Seamless Programme

MEDICAL MICROBIOLOGY

(A) INTRODUCTION

Objective of Training

The aim of this programme is to produce microbiologists who are able to:

1. Supervise a clinical microbiology laboratory
2. Provide clinical liaison and consultation based on an understanding of the biology of pathogens, interpretation of laboratory tests and clinical correlates of infection
3. Provide advice in infection prevention and control
4. Provide advice and help in implementing a multi-faceted antimicrobial stewardship programme
5. Conduct or support research to discover new knowledge or improve clinical microbiology services
6. Provide teaching and education to healthcare staff, trainees, students and medical technologists
7. Collaborate with authorities and other parties in public health surveillance and outbreak investigation

By end of the training, the trainee is expected to acquire the following knowledge and skills specified in the training syllabus (D).

(B) PROGRAMME OVERVIEW

Traineeship Duration for Seamless Training in Microbiology

This is a 5 year training programme, with rotations or postings relevant for microbiology.

(C) ADMISSION REQUIREMENTS

Entry Criteria / Pre-requisites

Applicants must fulfill the following entry criteria / pre-requisites as stated below:

- At least in PGY 2 to apply for Microbiology Traineeship.
- Successful applicants after selection interview can only start the traineeship in PGY 3.

(D) TRAINING SYLLABUS

A. Detailed Syllabus

Knowledge	Skills
1. Scientific basis of medical microbiology • Microbial structure, physiology and genetics. • Microbial taxonomy and classification. • Host defence mechanisms and immunity to infection. • Microbial pathogenicity. • Epidemiology of infectious diseases, including surveillance and control of infection. • Antimicrobial agents, their mode of action and	• Select appropriate laboratory tests for pathogen detection/identification and select appropriate anti-microbial therapies for a range of important infections. • Show expertise in considering infection-related differential diagnoses, informed by epidemiological factors and clinical presentation.

mechanisms of microbial resistance.	
2. **Laboratory safety** • Laboratory design, laboratory biosafety levels, Organism hazard groups and classes of cabinets. • Safety requirements including use of protective equipment when working in a microbiology laboratory. Correct laboratory dress and hygiene practices. • Handling and disposal of specimens and contaminated articles at the laboratory bench, the dangers of aerosol, and procedure for dealing with biological and chemical spills. • The principles and operation of biological safety cabinets. • Procedures for the safe transport of specimens and cultures. Know the national and international packaging and transport regulations for such material. • The principles and operation of high containment facilities for handling risk group agents.	• Correct microbiology laboratory techniques • Application of personal protective equipment • Hand hygiene • Handling biological spills • Prepare infection prevention and control written risk assessments • Laboratory Risk assessment
3. Sterilisation and disinfection • Principles and uses of sterilization and disinfection procedures for the preparation of media, instruments and microbiological waste. • Use of sterilization and disinfection in the laboratory, hospital and community. • Be familiar with Central Surgical Supplies Department • Endoscope protocols	
4. Handling of specimens • The optimal methods for collection, transport, storage of each type of specimen type and for different types of tests • Processing of various specimen types, including appropriate use of personal protective equipment and safety equipment.	• Primary plating of clinical specimens. • Inoculating agar plates and streaking • Set up anaerobic cultures; Set up pure cultures from mixed growth on a primary plate.
5. Microscopy • The principles of light, dark ground, phase contrast, fluorescence and electron microscopy. • Staining methods using various stains, including immunofluorescence stains. Perform and read. • Appearance of stained preparations and recognition of artefacts and their possible origin.	• Perform Gram stain and other special stains • Prepare specimens and examine by light microscopy • Read Gram stains and other special stains including immunofluorescence stains • Operation and basic configuration of the light microscope

6. Culture method • The wide range of selective, enrichment and inhibitory media available for general and specialized use, and the choice of the relevant media. • Processing methods for various specimen types. • The physical growth requirements of micro-organisms including atmosphere, temperature and incubation time, and the growth kinetics of solid phase and broth cultures. • The preparation of commonly used media, and understand the internal control process for such preparation. • The colonial and microscopic morphology of medically important bacteria including mycobacteria. • Recognition of potential pathogens from a mixture of colonies on culture plates, and isolation of such colonies in order to get pure growth for further work-up. • The diversity of microbial metabolism and the use of these properties in the identification of bacteria. The use of various conventional and automated methods for the identification of bacteria. • Supplementary methods leading to the identification of common pathogens including the use of commercially produced kits (eg enzyme immunoassays, latex agglutination, MALDI-TOF). • The reporting format for various specimen types and growth outcome. • Diagnosis of difficult to culture bacterial infections e.g. *Legionella*, *Leptospira*, *Mycoplasma pneumoniae,* syphilis infections.	• Read and interpret primary plates • Distinguish pathogens from normal flora • Recognise the colonial and microscopic appearance of commonly encountered or medically important organisms • Perform and interpret oxidase, catalase tests • Set up tests for identification • Determine viable counts in bacterial suspensions • Prepare, read and interpret antigen-antibody assays • Able to set up and run MALDI-TOF
7. Antimicrobial susceptibility • Scientific basis of antimicrobial susceptibility testing and establishment of clinical breakpoints • Wild type distributions, ECOFF, PK parameters, PK/PD indices and target attainment. Methods of testing the antibiotic sensitivities of various bacteria including disk diffusion and minimum inhibitory concentration (MIC) methods. • Categorical reporting of AST results (S, I, R) and its definitions • Antimicrobial assays using biological and automated techniques. • Use of antimicrobial assays and their relationship to the therapeutic and toxic effects on a patient in relation to dosage regimen.	• Perform and interpret disk diffusion test • Perform and interpret MIC and MBC tests as appropriate eg E Test • Detect beta-lactamases and other bacterial enzymes • Work with laboratory staff to further evaluate resistant organisms, including use of reference laboratories where appropriate

• Mechanisms of antimicrobial resistance. • Appropriate choice of antimicrobial testing panel for each organism type and site of infection. • Knowledge of common drug dosing in relation to clinical breakpoint.	
8. Antimicrobial usage • Be familiar with the spectrum of activity, pharmacodynamic and pharmacokinetic properties, and side effects of each antimicrobial agent. • Empiric, directed and prophylactic use of antimicrobial agents. • Surveillance and prevention of emergence of resistance. • Understand and apply antibiotic stewardship	• Advise clinicians on appropriate choice, dose and duration of antibiotics • Contribute to hospital policies on antibiotic usage. • Use therapeutic drug monitoring to reduce toxicity and optimise therapy • Recognise when other interventions in addition to (or instead of) antimicrobial agents are required to manage an infection – for example surgical intervention or topical treatments • Recognise conditions that do not merit antimicrobial treatment using clinical and laboratory information • Recommend escalation and de-escalation antimicrobial treatment appropriately and safely • Manage or advise on management of infections due to multi-resistant organisms
9. Virology • Structure and function of virus and viral component (basic virology). • Laboratory methods for diagnosis of viral infections including viral culture, antigen detection, serology and molecular methods. • Optimal methods for collection, transport, storage and processing of different types of specimens and tests. • Interpretation of results, for both clinical management and infection control purpose. • Virology policies in relation to health care workers, pregnancy, immunization and transplantation. • Special problems associated with the immunocompromised host. • Appropriate use of antiviral agents. • Antiviral resistance. • Viral vaccines. • Interpretation and limitations (if any) of serology in diagnosis	• Process different types of samples. • Set up and maintain viral cultures. • Read and interpret viral cytopathology effect (CPE) from tube or shell vial cultures • Set up and read immunofluorescence slides, enzyme and line immunoassays • Interpret virological results including molecular detection methods and serology for viral infections (For molecular skills, refer to item 14)
10. Mycobacteriology • Diagnosis: New tuberculosis (TB) infection, recurrent TB infection (relapse or reinfection), pulmonary TB, non-pulmonary TB, paediatric	• Perform, read and interpret acid fast smears. • Recognise colonial morphology on special

patients, latent TB, BCG infections • Current state of molecular testing, AFB smear and culture in the diagnosis of TB infections. Sensitivity/specificity/NPV/PPV and limitations (if any) of various lab tests in diagnosis of different types of TB infections • Interferon gamma release assays (IGRA) -clinical applications and limitations. • Biomarkers in TB infection- applications and limitations • Specimen collection: Specimen types, method of collection, infection control precautions, limitations -Expectorated sputum vs induced sputum, gastric lavage, BAL, tissue biopsy • Specimen processing for various specimen types • Culture methods: liquid and agar based; manual, semi-automated, automated methods. Evaluation of negative and positive cultures • Identification methods for *Mycobacterium tuberculosis* (MTB) • Susceptibility testing (ST) – Critical concentration, critical proportion, resistant ratio, MIC methods, genotypic methods, 1st and 2nd line TB drugs. Quality control for ST. • Role WGS and molecular typing • MTB laboratory cross contamination • TB infection control policies in health care institutions and public health setting • Sterilization and disinfection methods effective for TB • TB surveillance and control in Singapore • Immune responses to TB and vaccines eg. BCG. • Epidemiology of non-tuberculous mycobacteria (NTM) infections • Identification of NTM –phenotypic methods, MALDI-TOF, sequencing methods. Quality assurance of identification methods • Susceptibility testing of NTM – establishment of breakpoints, quality assurance and quality control	media • Read and interpret IGRAs. • Comment on relevance of mutations to susceptibility • **Interpret sequencing results**
11. Mycology • Laboratory methods for diagnosis of fungal infections. • Interpretation of results, for both clinical management and infection control purpose. • Special problems associated with the immunocompromised host. • Interpretation and limitations of serology and antigen detection in diagnosis,	• Read wet mounts • Set up and read germ tube • Set up and read Indian ink smear • Set up and read tease mounts • Recognise fungal morphology and colonial growth on various media • **Interpret sequencing results**

12. Parasitology • Laboratory methods for diagnosis of parasitic infections. • Interpretation of results, for both clinical management and infection control purpose. • Special problems associated with the immunocompromised host. • Interpretation and limitation of serology in diagnosis	• Read malarial blood smears • Read microscopy for stool ova, cysts and parasites
13. Immunology • Knowledge of immunological response to infection and laboratory methods to determine immunity • Various serological testing methods eg CFT, HI, EIA, immunoblot, particle agglutination, IF. • Pitfalls in serological diagnosis	• Correct interpretation of serology results eg syphilis, Toxoplasma, Legionella, Leptospira, HIV, hepatitis and rubella
14. Molecular diagnosis • Principle and practical applications of nucleic acid amplification assays in clinical microbiology. • Major new molecular-based techniques available for microbiology. • Advantages and pitfalls in molecular-based diagnosis. • Next Generation Sequencing (NGS)	• Extract nucleic acids from specimens • Set-up a polymerase chain reaction (PCR) assay; • Interpret real time polymerase chain reaction (PCR) graphs; • Prepare and read gels; • Nucleic acid sequencing of microbes • Wet laboratory preparation for NGS • Use of bioinformatics for analysis
15. Infection control in hospital and community • Management of local infection control problems, including outbreaks of infection. • Infection control policies for hospital and community. • Principles of patient isolation and their application. • Physical and chemical agents used in hospital infection control. • Application of microbial strain typing methods	• Analyze and manage an outbreak • Advice, infection prevention and surveillance
16. Data handling and IT • The use and application of information technology in handling laboratory tests information, including requisitioning and reporting of tests, and analysis of data including antibiogram. • The importance and need for data protection. • Understand performance data	• Able to use the laboratory information system to enter results, validate results and generate relevant microbiological data for audit and analysis • Be proficient in Excel

17. Quality assurance and laboratory management • Able to set protocols and to maintain standards within the laboratory. • Quality control and quality assurance of laboratory results. • Participation in external quality assurance programmes. • Knowledge of any existing laboratory accreditation schemes, and the requirements and process whereby the accreditation is conferred. • Know and apply the components in ISO 15189.	• Complete a clinical quality Improvement programme or equivalent • Audit a laboratory • Supervise a laboratory to ensure the laboratory is run in an efficient, safe and cost-effective way • Develop and critique evidence-based laboratory Work instructions or standard operating procedures • Able to recommend necessary metrics • Able to trouble shoot
18. Clinical experience and liaison • Understand the principles and practices of the various types of tests, and their advantages and limitations and be familiar with the scientific basis for laboratory diagnosis of infections. • Knowledge of the different types of pathogenic microorganisms, including epidemiology, pathogenesis, natural history of the disease, clinical and laboratory diagnostic approaches, treatment and prevention. • Know the special infectious disease issues associated with different clinical specialties eg. medical, surgical, ICU transplants, cardiothoracic, obstetrics & gynaecology, paediatric, family practice, etc.	• Act as liaison with clinical colleagues and participation in collaborative clinical activities. Emphasis should be placed on close relationship with special areas like Intensive Care Units and special departments like haematology and transplantation, where possible. • Provide informed advice on choice of laboratory tests, antibiotic therapy, immunization, preventive measures and infection control where appropriate.
19. Research • Know how to conduct research including the use of statistics and ethical issues. • Be able to estimate sample sizes • Understand dual use research of concern (DURC)	• Able to critically appraise journal articles • Able to plan and conduct research projects • Obtain CITI certified by Year 3
20. Public Health • Communicable diseases of public health importance. • Application of microbial strain typing methods. • Vaccination	Interpret typing data
21. Ethics and Legislation • PDPA issues • Human Biomedical Research • BATA	• Handle confidential patient data sensitively and securely. Ensure that patient confidentiality is maintained
22. Bioinformatics • Broad range PCR (e.g.16S RNA) • Whole Genome Sequencing (WGS)	• Understanding and use of bioinformatics tools e.g. 16S RNA sequencing for bacterial identification

B. Training activities/competencies:

1. **Training programme**

   The trainee will participate in various teaching programmes set by the training centre. This includes bench work, journal readings, teaching and clinical rounds.

   The trainee should also attend and participate in any other relevant training activities organized by other institutions and organizations.

2. **Rotations**

   The MOHH trainee will apply via MOPEX or direct to MOHH for postings to JCST accredited microbiology laboratories/departments. The trainee should be assigned a supervisor once posted to a training department. The training supervisor will draw up a training schedule to enable the trainee to cover all the required aspects of training. This should include sufficient time in various specialty areas as mentioned in the Detailed Syllabus above (points -1 - 21). Feedback from the Microbiology STC should be taken into consideration. Supervisors may work through their HODs to arrange for rotations to specific laboratories or departments relevant to the microbiology programme.

   Rotations to other laboratories during the course of traineeship is preferred. The trainee should check on specific requirements by various colleges (eg RCPA) regarding outside rotations.

   Rotations to the infectious disease department or an equivalent clinical department for at least 6 months is required.

3. **Presentations**

   The trainee should present posters and free paper publications of research projects at local, regional and international relevant meetings.

4. **Teaching**

   The trainee should participate in teaching for all levels of staff including for laboratory staff, visitors attached to the labs, students, nursing and other hospital staff, on various aspects of microbiology and infection control.

5. **Research**

   The trainees are encouraged to participate in and conduct research ideally with a research scientist or in a research facility. This is especially important for the RCPA Fellowship where a research project is required and examinable. The trainee should conduct critical literature review and know basic statistics.

(E) INSTITUTIONAL REQUIREMENTS (FACILITIES & RESOURCES)

There should be adequate number of trained staff who are full-time. Trainees are assigned a supervisor.

The training centre must provide trainees with adequate work space and facilities for the volume and work undertaken.

The training centre must have a reasonable number and variety of appropriate journals and medical texts, and preferably a medical library with borrowing facilities. On-line access should be provided.

There should be regular journal clubs, joint conferences and audit reviews.

(F) SUPERVISION OF TRAINEES

All trainees will be supervised by a designated consultant/ supervisor but in general all the consultant staff will be duty bound to take an active part in teaching. Assessment of progress and log should take place at least 6 monthly.

The supervisors should be actively practicing medical microbiology.

The supervisor is expected to:

- Draw up a prospective training programme. This should be devised in collaboration with the trainee and taking into account any recommendations from the STC.
- Delegate training responsibilities to other trainers and facilitate arrangement of various postings and attachments where appropriate.
- Monitor the trainee's progress by personal observation, feedback and discussion.
- Maintain contact with the STC, and feedback to STC any concerns about the trainee.
- Submit supervisor's report on the trainee to various institutions and organizations as required.

It is possible for trainees to opt for a new supervisor at a different department. Trainees should inform the Microbiology STC for further action.

(G) ASSESSMENT AND FEEDBACK

Logbook

All trainees are expected to keep a log book which will be reviewed regularly by the main supervisor. The log book will have a record of time spent in various postings, benches or disciplines in microbiology. Important cases seen should be recorded.

CME activities and training courses attended should also be recorded.

All projects, publications and teaching experiences e.g. conferences, seminars, papers presented, should also be recorded.

Assessment

Please refer to the Annex 1: Trainee Assessment for Microbiology Seamless Training Program".

All trainees accepted under the Seamless Traineeship programme, will undergo regular assessments of skills and knowledge in the form of Directly Observed Procedures (DOPS) and Case based Discussions (CBD) at the workplace. An assessment of knowledge after Y1 involves a set of MCQs. The Microbiology STC will review the outcomes of the assessments at the Meet-the-Trainee sessions (MTTS).

Trainees should sit and pass the **intermediate exam FRCPA Part** I in Year 3 of their training.

Entrustable Professional Activity (EPA)

Please refer to Annex 2 and 3.

'The entrustable professional activity (EPA) concept allows faculty to make competency-based decisions on the level of supervision required by trainees. EPAs are units of professional practice, defined as tasks or responsibilities to be entrusted to the unsupervised execution by a trainee once he or she has attained sufficient specific competence'. (Journal of Graduate Medical Education, March 2013).
See table of EPA for Microbiology Trainees (Annex 2)

Trainees and supervisors should sign off the **"Record of EPA"** form at the end of each posting noting the EPAs achieved (Annex 3).

Feedback

Six-monthly interviews with the trainees should be conducted by supervisors and STC to ensure that the training objectives for each rotation have been adequately met, as well as to monitor for any difficulties in workload and training activities. Feedback forms should also be provided at the end of each posting, and the programme supervisor is responsible for collating the results and instituting the appropriate changes to the training programmes.

(H) EXIT CERTIFICATION

Exit examinations include the FRCPA (Part II) or FRCPath (Part II) examination, or equivalent**.** Trainees may apply to sit the exit examinations at the appropriate time; and when deemed ready by the supervisor/HOD.

Refer to websites www.rcpa.edu.au and www.rcpath.org respectively for information about eligibility and examination details.

(I) GENERAL GUIDELINES

Please refer to Annex 4 for General JCST Guidelines on the following:

- Leave Guidelines
- Training Deliverables
- Retrospective Recognition
- Changes to Training Period
- Part-time Training
- Overseas Training
- Withdrawal of Traineeship
- Exit Certification

(J) APPLICATION FOR SEAMLESS TRAINEESHIP

Eligible doctors may enquire with the Joint Committee on Specialist Training (JCST) Secretariat on the next Seamless intake exercise.

Shortlisted applicants will be required to attend an interview.

All successful applicants will be issued with an offer letter of traineeship and are required to revert with their acceptance of traineeship offer to JCST. All successful applicants must be formally registered as a Trainee with the JCST Secretariat prior to commencement of traineeship.

Annex 1

Trainee Assessment for Microbiology Seamless Training Program

Trainee Competencies **MK:** Medical knowledge **PC:** Patient care **ISC:** Interpersonal skills and communication **P:** Professionalism **PBLI:** Practice-based learning and improvement **SBP:** Systems-based practice	**Trainee Assessment (Forms may be downloaded from RCPA, Australia or RCPath, UK)** **CbD: Case based discussion** **DOPS: Direct observation of practical skills** **ECE: Evaluation of clinical/management events** **MSF: Multi-source feedback**				
	Year 1 Formative assessment	**Year 2 Formative assessment**	**Year 3 Formative assessment**	**Year 4 Formative assessment**	**Year 5 Formative assessment**
A. Laboratory Methods and Microbiological Science (Competencies: MK, PC, PBLI)	At least 4 DOPS	At least 4 DOPS	At least 4 DOPS	At least 4 DOPS	At least 4 DOPS
B. Clinical consultation and interpretation (Competencies: MK, PC, PBLI, ISC, P, SBP)	At least 2 CbD (low-medium complexity)	At least 2 CbD (medium complexity) ECE	At least 2 CbD (medium complexity) ECE 1 MSF	At least 2 CbD (high complexity) ECE	At least 2 CbD (high complexity) ECE 1 MSF
C. Infection Control (Competencies: MK, PC, ISC, P, PBLI)	ECE	ECE	ECE	ECE 1 MSF	ECE
D. Research (Competencies: MK, PBLI)			Complete a simple research project		Publication in peer reviewed journal

Trainee Competencies **MK:** Medical knowledge **PC:** Patient care **ISC:** Interpersonal skills and communication **P:** Professionalism **PBLI:** Practice-based learning and improvement **SBP:** Systems-based practice	**Trainee Assessment (Forms may be downloaded from RCPA, Australia or RCPath, UK)** **CbD: Case based discussion** **DOPS: Direct observation of practical skills** **ECE: Evaluation of clinical/management events** **MSF: Multi-source feedback**				
	Year 1 Formative assessment	**Year 2 Formative assessment**	**Year 3 Formative assessment**	**Year 4 Formative assessment**	**Year 5 Formative assessment**
E. Laboratory Management (Competencies: PC, ISC, P, PBLI)			ECE	ECE	ECE
F. Teaching (Competencies: MK, ISC, P)		ECE	ECE	ECE	ECE
G. Laboratory Safety and Biosafety	ECE	ECE	ECE	ECE	ECE
H. Examination	End of year MCQ assessment		**FRCPA Part 1 (intermediate exam)**		

Annex 2

Entrustable Professional Activities for Microbiology Seamless Training Program

Entrustable Professional Activities (EPA)

EPA	Year 1	Year 2	Year 3	Year 4	Year 5
A. Laboratory Methods and Microbiological skills	Process/Reject specimens and report Gram stains independently Identify and workup of commonly isolated bacteria and corresponding susceptibility testing for major benches including: -blood -urine -respiratory -miscellaneous/pus -stool Interpret ID/ST results and provide clinically appropriate report. Perform QC for relevant tests Notify Ministry of Health (MOH) in timely manner when indicated.	Identify and workup of difficult organisms, GPB, Mycobacteria and corresponding ST if applicable. Detect, identify and workup of viruses, fungi and parasites with corresponding ST if applicable. Perform molecular tests and be able to troubleshoot Interpret results, provide clinically appropriate report and pick up unusual/unexpected results for following: -Non-sterile cultures -Sterile sites -Serology -Molecular test	Perform tests independently Act as laboratory's main person responsible for trouble-shooting Authorisation of microbiology reports including selective reporting of antimicrobials. Update breakpoint interpretation according to guidance documents. Recommend novel methods for resistance detection where relevant. Review and interpret lab quality assurance data at staff meetings that include QC and EQA especially for bacteriology and serology tests	Evaluate different test methods Independently oversee a section Implement new methods Review existing test procedures Participate in verification of laboratory information system (LIS) – hospital information system interface integrity Demonstrate understanding of scientific basis and limitations of laboratory equipment used and request alternative testing methods where applicable	Initiate, review and change lab methods to meet clinical needs Measurement of uncertainty Contribute to laboratory clients' manual, SOP and work instruction

EPA	Year 1	Year 2	Year 3	Year 4	Year 5
B. Clinical consultation and interpretation	Explain to clinical colleagues ID/ST procedures and rationale behind interpretation and reporting policies during Infectious diseases-microbiology plate rounds Appropriate antibiotic use according to established guidelines	Interpret and provide clinical management advice for typical/routine microbiology cases of low-medium complexity e.g. CAP, UTI, SSTI Interact with other pathology specialties e.g. histopathology, haematology when managing syndromes with no positive microbiological diagnosis Refer when appropriate	Interpret and provide clinical management advice for typical/routine microbiology cases of medium complexity eg hepatitis, syphilis, CMV serology Interact with physicians on rounds or in meetings In-depth knowledge of antibiotic use Participate in antimicrobial stewardship rounds and make recommendations under supervision Refer when appropriate	Interpret and provide clinical management advice for highly complex cases e.g. HIV, transplant, oncology and ICU settings In depth discussion with physicians and provision of advice on antibiotic choice, dose (apply PK/PD principles) and duration as well as further investigations where relevant Follow up significant cases and provide ongoing advice where indicated Independently make recommendations in antimicrobial stewardship rounds. Refer when appropriate	Able to function independently in giving advice on clinical and public health issues Participate in reviewing antibiotic recommendations Review and justify antibiotic reporting Involvement in public health issues

EPA	Year 1	Year 2	Year 3	Year 4	Year 5
C. Infection Control	Participate in hand hygiene assessment in hospital Participate in teaching nurses/phlebotomists venepuncture technique and needle-stick injury prevention	Recommend appropriate infection control measures Participate actively in infection control team meetings Participate in formulating disinfection policy for hospital departments e.g. Endoscopy suite	Participate in outbreak investigation Provide infection control advise as part of interaction with physicians on rounds or meetings Provide advice on hospital renovation/construction or OT /isolation room commissioning	Active member of infection control team Participate in hospital wide level pandemic planning exercise Participate in hospital antimicrobial resistance surveillance	Critically assess intervention strategies Present and interpret surveillance data to relevant medical/surgical departments and provide recommendations where relevant. Advise hospital independently on infection control measures for novel infective agents Review infection control policies based on best evidence
D. Research	Critically analyse scientific papers and apply evidence to existing practice where relevant	Plan simple experiments	Complete a simple project	Present one scientific paper (abstracted or published) Plan and execute projects. Participate in GCP or CITI (human research) or equivalent course.	Competent in planning, critical analysis and reviewing studies.

EPA	Year 1	Year 2	Year 3	Year 4	Year 5
E. Laboratory Management		Participate in management review or equivalent. Perform lean audit/Six sigma audit of laboratory or equivalent	Participate or observe internal audit of laboratory and apply elements of ISO 15189 quality system and requirements of CAP or equivalent in the process	Undertake Clinical Quality Improvement project concepts and tools e.g. fishbone, GANTT, Pareto. Assist in laboratory budgeting and costing	Handle HR issues, customer / client issues and service recovery issues. Participate in tendering process for laboratory equipment
F. Teaching	Participate in teaching of lab staff during CME sessions	Teaching of lab staff and other healthcare groups	Teaching of lab staff, physicians and nurses.	Give lectures at hospital and national level. Help supervise trainee.	Give lectures to various groups. Plan teaching programme in the department.

Annex 3

Record of of Entrustable Professional Activity (EPA) for Microbiology Seamless Training Program

Record of Entrustable Professional Activity (EPA) achieved at the end of each posting or 6 month period
Please refer to table of EPA (Annex 2) Entry to be signed off by both the trainee and supervisor

Year of Training: _____ Date of posting: _____ to _____

EPA	Tasks or responsibilities that the trainee can perform without supervision	Areas requiring further attention	Trainee signature/date	Supervisor signature/date
A. Laboratory Methods and Microbiological Skills	Eg Process/Reject specimens and report Gram stains independently Interpret ID/ST results and provide clinically appropriate report			
B. Clinical Consultation and and interpretation	Eg Appropriate antibiotic use according to established guidelines			
C. Infection Control	Eg Participate in hand hygiene assessment in hospital			

	Tasks or responsibilities that the trainee can perform without supervision	Areas requiring further attention	Trainee signature/date	Supervisor signature/date
D. Research				
E. Laboratory Management				
F. Teaching				
G. Laboratory Safety and Biosafety				