Degree in Medicine and Surgery

Integrated course: **Laboratory Medicine**
SSD: **BIO/12, MED/05, MED/07, VET/06, MED/16**
Coordinator: **Roberto Verna**

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: **Roberto Verna** (1 CFU) roberto.verna@unicamillus.org
Teacher: **Giovanni Barillari** (1 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: **David Di Cave** david.dicave@unicamillus.org

Modulo: **Rheumatology**
SSD: **MED/16**
Number of credits**: 1**
Teacher**: Roberta Priori** roberta.priori@unicamillus.org

PREREQUISITES
Regarding the module of Clinical Biochemistry and Clinical Molecular Biology, basic knowledge of chemistry, organic chemistry and biochemistry are needed. In order to learn to learn the contents of the Clinical Pathology module, the students should have knowledge of human anatomy and physiology, as well as general pathology. Knowledge of medical microbiology and of the basic elements of immunology as essential requisites for the understanding of both Clinical Microbiology and Clinical Parasitology. With regard to Rheumatology, the students should have knowledge of the anatomy of the musculoskeletal system as well as of other systems; basic knowledge of immunology is necessary, too.

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.
The module of Clinical Biochemistry and Clinical Molecular Biochemistry aims at delivering to students the theory and practical knowledge of the base principles of Clinical Biochemistry which are underlying to the execution and evaluation of the biochemical analysis tests of a patient biofluid samples. The student should possess knowledge of the methodology rigour, the rational of execution, and quality control of the molecular biochemical test applied to clinico-diagnostic areas of relevance such as enzymatic biomarkers, the control of the water homeostasis, blood gases as well as acid-base equilibria.
The Clinical Pathology module aims to provide the student with knowledge relating to the role that the clinical laboratory has in: i) assessing the patient's inflammatory or immune status; ii) monitoring of haematological, haemorrhagic, liver diseases, kidney diseases, or neoplasms ; iii) the blood levels of lipids and glucose; iv) the determination of drug concentration in patients' specimens.
The Clinical Microbiology module aims to provide the student with knowledge of the relevance of the clinical microbiology in the appropriate setting of diagnosis of infectious diseases, of the major microorganisms that are cause of infection in every human organ or apparatus, and of the modern tools for the diagnosis of infection.
The Clinical Parasitology module The Clinical Parasitology module will illustrate to the student the tools and methodologies useful for identifying parasites that infect humans, and the strategy in choosing and requesting the laboratory tests necessary for the diagnosis of parasitic diseases and the monitoring of their therapy.
The aim of the lessons of Rheumatology is to give the ability to recognize the clinical presentation, epidemiology, course and prognosis of adult autoimmune and inflammatory rheumatic diseases such as connective tissue diseases and systemic vasculitis, and identify appropriate investigations and basic management for these conditions.

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 erythocyte, 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.
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 abe 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

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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 scientic 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), □-Glutamyltransferase (□-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 cardio-vascular 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
Metazoan parasites: Flatworms, Flukes and Roundworms (Cestodes, Trematodes and Nematodes)
Laboratory diagnosis of parasitic diseases

Rheumatology
Classification of rheumatic diseases.
Autoimmune and inflammatory disorders of rheuatologic 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.
Idiopatic Inflammatory myopathies.
Systemic Vasculitis.
Autoinflammatory diseases.
Introduction to rheumatoid arthritis.

COURSE STRUCTURE
The teaching is divided into 80 hours of lessons, of which 20 are in Clinical Biochemistry and Clinical Molecular Biology, 20 in Clinical Pathology, 20 in Microbiology and Clinical Microbiology, 10 in Clinical Parassitology and 10 in Rheumatology. Lessons will be integrated by slide sets. Attendance is compulsory.

COURSE GRADE DETERMINATION
Concerning the module of Clinical Biochenmistry and Clinical Molecular Biology, the exam is articulated in two parts: a written and an oral test. The written test consists of 20 questions with multiple choice answer, with only one correct answer, each question has a 1 point value. In addition there is 1 question free text (max 20 rows) whose value is 10 points. No penalties are established for wrong answers. To access the oral test the student must have totalized a score in the written test at least 18/30. 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. The final evaluation will be evaluated mainly on the exit of the oral test.

For Clinical Microbiology, the examination will be oral, preceeded, when appropriate, by a written exam consisting in 30 multiple choice questions (of which only 1 if true). There will be one point for each quiz answered correctly, without penalty for the mistakes. To sustain the oral exam, the student must achieve a score of 18/30
For Clinical Pathology, Clinical Parasitology and Rheumatology, the exam will be oral only.
The final evaluation of the integrated course will be made with a weighted average on the CFU of the respective modules.

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

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