Course description

Informing students on course requirements

Program: PhD full-time program, elective course
Course: **Bacterial antibiotic resistance**
Course code: AOKDIASZV-12
Academic year/Semester: 2025/26, 2nd semester
Educator and contact details (e-mail): **Dr. Gabriella Spengler** associate professor spengler.gabriella@med.u-szeged.hu
Type of course: lecture
Weekly hours of the course: **2**
Credit vale of the course: **6**
Type of examination: colloquium (Coospace test, online assignment)
Preliminary requirements (preliminary academic performance or completed course required to fulfill the purposes and requirements of the course): no
Purpose of course: The emergence and spread of new drug-resistant bacteria threatens the effectiveness of appropriate antibacterial therapy. Particularly alarming is the rapid global spread of multidrug-resistant (MDR) bacteria (also known as "superbugs"), which cause infections that cannot be treated with existing antimicrobial agents such as antibiotics. The course covers the development of antibiotic resistance, the mechanisms involved in resistance, the most significant MDR bacteria, and possible solution strategies.
Outcome requirements of the course (specific academic results to be established by the course): *Knowledge* Knows the pathogenesis of the pathogenic microorganisms discussed in the course, the symptoms of the diseases they cause, and the diagnostic options. Knows the treatment and prevention options (antimicrobial agents, vaccines) for diseases caused by the pathogenic microorganisms discussed in the course. Is aware of the main resistance mechanisms and the processes of resistance spread. *Competence*

Is able to integrate the knowledge acquired in the course and form an opinion on the issue of resistance regarding the One Health (WHO) approach.

Attitude
Is receptive to deepening their previously acquired knowledge of microbiology and is committed to expanding it.

Autonomy-responsibility
Keeps up to date with new scientific findings related to microbiology with the help of up-to-date literature sources.

Topics:

1. The development of antibiotic resistance, the role of environmental and social factors
2. Mechanisms of antibiotic resistance in bacteria
3. Transfer of resistance genes in bacteria
4. Resistance and adaptation
5. Heterotypic resistance and cross-resistance
6. The importance of efflux pumps in antibiotic resistance, efflux pump inhibitor compounds
7. The relationship between bacterial communication (quorum sensing) and resistance
8. The importance of biofilm in infection and resistance
9. The problem of resistance in ESKAPE pathogens I.: *Enterococcus faecium, Staphylococcus aureus*
10. The problem of resistance in ESKAPE pathogens II.: *Klebsiella pneumoniae, Acinetobacter baumannii*
11. The problem of resistance in ESKAPE pathogens III.: *Pseudomonas aeruginos*a and Enterobacter spp.
12. MDR and XDR *Mycobacterium tuberculosis*
13. Possible solutions to overcome resistance: drug repurposing
14. EXAM

Supporting methods to achieve learning outcomes:
- PPT-supported lectures
- English-language scientific articles related to the course topics

Evaluation of the acquisition of expected learning outcomes:

The attendance at courses is compulsory. No justification is required for absences of up to 15%. Absences of more than 15% but less than 25% will only be accepted with justification. Absences exceeding 25% of the semester's classes will result in the course being considered incomplete.

When assessing performance, students must demonstrate that they have mastered the basics of bacterial antibiotic resistance and can integrate this knowledge into their existing knowledge.

The evaluation takes the form of a Coospace test (online assignment), for which the student receives a 5-point, criterion-oriented, summative assessment.

Evaluation:
failed (1)
passed (2)
accepted (3)
good (4)
excellent (5)

excellent (5): The student completes the exam task independently, based on accurate literature sources in English, using technical terms correctly and supporting their statements with examples.

good (4): The student completes the exam task independently, based on accurate professional literature sources in English, mostly using technical terms correctly and supporting their statements with examples. The submitted exam task contains only minor errors.

accepted (3): The exam paper submitted by the student contains several errors, and the teacher has to ask several questions about the assignment. The student often does not use technical terms correctly and does not always support their statements with examples.

passed (2): The student submits an incomplete exam paper and uses inappropriate sources. The student mostly uses technical terms incorrectly and is not always able to provide examples.

failed (1): The student does not complete the exam assignment properly, does not use literature sources, and the assignment lacks technical terms and examples.

Mandatory reading list:

1. Munita JM, Arias CA. Mechanisms of Antibiotic Resistance. Microbiol Spectr. 2016 Apr;4(2):10.1128/microbiolspec.VMBF-0016-2015. doi: 10.1128/microbiolspec.VMBF-0016-2015.

2. Byrne MK, Miellet S, McGlinn A, Fish J, Meedya S, Reynolds N, van Oijen AM. The drivers of antibiotic use and misuse: the development and investigation of a theory driven community measure. BMC Public Health. 2019 Oct 30;19(1):1425. doi: 10.1186/s12889-019-7796-8.

3. Huemer M, Mairpady Shambat S, Brugger SD, Zinkernagel AS. Antibiotic resistance and persistence-Implications for human health and treatment perspectives. EMBO Rep. 2020 Dec 3;21(12):e51034. doi: 10.15252/embr.202051034.

4. Abbas A, Barkhouse A, Hackenberger D, Wright GD. Antibiotic resistance: A key microbial survival mechanism that threatens public health. Cell Host Microbe. 2024 Jun 12;32(6):837-851. doi: 10.1016/j.chom.2024.05.015.

5. Kim DW, Cha CJ. Antibiotic resistome from the One-Health perspective: understanding and controlling antimicrobial resistance transmission. Exp Mol Med. 2021 Mar;53(3):301-309. doi: 10.1038/s12276-021-00569-z.

Recommended reading list:

- scientific publications available for download via targeted PubMed search

Indicating course requirements on CooSpace scene (summary)

Description (public):

The emergence and spread of new drug-resistant bacteria threatens the effectiveness of appropriate antibacterial therapy. Particularly alarming is the rapid global spread of multidrug-resistant (MDR) bacteria (also known as "superbugs"), which cause infections that cannot be treated with existing antimicrobial agents such as antibiotics.
The course covers the development of antibiotic resistance, the mechanisms involved in resistance, the most significant MDR bacteria, and possible solution strategies.

Outcome requirements of the course (specific academic results to be established by the course):

Knowledge
Knows the pathogenesis of the pathogenic microorganisms discussed in the course, the symptoms of the diseases they cause, and the diagnostic options. Knows the treatment and prevention options (antimicrobial agents, vaccines) for diseases caused by the pathogenic microorganisms discussed in the course. Is aware of the main resistance mechanisms and the processes of resistance spread.

Competence
Is able to integrate the knowledge acquired in the course and form an opinion on the issue of resistance regarding the One Health (WHO) approach.

Attitude
Is receptive to deepening their previously acquired knowledge of microbiology and is committed to expanding it.

Autonomy-responsibility
Keeps up to date with new scientific findings related to microbiology with the help of up-to-date literature sources.

Evaluation of the acquisition of expected learning outcomes:

The attendance at courses is compulsory. No justification is required for absences of up to 15%. Absences of more than 15% but less than 25% will only be accepted with justification. Absences exceeding 25% of the semester's classes will result in the course being considered incomplete.

When assessing performance, students must demonstrate that they have mastered the basics of bacterial antibiotic resistance and can integrate this knowledge into their existing knowledge.
The evaluation takes the form of a Coospace test (online assignment), for which the student receives a 5-point, criterion-oriented, summative assessment.

Evaluation:
failed (1)
passed (2)
accepted (3)
good (4)
excellent (5)

excellent (5): The student completes the exam task independently, based on accurate literature sources in English, using technical terms correctly and supporting their statements with examples.

good (4): The student completes the exam task independently, based on accurate professional literature sources in English, mostly using technical terms correctly and supporting their statements with examples. The submitted exam task contains only minor errors.

accepted (3): The exam paper submitted by the student contains several errors, and the teacher has to ask several questions about the assignment. The student often does not use technical terms correctly and does not always support their statements with examples.

passed (2): The student submits an incomplete exam paper and uses inappropriate sources. The student mostly uses technical terms incorrectly and is not always able to provide examples.

failed (1): The student does not complete the exam assignment properly, does not use literature sources, and the assignment lacks technical terms and examples.

Topics:

1. The development of antibiotic resistance, the role of environmental and social factors
2. Mechanisms of antibiotic resistance in bacteria
3. Transfer of resistance genes in bacteria
4. Resistance and adaptation
5. Heterotypic resistance and cross-resistance
6. The importance of efflux pumps in antibiotic resistance, efflux pump inhibitor compounds

7. The relationship between bacterial communication (quorum sensing) and resistance
8. The importance of biofilm in infection and resistance
9. The problem of resistance in ESKAPE pathogens I.: *Enterococcus faecium, Staphylococcus aureus*
10. The problem of resistance in ESKAPE pathogens II.: *Klebsiella pneumoniae, Acinetobacter baumannii*
11. The problem of resistance in ESKAPE pathogens III.: *Pseudomonas aeruginos*a and Enterobacter spp.
12. MDR and XDR *Mycobacterium tuberculosis*
13. Possible solutions to overcome resistance: drug repurposing
14. EXAM