

# 100% PRACTICAL RESEARCH PROGRAM ON

## GENOMICS OF INFECTIOUS DISEASES

*(Unveiling Pathogen Genomes: Navigating the Intricacies of Infectious Diseases through DNA Insights)*



### RESEARCH WORKSHOP AND PROJECT OUTLINE

**DURATION: MAXIMUM OF 3 MONTHS ONLY: 12 WEEKS**

#### OUTLINES

- Introduction, aims and objectives of research workshop.
  - Understanding the concept of population and comparative genome analysis to explore pathogenic bacteria
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- Search for subject related research articles and study them relative to your study of interest
  - **Research proposal** will entail 1<sup>st</sup> your pathogenic organism of interest to be studied, 2<sup>nd</sup> your special interest based on specific pathogenic functional capabilities of the bacteria relative to the host and 3<sup>rd</sup> your research paper title you have in mind.
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- We will treat a Practical session on **the fundamental of bioinformatics course** (what is bioinformatics, biomolecular data, data types, sequencing, file types, etc.) via a Video Drop.
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- Submitting your research proposal
  - Together, based on your previous research findings, we will Design a research project workflow for the entire study to be done.
  - **Introduction** to all software tools and the entire pipelines, including installations, and their applications which we will be using during the research workshop

- Knowing the number of WGS samples to work with geographical specifications
- Individual organism genomes of interest on NCBI database will be searched such as fastq raw data and assembly genomes for research work.
- Processing raw reads and performing genome assembly of individual organism genomes of interest.
- **Construct comparative general features via data table based on genome information which includes accession number, raw data size, sources, geographical regions platform, genomes type, layout, file types etc.**

- **Evaluation of the genome assembly results**
- **Plasmid prediction of all assembly genomes**
- **Prediction of a bacteria's pathogenicity towards human hosts.**
- **ToxFinder identifies genes involved in mycotoxin synthesis.**

- **Doing Comprehensive genome analysis of individual samples, including annotation, gene prediction, survival gene markers, etc.**
- **You need to do comprehensive genome analysis for other strains collected/retrieved as assembly fasta file from NCBI**
- **Commencing research paper write-up, relative to the organism of interest. Part 1 (introduction)**

- Comprehensive Evaluation of comprehensive genome analysis of individual samples
- Genome sequence properties
- **Construction of a comparative statistical table and figure of the functional genome properties**
- **Functional Genome categorization (GENOME MAP)**

- **Antibiotic resistant profiling** (resistance genes, susceptibility genes, resistant mechanism, antibiotics class, functional or putative proteins...)
- **Comparative AMR genes and result in data computation and visualizations (using a comparative approach)**
- **Comparative Resistant Mechanism and result in data computation and visualization**
- **Shared resistance genes between strains and result data computation and visualization**

- **Comparative Virulence factors and genes** between strains and result data computation
- Shared specific genes and result data computation
- Drug targets and Protein Structures

- Identification of mobile genetic elements and their relation to antimicrobial resistance genes and virulence factors.
- Evolutionary study (phylogenomics tree) (Whole Genome)
- ANI analysis

- Pan/core genomics analysis (genome map) of selected genomes
- Comparative Genome Analysis (Last Alignment)
- Construction table/figure for the output results of **subsystem functional categorization**
- Research paper writing: **part 2: materials and methods**

- Visualization of all Computed result data (Heatmaps, Histogram, bar chart etc.)
- Research paper writing: **part 3: finishing materials and methods and starting results writing (putting together all figures and tables) while combining all available work done.**

- Evaluation and report writing from comparative results from previous analysis
- Research paper writing: **part 4: detailed discussion starting from**
  1. Insights from functional genomes properties
  2. Result writing for computed tables, figures etc

- Thorough evaluation of all work done
- Research paper writing: **part 5: detailed discussion, this time for specific pathogenic investigations**

- Thorough evaluation of all work done
- Research paper writing: **part 6: finalizing discussion and making conclusion including references**

- **Finalizing all research project work done and remark**