SAGESA AMR Bioinformatics Workshop

Genomic Surveillance Overview

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PRESENTATION OUTLINE

By the end of the session, participants should be able to:

- Briefly describe the SAGESA project
- Define genomic surveillance
- Discuss use of genomic data

SAGESA PROJECT

A collaboration by

- Scientists from National Institute of Communicable Diseases in South Africa, the Faculty of Medicine and Health Sciences at the University of Zimbabwe, Wellcome Connecting Science and the Centre for Genomic Pathogen Surveillance, UK
- Funded by the Cambridge Africa ALBORADA Research Fund

SAGESA website

SAGESA OBJECTIVES

Main goal

- **T**o establish a critical mass of expertise in genomics-based surveillance of AMR, and promote AMR data sharing across Southern Africa

Strategic objectives

- Establish a research network and provide training, as an important step in building capacity for genomic surveillance of antimicrobial resistance (AMR)
- Enable sub-regional collaborative partnerships between researchers and public health institutions in Southern African countries as well as global partners involved in AMR research and training

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Introduction

- Genome
  - Complete genetic information of an organism or a cell
  - Stored on a single or double stranded nucleic acids in a linear or in a circular sequence
- Molecule of life
  - When was DNA discovered?

Historical background

- DNA
  - First identified in the 1860s by a Swiss chemist, Johann Friedrich Miescher
  - James Watson and Francis Crick in 1953 first published the structure of DNA
  - 1910 Nobel price winner Albrecht Kossel first described the chemical name deoxyribonucleic acid (DNA) and isolated the 5 nucleotide bases (adenine **(**A), cytosine (C), guanine (G), thymine (T) and uracil (U)) in 1881

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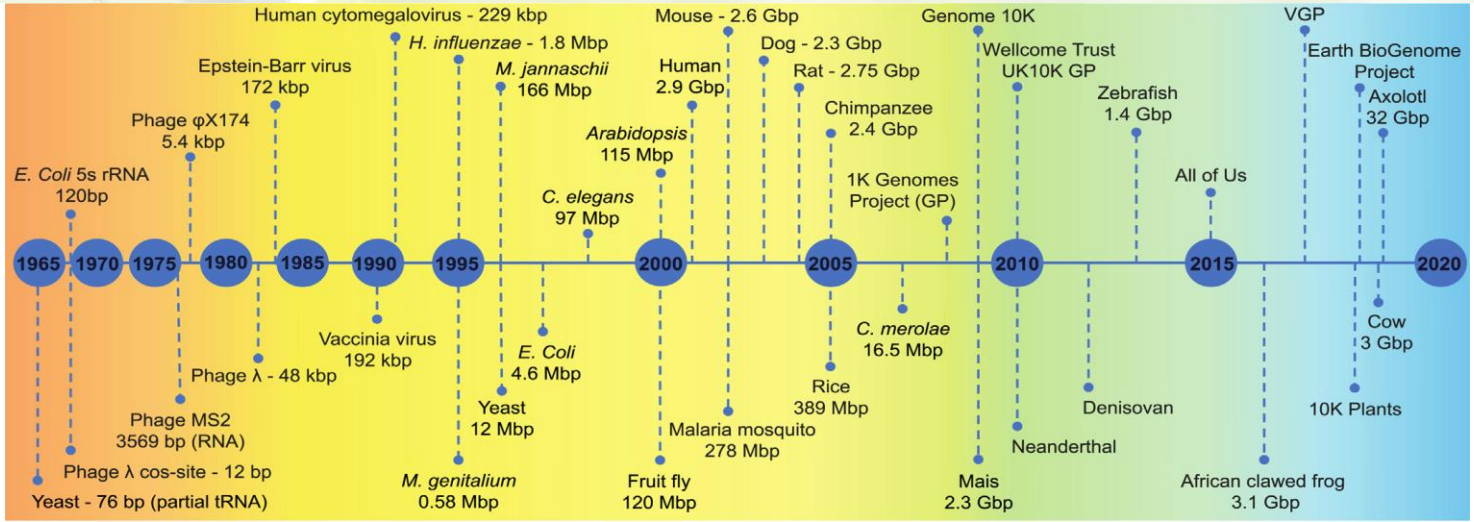
Genomic Surveillance



Source: A.M. Giani et al. / Computational and Structural Biotechnology Journal 18 (2020) 9–19

Definition of Whole Genome Sequencing

- A laboratory process used to determine nearly all of the approximately 3 billion nucleotides of an individual's complete DNA sequence, including non-coding sequence.
  - National Cancer Institute
- Useful in the identification of gene functions and their involvement in disease
  - Rui Yin et al. Whole Genome Sequencing Analysis; Encyclopedia of Bioinformatics and Computational Biology, 2019

Use of Whole Genome Sequencing in AMR Surveillance

- Antimicrobial resistance (AMR) is an increasing threat to public health and sustainable development
- The WHO Global Action Plan on AMR recommends genomic surveillance to inform strategies and monitoring the effectiveness of interventions
  - Global Antimicrobial Resistance and Use Surveillance System (GLASS)

Public Health Importance of Genomic Surveillance

- Policy formulation on strategies to manage AMR
- Diagnosis
  - AMR sequencing data provide key information to guide the development of rapid diagnostic tools for better and more rapid characterization of AMR, complementing phenotypic methods (WHO, 2020)
- Studying transmission patterns

Public Health Importance of Genomic Surveillance

- Drug discovery
- Describe pathogen diversity
  - Why is treatment outcome different between patients infected with same organism
- Treatment
  - Drug sensitivity testing and formulation of treatment regimen

Public Health Importance of Genomic Surveillance

- Describe mechanism of drug resistance development
- Vaccine development

Limitations of Genomic Surveillance

- Substantial initial and recurrent investment in lab infrastructure, standardization of bioinformatics methods, storage technology, QA protocols and protocols for data sharing
- Incomplete understanding of the molecular mechanisms underlying resistance to some antimicrobial classes
- Cannot replace phenotypic surveillance in fast growing bacteria as it only detect known resistance mechanisms

AMR Bioinformatics Training

- Limited capacity in analysing WGS data in the Africa region
- Training seeks to address these capacity issues in the Africa region
  - At least raise awareness and appetite to continue learning

Participants research focus

- Mixed
  - Mainly treatment, diagnosis, epidemiological and transmission studies
- Organisms
  - Varied
  - Enteric, respiratory and one health pathogens

Expectations

- Instructors wish list
  - Different skill level
  - Collaborate
  - Involve yourself in active outbreak investigation
- Participants wish list
  - Assist with data analysis
  - Develop skills to analyse my own data
  - Learn from others
  - Collaborate

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Thank you

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