicines with a narrow therapeutic index, such as tacrolimus, lithium, digoxin and selected antiepileptic medicines.

6. METHODOLOGICAL GUIDELINES FOR STUDYING CLINICAL PHARMACODYNAMICS
Students should understand the relationship between drug concentration, receptor interaction and clinical response.
The following topics should be studied:
Drug-receptor interactions;
Agonists and antagonists;
Dose-response relationships;
Potency and efficacy;
Therapeutic index;
Therapeutic window;
Tolerance and tachyphylaxis;
Pharmacodynamic variability;
Pharmacogenetic factors influencing drug response.
During practical classes, students should be able to explain why the same medicine may produce different therapeutic effects or adverse reactions in different patients.

7. METHODOLOGY FOR SELECTING MEDICINES
The selection of a medicine should be based on a comprehensive assessment of the patient's clinical condition and the available evidence.
Students are advised to follow a structured approach:
Step 1. Define the therapeutic objective.
Identify the condition requiring pharmacological treatment and determine the expected therapeutic outcome.
Step 2. Consider the available treatment options.
Identify medicines recommended by current clinical guidelines and reliable evidence sources.
Step 3. Compare efficacy and safety.
Evaluate the expected therapeutic benefits, adverse reactions and contraindications.
Step 4. Consider patient-specific factors.
Take into account:
Age and body weight;
Pregnancy and breastfeeding, where applicable;
Renal and hepatic function;
Allergies and previous adverse reactions;
Comorbidities;
Concomitant medicines;
Previous treatment response;
Medication adherence.
Step 5. Select the appropriate dosage regimen.
Determine the dose, route, frequency and duration of administration according to clinical indications and official prescribing information.
Step 6. Establish a monitoring plan.
Identify clinical and laboratory parameters required to assess treatment efficacy and safety.
Step 7. Reassess treatment.
Evaluate the patient's response and determine whether continuation, modification or discontinuation of treatment is appropriate.

8. METHODOLOGY FOR ANALYZING CLINICAL PHARMACOLOGICAL CASES
Clinical pharmacological cases are used to develop students' ability to apply theoretical knowledge to clinical situations.
When solving a case, students should follow this algorithm:
Read the clinical scenario carefully.
Identify the patient's main clinical problem.
Review the current medication regimen.
Identify the pharmacological groups and mechanisms of action.
Evaluate the appropriateness of the prescribed medicines.
Identify contraindications and potential drug interactions.
Assess the risk of adverse drug reactions.
Consider patient-specific pharmacokinetic factors.
Determine which clinical and laboratory parameters require monitoring.
Formulate a scientifically justified pharmacotherapeutic recommendation.

Example of a clinical pharmacological case
A 70-year-old patient with arterial hypertension and chronic kidney disease is receiving enalapril and spironolactone. Laboratory tests reveal an increase in serum potassium.
Students should:
Explain the mechanisms of action of both medicines;
Identify the potential pharmacodynamic interaction;
Explain the risk of hyperkalemia;
Identify relevant clinical and laboratory parameters;

Discuss possible measures for medication safety.
Students should justify their conclusions using pharmacological principles and relevant clinical guidelines.

9. METHODOLOGICAL GUIDELINES FOR DOSE CALCULATIONS
Dose calculation is an essential practical skill in clinical pharmacology.
Students should master:
Calculation of single and daily doses;
Calculation of loading doses;
Calculation of maintenance doses;
Weight-based dosing;
Calculation of drug concentration;
Calculation of infusion rates;
Adjustment of dosing regimens according to renal function;
Interpretation of pharmacokinetic parameters.

Example 1. Weight-based dose calculation
An educational task specifies a dose of 5 mg/kg for a patient weighing 60 kg.
Calculation:
5 × 60 = 300 mg.
The calculated dose is 300 mg.

Example 2. Calculation of a loading dose
A medicine has a volume of distribution of 40 L. The target plasma concentration is 5 mg/L. Bioavailability is 100%.
Formula:
Loading dose = Target concentration × Volume of distribution / Bioavailability.
Calculation:
5 × 40 / 1 = 200 mg.
The calculated loading dose is 200 mg.

Example 3. Calculation of maintenance dose rate
A medicine has a clearance of 4 L/hour. The target average steady-state concentration is 2 mg/L.
Formula:
Maintenance dose rate = Clearance × Target steady-state concentration.
Calculation:
4 × 2 = 8 mg/hour.
The calculated maintenance dose rate is 8 mg/hour.

All calculation exercises are educational. Actual clinical dosing requires consideration of the medicine's approved instructions, patient-specific factors and current clinical recommendations.

10. METHODOLOGY FOR STUDYING ADVERSE DRUG REACTIONS
Students should understand the importance of identifying, assessing, preventing and managing adverse drug reactions.
When studying an adverse reaction, students should identify:
The suspected medicine.
The possible mechanism of the reaction.
The time relationship between drug administration and symptom development.
Relevant patient risk factors.
Clinical manifestations.
Laboratory findings, where applicable.
Possible alternative explanations.
Appropriate safety measures and monitoring.
The need for reporting through pharmacovigilance systems.
Particular attention should be given to drug-induced liver injury, nephrotoxicity, bleeding, hypoglycemia, allergic reactions and QT interval prolongation.
Students should understand that suspected adverse drug reactions require clinical assessment and that decisions regarding discontinuation or modification of treatment must be made according to the patient's clinical condition.

11. METHODOLOGY FOR STUDYING DRUG INTERACTIONS
Drug interactions may significantly influence the efficacy and safety of pharmacotherapy.
Students should distinguish between:
Pharmacokinetic interactions;
Pharmacodynamic interactions;
Drug-food interactions;
Drug-alcohol interactions;
Interactions involving herbal and dietary supplements.
When analyzing a potential interaction, students should:
Identify the interacting medicines.
Determine the possible mechanism.

Evaluate the clinical significance.
Assess patient-specific risk factors.
Identify possible adverse consequences.
Determine whether monitoring or an alternative treatment strategy is required.
Students should be able to use reliable drug interaction databases and official prescribing information.

12. THERAPEUTIC DRUG MONITORING
Therapeutic drug monitoring (TDM) is the measurement of drug concentrations in biological fluids to support individualized treatment when clinically indicated.
Students should understand:
Indications for TDM;
Medicines requiring concentration monitoring;
Timing of blood sample collection;
Peak and trough concentrations;
Therapeutic and toxic concentration ranges;
Factors affecting drug concentrations;
Interpretation of laboratory results;
The relationship between drug concentration and clinical response.
Special attention should be paid to tacrolimus, cyclosporine, lithium, digoxin and selected antiepileptic medicines.
Students should interpret TDM results together with the patient's clinical condition, sampling time, adherence, renal and hepatic function, and concomitant medicines.

13. METHODOLOGY FOR STUDYING RATIONAL PHARMACOTHERAPY
Rational pharmacotherapy involves selecting the appropriate medicine for the appropriate patient, at the appropriate dose, by the appropriate route and for the appropriate duration.
Students should study:
Evidence-based medicine;
Clinical treatment guidelines;
Essential medicines lists;
Generic prescribing;
Cost-effectiveness;
Medication adherence;
Prevention of medication errors;
Polypharmacy;
Medication review;
Deprescribing;
Antimicrobial stewardship.
Students should develop the ability to evaluate whether each medicine in a patient's treatment regimen has a clear indication and whether its expected benefits outweigh potential risks.

14. METHODOLOGY FOR MEDICATION REVIEW AND DEPRESCRIBING
Medication review is a structured assessment of a patient's medicines to identify and resolve medication-related problems.
Students should be able to:
Collect a complete medication history.
Identify all prescribed and non-prescribed medicines.
Assess the indication for each medicine.
Evaluate dose, route and duration.
Identify potentially inappropriate medicines.
Detect clinically significant drug interactions.
Assess adherence and treatment burden.
Identify medicines that may no longer be necessary.
Consider opportunities for dose reduction or deprescribing.
Develop a monitoring and follow-up plan.
Deprescribing should be considered through an individualized clinical assessment, taking into account withdrawal risks and the possibility of recurrence or deterioration of the treated condition.

15. INDEPENDENT STUDENT WORK
Independent work is an important component of mastering Clinical Pharmacology.
It may include:
Studying recommended textbook chapters.
Preparing summaries of clinical pharmacological topics.
Creating comparative tables of medicines.
Preparing clinical pharmacological drug profiles.
Solving clinical case scenarios.
Performing pharmacokinetic calculations.
Analyzing drug interactions.
Preparing medication review reports.
Reviewing clinical guidelines.

Preparing presentations and scientific reports.
Analyzing scientific publications.
Completing self-assessment tests.
Recommended forms of independent assignments

Assignment 1. Clinical pharmacological drug profile
Students prepare a structured profile of a medicine, including its mechanism of action, pharmacokinetics, clinical indications, contraindications, adverse reactions, interactions and monitoring requirements.

Assignment 2. Comparative pharmacotherapy analysis
Students compare two medicines from the same pharmacological group according to efficacy, safety, pharmacokinetic properties, contraindications and cost-effectiveness.

Assignment 3. Medication review
Students analyze a hypothetical medication list and identify potential prescribing problems, drug interactions, unnecessary medicines and opportunities for treatment optimization.

Assignment 4. Clinical guideline analysis
Students select a clinical guideline and identify the recommended pharmacological treatment, evidence supporting the recommendations and safety considerations.

Assignment 5. Scientific literature review
Students analyze a recent clinical study or systematic review and summarize its objectives, methodology, results and implications for pharmacotherapy.

16. USE OF INFORMATION RESOURCES
Students should use reliable and scientifically validated sources.
Recommended resources include:
Katzung's Basic and Clinical Pharmacology;
Rang & Dale's Pharmacology;
Goodman & Gilman's The Pharmacological Basis of Therapeutics;
DiPiro's Pharmacotherapy: A Pathophysiologic Approach;
British National Formulary (BNF);
British National Formulary for Children (BNFC);
WHO guidelines;
PubMed;
NCBI Bookshelf;
European Medicines Agency (EMA);
Official prescribing information and drug databases.

When using scientific publications, students should assess the quality of evidence, study design, relevance to clinical practice and possible limitations.
Commercial promotional materials should not be used as the primary basis for pharmacotherapeutic decisions.

17. PREPARATION FOR PRACTICAL CLASSES
Before each practical class, students should:
Review the relevant lecture materials.
Study the recommended textbook chapter.
Revise the pharmacological mechanisms of the medicines under discussion.
Review indications and contraindications.
Study common and serious adverse drug reactions.
Prepare answers to review questions.
Complete assigned tests.
Solve the relevant clinical pharmacological cases.
Prepare for dose calculation exercises.
Review relevant clinical guidelines where appropriate.

During practical classes, students should actively participate in discussions, present their clinical pharmacological assessments and justify their recommendations.

18. PREPARATION FOR ONGOING ASSESSMENT
Ongoing assessment may include:
Oral questioning;
Written tests;
Multiple-choice questions;
Clinical case analysis;
Dose calculation tasks;
Medication review exercises;

Interpretation of therapeutic drug monitoring results;
Independent assignments;
Practical pharmacotherapeutic exercises.
Students should regularly review previously studied material and systematically complete assignments.

19. PREPARATION FOR INTERIM ASSESSMENT
Preparation for interim assessment should include revision of all major topics covered during the course.
Students should be able to:
Explain the clinical principles of pharmacokinetics and pharmacodynamics.
Select medicines based on clinical indications and evidence.
Justify individualized pharmacotherapy.
Calculate drug doses and dosing regimens.
Adjust treatment according to renal and hepatic function.
Identify adverse drug reactions.
Analyze clinically significant drug interactions.
Interpret therapeutic drug monitoring results.
Evaluate the efficacy and safety of treatment.
Conduct a basic medication review.
Apply antimicrobial stewardship principles.
Justify pharmacotherapeutic decisions in clinical situations.

20. CRITERIA FOR SUCCESSFUL MASTERING OF THE DISCIPLINE
Successful mastery of Clinical Pharmacology is demonstrated by the student's ability to:
Understand the principles of evidence-based pharmacotherapy;
Explain the clinical significance of pharmacokinetics and pharmacodynamics;
Select appropriate medicines according to clinical guidelines;
Develop individualized medication regimens;
Calculate and adjust drug doses;
Identify contraindications and drug interactions;
Recognize and assess adverse drug reactions;
Interpret relevant clinical and laboratory parameters;
Apply therapeutic drug monitoring principles;
Evaluate treatment efficacy and safety;
Identify inappropriate polypharmacy;
Apply medication review and deprescribing principles;
Use reliable clinical pharmacology information resources;
Justify pharmacotherapeutic decisions scientifically.

21. RECOMMENDED STUDY STRATEGY
For effective learning, students are advised to follow a systematic study schedule.
Before lectures: review the topic and become familiar with the main clinical pharmacology concepts.
After lectures: summarize the key mechanisms, clinical applications and safety considerations.
Before practical classes: study the relevant medicines, clinical guidelines and assigned clinical cases.
During independent study: complete dose calculations, analyze drug interactions, prepare medication reviews and study scientific publications.
Before examinations: revise all major topics, solve clinical pharmacological cases and practice interpreting pharmacokinetic and laboratory data.

22. FINAL RECOMMENDATIONS
Clinical Pharmacology is an essential discipline that connects basic pharmacological knowledge with practical medical decision-making.
Students should focus not only on knowing the properties of individual medicines but also on understanding how to select, prescribe, monitor and evaluate pharmacotherapy in individual patients.
The successful mastery of Clinical Pharmacology provides the foundation for safe, rational and evidence-based prescribing and contributes to the development of professional competencies required for future clinical practice.
The knowledge and skills acquired during the course should be further developed and applied in Internal Medicine, Surgery, Pediatrics, Infectious Diseases, Emergency Medicine and other clinical disciplines.