

Degree in Medicine and Surgery

Integrated course: **Laboratory Medicine**

SSD: **BIO/12, MED/05, MED/07, VET/06, MED/16**

Coordinator: **Carlo Federico Perno**

Module: **Clinical Biochemistry and Clinical Molecular Biology**

SSD: **BIO/12**

Number of credits: **2**

Teacher: **Gaetano Barbato** gaetano.barbato@unicamillus.org

Module: **Clinical Pathology**

SSD: **MED/05**

Number of credits: **2**

Teacher: **Giovanni Barillari** (2 CFU) giovanni.barillari@unicamillus.org

Module: **Microbiology and Clinical Microbiology**

SSD: **MED/07**

Number of credits: **2**

Teacher: **Carlo Federico Perno** carlofederico.perno@unicamillus.org

Module: **Clinical Parasitology**

SSD: **VET/06**

Number of credits: **1**

Teacher: **Lorenza Putignani** lorenza.putignani@unicamillus.org

Modulo: **Rheumatology**

SSD: **MED/16**

Number of credits: **1**

Teacher: **Roberta Priori** roberta.priori@unicamillus.org

PREREQUISITES

To understand the topics of this course, basic knowledge of chemistry, organic chemistry and biochemistry, as well as, of anatomy, physiology and general pathology is required.

Finally, knowledge of medical microbiology and the basics of immunology are an essential criterion.

LEARNING OBJECTIVES:

The integrated teaching of Laboratory Medicine is aimed at introducing the student to the logic and tools underlying the execution of the diagnostic tests of the Clinical Biochemistry, Clinical Pathology, Clinical Microbiology, Clinical Parasitology and Rheumatology. At the end of the integrated teaching, the student will be able to apply diagnostic tests in the clinical practice, and to interpret and evaluate their results.

LEARNING OUTCOMES

The learning outcomes expected from the integrated teaching of Laboratory Medicine are consistent with the provisions from the Bologna Process and are found within the Dublin descriptors as follows:

Knowledge and understanding:

At the end of the Clinical Biochemistry and Clinical Molecular Biology module, the student will demonstrate knowledge and understanding of: the basic principles to interpret laboratory data; sources of pre-analytical and analytical variation; principles of quality control; diagnostic databases and reference values; methodologies for dosing common enzyme markers and their diagnostic value, and also their use as organ biomarkers; water and electrolytes homeostasis; methods and principles for electrolytes dosing in clinical samples; methods and principles for evaluating blood gases; the impact of the acid-base equilibria in the development of pathologies.

At the end of the Clinical Pathology module, the student must: have learned the logic of the clinical use of laboratory tests, the interpretation of their results and their integration into clinical reasoning; knowing how to frame the biological marker in the context of evidence-based medicine; know the methodologies used for counting/ identifying the blood cells and investigating the most common erythrocyte, platelet and leukocyte pathologies; have a notion of the mechanisms underlying the haemostatic and fibrinolytic process, as well as the main laboratory investigations used to define the patient's hemorrhagic or thrombotic risk; know the diagnostic tests useful for evaluating the immune response or the presence of an inflammatory state in the patient, and their main clinical indications; have knowledge of laboratory investigations relating to the most common acute or chronic liver diseases; know the most frequently used methodologies to assess kidney function and know how to interpret the results of the macroscopic, microscopic and chemical-physical examination of the urine sample; understand the results of diagnostic tests aimed at determining the level of glucose or the concentration of lipids in the blood, know the reasons behind their pathological changes, and knowing how to correlate the obtained data with the risk of vascular damage ; know the markers employed to highlight the presence of a tumor or monitor its stage of progression; have notions about the typing of blood cells, and the laboratory investigations preparatory to transfusions; being able to identify the conditions in which to apply therapeutic drug monitoring and understanding the results; know the characteristics and applications of laboratory investigations aimed at ascertaining the presence and nature of a voluptuous intoxication; being able to identify and apply laboratory tests useful for monitoring the health status of individuals who perform sporting activities at different levels, disclosing any health risk factors resulting from overexertion and/or trauma.

Upon completion of the module of Clinical Microbiology, students should be able to: 1) know the relevance of an appropriate diagnosis of infections; 2) appreciate the importance of using new and updated technologies for an adequate diagnosis; 3) know the major microorganisms cause of infections in different organs and apparatuses, and how to diagnose them.

At the end of the Clinical Parasitology module, the student will know the main parasites that can infect humans, as well as the techniques used in the diagnosis of parasitic diseases and the correlation between pathogen, clinical course of the disease and treatment.

Upon completion of the module of Rheumatology, the students will be able to discuss the pathophysiology of the main rheumatic diseases, particularly autoimmune and inflammatory disorders of rheumatologic interest, and their distinctive clinical picture. They will be able to identify the indications for laboratory tests and interpret the results. The students will be able to use

an appropriate language, access and evaluate medical information relevant to the topics objects of this course.

Applying knowledge and understanding:

the general objective of the integrated course of Laboratory Medicine is the critical learning of the method of dosing biomarkers which are present in human body fluids, as well as their use in the diagnosis of pathological conditions . At the end of the integrated teaching, the student will be able to evaluate the results of a laboratory medicine test, critically using the reference value databases. Starting from the knowledge of the laboratory test and its result, the student will be able to learn how to: determine the presence of a disease or the predisposition to it; confirm the diagnosis already hypothesized through other instrumental methods and/or clinical semeiotics; define the prognosis of the disease; choose the appropriate therapy and monitor its effects.

Communication skills:

at the end of the integrated teaching, the student will be able to explain the laboratory analysis of the patient's specimen by dividing its various phases into logical steps. Ultimately, the student will be able to correlate specific biomarkers with the presence, or with the risk of developing, a disease.

Making judgements:

at the end of the integrated teaching, the student will be able to provide evaluations of the results obtained in a clinical laboratory, and understand the factors which influence laboratory tests.

Learning skills:

at the end of the integrated teaching, the student will acquire skills useful to deepen and expand their knowledge in the field of laboratory medicine, also through the consultation of scientific literature, databases, specialized websites.

INTEGRATED TEACHING SYLLABUS

Clinical biochemistry and clinical molecular biochemistry

- Definition, limits and scope of Laboratory Medicine; Classification of Disciplines within Laboratory Medicine. General organization of the Laborator. Rational behind laboratory test choice; strategy
- in requesting laboratory test (screening test, individual test, organ profiling, diagnostic protocols, therapy monitoring etc.).
- *Statistics*
- Basic statistics recall: Frequency distribution; Population and representative sample; Probability and Probability distribution; Population dispersion and Standard Deviation
- *Variation*
- Sources of Variation; impact of pre-analytical phase on variability: sample collection and transportation; impact of analytical on variability; analytical performance and indicators. Hierarchy of analytical methods; Errors.



- Impact of biological variation: nature of B. variation; reference values selection and use; cut-off.
- Use of the laboratory data: clinical performance of tests; clinical sensitivity, clinical specificity, Receiver operating characteristic (ROC) curves; Predictive value;
- Introduction to Quality Systems; accreditation and certification; Control of the analysis product.
- *Use of Diagnostic Biomarkers dosage:*
- Enzymatic Biomarkers : Enzyme's role in clinical diagnosis. Enzyme quantification in clinical chemistry; Early markers and late markers. Enzymatic dosing methodologies: Continuous and discrete measure dosing. Substrate, Product and co-factors dosing.
- Diagnostic dosing "Case Studies" in the Clinical Laboratory practice as organ markers: Creatin Kinase (CK), Lactic DeHydrogenase (LDH), Transaminases (ALT, AST), γ -Glutamyltransferase (γ -GGT), Alkaline (ALP) and Acidic (ACP) Phosphatases, Amylase, Lipase.
- Electrolytes and Blood Gases: Colligative properties; Water Homeostasis; Specimens for Electrolyte determination; Sodium; Potassium; Chloride; Bicarbonate; Methods for determination; Electrolyte exclusion effect; Osmotic Pressure; Osmolality; determination of Plasma and Urine Osmolality; Blood gases and pH; Henderson-Hasselbalch equation in gas measurements; oxygen in blood; hemoglobin saturation/dissociation; determination of pCO₂, pO₂ and pH.
- Electrolites and water composition of body fluids; extracellular and intracellular compartments; acid-base balance and status; buffer systems and regulation of body fluids pH; respiratory and renal mechanisms in the regulation of acid-base balance; conditions associated with abnormal acid-base status or abnormal electrolyte composition of blood; Metabolic acidosis and alkalosis; respiratory acidosis and alkalosis.

Clinical Pathology

- The clinical value of the laboratory.
- Injury and function markers.
- The blood count.
- Coagulation and pathologies of the coagulation system.
- Markers of inflammation and immune reactions.
- Diagnosis of leukocyte pathologies.
- Diagnosis of anemias.
- Liver, hepatitis and cirrhosis.
- Blood sugar.
- Lipemia
- Functional evaluation of the kidney, urinalysis.
- Tumor markers.
- Immunohematology and transfusion medicine.
- Laboratory evaluation of drug blood concentrations, drug abuse and doping.
- The laboratory in sport activities.

Microbiology and Clinical Microbiology

- Principles of medical microbiology and immunology
- Principles of diagnostic microbiology
 - Tests used

- Appropriate biological samples
- How to get and store biological samples
- Interpretation of microbiological results
- Elements of Diagnostic Microbiology: Direct and indirect tests, Microbial isolation, selection of the appropriate biological samples, antibiogram (Principles, purposes and interpretation)
- Elements of Diagnostic Virology: Direct and indirect tests, Viral isolation, Selection of the biological samples and their preservation and storage
- Elements of the diagnostic Mycology, biological isolation, selection of the biological samples; modern molecular and antigenic tests
- Main etiological agents of the infections of the Nervous System; Characteristics of the cerebrospinal fluid. Samples to be used, how to get them, storage, interpretation of the results
- Main etiological agents of the infections of the Upper and Lower Respiratory Tracts. Samples to be used, how to get them, storage, interpretation of the results
- Main etiological agents of the infections of the Gastrointestinal System. Food-related infections. Samples to be used, how to get them, storage, interpretation of the results
- Main etiological agents of the infections of the Urinary Tract. Samples to be used, how to get them, storage, interpretation of the results
- Systemic infections: How to use and interpret the Haemoculture. Infections of the cardiovascular apparatus
- Main etiological agents of the infections of the Genital Tract. Infections during pregnancy. Samples to be used, how to get them, storage, interpretation of the results
- Sexually transmitted diseases. Main etiological agents, samples to be used, how to get them, storage, interpretation of the results
- Diagnosis of HIV and viral hepatitis
- Hospital infections: Main etiological agents and their modern diagnosis. Microbiological control of the hospital infections.
- Infections in the immunocompromised host; Etiological agents, Modern diagnosis, Samples used, how to get them, storage, interpretation of the results
- Microbiota: Structure, clinical relevance, diagnostic methodologies
- General information about the rapid diagnosis of malaria

Clinical Parasitology

- Concepts of ecology applied to parasitism;
- General clinical parasitology principles regarding transmission routes, zoonosis, anthroozoonosis;
- Medically important Parasites belonging to Nematodes and Cestodes. Laboratory diagnosis of parasitic diseases, clinical symptoms and treatment

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Rheumatology

- Classification of rheumatic diseases.
- Autoimmune and inflammatory disorders of rheumatologic interest: pathogenesis, clinical presentation, epidemiology, course, basic management and prognosis.
- The role of laboratory investigations for the diagnosis of rheumatic diseases.
- Sjogren's syndrome.
- Systemic Lupus Erythematosus.
- Systemic sclerosis.
- Mixed connective tissue disease.



- Undifferentiated connective tissue disease.
- Antiphospholipid antibodies syndrome.
- Idiopathic Inflammatory myopathies.
- Systemic Vasculitis.
- Autoinflammatory diseases.
- Introduction to rheumatoid arthritis.

COURSE STRUCTURE

The course is divided into lectures. The teachers use didactic tools such as powerpoint presentation with explanatory diagrams, illustrations and images to describe the pathologies. Attendance is mandatory.

COURSE GRADE DETERMINATION

The exam is articulated in two parts: a written and an oral test.

The written exam consists of 30 questions with multiple-choice questions. A point will be assigned for each correct answer.

In the oral test student is given the opportunity to show his preparation discussing the course topics, and his elaboration skills on the thematics dealt demonstrating the acquisition of expressive capacity with a suitable scientific language.

RECOMMENDED TEXTBOOKS

- “Tietz fundamentals of Clinical Chemistry and molecular diagnostics”. 8th ed. N. Rifai, A.R. Horvath, C.T. Wittwer, Elsevier 2019. ISBN-13: 978-0323530446
- Michael Laposata. “Laboratory Medicine: the diagnosis of disease in the clinical laboratory” (3rd edition). LANGE editor
- Oxford handbook - “Infectious diseases and microbiology” – E Torok, E. Moran, F Cooke Second edition
- Wolters Kluwer – “Color atlas and textbook of Diagnostic Microbiology” – GW Procop, DL Church, GS Hall, WM Janda, EW Konemar, PC Schreckenberger, GL Wood – Seventh Edition
- Harrison’s Rheumatology, latest edition
- Harrison’s Principle of Internal Medicine, latest edition
- Oxford Handbook of Rheumatology, latest edition
- Clinical Microbiology, Murray, Rosenthal, Pfaller, 8 Edition