APHL GLOBAL HEALTH CAPABILITIES

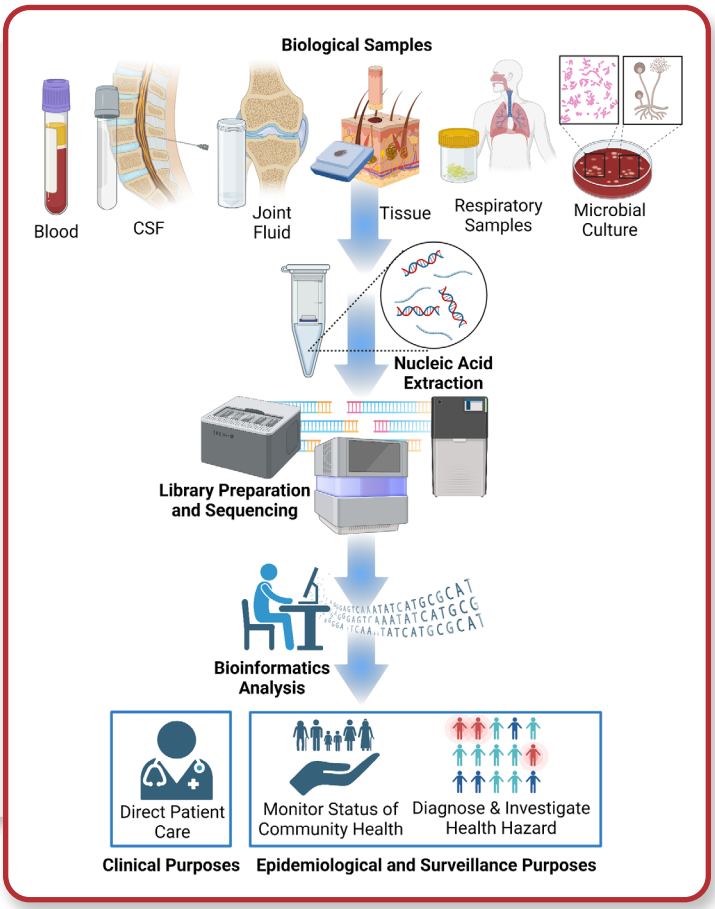
NEXT GENERATION SEQUENCING

DECEMBER 2023

Next generation sequencing (NGS) is a technique used to determine the genetic sequence of an organism. NGS involves simultaneously sequencing multiple pieces—millions—of genetic material, resulting in a far more rapid and scalable sequencing option than previous methods. NGS is widely used for disease diagnostics, transmission, routine and emerging pathogen surveillance, and outbreak investigations; the resulting data is used to shape public health policy.

While the benefits of NGS are numerous, it can be challenging to implement, scale appropriately or maintain a workforce trained in the technical laboratory and bioinformatic procedures.

The Association of Public Health Laboratories (APHL) has expertise and experience assisting public health laboratories build their NGS infrastructure capabilities and capacities.



NGS's Public Health Impact

NGS has improved public health emergency response to current and emerging infectious diseases (see one example of how NGS was utilized to monitor variant emergence during the COVID-19 pandemic in the graphic below). Such high-resolution data can determine transmission models, detect vaccine escape, and genomic changes that cause increased virulence or impact clinical outcomes. This information can be leveraged for public health action, such as food recalls, changes in vaccine strategies, public health communication, and improving patient outcomes.

Genomic Epidemiology and NGS Allow for Identification of Emergence and Spread SARS-CoV-2 Variants

Late 2021: Delta Predominant
(Shades of Purple)

Mid-2022: Omicron Expansion
(Shades of Green)

Early 2023: Omicron Diversification
(Shades of Yellow/Orange)

Generated using Nextstrain.org

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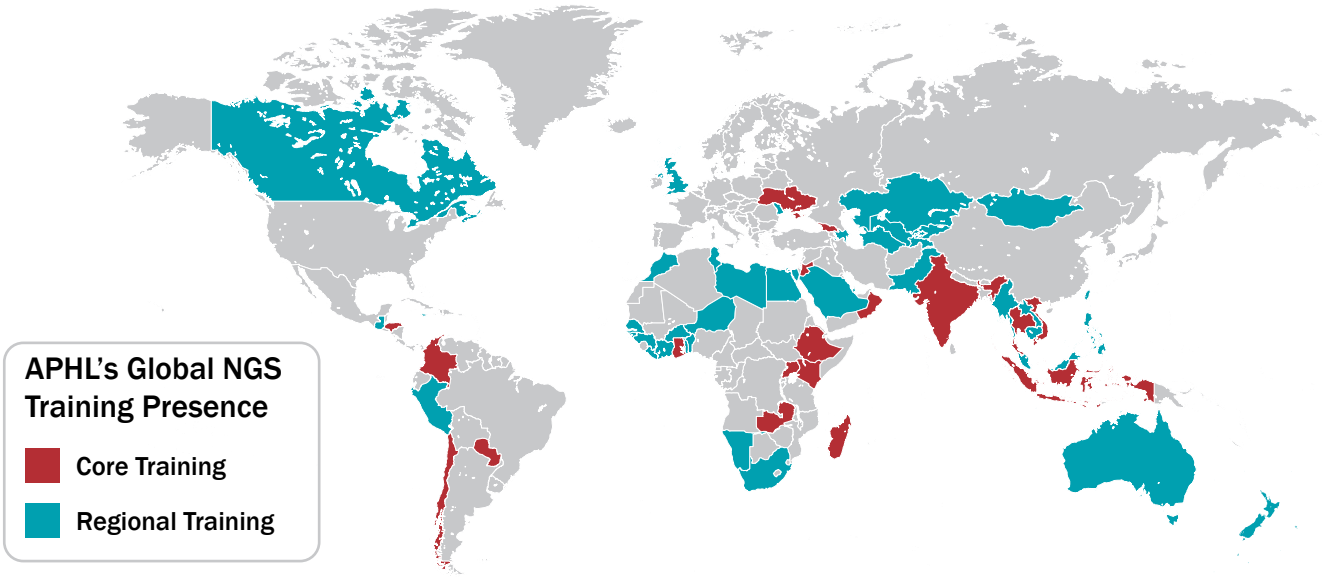

Inside APHL's NGS and Bioinformatics Capabilities

APHL has, or is currently, supporting NGS activities in countries all around the world. APHL helps develop and optimize NGS protocols and laboratory procedures. APHL also supports, trains and advises on laboratory capacity building for NGS, QMS, bioinformatics and genomic epidemiology to produce actionable genomic data for public health decision-making.

General NGS Capabilities

APHL can provide:

- Gap analysis to determine readiness for NGS, or resources needed to scale up existing NGS programs
- Assistance with NGS equipment, reagent, and supply decision-making and procurement
- Building bioinformatics infrastructure and sequence data management practices
- Workforce development via training (in person or virtual; for laboratory or bioinformatics)
- Genomic epidemiology training
- Onboarding of new NGS platforms and supplemental or automated equipment
- Technical assistance for partners and members
- Twinning and mentorship programs

NGS & Bioinformatics Training

APHL offers in-person training and virtual training with a quality management approach:

- Wet lab, bioinformatics, and genomic epidemiology
- Extended support via help desk, office hours, mentorship, and communities of practice
- Pathogen-agnostic techniques
- Metagenomics and pathogen discovery
- Wastewater-based surveillance
- Train the trainer sessions

Quality Management

Benchmarking NGS quality metrics can be complex. Ensuring the generation of quality sequencing data allows for cost and time efficiency. Quality data is crucial for maintaining trust and reproducibility in laboratory results and is also a cornerstone in generating actionable data. APHL has experience embedding quality management practices into NGS workflows, including sample tracking and organization, validation of sequencing processes, wet and dry lab best practices, sequence data management and tracking, and bioinformatic method versioning of documents and analysis methods.

Development and Optimization of Workflows

APHL works with laboratories to develop and optimize NGS and bioinformatic protocols in a scalable, pathogen-agnostic, and pathogen-specific approach on many different sequencing platforms. This allows for sustainable in-country NGS and bioinformatic capabilities. APHL supports, trains and advises on NGS and bioinformatic workflows with a quality management and genomic epidemiology focus on producing actionable genomic data for public health decision-making. APHL strives to develop regional leaders in bioinformatics and NGS.

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