AfricaCDC
Centres for Disease Control and Prevention

Safeguarding Africa's Health

Module G03

Generic Foundational Course

An Overview of the Role of Genomic Epidemiology in Pathogen Genomic Surveillance

NGS Academy for the Africa CDC

ASLM
AFRICAN SOCIETY FOR LABORATORY MEDICINE

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Pan African Bioinformatics Network for H3Africa

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Module

G03

An Overview of the Role of Genomic Epidemiology in Pathogen Genomic Surveillance

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Module last updated:
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Number of sessions	3–4
Total learning time	1–1.5 days
Target audience	Target audience: All personas - wet laboratory personnel (i.e., scientists, laboratory technicians, etc.), dry laboratory personnel (epidemiologists, bioinformatics scientists, and bioinformaticians), and managerial personnel (i.e., HODs, laboratory managers, policymakers, etc.).
Format	Lectures, videos
Level of the module	Introductory

Contributors

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Suggested pre-requisite module(s)

Module G02. Introduction to Traditional, Field, and Genomic Epidemiology

Module description

In Module G02. Introduction to Traditional, Field, and Genomic Epidemiology, participants were introduced to the basic concepts and principles of traditional, field, and genomic epidemiology, as well as their intersection. In this current module, participants briefly revisit these key concepts and principles and are introduced to the fundamentals of pathogen genomic surveillance. The intersection between genomic epidemiology and pathogen genomic surveillance, and the significance of pathogen genomic surveillance in disease outbreaks and public health responses, is also explored. In this module, participants are also introduced to the following topics and/or concepts:

- Revisitation of some key genomic epidemiology principles
- The role of genomic epidemiology in pathogen genomic surveillance

- Key principles of pathogen genomic surveillance
- The key steps in a pathogen genomic surveillance workflow
- The significance of pathogen genomic surveillance in public health
- How genomic data can be used to predict and track disease outbreaks
- Approaches to or frameworks for pathogen genomic surveillance
- Pathogen genomic surveillance and the One Health approach
- Key genomic techniques used in pathogen genomic surveillance
- A brief introduction to the common bioinformatics tools and databases used in pathogen genomic surveillance (e.g., BLAST, GenBank, GISAID)
- The importance of collaboration and data sharing among global health organisations
- How genomic surveillance data is integrated into public health strategies and decision-making
- How genomic information can inform public health responses
- Examples of successful genomic surveillance programs
- Explore emerging trends and innovations in pathogen genomic surveillance
- Advantages and limitations of current pathogen genomic surveillance strategies
- Potential future applications of pathogen genomic surveillance and their impact on global health security

Module learning outcomes

On completion of this module, participants will have a basic knowledge of, or will be able to:

- Define pathogen genomic surveillance
- Discuss the essential concepts in pathogen genomic surveillance
- List the key steps in a pathogen genomic surveillance workflow
- Explain the importance of genomic surveillance in public health and outbreak response
- Explain how genomic data is used to track pathogen evolution, spread, and emergence as well as predict and track disease outbreaks
- Discuss various approaches to or frameworks for pathogen genomic surveillance
- Explain how pathogen genomic surveillance supports the interconnected health relationships between humans, animals, and ecosystems under the One Health approach
- Describe the different techniques used to sequence pathogen genomes
- Compare and contrast between the different types of genomic data used in pathogen genomic surveillance
- Describe some of the common bioinformatics tools and databases used in pathogen genomic surveillance
- Briefly discuss the significance of collaboration among public health professionals, researchers, and policymakers
- Discuss how pathogen surveillance data informs public health strategies, decisions, and responses
- Discuss the recent innovations and advancements in the technology and methodology used in pathogen genomic surveillance
- List examples of successful genomic surveillance programs
- List the advantages and disadvantages of current pathogen genomic surveillance strategies
- Discuss the potential future applications of pathogen genomic surveillance

Module assessments

Module practical: Not applicable
Module quiz: Assessment questions available on the ASLM platform

Module resources

- WHO Video - What is Genomic Surveillance?
- WHO Video - Why is Genomic Surveillance important?
- ScienceDirect Article - Key steps in the public health pathogen genomics process (page 2 of article)
- NIH | NLM Article - Genomic surveillance strategy: Sample to response pipeline (page 2 of article)
- US CDC Video - The Emerging Role of Pathogen Genomics in Public Health
- Frontiers in Science Article - Genomic surveillance and pathogen intelligence
- US CDC Video - Using Genomic Epidemiology to Advance Public Health Action
- Frontiers in Science Article - Genomic surveillance of pathogens could help stop the next pandemic before it starts
- Frontiers in Science Article - Real-time genomic surveillance for enhanced control of infectious diseases and antimicrobial resistance
- The Lancet Article - Genomics for public health and international surveillance of antimicrobial resistance
- Africa CDC | Pathogen Genomics Surveillance Policy Framework
- WHO | Considerations for developing a national genomic surveillance strategy or action plan for pathogens with pandemic and epidemic potential
- WHO | Global genomic surveillance strategy for pathogens with pandemic and epidemic potential, 2022–2032
- NIH | NLM Article - Key aspects defining the development and implementation of a regional genomic surveillance strategy for the Eastern Mediterranean Region
- WHO Video - Genomic surveillance: What does local-to-global implementation of the strategy look like?
- ScienceDirect Article - Pathogen genomics and One Health
- NIH | NLM Article - Real-time genomics for One Health
- WHO Video - Genome Sequencing: Overview
- MDPI Article - Genomic techniques for pathogen detection and tracking (pages 1146 - 1163 of article)
- Illumina | Genomic surveillance methods to track infectious disease
- NIH | NLM Article - Current Bioinformatics resources in combating infectious diseases
- NIH | NLM GenBank Overview
- NIH | NLM BLAST QuickStart
- GISAID Database

- NIH | NLM Article - Data Sharing and Global Public Health: Defining What We Mean by Data
- NIH | NLM Article - Sharing Is Caring—Data Sharing Initiatives in Healthcare
- WHO International Pathogen Surveillance Network (IPSN)
- US CDC Traveler-based Genomic Surveillance for Early Detection of New SARS-CoV-2 Variants
- NIH | NLM Article - Toward a global virus genomic surveillance network
- Chapter - Global Governance of Genomic Pathogen Surveillance: Opportunities and Challenges
- Africa CDC Video - Genomic-informed pathogen surveillance in Africa: opportunities and challenges
- NIH | NLM Article - Genomic-informed pathogen surveillance in Africa: opportunities and challenges
- Nature Reviews Article - Towards a genomics-informed, real-time, global pathogen surveillance system
- NIH | NLM Article - Advancing pathogen genomics in resource-limited settings
- ScienceDirect Article - Developing One Health surveillance systems
- Frontiers in Bacteriology Article - Emerging applications of artificial intelligence in pathogen genomics
- The Lancet Article - Strengthening global health security by improving disease surveillance in remote rural areas of low-income and middle-income countries

References

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- OpenAI. (2024). ChatGPT 4o mini response on shortening or rephrasing the module overview (of G03) to 2 sentences but keeping an academic tone. Retrieved November 18, 2024, from ChatGPT

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