

Molecular techniques for detection and monitoring of antimicrobial resistance mechanisms

Opportunities and challenges for Latin America and the Caribbean

Priscila Lamb Wink, MSc., PhD.
PAHO International Consultant

Roberto Melano, MSc., PhD.
PAHO Technical Officer

Antimicrobial Resistance Special Program
Communicable Diseases Prevention, Control and Elimination



Agenda

- Overview about molecular AMR surveillance
- Vision and Strategy for WGS use in the Region
- Strategy on regional genomic surveillance for epidemic and pandemic preparedness and response
- Terms of Reference: PAHO's working group on WGS focused on AMR
- Challenges
- Opportunities
- Future perspectives
- Conclusions





Phenotypic and molecular AMR methods complement each other

Phenotypic methods

- ✓ Defining trends in AMR rates
- ✓ Assessing the frequency of AMR infections
- ✓ National list of essential antimicrobials
- ✓ Treatment guidance



Molecular methods

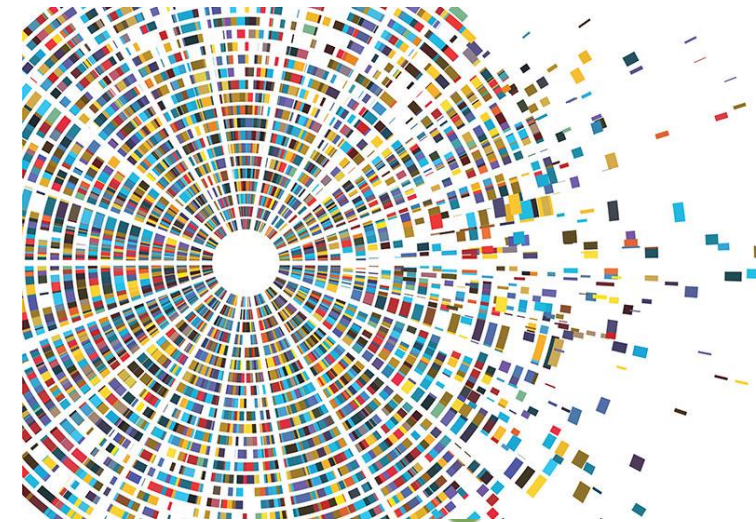
- ✓ Genetic basis of AMR mechanisms
- ✓ Genetic location of AMR mechanisms
- ✓ Epidemiology
- ✓ Treatment guidance



Diagnostic and surveillance

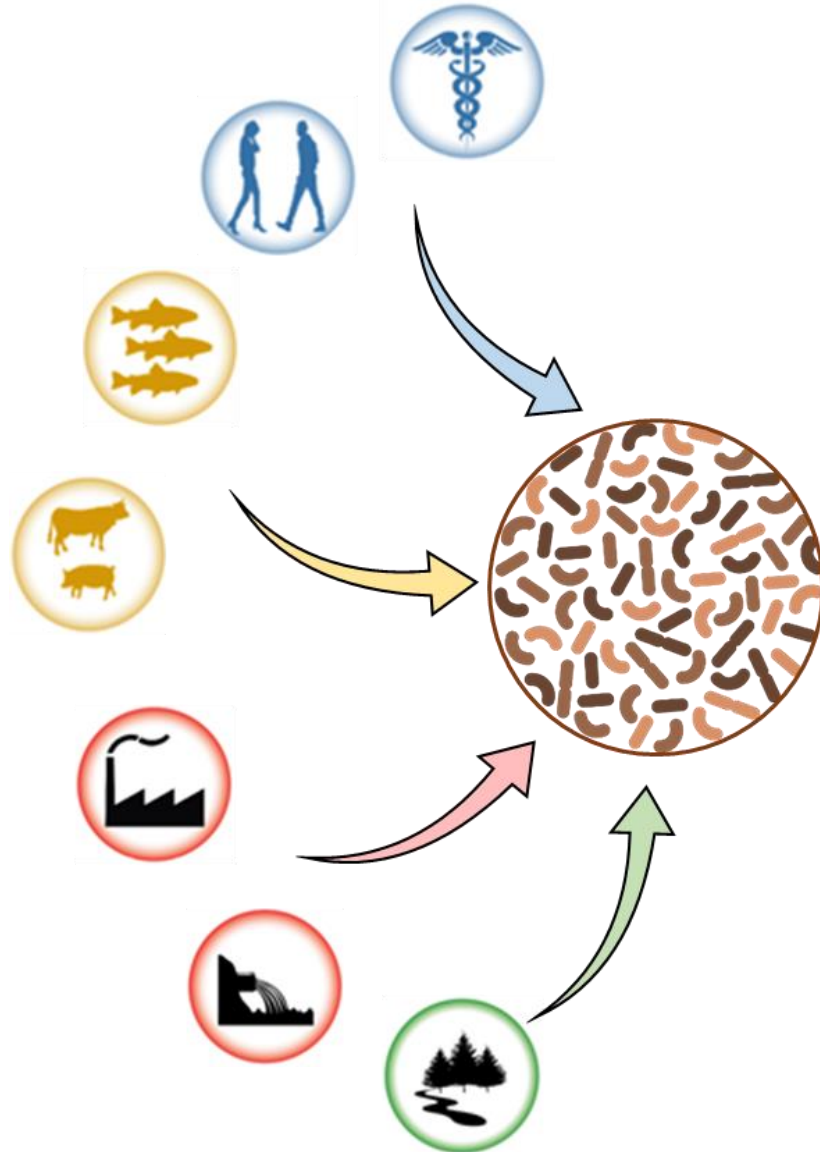
Diagnostic

- Accuracy (short time to obtain results)
- Simple questions
- Individual patient or small population
- *E. g., detection, ID, sensitivity testing and reporting of a pathogen.*



Surveillance

- More time is available
- More data can be obtained
- More complex questions can be addressed
- Larger populations can be studied
- Accuracy
- *E. g., AMR prevalence studies*



What is WGS?

- Complete DNA sequence of an organism
- Mechanisms of resistance / virulence
- Relatedness of isolates / clones
- Molecular subtyping of pathogens
- Genetic location of AMR mechanisms

WGS and AMR surveillance

Potential uses and benefits

➤ Local

- Detection of known AMR mechanisms
- Identification of emerging AMR mechanisms / Genetic location
- Analysis of outbreaks in local centers

➤ National

- Comparison of several genomes from different sites
- Analysis of local or subnational transmission networks
- Tracing the sources of local or regional outbreaks
- Identification of emerging resistance

➤ International

- Monitoring and evolution of bacteria populations
- Detection of high-risk resistant clones
- Evaluation of the impact of interventions
- Detection of outbreaks in several countries



Regional Vision and Strategy

WGS for AMR surveillance

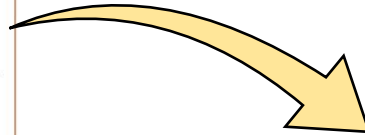
- Group of experts to establish standards, systems and framework for data sharing
- Secure framework for data sharing within the network of laboratories
- Pathogen prioritization according to emerging epidemiology
- Build technical and bioinformatics capacity for routine use in bacterial surveillance
- Create a regional support hub for countries with no in-country capacity
- Multidisciplinary interpretation of the information to guide public health action
- Encourage the One Health approach



Regional limitations, challenges and opportunities

WGS for AMR surveillance

- Group of experts to establish standards, systems and framework for data sharing
- Secure framework for data sharing within the network of laboratories
- Pathogen prioritization according to emerging epidemiology
- Build technical and bioinformatics capacity for routine use in bacterial surveillance
- Create a regional support hub for countries with no in-country capacity
- Multidisciplinary interpretation of the information to guide public health action
- Encourage the One Health approach



- Financial investments
- Lack of standards
- Data-sharing

- Cost of WGS reagents
- Access to WGS reagents
- Capacity-building, training

- Momentum • COVID-19
- Access to online tools
- Expert group on WGS for AMR
- PAHO priority
- Data-sharing • Local examples
- WHO-CC, horizontal cooperation





Pan American
Health
Organization



World Health
Organization
REGIONAL OFFICE FOR THE
Americas

30th PAN AMERICAN SANITARY CONFERENCE

74th SESSION OF THE REGIONAL COMMITTEE OF WHO FOR THE AMERICAS

Washington, D.C., USA, 26-30 September 2022

Provisional Agenda Item 4.7

CSP30/12
30 August 2022
Original: English

**STRATEGY ON REGIONAL GENOMIC SURVEILLANCE FOR
EPIDEMIC AND PANDEMIC PREPAREDNESS AND RESPONSE**

30th PAN AMERICAN SANITARY CONFERENCE
74th SESSION OF THE REGIONAL COMMITTEE OF WHO FOR THE AMERICAS

Washington, D.C., USA, 26-30 September 2022

Provisional Agenda Item 4.7

CSP30/12
30 August 2022
Original: English

**STRATEGY ON REGIONAL GENOMIC SURVEILLANCE FOR
EPIDEMIC AND PANDEMIC PREPAREDNESS AND RESPONSE**

Proposal

16. This strategy includes the following lines of action:

- a) Expand and consolidate a regional genomic surveillance network of public health, animal health, and environmental health laboratories for early detection and monitoring of emerging and existing pathogens of potential public health concern, including at the human-animal-environment interface.
- b) Strengthen technical capacity for genomic sequencing, including in bioinformatics.
- c) Strengthen genomic data reporting, including linkages to case data, and its integration with public health systems.
- d) Build capacity and define best practices for the use of genomic data in the response to outbreaks, epidemics, and pandemics, including mechanisms for intersectoral coordination and integration among public health, animal health, and environmental health surveillance teams, to generate timely information for decision-making and to generate public policies.



Global genomic surveillance strategy

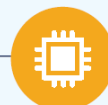
for pathogens with pandemic and epidemic potential

2022–2032

GOAL

Genomic surveillance is strengthened and scaled for quality, timely and appropriate public health actions within local to global surveillance systems

OBJECTIVES



Objective 1

Improve access to tools for better geographic representation



Objective 2

Strengthen the workforce to deliver at speed, scale and quality



Objective 3

Enhance data sharing and utility for streamlined local to global public health decision-making and action



Objective 4

Maximize connectivity for timely value-add in the broader surveillance architecture



Objective 5

Maintain a readiness posture for emergencies

STRATEGIC ACTIONS

- **Advocate for the value of genomic surveillance** with policy makers
- **Map and monitor** capability and capacity landscape
- **Deliver contextualized and sustainable** technology solutions
- **Stimulate innovation and research** to address local to global needs
- **Shape a sustainable and quality market to maximize access**

- Roll-out training packages in **genomics and bioinformatics**
- Promote **communities of practice and knowledge exchange**
- Implement **external quality assessment programmes**
- Strengthen programmes for **workforce development and retention**

- Develop consensus on **data and meta data standards**
- Establish **data sharing and access principles**
- Ensure **data sharing agreements**
- **Harmonize** norms, standards, benchmarks and reference materials
- **Make the use of genomics routine** in surveillance practice

- **Facilitate data, specimen and information sharing**
- **Increase network linkages** at local, regional and global levels
- Implement targeted collaboration with **One Health partners**
- **Strengthen networks** in routine, epidemic and pandemic contexts

- **Test the surge and stretch** of genomic surveillance systems
- **Establish or sustain joint projects** to maintain capacities
- **Implement inter- or after-action reviews** to strengthen practices

Terms of Reference. PAHO'S WORKING GROUP ON WHOLE-GENOME SEQUENCING FOCUSED ON ANTIMICROBIAL RESISTANCE

Goals

- To develop the best practices for analysis of WGS applied to the detection and analysis of AMR and its epidemiology by providing guidance for generating robust and laboratory standard operating procedures (SOP) and bioinformatic pipelines for the region
- To support capacity building associated with WGS

Specific Objectives

- To review the regional status of on-site sequencers and bioinformatic infrastructure (including dedicated staff)
- To review the bioinformatic tools and pipelines for AMR and epidemiology analysis
- To provide optimized SOPs for lab preparation and sequencing of bacterial isolates using different WGS platforms (Illumina and Nanopore)
- To provide regional standardization of the bioinformatic tools
- To provide training in laboratory and bioinformatic aspects, as needed
- To monitor the quality of work through sustainable quality programs
- To help in the implementation of these methodologies in countries without experience in the topic
- To facilitate data sharing between countries of the region

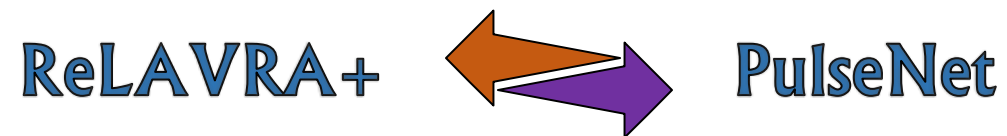
Strengths and Needs

WGS for AMR surveillance in the framework of the regional strategy

STRATEGY ON REGIONAL GENOMIC SURVEILLANCE FOR EPIDEMIC AND PANDEMIC PREPAREDNESS AND RESPONSE

a) Expand and consolidate a regional genomic surveillance network of public health, animal health, and environmental health laboratories for early detection and monitoring of emerging and existing pathogens of potential public health concern, including at the human-animal-environment interface.

- Link existing networks for genomic surveillance of acute health events - One Health



Genomic consolidation to work together and optimize results

Strengths and Needs

WGS for AMR surveillance in the framework of the regional strategy

STRATEGY ON REGIONAL GENOMIC SURVEILLANCE FOR EPIDEMIC AND PANDEMIC PREPAREDNESS AND RESPONSE

b) Strengthen technical capacity for genomic sequencing, including in bioinformatics.

- Successful pilot in Peru.
- PulseNet needs this kind of pipelines.
- Interdepartmental work within PAHO should facilitate this strengthening with the different experiences.

Strengths and Needs

WGS for AMR surveillance in the framework of the regional strategy

STRATEGY ON REGIONAL GENOMIC SURVEILLANCE FOR EPIDEMIC AND PANDEMIC PREPAREDNESS AND RESPONSE

c) Strengthen genomic data reporting, including linkages to case data, and its integration with public health systems.

d) Build capacity and define best practices for the use of genomic data in the response to outbreaks, epidemics, and pandemics, including mechanisms for intersectoral coordination and integration among public health, animal health, and environmental health surveillance teams, to generate timely information for decision-making and to generate public policies.

- Data reporting and its integration into public health systems: it is a more complicated issue to establish in bacteriology – PulseNet experience
- Promotion of intersectoral and integrated work.
- Collection of data in a single database that should be shared – One health

Future perspectives

WGS for AMR surveillance

- Establishing standards and systems
- Establishing framework for data sharing
- Pathogen prioritization
- Routine use in bacterial surveillance
- Regional support hub
- Multidisciplinary interpretation of the information
- One Health approach

- Financial investments
- Lack of standards
- Data-sharing

- Cost of WGS reagents
- Access to WGS reagents
- Capacity-building, training

- Momentum • COVID-19
- Access to online tools
- Expert group on WGS for AMR
- PAHO priority
- Data-sharing • Local examples
- WHO-CC, horizontal cooperation

- Integration of existing networks
- WGS use in routine AMR surveillance
- Expand the use of the WGS to One Health integrated surveillance
- Access regional genomic data through a common database



Conclusions



- The signing of a document of this caliber facilitates the use of the WGS not only in the emergence of pathogens in general, but also in AMR.
- Multiple regional limitations and challenges, but good time for planning changes!

Selected references and documents

- ✓ Global action plan on antimicrobial resistance, 2015. At <https://www.who.int/antimicrobial-resistance/global-action-plan/en/>
- ✓ Integrated surveillance of antimicrobial resistance in foodborne bacteria. Application of a One Health approach, 2017. At https://www.who.int/foodsafety/publications/agisar_guidance2017/en/
- ✓ Molecular methods for antimicrobial resistance (AMR) diagnostics to enhance the Global Antimicrobial Resistance Surveillance System, 2019. At <https://www.who.int/glass/resources/publications/molecular-methods-for-amr-diagnostics/en/>
- ✓ GLASS whole-genome sequencing for surveillance of antimicrobial resistance, 2020. At <https://www.who.int/publications/i/item/9789240011007>
- ✓ Expert opinion on whole genome sequencing for public health surveillance, 2016. At <https://www.ecdc.europa.eu/en/publications-data/expert-opinion-whole-genome-sequencing-public-health-surveillance>
- ✓ Global genomic surveillance strategy for pathogens with pandemic and epidemic potential, 2022–2032. At <https://www.who.int/publications/i/item/9789240046979>
- ✓ WHO - Resolution WHA74.7 Strengthening WHO preparedness for and response to health emergencies. At https://apps.who.int/gb/ebwha/pdf_files/WHA74/A74_R7-en.pdf
- ✓ Strategic Plan of the Pan American Health Organization 2020-2025: Equity at the Heart of Health. At <https://www.paho.org/en/documents/strategic-plan-pan-american-health-organization-2020-2025-equity-heart-health>
- ✓ One Health, a comprehensive approach for addressing health threats at the human-animal-environment interface. At <https://www.paho.org/en/documents/cd599-one-health-comprehensive-approach-addressing-health-threats-human-animal>
- ✓ Strategy on regional genomic surveillance for epidemic and pandemic preparedness and response. At https://www.paho.org/sites/default/files/csp30-12-e-regional-genomic-surveillance_0.pdf
- ✓ Quainoo et al. 2017. Whole-genome sequencing of bacterial pathogens: the future of nosocomial outbreak analysis. Clin Microbiol Rev 30:1015–1063. <https://doi.org/10.1128/CMR.00016-17>
- ✓ Gardy JL, Loman NJ. 2018. Towards a genomics-informed, real-time, global pathogen surveillance system. Nat Rev Genet. 19(1):9-20. doi: 10.1038/nrg.2017.88
- ✓ Hendriksen et al. 2019. Using genomics to track global antimicrobial resistance. Front. Public Health 7:242. doi: 10.3389/fpubh.2019.00242
- ✓ NIHR Global Health Research Unit on Genomic Surveillance of AMR. 2020. Whole-genome sequencing as part of national and international surveillance programmes for antimicrobial resistance: a roadmap. BMJ Global Health. 5:e002244. doi:10.1136/bmjgh-2019-002244
- ✓ Inzaule et al. 2021. Genomic-informed pathogen surveillance in Africa: opportunities and challenges. Lancet Infect Dis. 21(9):e281-e289. doi: 10.1016/S1473-3099(20)30939-7
- ✓ Brown et al. 2021. An economic evaluation of the Whole Genome Sequencing source tracking program in the U.S. PLoS One. 16(10):e0258262. doi: 10.1371/journal.pone.0258262
- ✓ Halpin et al. 2021. Framing bacterial genomics for public health (care). J Clin Microbiol 59:e00135-21. <https://doi.org/10.1128/JCM.00135-21>

Thank you!
¡Gracias!
Obrigada!

