

**COURSE DATA****Data Subject**

Code	43021
Name	Fundamentals of research in microbiology
Cycle	Master's degree
ECTS Credits	15.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
2137 - M.D. in Biomedical Research	Faculty of Medicine and Odontology	1	Second term

Subject-matter

Degree	Subject-matter	Character
2137 - M.D. in Biomedical Research	3 - Fundamentals of clinical research in biomedicine	Optional

Coordination

Name	Department
CAMARENA MIÑANA, JUAN JOSE	275 - Microbiology and Ecology

SUMMARY

In this module, the lines of research in Clinical Bacteriology, Clinical Virology and Clinical Mycology and Parasitology are analysed. Besides, the main syndromes of infectious diseases, analyzing its ethiopathogenesis, microbiological diagnostic and therapeutic approaches will be studied, with a special focus on recent advances in research in each of the sections covered in the program.

The main objective of the module is to provide the student with basic training in the field of biomedical research related to Clinical Microbiology, including clinical bacteriology, virology, mycology and parasitology. Through the scientific method and the systematic process of an increasingly multidisciplinary research, the achievement of these general objectives is proposed:



- To acquire a solid basis in the methodology of biomedical research applied to the world of Clinical Microbiology, acquiring the necessary training to carry out research on these issues both in the laboratory and in the clinic.

- To create a new climate that favours research in the field of Clinical Microbiology, integrating the student in the research activity of the different Departments of the Faculty of Medicine and the University Hospitals attached to them.

A second part of this module, starting in March, will be held at the Principe Felipe Research Center (CIPF). The overall aim will be the theoretical-practical development of content related to the methodologies currently used in biomedical research in different areas: genetics, biomarkers, neuroscience, bioinformatics, nanomedicine, cell therapy, etc.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

No se requieren.

OUTCOMES

2137 - M.D. in Biomedical Research

- To have the ability to apply the foundations of the scientific methodology to the clinic investigation in human beings.
- To have the ability to design, perform and analyse clinical protocols and essays.
- Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.
- Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.
- Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Students should possess and understand foundational knowledge that enables original thinking and research in the field.



- To have the ability to integrate and to teamwork within a group of consolidated biomedical research.
- To know how to make a suitable bibliographical and documentary search in order to know the state of the art of the issue.

LEARNING OUTCOMES

- Being able to integrate the knowledge acquired in the field of clinical research related to the etiopathogenesis, microbiological diagnosis and treatment of infectious diseases through the scientific method and the systematic process of research.
- Know the techniques and advances in the diagnosis of infectious diseases of bacterial origin, by viruses, fungi, protozoa and helminths in humans.
- Know the different methods of phenotypic and genotypic characterization of the microorganisms that cause human infectious pathology.
- Understand and know the etiology of the process and possible resistance mechanisms of each group of microorganisms (bacteria, viruses, fungi, protozoa and helminths) to be able to propose antimicrobial therapeutic alternatives.
- Being able to integrate into the research activity of the groups of the Department and the Services in the attached University Hospitals. Research is intended to be increasingly multidisciplinary, intersectoral and multipersonal.

DESCRIPTION OF CONTENTS

1.

Type of host-parasite relationship. Colonization, infection and infectious disease. Determinants of pathogenicity and virulence factors of interest in infection. Stages of the infectious process. Update on etiopathogenic aspects of infections in humans.

2. Human microbiome study

Microbiota. Study of the associations between the microbiome and different infectious and non-infectious diseases. Microbiome: currently proposed lines of research.

3.

Direct diagnostic procedures: conventional methods vs. molecular diagnosis. Molecular diagnostic methods and their indications. Rapid antigenic detection techniques and their indications. Indirect diagnostic procedures: Serological methods and their indications. Detection of cellular immune response.



4. etiopathogenesis of bacterial infections

Update on pathogenic aspects of infections by gram-positive bacteria. Special study of Staphylococcus, Streptococcus, Enterococcus, Listeria and other gram-positive infections. Update on pathogenic aspects of infections by gram-negative bacteria. Special study of infection by Neisseria, Brucella, Legionella, Enterobacteria, Vibrio, Pseudomonas, Acinetobacter and other gram negatives. Update on pathogenic aspects of infections by strictly anaerobic bacteria: Clostridium, Bacteroides and new anaerobes.

5. Lines of microbiological diagnosis of bacterial infections.

Current lines of microbiological diagnosis in infections by gram-positive microorganisms as causes of human infections. Special study of infection by Staphylococcus aureus, Streptococcus pneumoniae and Enterococcus spp. Current lines of microbiological diagnosis in infections by gram-negative microorganisms as causes of human infections. Special study of infection by Enterobacteriaceae, Legionella pneumophila, Pseudomonas aeruginosa and Acinetobacter baumannii.

6. Antibiotics Classification according to targets.

Update on antibacterials. Classification according to their targets and mechanisms and new molecules against the increase in multi-resistance.

7. Resistance mechanisms of microorganisms to antibacterial agents.

Methods and current lines of research on resistance in gram-positive and gram-negative. New resistance detection methods. Interpreted antibiogram. Characterization of resistotypes in bacteriology and its clinical interest.

8. Tuberculosis, leprosy and mycobacteriosis

Etiopathogenic and diagnostic aspects of Mycobacterium tuberculosis and Mycobacterium leprae infections. Mycobacteriosis. Ranking and your current interest. Update on new molecular methods for diagnosis and study of resistance in mycobacteria. Special study of Buruli ulcer and current lines of research.

9. Microbiology and nosocomial infection.

Concepts, etiopathogenesis and epidemiological aspects. Clinical syndromes in nosocomial infection and approaches to their microbiological diagnosis. Microbiological study and advances in molecular characterization of nosocomial outbreaks by the following microorganisms: Acinetobacter baumannii, Staphylococcus aureus, ESBL-producing Enterobacteriaceae, Pseudomonas aeruginosa, yeast (Candida spp.) or filamentous fungi (Aspergillus spp.)



10. Clinical virology

1. Advances in the microbiological diagnosis of viral infections. Direct virological diagnostic procedures: Molecular diagnostic methods in clinical virology and their indications. Rapid antigenic detection techniques in clinical virology and their indications. Indirect diagnostic procedures for viral infections: Serological methods. Main indications and current lines of research.
2. Structure, multiplication and classification of viruses of medical interest. General diagnostic approaches and current lines of work in infections by viruses of clinical interest: HSV, CMV, EBV, Erythrovirus, Papillomavirus, Respiratory Virus, Hepatitis Virus, Neurotropic Virus, HIV.
3. Update on emerging and re-emerging viruses. Coronaviruses (SARS-CoV, MERS and SARS CoV-2), Ebola virus, Nipah virus and Hendra virus. Hemorrhagic fever virus. Defective prions and viruses.
4. Antiviral Immune Response Assay Methods
- 4.1. Special study of acute viral infections: model of gastrointestinal infection. Molecular virology of gastrointestinal infections due to rotavirus, Astrovirus and Calicivirus.
- 4.2. Special study of chronic-persistent viral infections: Herpesviridae, Retroviridae, Hepaciviridae models. Transforming viral infections.
5. New antivirals and their clinical indications. Search and development of antivirals. clinical applications. Special study of antiretrovirals and antivirals active against hepatitis C virus, hepatitis B virus AND SARS-CoV-2.
6. Mechanisms of resistance in the treatment of viral infections. Characterization of mechanisms. Detection methods. Current lines of research

11. Clinical mycology.

1. Current situation of fungal infections and emerging processes. Specific diagnostic methods in mycology. Diagnostic approaches and advances in fungal infections that produce superficial, subcutaneous and systemic mycoses.
2. Special study of fungal infections producing opportunistic mycoses. Zigomycosis. Feohifomycosis. Hialohifomycosis. Aspergilosis.
3. Antifungals. Classification and resistances.

12. Clinical parasitology. General aspects.

1. Classification, anatomical, functional and pathogenic characteristics of protozoa and helminths associated with human infections.
2. Infections by protozoa of clinical interest. Update on intestinal, genito-urinary, tissue and blood protozooses.
3. Helminth infections of clinical interest. Classification and study of the different helminthiasis associated with infectious pathology.
4. Antiprotozoals and anthelmintics. Classification and updating in antiparasitic treatment. resistance mechanisms. Current lines of research.



13. CIPF. Diagnosis and treatment of rare diseases

Discovery of new genes associated with Mendelian diseases. Genealogy Workshop. Models and therapies for the study of hereditary retinal dystrophies.

14. CIPF. Bioinformatics

Introduction to transcriptomics and high-throughput technologies. Exploration and pre-processing of gene expression data. Differential expression analysis. Functional enrichment.

15. Biostatistics.

Introduction to free software R and Rstudio. Univariate and multivariate descriptive statistics. Basic concepts of statistical inference. Parametric and non-parametric hypothesis tests. Analysis of variance. Regression models: linear and generalized linear.

16. CIPF. Cancer biology

Introduction to cancer: What is cancer. cancer properties. Cancer genetics: Oncogenes and tumor suppressors. Growth factors, receptors and cancer. Oncogenic signaling. Tumor stem cells or cancer stem cells (CSC). Cancer and placentation. Tumor and Stroma.

17. CIPF. Neuropsychiatric pathologies: hepatic encephalopathy and schizophrenia

Hepatic encephalopathy. animal models. Neuroinflammation and alterations in neurotransmission. therapeutic implications. Ex vivo and in vivo study. behavioral studies. Analysis of neurotransmission by cerebral microdialysis in vivo. Molecular psychiatry: pathophysiology of cortical circuits. The cortex, the most complex region of the brain. Pathologies of the neurological development of cortical circuits. What happens if something goes wrong? The golden age of neurobiology: new tools to investigate cortical circuits.

18. CIPF. Cellular therapy

Pluripotent stem cells: fundamentals and types. iPS cells as a tool to study diseases. Cell Therapy in pathologies of the nervous system.

19. CIPF. Drugs and biomarkers

Nanomedicine in research and medical practice. Cell models for biomedical research. Animal experimentation models in drug development. Intercellular communication by exosomes and their use as biomarkers. Gut microbiota as functional food and biomarker of metabolic disease.

**WORKLOAD**

ACTIVITY	Hours	% To be attended
Theory classes	10,00	100
Other activities	6,00	100
Development of group work	25,00	0
Study and independent work	50,00	0
Readings supplementary material	40,00	0
Preparation of evaluation activities	40,00	0
Preparing lectures	50,00	0
Preparation of practical classes and problem	15,00	0
TOTAL	236,00	

TEACHING METHODOLOGY

Teaching methodology, material and work structuring for the module in clinical microbiology:- Approaches of the different projects based on the contents of the program and/or lines of work.- Review sessions on the technical and scientific problems proposed by each student in the development of their work and their resolution.- Presentation of the results obtained by each student from the proposed teaching-research projects and discussion on this topic.- Conclusions obtained and problems proposed throughout the completion of the course by students and teachers and evaluation of the knowledge acquired.

- Discussion in seminars of the work developed by the student individually or in groups.- Online teaching methods: based on the computer tools available for PDI and students at the University of Valencia: Virtual classroom, teaching blog, email, virtual disk... In addition, students will work with the virtual resources of the University of Valencia: library electronic journals with specialized journals in Clinical Microbiology and/or Infectious Diseases, electronic books on these subjects, databases, general or specific scientific dictionaries and encyclopedias, specialized textbooks, etc.... - Theoretical and practical sessions: Face-to-face sessions are organized in the School of Medicine (3h/day for 15 days) and 45 hours at the Principe Felipe Research Center, where the topics corresponding to the theoretical contents of the subject and seminars are developed:

- Presentation of the module, objectives, general and specific contents, structure, operation and possibilities of work to be carried out by each student.
- Approaches of the different projects based on the contents of the program and/or lines of work.
- Review sessions on the technical and scientific problems proposed by each student in the development of their work and their resolution.
- Presentation of the results obtained by each student from the proposed teaching-research projects and discussion on this topic.
- Conclusions obtained and problems proposed throughout the completion of the course by students and teachers and evaluation of the knowledge acquired.



EVALUATION

The evaluation will be both continuous evaluation, assessing attendance and participation, as well as the work presented and the final exam, applying the following sections: **MICROBIOLOGY SESSIONS (50% GLOBAL MARK):**

1. Continuous evaluation of the active participation in the face-to-face sessions and seminars (25%) where the professor responsible for the session will evaluate the degree of involvement, interest and preparation based on the material previously supplied through the Virtual Classroom of the UV, as well as the content of the final work assigned to each student,
2. Exhibition and defense (25%) in class of the final work assigned to each student in the first session, assessing its scientific content and the ability to transmit the knowledge acquired.

Exam (50%) with multiple-choice questions (30 tests) with a valid answer, which will include those contents worked on in the scheduled face-to-face sessions, seminars and papers presented by each of the students. **CIPF SESSIONS (50% GLOBAL MARK):**

1. Resolution of two questions chosen from a battery of practical questions.

REFERENCES

Basic

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- Murray PR, Rosenthal KS y Pfaller MA. (2021). Microbiología médica 9ª ed. Elsevier España SL. ISBN: 9788491138082
- Prats Pastor, G. (2013). Microbiología y parasitología médicas. Editorial Médica Panamericana SA. Madrid. ISBN: 9788491106111
- Ryan KJ, Ray CG. (2017). Sherris Microbiología Médica. 6ª ed. Editorial McGraw Hill. ISBN 9786071514127
- Bennett JE, Dolin R y Blaser MJ. (2020) Mandell, Douglas y Bennett. Enfermedades Infecciosas. Principios y Práctica 9ª ed. Elsevier España SL. Vol I. ISBN: 9780443065811
- García Sánchez JE, López R y Prieto J eds. (1999). Sociedad Española de Quimioterapia. Antimicrobianos en Medicina. Prous Science. ISBN 84-8124-167-9
- Carroll KC et al. Manual of Clinical Microbiology (2019). 12th Edition. ASM Press. Washington DC. ISBN 978-1-555-81983-5
- Strachan T, Read A. Human Molecular Genetics 3. Garland Publishing, 2004. ISBN-13: 978-0-81534182-6. ISBN-10. 0-81534182-2.



-Weinberg RA. The biology of cancer. New York: Garland Science, Taylor & Francis Group, 2014. ISBN-13: 978-0815342205. ISBN-10: 0815342209.

-Benítez-Páez A, Hess AL, Krautbauer S, Liebisch G, Christensen L, Hjorth MF, Larsen TM, Sanz Y; MyNewGut consortium. Sex, Food, and the Gut Microbiota: Disparate Response to Caloric Restriction Diet with Fiber Supplementation in Women and Men. Mol Nutr Food Res.

Additional

- La bibliografía específica se facilita por el profesor directamente a los alumnos que van a realizar el módulo y el trabajo correspondiente. Esto cambia cada año.