



THE REPUBLIC OF UGANDA

MICROBIOLOGY TECHNIQUES AND PRACTICES



**IN-SERVICE TRAINING CURRICULUM
FOR
LABORATORY PERSONNEL**

**MICROBIOLOGY TECHNIQUES
AND
PRACTICES**

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FOR

LABORATORY PERSONNEL

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Ministry of Health, Uganda, 2019

Ministry of Agriculture, Animal Industry and Fisheries

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First Edition

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Foreword

Modern medicine has led to dramatic changes in the management of infectious diseases. However, the emergence of Anti-microbial resistance (AMR) exacerbated by constrained resources now threatens our ability to adequately manage life threatening infectious diseases. Microbiology laboratories play a critical role in the detection of new antibiotic resistance, outbreaks of foodborne infection, and possible bioterrorism events. Providing high-quality microbiology laboratory services that meet national and international standard is critical in the appropriate management of infectious diseases and antimicrobial resistance, thereby improving treatment outcomes.

Uganda’s One Health Strategic Plan (2018-2022) recognizes that the health of humans, animals and the environment is interlinked and provides a framework for promoting multi-sectoral collaboration to effectively prevent and control emerging and re-emerging infectious diseases and AMR, especially in resource-limited settings like Uganda.

This in-service training curriculum endeavours to improve capacity and strengthen competencies demanded in microbiology laboratory practice. It will facilitate effective in-service training and follow up (integrated in a mentorship and supportive supervision system) to support trainees apply acquired competencies. The modular approaches are also adopted to help trainees master the competencies and progress at a pace, which motivates and facilitates further inquisitive learning.

It is our sincere hope that this curriculum will contribute to improvement of skills, highly motivate and ensure competent laboratory personnel that will promote a healthy and productive nation.

We commend the team that participated in the development of this curriculum, urge and pledge to work closely with other line ministries, government departments and stakeholders involved in improving clinical microbiology practices to support the implementation to provide the support necessary for the implementation of this course.

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List of Acronyms

AMR	Antimicrobial Resistance
AST	Antimicrobial Susceptibility Testing
CDC	Centers for Disease Control
CPHL	Central Public Health Laboratories
CSF	Cerebral Spinal Fluid
EQA	External Quality Assessment
GCLP	Good Clinical laboratory Practices
GHSP	Global Health Security Project
GIT	Gastrointestinal Tract
GLASS	Global Antimicrobial Resistance Surveillance System
HMIS	Health Management Information System
ID	Identification
IDI	Infectious Disease Institute
IDSR	Integrated Disease Surveillance Response
IHR	International Health Regulation
IPC	Infection Prevention and Control
ISO	International Organisation for Standardization
LCD	Liquid crystal display
LCH	Lecture Hours
LQMS	Laboratory Quality Management System
MICRO	Microbiology
MoH	Ministry of Health
NADDEC	National Animal Disease Diagnostics and Epidemiology Centre
NCDC	National Curriculum Development Centre
PCH	Practical Hours
PCR	Polymerase Chain Reaction
POC	Point of Care
QA	Quality Assurance
QC	Quality Control
QMS	Quality Management System
RT	Real Time
SOPs	Standard Operating Procedures
TNA	Training Needs Assessment
UNHLS	Uganda National Health
USAID	United States Agency for International Development
WHO	World Health Organisation
CMTP	Certificate of Competency in Microbiology Techniques and Practices
ZN	Ziehl Neelsen

1. Introduction

1.1. Background

Microbiology is the field of science, concerned with the diagnosis of human diseases caused by bacteria, viruses, fungi, and parasites, as well as antimicrobial susceptibility testing, infection control, public health (surveillance and outbreak response), and laboratory quality, safety, management, and regulation. Microbiology laboratory practices and procedures consists primarily of three major spheres of activity:

- Technical direction of a microbiology laboratory services and provision of clinical consultations;
- Sample collection, handling and transportation; and
- Identification, characterization and reporting of investigations of micro-organisms causing infectious diseases;

The training of Microbiology Laboratory Personnel in Uganda started in 1929 by Dr. Turton, a Bacteriologist, employed by the British Government (in-service). In 1965, Britain changed the training system from a hospital broad-based and skill-oriented to specialized institution-based and mainly academic-oriented training (Pre-service). Laboratory training institutions have been following this mode of delivery which largely provides knowledge but limited in skills and competence building. However, the market requires that the laboratory personnel competently perform microbiology techniques and practices. In the recent past, In-service microbiology trainings have been conducted by various institutions without a standardized curriculum. Establishment and roll out of a standardized competence based in-service training curriculum is one of the strategies to strengthening microbiology laboratory skills and competencies required to support patient care, AMR surveillance, disease surveillance, outbreak investigation, preparedness and response.

1.2. Justification

Microbiology laboratories play a vital role in the detection, monitoring, outbreak investigation and the provision of scientific evidence to prevent and control infectious diseases (Public Health System). As the microbiology network grows, there is an increasing

demand for practical skills training and this calls for development of an in-service practical microbiology curriculum to streamline the capacity building of the laboratory science practitioners. The in-service training will represent a significant investment for continued competence building of the microbiology laboratory workforce.

1.3. Philosophy

This in-service training curriculum adopts a five staged accelerated Learning Cycle¹ as described in figure 1 and table 1 below, to increase learning success. This framework offers a structured approach that recognizes the natural stages of learning.

Figure 1: Accelerated learning cycle



Source: Adopted accelerated Learning Cycle- International Alliance for Learning

1.4. Program overview

1.4.1. Program Title

Certificate of Competency in Microbiology Techniques and Practices (CMTP).

1.4.2. Course Description

Aim

The main aim of the program is to build and strengthen the capacity of laboratory personnel to competently provide efficient and effective Microbiology testing services to improve quality of health care services.

Objectives

This program is intended to equip trainees with on job skills to:

¹ Accelerated Learning Cycle accessed at: <http://iaalp.org/cycle> on 15th Aug 2018

1. Perform Microbiology investigations correctly according to the recommended standard.
2. Manage microbiology laboratory resources and services effectively and efficiently.
3. Manage microbiology laboratory infection prevention and control to promote Biosafety.
4. Conduct microbiology Quality Assurance and control
5. Conduct Disease Surveillance and response.
6. Document and disseminate microbiology information.
7. Package, store and refer microbial isolates for further testing.

1.5. Job Profile for Laboratory Professionals

1.5.1. Job Tasks and Duties

JOB	DUTIES / TASKS
	Oversee laboratory services
	Analyse samples for abnormalities
	Design and conduct research
	Assign tasks to subordinates
	Perform Administrative Tasks
	Provide Continuous Professional Development
	Perform routine and advanced laboratory tests
	Process specimens for testing
	Interpret laboratory results
	Maintain and operate standard laboratory equipment
	Guide the patients and clinical staff on specimen collection
	Archiving and Storage of specimen
	Conduct research
	Ensure the laboratory is well-stocked and resourced
	Design and maintain quality assurance system
	Assign tasks to subordinates
	Observe health and safety precautions
	Maintain Health Information Management System
	Perform Routine Parasitological, Haematological, Chemistry, Microbiological and immunological tests.
	Provide Continuous Professional Development
	Laboratory data management
Monitoring trends.	
	Collect specimens from animals for laboratory examination and analysis.

JOB	DUTIES / TASKS
	Operate diagnostic equipment and interpret the resulting images.
	Design and conduct laboratory procedure to support research
	Oversee laboratory services
	Observe biosafety and biosecurity to prevent the spread of diseases
	Perform laboratory tests in order to produce reliable and precise data
	Processing specimens for testing
	Maintain and operate standard laboratory equipment
	Ensure the laboratory is well-stocked and resourced
	Process specimens for testing
	Interpret laboratory results
	Guide the patients and clinical staff on specimen collection
	Archiving and Storage of specimen
	Assign tasks to subordinates
	Laboratory data management
	Monitoring trends.
	Observe health and safety precautions
	Maintain Health Information Management System
	Perform Routine Parasitological , Haematological, Chemistry, Microbiological and immunological tests
	Perform Administrative Tasks
	Provide Continuous Professional Development
	Laboratory data management
	Guide the patients and clinical staff on specimen collection
	Perform laboratory tests in order to produce reliable and precise data

JOB	DUTIES / TASKS
Medical Laboratory Technician and Assistant	Prepare specimens and samples
	Maintain and operate standard laboratory equipment
	Prepare Laboratory materials for outreach tasks
	Observe health and safety precautions
	Collect Specimen for Laboratory Tests
	Maintain Health Information Management System
	Perform Routine Parasitological, Haematological, Chemistry, Microbiological and immunological tests.

1.5.2. Employment areas for the successful participant

1. Human Health Sector at Health Centres and hospitals
2. Animal Health Sector at Veterinary laboratories
3. Education sector e.g. at training institution
4. Manufacturing Industries e.g. food processing
5. Security institutions e.g. police for forensic diagnoses
6. Research Laboratories

1.6. Training Modules, Durations and Target Group

There are four Modules in the microbiology Laboratory techniques and practices curriculum as depicted in table 1 below:

TABLE 1: TRAINING MODULES AND TARGET AUDIENCE

Courses	Duration	Target audience
1:Basic Microbiology Laboratory Techniques	10 days	Laboratory Assistants, Technicians, Technologists and Scientists.
2:Advanced Microbiology Laboratory techniques and Practices	10 days	Laboratory Technicians, Technologists, Scientists and Pathologists.
3: Advanced Microbiology - Molecular and Immunology techniques	5 days	Laboratory Technicians, Technologists, Scientists and Pathologists

1.7. Curriculum development process

The process for the development of this curriculum was participatory involving participants from MoH, UNHLS/CPHL, NCDC, stakeholders from academia, research and other key implementing partners.

The development was based on core microbiology laboratory competencies, skills, abilities, and knowledge needed to effectively detect infectious disease pathogens in a timely manner.

1.8. Training approach

Training Preparation: The training team will work with UNHLS/CPHL, collaborating partners and stakeholders to identify trainees, agree on appropriate practical training facilities with good microbiology laboratory facilities and equipment for performing a variety of microbiology techniques, etc. A training planning checklist will be utilized to ensure adequate, efficient and timely delivery of the training in line with the established curriculum.

Training Implementation: The training will be implemented in three phases; didactic, practicum and onsite mentorship

Assessment/evaluation of Learners: Training evaluation tools are developed, validated and utilized to assess competence (knowledge, skills, and attitudes). Improvements will be made based on lessons learnt from each training module and will be used to improve the next training hence creating cycles of improvements. Pre-tests and post-tests will be used to assess knowledge gain and skills acquisition.

Training follow-up and support: The training program will have a process and guide for following up and supporting trainees. A follow up package will be designed to include but not limited to mentorship, supportive supervision and competence assessments.

1.9. Programme Delivery

This is an in-service training programme structured into specific competencies followed by on site mentorship and support supervision. The trainees shall do pre and post-test which upon successful passing with 80% pass mark (post – test) will lead to award of a certificate of attendance. On fulfilling the competence requirements during followup and support Supervision, a Certificate of Competence will be awarded. Those who will not attain the pass mark shall be given a chance to repeat when next due upon demonstration of self-funding. Non-governmental organization or individuals who wish to attend the course shall be allowed on condition of self-sponsorship.

1.10. Attendance of trainees

Trainees shall be selected from the health facilities with Microbiology laboratory infrastructure and these should be willing to voluntarily carry out microbiology testing. Selected personnel should be available to attend the entire training duration.

1.11. Entry requirements for training

The candidate must be a laboratory worker with basic training in Laboratory technology/Science from a recognized training institution at the following levels:

- Certificate, Diploma, Bachelor's degree, and Master's degree.

The candidate should also be registered with respective Professional Regulatory body.

1.12. Training assessment

Each course shall be assessed as follows: -

- Pretest: done for purpose of needs assessment to reveal prior knowledge and skills
- Coursework (progressive/continuous assessment): This contributes 40 marks to the overall performance score
- Post-test: This contributes 60 marks to the overall performance scores
- Onsite competence assessment: This will be a standalone assessment and contributes 100 marks.

1.13. Certification/Award

Certificate of attendance: A candidate should have attended 100% of the training course and scored at least 80% in progressive assessment and at least 60% in the post test. The awarding body will be MoH and MAAIF.

Certificate of competence: A candidate should have scored at least 80% of the competence assessment. The competence certificate will be valid for one year.

Renewal of the competence certificate will be upon competence test, which will be carried out on job once a year. When the candidate fails to meet the competence standards for the subsequent year, he/she will be reassessed after three months on implementation of corrective action.

2. Programme content

2.1. Course 01: Basic Microbiology Laboratory Techniques and Practices

Duration of Module: 80 hrs

Overview

The module aims at providing the learner with in depth knowledge in general microbiology as well as equipping them with competencies to process specimens for the diagnosis of bacterial, fungal, parasitic, viral diseases and immunological reactions.

Learning Outcome

By the end of this module, the trainees will be able to:

- Manage microbiological specimens
- Processes of specimens
- Operate and maintain equipment
- Select and manage reagent and supplies
- Prepare media, reagents and stains
- Isolate and identify bacteria
- Perform serological Diagnostic tests
- Apply disinfection and sterilization methods.

Competences

The trainees will;

- Observe safety precautions and Bioethics
- Perform disinfection and sterilization methods for infection control and prevention.
- Operate and maintain key Microbiology Equipment.
- Select and manage microbiology reagents and supplies
- Prepare media, reagents and stains for identification of microorganisms.
- Manage microbiological specimens
- Process microbiological specimens, interpret, report and timely dispatch results

- Perform antimicrobial susceptibility testing, interpret, report and timely dispatch results
- Perform inoculation and incubation techniques for culture and identification of microorganisms
- Perform antimicrobial Susceptibility testing techniques
- Carry out serological diagnostic tests.
- Observe the practices of laboratory waste management.

Summary of Sessions

No.	Sessions and contents	LH	PH
1.	Introduction to microbiology <ul style="list-style-type: none"> • Describe microbiology • Discuss the historical perspective of Microbiology • Explain the benefits of microorganisms in health • Describe host pathogens and normal flora 	2hr	
2.	Microbiology Laboratory biosafety <ul style="list-style-type: none"> • Discuss the transmission of infections • Conduct risk assessments • Observe safety practices in the microbiology laboratory • Perform disinfection and sterilization procedures • Safely handle and disposal waste 	1 hrs 30 min	3 hrs 30min
3.	Professional ethics in microbiology laboratory practice <ul style="list-style-type: none"> • Describe ethical issues related to microbiology laboratory practice • Explain the importance of professional ethics • Apply ethical conduct to microbiology laboratory practice 	30 min	1 hr
4.	Operation and management of assorted microbiology equipment Autoclave, Incubators, Hot Air Oven, Microscope, Water Bath, Centrifuge, Weighing Balance, Vortex mixer, pH meter, Bunsen burner, Spirit lamp, Biosafety hood, Refrigerator, Colony counter, Hot plate with magnetic stirrer, Bunsen Burner, Automated blood culture systems. <ul style="list-style-type: none"> • Outline the steps involved acquiring and using a new equipment • Discuss operating principles of listed microbiology equipment • Properly Use, care and maintain listed microbiology equipment • Outline procedures for handling faulty and obsolete equipment 	1hr	3hrs
5.	Procurement and inventory management <ul style="list-style-type: none"> • List essential reagents and supplies required for performing the essential microbiology tests • Forecast reagents and supplies needed based on the number of tests performed during a specific period 	1 hr	1 hr 30 min

No.	Sessions and contents	LH	PH
	<ul style="list-style-type: none"> • Describe the procurement processes • Explain the use and importance of the stock cards in maintaining an adequate inventory • Explain storage and shelf life requirements of essential microbiology reagents and supplies 		
6.	Staining Techniques in Microbiology <ul style="list-style-type: none"> • Identify and discuss the different types of stains • Explain principles of common staining techniques • Prepare stains, perform staining methods, interpret, quality control and report results • Appropriately handle, store and dispose examined slides 	2hrs 30 min	9hrs
7.	Preparation of culture media Mueller Hinton Agar, XLD, SABOURAUD Dextrose Agar (SDA), DCA, Stuart's medium, Chromogenic agar – MRSA, CLED agar, Chocolate, MacConkey agar, XLD, Selenite F, TCBS, Alkaline Peptone Water, Candida Agar <ul style="list-style-type: none"> • Classify and identify the different types of common culture media and their use • Prepare different culture and identification media • Conduct quality control checks on prepared media • Properly store and dispose prepared culture Media 	2hrs	6hrs
8.	Collection, handling, transport and receipt of microbiology specimens <ul style="list-style-type: none"> • Describe different types of specimen collection containers. • Identify specimens for microbiological examination • Prepare specimen collection containers. • Properly Collect different types of microbiology specimens • Properly Label specimen • Maintain and preserve laboratory specimen to maintain integrity • Properly Package specimens for safe transportation • Process specimens for microbiological examination 	1hrs 30 min	7 hrs 30 min

No.	Sessions and contents	LH	PH
	<ul style="list-style-type: none"> Explain the different storage conditions for microbiology specimens. Appropriately receive microbiology specimen for testing 		
9.	Microbial Culture Techniques <ul style="list-style-type: none"> Describe the different inoculation methods. Describe the different incubation conditions such as Aerobic, Anaerobic, Carboxyphilic and Micro-aerophilic Conduct different inoculation and incubation methods Perform microbial culture techniques on commonly encountered specimen, QC, interpret and report results Autoclave and dispose used culture media 	5hrs 40 min	14hrs 30min
10.	Microbial identification Techniques Catalase, TSI, Citrate, SIM, lysine, identification sugars, Coagulase, Novobiocin, Bacitracin, Optochin, Bile esculin, DNase, Urease, Oxidase, X&V Factors <ul style="list-style-type: none"> Explain principles underlying the listed identification tests Perform and interpret the listed identification tests Conduct quality control checks for the listed identification tests 	1hr	3hrs
11.	Antimicrobial Susceptibility Testing Methods <ul style="list-style-type: none"> Discuss the different classes of antibiotics and their mode of action Describe the mechanisms of antimicrobial resistance Discuss the importance and limitations of commercial antimicrobial susceptibility test systems Perform AST using the disk diffusion methods, QC checks, interpret and report results 	1 hrs 30mi n	6hrs
12.	Antigen-antibody Assays Pregnancy test, Brucella Agglutination Test, Rheumatoid factor, CRP (Latex), VDRL, RPR, TPHA, ASOT, Salmonella IgG/IgM, CRAG, Toxoplasma IgG/IgM, H pylori and Leptospirosis.	30hrs	3hrs

No.	Sessions and contents	LH	PH
	<ul style="list-style-type: none"> Describe antigen-antibody tests and their application in microbiology laboratory investigations Perform listed antigen-antibody tests, quality control checks, interpret and report results 		
13.	Documentation of microbiology activities and procedures <ul style="list-style-type: none"> Define documentation and its importance in microbiology laboratories Outline the key documents and records that need to be maintained Discuss the implication of poor documentation practices Complete and maintain key laboratory tools 	20 min	40 min
Total hours		20hrs	61hrs
KEY			
LH = Lecture Hours; PH = Practical Hours			

Delivery Method:

- Brain storming
- Demonstration
- Discussions
- Mentorship
- Question/Answer

Assessment Methods/Tools

- Pre Tests.
- Course work.
- Post Tests.
- On-site Competence assessment

Resources:

- Specimens
- SOPs
- Quality Control materials

- Media, Reagents and Stains
- Microscopes
- Autoclave
- Incubator
- Slides
- Antisera
- ICT gadgets
- PPE
- Stationary

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2.2. Course 02: Advanced Microbiology Laboratory Techniques in bacteriology and mycology

Duration: 80 hrs

Overview

This module will build and strengthen the capacity of laboratory personnel to perform Isolation and identification of microbial, antimicrobial susceptibility Testing of microbial pathogens, and AMR surveillance.

Learning Outcome

By the end of this module, the trainees will be able to Isolate, Identify microbial pathogens and carry out antimicrobial susceptibility testing for patient management and generate data for AMR surveillance

Competences

The trainee will,

Carryout Isolation techniques for microbial pathogens

- Isolate microbial pathogens
- Identify microbial pathogens
- Set up antimicrobial susceptibility Testing of microbial pathogens
- Conduct AMR surveillance.

Summary of Sessions

No.	Sessions	LCH	PCH
1	Isolation of microbial pathogens <ul style="list-style-type: none">• Explain principles of media use and growth/nutritional requirements of microorganisms• Describe colony characteristics of different microorganisms• Practice inoculation of media• Carry out incubation of inoculated media• Practice plate reading.• Carry out purity subculture.	4hrs	18hrs
2	Identification of microbial pathogens	4hrs	15hrs

No.	Sessions	LCH	PCH
	<ul style="list-style-type: none"> • Selection of identification tests • Set identification tests • Read results of the tests performed. • Quality control measures. • Interpretation of results. • Reporting results. 		
3	<p>Antimicrobial susceptibility Testing Classification of antibiotics</p> <ul style="list-style-type: none"> • Demonstrate the mode of action of antibiotics • Illustrate mechanisms of resistance to antibiotics • Selection of antibiotics • Demonstrate methods of performing AST (Disc diffusion, Agar well diffusion, Broth dilution, E-test, automation) • Carry out Quality control 	3hrs	20hrs
4	<p>Conduct AMR surveillance.</p> <ul style="list-style-type: none"> • Enhance awareness and understanding of antimicrobial resistance • Strengthen awareness on National laboratory surveillance system for antimicrobial resistance • Equip participants with skill or knowledge in/on; <ul style="list-style-type: none"> i) Establishing laboratory-based surveillance system for AMR ii) Identifying Priority pathogens (GLASS) iii) GLASS specimen and antibiotics iv) Data management and information sharing v) Monitoring and evaluation AMR lab-based surveillance. 	3hrs	13hrs
Total hrs		14hrs	66hrs
<p>KEY LCH = Lecture Hours; PCH = Practical Hours</p>			

Delivery methods

- Group discussions through activities, scenarios and case studies
- Brain storming
- Tutorials
- Demonstration and return demonstration

Assessment methods

- Pre Tests.
- Course work.
- Post Tests.
- On-site Competence assessment

Resources:

- Specimens
- SOPs
- Sensitivity discs
- Inoculation loops
- Incubators
- Automatic culture equipment
- Gas burners
- Quality Control materials
- Media, Reagents and Stains
- Microscopes
- Autoclave
- Slides
- Waterbaths
- Antisera
- Stationery
- Safety gears

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2.3. Module 03: Advanced Microbiology laboratory techniques in Molecular biology and Immunology

Duration: 40 hrs

Overview:

This course describes the principles of immunology and Molecular Biology and how these are exploited for the treatment, diagnosis and/or control of common infections in the tropics. The laboratory personnel will acquire knowledge skills and attitudes in on technology, laboratory theory and practical approaches prerequisite for the performance of common immunological/molecular genetics methods to the pathogenesis and diagnosis of infectious diseases.

Learning outcome

The trainee will acquire knowledge and skills in Molecular biology and Immunology for application of molecular genetics in the diagnosis and control of infectious diseases.

Competences

The trainee will:

- Describe the scope of molecular biology and immunology in the view of diagnostics and disease control
- Carry out specimen collection, transportation, processing and storage in the view of molecular diagnostics and diagnostic immunology
- Perform immunological and molecular diagnostic tests for diagnosis the common microbial diseases
- Describe the major clinical/medical uses of molecular diagnostic techniques
- Classify the various commercial molecular diagnostic techniques
- Explain clinical applications of molecular diagnostic techniques
- Detect emerging infectious diseases
- Discuss genetic methods currently used in predicting drug resistance, transmission patterns, and evolutionary trends in infectious diseases of public health importance
- Design immunology and molecular diagnostic laboratories for standard workflow

Summary of Sessions:

Session	Competency	LCH (Hrs.)	PCH (Hrs.)
1	Introduction to Molecular Diagnostics (DNA Extraction, Conventional PCR, Real time PCR) <ul style="list-style-type: none"> • Discuss definitions, principle and application • Practice DNA / RNA diagnostics methods 	3hrs	5hrs
2	Specimen Handling; Collection, Transportation, Processing and storage <ul style="list-style-type: none"> • Describe animal and human clinical specimens. • Describe environmental specimens such as food, water, and fomites. • Practice proper methods of human / animal specimen collection and transportation 	3hrs	5hrs
3	Molecular Mechanisms of Microbial drug resistance <ul style="list-style-type: none"> • Demonstrate Genotypic mechanisms of drug resistance (ESBL, MSRA, CPE's, VRE's) 	3hrs	5hrs
4	Molecular epidemiology: <ul style="list-style-type: none"> • Facilitate the ability of scientists to conduct etiological research. • Increase knowledge about determinants of disease. • Contribute to development of approaches for disease prevention. 	3hrs	5hrs
5	Diagnostic immunology <ul style="list-style-type: none"> • Discuss the principles of immunology • Carry out Immunological diagnostic methods • Discuss the application of diagnostic immunology (Immuno-assays) • Demonstrate equipment use and maintenance 	3hrs	5hrs
Total hrs		15hrs	25hrs
KEY LCH = Lecture Hours; PCH = Practical Hours			

Delivery methods:

- Tutorial
- Modified lectures
- Brain storming
- Group discussions
- Practical
- Demonstrations

Assessment methods

- Pre Tests.
- Course work.
- Post Tests.
- On-site Competence assessment

Resources

Specialised laboratory

SOPs

Specimens

Equipment

QC materials

PPE

Biohazard bags

Reagents

Reference:

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