Assessment Toolkit for the discipline

"PHARMACOLOGY"

Higher Education Level

SPECIALIST DEGREE PROGRAM

Field of Study **560001 General Medicine (For international students)**

(code and name of the field of study)

Qualification: **Physician (General Medicine)**

Bishkek-2026

The set of assessment tools is designed to monitor students' knowledge in the field of study (specialty) "General Medicine" within the discipline of "Pharmacology."

The set of assessment tools has been reviewed and approved at a meeting of the Department of Basic and Clinical Pharmacology, Chemistry, and Biochemistry.

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FUND OF ASSESSMENT TOOLS (FAT)

For the Discipline "PHARMACOLOGY"

Educational Programme: General Medicine (560001)

Qualification: General Practitioner

Language of Instruction: English

Forms of Assessment: Ongoing Assessment and Interim Assessment

1. General Provisions

The Fund of Assessment Tools (FAT) is designed to evaluate students' knowledge, skills and practical competencies acquired during the study of Pharmacology.

The main objectives are to assess students' ability to understand drug mechanisms of action, explain pharmacological effects, analyze drug interactions, identify adverse drug reactions, calculate doses, write prescriptions and apply principles of rational pharmacotherapy.

2. Expected Learning Outcomes

Knowledge	**Skills**	**Practical competencies**
Principles of pharmacokinetics and pharmacodynamics	Explain mechanisms of drug action	Pharmacological analysis of medicines
Drug classifications and pharmacological effects	Compare drugs within therapeutic groups	Identification of drug interactions
Indications, contraindications and adverse reactions	Calculate drug doses	Prescription writing
Mechanisms of drug interactions	Identify potential adverse reactions	Analysis of pharmacological case scenarios
Principles of rational pharmacotherapy	Use official prescribing information	Evaluation of pharmacological safety

3. Structure of Assessment Tools

Assessment tool	**Recommended number**	**Assessment stage**
Review questions	70	Ongoing assessment
Multiple-choice questions (MCQs)	100	Ongoing/interim
Situational pharmacological tasks	20	Ongoing/interim
Drug dosage calculation tasks	15	Ongoing
Prescription-writing tasks	20	Ongoing/interim
Pharmacological drug analysis tasks	20	Ongoing
Examination questions	60	Interim

Examination tickets	20	Interim

The numbers above define the proposed complete FAT structure. The following sections contain the core assessment materials and representative tasks; the full question bank can be оформлен as separate appendices.

4. Review Questions for Ongoing Assessment

Section I. General Pharmacology

1. Definition, objectives and branches of pharmacology.
2. Main routes of drug administration.
3. Mechanisms of drug absorption.
4. Drug distribution and plasma protein binding.
5. Drug metabolism: Phase I and Phase II reactions.
6. Renal and non-renal drug excretion.
7. Bioavailability and bioequivalence.
8. Volume of distribution and clearance.
9. Elimination half-life and steady-state concentration.
10. Drug receptors and mechanisms of action.
11. Agonists, partial agonists and antagonists.
12. Dose-response relationships and therapeutic index.
13. Drug tolerance, tachyphylaxis and dependence.
14. Adverse drug reactions and their classification.
15. Pharmacokinetic and pharmacodynamic drug interactions.

Section II. Drugs Acting on the Peripheral Nervous System

16. Cholinergic neurotransmission.
17. Muscarinic receptor agonists and antagonists.
18. Acetylcholinesterase inhibitors.
19. Adrenergic receptors and their functions.
20. Alpha- and beta-adrenoceptor agonists.
21. Alpha- and beta-adrenoceptor antagonists.
22. Local anesthetics: classification and mechanisms.
23. Factors affecting the action of local anesthetics.

Section III. Drugs Acting on the Central Nervous System

24. General anesthetics.
25. Sedative and hypnotic drugs.
26. Benzodiazepines and their pharmacological effects.
27. Antiepileptic drugs.
28. Opioid analgesics.
29. Non-opioid analgesics.
30. Antipsychotic drugs.
31. Antidepressants.
32. Drugs used in Parkinson's disease.

Section IV. Cardiovascular and Renal Pharmacology

33. Antihypertensive drug classification.

34. ACE inhibitors and angiotensin receptor blockers.
35. Beta-blockers and calcium channel blockers.
36. Diuretics: classification and mechanisms.
37. Drugs used in heart failure.
38. Antiarrhythmic drugs.
39. Antianginal drugs.
40. Anticoagulants and antiplatelet agents.
41. Lipid-lowering drugs.

Section V. Anti-inflammatory and Endocrine Pharmacology

42. Nonsteroidal anti-inflammatory drugs.
43. Glucocorticoids.
44. Antihistamines.
45. Insulin preparations.
46. Oral glucose-lowering drugs.
47. Thyroid hormones and antithyroid drugs.
48. Drugs affecting bone metabolism.

Section VI. Antimicrobial Chemotherapy

49. General principles of antimicrobial chemotherapy.
50. Beta-lactam antibiotics.
51. Macrolides.
52. Aminoglycosides.
53. Tetracyclines.
54. Fluoroquinolones.
55. Glycopeptide antibiotics.
56. Antituberculosis drugs.
57. Antifungal drugs.
58. Antiviral drugs.
59. Antimicrobial resistance.
60. Principles of antimicrobial stewardship.

Section VII. Clinical Applications and Drug Safety

61. Principles of rational prescribing.
62. Polypharmacy and potentially inappropriate medication use.
63. Drug use in children.
64. Drug use during pregnancy and lactation.
65. Drug use in older adults.
66. Dose adjustment in renal impairment.
67. Dose adjustment in hepatic impairment.
68. Pharmacovigilance and adverse drug reaction reporting.
69. Drug interactions in patients with multimorbidity.
70. Deprescribing: pharmacological principles and safety considerations.

5. Multiple-Choice Questions (MCQs)

Choose one correct answer.

Sample MCQ assessment — 10 questions

Single best answer

1. Which pharmacokinetic parameter describes the fraction of an administered dose reaching systemic circulation unchanged?

A. Clearance
B. Bioavailability
C. Volume of distribution
D. Half-life

2. Which receptor is primarily responsible for the bronchodilator effect of salbutamol?

A. Alpha-1
B. Beta-1
C. Beta-2
D. Muscarinic M2

3. Which drug class inhibits angiotensin-converting enzyme?

A. Beta-blockers
B. ACE inhibitors
C. Calcium channel blockers
D. Thiazide diuretics

4. Which enzyme is primarily inhibited by aspirin?

A. Acetylcholinesterase
B. Cyclooxygenase
C. Monoamine oxidase
D. Xanthine oxidase

5. Which antibiotic class inhibits bacterial cell wall synthesis?

A. Macrolides
B. Tetracyclines
C. Beta-lactams
D. Aminoglycosides

6. Which laboratory parameter is routinely used to monitor warfarin therapy?

A. Blood glucose
B. INR
C. Serum sodium
D. Hemoglobin A1c

7. Which drug is a loop diuretic?

A. Hydrochlorothiazide
B. Spironolactone
C. Furosemide
D. Amiloride

8. Which receptor is blocked by atropine?

A. Nicotinic receptor
B. Muscarinic receptor
C. Beta-1 receptor
D. Dopamine D2 receptor

9. Which adverse effect is particularly associated with aminoglycosides?

A. Ototoxicity
B. Gingival hyperplasia
C. Dry cough
D. Hypoglycemia

10. Which drug reverses opioid-induced respiratory depression?

A. Flumazenil
B. Naloxone
C. Atropine
D. Protamine
Check answersReset

6. Situational Pharmacological Tasks

Case 1. NSAIDs and Anticoagulants

A 68-year-old patient with atrial fibrillation is receiving warfarin. The patient develops joint pain and asks whether ibuprofen can be taken regularly.

Questions:

1. Explain the pharmacological interaction between warfarin and ibuprofen.
2. Identify the potential adverse effects.
3. Suggest safer pharmacological considerations for pain management.

Expected answer: Increased bleeding risk due to the anticoagulant effect of warfarin and the effects of ibuprofen on gastrointestinal mucosa and platelet function. Alternative analgesia requires individual assessment, and INR monitoring remains important. Warfarin should not be discontinued without medical supervision.

Case 2. ACE Inhibitor–Induced Cough

A patient receiving enalapril develops a persistent dry cough.

Questions:

1. Explain the mechanism of this adverse reaction.
2. Identify the pharmacological class of enalapril.
3. Which alternative drug class may be considered?

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

Case 3. Aminoglycoside Toxicity

A patient receiving gentamicin develops impaired hearing and increased serum creatinine.

Questions:

1. Identify the suspected adverse drug reactions.
2. Explain their pharmacological basis.
3. Describe appropriate safety monitoring.

Expected answer: Possible ototoxicity and nephrotoxicity. Renal function, drug exposure and auditory/vestibular symptoms should be assessed; drug-level monitoring is used when indicated.

Case 4. Beta-Blockers and Bronchial Asthma

A patient with bronchial asthma receives propranolol and subsequently develops bronchospasm.

Questions:

1. Explain the mechanism of bronchospasm.
2. Compare nonselective and cardioselective beta-blockers.
3. Identify the pharmacological precautions.

Expected answer: Propranolol blocks beta-2 adrenergic receptors, potentially causing bronchoconstriction. Beta-1-selective agents have less beta-2 blockade but still require careful individual risk assessment.

Case 5. Hypoglycemia During Insulin Therapy

A patient receiving insulin develops sweating, tremor, palpitations and confusion.

Questions:

1. Identify the likely adverse effect.
2. Explain the pharmacological mechanism.
3. Identify the main principles of prevention and immediate management.

Expected answer: Suspected hypoglycemia caused by insulin-mediated glucose lowering. Confirm glucose promptly when feasible and treat according to consciousness, swallowing ability and established hypoglycemia protocols.

7. Drug Dosage Calculation Tasks

All values in these tasks are illustrative educational data, not universal clinical prescribing recommendations.

No.	Task
1	Calculate the volume required for a 250 mg dose from a solution containing 100 mg/mL.
2	Calculate a 12 mg/kg dose for a patient weighing 25 kg.
3	A tablet contains 500 mg. How many tablets provide 1 g?

4	Calculate the infusion rate for 500 mL over 4 hours in mL/hour.
5	Convert 0.75 g into milligrams.
6	Calculate the volume containing 40 mg from a 2% w/v solution.
7	Calculate the total daily dose for 250 mg administered three times daily.
8	A vial contains 1 g in 10 mL after reconstitution. Calculate the volume for 400 mg.
9	Calculate a 5 mg/kg educational dose for a 60 kg patient.
10	Convert 125 micrograms into milligrams.

For final assessment, each calculation task should have a model answer, units, scoring rubric and a safety check where applicable.

8. Prescription-Writing Tasks

Write educational prescriptions using appropriate dosage forms, strengths and standard prescription conventions for the following medicines:

1. Paracetamol tablets.
2. Ibuprofen tablets.
3. Amoxicillin capsules.
4. Omeprazole capsules.
5. Salbutamol metered-dose inhaler.
6. Enalapril tablets.
7. Amlodipine tablets.
8. Metformin tablets.
9. Furosemide tablets.
10. Loratadine tablets.
11. Prednisolone tablets.
12. Doxycycline capsules.
13. Fluconazole capsules.
14. Atorvastatin tablets.
15. Nitroglycerin sublingual tablets.
16. Metoprolol tablets.
17. Spironolactone tablets.
18. Ceftriaxone powder for injection.
19. Lidocaine solution for injection.
20. Insulin preparation.

For each prescription, students must identify the drug's pharmacological group, mechanism of action, major indications, contraindications and clinically important adverse reactions.

9. Examination Questions for Interim Assessment

The final examination should include questions covering all major pharmacological systems, with particular emphasis on mechanisms of action, comparison of pharmacological groups and drug safety.

Suggested examination domains:

Domain	**Number of questions**

General pharmacology	10
Autonomic nervous system and local anesthetics	8
Central nervous system	8
Cardiovascular and renal pharmacology	10
Endocrine and anti-inflammatory pharmacology	8
Antimicrobial chemotherapy	10
Rational drug use and pharmacovigilance	6
Total	60

10. Sample Examination Tickets

Examination Ticket No. 1

1. Pharmacokinetics: absorption, distribution, metabolism and excretion.
2. Beta-adrenergic blockers: classification, mechanisms and adverse reactions.
3. Practical task: calculate a drug dose based on body weight.

Examination Ticket No. 2

1. Drug receptors: agonists and antagonists.
2. Beta-lactam antibiotics: mechanisms, classification and resistance.
3. Practical task: analyze an antibiotic-related adverse reaction.

Examination Ticket No. 3

1. Drug bioavailability and elimination half-life.
2. NSAIDs: classification, mechanisms and safety.
3. Practical task: identify a clinically significant drug interaction.

11. Assessment Criteria

Score	**Grade**	**Assessment criteria**
90–100	Excellent	Comprehensive knowledge; accurate explanation of mechanisms; correct application of pharmacological principles; no significant errors
75–89	Good	Good knowledge and understanding; minor inaccuracies
60–74	Satisfactory	Basic knowledge; partial understanding; some errors in application
Below 60	Unsatisfactory	Insufficient knowledge; major errors in mechanisms, calculations or drug safety

The proposed grading thresholds should be aligned with the university's approved assessment regulations.

12. Matrix of Assessment Tools and Learning Outcomes

Assessment tool	**Knowledge**	**Skills**	**Practical competencies**
Review questions	✓		
MCQs	✓	✓	

Situational tasks	✓	✓	✓
Calculation tasks	✓	✓	✓
Prescription-writing tasks	✓	✓	✓
Drug analysis tasks	✓	✓	✓
Final examination	✓	✓	✓

13. Methodological Recommendations for Examiners

Assessment should focus on the student's understanding of pharmacological mechanisms rather than memorization of isolated drug names.

Special attention should be paid to drug safety, recognition of adverse drug reactions, clinically important drug interactions, appropriate use of antimicrobial medicines, dose calculation and rational prescribing.

The examiner should evaluate the student's ability to explain the pharmacological basis of a decision and identify potential risks. A serious error involving unsafe dose calculations or failure to recognize a major contraindication should be considered separately under the approved assessment rubric.

APPENDIX 1. PHARMACOLOGICAL DRUG STUDY TEMPLATE

1. Purpose

This template is designed to help students systematically study medicinal products, understand their pharmacological properties, mechanisms of action, therapeutic effects, indications, contraindications and adverse reactions.

Students should use this template when studying individual drugs and pharmacological groups during practical classes and independent work.

2. Pharmacological Drug Study Form

1. General information

- International Nonproprietary Name (INN):
- Brand name(s):
- Pharmacological group:
- Chemical class (if applicable):
- Dosage forms:
- Routes of administration:

2. Mechanism of action

- Main molecular or cellular target:
- Mechanism of pharmacological action:
- Effects on organs and systems:
- Relationship between mechanism of action and therapeutic effect:

3. Pharmacodynamics

- Main pharmacological effects:
- Therapeutic effects:
- Additional or secondary effects:
- Dose-response relationship:
- Selectivity of action:

4. Pharmacokinetics (ADME)

- Absorption:
- Bioavailability:
- Distribution:
- Plasma protein binding:
- Metabolism:
- Main metabolic pathways:
- Elimination:
- Half-life (T½):
- Factors affecting pharmacokinetics:

5. Indications

- Main clinical indications:

- Additional indications:
- Clinical situations in which the medicine may be preferred:

6. Contraindications and precautions

- Absolute contraindications:
- Relative contraindications:
- Precautions in patients with comorbidities:
- Use in pregnancy and lactation:
- Use in children and older adults:

7. Adverse drug reactions

- Common adverse reactions:
- Serious adverse reactions:
- Dose-dependent adverse reactions:
- Important organ-specific toxicities:
- Prevention and management of adverse reactions:

8. Drug interactions

- Pharmacodynamic interactions:
- Pharmacokinetic interactions:
- Clinically significant interactions:
- Medicines or substances that should be avoided or used with caution:

9. Dosage and administration

- Usual adult dose (according to approved prescribing information):
- Route of administration:
- Frequency of administration:
- Duration of treatment:
- Dose adjustment in renal impairment:
- Dose adjustment in hepatic impairment:
- Special dosing considerations:

10. Monitoring of treatment

- Parameters for assessing therapeutic efficacy:
- Clinical parameters to be monitored:
- Laboratory parameters:
- Signs of toxicity:
- Criteria for treatment modification or discontinuation:

11. Rational use of the medicine

- Evidence supporting its use:
- Place in current clinical guidelines:
- Important alternatives:
- Cost-effectiveness and availability considerations:
- Key principles of safe prescribing:

12. Student's conclusion

Summarize the main pharmacological characteristics of the medicine and explain the clinical rationale for its use.

3. Student Assessment Checklist

The student should demonstrate the ability to:

- Identify the pharmacological group and mechanism of action.
- Explain the relationship between pharmacodynamics and therapeutic effects.
- Describe the main pharmacokinetic characteristics.
- Identify indications and contraindications.
- Recognize clinically significant adverse reactions.
- Identify important drug interactions.
- Explain principles of dosage selection and adjustment.
- Determine parameters for monitoring efficacy and safety.
- Justify the rational use of the medicine.

APPENDIX 2. SELF-ASSESSMENT QUESTIONS AND PRACTICAL TASKS

1. Purpose

This appendix is intended for students' independent preparation, ongoing assessment and revision of the main topics of Pharmacology.

It includes review questions, multiple-choice questions and situational tasks covering general and special pharmacology.

2. Review Questions by Topic

Topic 1. General Pharmacology

1. Define pharmacology and describe its main branches.
2. What is pharmacokinetics?
3. What is pharmacodynamics?
4. Describe the main stages of ADME.
5. Explain the concept of bioavailability.
6. What is the volume of distribution?
7. Define plasma half-life.
8. What is drug clearance?
9. Explain the difference between agonists and antagonists.
10. What is the therapeutic index?
11. Describe the main routes of drug administration.
12. What factors influence drug absorption?
13. Explain first-pass metabolism.
14. What is drug tolerance?
15. What is drug dependence?

Topic 2. Drugs Affecting the Peripheral Nervous System

1. Describe the organization of the autonomic nervous system.
2. What are cholinergic receptors?
3. Classify cholinergic agonists.
4. Describe the pharmacological effects of anticholinesterase agents.
5. What are antimuscarinic drugs?
6. Describe the effects of alpha- and beta-adrenergic receptor stimulation.
7. Classify adrenergic agonists.
8. What are beta-adrenoceptor blockers?
9. Describe the therapeutic uses of alpha-adrenoceptor blockers.
10. Explain the pharmacological effects of neuromuscular blocking agents.

Topic 3. Drugs Affecting the Central Nervous System

1. Classify sedative and hypnotic drugs.
2. Describe the mechanism of action of benzodiazepines.
3. What are the main adverse effects of benzodiazepines?
4. Classify antiepileptic drugs.
5. Describe the mechanisms of action of major antiepileptic drug groups.
6. Classify antipsychotic drugs.
7. What are extrapyramidal adverse effects?

8. Describe the pharmacological effects of antidepressants.
9. Classify opioid analgesics.
10. Explain the mechanism of action of non-opioid analgesics.

Topic 4. Cardiovascular Drugs

1. Classify antihypertensive medicines.
2. Describe the mechanism of action of ACE inhibitors.
3. What are the indications and adverse effects of angiotensin II receptor blockers?
4. Classify calcium channel blockers.
5. Explain the mechanism of action of beta-blockers.
6. Classify antianginal drugs.
7. Describe the main groups of antiarrhythmic drugs.
8. Classify diuretics.
9. Explain the mechanism of action of loop diuretics.
10. Describe the pharmacological effects of statins.
11. What are the main adverse effects of anticoagulants?
12. Compare antiplatelet agents and anticoagulants.

Topic 5. Drugs Affecting the Respiratory and Digestive Systems

1. Classify bronchodilators.
2. Describe the mechanism of action of beta-2 agonists.
3. What is the role of inhaled corticosteroids in asthma?
4. Classify antitussive and mucolytic agents.
5. Classify proton pump inhibitors.
6. Describe the mechanism of action of H2-receptor blockers.
7. What are prokinetic agents?
8. Classify antiemetic drugs.
9. Describe the pharmacological effects of laxatives.
10. What are the main groups of antidiarrheal drugs?

Topic 6. Endocrine Pharmacology

1. Classify insulin preparations.
2. Describe the mechanism of action of insulin.
3. Classify oral glucose-lowering medicines.
4. Explain the mechanism of action of metformin.
5. Describe the pharmacological effects of SGLT2 inhibitors.
6. What are the main adverse effects of sulfonylureas?
7. Classify thyroid hormone preparations and antithyroid drugs.
8. Describe the pharmacological effects of glucocorticosteroids.
9. What are the risks of long-term glucocorticosteroid therapy?
10. Describe the pharmacological effects of sex hormones.

Topic 7. Antimicrobial Pharmacology

1. Classify antibacterial medicines.
2. Describe the mechanisms of action of beta-lactam antibiotics.
3. Compare penicillins and cephalosporins.
4. What are the mechanisms of bacterial resistance?
5. Describe the pharmacological effects of macrolides.

6. What are the main adverse effects of aminoglycosides?
7. Classify fluoroquinolones.
8. What is antimicrobial stewardship?
9. Explain the importance of rational antibiotic selection.
10. What factors determine the duration of antimicrobial therapy?

3. Multiple-Choice Questions

Choose ONE correct answer.

1. Bioavailability refers to:

A. The degree of plasma protein binding
B. The fraction of an administered dose reaching systemic circulation unchanged
C. The rate of renal elimination
D. The duration of drug action

2. Which route of administration avoids gastrointestinal absorption?

A. Oral
B. Sublingual
C. Intravenous
D. Rectal

3. Which receptor is primarily stimulated by salbutamol?

A. Alpha-1 adrenergic receptor
B. Beta-1 adrenergic receptor
C. Beta-2 adrenergic receptor
D. Muscarinic receptor

4. Which medicine is an ACE inhibitor?

A. Enalapril
B. Amlodipine
C. Losartan
D. Bisoprolol

5. Which adverse effect is characteristic of loop diuretics?

A. Hyperkalemia
B. Hypokalemia
C. Hyperglycemia in all patients
D. Severe bradycardia

6. Which drug group inhibits platelet aggregation?

A. Proton pump inhibitors
B. Antiplatelet agents
C. Loop diuretics
D. Antihistamines

7. Which medicine is a proton pump inhibitor?

A. Omeprazole
B. Metoclopramide
C. Famotidine
D. Ondansetron

8. Which adverse reaction is associated with aminoglycosides?

A. Nephrotoxicity
B. Severe hypoglycemia
C. Hyperthyroidism
D. Constipation in all patients

9. Metformin primarily reduces:

A. Hepatic glucose production
B. Insulin secretion
C. Intestinal protein absorption
D. Renal potassium excretion

10. Which medicine is used to reverse the effects of unfractionated heparin?

A. Vitamin K
B. Protamine sulfate
C. Naloxone
D. Atropine

11. Which group of drugs is associated with an increased risk of gastrointestinal bleeding?

A. NSAIDs
B. Antacids
C. Antihistamines
D. Bronchodilators

12. Which parameter is particularly important when monitoring aminoglycoside treatment?

A. Renal function
B. Visual acuity only
C. Thyroid function only
D. Serum calcium only

13. Which medicine is a selective serotonin reuptake inhibitor (SSRI)?

A. Fluoxetine
B. Diazepam
C. Haloperidol
D. Carbamazepine

14. Which drug is an opioid receptor antagonist?

A. Morphine
B. Naloxone
C. Tramadol
D. Fentanyl

15. Which of the following is a major principle of rational pharmacotherapy?

A. Prescribing the maximum number of medicines
B. Selecting treatment based on clinical evidence and patient characteristics
C. Using antibiotics for all febrile conditions
D. Avoiding treatment monitoring

4. Answer Key

Question	Correct answer
1	B
2	C
3	C
4	A
5	B
6	B
7	A
8	A
9	A
10	B
11	A
12	A
13	A
14	B
15	B

5. Situational Clinical Tasks

Case 1. Adverse Effects of Antihypertensive Therapy

A 58-year-old patient develops a persistent dry cough after starting enalapril.

Questions:

1. Which pharmacological group does enalapril belong to?
2. Explain the mechanism responsible for the cough.
3. Which alternative pharmacological group may be considered?
4. What parameters should be monitored after changing treatment?

Expected answer: Enalapril is an ACE inhibitor. ACE inhibition reduces bradykinin degradation, which may contribute to a persistent dry cough. An angiotensin II receptor blocker may be considered when clinically appropriate. Blood pressure, renal function and serum potassium should be monitored.

Case 2. Hypoglycemia

A patient with diabetes mellitus develops sweating, tremor, palpitations and confusion after taking insulin without eating.

Questions:

1. What is the most likely adverse reaction?
2. Explain the mechanism.
3. What immediate measures are required?
4. How can similar episodes be prevented?

Expected answer: Insulin-induced hypoglycemia. Insulin increases glucose uptake and reduces blood glucose concentration. Immediate treatment depends on consciousness and ability to swallow; oral fast-acting glucose is appropriate for an alert patient, whereas severe hypoglycemia requires emergency treatment according to protocol. Review insulin timing, dose, meals and glucose monitoring.

Case 3. Antibiotic-Associated Diarrhea

A patient develops diarrhea during a course of broad-spectrum antibiotics.

Questions:

1. What may be the pharmacological cause?
2. Which serious complication should be considered?
3. What clinical information should be assessed?
4. What principles should guide further antibiotic use?

Expected answer: Antibiotic-associated diarrhea due to disruption of normal intestinal microbiota is possible. Clostridioides difficile infection should be considered, especially in significant or persistent diarrhea. Assess severity, hydration, recent antibiotic exposure and other risk factors. Reassess the indication for antibiotics and follow appropriate diagnostic and treatment guidance.

Case 4. NSAID Use

A 65-year-old patient with hypertension and a history of peptic ulcer disease takes ibuprofen for joint pain.

Questions:

1. What pharmacological group does ibuprofen belong to?
2. Explain its mechanism of action.
3. Identify major risks in this patient.
4. What safer prescribing principles should be considered?

Expected answer: Ibuprofen is a non-steroidal anti-inflammatory drug (NSAID) that inhibits cyclooxygenase and reduces prostaglandin synthesis. Potential risks include gastrointestinal bleeding, renal impairment, fluid retention and worsening blood pressure control. Assess the need for an NSAID, contraindications, alternatives and gastroprotection where appropriate.

Case 5. Bronchial Asthma

A patient uses salbutamol frequently to relieve asthma symptoms.

Questions:

1. Which receptor does salbutamol stimulate?
2. What is its principal pharmacological effect?
3. What does frequent use of a reliever inhaler indicate?
4. What should be reviewed in the patient's treatment plan?

Expected answer: Salbutamol is a short-acting beta-2 agonist that produces bronchodilation. Frequent use may indicate inadequate asthma control. Assess symptoms, inhaler technique, adherence, exacerbation risk and the need for an inhaled corticosteroid-containing treatment regimen in accordance with current asthma guidelines.

6. Practical Assessment Tasks

1. Classify the main groups of antihypertensive drugs and provide examples.
2. Explain the mechanism of action of beta-blockers.
3. Compare loop and thiazide diuretics.
4. Describe the pharmacological effects of glucocorticosteroids.
5. Explain the mechanism of action of insulin.
6. Compare oral and parenteral routes of drug administration.
7. Identify the main adverse effects of NSAIDs.
8. Explain the principles of rational antibiotic therapy.
9. Prepare a pharmacological profile of one assigned medicine using Appendix 1.
10. Write a prescription for a medicine using the correct Latin prescription format and an appropriate dosage form.

7. Criteria for Self-Assessment

- **Excellent:** demonstrates comprehensive knowledge, explains mechanisms of action, applies knowledge to clinical situations and identifies important safety issues.
- **Good:** demonstrates sound knowledge and can solve standard tasks with minor inaccuracies.
- **Satisfactory:** demonstrates basic knowledge but has difficulty applying it to clinical situations.
- **Unsatisfactory:** demonstrates insufficient knowledge and cannot correctly explain the main pharmacological principles or solve basic tasks.

APPENDIX 3. GUIDELINES FOR PRESCRIPTION WRITING AND DRUG DOSAGE CALCULATIONS

1. Purpose

This appendix provides students with basic principles of prescription writing, dosage form selection and drug dose calculations.

The aim is to develop practical skills necessary for safe and rational prescribing in clinical practice.

2. General Principles of Prescription Writing

A prescription is a formal instruction from an authorized healthcare professional to dispense and use a medicinal product.

A prescription should be:

- Legible and unambiguous.
- Complete and clinically justified.
- Written using the International Nonproprietary Name (INN), whenever applicable and consistent with local regulations.
- Consistent with approved prescribing information and current clinical guidelines.
- Appropriate for the patient's age, weight, diagnosis, renal and hepatic function, and other relevant characteristics.

3. Main Elements of a Prescription

A traditional prescription may contain the following elements:

1. **Inscriptio** – information about the healthcare institution or prescriber.
2. **Datum** – date of issue.
3. **Nomen aegroti** – patient's name.
4. **Aetas aegroti** – patient's age.
5. **Invocatio (Rp.)** – prescription instruction.
6. **Praescriptio** – name and quantity of the medicinal product.
7. **Subscriptio** – instructions to the pharmacist.
8. **Signatura (S.)** – instructions for the patient.
9. **Nomen medici** – prescriber's name and signature.

The exact format and legal requirements must follow the applicable national regulations and institutional procedures.

4. Common Dosage Forms

Dosage form	Latin term	Example
Tablet	Tabuletta	Tabulettae
Capsule	Capsula	Capsulae
Solution	Solutio	Solutionis
Suspension	Suspensio	Suspensionis
Ointment	Unguentum	Unguenti
Cream	Cremor	Cremoris

Suppository	Suppositorium	Suppositoria
Drops	Guttae	Guttarum
Powder	Pulvis	Pulveris

5. Examples of Prescription Writing

The following examples are educational exercises. They must not be interpreted as recommendations for individual patients.

Example 1. Tablets

Rp.: Tabulettas Paracetamoli 0.5 № 10

D.S. Take one tablet orally as directed.

Example 2. Capsules

Rp.: Capsulas Amoxicillini 0.5 № 20

D.S. Use according to the prescribed treatment regimen.

Example 3. Oral Solution

Rp.: Solutionis Paracetamoli 120 mg/5 ml — 100 ml

D.S. Administer orally according to the prescribed dose.

Example 4. Ointment

Rp.: Unguenti Hydrocortisoni 1% — 10.0

D.S. Apply externally as directed.

Note: Prescription format, Latin nomenclature, quantities and dispensing requirements should be adapted to the current regulations of the Kyrgyz Republic. These examples are intended for teaching prescription structure, not for actual dispensing.

6. General Rules for Drug Dosage Calculations

Students should be able to calculate:

- A single dose.
- A daily dose.
- The total amount of medicine required for a course of treatment.
- The volume of liquid medicine corresponding to a prescribed dose.
- Weight-based doses (mg/kg).
- Infusion rates.
- Dose adjustments where clinically indicated.

6.1. Calculation of the Daily Dose

Formula:

Daily dose = Single dose × Number of administrations per day

Example:

A medicine is prescribed at 250 mg three times daily.

Daily dose = 250 mg × 3 = 750 mg/day.

6.2. Calculation of the Total Course Dose

Formula:

Total course dose = Daily dose × Number of treatment days

Example:

A medicine is prescribed at 500 mg twice daily for 5 days.

Daily dose = 500 × 2 = 1,000 mg/day.

Total course dose = 1,000 × 5 = 5,000 mg.

6.3. Weight-Based Dose Calculation

Formula:

Prescribed dose = Recommended dose (mg/kg) × Body weight (kg)

Example:

A hypothetical medicine has a recommended educational dose of 10 mg/kg for a patient weighing 20 kg.

Dose = 10 × 20 = 200 mg.

The actual dose must be checked against the medicine's maximum recommended dose, age-specific guidance, indication and patient-specific factors.

6.4. Calculation of Liquid Medicine Volume

Formula:

Volume (ml) = Required dose (mg) ÷ Concentration (mg/ml)

Example:

Required dose: 150 mg.
Medicine concentration: 50 mg/ml.

Volume = 150 ÷ 50 = 3 ml.

6.5. Calculation of Infusion Rate

Formula:

Infusion rate (ml/hour) = Total volume (ml) ÷ Infusion time (hours)

Example:

A solution of 500 ml is administered over 4 hours.

Infusion rate = 500 ÷ 4 = 125 ml/hour.

For gravity infusion, the drop rate is calculated using the specific infusion set's drop factor:

Drops/minute = Volume (ml) × Drop factor (drops/ml) ÷ Time (minutes).

7. Special Considerations in Dosage Selection

7.1. Pediatric Patients

- Calculate doses according to the child's body weight or body surface area when required.
- Check the maximum single and daily doses.
- Consider age-related differences in absorption, distribution, metabolism and elimination.
- Use age-appropriate dosage forms.
- Verify the concentration of liquid preparations carefully.

7.2. Older Adults

- Consider age-related changes in renal and hepatic function.
- Assess polypharmacy and potential drug interactions.
- Start with an appropriate dose and titrate according to clinical response where indicated.
- Monitor adverse reactions and treatment effectiveness.

7.3. Renal Impairment

- Assess renal function using an appropriate method for the medicine and clinical situation.
- Identify medicines requiring dose or interval adjustment.
- Consider accumulation and toxicity.
- Follow the approved prescribing information and relevant clinical guidelines.

7.4. Hepatic Impairment

- Consider the role of hepatic metabolism in drug elimination.
- Assess the risk of accumulation and toxicity.
- Review medicines with significant hepatic metabolism or hepatotoxic potential.
- Use specific dose-adjustment recommendations where available.

8. Practical Tasks for Students

Task 1. Daily Dose

A medicine is prescribed at 100 mg three times daily. Calculate the total daily dose.

Answer: 300 mg/day.

Task 2. Course Dose

A medicine is prescribed at 250 mg twice daily for 7 days. Calculate the total amount required for the course.

Answer: 3,500 mg (3.5 g).

Task 3. Weight-Based Dose

A hypothetical medicine is prescribed at 5 mg/kg for a patient weighing 30 kg. Calculate the dose.

Answer: 150 mg.

Task 4. Liquid Preparation

The required dose is 200 mg. The solution contains 100 mg in 5 ml. Calculate the volume.

Answer: 10 ml.

Task 5. Infusion Rate

A 1,000 ml infusion is administered over 8 hours. Calculate the infusion rate.

Answer: 125 ml/hour.

Task 6. Number of Tablets

A patient is prescribed 500 mg of a medicine. Each tablet contains 250 mg. How many tablets correspond to one dose?

Answer: 2 tablets.

Task 7. Total Daily Dose

A medicine is prescribed at 75 mg four times daily. Calculate the daily dose.

Answer: 300 mg/day.

Task 8. Infusion Drop Rate

A 500 ml infusion is administered over 5 hours using an infusion set with a drop factor of 20 drops/ml. Calculate the approximate drop rate.

Answer: 33 drops/minute (rounded).

9. Practical Skills Checklist

The student should be able to:

1. Identify the INN and dosage form.

2. Select an appropriate route of administration.
3. Write a prescription using the required format.
4. Indicate the dose, frequency and duration of administration.
5. Calculate single and daily doses.
6. Calculate total course quantities.
7. Calculate doses according to body weight.
8. Calculate the volume of liquid preparations.
9. Calculate infusion rates.
10. Identify situations requiring dose adjustment.
11. Recognize common prescribing and calculation errors.
12. Verify the safety and appropriateness of a prescribed regimen.

10. Common Errors in Prescription Writing and Dose Calculations

- Confusion between milligrams (mg), micrograms (mcg) and grams (g).
- Incorrect conversion between mg and ml.
- Failure to check the concentration of liquid preparations.
- Confusion between single and daily doses.
- Failure to calculate the total course quantity.
- Incorrect frequency or route of administration.
- Failure to consider maximum recommended doses.
- Failure to account for renal or hepatic impairment.
- Use of ambiguous abbreviations.
- Incomplete or unclear patient instructions.

11. Safety Requirements

All dosage calculations must be checked before a medicine is prescribed or administered. Students must verify the medicine, formulation, concentration, dose, route, frequency and duration.

For high-alert medicines, including insulin, anticoagulants, opioids and concentrated electrolytes, additional independent verification should be performed in accordance with institutional policy.

Important: Educational calculations do not replace clinical judgment. Actual prescribing must comply with current national regulations, approved prescribing information, clinical guidelines and patient-specific requirements.