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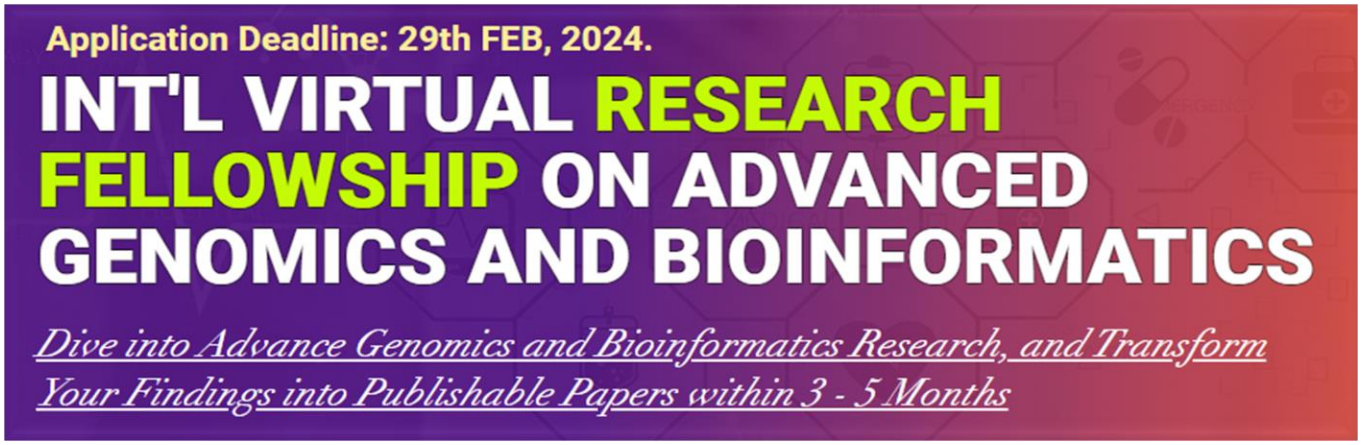

*We envision inspiring and empowering life scientists to leverage **GENOMICS AND BIOINFORMATICS** to tackle critical challenges, drive innovation, and promote sustainable progress across the globe.*

Research Domain: Clinical Genomics & Epidemiology.
Research Focus: Clinical Genomics of Infectious Diseases.
Research Case Study: *Human or Animal or Plant or Food pathogens*
Research Topic: *To be crafted by the participant*
Research Aim: *To be crafted by the participant*
Research Objectives: *To be crafted by the participant*

LEARNING OBJECTIVES

- **Genomic Techniques Proficiency:** Master advanced genomic techniques for identifying genetic determinants of antimicrobial resistance.
- **Global Surveillance Competence:** Develop expertise in designing and interpreting global surveillance data to track antimicrobial resistance worldwide.
- **Molecular Biology Mastery:** Enhance skills in manipulating and studying antimicrobial resistance-associated genes at the molecular level.
- **Data Analysis and Presentation:** Gain proficiency in utilizing bioinformatics for analyzing and presenting large-scale genomic datasets related to resistance.
- **Translation of Findings into Public Health Strategies:** Learn to translate research results into evidence-based recommendations for global health policies and interventions.
- **Craft Research Papers for Publication:** Learn how to synthesize and present your findings coherently, culminating in the preparation of research papers suitable for publication, contributing to the broader understanding of the evolution and dissemination of infectious diseases.

EXPECTATIONS WHILE UNDERTAKING THIS FELLOWSHIP PROGRAM:

- **Knowledge of Genomics and Bioinformatics:** Develop a solid foundation in genomics and bioinformatics, including an understanding of key concepts, methodologies, and technologies used in the program
- **Proficiency in Data Analysis:** Gain proficiency in analyzing genomic data using bioinformatics tools and software. This includes skills in data preprocessing, quality control, data visualization, and statistical analysis.
- **Research Skills:** Acquire research skills necessary for conducting genomics and bioinformatics studies. This includes formulating research questions, designing experiments, collecting and analyzing data, and interpreting research findings.
- **Critical Thinking and Problem-Solving:** Develop critical thinking skills to analyze complex genomic and bioinformatics problems and propose creative solutions. You would be able to evaluate scientific literature, identify research gaps, and contribute to the advancement of knowledge in the field.
- **Computational Skills:** Gain proficiency in software and applications commonly used in bioinformatics, such as Geneious software, web servers etc. to analyze genomics data and interpret results
- **Communication Skills:** You would be able to effectively communicate your research findings and scientific concepts to both technical and non-technical audiences. This includes writing scientific reports, presenting research orally, and participating in scientific discussions and collaborations.
- **Collaboration and Teamwork:** Be able to develop skills in collaborating with peers and professionals in multidisciplinary research teams. This includes effective communication, teamwork, and the ability to contribute constructively to group projects.
- **Professional Development:** You would be able to develop a professional mindset, including skills in time management, organization, and project management. They should also be aware of current trends and advancements in genomics and bioinformatics, and actively seek opportunities for professional growth and development.

PROGRAM OUTLINE AND SCHEDULE

CLASSES	TOPICS/FOCUS	SCHEDULE & DELIVERABLES
General Classes	Overview of genomics, bioinformatics, and their applications in various fields	**WEEK 1**
	Understanding the central dogma of molecular biology	
	Introduction to genomics technologies and data generation	
	Data formats in Genomics and Bioinformatics (Practical)	
	Internet tools and Databases (Practical on data retrieval, Blast etc.)	
	Introduction to software tools and their installation, web servers, and pipeline tools (Practical), Basic Linux Command Line Interface	
	Genomics Data and its Analysis using cutting-edge tools (Practical DNA, RNA and Protein samples)	
Specialized Classes	Introduction to clinical genomics of infectious diseases	

	The experimental application of each of these in your field of study	
	Problem identification relative to the above area in the healthcare, industrial, and other life science research space	
	The use of critical thinking and problem-solving tools to design a hypothesis in solving identified problems	
PRACTICAL SESSIONS		**WEEK 2**
Data Acquisition and Preprocessing	**Collection of WGS (NGS) Genomic Data:** Gather whole-genome sequencing data of multi-drug resistant pathogenic bacteria strains from relevant sources and databases.	
	Table 1: Construction of General Sequence Properties: via data table based on genome information which includes accession number, raw data size, sources, geographical regions platform, genome type, layout, file types, etc.	**Deliverable:** (Materials and Methods)
	Quality Control: Assess data quality, perform trimming, and filter out low-quality reads to ensure reliable results.	
	Write Up 1: Reads Processing and Genome Assembly	
Comprehensive Genome Analysis	**Functional Annotation:** **Gene prediction, Protein features, Specialty features, Chromosomal properties, and Circus-view, among others.**	
	Write Up 2: Functional Genome Annotation	**Deliverable:** (Materials and Methods)
	Table 2: Construction of Chromosomal Genome Properties: CDS, Genes, RNA, Hypothetical Protein, Functional Protein, Go assignments, PGfam, Cripsr, etc.	**Deliverable:** (Results)
	Functional Genome Categorization: The use of the Rastk tool kit to perform comparative subsystem categorization of all genome strains.	**WEEK 3**
	Write Up 3: Subsystem Functional Categorization	**Deliverable:** (Materials and Methods)
	Figure 1: Subsystem Functional Categorizations	**Deliverable:** (Results)
Genomic Insights into Drug Resistance and Mechanisms of Adaptation	**Resistome Profile Study:** Understanding the mechanisms underlying antibiotic resistance and its relevance to the spread and evolution of multi-drug resistant pathogenic bacteria.	**WEEK 4**
	Write Up 4: Resistome Profiling Analysis	**Deliverable:** (Materials and Methods)
	Statistical Analysis: • **Figure 2:** Heatmap of antibiotic resistance genes (ARG) types across strains (Antibiotic Class) • **Figure 3:** Prevalence of AMR genes across strains • **Figure 4:** Percentage distribution of ARG resistance mechanism • **Figure 5:** Relative distribution of AMR genes in antibiotics	**Deliverable:** (Results)

	• **Table 3:** Shared resistance genes and their putative functions between strains	
Genomics Insights into the Mechanisms of Bacteria's Pathogenicity	**Virulome Profile Study:** Understanding the mechanisms through which the strains evade host defenses and cause infections. **Plasmid/Prophages prediction:** **Mobilome Analysis:**	**WEEK 4**
	Write Up 5: Virulome Profile Analysis, Mobilome, Plasmid and Prophages	**Deliverable:** (Materials and Methods)
	Statistical Analysis: • **Figure 6: Comparative Virulence factors and genes between strains** • **Table 4:** Shared specific encoding of VR and A and their putative functions. • **Table 5:** Prediction of a bacteria's pathogenicity towards human hosts: • **Figure 7:** Expression level of MGEs across strains	**Deliverable:** (Results)
Identification of Genetic Markers	**Variant Annotation:** Annotate SNPs to identify variants with potential functional significance, such as drug resistance-associated mutations etc. **Pathogenicity Assessment:** Predict the impact of variants on protein function and assess their potential contributions to pathogenicity.	**WEEK 5**
	Write Up 6: Variant Calling and Pathogenicity Assessment	**Deliverable:** (Materials and Methods)
	Statistical Analysis: • **Table 6:** AMR/Virulence Genes retrieved across samples • **Figure 8:** Variant calling View • **Table 7:** Annotated SNPs and their functions • **Figure 9:** Percentage abundance of all SNPs across genes • **Figure 10:** Ratio of Functional SNPs	**Deliverable:** (Results)
Comparative Genome Analysis (Insights into Spread and Transmission)	**Phylogeographic Analysis:** • **Phylogenetic Tree Construction:** Build a phylogenetic tree using SNPs to reveal the evolutionary relationship among the strains. • **Phylogeographic Mapping:** Overlay phylogenetic data onto geographical maps to visualize patterns of spread and transmission routes.	**WEEK 6**
	Write Up 7: Phylogeographic Spead and Transmission Analysis	**Deliverable:** (Materials and Methods)
	Figure 11: SNP-based phylogenetic tree **Figure 12:** Phylogeographic construction	**Deliverable:** (Results)

RESEARCH PROJECT OUTLINE FOR PUBLICATION

Research Outline	Aims and Objectives	
	Abstract	
	Introduction	**WEEK 7**
	Materials and Methods	**WEEK 8**
	Results	**WEEK 9 & 10**
	Discussion	**WEEK 11**
	Conclusion	
	References	
Round Up	Certification and Recommendation Letter	**WEEK 12 UPWARD**
	Follow-up and Publication	