THE GLOBAL FUND

Wastewater-based surveillance as an early warning tool to monitor infectious diseases at community level

Information Session – 27 June 2023

This session is being recorded.

Agenda

Topic		Presenters
1	**Opening remarks**	**Peter Sands** Executive Director, The Global Fund to Fight AIDS, Tuberculosis and Malaria
2	**Regional perspectives on environmental surveillance through wastewater-based surveillance**	**Yenew Kebede Tebeje** Head, Laboratory Systems and Network Division and Acting Head, Division of Surveillance and Disease Intelligence, Africa CDC
3	**Phase I: COVID-19 wastewater-based surveillance implementation**	**Noah Hull** Laboratory Technical Manager, APHL
4	**Updates** • **Ethiopia** • **Kenya** • **Mozambique**	**Daniel Abera** Team Lead, Environmental Health Research Team, MOH/EPHI, Ethiopia **Leonard Kingwara** Head National Genomics and Molecular Surveillance Laboratory, MOH/NPHI, Kenya **Natalia Ismael** MOH/NIS, Mozambique
5	**Phase II: Using NGS for multi-pathogen wastewater-based surveillance**	**Noah Hull** Laboratory Technical Manager, APHL
6	**Q&A**	
7	**Closing remarks**	**Shunsuke Mabuchi** Head of RSSH, TAP, The Global Fund to Fight AIDS, Tuberculosis and Malaria

APHL Project Stellar: Wastewater-based Surveillance

Information Session
27 June 2023

Value of Testing Wastewater (WWBS)

Near-real-time information on disease prevalence

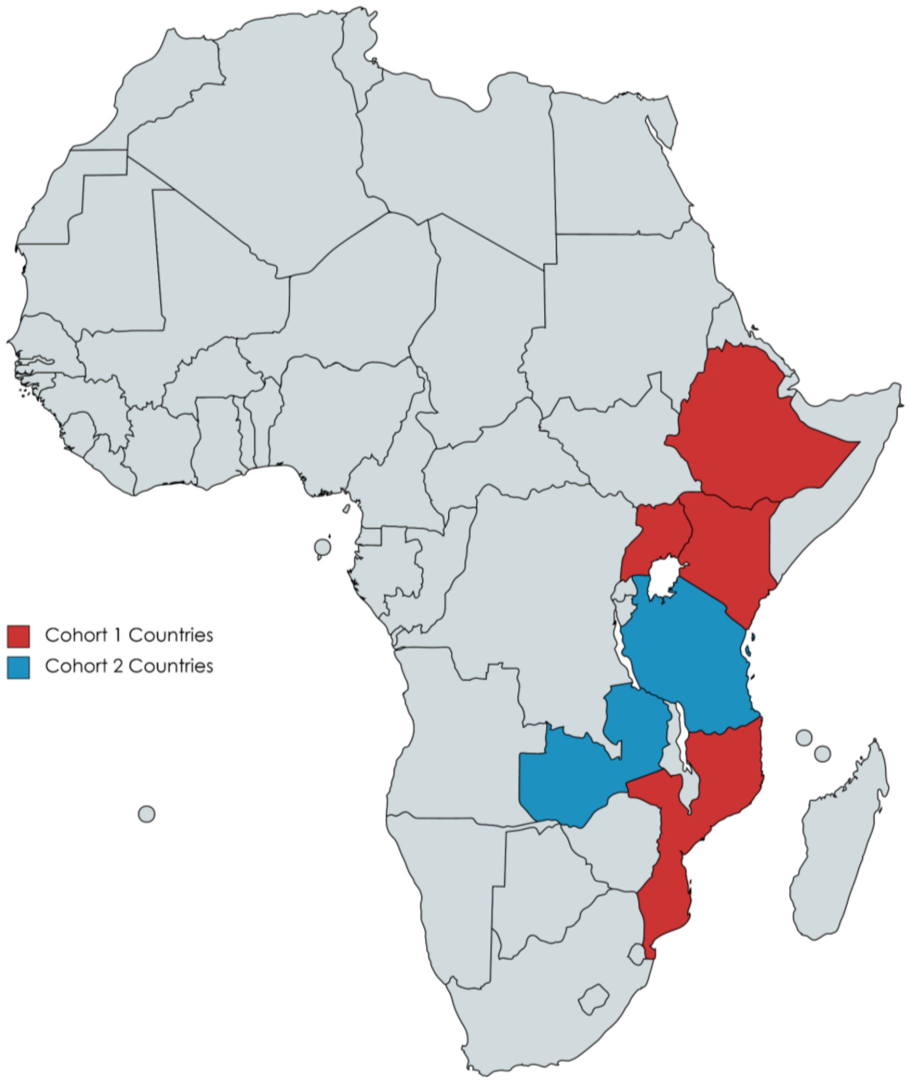
High sensitivity to detect mild and asymptomatic cases

Provides public health with early evidence for action

Cost-effective means to survey transmission in entire communities

APHL Project Stellar Objectives

- Support the development of testing capacity for SARS-CoV-2 in wastewater
- Technical assistance for validation of collection and testing protocol
- Technical assistance to improve data management and electronic test reporting system, including transfer from Laboratory Information Management Systems to epidemiology partners
- Support the use of data from WWBS surveys to complement case-based surveillance and monitor in-country trends
- Support and implement next-generation sequencing (NGS) of wastewater for SARS-CoV-2 and other pathogens of public health concern (e.g., AMR, VHF, pan-respiratory, etc.)



Ethiopia Case Study

Daniel Abera, PI

Ethiopian Public Health Institute

27 June 2023

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MINISTRY OF HEALTH-ETHIOPIA
የዜጎች ጤና ለሃገር ብልጽግና!
HEALTHIER CITIZENS FOR PROSPEROUS NATION!

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Ethiopian Public Health Institute

Project Timeline and Implementation

Phase and Timeline	Major activities	Accomplishments
Phase I: May – June 2022 Assess laboratory readiness	• Tools developed, assessment of laboratory capability and capacity strengths, weaknesses, risks	Gap analysis and country report completed
Phase II: July - January 2023 Strengthen lab capacity	• Contract agreement and Stakeholders' engagement	MoU approved and TWG established
	• Develop protocol, work plans, SOPs, budget and timelines.	All completed/ IRB certified protocol
	• Establish twining and training of staff	Staff capacity built
	• Procurement of equipment and supplies	Supplies procured for pilot testing
Phase III: Feb 2023 – to date Testing and result reporting:	• Sample site assessment and selection	Completed
	• Samples collection and test validation	Completed
	• Surveillance testing and report results	Ongoing
	• LIS and data management system	Ongoing
	• Genomic sequencing	Not started

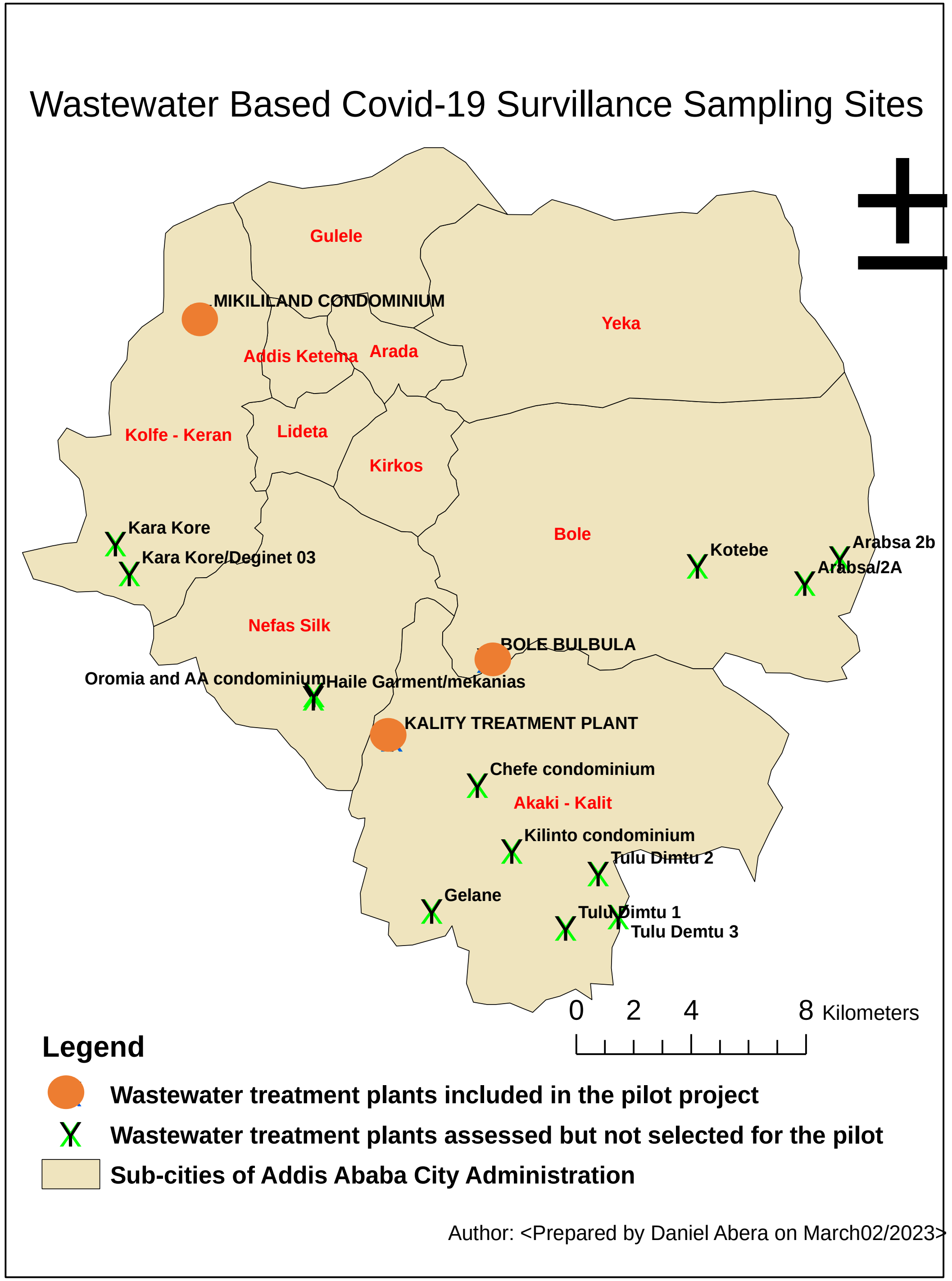
Methods and Study Areas

Study Site: Addis Ababa

- 3 sites that represented different sub-cities and treatment technologies, were selected based on population served, flow rate, and/or suitability for the intended purpose.

Sampling design: Longitudinal design:

- Wastewater influent samples collected three time a week per site for a period of 8-9 months
- Sample size: 300



Sample Collection Sites - Population data

1) Kality Wastewater Treatment Plant (WTP)
   - A centralized and older plant in Ethiopia.
   - Estimated population size currently served could reach 2,000,000, mostly living in the northwestern part of Addis Ababa
2) Mikililand Waste Stabilization Pond
   - It serves nearly 4,634 houses with an estimated population of 24,000 in 'Condominium'
3) Bulbula Wastewater Treatment Plant
   - It serves nearly an estimated population of 34,000 living in 'Condominium'

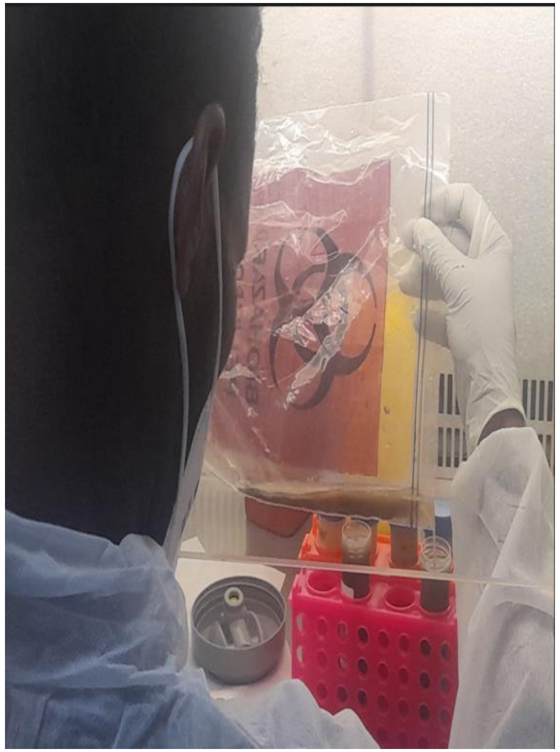
Notes: Population size is received from Addis Ababa Water and Sewerage Authority.

Ethiopia: Sample Collection and Transportation

Installation of SWAB at WTP

Collection of SWAB after 24 hrs

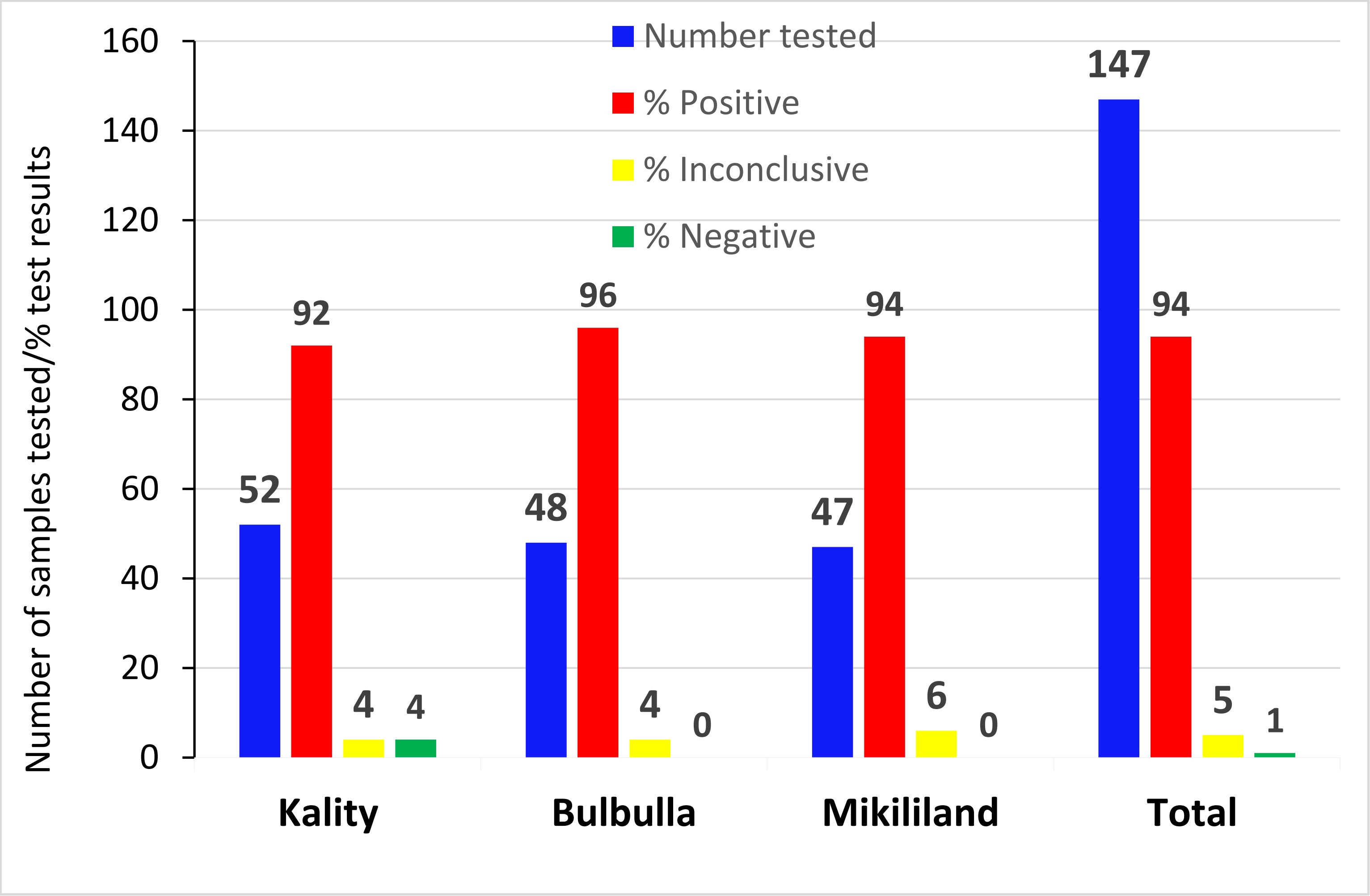
Sample Transportation to EPHI Lab



Squeezing SWAB at EPHI Lab

Wastewater-based Samples Tested for SARS-CoV-2

Test results, February - June 2023



- High rate of SARS-CoV-2 detection suggests active and subclinical cases circulating in the community
- Further expansion and active surveillance and monitoring of trends needed
- There is a need to develop a strategy to integrate with the case-based surveillance

Project Stellar: Pilot of wastewater as a surveillance tool in Kenya

27 June 2023

Leonard Kingwara, PhD
National Laboratory Services
MoH Kenya

Challenges and Interventions

Challenges	Intervention
Unavailability of required supplies in country and delay in procurement process	Purchased and imported from Kenya
Limited budget for NGS supplies for pilot and future of WWBS	Pending-NGS supplies to be procured by Principal Recipient; Awaiting confirmation from PR.
Limited budget for personnel cost for NGS implementation for this pilot	Discussion ongoing with PR and EPHI to address the gap
Unclear lead time/ status for procurement delivery of NGS supplies	Continue to follow up with the PR and request GF advocacy on our behalf
Expansion of WWBS is a priority but constrained by limited resources	MOH/EPHI will address in GC-7 application and/or resource leverage

Lessons Learned

- Joint planning and coordination with surveillance and epidemiology units is paramount in ensuring success and sustainability
- Strong partnership and close working relationship with EPHI and APHL were critical for the implementation of the project
- Building local capacity through twinning with US-based institution
- Establishing TWG and engagement with key stakeholders
- Leveraging and use of existing in-country C19RM resources increased efficiency and cost-effectiveness
- The need to address procurement and supply chain system
- Allocation of sufficient resources for the expansion plan, including NGS

Wastewater-Based Surveillance Pilot Study Implementation

- NPHL began the WW pilot study in April 2022, bringing together stakeholders to create a workplan for implementation.
- Sampling and testing began in December 2022 at two collections sites in Nairobi
- Sample collection and detection
  - Samples collected: 98
  - Positivity rate: 80.6%
- Twinning between NGMSL and Wisconsin lab
  - Sample collection, testing and analysis methodology

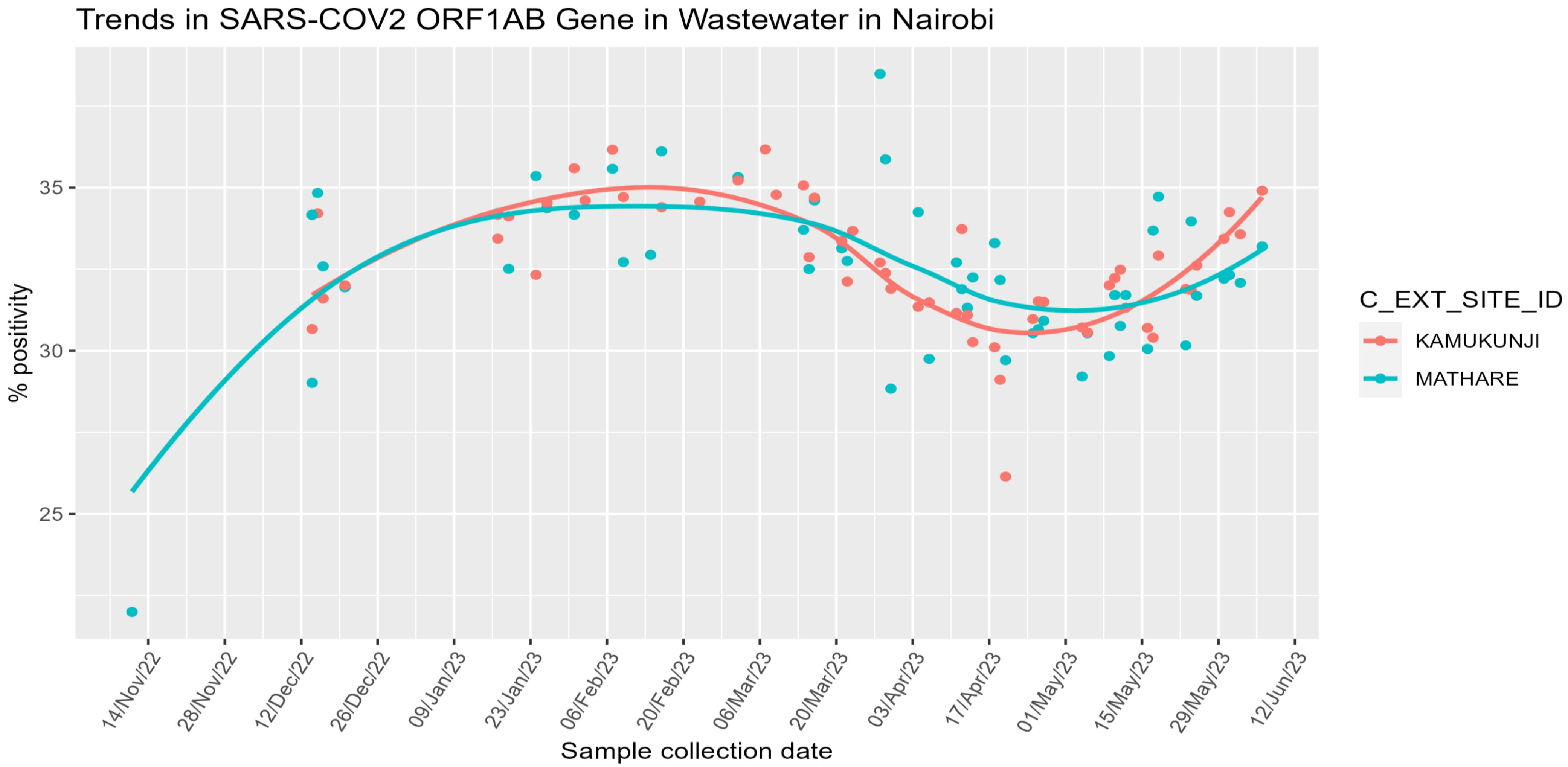




What's Next…

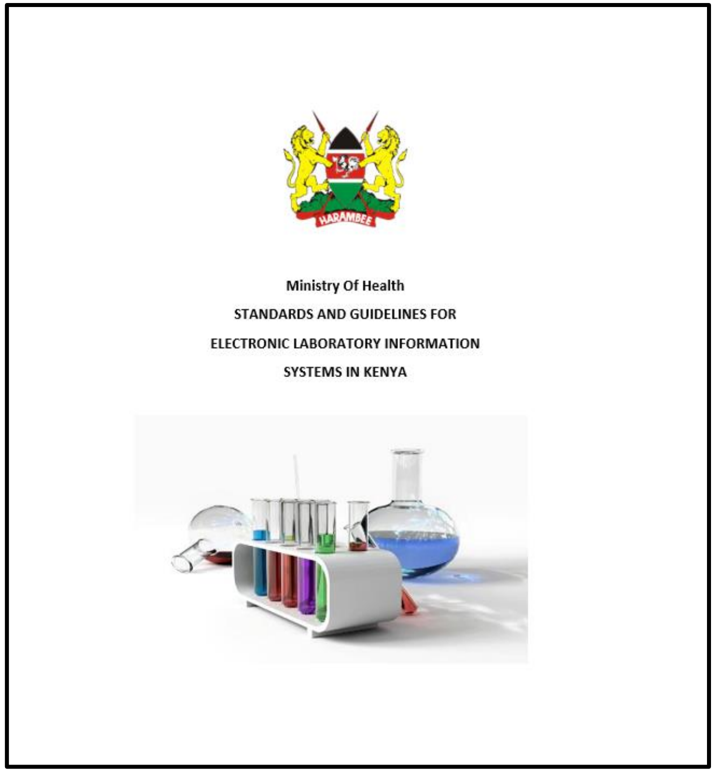
- Study expansion from 2 to 17 sites
- Scale up of community testing
- WWBS sample sequencing (to include other pathogens of interest)

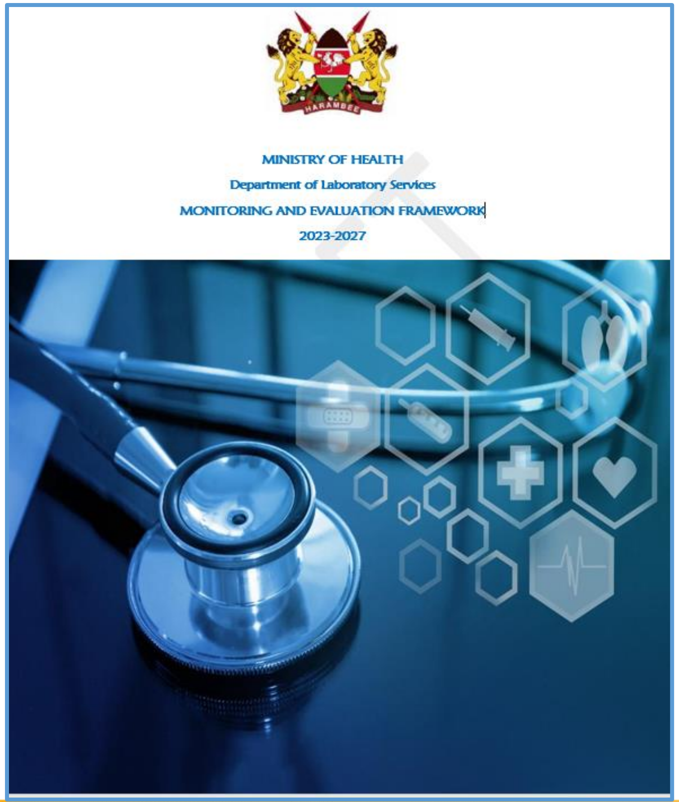
Wastewater-based Surveillance Results from the Pilot Sites



Laboratory Information System (LIS) Policy Changes: Pending Final Approval

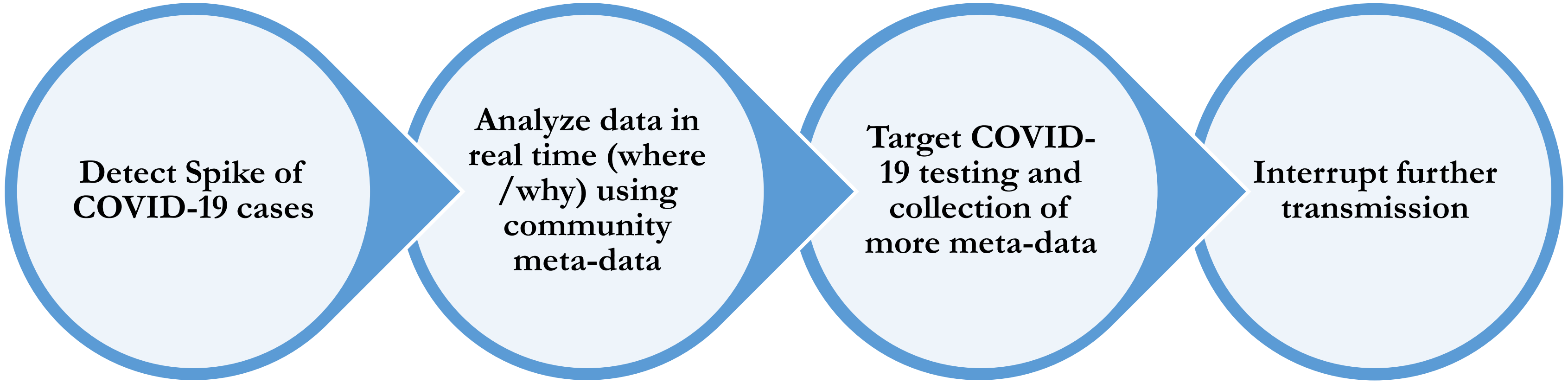
This framework will help evaluate and choose the right LIS solutions systematically. It also provides a clear set of steps for implementation. It includes guidelines for defining strategic indicators and goals, determining data sources, and collecting information to make informed decisions.



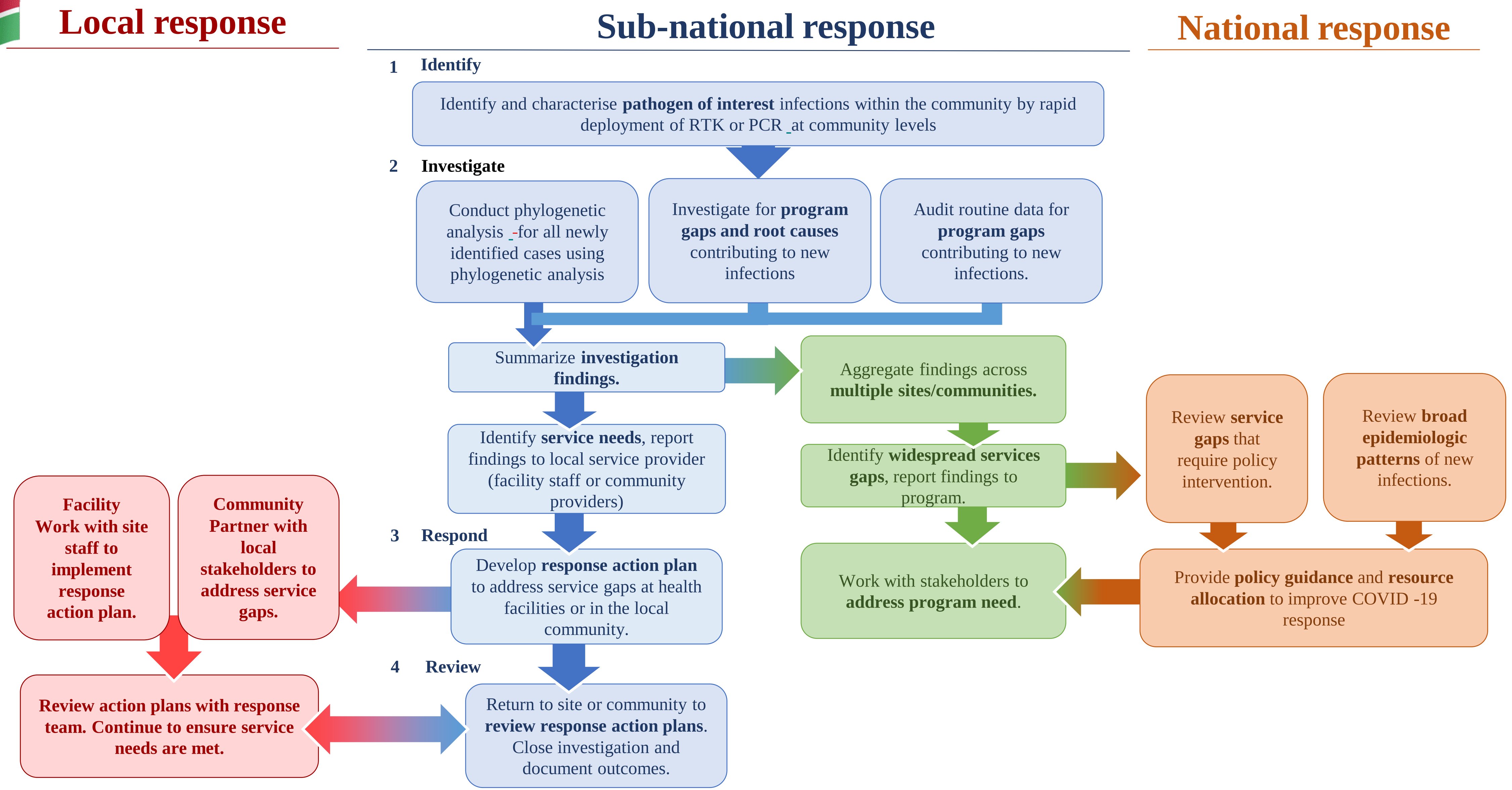


Proposed Public Heath Response

- MoH Kenya is proposing to use WWBS data to scale up the use of Covid 19 of rapid test kit at the facilities/community level.
- A draft document has been produced which aims to outline the process of implementing public health responses from data on wastewater-based epidemiological surveillance of SARS CoV2 in Kenya with the aim of interrupting transmission and detecting any spike within the population.



Proposed Public Heath Response on WWBE



Lessons Learned from the Project Stellar Implementation:

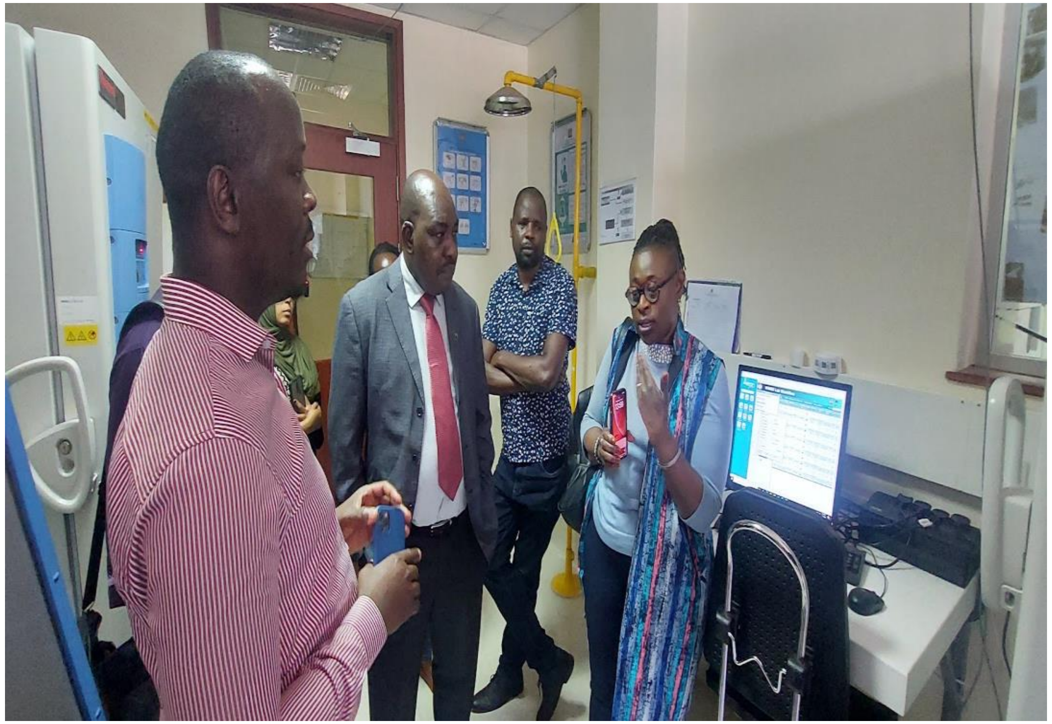
- Scale up the implementation of wastewater-based surveillance in all 47 counties in Kenya to help **monitor pathogens of concerns in wastewater to detect outbreaks early** and provide a more comprehensive understanding of disease transmission.

- **WWBS enhanced collaboration between the lab and DDSR**. Translates to policy decision-making within the program from data generated. WWBS included as an Early Warning System for DDSR

- **Optimized data transmission and interoperability** with reduced patient identifier duplication and transcription errors allowing for longitudinal review of patient results.

- Established national ToTs to **support LIS to sustain and track its usage**.

Great Team and Motivated Staff



Great Leadership from Management and collaboration with MoH disease surveillance

Excellent Teamwork

The use of NGS for Waste Waster Surveillance in Mozambique: Way Forward

REVIGEN
Rede de Vigilância Genómicade Moçambique

Instituto Nacional de Saúde (INS)
Nalia Ismael
Head of the Biotechnology Laboratory, INS

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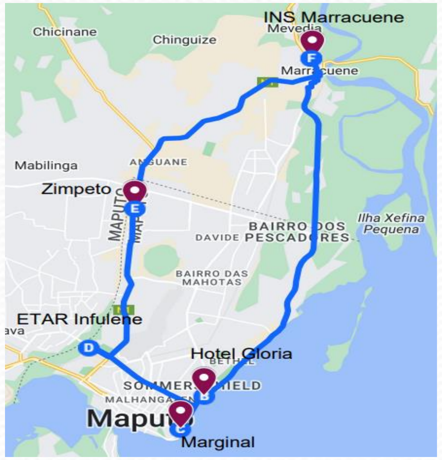
Surveillance of SARS-CoV-2 in Wastewater

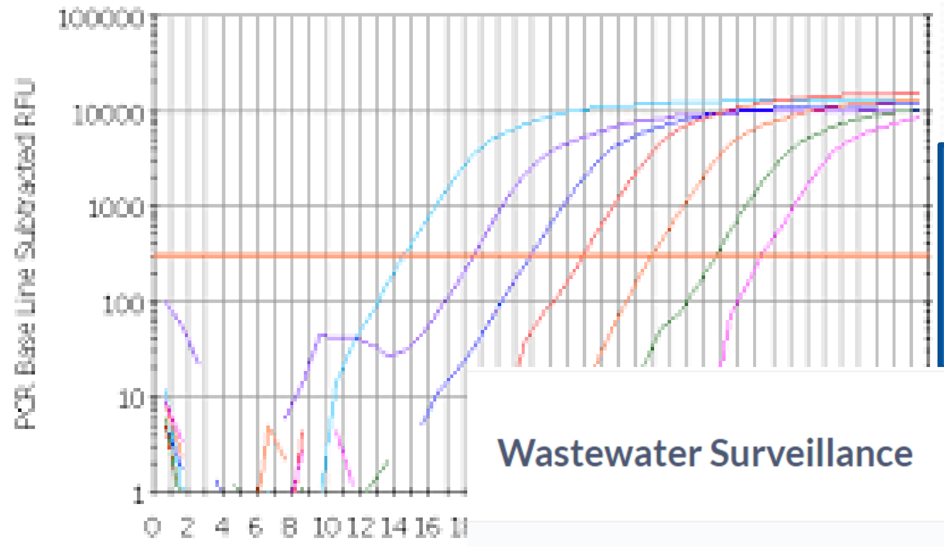
Objective of current Pilot
Validate the method of detection and quantification of SARS-CoV-2 from wastewater in 4 sites



March 21st Sample collection
4 sampling sites
2 samples/site/week

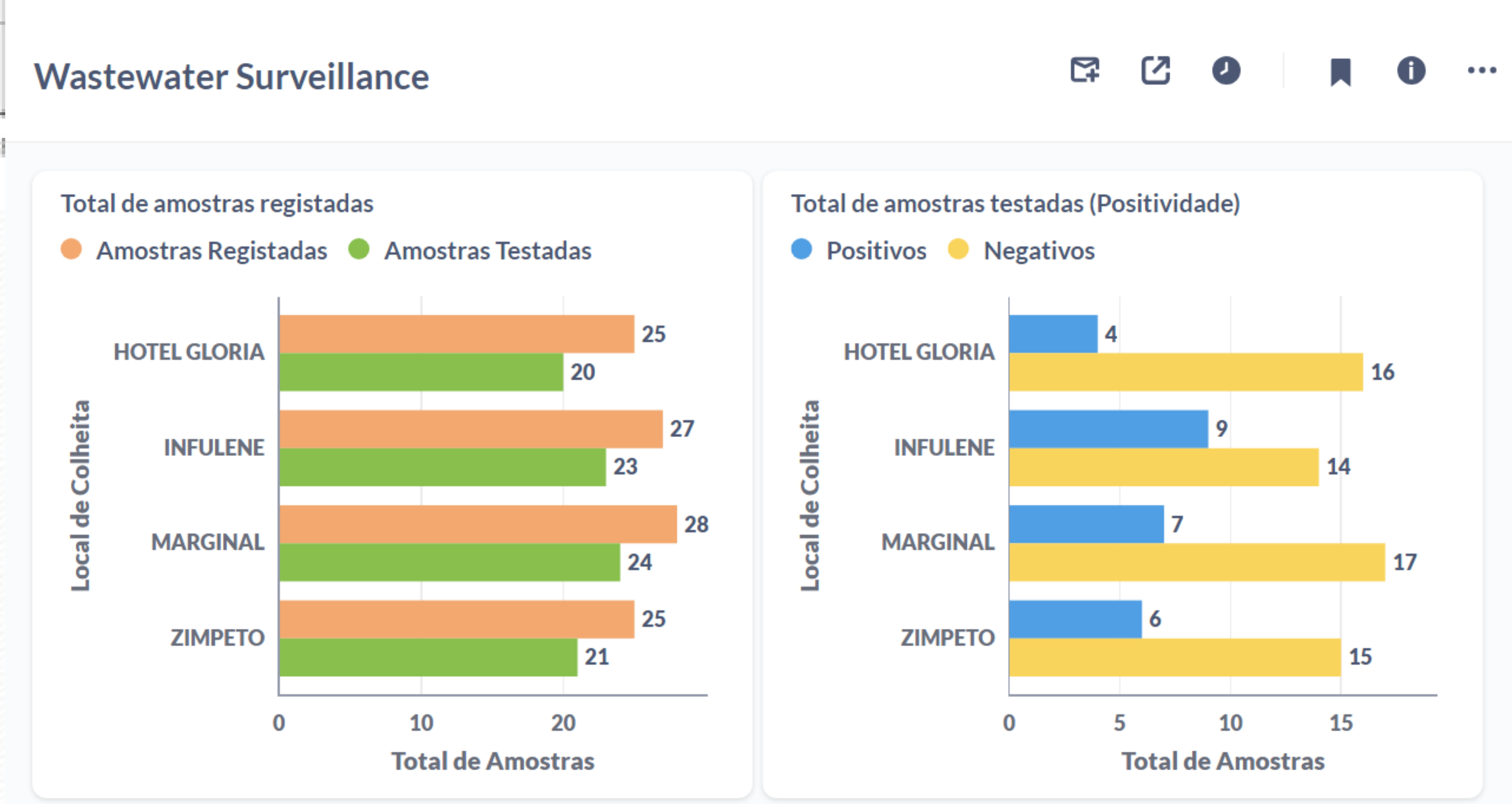
To Date:
113 Samples collected
91 Tested

Sample Collection and Data Sharing



DASHBOARD (developed)

113 Samples collected
91 Tested



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NGS Implementation: Project Stellar

Overview

- Implement NGS testing for WWBS
- Detect and monitor genetic changes in SARS-CoV-2 with Illumina COVIDSeq Assay
  - Look for novel mutations that may confer virulence and immune-evasion
- Watch for and act to impede emerging health threats such as antimicrobial resistance

Implementation

- Assess laboratory needs to implement NGS
- Receive technical assistance for wet-bench and dry-bench trainings
- Data analysis using Terra.Bio bioinformatics tool
- Procurement of supplies and reagents to be done by the Principal Recipient (PR)
- Pandemic preparedness using targeted panels from Illumina

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Benefits of NGS with WWBS

WWBS NGS in Moz

- For limited settings such as Mozambique it is Cost effective
- Control the effectiveness of vaccines for diseases such as Polio
- Exp Cholera Outbreak Monitor the spread in communities
- Because of climate changes the spread and transmission arboviruses need to tracked
- High levels of inappropriate antibiotic use at the community level monitor AMR
- Detection of genetic profiles of other respiratory viruses beyond COVID in schools

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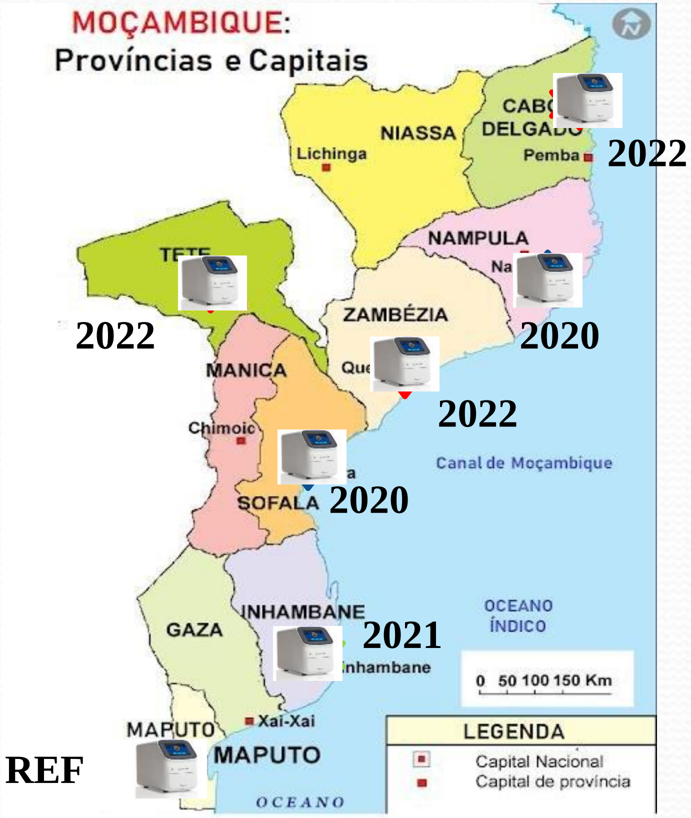
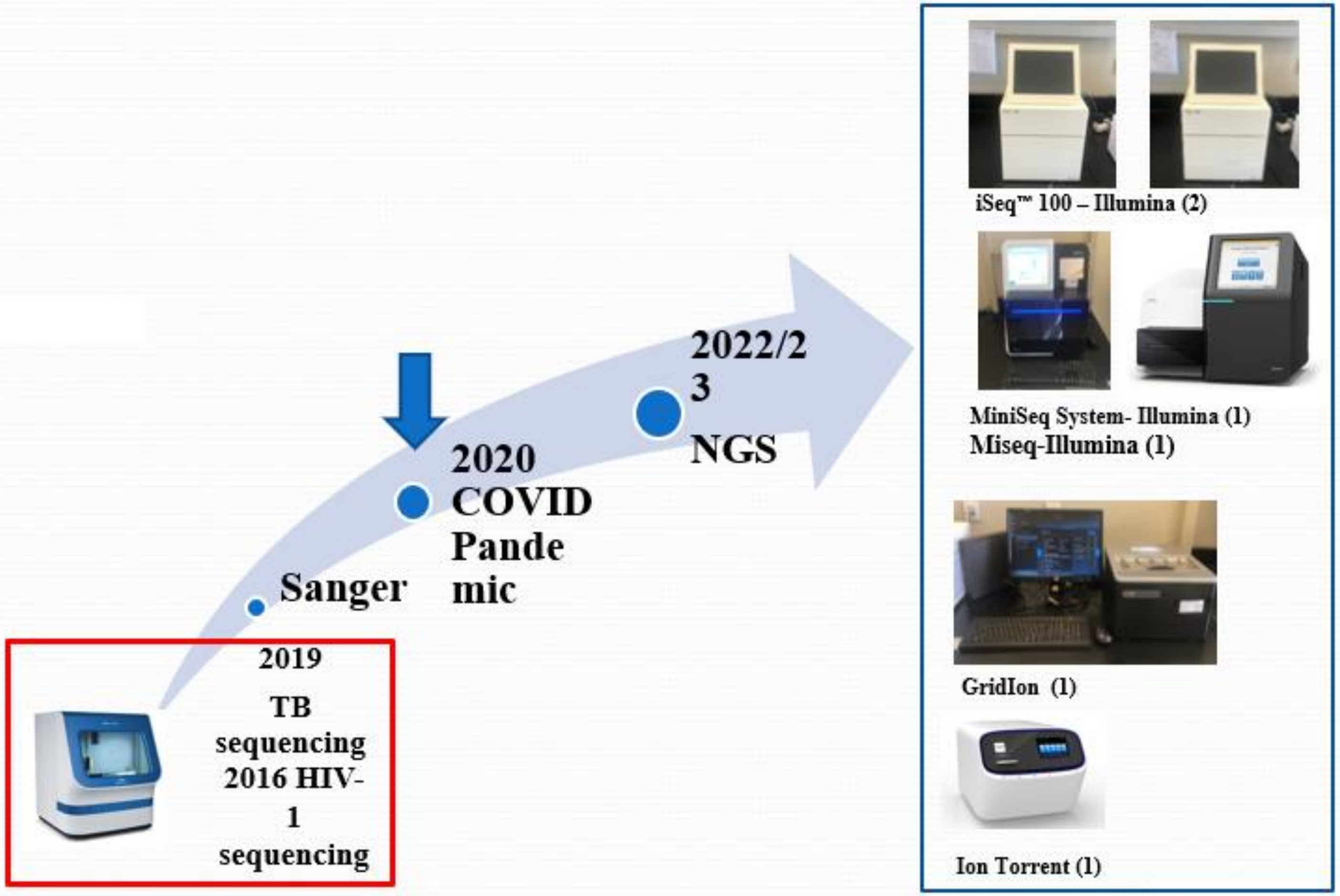
Public Health Laboratories Network and NGS Sequencing Capacity Created During the Pandemic





Road Map for Implementation of Integrated Genomic Surveillance in Mozambique

Conduct I workshop for integrated genomic surveillance — **2023**

- Advocate for and raise awareness of the value of genomic surveillance with policymakers to bring genomics into national disease control strategies
- Strengthen current surveillance programs to integrate genomics into their systems

Develop a 5-year strategic plan — **2023**

- Address the vision, mission and goals of genomic surveillance in Mozambique
- Define the priority pathogens (eg High burden, emerging and re-emerging diseases)
- Implement a best-fitted system to prevent, detect and rapidly respond to outbreaks (ww, one health)

Capacity Building and Implementat ion — **2023-2024**

- Deliver contextualized and sustainable systems that integrates other pathogens (standards samples and data collection system)
- Develop genomics and bioinformatics capacity for other pathogens beyond covid-19
- Create and strengthen a network o genomics laboratories within Mozambique

Enhance data sharing with other stakeholders — **2024-2025**

- Establish a dashboard to visualize genomics data in real time
- Make use of genomics routine in surveillance practice

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Future of WWBS

Noah Hull

Future of WWBS

- Future use of WW will be driven by country and MoH needs
- *Dynamic* field with evaluation by pathogen taking place now
- Expansion of WW sites within each of the countries
  - Actionable public health data – expanded testing +/- public health messaging
- Targeted WWBS:
  - Aircraft (blue water)
  - Communal living facilities
  - One Health: livestock sites and wet markets

Future of WWBS – Other Select Pathogens

Agent	Urine	Feces	Sewage	Reference
Enteric bacteria + AMR (*V. cholerae*)	Yes	Yes	Yes	Chahal et al. (2016)
Enteroviruses	Yes	Yes	Yes	Maier et al. (2000); Poyry et al. (1994); Hovi et al. (1997)
Hep A	Rare	Yes	Yes	Alter et al. (1977); Bancroft et al. (1977); Arvanitidou et al. (1998)
Hep B	Rare	Yes	Yes	Dienstag et al. (1971); Alter et al. (1977); Bancroft et al. (1977); Arvanitidou et al. (1998)
HIV	Yes	Yes	Yes	Levy (1989); Yolken et al. (1991)
Human poliovirus	Yes	Yes	Yes	Jorba et al. (2017); Grassly et al. (2009); Nandy et al. (2016)
Mycobacterium tuberculosis	Yes	Yes	Yes	Mtwtwa et al. (2022)
Nipah virus	Yes	Yes	Yes	Chadha et al. (2006); Chua et al., (2002)
Rabies	Yes	No	?	Wacharapluesadee and Hemachudha (2002)
Viral encephalitis	Yes	Yes	?	Mathur et al. (1995)

WWBS Expansion and Sustainability

- There is great enthusiasm from laboratory personnel and MOHs to implement WWBS and continue expansion to additional sites, NGS, and other pathogens.
- We would like to suggest The Global Fund consider alternative funding strategies that can better enable TA providers and laboratories to procure needed reagents and to appropriately scale up staffing as needed.
- We believe that this alternative funding strategy will ensure both sustainability and better funding absorption by directly providing the TA providers and labs the resources needed to implement/expand WWBS successfully.

Thank you!

- WWBS ***<u>is</u>*** the future of public health surveillance
- Labs in ~14 months have gone from ideation to sampling and testing
  - Wanting and have expanded the number of sites
  - Implemented public health actions
  - Prepared and eager to implement WWBS NGS testing
- As a leader in laboratory system strengthening, APHL remains committed to ensuring that WWBS is implemented to its full potential and looks forward to the possibility of expanding our work through strong partnerships with TGF, Africa CDC, and Country MoHs/Labs.

Thank you!

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