**Module
W01**

Wet-lab Foundational Course

Introduction to Biosafety and Biosecurity

NGS Academy for the Africa CDC

ASLM
AFRICAN SOCIETY FOR LABORATORY MEDICINE

H3ABioNet
Pan African Bioinformatics Network for H3Africa

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Module
W01

An Introduction to Biosafety and Biosecurity

Module last updated:
December 2024

Number of sessions	2
Total learning time	4 hours
Target audience	Wet laboratory personnel (i.e., scientists, laboratory technicians, etc.) and managerial personnel (i.e., HODs, laboratory managers, policy makers, etc.)
Format	Lectures, videos, practicals/tutorials
Level of the module	Introductory

👤 Contributors

Olusolu Akanbi, Elizabeth Akande, Onikepe Folarin, Carla Garcia, Siddiqah George, Shahiid Kiyaga, Carolina Matos, Andargachew Mulu, and Eugene Yeboah.

📖 Module description

This module provides an overview of laboratory biosafety and biosecurity principles, emphasizing risk management and regulatory compliance in pathogen genomic surveillance. Participants will learn to identify, assess, and mitigate biological risks associated with handling infectious agents and their genetic material. The module covers biosafety levels, risk assessments, emergency response, and laboratory practices specific to pathogen genomics. Participants will learn to identify and manage biological hazards across different biosafety levels, implementing effective control measures and emergency response protocols. In this module, participants are also introduced to the following topics and/or concepts:

- Define biosafety and biosecurity and explain their importance in laboratory settings
- Various types of biological hazards
- Different biosafety levels and their requirements
- Regulatory requirements for biosafety and biosecurity
- Guidance on implementing regulatory requirements for biosafety and biosecurity
- Common laboratory-associated infections (LAIs)
- The significance of biological risk assessments and management
- The key considerations and steps for conducting a biological risk assessment

- The Assessment, Mitigation, and Performance (AMP) Model approach to biorisk management
- Risk mitigation strategies and hierarchy of control methods
- Universal laboratory precautions and safety practices
- Workspace management and workflow safety in a laboratory
- Key considerations for next-generation sequencing (NGS) risk assessments
- Common laboratory decontamination strategies
- Personal protective equipment (PPE) goals and usage
- Laboratory incidences and appropriate emergency responses
- Best laboratory practices, techniques, and compliance for maintaining biosafety and biosecurity
- Good clinical laboratory practice (GCLP)
- Handling of biological samples in preparation for next-generation sequencing (NGS)
- Biological sample management and quality control in the laboratory
- Routine maintenance of laboratory equipment
- Biological waste management
- Various surveillance strategies and their impact on biosafety, biosecurity, laboratory operations, and staff well-being
- The role of biobanking in public health research and pathogen surveillance
- Developing an onboarding plan and the steps involved in integrating a new laboratory member

Module learning outcomes

On completion of this module, the participants will have a basic knowledge of, or will be able to:
- Differentiate between biosafety and biosecurity measures
- Explain the roles of biosafety and biosecurity in protecting laboratory personnel, the environment, and the public
- List different types of biological hazards
- Discuss different biosafety levels and the requirements of each level
- Discuss key regulatory requirements for biosafety and biosecurity
- List common laboratory associated infections (LAIs) and their routes of infection
- Explain the main goals of biological risk assessment and management
- Describe the key steps involved in a biological risk assessment
- Explain the purpose of the Assessment, Mitigation, and Performance (AMP) Model
- Discuss the role that the hierarchy of control methods plays in risk mitigation strategies
- Discuss universal precautions and safety practices with a laboratory
- Discuss key best laboratory practices and techniques and their role in maintaining biosafety and biosecurity
- Explain the key principles and requirements of Good Laboratory Practice (GLP) in order to ensure the quality and integrity of non-clinical laboratory studies
- Describe the essential elements of Good Clinical Laboratory Practice (GCLP)
- Explain how adherence to GCLP guidelines can enhance the reliability and reproducibility of clinical laboratory data
- Explain how the management and arrangement a workspace can improve workflow safety
- Discuss the key considerations for a next-generation sequencing (NGS) risk assessment
- Describe common laboratory decontamination strategies
- Explain how PPE is selected, the goals thereof, and how it is safely used and discarded

- Provide examples of laboratory incidences and the appropriate emergency responses
- Describe a safety procedure for collecting and handling biological samples
- Explain how to collect, transport, and safely store biological samples for NGS or other molecular techniques
- List sources of biological sample contamination
- Explain how to transport, store, and select biological samples appropriately for sequencing, according to a research question and/or surveillance strategy
- List techniques to minimise contamination during wet-lab preparations
- Describe key aspects of biological waste management strategies
- Explain the significance of biobanking in public health research and pathogen surveillance
- Discuss the requirements for designing an effective on boarding process
- Explain the procedures for successfully integrating a new laboratory member

Module assessments

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

Module resources

- WHO Laboratory Biosecurity Guidance 2024
- WHO | Strengthening laboratory biological risk management
- US CDC | Biosafety in Microbiological and Biomedical Laboratories (BMBL), 6th Edition
- MRI Global Slides - Biological Risk Assessment and Biosafety Considerations in the Laboratory
- US CDC | Biological Hazards
- PMC | Biosafety and Biohazards: Understanding Biosafety Levels and Meeting Safety Requirements of a Biobank
- NIH | NLM Article: Biohazard Levels
- Africa CDC | The regulatory and certification framework for institutions handling high risk pathogens in the Africa Region
- WHO | Laboratory Quality Management System
- Africa CDC /ICAFRICA NETWORK IPC WEBINAR | April 20, 2022. 2022 - YouTube
- Africa CDC | Laboratory Network Information Management System
- EMA | Good laboratory practice compliance
- WHO GUIDANCE on implementing regulatory requirements for biosafety and biosecurity in biomedical laboratories - a stepwise approach
- WHO Laboratory Biosafety Manual, 4th edition
- The Lancet | Laboratory-acquired infections and pathogen escapes worldwide between 2000 and 2021: a scoping review
- US CDC | Biorisk Management
- US CDC | Biological Risk Assessment
- US CDC | Biological Risk Assessment: General Considerations for Laboratories
- US CDC | Biological Risk Assessment Process

- Africa CDC | The regulatory and certification framework for institutions handling high risk pathogens in the Africa Region
- US CDC | Evaluating Your Laboratory's Risk Management Process or Quality Improvement Process
- US CDC | Fundamentals of Laboratory Safety Videos
  - Introduction to Laboratory Safety
  - Laboratory Work Practices Scenario
  - Laboratory Hazards Scenario
  - Emergency Procedures and Reporting Scenario
  - Risk Management Scenario
  - Safety Resources Scenario
  - Near Miss Scenario
  - Incident or Near Miss Scenario
- US CDC | Basic Molecular Biology: Laboratory Practice – The Laboratory Working Areas
- Africa PGI | The Development of a Pathogen Genomics Network Information Management System
- WHO | Decontamination and Waste Management
- US CDC | Fundamentals of Laboratory Safety Videos
  - Donning and Doffing PPE in Clinical Laboratories: Basic PPE for Routine Laboratory Procedures
  - Donning and Doffing PPE in Clinical Laboratories: Removing Gown and Gloves Together
  - Donning and Doffing PPE in Clinical Laboratories: Removing Gown First and Gloves Second
- Africa CDC | Biosafety and Biosecurity Resources
- WHO | Good Clinical Laboratory Practice (GCLP)
- U.S. FDA | Good Laboratory Practice for Nonclinical Laboratory Studies
- APHL | Specimen Collection, Handling, Transport and Processing
- MRI Global | Biological Sample Management
- WHO | Maintenance Manual for Laboratory Equipment, 2nd Edition
- Africa CDC | Laboratory Equipment Management: A Guidance to African Union Member States
- Eppendorf | Video - How to Take Care of Your Pipette | Pipetting Tutorials | Ep. 6: Maintenance
- Arizona Department of Health Services | Video - Pipette Calibration and Cleaning
- WHO | Strengthening Public Health Laboratory Services
  - Safeguarding biosafety and biosecurity in laboratories
  - Videos
  - Publications
- FIND | Video - From sample donors to new diagnostics: building bridges with biobanks
- Stellenbosch Faculty of Medicine & Health Sciences | Video - Biobanking and Beyond
- US CDC | Laboratory Onboarding Template
- US CDC Laboratory Training - OneLab™

References

- OpenAI. (2024). Gemini response on learning objectives for an introduction to biosafety and biosecurity module. Retrieved July 29, 2024, from https://gemini.google.com/
- OpenAI. (2024). ChatGPT 4o mini response on learning objectives for an introduction to biosafety and biosecurity module. Retrieved July 29, 2024, from https://chatgpt.com/
- OpenAI. (2024). Claude 3.5 Sonnet response on learning objectives for an introduction to biosafety and biosecurity module. Retrieved July 29, 2024, from https://claude.ai/new
- OpenAI. (2024). Copilot response on learning objectives for an introduction to biosafety and biosecurity module. Retrieved July 29, 2024, from https://copilot.microsoft.com/

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