

MEDICAL GENETICS TRAINING PROGRAM
Mount Sinai School of Medicine

GOALS & OBJECTIVES: Biochemical Genetics Laboratory

The overall goal of the Clinical Biochemical Genetics Training Program is to provide the trainee with the skills they will need to direct a biochemical diagnostic laboratory. This includes gaining expertise in test design and validation; interpretation, troubleshooting, reporting and communication of results to providers; proper quality control and assurance and to direct a fellowship program in the future. In addition, the trainee will perform research in biochemical genetic testing.

The specific skills to master are outlined below:

Patient Care and Laboratory Skills:

1. Preanalytical Laboratory Skills

- Accurately select appropriate lab testing based on diagnosis and/or clinical features
- Identify appropriate specimen type for different study
- Knowledgeable in specimen collection, storage, stability, common interferences, acceptability, accession, specimen tracking, and appropriate documentation of necessary records and clinical database
- Knowledgeable in principles of separation of plasma, serum, WBC and tissue culture and harvesting

2. Analytical Laboratory Skills

- Perform quantitative amino acids analysis on plasma, urine, CSF and dried blood spot (DBS) samples for 3 months
 - Understand principle of ion exchange chromatography of amino acids, instrumentation of Biochrom Analyzer, different separation program for different applications
 - Adhere quality control policy
 - Perform necessary maintenance to Biochrom Analyzer necessary troubleshooting when needed
 - Evaluate raw chromatography data including correct peak identification, awareness of co-eluting compound, interfering artifact
 - Report results with proper units, age specific range and clinical relevant interpretation
- Perform urine organic acids analysis using gas chromatography/mass spectrometry (GC/MS)
 - Understand principle of gas chromatographic separation, electron impact ionization, and mass spectrometry identification of organic acids
 - Competent in reading mass spectra and organic acids profile. Correctly identify organic acids compounds using ion extraction and subtraction if necessary
 - Competent in recognizing abnormal disease specific pattern or abnormal pattern related to metabolic decompensation
 - Competent in quantifying important organic acids
 - Adhere quality control policy
 - Perform necessary maintenance to GC/MS and troubleshooting when needed
- Perform carnitine and acylcarnitine analysis on liquid chromatography tandem mass spectrometry (LC/MS/MS)

- Understand principle of MS/MS analysis (precursor ion scan) on carnitine and acylcarnitine and other MS/MS analysis such as neutral loss for amino acids, multiple reaction monitoring (MRM) for general quantification
 - Competent in operating LC/MS/MS instrumentation including basic maintenance and troubleshooting
 - Competent in identify abnormal acylcarnitine profile
 - Report results with proper units, age specific range and clinical relevant interpretation
 - Perform enzyme assays
 - Understand principle of enzyme assay: substrate preparation, assay condition, sample integrity, and expression of enzyme activity
 - Understand clinical utility in defining affected individual or heterozygote from normal individuals
 - Adhere quality control policy: positive and negative controls with clinical samples
 - Report patients results with clearly defined ranges for normals, affected and heterozygotes
 - Can interpret laboratory reports and predict phenotype and impact for patient
- 3. Postanalytical Laboratory Skills-through all lab rotations
 - Competent in practicing general lab quality management procedures
 - Perform reagent controls with all assays including tracking critical reagents lots, testing new critical reagents prior to use, appropriate labeling of all reagents
 - Perform quality control with all assays, compile quality control (QC) record, track QC trend
 - Perform regular analytical measurement range (AMR) reverification of quantitative assays
 - Perform regular calibration procedures
 - Demonstrate knowledge in setting up and implementing necessary quality measure to assure and improve testing quality
 - Get involved with preparation for lab inspections
 - Results interpretation and reporting
 - Competent in result interpretation. Recognize significant metabolic pattern, determine the clinical significance, correlate with clinical findings and recent literatures, make recommendations for additional testing
 - Competent in drafting accurate clinical reports summarizing positive and important negative findings and interpretations
 - Communicate results clearly with healthcare professionals (residents and genetic counselors)

Medical Genetic Knowledge:

1. Understand the principles of biology and genetics related to biochemical genetics-covered by departmental and divisional seminars, journal clubs and case conferences and medical genetics course
2. Understand principles of major inborn errors of metabolism (IEM) etiology-weekly didactic lectures
 - Enzyme defects of major pathways
 - Receptor, transporter or abnormal protein structures
 - Cellular organelle disorders (lysosomal storage disease (LSD), peroxisomal, etc)
 - Mitochondrial disorders
3. Understand treatment principles
 - Restriction of precursor
 - Supplement of co-factor or deficient products
 - Utilization of alternative pathway to get rid of toxins

- Enzyme replacement
 - Organ transplantation/BM transplantation
 - Chaperons to correct misfolded protein
 - Gene therapy
4. Understand newborn screening (NBS) principles and current updates in NBS
 5. Familiar with algorithm of NBS confirmatory testing strategy

Practice-Based Learning

1. Can review literature to obtain information on biochemical genetics techniques and their use in clinical medicine
2. Participate in presenting positive cases at division case conference

Interpersonal & Communication Skills

1. Can obtain clinical information to assist the lab in appropriate test selection
2. Can explain clinical findings and their significance to laboratory staff
3. Can communicate laboratory results in a appropriate manner to patients & their families, and referring physicians and genetic counselors

Professionalism

1. Demonstrates respect for patient confidentiality
2. Considers sensitivity to patients of diverse backgrounds when communicating lab results
3. Become sensitive to ethical issues in genetics, particularly those raised by biochemical genetic testing

System-Based Practice

1. Work effectively with various members of the clinical and laboratory team to facilitate accurate and appropriate patient testing and reporting of results
2. Is aware of the cost and risks/benefits of obtaining samples and providing testing
3. Participate in lab quality management process including quality control, quality assurance and quality improvement
4. Familiarize with other lab management process including laboratory information systems, billing and reimbursement issues and policy implications

Research-Related Activities

1. Learn IRB and HIPAA regulations, protocols, and consents process
2. Development of new laboratory tests and validation of assays for clinical use
3. Participate in ongoing translational research projects related to biochemical genetics