Genomic Surveillance of SARS-CoV-2 in Africa: connecting the dots between the clinical and the sequencing labs

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Outline

- Public Health Pathogen Genomics at the Africa CDC
- Accelerating SARS-CoV-2 sequencing in Africa
- Progress, challenges & lessons learned
- Summary
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Public Health Pathogen Genomics at the Africa CDC

Continental assessment of genomics and bioinformatics capacity was conducted
• In collaboration with ASLM

January 2017: Africa CDC officially launched

January 2020: Continental consultation on Pathogen Genomics
Major findings:

- Limited infrastructure and skilled workforce
  - Laboratory and bioinformatics
- Enabling mechanisms
  - Lack of policies and frameworks
  - Leadership and coordination
  - Supply chain, cost & custom challenges
Public Health Pathogen Genomics at the Africa CDC

Major findings:

- Sporadic capacity
  - >70% capacity in 5 countries
- Limited capacity in public health institutions (< 30%)

[Map of Africa showing number of NGS devices per country]
Public Health Pathogen Genomics at the Africa CDC

January 2017: Africa CDC officially launched

Continental assessment of genomics and bioinformatics capacity was conducted
- In collaboration with ASLM
- Funding from BMGF

November 2019: Africa CDC Institute of Pathogen Genomics launched
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January 2017: Africa CDC officially launched

November 2019: Africa CDC Institute of Pathogen Genomics launched

COVID-19 Pandemic

October 2020: Africa PGI launched

August 2020:
Accelerating genomics-based surveillance for COVID-19 response in Africa
Africa Pathogen Genomics Initiative
Strengthening Laboratory Networks and Surveillance Systems

In Partnership with:
Key components of the Africa PGI

- **Strengthening Africa CDC Institute of Pathogen Genomics**
  - Enabling mechanisms
  - Leadership
  - Policies and guidelines
  - Coordination
  - Partnerships
  - Resource mobilization

- **Pathogen Genomics and Bioinformatics Network**
  - Continental network
  - Capacity building in 20+ NPHIs

- **Africa Pathogen Genomics Initiative (Africa PGI)**

- **NGS Academy**
  - Laboratory
  - Bioinformatics
  - Genomic epidemiology

- **Data architecture and systems**
  - Data governance
  - Data analyses
  - Data utilization
  - Data sharing

- **High-impact genomic-use cases**
  - Emerging and re-emerging diseases
  - Endemic disease
  - NTDs
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Africa CDC 2021 targets:

1. Operationalize the network and support the sequencing of 50,000 SARS-CoV-2 genomes

2. Support member states with limited or no sequencing capacity through sample referral – support at least 35 countries and 20,000 samples

3. Conduct hands on trainings to train at least 100 candidates in support of SARS-CoV-2 Sequencing by Member States
Acclerating SARS-CoV-2 sequencing in Africa

Africa CDC and WHO AFRO COVID-19 Sequencing Network

Specialized Genomics and Bioinformatics Centers (SGBC)

Regional Sequencing Hubs

National Sequencing Labs

ACEGID Nigeria
SANBI South Africa
ILRI Kenya
KRISP South Africa

Institut Pasteur Morocco
IPD Senegal
NMIMR Ghana
Nigeria CDC
INRB DRC
CiRMF Gabon
UVRI Uganda
KEMRI Kenya
NICD South Africa

Morocco
Libya
Egypt
Tunisia
Algeria
Mauritania
Sahrawi Arab Democratic Republic

Senegal
The Gambia
Mali
Burkina Faso
Guinea
Côte d’Ivoire
Guinea-Bissau
Niger
Cabo Verde

Ghana
Benin
Liberia
Sierra Leone
Togo

Nigeria
DR Congo
Cameroon
Central African Republic
Chad
Rep. of the Congo

Gabon
São Tomé and Príncipe
Equatorial Guinea

Uganda
Rwanda
S.Sudan
Tanzania
Burundi

Kenya
Djibouti
Eritrea
Ethiopia
Somalia
Seychelles
Comoros

South Africa
Angola
Botswana
Eswatini
Lesotho
Malawi
Mozambique
Namibia
Zambia
Zimbabwe
Mauritius
Madagascar
Acclerating SARS-CoV-2 sequencing in Africa

Leverage & strengthen
Network [Access to sequencing]
Expand & democratize
Sample referral network

- **36 Member States**
  - Referred SARS-CoV-2 specimens for sequencing

- **24,784**
  - SARS-CoV-2 specimens referred (124% of our target)

- **3 days**
  - Average number of days from sample pick up to delivery. It ranges from 1 to 15 days.

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**Acclerating SARS-CoV-2 sequencing in Africa**

Cumulative number of referred specimens

Sample referring Member States

African Union

ASLM

AFRICA CDC

Insgombe Muitua’s Health
Leverage and strengthen regional hubs

$1.7M in subaward
to support SARS-CoV-2 sequencing in 10 regional hubs

+64,000 sequencing reagents
Reagents to sequence SARS-CoV-2 specimens

12 sequencing equipment
Illumina: 4x NextSeq 2000s & 1x Miseq
ONT: 5x GridIONs & 2x MinION Mk1C

Acclerating SARS-CoV-2 sequencing in Africa
Acclerating SARS-CoV-2 sequencing in Africa

Democratize and expand sequencing in NPHIs and NRLs

- 14 Member States
- +35,000 reagents
  - Reagents to sequence SARS-CoV-2 specimens and/or to detect VOCs
- 12 sequencing equipment
  - ONT: 1x GridIONs & 11x MinION Mk1B/MK1C
Trainings on COVID-19 sequencing:

- 46 Member States
- 6 trainings (4 hands-on & 2 virtual)
- 117 trainees on SARS-CoV-2 sequencing
  - 79 trained in hands-on & 38 trained in virtual
  - 38% of the trainees were females
  - 44 Member States included in the hands-on training
Training on infectious substance handling and transport

3 trainings on Infectious Substances Transport

39 trainees trained on Infectious Substances Handling and Transport

34 Member States included in the 3 trainings
several other initiatives at national and regional level are supporting SARS-CoV-2 sequencing in Africa
SARS-COV-2 sequencing in Africa | 2021 at a glance

12X more SARS-CoV-2 sequences in 2021 (compared to 2020)

- 2020: ~5,200 sequences
- 2021: ~60,000 sequences

Target: 2021
SARS-COV-2 sequencing in Africa | 2021 at a glance

As of 31 Dec 2020

20
Member states with >10 sequences

6
Member states with routine* sequencing

0.19%
of confirmed cases sequenced

As of 31 Dec 2021

50
Member states with >10 sequences

25
Member states with routine* sequencing

0.87%
of confirmed cases sequenced

*routine SARS-CoV-2 sequencing is defined by generating and sharing sequences in 7 out of the 12 months of the year
SARS-COV-2 sequencing in Africa | 2021 at a glance

Frequency of VOCs in Africa (as of 31 Dec 2021)

Sample Collection Date

VOCs: Alpha  Beta  Delta  Gamma  Omicron  other lineages
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Components of a genomic surveillance ecosystem

- Sampling & sequencing strategy
- Laboratory systems
- Data systems: analytics, interpretation
- Data interpretation and utilization to inform public health decision making
SARS-COV-2 sequencing in Africa | Connecting the Dots

RNA EXTRACTION → PCR AND LIBRARY PREPARATION → SEQUENCING → GENOMIC DATA ANALYSIS → DATA INTERPRETATION & REPORTING → Public health Decision → SPECIMENS → RNA EXTRACTION

Public health Decision

SARS-COV-2 sequencing in Africa
SARS-COV-2 sequencing in Africa | Sampling & sequencing strategy

Key considerations and lessons

Sampling & sequencing strategy

- Define the objective and purpose of sequencing
- Sampling and sequencing strategy should be developed based on the local context
  - Representative sampling and sequencing – to detect and monitor new variants of concern
  - Targeted sampling and sequencing - to investigate vaccine breakthrough infections, outbreaks, clusters of infections, unusual events
Key lessons:

Sampling & sequencing strategy:

- Sample quality is key to have high quality genomes
- Samples must be accompanied by Metadata – clinical and epidemiological data to inform the interpretation of the genomic data
- Metadata templates are available:
  - PHA4GE: [https://github.com/pha4ge/SARS-CoV-2-Contextual-Data-Specification](https://github.com/pha4ge/SARS-CoV-2-Contextual-Data-Specification)
  - Africa CDC – [https://forms.gle/VJsHiiwhdcZov36K9](https://forms.gle/VJsHiiwhdcZov36K9)
Sample referral network – challenges

Regulatory challenges:
- MTA
- Import & export permits

Cost of shipment:
- Courier efficiency & connectivity
- Dry ice & packaging materials
- COVID-19 related disruptions

4 days
[IQR:2-6 days]
Key considerations and lessons

- Genomics infrastructure
- Well trained workforce
- Quality assurance
- Turnaround time
SARS-COV-2 sequencing in Africa | Laboratory systems

Key challenges lessons:

- Trained personnel, throughput and automation
- Turnaround time is key
- Reagents & supplies – global demand and supply chain disruptions
- Quality assurance – lack of EQA PT panels for genomics
- Sustainability and continuity of support is key

14 days [IQR:7-35 days]*
SARS-COV-2 sequencing in Africa | Data systems

Key considerations and lessons

- Data infrastructure
- Well trained workforce
- Quality assurance of the data
- Turnaround time
SARS-COV-2 sequencing in Africa | Data systems

Key challenges:

- Trained personnel in Bioinformatics
- Data sharing - Turnaround time is key
SARS-COV-2 sequencing in Africa | Data Utilization

Key considerations for data use

- Representative data
- Complete data & Metadata
- Quality assured
- Timely generated & analyzed
- Linked with the public health system
- Inform public health decision making
How can we build on these efforts for pandemic preparedness and diseases surveillance in Africa?
How do we use the network for other use-cases?

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Africa PGI aspires to create a unique platform for partnerships to effectively implement and translate pathogen genomics into public health action

**Coordination**
for multi-pathogen and integrated implementation of public health pathogen genomics across Africa

**Collaboration**
to develop and deploy state-of-the-art technologies and tools to translate genomic data into public health action

**Commitment**
to adopt enabling mechanisms, build trusted partnerships, and ensure long-term sustainability
Acknowledgment