Clinical Cytogenetics & Molecular Genetics Training Program

Introduction

In the recent past Biotechnology has witnessed tremendous progress in the fields of applied medical genetics and recombinant DNA technology. However since there only a few specialized genetic centers in the Arab and Islamic world in general; the Center of Excellence in Genomic Medicine Research (CEGMR) at Jeddah's King Abdul-Aziz University was established to help address the needs of the region. Since its establishment CEGMR has placed priority on setting up a professional training program designed to assist transfer of applied genetic technology.

Today CEGMR stands out as a specialized genetic facility with state-of-the art equipment for cytogenetic and molecular testing of human genes and subsequent mutations, some of which may have clinical relevance for certain types of cancer and inherited disorders.

Program Objectives

The fundamental aim of the CEGMR training program is to provide specialized training to physicians and medical laboratory technologists in the fields of:

- Clinical Cytogenetics
- Molecular Cytogenetics
- Molecular Genetics

At the end of the training the applicant is expected to have a clear understanding of the following:

- Recent advances in cellular and molecular aspects of human genetics.
- Chromosome karyotyping techniques and their applications.
- Analyzing DNA and RNA for diagnosing certain inherited diseases.
- Detection and sequencing of common disease related mutations prevalent in Saudi population.
- Patterns of genetic inheritance and the process of anticipation in genetic diseases.
- Concept of DNA banking system and bioinformatics.
- Implications of ethical and social issues based upon Islamic Values and legislation concerning genetic diagnosis of inherited diseases.
- **Correctly handling the following specialized instruments:**
  - **PCR**
  - **Real time PCR**
  - **DNA Sequencing**
  - **Microarray Affymetrix**
  - **Gel Documentation**
  - **Applied Image Cytogenetic Workstation**
  - **Light Microscopy**
  - **Fluorescent Microscopy**
  - **Inverted Microscopy**

Training Period and Certification

The trainee will spend a total of two full months at CEGMR: four weeks at the Cytogenetics and Molecular Cytogenetic laboratory and the remaining four weeks at the Molecular biology laboratory. On fulfillment of all the training criteria, including time spent in the laboratory and successfully passing the examination, the trainee will be granted a certificate of workshop completion in the fields of Cytogenetics and Molecular biology.

Training Program Requirement

The applicant must fulfill the following criteria for acceptance:

- He / she must be a Saudi citizen or a valid Iqama holder.
- Applicant must hold a Bachelor degree from College of Medicine, Applied Medical sciences or from any equivalent college program.
- Minimum grade required is 'Good'
- Applicant must successfully pass an interview
- Show competency in both written and spoken English
- Submit the required tuition fees
- Comply with the overall rules and regulations of King Abdul-Aziz University

Supervisory and Consultancy Committee

The training is supervised by a group of specialized teaching staff from the College of Medicine and Applied Medical Sciences.

Training Facility

The training will take place at CEGMR based at King Abdul-Aziz University. CEGMR is composed of well equipped laboratories spanning region of 1700m^2, plus 10 specialized satellite laboratories covering an additional area of 16m^2 each. There is also a full size teaching and training laboratory equipped with latest apparatus required for applied Cytogenetic and Molecular analysis.

The center has dedicated a staff comprising of laboratory supervisors, seniors, technologists, technicians and administrative personnel, who are all fully trained in the skills required to carry out the technical and diagnostic tasks of the laboratory.

Training Course Outline

The duration of the program is two months, i.e. 8 weeks in Cytogenetics and Molecular Biology. During this period the trainee will be supervised on day-to-day basis with the opportunity for technical experimentation. The applicant will gain theoretical knowledge by attending specialized lectures delivered by professionals. Quizzes and practical assignments will be given throughout the course to monitor the progress of the trainee. Finally the applicant will be required successfully pass the final exam, after which he/she will to achieve the completion of training certificate.

The applicant may join the training program at any of 3 starting point each year, in addition, under certain circumstances the course could be taken during summer vacation.

The training course will be used as a knowledge seeking platform for scientists from any specialty (whether they are health professionals, postgraduate students or researchers) who will benefit from the knowledge and will be able to apply what they have learned for the benefit of the community.

This hands on training program, to the best of our knowledge, is the first of its kind in the region.

Training Guideline Learning outcomes:

Cytogenetic and Molecular Cytogenetic

Knowledge:

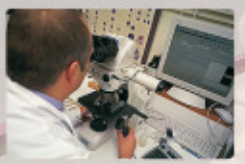
Trainees are required to demonstrate an understanding of:

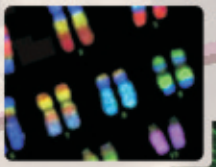
- Safety in Cytogenetic laboratory.
- Quality control regulations affecting cytogenetic work.
- Clinical indications for cytogenetic testing and clinical implications of test result.
- Ethical issues in genetics.
- Principles of prenatal cytogenetic diagnosis, and cancer cytogenetic.
- Types of samples and methods of collections.
- Major techniques used in clinical cytogenetic, including culture of peripheral blood, fibroblasts, amniotic fluid, and chorionic villi, chromosome staining, karyotyping.
- Cell cycle, including mitosis and meosis.
- Chromosome structure and function..
- Chromosome band Nomenclature.
- Aneuploidy-numeric abnormalities of autosomes and sex chromosomes, Chromosome structural abnormalities-micro deletions, markers, rearrangements and segregation; rearrangements and segregation.
- Major syndromes due to numerical aberration and chromosomal imbalance.
- Chromosome breakage/instabiity syndromes/fragile sites.
- Principles and applications of techniques and stains used in diagnostic Cytogenetic. For example, solid banding, high resolution banding, C banding, R-banding, Distamycin A/DAPI, NOR, late replication and sister chromatid.
- Principles and applications of fluorescence in situ hybridization techniques.
- Genetic counseling.
- Gamete or genomic imprinting and uniparental disomy.

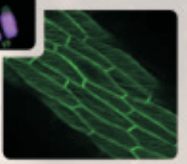
Skill

Trainees are required to demonstrate the ability to:

- Perform routine cell culture and chromosome preparation techniques from blood and specialized procedures such as fragile site induction, Chromosome breakage/instability syndromes and high resolution banding.
- Observe routine cell culture from hematopoietic tissue, solid tumor tissue, amniocytes, chorionic villi and fibroblast.
- Perform slide making technique.
- Perform routine staining techniques (solid, and G).
- Karyotype and identify normal and abnormal chromosome complements by microscopic and print analysis.
- Perform computerized karyotyping;
- Perform fluorescence in situ hybridization(FISH) procedures of metaphase.
- Chromosome and interphase nuclei for cytogenetic diagnosis.
- Assess whether further work is required on a case and write a report with a review of the literature if appropriate;







Molecular Genetic

Knowledge

Trainees are required to demonstrate:

- General knowledge of molecular biology;
- Advanced knowledge of molecular genetics, particularly as it is applied to the Investigation of human disease;
- General knowledge of the pathophysiology of inherited disorders, particularly those amenable to molecular diagnosis;
- Advanced knowledge of human genome, structure of genes, the nature of mutation at well recognized human loci and the correlation between genotype and phenotype at these loci;
- Advanced knowledge of methods for direct analysis of mutations;
- Advanced understanding of the estimation of genetic risk by inferential methods including linkage analysis and lod scores, Bayesian probability, pedigree analysis and risk calculation in familial or potential new mutation situations using linked polymorphisms. Candidates will be expected to be familiar with a board spectrum of disorders representing all modes of inheritance, as well as an understanding of the relationship between physical and genetic maps of chromosomes; and
- Advanced knowledge of the human genome project.

Skill

The trainee are required to demonstrate competence in the theory and practice of Techniques used in the molecular analysis of genetic disease, including an awareness of the variables that contribute to the quality of results and ability to "trouble-shoot" successfully.
These should include (but are not limited to) the following:

- DNA and RNA isolation from various biological samples.
- Polymerase Chain Reaction and Gel Electrophoresis.
- Confirmatory strand gel electrophoresis (CSGE).
- Restriction fragment length polymorphism (RFLP) and application of restriction enzymes, and interpretation of the data.
- DNA sequencing by the capillary method and finding sequence variations.
- Real time quantitative PCR (qPCR).
- Bioinformatics and use of electronic resources in molecular biology research.