

**MINISTRY OF HEALTH OF UKRAINE
ODESA NATIONAL MEDICAL UNIVERSITY**

Medical, International Faculty

**Department of General and Clinical Epidemiology and Biosafety
with course in Microbiology and Virology**

**Syllabus of course
“ANTIMICROBIAL RESISTANCE. THEORY AND METHODS”**

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| Volume: | Total number of hours: 90 hours, 3 credits Semester: V - VI 3 rd course |
| Days, Time, Place: | According to the Schedule Department of General and Clinical Epidemiology and Biosafety with course in Microbiology and Virology, academic discipline “Microbiology, Virology and Immunology”. Odesa, 1 Knyazivska str., rooms 1-6 |
| Teacher(s) | Hruzesvkiy O.A., MD, Doctor of Science, full professor; Associate professors: Holovatiuk O.L., MD, PhD, Koltsova I.G., MD, PhD, Kurtova M.M., MD, PhD, Shevchuk H.Y., PhD; Assistant professors: Denysko T.V., Dubina A.V, MD, Kahliak M.D., Tabulina A.M., Tarasov Y.V., MD |
| Contact information | <i>Phone:</i> Shevchuk Hanna, Head of studies 093-419-96-77 Dubina Anzhela, responsible for the organizational and educational work of the department 067-428-63-43 Cheban Maya, laboratory assistant 048-753-09-81 <i>E-mail:</i> onmedumicrobio@onmedu.edu.ua ; Offline consultations: Thursday – 14.00 - 16.00; Saturday – 9.00 - 13.00; Online consultations: Thursday – 14.00 - 16.00; Saturday – 9.00 - 13.00; The link to the online consultation is provided to each group during the classes separately. |

COMMUNICATION

Communication with students will be carried out in the classroom (in person).

During distance learning, communication is carried out through the Microsoft Teams platform, Moodle, as well as through e-mail correspondence, Viber and Telegram messengers (through groups created in Telegram for each group, separately through the group head).

ANNOTATION OF THE COURSE

The subject of study of the discipline is theoretical issues of antibiotic resistance development in microorganisms, phenotypic and genotypic methods for determining the susceptibility of microbial cultures to antimicrobial drugs, basic principles of clinical use of antibiotics to avoid the development of resistance and its spread in the microbial population.

Prerequisites and post-requisites of the discipline (place of the discipline in the educational program):

Prerequisites: Latin, medical biology, medical and biological physics, biological and bioorganic chemistry, human anatomy, histology, cytology and embryology, physiology.

Post-requisites: Hygiene, epidemiology with a course of evidence-based medicine, pathophysiology, pathomorphology, clinical immunology and allergology, infectious diseases with children's infectious diseases, internal medicine, general surgery and other clinical disciplines.

The purpose is: to master the knowledge and skills on the development of antibiotic resistance in microorganisms, phenotypic and genotypic methods of measuring the susceptibility of microorganisms to antimicrobial drugs.

The tasks of the discipline:

1. To give an idea of the most important groups of antimicrobial drugs and their mechanisms of action
2. To understand the basic concepts of antimicrobial resistance development from several perspectives (clinical, research and microbiological), including the concepts of transmission, selection and spread of antimicrobial resistance, as well as the mechanisms that may be involved in this process.
3. To provide detailed theoretical knowledge of how to perform basic methods for determining the susceptibility of microorganisms to antibiotics in the laboratory and to conduct practical implementation of basic techniques.
4. To provide basic concepts on the analysis and interpretation of results, as well as the importance of knowledge and skills related to quality assurance and standardization of antibiotic susceptibility testing methods.
5. To introduce the concept of "hospital acquired strains" of microorganisms and discuss the basic principles of antibiotic administration to avoid the spread of antibiotic resistant microorganisms.

Expected result:

As a result of studying the discipline, the student has to:

Know:

- the most important groups of antimicrobial drugs and their mechanisms of action;
- basic concepts of antimicrobial resistance development;
- methods used for testing for antimicrobial susceptibility and the theoretical basis of the following techniques: disc diffusion method, method of serial dilutions in liquid and dense culture media;
- the concept of applying genomic analysis tools used to identify resistance genes and other relevant genes from whole-genome sequencing data;
- approaches to quality control in measuring the susceptibility of microorganisms to antimicrobial agents;
- basic concepts of analysis and interpretation of the results of determining the susceptibility of microorganisms to antimicrobial agents;
- basic principles of administration of antibiotics in order to avoid the spread of antibiotic-resistant microorganisms.

Be able:

- to determine the susceptibility to antimicrobial agents by the disc diffusion method;
- to determine the susceptibility to antimicrobial agents by the method of serial dilutions in liquid culture medium;
- to determine the susceptibility to antimicrobial agents by the method of serial dilutions in agar;
- to interpret the results of genomic analysis in practice;
- to analyze errors in the above methods and obtained incorrect results.

DESCRIPTION OF THE COURSE

Forms and methods of teaching

The course will be presented in the form of practical lessons (30 hours), organization of independent work of students (60 hours).

Teaching methods: conversation, explanation, discussion, discussion of the acute issues; visual methods: illustration (including multimedia presentations); testing.

The content of the discipline

Theme 1: Brief history of antibiotics and some achievements in their synthesis.

Theme 2. Molecular mechanisms of action of antibiotics and chemotherapeutic agents.

Theme 3. Resistance to antimicrobial agents. Mechanisms of resistance and its spread.

Theme 4. Epidemiology of antimicrobial resistance.

Theme 5. Bacterial biofilms as a factor of phenotypic resistance.

Theme 6. Disinfectants and antiseptics. Mechanisms of action and resistance.

Theme 7. Analysis of 10 principles of rational antibiotic therapy.

Theme 8: Strategies for overcoming antibiotic resistance.

Theme 9: The concept of phenotypic and genotypic methods for determining the sensitivity of microorganisms to antibiotics. The method of paper disks on agar (Kirby-Bauer method), theoretical and practical aspects, advantages and disadvantages.

Theme 10. Method of serial dilutions in liquid culture medium and agar, theoretical and practical aspects, advantages and disadvantages.

Theme 11. Genotypic methods for determining resistance. The concept of ResFinder.

Theme 12: Standardization and quality control of antimicrobial susceptibility testing. Standards of the European Committee on Antimicrobial Susceptibility Testing (EUCAST).

Theme 13. Hospital strains of microorganisms, the problem of multidrug-resistant strains. ESKAPE group (*Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa* and *Enterobacter spp.*)

Theme 14: Interpretation of the results of phenotypic and genotypic studies in practice, analysis of errors in the above methods and obtained incorrect results.

Theme 15: New antibiotics and alternatives to antibiotics.

List of recommended literature:

Main:

1. Abbas, A., Litchman, A. H. & Pillai, S. Basic Immunology - 6th Edition. (Elsevier Ltd, 2019).
2. Anantharyan R. Jayaram Paniker C. K. Textbook of Microbiology. 12-th Edition.- Orient Longman, 2022.
3. Male, D., Peebles, S. & Male, V. Immunology. (2020).

Additional:

1. Larsson, D.G.J., Flach, CF. Antibiotic resistance in the environment. Nat Rev Microbiol 20, 257–269 (2022). <https://doi.org/10.1038/s41579-021-00649-x>
2. Smith WPJ, Wucher BR, Nadell CD, Foster KR. Bacterial defences: mechanisms, evolution and antimicrobial resistance. Nat Rev Microbiol. 2023 Aug;21(8):519-534. doi: 10.1038/s41579-023-00877-3. Epub 2023 Apr 24. PMID: 37095190.
3. Christaki E, Marcou M, Tofarides A. Antimicrobial Resistance in Bacteria: Mechanisms, Evolution, and Persistence. J Mol Evol. 2020 Jan;88(1):26-40. doi: 10.1007/s00239-019-09914-3. Epub 2019 Oct 28. PMID: 31659373.
4. Reygaert WC. An overview of the antimicrobial resistance mechanisms of bacteria. AIMS Microbiol. 2018 Jun 26;4(3):482-501. doi: 10.3934/microbiol.2018.3.482. PMID: 31294229; PMCID: PMC6604941.

5. Giske CG, Turnidge J, Cantón R, Kahlmeter G; EUCAST Steering Committee. Update from the European Committee on Antimicrobial Susceptibility Testing (EUCAST). *J Clin Microbiol.* 2022 Mar 16;60(3):e0027621. doi: 10.1128/JCM.00276-21. Epub 2021 Aug 4. PMID: 34346716; PMCID: PMC8925892.
6. European Committee on Antimicrobial Susceptibility Testing. EUCAST general website. www.eucast.org.
7. Friedman ND, Temkin E, Carmeli Y. The negative impact of antibiotic resistance. *Clin Microbiol Infect.* 2016 May;22(5):416-22. doi: 10.1016/j.cmi.2015.12.002. Epub 2015 Dec 17. PMID: 26706614.
8. Simonson W. Antibiotic stewardship: Revisiting quinolone antibiotics. *Geriatr Nurs.* 2017 Mar-Apr;38(2):152-153. doi: 10.1016/j.gerinurse.2017.03.008. Epub 2017 Mar 23. PMID: 28342653.
9. Moore M. Antibiotic stewardship: where next? *Br J Gen Pract.* 2023 Feb 23;73(728):100-101. doi: 10.3399/bjgp23X732033. PMID: 36823054; PMCID: PMC9976821.

CRITERIA EVALUATION

Ongoing control: individual survey on the theme, testing, evaluation of practical skills, solving situational problems, the ability to analyze and interpret research results and correctly draw reasonable conclusions, evaluation of activity in the classroom.

Criteria of ongoing assessment at the practical class

| Score | Assessment criterion |
|-----------------------|--|
| Excellent «5» | The student takes an active part in practical classes, demonstrates deep knowledge, gives complete and detailed answers to questions. Takes an active part in discussing problem situations, demonstrates good skills and abilities in performing practical tasks, correctly evaluates the results. Test tasks are completed in full. |
| Good «4» | The student participates in practical classes; has a good command of the material. Demonstrates the necessary knowledge, but answers questions with some mistakes; participates in the discussion of problem situations. Test tasks are completed in full, at least 70% of answers to questions are correct. |
| Satisfactory «3» | The student sometimes participates in practical classes; partially speaks and asks questions; makes mistakes when answering questions; shows passive work in practical classes. Demonstrates skills and abilities in performing practical tasks, but evaluates the results obtained insufficiently fully and accurately. Testing is completed in full, at least 50% of answers are correct, answers to open questions are not logical, with obvious significant errors in definitions. |
| Unsatisfactory «2» | The student does not participate in the practical lesson, is only an observer; never speaks and does not ask questions, is not interested in learning the material; gives incorrect answers to questions, demonstrates insufficient skills and abilities, cannot cope with practical work and evaluation of the results. Testing is not completed. |

Final control: Credit is given to an applicant who has completed all the tasks of the work program of the discipline, actively participated in seminars and has an average current grade of at least 3.0 and has no academic debt.

Possibility and conditions for receiving additional (bonus) points: not provided.

INDEPENDENT WORK OF STUDENTS

Independent work involves preparation for each seminar, independent study of a certain list of topics or topics that require in-depth study. Questions on topics assigned for independent study are included in the control measures.

COURSE POLICY

Policy on deadlines and retakes:

- Unexcused absences will be made up as scheduled by the teachers on duty.
- Excused absences are made up on an individual schedule with the permission of the dean.

Policy on academic integrity:

It is obligatory to observe academic integrity by students, namely independent performance of all types of work, tasks, forms of control provided by the work program of this discipline:

- references to sources of information in case of using ideas, developments, statements, information;
- compliance with copyright and related rights legislation;
- providing reliable information about the results of their own educational (scientific) activities, used research methods and sources of information.

Unacceptable in educational activities for participants in the educational process are:

- the use of family or official ties to obtain a positive or higher grade during any form of control of learning outcomes or advantages in scientific work;
- use of prohibited auxiliary materials or technical means (cribs, notes, micro-headphones, phones, smartphones, tablets, etc.) during control assessments;
- passing the procedures for controlling the results of training by fictitious persons.

For violation of academic integrity, students may be brought to such academic responsibility:

- lowering the results of the assessment of control work, assessment in the classroom, test, etc;
- repeated passing of assessment (control work, test, etc.)
- appointment of additional control assessments (additional individual tasks, control works, tests, etc.);
- conducting an additional check of other works of the offender's authorship.

Policy on attendance and lateness:

Uniform: medical gown that completely covers the outer clothing, or medical pajamas, cap, mask, change of shoes.

Equipment: notebook, pen.

Health status: students with acute infectious diseases, including respiratory diseases, are not allowed to attend classes.

Lateness to classes is not allowed. A student who is late for the lesson may attend it, but if the teacher has put "ab" in the register, they must make it up in the general order.

Use of mobile devices:

The use of any mobile devices is prohibited. In case of violation of this paragraph, the student must leave the class and the teacher puts "ab" in the register, which they must make up in the general order.

Mobile devices can be used by students with the permission of the teacher if they are needed to complete the task.

Behaviour in the classroom:

The behavior of students and teachers in the classroom must be working and calm, strictly comply with the rules established by the Regulations on Academic Integrity and Ethics of Academic Relations at Odesa National Medical University, in accordance with the Code of Academic Ethics and Relations of the University Community of Odesa National Medical University, the Regulations on the Prevention and Detection of Academic Plagiarism in the Research and Educational Work of Higher Education Students, Researchers and Teachers of Odesa National Medical University.