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# HEALTH WORKERS' EDUCATION AND TRAINING ON ANTIMICROBIAL RESISTANCE

➔ CURRICULA GUIDE



World Health  
Organization



Public Health  
England



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England

## Health workers' education and training on antimicrobial resistance: curricula guide

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## FOREWORD

Antimicrobial resistance (AMR) is a global public health threat. To achieve the health-related Sustainable Development Goal targets, we must halt the spread of AMR and address the complex and multifactorial contributory factors in all countries. We must put all efforts into ensuring that AMR is reduced to the barest minimum.

Health workers across a spectrum of disciplines play important roles in ensuring the responsible use of antimicrobial agents to treat prevalent infectious diseases. Vast discrepancies across global settings in the availability, comprehensiveness, quality, standards and accessibility of health worker education and training on AMR exacerbate the immense challenge. Evidence shows that health workers and students want to improve their knowledge and level of competency through targeted, effective and relevant education and training on AMR.

The World Health Organization, in collaboration with Public Health England, has developed an evidence-based learning framework for AMR education and training to meet this need. Building on the foundation of the WHO competency framework steered by an Expert Consultative Group, this curricula guide for educators of health professionals and other allied health-related disciplines outlines learning objectives and expected outcomes to guide users. To enhance its relevance and applicability within interprofessional settings, the guide's flexible modular structure simplifies the selection and translation of content into teaching syllabi and learning materials based on local priorities and needs.

This curricula guide marks an important milestone. We now have a robust foundation for pre-service training and for strengthening multidisciplinary health worker capacity across a variety of settings, ranging from community-based facilities to hospital environments to leadership and policy-setting institutions. Embedding AMR knowledge and skills in practice is vital for present and future health workers to use antimicrobials responsibly as part of the One Health approach. As today's students are tomorrow's educators and role models, this learning framework provides the foundation to build a health workforce that champions, implements and preserves the potential of antimicrobials to restore health and save lives.

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# ABBREVIATIONS



AMR	antimicrobial resistance
AMS	antimicrobial stewardship
ANSORP	Asian Network for Surveillance of Resistant Pathogens
ANTT	aseptic no touch technique
AUC	area under the curve
AWaRe	Access, Watch and Reserve
CAESAR	Central Asian and Eastern European Surveillance of Antimicrobial Resistance
CLSI	Clinical and Laboratory Standards Institute (United States of America)
COSHH	Control of Substances Hazardous to Health regulations (United Kingdom of Great Britain and Northern Ireland)
CRE	carbapenem-resistant Enterobacteriaceae
EARs-NET	European Antimicrobial Resistance Surveillance Network
ESAC-Net	European Surveillance of Antimicrobial Consumption Network
EUCAST	European Committee on Antimicrobial Susceptibility Testing
GAP-AMR	WHO Global Action Plan on Antimicrobial Resistance
GLASS	Global Antimicrobial Resistance Surveillance System
IPC	infection prevention and control
LQSI	Laboratory Quality Stepwise Implementation tool (WHO)
MBC	minimum bactericidal concentration
MIC	minimum inhibitory concentration
MRSA	methicillin-resistant <i>Staphylococcus aureus</i>
MUR	medicines utilization review
OSCE	observed structural clinical examination
OSPE	observed structural practical examination
PHE	Public Health England
ReLAVRA	Red Latinoamericana de Vigilancia de la Resistencia a los Antimicrobianos
SAM	suggested assesment method
WASH	water, sanitation and hygiene
WHO	World Health Organization



## EXECUTIVE SUMMARY

Antimicrobial resistance is a global public health threat. The WHO Global Action Plan on Antimicrobial Resistance (GAP-AMR) sets out five main objectives to address the challenge of AMR. This curricula guide builds on several existing products of WHO and partners, aimed at supporting countries in their effort to address the first objective of the GAP-AMR (to improve awareness and understanding of AMR). Targeted specifically at health educators and policy planners, the curricula guide on health workers' education and training on AMR encompasses a systematic modular and submodular collection of learning objectives and outcomes that are organized according to the key occupational groups involved in the use of antimicrobials in human health. The modules are aligned with the domains of the WHO AMR competency framework as follows:

- A. Foundations that build knowledge and awareness of antimicrobial resistance
- B. Appropriate use of antimicrobial agents
- C. Infection prevention and control
- D. Diagnostic stewardship and surveillance
- E. Ethics, leadership, communication and governance.

The aim of the curricula guide is to provide educators at pre-service and in-service levels with comprehensive guidance on what and how they may develop or include learning content in their local AMR curricula or syllabi. The occupational groups covered include prescribers of antimicrobials, nurses, midwives, pharmacists, laboratory scientists and public health officers and health services managers. Health workers in supportive care roles, whether working independently or as part of stewardship teams, also have a defined curriculum to cater to their level of responsibility. The end goal of the curricula guide is to ensure that health workers are equipped with the practical competencies to manage antimicrobials according to their roles or allowed scope of practice. The expected end goals of student or health worker learning can be summarized in the following key messages:

- Health workers are enabled to protect antimicrobials, handling them as a scarce and limited resource.
- Health workers do not prescribe antibiotics for viral-only illnesses, e.g. flu and common colds.
- Health workers practise regular handwashing and other personal and environmental hygiene measures to prevent the spread of germs.
- Health workers follow and adhere to evidence-based clinical guidelines when prescribing antimicrobials.

# 1. INTRODUCTION



Antimicrobial resistance (AMR) is a significant threat to public and environmental health. If not appropriately addressed, common infections, minor injuries and routine elective surgery could be associated with life-threatening risk. The scale of the AMR threat is such that no country is free from its health and socioeconomic impacts: efforts to tackle the problem requires collaboration across national and continental boundaries (1). Antimicrobial resistance occurs when microbes become resistant to medicines to which they were initially susceptible. The development of drug-resistance occurs in many microbes causing a wide variety of diseases, including in common infections such as pneumonia, urinary tract infections, human immunodeficiency virus, tuberculosis and malaria (2).

One major global driver for the development of AMR is the misuse or overuse of antimicrobials. A variety of factors can result in the misuse or overuse of antimicrobials in health care settings including: a lack of knowledge or up-to-date information on prescription of antimicrobials, lack of treatment guidelines, lack of laboratory capacity to identify the organism and its antimicrobial susceptibility, unreliable or absent surveillance data on AMR and antimicrobial usage, unregulated over-the-counter use and poor antimicrobial stewardship (AMS). In addition, patient and public expectation and pressure to prescribe antibiotics, or situations that allow for financial benefit from the supply of medicines, can also drive inappropriate antimicrobial prescribing. Inadequate adherence to infection prevention and control (IPC) measures in health care facilities and poor hygiene and sanitation in communities exacerbate the spread of infections and increase the use of antimicrobial agents. This situation is made worse in many settings around the world by gaps that are known to still exist in knowledge and awareness of AMR, as well as the availability of quality teaching resources to address education in AMR (3–6).

Measures to tackle these challenges (including through collaboration of various stakeholders) are required to avert the growth of resistance, particularly in resource-constrained settings (7, 8). The first objective of the WHO Global Action Plan on Antimicrobial Resistance (GAP-AMR) calls for raising awareness and educating and training health workers to improve antimicrobial prescribing and dispensing behaviours (9). On a similar policy level, the Global Strategy on Human Resources for Health: Workforce 2030 complements the GAP-AMR by offering policy guidance options on broader policies and approaches to optimize health worker education and training (10). WHO plays a crucial role in collating and making available AMR education and training resources to support educators, decision-makers and health policy planners to implement effective policies to control the emergence and spread of AMR (11). This curricula guide for health workers' education and training on AMR is designed to aid users in adapting their own curricula according to their contexts and needs.

## 1.1 Rationale

### 1.1.1 Purpose of the curricula

Educational institutions and learned bodies in many countries have developed AMR curricula for health workers; however, many are tailored to local health care systems and gaps remain in terms of access to standardized curricula that can be adapted globally. The purpose of this curricula guide is to strengthen the ability of educators to deliver quality and standard education and training on AMR. The curricula are designed to serve the education and training needs of the major cadres of health workers (including prescribers, non-prescribers, policy-makers and managers) involved in how antimicrobials are procured, prescribed and used.

The curricula contained in this guide outline learning objectives and outcomes (according to health worker category) aimed at developing competencies across five modules as follows:

- A. Foundations that build knowledge and awareness of antimicrobial resistance
- B. Appropriate use of antimicrobial agents
- C. Infection prevention and control
- D. Diagnostic stewardship and surveillance
- E. Ethics, leadership, communication and governance (this module is standardized across all curricula in the guide and should be applied to all health worker categories described in the document).

### 1.1.2 Objectives and scope

The objective of the curricula guide is to ensure that health workers receive adequate education and training to become good stewards of antimicrobials in whatever roles they perform. Although the curricula guide focuses on knowledge and awareness of AMR in relation to bacterial organisms, many principles covered are applicable to the management of AMR attributable to other types of microorganisms such as viruses and parasites.

The curricula are aimed at guiding educators, faculties and health education regulatory bodies in the development or review of learning materials for pre-service students and in-service learners (Box 1). Given the differences between the various settings of health education and practice, it is recommended for users to adapt the AMR curricula according to local relevance, needs, AMR patterns and local and national AMS policy or plans.



### Box 1. Association between pre-service and in-service learning outcomes as conceptualized in this curricula guide

	Pre-service	In-service
Knowledge	To gain the basic concepts that underpin knowledge and awareness of AMR.	To gain enhanced concepts that lead to a greater depth of knowledge and awareness of AMR.
Skills	To facilitate skills-based learning through observership and performance under supervision where relevant.	To facilitate skills acquisition, achieving a degree of competency to be able to carry out tasks independently.
Attitudes	To promote the development of appropriate attitudes for the responsible stewardship of antimicrobials through training and observership.	To actively demonstrate appropriate attitudes and lead by example to ensure responsible stewardship of antimicrobials.

### Link to antimicrobial stewardship

Antimicrobial stewardship is defined as a set of coherent actions aimed at promoting responsible antimicrobial use (12). It includes the following components:

- Improving the diagnostic process (clinically, microbiologically or in other ways) as an inherent part of any AMS programme.
- Prescribing appropriately according to treatment guidelines once there is a suspected or proven diagnosis.
- Deploying strategies that cut across all levels (national, district, local) to promote responsible antimicrobial use.

The curricula embody the overall concept of AMS as defined above by outlining learning objectives and outcomes around the knowledge, skills and attitudes needed for health workers to responsibly use antimicrobials in protecting the health of individuals and populations – whether working alone or as part of multidisciplinary public health, primary care or health care facility-based teams. Learning objectives and outcomes related to defined AMS teams within health care facilities are provided where relevant, according to the health worker category and expected roles and scopes of practice. Educators and other users are encouraged to refer to local or other guidelines/resources for additional guidance on how to educate and train learners to perform roles as functional members of stewardship teams. A key resource for educators is: *Antimicrobial stewardship programmes in health care facilities in low- and middle-income countries: a practical toolkit* (WHO, 2019).

Diagnostic stewardship is integral to AMS as an overarching concept. Good diagnostic stewardship is essential for the generation of AMR data from the laboratory. These data, including patient meta-data and outcome data, contribute to accurate and reliable surveillance of AMR and provide valuable information on the burden of disease due to AMR, hence the association of diagnostic stewardship with surveillance. Noting the essentials of AMS, educators and instructors should aim to ensure, as a minimum, that the key principles are covered and emphasized in teaching pre-service and in-service students and that they are implemented in practice. The essentials are as follows:

### Box 2. Essential antimicrobial stewardship messages for health workers

1. Antimicrobials are a scarce and limited resource. Health workers need to protect them by ensuring they are used appropriately and responsibly.
2. Do not prescribe antibiotics for viral-only illnesses, e.g. flu and common colds.
3. Practise regular hand washing and ensure personal and environmental hygiene to prevent the spread of germs.
4. Follow and adhere to relevant evidence-based clinical guidelines when prescribing antimicrobials.

#### 1.1.3 Curricula format

The curricula format follows a matrix system with vertical pillars and horizontal spines (Fig. 1). The structure is based on the concept of combining desired learning objectives with the modular application of respective domains and subdomains in achieving the outlined learning outcomes suitable to the learning audience being targeted.

The **vertical pillars** represent the following categories of health workers according to roles performed:

- Prescribers – medical doctors and dentists, pharmacists, nurses and midwives and other allied health workers – who are permitted by law to prescribe antimicrobials. The extent to which the prescribing learning objectives and outcomes are relevant to the different groups of health workers may vary according to scopes of practice and local regulation.
- Non-prescribers – pharmacists, nurses, laboratory scientists – for settings where they are not allowed by regulation to prescribe antimicrobials.
- Public health officers and health services managers with leadership/advocacy and policy responsibilities. This category may include personnel from the prescribing and non-prescribing occupational groups who have a leadership role or authority in managing health facilities or AMR control programmes at any level of care.



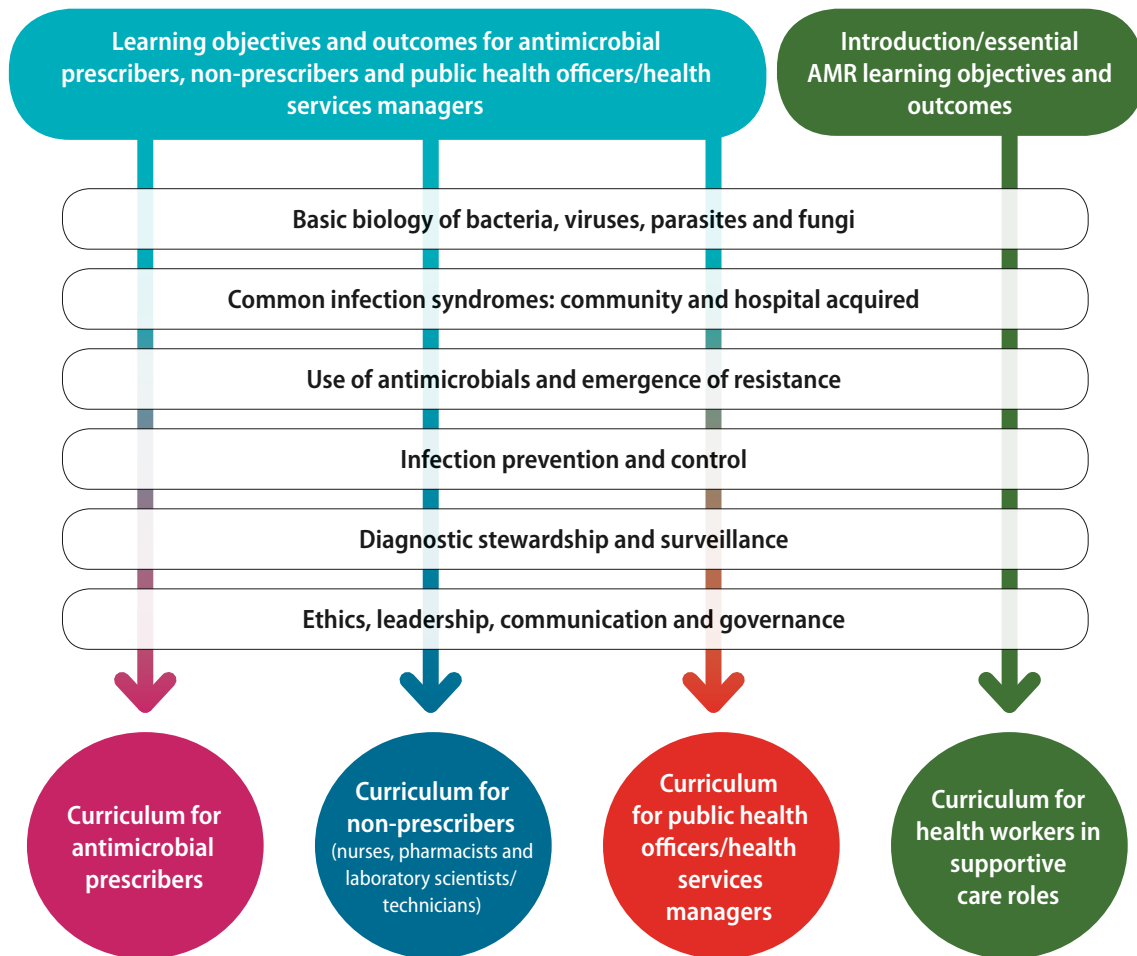
- Health workers with at least a supportive patient management role and requiring mostly introductory/essential AMR competencies to perform their tasks effectively. This group could include clinical officers, surgical technicians, community health workers and allied health workers involved in patient care. For this category, educators/trainers should tailor their eventual learning content according to the expected level of educational qualifications, experience and expertise of the audience.

The **horizontal spines** comprise modular and submodular learning topics aligned with the main AMR domains (described in the WHO competency framework on AMR), as relevant for the categories of health workers listed above.

### Box 3. Differentiating between core and additional learning outcomes and assessment methods

- The learning outcomes and suggested assessment methods (SAMs) under the modules and submodules are categorized as core and additional. The additional learning outcomes and methods of assessment are italicized for ease of reference.
- The content marked as core is considered essential to be taught both for pre-service and in-service learners. However, the time and depth dedicated to each topic could differ significantly depending on the audience. Although additional learning outcomes are assumed to be advanced in many settings, it is useful for educators or instructors to consider whether to justify their inclusion, according to the learning needs and experience of the learning audience.
- Multisectoral groups (involving relevant stakeholders such as health authorities, academics, antimicrobial use specialists, scientific societies and professional institutions working on AMR etc.) might be convened by local authorities or the institution to define the scope of learning objectives and outcomes according to the realities of their setting. This should be determined both for pre-service education and in-service training.
- The topics included and the time to be allotted should be defined by each user or institution according to their needs (i.e. local epidemiology and AMR burden, human and material resources, and availability of diagnostic and therapeutic tools etc.).
- The expected level of effort required by educators to develop the AMR curriculum and the learning materials can differ for both groups. For example, at pre-service stages it is expected that a greater input in terms of time and guidance will be required of educators.
- The SAMs might be adapted in several ways keeping in mind the following considerations: local content prioritization, existing methods of assessment in each setting, cultural factors and the number of educators/number of students or trainees.

**Fig. 1. Matrix model for antimicrobial resistance curricula**



## 1.2 Curricula delivery

### 1.2.1 Integrating the curricula guide with existing health education and training needs

The curricula are designed in stand-alone modular packages. It is, however, expected that some institutions may already cover content in related fields of study such as in microbiology, pharmacology or patient safety courses, depending on the training programme being offered. Also, considering that syllabi for health education and training programmes may already be full of competing needs, it may become necessary to incorporate only relevant modules or submodules (see glossary for definitions) within the AMR curriculum to ensure balance and effectiveness. A good approach for educators is to conduct a situational analysis or review of existing curricula



and consider where there is need and how to fit in relevant content (including clinical training where applicable). It is also helpful for educators to be socially accountable (13) in assigning the equivalent levels of weight to modules based on local AMR needs and priorities. In reviewing and applying the curricula, key principles for educators to consider are the need for ensuring integrated learning approaches and interprofessional education, particularly for the foundation modules. For in-service training in particular, learning needs may vary according to occupational groups and expected roles. Where applicable, it is also recommended that a situational analysis exercise on existing curricula and training methods be conducted by a multistakeholder group that includes educators and decision-makers representing both educational and health sectors (see Annex 2). Educators are encouraged to consider health worker roles and needs in managing AMR to identify and select content that is in line with the continued development of the learner.

### 1.2.2 Suggested teaching methods

The following teaching methods or training techniques can be used to deliver the curricula depending on the learning objective, audience type and learning environment and availability of technology. It is important that curricula aimed at teaching AMS should incorporate multiple pedagogical and assessment techniques (as relevant and affordable according to context) and not rely solely on didactic methods (14, 15).

- Interactive lectures.
- Interactive small group tutorials using problem-solving exercises and case-based learning – encouraging the trainee to present, analyse and discuss.
- “Flipped” classroom approach – prior to live instructional events, learners obtain basic knowledge and come to seminars/lectures to apply what they have learned. They then receive feedback and gain in-depth understanding of the subject matter or topic from the instructor.
- By apprenticeship, learning by doing – as in in-service training and practical laboratory-based exercises.
- Simulation and role playing for pre-service and in-service education.
- Didactic lectures, i.e. learning by listening.
- Using e-learning modules such as massive open online courses and webinars. For example, WHO has developed an online course on a competency-based approach to AMS. The course delivers learning materials targeted at improving antimicrobial prescribing in common clinical scenarios (16). There is also evidence to suggest that using digital or blended means to deliver education and training for antibiotics management can be more effective than using only traditional learning, especially in in-service settings (17).
- Project-based learning with creation of project reports, strategic papers and critical appraisal of literature.

### 1.3 Assessing learners

Learners can be assessed in several ways during their training. Assessment can be summative, which is an assessment *of* learning, or formative, which is described as an assessment *for* learning. It is anticipated that educators would apply formative assessments as learning progresses on any of the modules or submodules. It is preferable for summative assessments to be applied upon completion of modular sections or the entire health worker category curriculum and tailored according to local syllabus/course requirements.

**Formative assessments:** These are referred to as “low stakes” and are used to monitor student learning and provide ongoing feedback. They help students identify their strengths and weaknesses and target areas that need improvement. They are used to help faculty recognize where students are struggling and address problems immediately.

Workplace-based assessments are a good example of formative assessments. They allow trainees to be assessed in the workplace by appropriately trained, qualified and experienced assessors. These workplace-based assessments may include case-based discussions, evaluation of patient management plans and discussions on clinical risk assessments, where they apply. Directly observed procedures in the laboratory or by the patient’s bedside (such as taking appropriate culture samples from the patient) are useful to inform good and safe laboratory/clinical practice. Use of trainer feedback and multisource feedback can be used to assess behaviours as well as competencies.

**Summative assessments:** These are also called “high stakes” assessments in that there is a pass mark – as in an examination, project report or paper. Examinations which involve essay questions, short answer questions, multiple choice questions and extended matching questions are examples of written summative assessments. The observed structured clinical examination (OSCE) and the observed structured practical examination (OSPE) (18) are also examples of summative assessments.

The OSCE examination tool is designed for assessments in clinical settings and is based on principles of objectivity and standardization, in which candidates move through a series of time-limited stations in a circuit for the purposes of assessment of performance in a simulated clinical environment. At each station candidates are assessed and marked against standardized scoring methods using a checklist and by trained assessors.

The OSPE resembles the OSCE but uses facilities or equipment rather than people to demonstrate pre-clinical or procedural skills. The OSPE provides a similar and flexible format that allows assessment of practical skills and allows for a broad sampling of the curriculum across a diverse range of scenarios. The OSPE facilitates assessment of the application of knowledge, laboratory skills and communication in scenarios encountered by health workers in their field of practice.

**Table 1. Suggested assessment methods (SAMs)**

The following SAMs are used throughout the curricula and referenced with the code in the second column. In the curricula, the SAMs are not assigned to individual learning outcomes, rather they are grouped together for users to deploy as they wish.

<b>Suggested assessment methods</b>	<b>Code</b>
Written essay/single best answer/multiple choice questions	SAM 1
OSPE or OSCE	SAM 2
Bedside competency assessment	SAM 3
Case-based discussions	SAM 4
One-to-one meetings/guided reflections	SAM 5
Multisource feedback	SAM 6
Apprenticeship	SAM 7
Field/other project report assessment	SAM 8
Written assignments	SAM 9
Simulation exercises	SAM 10
Problem-solving exercises	SAM 11
Directly observed procedures	SAM 12
Assessment of small group discussions	SAM 13
Reflective portfolio	SAM 14
Training portfolio	SAM 15
Critical analysis of literature/data	SAM 16
Report on quality improvement programmes	SAM 17
Root cause analysis report	SAM 18
Serious incident report	SAM 19
Preparation of a report translating evidence to policy	SAM 20
Preparation of: <ul style="list-style-type: none"> <li>• concept notes</li> <li>• briefing notes</li> <li>• options appraisals</li> <li>• situation and gap analyses</li> <li>• business cases.</li> </ul>	SAM 21

## 1.4 Methods

The modules, learning objectives and outcomes of this curricula guide are based primarily on the WHO AMR competency framework (19). It follows an organized didactic construct and flow to reflect the WHO AMR competency framework content – organized learning bundles across the selected health worker groups. Some learning objectives and outcomes have been added to the modules based on wider evidence and guidance extracted from relevant scientific and grey literature related to competency frameworks on appropriate prescribing and other AMR-related competencies (20–35).

The curricula guide focuses on human health and is holistic in approach as it brings together the inter-related technical areas such as microbiological principles that build awareness of AMR, appropriate use of antimicrobial agents, including AMS, IPC, diagnostic stewardship and surveillance, ethics, leadership, communication and governance.

The format and content of the curricula guide for health workers in supportive care roles and prescriber categories draws upon the thematic constructs as described in the curriculum published by the United Kingdom of Great Britain and Northern Ireland's Royal College of Pathologists and the Joint Royal Colleges of Physicians Training Board, in May 2014 (36). The curricula guide for non-prescribing nurses, pharmacists and laboratory scientists draws upon material published by the United Kingdom of Great Britain and Northern Ireland's Royal College of Nursing, and a recently published study on national AMS competencies for undergraduate health professionals (37, 38); the Royal Pharmaceutical Society (39); and the Institute of Biomedical Science (40). Elements of the curricula guide related to AMS for nurses and other health professionals were drawn from published scientific material (41). The guide also draws upon evidence-based WHO guidelines on laboratory quality management (42), IPC (43), patient safety, the *WHO Model list of essential medicines* (including the EML list for children) and related documents on the appropriate use of antibiotics, including the WHO AWaRe (Access, Watch and Reserve) categorization (22, 44–48). The International Society of Infectious Diseases *A guide to infection control in the hospital* was used as a resource for guidance and recommendations in this document across the spectrum of health care professionals (49). The American Society of Hospital Pharmacists is acknowledged for information on the role of the pharmacy and therapeutics committee in AMS (50, 51). The European Committee on Antimicrobial Susceptibility Testing (EUCAST) and the America-based Clinical and Laboratory Standards Institute (CLSI) were used as the reference standards for testing antimicrobial susceptibility for detection of AMR and AMR mechanisms (52, 53). Guidance from the Health and Safety Executive, United Kingdom of Great Britain and Northern Ireland, on the Control of Substances Hazardous to Health was referred to when describing safe laboratory practice (54).



## 2. PRESCRIBERS



## 2. PRESCRIBERS

This section is devoted to those health care workers (medical doctors and dentists), who routinely prescribe antimicrobial agents. It is recognized that pharmacists, nurses and midwives and other health workers are also included in this category in some settings where they are allowed by regulation to prescribe antimicrobials. The extent to which the prescribing competencies are relevant to the different cadres may vary according to scopes of practice and local regulation. The curriculum provides the broadest possible scope and will need to be adapted to local conditions of practice.

### 2.1 Curriculum guide for prescribers

#### Modular outline

##### A. Foundations that build awareness of antimicrobial resistance

- 2.1 A1 Eliciting a clinical history and performing a clinical examination relevant to prescription of antimicrobial agents
- 2.1 A2 Use of available clinical microbiology laboratory services in investigation, management and prevention of infection
- 2.1 A3 Important infection syndromes
- 2.1 A4 Understanding antimicrobial agents and the threat of antimicrobial resistance

##### B. Appropriate use of antimicrobial agents

- 2.1 B1 Use of antimicrobial agents in clinical management
- 2.1 B2 Safe use of antimicrobial agents
- 2.1 B3 Antimicrobial stewardship and governance

##### C. Infection prevention and control


- 2.1 C1 Health care-associated infection, antimicrobial resistance and infection prevention and control

##### D. Diagnostic stewardship and surveillance

- 2.1 D1 Surveillance of antimicrobial resistance linked to diagnostic stewardship

##### E. Ethics, leadership, communication and governance

- 2.1 E1 Importance of ethics, leadership, communication and governance

 Note that the learning outcomes and suggested assessment methods (SAMs) in the modules and submodules are categorized as core and additional – the latter are italicized (see Box 3).



## A. Foundations that build awareness of antimicrobial resistance

**Competency statement:** The prescriber demonstrates that they have the knowledge and awareness of effective approaches to reduce the emergence and control the spread of antimicrobial resistance, and the skills and attitudes to implement change according to role and level of training.

### 2.1 A1 Eliciting a clinical history and performing a clinical examination relevant to prescription of antimicrobial agents

#### Learning objective

Understand the importance of taking a relevant, focused history in patients presenting with a possible infection; recording, analysing and risk assessing history findings to arrive at a differential diagnosis; and taking a problem-solving approach based on pattern recognition to arrive at a management plan.

#### Knowledge

SAM (suggested  
assessment method)

- Describe the common patterns of presentation (history, symptoms and signs) in patients presenting with infection. SAM 1  
SAM 4
- Explain the importance of taking a family history of infection.
- Explain the relevance of travel history – local, national and international.
- Explain the importance of eliciting a past medical history of hospitalization (at home or abroad) with details of procedures performed and treatment received (including but not limited to antimicrobial agents).
- Describe relevant co-morbidities including drug allergies that may influence choice, dose and duration of antimicrobial agents.
- Explain the relevance of extremes of age and physiological states such as pregnancy and breast feeding as risk factors for developing infection.
- Explain the importance of measuring vital signs and performing a systematic clinical examination (according to health worker specialty/profession) based on the pathophysiology of the suspected infection.

#### Skills

- Demonstrate the ability to communicate effectively with a patient so as to take a clinical history in a succinct and logical manner. SAM 2  
SAM 3
- Demonstrate the ability to perform a relevant clinical examination and assessment (according to health worker specialty/profession). SAM 7  
SAM 14
- Demonstrate the ability to prioritize urgent and important clinical tasks.
- Recognize the acutely unwell patient, prioritize and escalate appropriately.
- Demonstrate the ability to perform appropriate clinical reasoning and decision-making in formulating a management plan.
- Record all data accurately and completely.

#### Attitudes

- Show empathy and respect for patients. SAM 5
- Recognize the interaction of social and cultural factors and the patient's infection. SAM 6
- Respect patient confidentiality. SAM 7
- Recognize one's limitations and escalate appropriately to seek advice, e.g. from a senior clinician, clinical microbiologist/infectious disease specialist physician, pharmacist and other allied professionals as appropriate. SAM 14
- Show willingness to work in a multidisciplinary team.

## 2.1 A2 Use of available clinical microbiology laboratory services in investigation, management and prevention of infection

### Learning objective

Appreciate the role of the clinical microbiology laboratory in diagnosing and preventing infection and detecting antimicrobial resistance.

Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>Understand the crucial role of the laboratory in detecting antimicrobial resistance.</li> <li>Describe the repertoire of microbiology investigations available for a given infection scenario and understand its use.</li> <li>Understand the microbiological principles of culture and susceptibility testing (drug-bug combinations) that will inform treatment/prevention strategies.</li> <li>Describe broadly the method of collection and transport of relevant clinical specimens to the laboratory.</li> <li>Understand the importance of labelling and completing the request form with the relevant clinical and demographic information.</li> <li><i>Describe the microbiology investigations used as screening tools to detect asymptomatic carriage and prevent infection.</i></li> <li><i>Identify the cost–effectiveness (according to practice setting) of performing appropriate investigations.</i></li> </ul>	<p>SAM 1 SAM 16</p>
Skills	
<ul style="list-style-type: none"> <li>Demonstrate the ability to recommend the right investigation for the right condition at the right time.</li> <li>Recognize the importance of performing these investigations safely, protecting both the patient and the health worker.</li> <li>Fill in the laboratory request form with the key information required – completely, accurately and legibly.</li> <li>Interpret the result of investigations and manage the patient accordingly.</li> <li><i>Demonstrate the ability to perform sample collection correctly, e.g. taking a blood culture or a throat swab etc.</i></li> </ul>	<p>SAM 2 SAM 7 SAM 12 SAM 15</p>
Attitudes	
<ul style="list-style-type: none"> <li>Effectively communicate with the patient about the method of sample collection and why it is required.</li> <li>Respect patient confidentiality.</li> <li>Recognize one's limitations in interpreting results and escalate appropriately to seek advice from a senior clinician, clinical microbiologist/infectious disease specialist, laboratory scientist and other allied professionals as appropriate.</li> <li>Show willingness to work in a multidisciplinary team.</li> </ul>	<p>SAM 2 SAM 7 SAM 5 SAM 6 SAM 14</p>





## 2.1 A3 Important infection syndromes

<b>Learning objective</b>	
Display competence in the diagnosis and management of important infectious clinical syndromes.	
Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>Describe how to assess infection risk in a patient, based on a detailed knowledge (incorporating epidemiology, predisposition, presentation, clinical features, investigations, differential diagnosis, management and prognosis) of key infection syndromes, including community-acquired and health care-associated infections.<sup>1</sup></li> <li>Explain the importance of normal flora and differentiate between colonization/asymptomatic carriage and active infection.</li> <li><i>Explain the nature of infection in special populations, including the complexities associated with their management, e.g. excessive alcohol and illicit drug users, the elderly, the obese, pregnant, postpartum and breast-feeding women, neonates, primary and secondary immunodeficiency, and those with liver and renal impairment.</i></li> </ul>	<p>SAM 1 SAM 4</p>
Skills	
<ul style="list-style-type: none"> <li>Demonstrate use of history-taking and clinical assessment skills in clinical reasoning and decision-making.</li> <li>Request the appropriate investigations to arrive at a diagnosis.</li> <li>Demonstrate the ability to source and use evidence-based guidelines and treatment protocols.</li> <li>Recognize the acutely unwell patient and escalate management appropriately; use of the sepsis pathway.</li> <li>Adjust management plans considering results of investigations and patient progress.</li> </ul>	<p>SAM 2 SAM 3 SAM 4 SAM 7 SAM 15</p>
Attitudes	
<ul style="list-style-type: none"> <li>Establish rapport with other clinical personnel.</li> <li>Interpret and explain treatments and progress to patients and relatives.</li> <li>Respect patient confidentiality.</li> <li>Recognize one's limitations and escalate appropriately to seek advice from a senior clinician, clinical microbiologist/infectious disease specialist physician, pharmacist and other allied professionals as appropriate.</li> <li>Show willingness to work in a multidisciplinary team.</li> </ul>	<p>SAM 2 SAM 5 SAM 6 SAM 7 SAM 14</p>

<sup>1</sup> The following are examples of syndromes clinicians could encounter: sepsis; blood stream infections; pyrexia of unknown origin; multisystem infections; cardiovascular infections; skin and soft tissue infections including post-surgical site infections; bone and joint infections; upper (including acute otitis media) and lower respiratory tract infections; gastrointestinal, hepatic, pancreatic and biliary infections; urinary tract and genital infections including sexually transmitted infections; neurological infections; ocular infections; device-associated infections; zoonotic infections; exanthemata; pregnancy-associated infection. More specifically, dentists may come across the following: facial and dental abscesses and odontogenic orofacial infections etc.

## 2.1 A4 Understanding antimicrobial agents and the threat of antimicrobial resistance

### Learning objective

Understand the classification and clinical applications of antimicrobial agents and the development and consequences of antimicrobial resistance.

Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>Outline the common classification of antimicrobial agents (<math>\beta</math>-lactam, aminoglycosides, quinolones etc.).</li> <li>Explain the concept of broad- and narrow-spectrum antimicrobial agents.</li> <li>Explain the key properties of the classes of antimicrobial agents against bacteria:               <ul style="list-style-type: none"> <li>mechanism of action</li> <li>spectrum of activity</li> <li>route of administration</li> <li>dosing regimen</li> <li>dosage adjustments for special populations</li> <li>tissue penetration</li> <li>side-effects and cost.</li> </ul> </li> <li>Explain the mechanisms by which organisms become resistant to antimicrobial agents: innate and acquired mechanisms of resistance.</li> <li>Understand basic concepts of pharmacodynamics and pharmacokinetics in relation to antimicrobial use.</li> <li>Explain the concept of empiric, syndromic and culture-based treatment strategies for treating infections.</li> <li>Have knowledge of published guidelines that recommend antimicrobial treatment therapy based on local antimicrobial resistance patterns if available.</li> <li><i>Understand local antimicrobial resistance epidemiology, if available, and how this helps with selection of treatment options.</i></li> <li><i>Explain the laboratory methods to detect antimicrobial resistance and resistance mechanisms and their limitations.</i></li> </ul>	SAM 1 SAM 16
Skills	
<ul style="list-style-type: none"> <li>Demonstrate the ability to explain the purpose and expected outcomes of antimicrobial therapy to colleagues.</li> <li>Effectively communicate with the patient about the role of antimicrobial agents, manage expectations and advise on appropriate use.</li> <li><i>Demonstrate the ability to use laboratory information on organism identification and susceptibility test results to create an antimicrobial treatment plan.</i></li> </ul>	SAM 2 SAM 3 SAM 4 SAM 7
Attitudes	
<ul style="list-style-type: none"> <li>Be willing to engage with patients, relatives and the public to advise on the role of antimicrobial agents in therapy and the threat of resistance.</li> <li>Be a role model for good prescribing behaviour and encourage use of local protocols and guidelines.</li> <li>Show enthusiasm in performing clinical audit and participation in quality improvement programmes relating to antimicrobial use.</li> <li>Show willingness to teach students, colleagues and other health professionals regarding antimicrobial use and resistance.</li> <li>Keep up to date with recent advances and show enthusiasm for continued professional development.</li> </ul>	SAM 2 SAM 5 SAM 6 SAM 7 SAM 14



## B. Appropriate use of antimicrobial agents

**Competency statement:** The prescriber demonstrates that they have the knowledge and understanding, according to their field and level of expertise, to facilitate optimal and safe use of antimicrobial agents for management of infections.

### 2.1 B1 Use of antimicrobial agents in clinical management

Learning objective	
Achieve appropriate antimicrobial use in clinical practice.	
Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>Explain the selection of optimal antimicrobials and dosage, including combination therapy, for treatment of infection based on the clinical scenario, culture and susceptibility report and the results of other investigations.</li> <li>Explain the optimal duration of appropriate therapy and when to escalate/de-escalate.</li> <li>Understand the concept that targeted therapy with a narrow-spectrum agent is preferable to blanket use of broad-spectrum agents.</li> <li>Demonstrate knowledge of current evidence-based guidelines for management of the various infection syndromes.</li> <li>Understand that colonization states in the absence of infection need not be treated with systemic antimicrobial agents.</li> <li><i>Describe the appropriate prophylactic, empiric, syndromic or culture-based antimicrobial therapy for common community-acquired infection syndromes.</i></li> </ul>	<p>SAM 1 SAM 16</p>
Skills	
<ul style="list-style-type: none"> <li>Demonstrate the ability to carry out appropriate antimicrobial prescribing tailored to the clinical condition and the putative or proven organism.</li> <li>Demonstrate clinical judgement to differentiate viral from bacterial infection and refrain from use of empiric antibacterial therapy.</li> <li>Demonstrate use of local or other relevant guidelines in selecting the most appropriate antimicrobial agent.</li> <li>Demonstrate the ability to use laboratory information on organism identification and susceptibility test results to escalate/de-escalate or change treatment.</li> <li><i>Demonstrate the decision-making process for choice of appropriate empiric, syndromic or culture-based antimicrobial to treat the patient.</i></li> <li><i>Demonstrate clinical judgment to differentiate colonization from infection and refrain from prescribing systemic antimicrobial therapy.</i></li> </ul>	<p>SAM 2 SAM 4 SAM 7</p>
Attitudes	
<ul style="list-style-type: none"> <li>Show willingness to take advice and direction from the clinical microbiologist, the pharmacist and the infection prevention and control specialist and other members of the antimicrobial stewardship team.</li> <li>Be a role model for good prescribing behaviour and encourage use of local protocols and guidelines.</li> <li>Show enthusiasm for performing clinical audit and participation in quality improvement programmes relating to antimicrobial use.</li> <li>Show willingness to teach students, colleagues and other health professionals about antimicrobial use and resistance.</li> <li>Keep up to date with recent advances and show enthusiasm for continued professional development.</li> </ul>	<p>SAM 5 SAM 6 SAM 7</p>

## 2.1 B2 Safe use of antimicrobial agents

### Learning objective

Achieve safe and appropriate antimicrobial use in clinical practice.

Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>• Explain the importance of safe and responsible use of antimicrobial agents.</li> <li>• Describe common signs and symptoms of antimicrobial toxicity and toxicity related to bone marrow, liver and renal impairment.</li> <li>• Understand appropriate use of antimicrobial agents in pregnancy and in children.</li> <li>• Have an understanding of and know the difference between common antimicrobial drug allergies and drug interactions involving antimicrobial agents, other therapeutic agents and certain foods/alcohol.</li> <li>• Explain the adverse consequences of antimicrobial agents on normal microbial flora and the risk of secondary bacterial or fungal infections.</li> <li>• Describe contraindications to selected antimicrobials in certain clinical conditions.</li> <li>• Understand how using broad-spectrum antimicrobial agents inappropriately can increase the risk of developing multidrug-resistant infections due to selection pressure. For instance, acquisition of <i>Clostridium difficile</i> infection may be aided by using high-risk agents such as clindamycin, quinolones and cephalosporins.</li> <li>• Understand the risk of antimicrobial resistance and how it could affect routine patient care and spread within the health care environment and the community.</li> <li>• <i>Explain the importance of measuring blood levels of certain antimicrobial agents (especially those with a narrow therapeutic index) to ensure clinical efficacy and reduce toxicity.</i></li> </ul>	<p>SAM 1</p> <p>SAM 16</p>
Skills	
<ul style="list-style-type: none"> <li>• Demonstrate the ability to choose the most effective and safe regime for the patient.</li> <li>• Recognize risk and demonstrate caution for potential side-effects and monitor appropriately.</li> <li>• Demonstrate good practice in terms of adjusting antimicrobial prescribing to allergy states, pregnancy, children, overweight patients and those with liver, bone marrow or kidney impairment.</li> </ul>	<p>SAM 2</p> <p>SAM 4</p> <p>SAM 7</p>
Attitudes	
<ul style="list-style-type: none"> <li>• Show willingness to take advice from other health professionals, such as the pharmacist, clinical microbiologist, infectious diseases specialist and other members of the antimicrobial stewardship team.</li> <li>• Establish rapport with laboratory scientists and personnel from other specialties.</li> <li>• Be a role model for good prescribing behaviour.</li> <li>• Keep up to date with recent advances and participate actively in continued professional development.</li> </ul>	<p>SAM 5</p> <p>SAM 6</p> <p>SAM 7</p>



## 2.1 B3 Antimicrobial stewardship and governance

### Learning objective

Understand the importance of stewardship and good governance processes to reduce the emergence and control the spread of antimicrobial resistance.

Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"><li>• Explain the importance of appropriate use of antimicrobial agents.</li><li>• Explain the importance of antimicrobial formularies, consumption data and prescribing policies and processes to monitor use of antimicrobials.</li><li>• Explain how local antimicrobial resistance patterns should be used to direct empirical antimicrobial treatment.</li><li>• Understand the importance of 48- to 72-hour review of all antimicrobial prescriptions to check optimal duration and prevent overuse.</li><li>• Understand the need to de-escalate from empirical broad-spectrum therapy to targeted narrow-spectrum therapy.</li><li>• Explain the importance of intravenous to oral switch of antimicrobial therapy when appropriate.</li><li>• Describe the concept of first-, second- and third-line antimicrobial therapy for certain conditions.</li><li>• Understand the WHO tool for optimizing use of antimicrobial agents: Access, Watch and Reserve (AWaRe).</li><li>• Understand the evidence base and the rationale for peri-operative surgical and other prophylaxis regimens.</li><li>• <i>Explain the role of the drug and therapeutics committee (or equivalent) and the antimicrobial pharmacist for inclusion of new agents into the formulary.</i></li><li>• <i>Explain the importance of restricted reporting of susceptibility data by the microbiologist to control antimicrobial use in settings where it is accepted.</i></li><li>• <i>Understand the concept of an outpatient parenteral antimicrobial therapy service as part of antimicrobial stewardship, as applicable to the local setting.</i></li><li>• <i>Understand the basic principles of antimicrobial research and development and market access strategies including pricing mechanisms.</i></li></ul>	<p>SAM 1 SAM 16 SAM 17</p>
Skills	
<ul style="list-style-type: none"><li>• Demonstrate rational prescribing by adhering to the principles of the stewardship programme for treatment and prophylaxis.</li><li>• <i>Contribute to reviews and updates to the formulary within your specified field.</i></li><li>• <i>Demonstrate the ability to compile evidence and make a case for inclusion of a new antimicrobial agent into the hospital formulary.</i></li><li>• <i>Demonstrate the ability to contribute to the design of audit and quality improvement programmes for antimicrobial prescribing.</i></li></ul>	<p>SAM 2 SAM 4 SAM 7 SAM 17</p>
Attitudes	
<ul style="list-style-type: none"><li>• Show willingness to take advice from other health professionals, such as the pharmacist and the clinical microbiologist and other members of the antimicrobial stewardship team.</li><li>• Demonstrate willingness to embrace the principles of antimicrobial stewardship.</li><li>• Demonstrate willingness to accept the role of the pharmacist and the feedback they provide on decisions made.</li><li>• Be a role model for good prescribing behaviour.</li><li>• Have an enthusiastic approach to the culture of quality improvement in prescribing antimicrobials.</li><li>• Avoid market incentives that encourage prescription of certain antimicrobials or combinations of antimicrobial agents not included in the formulary or recognized treatment protocols.</li><li>• <i>Demonstrate willingness to have certain antimicrobial agents pre-authorized (depending on local policy or setting) by a senior clinician, clinical microbiologist or an infectious diseases specialist physician before use.</i></li></ul>	<p>SAM 5 SAM 6 SAM 7</p>

## C. Infection prevention and control

**Competency statement:** The prescriber demonstrates an understanding of the broad principles of infection prevention and control; including the importance of water, sanitation and hygiene (WASH) in health care facilities to reduce the emergence and control the spread of antimicrobial resistance.

### 2.1 C1 Health care-associated infection, antimicrobial resistance and infection prevention and control

#### Learning objective

Understand the relationship between health care-acquired infection, antimicrobial resistance and infection prevention and control.

#### Knowledge

**SAM** (suggested assessment method)

- Understand the predisposing factors that make patients vulnerable to health care-associated infection: extremes of age, co-morbidities, trauma, surgical procedures, indwelling devices, medication including antimicrobial agents which can select for multidrug-resistant organisms. SAM 1  
SAM 8  
SAM 16
- Understand the clinical and infection prevention and control decision-making process behind using source and protective isolation to protect patients.
- Understand the components of clinical care bundles:
  - peripheral and central venous access devices
  - sepsis
  - ventilator associated pneumonia
  - surgical site infection
  - urinary catheterization.
- Have awareness of relevant guidelines (including WHO guidelines) for hand hygiene, prevention and control of multidrug-resistant organisms in health care facilities, surgical site infections and other aspects of infection prevention and control.
- *Have a detailed understanding of the dynamics of transmission of health care-associated infections: via contact, droplet, airborne, bloodborne and food and waterborne routes.*
- *Describe the risk factors, aetiology, clinical presentation and management (including antimicrobial treatment and infection prevention and control) of common health care-associated infections:*
  - *urinary tract infections*
  - *pneumonia*
  - *surgical site infections*
  - *blood stream infections*
  - *device-related infections*
  - *diarrhoea, including norovirus and Clostridium difficile infections.*
- *Describe the infection prevention and control recommendations unique to primary and community care from evidence-based guidelines.*



### Skills

- Demonstrate the ability to follow local protocols and source information from the local infection prevention and control policy/or other international policies. SAM 2  
SAM 7
- Demonstrate skill with use of care bundles. SAM 10
- Demonstrate the ability to work in a team especially with infection prevention and control specialists. SAM 15
- *Demonstrate the ability to perform a clinical risk assessment of the health care environment and put in processes to protect the most vulnerable patients from risk of health care-associated infections or multidrug-resistant infections.*
- *Demonstrate local leadership skills in instigating or contributing to quality improvement processes and audit.*

### Attitudes

- Maintain meticulous hand hygiene practice and be a role model for other personnel. SAM 5
- Have a high standard of compliance with all aspects of infection prevention and control according to agreed policy. SAM 6  
SAM 7
- Demonstrate a high degree of organization in planning and carrying out procedures so infection prevention and control processes are implemented appropriately. SAM 14
- Respect the contribution of infection prevention and control specialists and recognize when their expertise is needed.
- Show willingness to follow the advice of infection prevention and control specialists and take corrective instruction from them.
- Educate staff and the public in the importance of following good infection prevention and control practice and maintaining WASH standards both in hospital and in the community.

## D. Diagnostic stewardship and surveillance

**Competency statement:** The prescriber demonstrates an understanding, relevant to their field and level of expertise, of the principles and processes of diagnostic stewardship, surveillance of antimicrobial resistance that underpin prophylaxis and treatment guidelines, and antimicrobial resistance control strategies.

### 2.1 D1 Surveillance of antimicrobial resistance linked to diagnostic stewardship

Learning objective	
Understand the relevance of quality surveillance data to aid diagnostic stewardship and vice versa.	
Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>Describe the use of surveillance data to inform policy-makers and for the development of treatment guidelines.</li> <li>Understand how monitoring antimicrobial consumption can influence rational prescribing and behavioural change.</li> <li><i>Understand the flow of data from receipt of the specimen in the laboratory to performance of identification and susceptibility testing to reporting of the data to a data repository.</i></li> <li><i>Understand the importance of meta-data (clinical and demographic information) and outcome data to enhance antimicrobial resistance surveillance.</i></li> <li><i>Describe basic epidemiology indicators, i.e. incidence and prevalence data, point prevalence studies, use of appropriate denominator data to inform burden of disease.</i></li> <li><i>Describe the key elements of a surveillance framework – laboratory data together with demographic, clinical and outcome data; appropriate denominators and trend analyses.</i></li> <li><i>Have knowledge of surveillance networks, the information they provide and how this can be used in clinical practice, i.e. Asian Network for Surveillance of Resistant Pathogens (ANSORP), Central Asian and Eastern European Surveillance of Antimicrobial Resistance (CAESAR), European Antimicrobial Resistance Surveillance Network (EARS-NET), Global Antimicrobial Resistance Surveillance System (GLASS) and Red Latinoamericana de Vigilancia de la Resistencia a los Antimicrobianos (ReLAVRA).</i></li> </ul>	<p>SAM 1 SAM 8 SAM 9</p>
Skills	
<ul style="list-style-type: none"> <li><i>Demonstrate ability to use existing local surveillance data sets in designing local policy.</i></li> <li><i>Demonstrate ability to source information from existing national, regional and global surveillance networks, i.e. ANSORP, CAESAR, EARS-NET, GLASS and ReLAVRA, when contributing to local protocols.</i></li> <li><i>Contribute clinical data and participate in measurement of local antimicrobial consumption.</i></li> </ul>	<p>SAM 7 SAM 16</p>
Attitudes	
<ul style="list-style-type: none"> <li>Promote appropriate use of the clinical microbiology laboratory to ensure availability of quality antimicrobial resistance surveillance data.</li> <li>Maintain patient confidentiality and data protection regulations.</li> <li>Be meticulous with record-keeping and documentation of demographic, clinical, microbiological and outcome data to enhance surveillance.</li> <li>Show willingness to participate in quality improvement programmes.</li> <li>Demonstrate a willingness to work with multidisciplinary teams.</li> <li>Be an antimicrobial champion and guardian to protect the effectiveness of antimicrobial agents as an ethical imperative for the common good.</li> </ul>	<p>SAM 5 SAM 6 SAM 7 SAM 14</p>





## E. Ethics, leadership, communication and governance

**Competency statement:** The prescriber understands the concept of ethical practice, effective leadership, the importance of communication and good governance as important strategies that underpin the prevention and control of antimicrobial resistance.

### 2.1 E1 Importance of ethics, leadership, communication and governance

Learning objective	
Understand the principles of ethical practice, leadership, communication and governance in ensuring the quality of antimicrobials and promoting their responsible use.	
<b>Knowledge</b>	<b>SAM</b> (suggested assessment method)
<ul style="list-style-type: none"> <li>Understand the importance of reporting substandard and falsified products and adverse events.</li> <li>Understand the importance of proper record-keeping of medicines inventories and use of product codes (according to setting) for traceability.</li> <li>Understand the importance of leadership, good governance and accountability.</li> <li>Understand the importance of learning and development as part of personal and team development.</li> <li>Describe strategies for effective communication.</li> <li>Understand the importance of having and abiding by a local ethics policy.</li> <li><i>Describe the main role of national medicine regulatory authorities in the regulation of medicines.</i></li> </ul>	<p>SAM 1 SAM 8 SAM 9</p>
<b>Skills</b>	
<ul style="list-style-type: none"> <li>Demonstrate basic skills in patient safety.</li> <li>Demonstrate good record-keeping and documentation.</li> <li>Participate in quality improvement programmes.</li> <li>Demonstrate compliance with national and local policies.</li> <li><i>Apply creative thinking in achieving change and improving patient safety.</i></li> </ul>	<p>SAM 7 SAM 17</p>
<b>Attitudes</b>	
<ul style="list-style-type: none"> <li>Believe that every individual has the capacity to lead by example within their peer group.</li> <li>Be a role model for students, colleagues and peers.</li> <li>Demonstrate commitment to probity, openness and transparency.</li> <li>Where necessary, manage ethical dilemmas and challenge poor behaviour.</li> <li>Show recognition of one's limitations and willingness to ask for advice.</li> <li>Show enthusiasm for learning and for training others.</li> <li>Where relevant, include the patient in shared decision-making on adherence.</li> </ul>	<p>SAM 5 SAM 6 SAM 7</p>





# 3. NON-PRESCRIBERS





## 3. NON-PRESCRIBERS

### 3.1 Curriculum guide for nurses/midwives

This section is devoted to the educating and training of nurses, nurse-midwives and midwives who, by regulation, do not prescribe antimicrobial agents in their practice settings. The curriculum provides a broad scope of learning objectives according to expected roles and will need to be adapted to local conditions of practice.

#### Modular outline

##### A. Foundations that build awareness of antimicrobial resistance

- 3.1 A1 Systemic approach to the individual with an infection
- 3.1 A2 Understanding antimicrobial agents and their management

##### B. Appropriate use of antimicrobial agents

- 3.1 B1 Use of antimicrobial agents in clinical management

##### C. Infection prevention and control


- 3.1 C1 Health care-associated infection, antimicrobial resistance and infection prevention and control

##### D. Diagnostic stewardship and surveillance

- 3.1 D1 Interaction between diagnostic stewardship, surveillance of antimicrobial resistance and overall antimicrobial stewardship

##### E. Ethics, leadership, communication and governance

(Refer to submodule in the curriculum guide for prescribers – 2.1 E1.)



Note that the learning outcomes and suggested assessment methods (SAMs) in the modules and submodules are categorized as core and additional – the latter are italicized (see Box 3).



## A. Foundations that build awareness of antimicrobial resistance

**Competency statement:** The nurse/midwife demonstrates that they have the knowledge and awareness of effective approaches to control antimicrobial resistance, and the skills and attitudes to implement change according to role and level of training.

### 3.1 A1 Systemic approach to the individual with an infection

Learning objective	
Evaluate the individual presenting with an infection.	
Knowledge	SAM (Suggested assessment method)
<ul style="list-style-type: none"><li>• Understand the general systemic features in patients who present with infection/sepsis – application of the “early warning score”:<ul style="list-style-type: none"><li>○ respiration rate</li><li>○ oxygen saturation</li><li>○ systolic blood pressure</li><li>○ pulse rate</li><li>○ level of consciousness or new confusion</li><li>○ temperature.</li></ul></li><li>• Describe the clinical features and presentation of patients with common infections.</li></ul>	SAM 1 SAM 8 SAM 9
Skills	
<ul style="list-style-type: none"><li>• Demonstrate the ability to use early warning score for infection/sepsis.</li><li>• Demonstrate a systematic approach to evaluating clinical signs and symptoms of infection and identifying the potential source of infection.</li><li>• Demonstrate judgement in referring patients that require further review by physicians.</li></ul>	SAM 2 SAM 7 SAM 14
Attitudes	
<ul style="list-style-type: none"><li>• Have empathy with patients and have a patient-centred focus.</li><li>• Be meticulous with record-keeping and documentation of vital signs and daily patient progress.</li><li>• Work with teams to achieve the best outcome for patients.</li><li>• Have an enthusiastic approach to learning.</li></ul>	SAM 6

### 3.1 A2 Understanding antimicrobial agents and their management

<b>Learning objective</b>	
Understand safe and effective management, storage, administration and disposal of antimicrobial agents.	
<b>Knowledge</b>	<b>SAM</b> (Suggested assessment method)
<ul style="list-style-type: none"> <li>• Understand the procedures for storage, preparation, administration, disposal and recording of antimicrobial agents.</li> <li>• Describe safe administration methods of antimicrobial agents.</li> <li>• Ensure that antimicrobial agents are administered on time as per the prescription.</li> <li>• Ensure the minimal hang time between prescription and administration.</li> <li>• Understand how to calculate doses of oral and intravenous antimicrobial agents especially for special populations such as those with kidney or liver impairments, children, pregnant and breast-feeding women.</li> <li>• Describe the known side-effects (including allergies) and toxicities of common antimicrobial agents.</li> <li>• Understand the process of medicine reconciliation.</li> <li>• Understand how to use local policies and guidelines for medicines management.</li> <li>• <i>Understand legal and ethical perspectives to medicines management.</i></li> </ul>	SAM 1
<b>Skills</b>	
<ul style="list-style-type: none"> <li>• Demonstrate the ability to properly store, prepare, administer and dispose of left over or expired antimicrobials.</li> <li>• Demonstrate accurate dose calculations and dosing intervals.</li> <li>• Demonstrate safe medicine administration practices to protect patients and health workers.</li> <li>• Demonstrate performance of effective medicine reconciliation with regard to administration and patient review.</li> </ul>	SAM 2 SAM 7 SAM 15
<b>Attitudes</b>	
<ul style="list-style-type: none"> <li>• Have empathy with patients.</li> <li>• Be meticulous with record-keeping and documentation of medication.</li> <li>• Follow high standards of ethical practice.</li> <li>• Be an advocate for safe practices in the health care environment including in relation to infection prevention.</li> </ul>	SAM 6



## B. Appropriate use of antimicrobial agents

**Competency statement:** The nurse/midwife demonstrates that they have the knowledge and understanding, according to their field and level of expertise, to facilitate optimal and safe use of antimicrobial agents for management of infections.

### 3.1 B1 Use of antimicrobial agents in clinical management

Learning objective	
Demonstrate appropriate administration and monitoring of antimicrobial agents in clinical practice.	
Knowledge	SAM (Suggested assessment method)
<ul style="list-style-type: none"> <li>Understand nurses' roles and responsibilities when administering antimicrobial agents (dose, dosing intervals, duration) and monitoring their use.</li> <li>Understand the importance of allergy history and other co-morbidities that could adversely affect choice and effectiveness of antimicrobial therapy.</li> <li>Understand the importance of compliance with standard treatment guidelines.</li> <li><i>Understand the importance of other parameters such as peripheral white cell count, C-reactive protein, liver and kidney function tests, clotting indices (for route of administration) when administering antimicrobial agents.</i></li> <li><i>Understand the role of therapeutic drug monitoring and interpretation of toxic levels of systemic antimicrobials.</i></li> <li><i>Understand the importance of microbiology culture and susceptibility results.</i></li> </ul>	SAM 1
Skills	
<ul style="list-style-type: none"> <li>Demonstrate ability in preparing and administering antimicrobial agents including the appropriate dose, dosing interval, route and duration.</li> <li>Demonstrate accurate records of prescriptions in drug charts including date, time and indication.</li> <li>Demonstrate the ability to record routine haematology and biochemistry test results and report any significant findings to the management team.</li> <li>Communicate effectively with patients and relatives in explaining the need for adherence to antimicrobial therapy and expected outcomes.</li> <li>Demonstrate effective team work with other teams including other members of the antimicrobial stewardship team.</li> <li><i>Demonstrate the ability to record microbiology culture and susceptibility results and report any significant findings to the management team.</i></li> </ul>	SAM 7 SAM 10 SAM 15
Attitudes	
<ul style="list-style-type: none"> <li>Be meticulous in keeping accurate and legible contemporaneous records of antimicrobial stocks, prescriptions and administration.</li> <li>Maintain legible patient records of daily progress.</li> <li>Be willing to engage with multidisciplinary team members (prescribers, laboratory scientists, pharmacists), seek advice and escalate concerns appropriately and promptly.</li> <li>Establish rapport with people and communities and advise on when antimicrobials are useful and when they are not.</li> </ul>	SAM 6 SAM 14

## C. Infection prevention and control

**Competency statement:** The nurse/midwife demonstrates an understanding of the broad principles of infection prevention and control; including the importance of water, sanitation and hygiene (WASH) in health care facilities to control and reduce the spread of antimicrobial resistance.

### 3.1 C1 Health care-associated infection, antimicrobial resistance and infection prevention and control

#### Learning objective

Understand the relationship between acquisition of health care-associated infection, antimicrobial resistance and infection prevention and control.

#### Knowledge

SAM (suggested assessment method)

- Understand, factors that predispose to health care-associated infection: extremes of age, co-morbidities, trauma, surgical procedures, indwelling devices, medication including antimicrobial agents that select for multidrug-resistant organisms.
- Understand when and how to decontaminate equipment and patient areas (including awareness of local or international spillage policies).
- Understand the basis and the consequences of using source and protective isolation (or cohorting for individuals carrying the same infection) to protect patients.
- Understand, the components of clinical care bundles:
  - peripheral and central venous access devices
  - sepsis
  - ventilator associated pneumonia
  - surgical site infection
  - urinary catheterization.
- Have awareness of local or relevant international guidelines for prevention and control of multidrug-resistant organisms in health care facilities, for surgical site infections and other aspects of infection prevention and control.
- Describe the infection prevention and control recommendations, unique to primary and community care from evidence-based guidelines.
- *Understand the dynamics of transmission of health care-associated infections: via contact, droplet, airborne, bloodborne and food and waterborne routes and how this influences practice.*
- *Where information is available, have knowledge of local methicillin-resistant Staphylococcus aureus (MRSA), carbapenem-resistant Enterobacteriaceae (CRE) and other multidrug-resistant screening policies.*

SAM 1  
SAM 8





## Skills

- Demonstrate the ability to follow local protocols and source information from the local infection prevention and control policy/or relevant international policies and apply this to decision-making and to set up best practice locally for all aspects of standard precautions including:
  - hand hygiene SAM 4
  - isolation SAM 7
  - waste management SAM 10
  - linen and laundry SAM 12
  - antiseptic technique and aseptic no touch technique (ANTT) SAM 14
  - sharps disposal
  - environmental cleaning and safe handling of spillage.
- Demonstrate the ability to use care bundles.
- Demonstrate the ability to advise patients and relatives on importance of immunization for health outcomes.
- Demonstrate the ability to work in a team, especially with infection prevention and control specialists.
- *Demonstrate the ability to contribute to a risk assessment of the health care environment and put in processes to protect the most vulnerable patients from risk of health care-associated infection or multidrug-resistant infections.*
- *Demonstrate local leadership skills in instigating or contributing to quality improvement processes and audit; monitor compliance with infection prevention and control and patient safety measures.*

## Attitudes

- Maintain meticulous hand hygiene practice and be a role model for other personnel. SAM 5
- Take responsibility for one's personal immunization status. SAM 6
- Have a high standard of compliance with all aspects of infection prevention and control according to agreed policy or international standards of infection prevention and control and patient safety. SAM 7  
SAM 14
- Show willingness to communicate and engage with multidisciplinary team members (prescribers, laboratory scientists, pharmacists, fellow nurses at all care levels) on the infection status of patients.
- Respect the contribution of infection prevention and control specialists and recognize when their expertise is needed.
- Show willingness to follow the advice of infection prevention and control specialists and take corrective instruction from them.
- Show willingness to educate personnel and the public in the importance of following good infection prevention and control practice and maintaining WASH standards both in hospital and in the community.
- *Demonstrate a high degree of organization in planning and laying out procedures so infection prevention and control processes are implemented appropriately.*

## D. Diagnostic stewardship and surveillance

**Competency statement:** The nurse/midwife demonstrates an understanding, relevant to their field and level of expertise, of the principles and processes of diagnostic stewardship, surveillance of antimicrobial resistance that underpin prophylaxis and treatment guidelines and antimicrobial resistance control strategies.

### 3.1 D1 Interaction between diagnostic stewardship, surveillance of antimicrobial resistance and overall antimicrobial stewardship

#### Learning objective

Appreciate the role of the nurse/midwife in achieving diagnostic and overall antimicrobial stewardship.

#### Knowledge

SAM (suggested assessment method)

- Describe the key elements of an antimicrobial stewardship programme at the hospital ward level. SAM 1
- Describe the key elements of diagnostic stewardship at hospital ward level.
- Describe the role of the nurse/midwife in antimicrobial stewardship teams.
- *Describe the interaction of antimicrobial stewardship, diagnostic stewardship, infection prevention and control and surveillance of antimicrobial resistance.*
- *Describe how these processes can inform treatment, prophylaxis and antimicrobial resistance control strategies.*

#### Skills

- Effectively contribute to the set up key elements of a diagnostic and antimicrobial stewardship programme:
  - At patient admission:
    - › triage (early warning score) and appropriate isolation (or cohorting of individuals if appropriate)
    - › accurate allergy history
    - › early and appropriate cultures before commencing antimicrobials
    - › timely antimicrobial initiation
    - › medication reconciliation.
  - Daily clinical progress monitoring:
    - › clinical assessment
    - › preliminary microbiology results and potential for antibiotic adjustment
    - › check antibiotic dosing/dosing interval and route (intravenous to oral switch) and suggest de-escalation
    - › indicate a planned stop date for antimicrobial prescription.
  - Patient safety and quality:
    - › document adverse events and any change in patient's condition
    - › *monitor haematology and biochemistry results (inflammatory markers, renal and liver status) as part of patient safety monitoring*
    - › document microbiology culture and susceptibility result(s)
    - › *flag relevant antimicrobial resistance test results.*
  - Patient education and discharge:
    - › record duration and indication of oral antimicrobial therapy at discharge
    - › educate patients on appropriate use of antimicrobial agents in the community and potential side-effects including development of resistance
    - › provide advice on re-admission and other safety nets in case of deterioration.



### Attitudes

- |  |        |
|--|--------|
| • Be organized in creating a patient management plan.  | SAM 6  |
| • Show commitment to patient safety and quality of care.   | SAM 14 |
| • Educate patients, colleagues and students on safe and effective antimicrobial use.                               |        |
| • Show leadership and be an advocate for the appropriate use of antimicrobials.                                    |        |
| • <i>Show willingness to collect and analyse data and participate in audit and quality improvement programmes.</i> |        |

## 3.2 Curriculum guide for pharmacists

This section is devoted to pharmacists who, by regulation, usually do not prescribe antimicrobial agents in their practice setting. The curriculum provides a broad learning scope, including learning outcomes for pharmacists in antimicrobial stewardship teams, and will need to be adapted to local conditions of practice and according to expected roles.

### Modular outline

#### A. Foundations that build awareness of antimicrobial resistance

3.2 A1 General pharmaceutical skills applied to the infected individual

3.2 A2 Antimicrobial agents and the threat of antimicrobial resistance

#### B. Appropriate use of antimicrobial agents

3.2 B1 Pharmaceutical management of antimicrobial agents for the infected individual

3.2 B2 Safe use of antimicrobial agents

3.2 B3 Antimicrobial stewardship and governance

#### C. Infection prevention and control

3.2 C1 Health care-associated infection, antimicrobial resistance and infection prevention and control

#### D. Diagnostic stewardship and surveillance

3.2 D1 Surveillance of antimicrobial consumption, antimicrobial resistance and links to diagnostic stewardship

#### E. Ethics, leadership, communication and governance

(Refer to submodule in the curriculum guide for prescribers – 2.1 E1.)



Note that the learning outcomes and suggested assessment methods (SAMs) in the modules and submodules are categorized as core and additional – the latter are italicized (see Box 3).



## A. Foundations that build awareness of antimicrobial resistance

**Competency statement:** The pharmacist demonstrates that they have the knowledge and awareness of effective approaches to control antimicrobial resistance, and the skills and attitudes to implement change according to role and level of training.

### 3.2 A1 General pharmaceutical competence applied to the infected individual

Learning objective	
Apply general pharmaceutical competencies to the infected individual.	
Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>Understand the microbial causes of common infections – community and hospital acquired.</li> <li>Understand the processes involved in the diagnosis, transmission, prevention and control of common infections – community and hospital acquired.</li> <li>Understand how complex co-morbidities, particularly with liver, renal and bone marrow impairment and drug allergies, influence the choice of antimicrobial therapy.</li> <li>Understand the importance of extremes of age and physiological states such as pregnancy and breast feeding on antimicrobial therapy.</li> <li>Have knowledge of current evidence base and relevant best-practice guidelines.</li> <li><i>Understand the relevance of diagnostic methodologies, including microbiology, haematology, biochemistry, immunology and imaging, for antimicrobial therapy.</i></li> </ul>	<p>SAM 1 SAM 8</p>
Skills	
<ul style="list-style-type: none"> <li>Demonstrate the ability to advise on an appropriate antimicrobial drug depending on potential source of infection.</li> <li>Demonstrate application of laboratory and imaging test results to the pharmaceutical care of the infected patient.</li> <li>Demonstrate ability to source information from current literature or evidence-based guidelines to provide adequate advice on the use of antimicrobials.</li> <li><i>Demonstrate use of laboratory indices in advising on the management of patients with infection.</i></li> </ul>	<p>SAM 7 SAM 15 SAM 16</p>
Attitudes	
<ul style="list-style-type: none"> <li>Have a patient-centred focus in managing the medication of individuals with infections.</li> <li>Be committed to meticulous record-keeping and documentation of antimicrobial history.</li> <li>Show willingness to work within a team of care personnel or antimicrobial stewardship teams.</li> <li>Be vigilant for errors in antimicrobial prescription and escalate appropriately.</li> <li>Have an enthusiastic approach to learning and recognize when to ask for advice or help from other colleagues.</li> </ul>	<p>SAM 6</p>

## 3.2 A2 Antimicrobial agents and the threat of antimicrobial resistance

### Learning objective

Explain the classification and pharmaceutical applications of antimicrobial agents, and the development and consequences of antimicrobial resistance.

Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>Outline the common classification of antimicrobial agents (<math>\beta</math>-lactam, aminoglycosides, quinolones etc.).</li> <li>Explain the concept of broad- and narrow-spectrum antimicrobial agents.</li> <li>Explain the key properties of the classes of antimicrobial agents against bacteria:               <ul style="list-style-type: none"> <li>mechanism of action</li> <li>spectrum of activity</li> <li>route of administration and bioavailability</li> <li>dosing regimen</li> <li>tissue penetration</li> <li>half-life and clearance</li> <li>adverse effects.</li> </ul> </li> <li>Explain drug-bug combinations in terms of minimum inhibitory concentration (MIC), minimum bactericidal concentration (MBC), time above MIC and area under the curve (AUC).</li> <li>Explain the mechanisms by which organisms become resistant to antimicrobial agents: innate and acquired mechanisms of resistance.</li> <li>Describe the details of pharmacokinetics of antimicrobial agents: absorption, distribution elimination.</li> <li>Describe the details of pharmacodynamics: efficacy and toxicity.</li> <li>Explain the concept of empirical, syndromic and culture-based treatment strategies for treating infections.</li> <li>Have knowledge of local or other published guidelines that recommend antimicrobial choices for treatment of infection.</li> <li><i>Understand how to interpret data from clinical trials relating superiority and non-inferiority of trial arms.</i></li> </ul>	<p>SAM 1 SAM 16</p>
<h3>Skills</h3> <ul style="list-style-type: none"> <li>Demonstrate the ability to develop and implement a pharmaceutical care plan for the infected patient.</li> <li>Demonstrate the ability to source information from current literature and published guidelines keeping in mind local antimicrobial resistance patterns.</li> <li>Demonstrate the ability to modify pharmaceutical care plans in patients with altered physiological states, extremes of age or with complex co-morbidities.</li> <li><i>Demonstrate the ability to advise on how laboratory information, including routine haematology, biochemistry and microbiology test results, impact on antimicrobial treatment.</i></li> <li><i>Demonstrate the ability to interpret clinical trial data (superiority, non-inferiority and adverse events) and advise appropriately.</i></li> </ul>	<p>SAM 2 SAM 3 SAM 4 SAM 7</p>
<h3>Attitudes</h3> <ul style="list-style-type: none"> <li>Show willingness to communicate with colleagues in the team about the role of antimicrobial agents.</li> <li>Engage with colleagues and the public to advise on the role of antimicrobial agents in therapy and the threat of resistance.</li> <li>Keep up to date with recent scientific advances and show enthusiasm for continued professional development on antimicrobial resistance.</li> <li><i>Show enthusiasm in performing or contributing to clinical audit and participation in quality improvement programmes relating to antimicrobial use.</i></li> <li><i>Show willingness to teach students, colleagues and other health professionals about antimicrobial agents and the development of resistance.</i></li> </ul>	<p>SAM 5 SAM 6 SAM 7</p>



## B. Appropriate use of antimicrobial agents

**Competency statement:** The pharmacist demonstrates that they have the knowledge and understanding, according to their field and level of expertise, to facilitate optimal and safe use of antimicrobial agents for management of infections.

### 3.2 B1 Pharmaceutical management of antimicrobial agents for the infected individual

Learning objective	
Plan, manage, monitor, advise and review appropriate antimicrobial use in clinical practice.	
Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>Describe the pharmacodynamics and pharmacokinetics of antimicrobial agents, including combination therapy for treatment of infection.</li> <li>Describe use of AUC/MIC data and the concept of time and concentration dependent killing and persistent antimicrobial effect and how this affects choice of antimicrobial agent, the dosing regimen and method of administration.</li> <li>Explain the basis of modifying therapy in line with complex co-morbidities, allergies, drug interactions, extremes of age or other physiological states such as pregnancy and breast feeding.</li> <li>Understand the need for therapeutic drug monitoring and when this is required.</li> <li>Describe the optimal dose, route, dosing interval and duration of antimicrobial therapy for a given clinical condition and when to escalate/de-escalate.</li> <li>Demonstrate knowledge of current evidence-based guidelines for management of the various infectious disease syndromes.</li> <li><i>Describe the role of prophylactic, empirical, syndromic or culture-based antimicrobial therapy for the common conditions listed.</i></li> </ul>	<p>SAM 1 SAM 16</p>
Skills	
<ul style="list-style-type: none"> <li>Demonstrate the ability to carry out a medicines utilization review (MUR) and create a medicines management plan.</li> <li>Demonstrate the ability to accurately dispense prescriptions of antimicrobial agents for outpatient and inpatient care.</li> <li>Is able to give clear advice on dosage, preparation and method of administration, dosing intervals, storage, side-effects, interactions and contraindications of antimicrobial agents for all patients and especially for vulnerable patients.</li> <li>Demonstrate the ability to interpret laboratory test results and advise on treatment modifications.</li> <li>Demonstrate the ability to advise on dosing and method of administration based on pharmacokinetic/pharmacodynamic data.</li> <li>Demonstrate the ability to source information from current literature and evidence-based practice.</li> </ul>	<p>SAM 2 SAM 3 SAM 4 SAM 7</p>
Attitudes	
<ul style="list-style-type: none"> <li>Show willingness to communicate in a multidisciplinary team.</li> <li>Show enthusiasm in performing or contributing to clinical audit and participation in quality improvement programmes relating to antimicrobial use.</li> <li>Display a high level of organization in ensuring adequate stock and timely supply of drugs.</li> <li>Show willingness to teach students, colleagues and other health professionals about antimicrobial use and resistance.</li> <li>Keep up to date with scientific advances and participate in continued professional development.</li> </ul>	<p>SAM 5 SAM 6 SAM 7</p>

### 3.2 B2 Safe use of antimicrobial agents

#### Learning objective

Understand the pharmacist's role in safe and appropriate antimicrobial use in clinical practice.

Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>• Explain the importance of safe and responsible use of antimicrobial agents.</li> <li>• Describe common signs and symptoms of antimicrobial toxicity and toxicity related to bone marrow, liver and renal impairment.</li> <li>• Explain the importance of therapeutic drug monitoring of certain antimicrobial agents to ensure clinical efficacy and reduce toxicity.</li> <li>• Understand common drug allergies (immediate, non-life threatening and life threatening), and interactions involving other therapeutic agents (including other antimicrobial agents) and certain foods/alcohol.</li> <li>• Explain the adverse consequences of antimicrobial agents on normal microbial flora and the risk of secondary bacterial or fungal infections.</li> <li>• Describe contraindications to selected antimicrobials in certain clinical conditions.</li> <li>• Understand the risk of using broad-spectrum antimicrobial agents, i.e. development of <i>Clostridium difficile</i> infection and multidrug-resistant infections due to selection pressure.</li> <li>• Understand the risk of antimicrobial resistance and how it could affect routine patient care and spread within the health care environment and the community.</li> <li>• Explain the method of safe disposal of unused antimicrobial agents.</li> </ul>	<p>SAM 1</p> <p>SAM 16</p>
<h4>Skills</h4> <ul style="list-style-type: none"> <li>• Demonstrate the ability to advise on the most effective and safe regimen for the patient.</li> <li>• Demonstrate the ability to advise on which patients/antimicrobial agents require therapeutic drug monitoring, interpret the results and advise on treatment modifications.</li> <li>• Advise on alternative regimens in case of drug interactions and adverse effects.</li> <li>• Create a system to investigate, record and report adverse events and substandard and falsified antimicrobial agents to the relevant authorities.</li> </ul>	<p>SAM 2</p> <p>SAM 3</p> <p>SAM 4</p> <p>SAM 7</p>
<h4>Attitudes</h4> <ul style="list-style-type: none"> <li>• Be an advocate for patient safety.</li> <li>• Show commitment to meticulous and accurate documentation of prescriptions and other records.</li> <li>• Encourage good prescribing practice, e.g. compliance with prescriptions and use of local guidelines and formularies.</li> <li>• Show willingness to educate patients and the public in safe and appropriate use of antimicrobials, discouraging self-prescription and over-the-counter purchasing of antimicrobial agents wherever possible.</li> <li>• Be a role model for good prescribing and dispensing behaviour of antimicrobials.</li> <li>• Keep up to date with recent advances and participate actively in continued professional development.</li> </ul>	<p>SAM 5</p> <p>SAM 6</p> <p>SAM 7</p>





### 3.2 B3 Antimicrobial stewardship and governance

#### Learning objective

Appreciate the pharmacist's role in the processes of antimicrobial stewardship and good governance to control the development and spread of antimicrobial resistance.

Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>• Describe the vital role played by the pharmacist in antimicrobial stewardship – if relevant to the setting describe the unique roles and responsibilities of the pharmacist.</li> <li>• Explain the pharmacist's contribution to appropriate use of antimicrobial agents.</li> <li>• Explain the importance of antimicrobial formularies, consumption data, principles of antimicrobial pharmaco-epidemiology and prescribing policies and processes to monitor use.</li> <li>• Explain how local antimicrobial resistance patterns should be used to direct empirical antimicrobial use.</li> <li>• Explain the role of the drug and therapeutics committee (or equivalent).</li> <li>• Explain the pharmacist's role in evaluating evidence from clinical trials and current literature to inform inclusion of new antimicrobial agents into the formulary.</li> <li>• Explain the importance of restricted reporting of susceptibility data by the microbiologist to control antimicrobial use.</li> <li>• Understand the importance of 48- to 72-hour review of all antimicrobial prescriptions to check optimal duration and prevent overuse.</li> <li>• Understand the need to de-escalate from empirical broad-spectrum therapy to targeted narrow-spectrum therapy.</li> <li>• Explain the importance of intravenous to oral switch of antimicrobial therapy when appropriate.</li> <li>• Understand the WHO strategy for optimizing use of antimicrobial agents: Access, Watch and Reserve (AWaRe) categorization.</li> <li>• Understand the importance of pre-authorization of certain antimicrobial agents (for settings where policy is applied) and the role of the pharmacist in achieving this safely and without risk to patients.</li> <li>• Understand the evidence base and the rationale for surgical site and other antibiotic prophylaxis regimens.</li> </ul>	<p>SAM 1 SAM 16 SAM 17</p>
<h4 data-bbox="231 1458 300 1496">Skills</h4> <ul style="list-style-type: none"> <li>• Demonstrate the ability to critically assess all prescriptions for accuracy, safety and adherence to local policies.</li> <li>• Advise clearly and knowledgeably on optimum preparation dose, route, dosing interval, risks and interactions with other antimicrobial agents in a patient-focused manner.</li> <li>• Demonstrate the ability to critically assess evidence from clinical trials and the current literature to inform procurement practices.</li> <li>• Contribute to reviews and updates to the formulary within your specified field.</li> <li>• <i>Demonstrate the ability to design or contribute to audit processes and quality improvement programmes for antimicrobial prescribing.</i></li> </ul>	<p>SAM 2 SAM 3 SAM 4 SAM 7</p>

## Attitudes

- Show a high degree of scrutiny in reviewing prescriptions to ensure accurate and safe prescribing. SAM 5  
SAM 6
- Demonstrate willingness to embrace the principles of antimicrobial stewardship. SAM 7
- Show willingness to consult more experienced colleagues and if necessary be confident in querying treatment decisions and advise on appropriate and alternative choices.
- Be an active participant and contribute effectively to multidisciplinary team objectives and meetings.
- Have an enthusiastic approach to the culture of quality improvement.
- Avoid any conflict of interest particularly financial or market incentives that encourage prescription of certain antimicrobials or combinations of antimicrobial agents not included in the formulary or recognized treatment protocols.
- Maintain an attitude of keeping the patient's best interest in mind at all times including while dispensing antimicrobials and other medicines.



## C. Infection prevention and control

**Competency statement:** The pharmacist demonstrates an understanding of the broad principles of infection prevention and control; including the importance of water, sanitation and hygiene (WASH) in health care facilities to control and reduce the spread of antimicrobial resistance.

### 3.2 C1 Health care-associated infection, antimicrobial resistance and infection prevention and control

#### Learning objective

Understand the relationship between the acquisition of health care-associated infection, antimicrobial resistance and infection prevention and control.

Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>• Understand that health care-associated infection can occur when pharmacological formulations are contaminated with microbes and that it can cause life-threatening infections.</li> <li>• Understand that this may occur during manufacture or when medications are improperly prepared, handled, dispensed, stored or become outdated locally.</li> <li>• Understand where the risk for contamination is greatest in the hospital/community, i.e. in the pharmacy or at ward level when medications are prepared prior to administration.</li> <li>• Have knowledge of the routes of contamination and how to prevent contamination:               <ul style="list-style-type: none"> <li>○ direct contact</li> <li>○ use of contaminated constituents</li> <li>○ airborne contamination.</li> </ul> </li> <li>• Understand the need to follow sterile techniques and sterile or single-use equipment when preparing or reconstituting medication.</li> <li>• Have knowledge of infection control practices for a pharmacy, i.e.:               <ul style="list-style-type: none"> <li>○ use of laminar flow cabinet (if available)</li> <li>○ use of appropriate gown, gloves, visor and mask</li> <li>○ hand hygiene</li> <li>○ temperature monitoring of drug refrigerators</li> <li>○ cleanliness of the environment.</li> </ul> </li> <li>• Understand the risks involved in using multiple-dose vials and the importance of use by time/date of both single- and multiple-dose vials once opened.</li> <li>• Understand the need to educate patients on how to use antimicrobials provided at the time of discharge.</li> <li>• Understand the value of monitoring and identifying contamination and developing a surveillance system.</li> <li>• <i>Understand the differences and impact of health care-associated infection and community-acquired infections.</i></li> </ul>	<p>SAM 1 SAM 8</p>

### Skills

- Demonstrate the ability to follow standards of aseptic practice within the pharmacy and for the preparation of medication on the wards. SAM 7  
SAM 10
- Demonstrate ability to monitor good practice in the pharmacy and the wards, i.e. maintain temperature logs of refrigerators and maintenance records of equipment such as laminar flow cabinets. SAM 12  
SAM 15
- Demonstrate the ability to refer suspected or proven cases of antimicrobial contamination to the appropriate authorities.
- Demonstrate adherence to instructions when using single- or multiple-dose vials once they have been opened.
- Demonstrate proper labelling, dating and storage of sterile products.
- Be willing to participate in infection control programmes of the health care facility.

### Attitudes

- Maintain meticulous hand hygiene practice. SAM 5
- Have a high standard of compliance with all aspects of infection prevention and control according to agreed policy in the pharmacy and on the wards. SAM 7  
SAM 6
- Demonstrate a high degree of organization and aseptic technique when preparing medication. SAM 14
- Self-declare and abstain from preparation of medications if suffering from rashes, sunburn, weeping sores, broken skin, conjunctivitis, and respiratory or gastrointestinal infections.
- Show compliance with manufacturers' instructions for drugs and equipment and commitment to meticulous record-keeping.



## D. Diagnostic stewardship and surveillance

**Competency statement:** The pharmacist demonstrates an understanding, relevant to their field and level of expertise, of the principles and processes of diagnostic stewardship, surveillance of antimicrobial resistance and antimicrobial stewardship that underpin prophylaxis and treatment guidelines and antimicrobial resistance control strategies.

### 3.2 D1 Surveillance of antimicrobial consumption, antimicrobial resistance and links to diagnostic stewardship

Learning objective	
Understand the role of the pharmacist in influencing antimicrobial consumption using data from diagnostic stewardship, surveillance of antimicrobial resistance and antimicrobial stewardship.	
Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>Describe how to collect and analyse antimicrobial consumption data and antimicrobial costs/expenditure.</li> <li>Describe the flow of data from receipt of the specimen in the laboratory to performance of identification and susceptibility testing to reporting of the data to a data repository.</li> <li>Describe basic epidemiology indicators, i.e. incidence and prevalence data, point prevalence studies, use of appropriate denominator data to inform burden of disease.</li> <li><i>Describe the importance of meta-data (clinical and demographic information) antimicrobial consumption and outcome data to enhance antimicrobial resistance surveillance.</i></li> <li><i>Describe the key elements of an antimicrobial consumption and surveillance framework – laboratory data together with demographic, clinical, antimicrobial usage and outcome data; appropriate denominators and trend analyses.</i></li> <li><i>Describe the use of surveillance and consumption data to inform policy-makers and treatment guidelines.</i></li> </ul>	<p>SAM 1 SAM 8 SAM 9</p>
Skills	
<ul style="list-style-type: none"> <li>Demonstrate the ability to collect and analyse antimicrobial consumption data to inform local quality initiatives.</li> <li>Demonstrate the ability to prepare reports and present data to influence policy.</li> <li>From a pharmacist's perspective, contribute to local indicators that measure antimicrobial use.</li> <li>Demonstrate the ability to perform simple analyses linking laboratory, clinical and antimicrobial usage data to improve prescribing.</li> <li><i>Demonstrate the ability to interpret antimicrobial culture and sensitivity reports to advise on escalation/de-escalation of therapy.</i></li> </ul>	<p>SAM 7 SAM 16</p>
Attitudes	
<ul style="list-style-type: none"> <li>Show respect for patient confidentiality and data protection regulations.</li> <li>Be committed to meticulous record-keeping and documentation.</li> <li>Show willingness to participate in quality improvement programmes.</li> <li>Demonstrate a willingness to work in multidisciplinary teams.</li> <li>Be an educator of colleagues, patients and the public and promote good antimicrobial prescribing.</li> <li>Be an antimicrobial champion and guardian to protect the effectiveness of antimicrobial agents as an ethical imperative for the common good.</li> </ul>	<p>SAM 5 SAM 6 SAM 7 SAM 14</p>

### 3.3 Curriculum guide for laboratory scientists

This section is devoted to laboratory scientists. The curriculum provides a broad scope and will need to be adapted to local conditions of practice.

#### Modular outline

##### A. Foundations that build awareness of antimicrobial resistance

3.3 A1 Laboratory diagnosis of infection: pre-analytical phase

3.3 A2 Laboratory diagnosis of infection: analytical phase

3.3 A3 Laboratory diagnosis of infection: post-analytical phase

3.3 A4 Laboratory management, safety and quality assurance

##### B. Appropriate use of antimicrobial agents

3.3 B1 Role of the laboratory in detecting, reporting and controlling antimicrobial resistance

##### C. Infection prevention and control

3.3 C1 Health care-associated infection, antimicrobial resistance and infection prevention and control

##### D. Diagnostic stewardship and surveillance

3.3 D1 Role of the microbiology laboratory in diagnostic stewardship, antimicrobial stewardship and surveillance

##### E. Ethics, leadership, communication and governance

(Refer to submodule in the curriculum guide for prescribers – 2.1 E1.)



Note that the learning outcomes and suggested assessment methods (SAMs) in the modules and submodules are categorized as core and additional – the latter are italicized (see Box 3).



## A. Foundations that build awareness of antimicrobial resistance

**Competency statement:** The laboratory scientist demonstrates that they have the knowledge and awareness of effective approaches to control antimicrobial resistance, and the skills and attitudes to implement change according to role and level of training.

### 3.3 A1 Laboratory diagnosis of infection: pre-analytical phase

<b>Learning objective</b>	
Demonstrate awareness of the routine investigations available for the diagnosis of the different infection syndromes and the key aspects of collection and transport of clinical specimens to the laboratory.	
<b>Knowledge</b>	<b>SAM</b> (suggested assessment method)
<ul style="list-style-type: none"> <li>Describe the repertoire of laboratory investigations available for a given clinical scenario and understand their usefulness and limitations.</li> <li>Understand the need for following standard operating procedures for collection and safe transport of laboratory specimens.</li> <li>Describe how to collect the correct sample: the volume, time of collection, the container (with transport media if applicable) and the conditions of storage and transport to the laboratory during working hours and out of hours.</li> <li>Understand the need for a detailed laboratory user manual for health workers who use laboratory services.</li> <li>Have knowledge of available standardized national or international protocols for the collection and transportation of clinical samples.</li> </ul>	<p>SAM 1 SAM 9</p>
<b>Skills</b>	
<ul style="list-style-type: none"> <li>Demonstrate the ability to select the most appropriate test based on clinical presentation and/or available specimen.</li> <li>Show the ability to source information from national or international standards and protocols for the collection and transportation of clinical samples.</li> <li>Contribute to developing and updating relevant standard operating procedures and how they are used.</li> </ul>	<p>SAM 3 SAM 7 SAM 10 SAM 15</p>
<b>Attitudes</b>	
<ul style="list-style-type: none"> <li>Show willingness to liaise with other laboratory and clinical personnel.</li> <li>Show initiative to communicate with, provide guidance to and educate colleagues or other health workers on specimen collection and transportation.</li> </ul>	<p>SAM 6</p>

### 3.3 A2 Laboratory diagnosis of infection: analytical phase

#### Learning objective

Understand the processes, interpretation and limitations of analyses and the role of reference laboratories; and safe laboratory working practices.

Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>• Describe the health and safety aspects including biosafety classification of laboratory work.</li> <li>• Understand the importance of robust bacterial identification and aseptic technique.</li> <li>• Describe the scientific principles, methods, interpretation and limitations of culture-based methods, antimicrobial susceptibility testing, nucleic acid based testing and other relevant testing methods.</li> <li>• Understand the importance of standard operating procedures for all laboratory processes.</li> <li>• Explain the repertoire of services suited to, or available from, a reference laboratory and how to avail of these facilities where available.</li> </ul>	<p>SAM 1 SAM 9</p>
<h4 data-bbox="231 907 295 940">Skills</h4> <ul style="list-style-type: none"> <li>• Demonstrate safe working practices in the laboratory.</li> <li>• Demonstrate the ability to use a standard operating procedure (including the performance and documentation of quality control and other established standards) and perform a procedure effectively and efficiently to achieve the required turnaround time.</li> <li>• Demonstrate the ability to use local or internationally standardized methodologies or quality assured and standardized national protocols for antimicrobial susceptibility testing.</li> </ul>	<p>SAM 7 SAM 15</p>
<h4 data-bbox="231 1182 343 1216">Attitudes</h4> <ul style="list-style-type: none"> <li>• Show willingness to learn and work safely and efficiently in the laboratory.</li> <li>• Be a role model by showing willingness to perform laboratory tasks and procedures to the highest quality.</li> <li>• Show commitment to meticulous record-keeping regarding clinical samples and laboratory resources.</li> <li>• Show willingness to work in a team with other health workers.</li> </ul>	<p>SAM 6</p>





### 3.3 A3 Laboratory diagnosis of infection: post-analytical phase

<b>Learning objective</b>	
Understand the importance of recording, interpreting and reporting results to clinical personnel.	
<b>Knowledge</b>	<b>SAM</b> (suggested assessment method)
<ul style="list-style-type: none"> <li>Describe the process of keeping accurate, legible and confidential records of laboratory investigations.</li> <li>Describe how results should be technically and scientifically (or clinically) validated before authorization.</li> <li>Describe when and how to use the reference laboratory where available.</li> <li>Describe how isolates are stored for further work once testing is complete.</li> <li>Describe the importance adhering to turnaround times when issuing preliminary and final reports.</li> <li>Understand the need for a standardized reporting standard operating procedure.</li> </ul>	<p>SAM 1 SAM 9</p>
<b>Skills</b>	
<ul style="list-style-type: none"> <li>Demonstrate the ability to produce a laboratory report containing the right result with the appropriate interpretation and validation.</li> <li>Explain results comprehensively with results from other specimens from the same patient.</li> <li>Link results from the reference laboratory and interpret accordingly.</li> <li>Demonstrate the ability to use a standard operating procedure to achieve the required turnaround time for reporting preliminary and final results.</li> </ul>	<p>SAM 2 SAM 7 SAM 15</p>
<b>Attitudes</b>	
<ul style="list-style-type: none"> <li>Be willing to communicate appropriately to clinical personnel prioritizing urgent reports.</li> <li>Show commitment to patient confidentiality.</li> <li>Show commitment to meticulous record-keeping regarding clinical samples and laboratory resources.</li> </ul>	<p>SAM 6</p>

### 3.3 A4 Laboratory management, safety and quality assurance

<b>Learning objective</b>	
Understand the importance of a laboratory quality management system and laboratory safety.	
<b>Knowledge</b>	<b>SAM</b> (suggested assessment method)
<ul style="list-style-type: none"> <li>• Understand the importance of transcription errors in specimen handling and its potential implication for patient management.</li> <li>• Describe the principles behind quality management systems for laboratories.</li> <li>• Understand the importance of internal and external quality assurance and methods of reporting failures in quality assessment (consumables, equipment calibration/ maintenance and processes) to appropriate authorities.</li> <li>• Understand the importance of laboratory accreditation.</li> <li>• <i>Understand the principles of Control of Substances Hazardous to Health regulations (COSHH) and how to perform workplace COSHH risk assessments or local equivalent, as applicable.</i></li> <li>• <i>Have knowledge of the WHO Laboratory Quality Stepwise Implementation tool (LQSI).</i></li> </ul>	SAM 1
<b>Skills</b>	
<ul style="list-style-type: none"> <li>• Demonstrate use of the laboratory quality management system.</li> <li>• Demonstrate performance of horizontal, vertical and examination audits to monitor laboratory performance and safety.</li> <li>• <i>Demonstrate the ability to perform a COSHH or local equivalent risk assessment.</i></li> </ul>	SAM 7 SAM 10 SAM 15
<b>Attitudes</b>	
<ul style="list-style-type: none"> <li>• Demonstrate commitment to maintaining quality and safety standards.</li> <li>• Be a role model for other personnel and students in maintaining laboratory quality and safety standards.</li> <li>• Show commitment to meticulous record-keeping.</li> </ul>	SAM 6



## B. Appropriate use of antimicrobial agents

**Competency statement:** The laboratory scientist demonstrates that they have the knowledge and understanding, according to their field and level of expertise, to facilitate the optimal and safe use of antimicrobial agents for management of infections.

### 3.3 B1 Role of the laboratory in detecting, reporting and controlling antimicrobial resistance

Learning objective	
Appreciate the role of the laboratory in detecting antimicrobial resistance, and its contribution to treatment and control strategies.	
Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>Understand the importance of the laboratory in providing timely, accurate and quality assured antimicrobial susceptibility test results to guide patient management.</li> <li>Understand the difference between diagnosing infection with antimicrobial resistance and screening for antimicrobial resistance for surveillance purposes.</li> <li>Describe the standard drug-bug panels used for testing.</li> <li>Understand the importance of bacterial identification for the selection of drug-bug panel to test.</li> <li>Understand the importance of procuring and maintaining standard control strains of bacteria as part of quality control.</li> <li>Understand the methods (culture-based, molecular, immunological and point of care) used to detect antimicrobial resistance mechanisms, how to interpret these and what the limitations are (both qualitative and quantitative) and the treatment implications.</li> <li>Describe the importance of daily/weekly quality checks of laboratory consumables and processes.</li> <li>Demonstrate competence in reading and interpreting test results bearing in mind treatment implications.</li> <li>Demonstrate scientific judgement and the ability to prioritize and communicate urgent results without delay.</li> <li>Demonstrate the ability to scientifically validate and authorize a report.</li> <li><i>Understand the importance of a detailed standard operating procedure for performance of antimicrobial susceptibility testing.</i></li> <li><i>Understand the importance of and the procedures for using standardized methodologies for antimicrobial susceptibility testing (EUCAST/CLSI).</i></li> <li><i>Describe the steps in performing an antimicrobial susceptibility test, how to interpret it and what the limitations are and the treatment implications.</i></li> </ul>	SAM 1
Skills	
<ul style="list-style-type: none"> <li>Demonstrate the ability to follow guidelines for antimicrobial susceptibility testing and standard operating procedures for reporting results.</li> <li><i>Demonstrate competence in performing an antimicrobial susceptibility test including the appropriate quality assurance tests.</i></li> </ul>	SAM 2 SAM 3 SAM 7 SAM 15
Attitudes	
<ul style="list-style-type: none"> <li>Be a meticulous laboratory worker.</li> <li>Show willingness to liaise with clinical personnel to seek clarification, communicate urgent results and provide interpretation including the mechanism of resistance and implications for treatment.</li> <li>Show commitment to accurate record-keeping of test results and quality management processes.</li> <li>Protect patient confidentiality.</li> <li>Establish rapport with clinical personnel with an aim to aid rational antimicrobial prescribing.</li> </ul>	SAM 6

## C. Infection prevention and control

**Competency statement:** The laboratory scientist demonstrates an understanding of the broad principles of infection prevention and control, including the importance of water, sanitation and hygiene (WASH) in health care facilities to control and reduce the spread of antimicrobial resistance.

### 3.3 C1 Health care-associated infection, antimicrobial resistance and infection prevention and control

#### Learning objective

Understand the role of infection prevention and control in preventing acquisition of health care-associated infection and controlling antimicrobial resistance.

Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>• Understand the role of the laboratory in timely diagnosis of antimicrobial resistance – both for screening and diagnosis of infection and management of outbreaks.</li> <li>• Understand the need for a laboratory scientist to be part of an infection outbreak team and the infection prevention and control team.</li> <li>• Understand the key principles that underpin the prevention of laboratory-acquired infection:               <ul style="list-style-type: none"> <li>○ appropriate handling in the relevant cabinet</li> <li>○ hand hygiene</li> <li>○ correct use of personal protective equipment</li> <li>○ appropriate immunization of laboratory workers</li> <li>○ use of disinfectants for the environment/bench surfaces and management of spillages</li> <li>○ methods of sterilization as relevant to the laboratory</li> <li>○ waste disposal of laboratory and clinical waste.</li> </ul> </li> <li>• Understand safe working practices in the laboratory.</li> </ul>	SAM 1 SAM 8
<h4>Skills</h4> <ul style="list-style-type: none"> <li>• Demonstrate the ability to review laboratory results for the identification of clusters of health care-associated infection or community-acquired infection.</li> <li>• Demonstrate safe laboratory working practices.</li> <li>• Report laboratory incidents and laboratory-acquired infection to appropriate governance authorities and safety managers.</li> <li>• <i>Demonstrate the ability to prioritize laboratory tests and communicate test results related to infection prevention and control concerns, not only to the clinical personnel but also to the infection prevention and control specialists.</i></li> </ul>	SAM 7 SAM 12 SAM 15
<h4>Attitudes</h4> <ul style="list-style-type: none"> <li>• Show commitment to meticulous hand hygiene and safe laboratory practices.</li> <li>• Show team spirit and work closely with infection prevention and control specialists in providing and interpreting test results and contributing to surveillance.</li> </ul>	SAM 5 SAM 6 SAM 7



## D. Diagnostic stewardship and surveillance

**Competency statement:** The laboratory scientist demonstrates an understanding, relevant to their field and level of expertise, of the principles and processes of diagnostic stewardship and surveillance of antimicrobial resistance that underpin prophylaxis and treatment guidelines for antimicrobial resistance control strategies and overarching antimicrobial stewardship.

### 3.3 D1 Role of the microbiology laboratory in diagnostic stewardship, antimicrobial stewardship and surveillance

Learning objective	
Appreciate the role of the microbiology laboratory in diagnostic stewardship, antimicrobial stewardship and surveillance of antimicrobial resistance.	
Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>Describe the role of the laboratory in diagnostic stewardship, antimicrobial stewardship and surveillance to inform treatment guidelines and public health policy.</li> <li>Describe the process by which antimicrobial resistance data can be monitored and analysed to understand local trends in antimicrobial resistance and to inform local treatment guidelines and control the spread of antimicrobial resistance.</li> <li><i>Understand the scope of the WHONET surveillance tool.</i></li> <li><i>Understand the importance of meta-data (clinical and demographic data) and outcome data in analysing the burden of antimicrobial resistance.</i></li> <li><i>Describe how locally generated antimicrobial resistance data and appropriate denominator data can contribute to national, regional and global surveillance databases (e.g. ANSORP, CAESAR, EARS-NET, GLASS and ReLAVRA).</i></li> <li><i>Understand the principle of restricted reporting in settings where allowed (reporting susceptibility test results on selected antimicrobial agents) as a part of antimicrobial stewardship.</i></li> </ul>	SAM 1
Skills	
<ul style="list-style-type: none"> <li>Be an advocate for use of the laboratory as part of diagnostic stewardship.</li> <li>Practise restricted reporting in line with local policies.</li> <li>Demonstrate effective database management: accurately record/upload antimicrobial resistance data from patient samples to an antimicrobial resistance database.</li> <li><i>Demonstrate basic skills to analyse antimicrobial resistance data, meta-data and outcome data (if accessible) with appropriate denominator data.</i></li> <li><i>Demonstrate the ability to produce reports on antimicrobial resistance prevalence and trends for local health workers.</i></li> </ul>	SAM 7 SAM 15
Attitudes	
<ul style="list-style-type: none"> <li>Show leadership and commitment to developing and maintaining a surveillance culture for determining antimicrobial resistance patterns.</li> <li>Be an active member of the local stewardship team where available.</li> <li>Be meticulous in recording data.</li> <li><i>Show initiative to further capturing antimicrobial resistance meta-data and outcome data.</i></li> </ul>	SAM 6





# 4. PUBLIC HEALTH OFFICERS/ HEALTH SERVICES MANAGERS





## 4 PUBLIC HEALTH OFFICERS/HEALTH SERVICES MANAGERS

This section is devoted to those health workers such as public health officers or health services managers who, by their grade level or experience, are in positions of leadership and responsibility. They may include personnel from the prescribing and non-prescribing occupational groups. Such personnel may have a management portfolio in antimicrobial resistance control programmes that includes supervisory/line management of other personnel as well as the handling of budgetary responsibilities. This curriculum provides the broadest possible scope (including awareness of and interaction with the multisectoral or “One Health” approach to antimicrobial resistance) and will need to be adapted to local conditions of practice across all levels of care.

### 4.1 Curriculum guide for public health officers/health services managers

#### Modular outline

##### A. Foundations that build awareness of antimicrobial resistance

4.1 A1 Importance of institutional structure and processes to tackle antimicrobial resistance

##### B. Appropriate use of antimicrobial agents

4.1 B1 Advocacy, policy and stewardship of antimicrobials: procurement and use

##### C. Infection prevention and control

4.1 C1 Leadership in infection prevention and control: links to prevention of health care-associated infection and effective control of antimicrobial resistance

##### D. Diagnostic stewardship and surveillance

4.1 D1 Leadership in diagnostic stewardship and surveillance

##### E. Ethics, leadership, communication and governance

(Refer to submodule in the curriculum guide for prescribers – 2.1 E1.)

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Note that the learning outcomes and suggested assessment methods (SAMs) in the modules and submodules are categorized as core and additional – the latter are italicized (see Box 3).





## A. Foundations that build awareness of antimicrobial resistance

**Competency statement:** The public health officer/health services manager demonstrates that they have the knowledge and awareness of effective approaches to control antimicrobial resistance, and the skills and attitudes to implement change according to their role and level of training.

### 4.1 A1 Importance of institutional structure and processes to tackle antimicrobial resistance

#### Learning objective

Appreciate importance of a robust structure and processes to achieve effective control of antimicrobial resistance.

Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>• Have awareness of multisectoral approaches to antimicrobial resistance control, as part of a comprehensive One Health approach.</li> </ul>	SAM 1 SAM 8
<ul style="list-style-type: none"> <li>• Understand the role of various operational and governance bodies in antimicrobial resistance control at local, national and international levels.</li> </ul>	SAM 16 SAM 21
<ul style="list-style-type: none"> <li>• Understand the importance of an appropriately trained workforce for implementing an effective antimicrobial resistance control strategy (infection prevention and control nurses, pharmacists, epidemiologists etc.).</li> </ul>	
<ul style="list-style-type: none"> <li>• Have knowledge of the core elements of antimicrobial stewardship and infection prevention and control programmes at national and hospital levels.</li> </ul>	
<ul style="list-style-type: none"> <li>• Understand the need and urgency for investment in infrastructure and resources to tackle antimicrobial resistance, i.e. capacity building in the clinical environment, and for clinical, laboratory, pharmacy, surveillance, infection prevention and control, teaching, training, stewardship and governance.</li> </ul>	
<ul style="list-style-type: none"> <li>• Understand the advantages to the health system of controlling antimicrobial resistance including patient safety, quality of care and economic benefits from cost savings.</li> </ul>	
<ul style="list-style-type: none"> <li>• Understand the need for robust quality standards and policies for all aspects within antimicrobial stewardship processes: clinical, laboratory, pharmacy, surveillance, infection prevention and control, teaching and training and governance.</li> </ul>	
<ul style="list-style-type: none"> <li>• Have knowledge of quality improvement frameworks and evidence-based guidelines and resources for prevention and control of antimicrobial resistance.</li> </ul>	
<ul style="list-style-type: none"> <li>• Understand the importance of investment in high-quality research and development of strategies for antimicrobial resistance control.</li> </ul>	
<ul style="list-style-type: none"> <li>• <i>Understand the need to include control of antimicrobial resistance as an institutional priority with designated leadership and responsible officer(s).</i></li> </ul>	
<ul style="list-style-type: none"> <li>• <i>Understand the need for a multidisciplinary senior management team and the roles and responsibilities of hospital team members involved in antimicrobial resistance including the lead clinician/nurse, lead for infection prevention and control, antimicrobial stewardship programme lead and hospital epidemiologist.</i></li> </ul>	

## Skills

- Demonstrate leadership skills in lobbying for a structure and processes for effective control of antimicrobial resistance. SAM 7  
SAM 14
- Demonstrate cross-sector leadership and ability to build alliances with multisectoral partners, including civil society organizations for antimicrobial resistance control. SAM 15
- Lead the development of an institutional vision and mission statement to reflect commitment to controlling antimicrobial resistance.
- Demonstrate leadership in creating resource allocation or a dedicated budget for control of antimicrobial resistance including a trained workforce.
- Demonstrate leadership skills in assembling and guiding a multidisciplinary taskforce to enable control of antimicrobial resistance.
- Demonstrate leadership in designating appropriate specialists to create evidence-based guidelines/protocols/policies for effective control of antimicrobial resistance.
- Lead or delegate appropriate specialists to undertake quality improvement programmes including training and education in antimicrobial resistance and disseminate results.
- Demonstrate effective communication skills to spread the message of antimicrobial resistance prevention and control to professional colleagues, allied health workers, decision-making bodies and governments.
- Demonstrate clear and succinct report writing skills such as writing concept notes, business cases, options appraisals, funding proposals, situational analyses and other strategic documents, including monitoring and evaluation reports.
- Communicate effectively with relevant audiences regarding the importance of antimicrobial resistance control.
- *Demonstrate the ability to identify and intervene on drivers of antimicrobial resistance outside the health care delivery system.*

## Attitudes

- Show commitment to the cause of effective control of antimicrobial resistance. SAM 6
- Be a champion for effective control of antimicrobial resistance, and change management to align antimicrobial resistance control strategies to evidence-based guidelines and national and relevant international strategies. SAM 14
- Demonstrate willingness to challenge practices, policies and guidelines that are not in line with antimicrobial resistance control strategies.
- Show support for quality improvement programmes and innovative interventions for control of antimicrobial resistance.
- Promote excellence and best practice in antimicrobial resistance control at all levels of the health and social care system.
- Acknowledge the need to balance individuals' need for antimicrobials and the societal need to control antimicrobial resistance.



## B. Appropriate use of antimicrobial agents

**Competency statement:** The public health officer/health services manager demonstrates that they have the knowledge and understanding, according to their field and level of expertise, to facilitate optimal and safe use of antimicrobial agents for management of infections.

### 4.1 B1 Advocacy, policy and stewardship of antimicrobials: procurement and use

Learning objective	
Understand the role of appropriate leadership in advocating for or leveraging resources for antimicrobial procurement and stewardship.	
Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>• Understand the role of legislative and policy reforms for effective antimicrobial resistance control especially in sale, procurement and use of antimicrobials.</li> <li>• Understand the role of vaccination and immunization in antimicrobial resistance control.</li> <li>• Have knowledge of the essential elements of an antimicrobial stewardship programme.</li> <li>• Understand the need for an antimicrobial stewardship team and the need for leadership in creating an appropriate team.</li> <li>• Understand the importance an institutional drug and therapeutics committee (or similar body) and its role in the inclusion of new antimicrobial agents into the formulary.</li> <li>• Understand the need to have an evidence-based and cost-effective strategy for procurement of antimicrobial agents and for their use (including the WHO AWaRe categorization of antimicrobial agents).</li> <li>• Understand the basis of the <i>Good review practices: guidelines for national and regional regulatory authorities</i> in guiding standards for pharmaceutical preparations and medical devices.</li> <li>• Demonstrate an understanding of guideline development and the need for local policies and protocols for antimicrobial prescribing.</li> <li>• Describe the process of governance, audit and quality improvement to review and monitor antimicrobial prescribing.</li> <li>• Understand the importance of recording and measuring antimicrobial consumption and other indicators that assess the appropriateness of prescriptions.</li> </ul>	<p>SAM 1 SAM 20</p>

## Skills

- Effectively support or lead the antimicrobial stewardship committee/team to achieve a successful programme. SAM 4  
SAM 7
- Demonstrate ways to ensure compliance with antimicrobial stewardship policies and treatment guidelines according to local/national policies or by sourcing evidence-based best practice. SAM 10  
SAM 14  
SAM 15
- Demonstrate the ability to interpret data from prescribing audits and translate findings to support antimicrobial resistance control plans.
- Demonstrate the ability to lead a guideline development group or be an active member of the group that translates evidence to policy according to local need.
- Implement/advocate for regulatory or enforcement mechanisms for rational antibiotic use in acute care and community settings.
- Communicate effectively with both public and professionals on rational use of antimicrobials and the essential elements of antimicrobial stewardship.

## Attitudes

- Demonstrate probity and transparency in all matters related to budget and procurement – demonstrate good governance ensuring personal and team accountability for procurement and prescription of antimicrobial agents. SAM 6  
SAM 14
- Promote improvements in immunization coverage and infection prevention and control measures for effective antimicrobial resistance control.
- Encourage an environment of responsibility and accountability for decisions without apportioning blame.
- Encourage and support learning and development in teams.
- Encourage and allocate time for performance of audit and quality improvement activities for personnel.
- Take personal responsibility for procuring the best and most cost-effective products whilst ensuring patient safety.



## C. Infection prevention and control

**Competency statement:** The public health officer/health services manager demonstrates an understanding of the broad principles of infection prevention and control; including the importance of water, sanitation and hygiene (WASH) in health care facilities to reduce and control the spread of antimicrobial resistance.

### 4.1 C1 Leadership in infection prevention and control: links to prevention of health care-associated infection and effective control of antimicrobial resistance

#### Learning objective

Understand the link between infection prevention and control leadership, effective control of antimicrobial resistance and prevention of health care-associated infection.

Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>• Understand the relationship between infection prevention and control, occupational health and patient safety matters in relation to antimicrobial stewardship and control of antimicrobial resistance.</li> <li>• Understand the importance of a dedicated budget for infection prevention and control-related personnel, their professional development and activities.</li> <li>• Understand the economic and humanitarian implications of a lack of adequate funding for infection prevention and control.</li> <li>• Understand the importance of an institutional infection prevention and control and occupational health lead role and policies.</li> <li>• Understand the need for a scientific and evidence-based approach to creating an effective infection prevention and control and occupational health policy.</li> <li>• Understand the importance of quality improvement programmes and audit.</li> <li>• Understand the need for an infection prevention and control committee and its role as one of the governance mechanisms for effective antimicrobial resistance control.</li> <li>• Understand the importance of training and leadership in managing outbreaks, undertaking infection prevention and control inspections, root cause analyses and serious incident investigations – and in interpreting and acting on the results.</li> <li>• Understand the need to develop personnel with skills in building design concepts for health care (through recognized national or international standards).</li> <li>• Understand the importance of guidelines and standards and appropriately trained personnel to undertake risk assessments in key areas including but not limited to the following:               <ul style="list-style-type: none"> <li>○ water, sanitation (including environmental cleaning) and hygienestructures and processes</li> <li>○ ventilation in general and special areas (e.g. operating theatre, pharmacy, for source and protective isolation)</li> <li>○ central sterilization and disinfection service.</li> </ul> </li> <li>• Understand the role of leadership in health technology product procurement and materials management.</li> </ul>	SAM 1 SAM 8 SAM 16 SAM 17 SAM 18 SAM 19 SAM 21

## Skills

- Demonstrate or ensure effective leadership for multimodal infection prevention and control processes and change management. SAM 4  
SAM 7
- Demonstrate leadership (or membership) of the infection prevention and control policy development/review and guideline development/review groups and ability to critically appraise published evidence. SAM 10  
SAM 14  
SAM 15
- Demonstrate effective leadership of incident management, root cause analyses and lessons learned.
- Demonstrate the ability to perform infection prevention and control risk assessments and propose improvements in relevant areas such as WASH.
- Demonstrate the ability to commission new and refurbished premises within the health care environment from an infection prevention and control perspective.
- Demonstrate the ability to lead or enlist dedicated governance leads to analyse and disseminate results of audit and quality improvement programmes and change practices.
- Maintain accurate and detailed records.

## Attitudes

- Show support for implementation of multimodal strategies for effective infection prevention and control and behaviour change. SAM 5  
SAM 6
- Promote an institutional infection prevention and control culture, making it an essential element of routine monitoring and quality improvement strategies – act as a role model for good practice and communicate this effectively. SAM 7  
SAM 14
- Raise visibility and awareness related to infection prevention and control for effective antimicrobial resistance control and aim to achieve institutional excellence in this area.
- Recognize and respect the contribution of all personnel involved in infection prevention and control.
- Show probity and transparency in financial management and in matters related to product procurement.
- Demonstrate willingness to educate and mentor personnel.
- Show willingness to lead, organize and mentor a team to take a project to completion.



## D. Diagnostic stewardship and surveillance

**Competency statement:** The public health officer/health services manager demonstrates an understanding, relevant to their field and level of expertise, of the principles and processes of diagnostic stewardship, surveillance of antimicrobial resistance and antimicrobial stewardship that underpin prophylaxis and treatment guidelines and antimicrobial resistance control strategies.

### 4.1 D1 Leadership in diagnostic stewardship and surveillance

Learning objective	
Understand the importance of leadership for diagnostic stewardship and surveillance.	
Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>• Understand the vital role of diagnostic stewardship and the use of clinical, laboratory and pharmacy data for surveillance of antimicrobial resistance to inform policy interventions.</li> <li>• Understand the importance of data linkage of clinical, laboratory and prescribing data, with patient outcomes to estimate burden of disease caused by antimicrobial resistance.</li> <li>• Understand the different types of antimicrobial resistance surveillance – routine, enhanced, event-based and point prevalence surveys – and how these feed into monitoring and governance systems.</li> <li>• Describe the role of regulatory authorities in maintaining diagnostic test and antimicrobial product assurance.</li> <li>• Understand the importance of IT as a tool for data analysis and the need to invest in IT.</li> <li>• Describe the process for outlining a dedicated budget for trained surveillance personnel and mechanisms for effective surveillance of antimicrobial resistance and antimicrobial consumption.</li> <li>• Understand how surveillance data are interpreted to inform evidence-based and targeted antimicrobial resistance control strategies.</li> <li>• Understand early warning systems for tracking alert organisms to identify clusters and outbreaks early.</li> <li>• Understand the importance of recognizing trends, performing a risk assessment and instigating interventions locally.</li> <li>• Recognize the importance of R&amp;D for improving knowledge and understanding of effective antimicrobial resistance control.</li> <li>• <i>Understand the scope of the WHONET surveillance and other surveillance packages.</i></li> <li>• <i>Have knowledge of current international recommendations for regional, national and global collection, analysis and sharing of antimicrobial resistance surveillance (ANSORP, CAESAR, EARS-NET, GLASS and ReLAVRA networks).</i></li> <li>• <i>Understand how to monitor antimicrobial consumption data (e.g. the European Surveillance of Antimicrobial Consumption Network [ESAC-Net]) and analyse according to WHO AWaRe categorization of antimicrobial agents.</i></li> <li>• <i>Understand the national responsibility as endorsed by WHO in reporting emerging risks as a Public Health Emergency of International Concern under International Health Regulations in matters relating to antimicrobial resistance.</i></li> </ul>	<p>SAM 1 SAM 20</p>

## Skills

- Demonstrate leadership in leveraging financial and IT support and appropriate personnel skills to create a framework for diagnostic stewardship and surveillance of antimicrobial resistance and antimicrobial consumption. SAM 7  
SAM 10  
SAM 14
- Demonstrate decision-making skills based on reported trends from data generated through antimicrobial resistance and antimicrobial consumption surveillance and antimicrobial stewardship. SAM 15
- Demonstrate the ability to perform a risk assessment based on antimicrobial resistance and antimicrobial consumption surveillance data, to trigger local incident response and management.
- Be able to escalate serious incidents upwards and participate in international reporting of risk as required by the International Health Regulations.
- Take the lead in setting up and monitoring quality improvement programmes based on antimicrobial resistance and antimicrobial consumption surveillance data.
- Demonstrate the ability to translate complex antimicrobial resistance and antimicrobial consumption surveillance data and communicate effectively with a range of audiences such as policy-makers, providers of health services and government entities.

## Attitudes

- Establish a culture of regular dissemination of information from surveillance reports to facility personnel to enable evidence-based interventions. SAM 5  
SAM 6
- Show support and respect the skills and remit of health workers involved in stewardship and surveillance.
- Be a champion for robust antimicrobial resistance surveillance, diagnostic and antimicrobial stewardship and communicate this effectively.
- Be approachable as a manager to troubleshoot and take appropriate decisions in an atmosphere that does not apportion blame.





# 5. HEALTH WORKERS IN SUPPORTIVE CARE ROLES





## 5. HEALTH WORKERS IN SUPPORTIVE CARE ROLES

This section is devoted to providing learning content for health workers requiring introductory/basic antimicrobial resistance competencies to understand and perform their roles effectively. At this stage concepts are introduced to enhance the learner's knowledge base and to lay a foundation for subsequent stages of learning where the same concepts may be addressed at greater depth. The level of detail taught in these modules will need to be adjusted to the level of the learner or health worker audience.

### Box 4. Health workers in supportive care roles

This curriculum caters to health workers in supportive patient management roles outside of the four other main groups described in this document – antimicrobial prescribers, nurses/midwives, pharmacists, laboratory scientists and public health officers/health services managers.

Health workers for which this curriculum can be tailored may include mid-level health professionals, community health workers and auxiliary health workers in care facilities and communities.

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### 5.1 Curriculum guide for health workers in supportive care roles

#### Modular outline

#### A. Foundations that build awareness of antimicrobial resistance

- 5.1 A1 Basic biology of bacteria, viruses, fungi and parasites; host-pathogen relationships
- 5.1 A2 Common infection syndromes: community and hospital acquired
- 5.1 A3 Antimicrobial agents, emergence and threat of antimicrobial resistance

#### B. Appropriate use of antimicrobial agents

- 5.1 B1 Introduction to antimicrobial agents

#### C. Infection prevention and control

- 5.1 C1 Infection prevention and control: roles and responsibilities
- 5.1 C2 Infection prevention and control: basic principles and practice

#### D. Diagnostic stewardship and surveillance

- 5.1 D1 Diagnostic stewardship, surveillance and antimicrobial stewardship

#### E. Ethics, leadership, communication and governance

(Refer to submodule in the curriculum guide for prescribers – 2.1 E1.)



Note that the learning outcomes and suggested assessment methods (SAMs) in the modules and submodules are categorized as core and additional – the latter are italicized (see Box 3).



## A. Foundations that build awareness of antimicrobial resistance

**Competency statement:** The health worker demonstrates basic knowledge and awareness of antimicrobial resistance and their expected role (according to training and level of expertise) in contributing to effective management and control plans.

### 5.1 A1 Basic biology of bacteria, viruses, fungi and parasites; host-pathogen relationships

Learning objective	
Understand the basic biology of potential disease-causing microorganisms in humans, and their mechanisms of infection.	
Knowledge	SAM (suggested assessment method)
<ul style="list-style-type: none"> <li>Understand the basic knowledge of microorganisms, i.e. bacteria, viruses, fungi and parasites.</li> <li>Understand the relevance of the nature of microorganisms to how antimicrobial therapy works.</li> <li>Understand host-microorganism-environment associations.</li> <li><i>Understand host-microorganism relationships including the importance of normal flora and that some organisms can be carried by the host without symptoms.</i></li> <li><i>Understand principles of active and passive immunization.</i></li> </ul>	SAM 1
Skills	
<ul style="list-style-type: none"> <li>Demonstrate application of knowledge of microorganisms and their properties to the principles of infection management according to role.</li> <li><i>Demonstrate application of knowledge to role-appropriate decision-making.</i></li> </ul>	SAM 2 SAM 3 SAM 7
Attitudes	
<ul style="list-style-type: none"> <li>Show an enthusiastic approach to learning.</li> <li>Demonstrate willingness to learn from other students or colleagues irrespective of grade and level.</li> <li>Demonstrate willingness to communicate with, guide, inform and educate other co-workers.</li> </ul>	SAM 7

## 5.1 A2 Common infection syndromes: community and hospital acquired

### Learning objective

Demonstrate awareness of the causes, presentation, principles of investigation and management of community and health care-associated infections.

Knowledge	SAM (Suggested assessment method)
<ul style="list-style-type: none"> <li>• Have introductory knowledge (incorporating modes of spread, risk factors, presentation, investigations, and principles of treatment, prevention and control) of key clinical syndromes including community-acquired and health care-associated infections.               <ul style="list-style-type: none"> <li>○ Community-acquired infections such as respiratory tract, skin and soft tissue, urinary tract, bone and joint, gastrointestinal tract, sexually transmitted infections, meningitis and sepsis.</li> <li>○ Hospital-acquired infection such as surgical site infection, urinary tract infection, hospital-acquired pneumonia, device-related infections and sepsis.</li> </ul> </li> <li>• Understand the role of the laboratory in diagnosing infection and guiding treatment.</li> <li>• Introduce the concept of evidence-based protocols for infection management.</li> </ul>	SAM 1 SAM 3
<b>Skills</b>	
<ul style="list-style-type: none"> <li>• Demonstrate application of knowledge of infection syndromes and infection management according to learner or health worker role.</li> </ul>	SAM 2 SAM 4 SAM 7
<b>Attitudes</b>	
<ul style="list-style-type: none"> <li>• Show commitment to maintaining patient confidentiality.</li> <li>• Maintain a non-judgemental attitude to patients with infectious diseases.</li> <li>• Demonstrate willingness to work and learn in a multidisciplinary team.</li> <li>• Demonstrate willingness to communicate, guide, inform and educate other co-workers.</li> </ul>	SAM 5 SAM 6 SAM 7



### 5.1 A3 Antimicrobial agents, emergence and threat of antimicrobial resistance

<b>Learning objective</b>	
Appreciate the concept of antimicrobial resistance and its threat to human health and the properties of antimicrobial agents.	
<b>Knowledge</b>	<b>SAM</b> (Suggested assessment method)
<ul style="list-style-type: none"> <li>Understand the role of livestock, food and the environment in acquisition and spread of antimicrobial resistance.</li> <li>Understand common methods of spread of antimicrobial resistance among people.</li> <li>Acquire a basic understanding of common antimicrobial agents, i.e. broad- and narrow-spectrum agents.</li> <li>Understand how microorganisms (especially bacteria) evolve to become resistant to antimicrobial agents.</li> <li>Describe the main risk factors for the development antimicrobial resistance.</li> <li>Understand the scale of antimicrobial resistance among common pathogens globally and implications for patient care.</li> <li>Understand the consequences of antimicrobial resistance in terms of economic burden, patient morbidity and mortality.</li> </ul>	<p>SAM 1 SAM 9 SAM 8</p>
<b>Skills</b>	
<ul style="list-style-type: none"> <li>Demonstrate application of knowledge on antimicrobial resistance in reducing the development and spread of resistance.</li> <li>Demonstrate the use of treatment guidelines and evidence-based literature and translate this into decision-making according to role.</li> </ul>	<p>SAM 7 SAM 10 SAM 11</p>
<b>Attitudes</b>	
<ul style="list-style-type: none"> <li>Demonstrate commitment to preserving antimicrobial agents and decreasing the development of resistance.</li> <li>Show willingness to communicate with peers, patients and the public regarding the threat of antimicrobial resistance.</li> <li>Be an antimicrobial champion and guardian to protect the effectiveness of antimicrobial agents as an ethical imperative for the common good.</li> </ul>	<p>SAM 5 SAM 6 SAM 7</p>

## B. Appropriate use of antimicrobial agents

**Competency statement:** The health worker demonstrates that they have the knowledge and understanding, according to their field and level of expertise, to contribute to optimal and safe use of antimicrobial agents.

### 5.1 B1 Introduction to antimicrobial agents

Learning objective	
Understand the rational use of antimicrobial agents based on evidence or relevant existing policies.	
Knowledge	SAM (Suggested assessment method)
<ul style="list-style-type: none"> <li>• Understand how the development of antimicrobial agents have improved chances of survival from common bacterial infections, e.g. pneumonia.</li> <li>• Understand that antimicrobial agents should only be used to treat bacterial infections, not for the common cold and other viral infections.</li> <li>• Understand that antimicrobial agents should be prescribed and used according to evidence-based treatment guidelines.</li> <li>• Understand the importance of only using antimicrobial agents prescribed by a qualified health care professional.</li> <li>• Understand the role of a multidisciplinary team, including the doctor, pharmacist, the nurse/midwife and the laboratory scientist, to achieve appropriate antimicrobial prescribing.</li> <li>• <i>Understand the use of the WHO strategy for optimizing use of antimicrobial agents: Access, Watch and Reserve (AWaRe) groups in preventing development of resistance and the WHO Model list of essential medicines (including the EML list for children).</i></li> <li>• <i>Understand the risk of using antimicrobial agents including development of resistance.</i></li> </ul>	<p>SAM 1 SAM 9</p>
Skills	
<ul style="list-style-type: none"> <li>• Demonstrate application of knowledge in handling antimicrobial agents according to learner or health worker role.</li> </ul>	<p>SAM 7 SAM 10</p>
Attitudes	
<ul style="list-style-type: none"> <li>• Show willingness to participate in quality improvement programmes including feedback exercises.</li> <li>• <i>Demonstrate commitment to preserving antimicrobial agents and decreasing the development and spread of resistance.</i></li> <li>• <i>Show willingness to communicate with peers, patients and the public regarding the threat of antimicrobial resistance.</i></li> <li>• <i>Be an antimicrobial champion and guardian to protect the effectiveness of antimicrobial agents as an ethical imperative for the common good.</i></li> </ul>	<p>SAM 5 SAM 6 SAM 7</p>



## C. Infection prevention and control

**Competency statement:** The health worker is able to effectively contribute to infection prevention and control, and reduce the spread of infections and antimicrobial resistance.

### 5.1 C1 Infection prevention and control: roles and responsibilities

Learning objective	
Demonstrate awareness of institutional infection prevention and control framework and policies.	
Knowledge	SAM (Suggested assessment method)
<ul style="list-style-type: none"> <li>Understand the roles and responsibilities of the infection prevention and control lead, infection prevention and control nurse/s and other infection prevention and control team members.</li> <li>Understand that every health worker is responsible for infection prevention and control.</li> <li>Understand the need for adhering to local infection prevention and control policy document or strategy.</li> <li><i>Have awareness of institutional responsibility for maintenance of infection prevention and control – through leadership and policy.</i></li> <li><i>Have knowledge of sources of information and guidelines, i.e. local or relevant international documents, guidelines, recommendations.</i></li> <li><i>Understand the role of infection prevention and control in patient safety and the links between infection prevention and control and risk of acquisition and spread of antimicrobial resistance.</i></li> </ul>	SAM 1
Skills	
<ul style="list-style-type: none"> <li><i>Demonstrate the ability to follow infection prevention and control information from local infection prevention and control leads, policy documents and international guidelines.</i></li> </ul>	SAM 2 SAM 3 SAM 7
Attitudes	
<ul style="list-style-type: none"> <li>Demonstrate adherence to the good infection prevention and control practice.</li> <li>Show willingness to take advice and accept constructive input from infection prevention and control team members.</li> <li>Demonstrate willingness to communicate with, guide, inform and educate colleagues or co-workers about infection prevention and control.</li> </ul>	SAM 5 SAM 6 SAM 7

## 5.1 C2 Infection prevention and control: basic principles and practice

### Learning objective

Understand basic principles and practice of infection prevention and control: importance and compliance.

Knowledge	SAM (Suggested assessment method)
<ul style="list-style-type: none"> <li>• Understand the concept of aseptic no touch technique (ANTT) and the management of re-usable and disposable instruments and personal protective equipment.</li> <li>• Explain the importance of water, sanitation and hygiene (WASH) and safe disposal of waste.</li> <li>• Understand the importance of occupational health and immunization for health workers.</li> <li>• Understand the concept of the “chain of infection”, including:               <ul style="list-style-type: none"> <li>○ pathogen or infectious agent</li> <li>○ reservoir (patient, health care worker, environment)</li> <li>○ portal of exit</li> <li>○ portal of entry</li> <li>○ mode of transmission</li> <li>○ <i>susceptible host risk factors</i>.</li> </ul> </li> <li>• Describe the components included in standard precautions for infection prevention and control:               <ul style="list-style-type: none"> <li>○ hand hygiene</li> <li>○ use of personal protective equipment (e.g. gloves, gowns, masks)</li> <li>○ prevention of sharps injuries</li> <li>○ safe handling of potentially contaminated equipment/surfaces and waste in the patient environment</li> <li>○ environmental cleaning</li> <li>○ respiratory hygiene/cough etiquette.</li> </ul> </li> <li>• <i>Understand the concept of transmission-based precautions: source and protective isolation (or cohorting for individuals carrying the same infection) and contact, droplet and airborne precautions.</i></li> </ul>	<p>SAM 1</p>
<h4 data-bbox="231 1355 295 1388">Skills</h4> <ul style="list-style-type: none"> <li>• Demonstrate ability to practise hand hygiene following local guidelines and/or WHO recommendations.</li> <li>• Apply and remove personal protective equipment appropriately.</li> <li>• Demonstrate compliance with all standard and transmission-based precautions.</li> <li>• Demonstrate an understanding of when to contact an infection prevention and control professional for expertise and advice.</li> <li>• <i>Demonstrate the ability to identify risk including the potential for transmission of infection and report to the appropriate lead.</i></li> <li>• <i>Demonstrate performing procedures safely and using ANTT.</i></li> </ul>	<p>SAM 7 SAM 10 SAM 12</p>
<h4 data-bbox="231 1724 343 1758">Attitudes</h4> <ul style="list-style-type: none"> <li>• Demonstrate willingness to take advice and correction from infection prevention and control specialists.</li> <li>• Demonstrate personal responsibility and commitment to all aspects of infection prevention and control in hospital and community settings.</li> <li>• Demonstrate high standards of hand hygiene discipline.</li> <li>• Self-declare and abstain from patient contact if suffering from conditions such as rashes, sunburn, weeping sores, broken skin, conjunctivitis or respiratory or gastrointestinal infections.</li> <li>• Be a role model for colleagues and students.</li> </ul>	<p>SAM 7</p>





## D. Diagnostic stewardship and surveillance

**Competency statement:** The health worker demonstrates elementary understanding, relevant to their occupational field and level of expertise, of the principles and processes of diagnostic stewardship, surveillance of antimicrobial resistance and antimicrobial use and antimicrobial stewardship.

### 5.1 D1 Diagnostic stewardship, surveillance and antimicrobial stewardship

Learning objective	
Understand the importance of multidimensional and interprofessional coordination for optimal control of the emergence and spread of antimicrobial resistance.	
Knowledge	SAM (Suggested assessment method)
<ul style="list-style-type: none"> <li>Understand the concept of diagnostic stewardship as an important element of antimicrobial stewardship.</li> <li><i>Understand that a quality-assured laboratory is vital to ascertain the identification of the organism and its susceptibility so as to inform antimicrobial management and contribute to antimicrobial resistance surveillance.</i></li> <li><i>Understand the concept of antimicrobial stewardship, i.e. all coherent actions to promote responsible use of antimicrobials including prescription of the right drug in the right dose by the right route at the right time and for the right duration to achieve optimal patient outcomes.</i></li> <li><i>Understand the importance of collecting antimicrobial resistance and antimicrobial consumption data to enable effective surveillance and inform treatment guidelines.</i></li> <li><i>Be aware of existing surveillance networks and what information they provide. They could include the following: ANSORP, CAESAR, EARS-NET, GLASS and ReLAVRA.</i></li> <li><i>Understand the association between diagnostic stewardship, surveillance and antimicrobial stewardship to achieve optimum antimicrobial use.</i></li> </ul>	<p>SAM 1 SAM 9</p>
Skills	SAM (Suggested assessment method)
<ul style="list-style-type: none"> <li><i>Demonstrate ability to source information from evidence-based treatment guidelines and appreciate the limitations regarding local use.</i></li> <li><i>Demonstrate how information is sourced from existing surveillance networks, i.e. ANSORP, CAESAR, EARS-NET, GLASS and ReLAVRA.</i></li> </ul>	<p>SAM 7 SAM 13</p>
Attitudes	SAM (Suggested assessment method)
<ul style="list-style-type: none"> <li>Commitment to maintain patient confidentiality and data protection regulations.</li> <li>Be meticulous with record-keeping and documentation.</li> <li>Show willingness to participate in quality improvement programmes.</li> <li>Demonstrate a willingness to work in multidisciplinary teams.</li> <li>Be an antimicrobial champion and guardian to protect the effectiveness of antimicrobial agents as an ethical imperative for the common good.</li> </ul>	<p>SAM 6 SAM 7</p>

# ANNEX 1. STRENGTHENING EDUCATORS' COMPETENCIES

An educator is a trainer or member of an academic faculty who is appropriately trained to be responsible for the overall teaching, management and supervision of students' or trainees' trajectory of learning during a period of time. Accordingly, it is important that the competencies to be taught to or instilled in the learners, whether prescribers of antimicrobials or other groups (see *WHO Competency framework for health workers' education and training on antimicrobial resistance*) (19), are understood, already acquired, maintained and practised by the educators who will be discharging these curricula. The level of appropriate training needed to deliver curricula to pre-service students or in-service learners will vary from setting to setting. Other prerequisites should include affiliation to a faculty position that is tied to an accredited health education and training institution. These foundational requirements will enable the educator to guide the student or trainee to achieve agreed learning outcomes. Educators are responsible for bringing together all relevant evidence to form a summative judgement at the end of the training period.

Educators must be experienced in their role, be occupationally competent, and familiar with the modules/programmes they will be facilitating. They should have the ability and commitment to meet with trainees regularly and reflect and receive feedback on their supervision and teaching. The educator is required to offer support, guidance and feedback to the trainee whilst they undertake their learning and assessment and to facilitate the implementation of their learning within their workplace (applies to in-service training).

Educators should undertake regular performance evaluation and work towards meeting their own professional requirements as trainers. The seven areas, briefly described below, are modified from leading professional development frameworks for educators (18, 55).

## 1. Ensuring safe and effective care through training

This area relates to how an educator ensures that learners are competent to provide individuals and communities with quality care. Educating learners to cater for patients, especially those who require the prescription of antimicrobials as part of their management, could be delivered using case-based teaching. For in-service training, the service delivery needs are balanced with the appropriate methods of delivering the required education. Once learners have undertaken appropriate induction (this may include the validation of their competencies through an assessment method), they work under supervision appropriate to their level of training. This allows learners, when suitably competent, to take responsibility for care (including providing culturally competent care), appropriate to the needs of the patient.



## 2. Establishing and maintaining an environment for learning

This area focuses on how the educator makes the health care environment safe and conducive to effective learning. Educators should encourage participation through provision of equity of opportunity and acknowledgement of diversity. This should be delivered in an intellectually stimulating environment and without fear of criticism. Educators should ensure learners receive the necessary instruction and protection in situations that might expose them to risk (as in the laboratory). The learning environment and resources should be suitable for the programme. The educator should be open, approachable and available, and maintain good interpersonal relationships with learners and colleagues. In-service training should ensure that trainees have protected time for learning.

## 3. Teaching and facilitating learning

This area deals with how educators work with learners to facilitate their learning. Educators need to have up-to-date subject knowledge and/or skills, provide direct guidance on clinical work, where appropriate, and have effective educational, facilitation, supervisory and communication skills. The learning and teaching episodes should be planned and use a range of appropriate teaching interventions in the health care setting. The trainee should be helped to develop the ability for self-directed learning.

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## 4. Enhancing learning through assessment

This area discusses the educator's approach to assessment and feedback. Educators should regularly observe the learner's performance and offer feedback. They should plan a range of formative and summative assessments and use workplace-based assessments (formative and summative) appropriately. Educators should provide feedback that is clear, focused and aimed at improving specific aspects for the trainee. The educator should provide support through mock exams, exercises and scenarios in preparation for examinations.

## 5. Supporting and monitoring educational progress

This area explores the support educators provide to learners in their progression towards completion of training and their intended career destination. The educator needs to understand the curriculum requirements of the discipline and stage of training and identify learning needs and set educational objectives. They should involve the trainee in this process by establishing and discussing the learners' expectations for the course ahead. Learners should also be encouraged to shape training where possible.

## **6. Guiding personal and professional development**

This area looks at the support educators provide to trainees in relation to their personal and professional development. They need to act as positive role models, have effective communication skills, be able to set and maintain appropriate boundaries and understand when they may have to refer a trainee to other agencies such as occupational health, counselling and other pastoral care amenities.

## **7. Continuing professional development as an educator**

This area describes the educator's own professional development as a health care educator. This is accomplished by self-reflection and through peer and student feedback. They should maintain their professional practice in line with local specialty and regulatory requirements.



## ANNEX 2. UNDERTAKING AN INSTITUTIONAL ANTIMICROBIAL RESISTANCE CURRICULA REVIEW

While this set of curricula may be applied directly in its current format, users are strongly encouraged to take an adaptive approach to selecting and designing their local content to increase efficiency and relevance (56). This section is intended to provide a brief outline of how decision-makers, likely educators and faculties may go about developing their own AMR curricula or incorporate content from this curricula guide within competency-based education and training modules in a socially accountable manner and according to their contextual needs and priorities. Other users, such as health education regulatory institutions or accreditation bodies, may use the curricula to guide the development of norms and standards for occupational roles or the delivery of AMR education and training. Use under such circumstances may follow a different process altogether though the approach described in Box 5 is more relevant to academic education and training institutions.

## Box 5. Suggested stepwise approach to antimicrobial resistance curricula review

1. Conduct a situational analysis and understand your local context. This could include details on the local burden of AMR, a general assessment of the competency requirements expected of health workers (see the *WHO Competency framework for health workers' education and training on antimicrobial resistance*) (19), typical roles and tasks that the health worker will need to carry out, and faculty and institutional capacity (including financial and human resources) needed to provide education and training to learners.
2. Identify relevant stakeholders and establish a coordinating group. Ideally, the coordinating group should be multidisciplinary and include representation from students or the learning audience.
3. Conduct curriculum review/development using relevant sections of this guide:
  - Outline your overall objectives and goals according to your context.
  - Define and agree on the methodology or process of local content review and adaptation. For example, if AMR content is currently being taught within the context of multiple programmes or faculties within an institution, the coordination group or leader may want to identify how best to embed the modules/submodules in these programmes.
  - Decide on the target audience of learners, e.g. pre-service students, pre-service interprofessional groups, in-service prescribers and other in-service health care professionals.
  - Assess existing local curriculum content and compare with this curriculum guide to identify where gaps exist or areas needing modification. Attribute learning objectives as may be relevant to pre- and in-service learners. Note the core and additional learning outcomes (as detailed in italics in each submodule) and suggested assessment methods.
  - Define syllabus contents: learning objectives, amount of time needed to deliver the full course and attribute weights to learning objectives, as necessary.
  - Determine what method(s) of assessment apply best to your learning audience.
  - Outline learning resources to be used including additional reading materials, text books etc.
4. Outline teaching or instruction plans and strategies as well as a time frame for review of the curriculum.
5. Conduct a post-learning impact review of the curriculum with a view to improving the curriculum.

## GLOSSARY

**Antimicrobial:** An agent or substance, derived from any source (microorganisms, plants, animals, synthetic or semisynthetic compounds), that acts against any type of microorganism such as bacteria (antibacterial), mycobacteria (antimycobacterial), fungi (antifungal), parasite (antiparasitic) and viruses (antiviral). All antibiotics are antimicrobials, but not all antimicrobials are antibiotics.

**Antimicrobial resistance:** The ability of microorganisms (such as bacteria, fungi, viruses and parasites) to multiply or persist in the presence of an increased level of an antimicrobial agent (such as antibiotics, antifungals, antivirals, antimalarials and anthelmintics) relative to the susceptible counterpart of the same species.

**Antimicrobial stewardship:** A coherent set of actions which promotes using antimicrobials responsibly. It embodies an organizational or health system-wide approach to promote and monitor the appropriate use of antimicrobials to maximize both their current and future effectiveness.

**Apprenticeship:** Allows health workers or trainees to be assigned to clinical or other skilled roles to learn and improve their competencies while gaining work experience at the same time. Apprenticeships also provide opportunities to assess the health worker's understanding and this can be done in a formative or summative manner.

**Cohorting:** A process by which a group of patients (cohort) with the same infection are placed together. Cohorts are created based on clinical diagnosis, microbiological confirmation when available, epidemiology and mode of transmission of the infectious agent.

**Competencies:** A combination of knowledge, skills, motives and personal traits, development of which should help individuals to continually improve their performance and work more effectively.

**Curriculum:** A set of learning goals articulated according to expected health worker roles that outline the intended content and process goals of learning at points in time and throughout a career. These goals, in the context of learning about AMR, are relevant at both personal and societal level.

**Diagnostic stewardship:** The coordination of guidance and interventions to improve appropriate use of microbiological diagnostics to guide therapeutic decisions. It should promote appropriate, timely diagnostic testing, including specimen collection, and pathogen identification and accurate, timely reporting of results to guide patient treatment. Diagnostic stewardship is a vital component of overall antimicrobial stewardship actions aimed at ensuring the responsible use of antimicrobials.

**Directly observed procedures:** An evidence-based assessment method used to guide trainee learning and competency development. It involves the performance of a procedure or skill by the trainee under the observation of an assessor to facilitate feedback and trainee development.

**Health workers:** All people engaged in actions whose primary intent is to enhance health.

**Infection prevention and control:** A pragmatic scientific approach designed to prevent harm caused by infections to patients and health workers.

**In-service training:** Training received while one is employed; usually undertaken after the post-registration phase for health care professionals. The aim is to reinforce existing competencies or equip the learner with additional competencies to deliver specific interventions.

**Interprofessional education:** Faculty and students from two or more health professions engaged in learning with, from and about each other in some or all components of curricula, including the practical elements, to enable effective collaboration and improve health outcomes.

**Learning objective:** As applied in this tool, the main statement goal outlining what students/trainees should be able to perform competently upon completion of the respective module or submodule.

**Module:** As applied in this tool, refers to all the learning objectives and outcomes under any singular domain in any of the curricula.

**Multisource feedback:** Multisource feedback is a peer evaluation method that collects information about clinical performance and professional behaviour and is often used in workplace-based assessment of clinical health workers.

**Prescribers:** All health care professionals qualified by training and allowed by regulation to prescribe antimicrobials. In addition to physicians of all specialties and dental practitioners, the term may apply to *inter alia* prescribing nurses and pharmacists, clinical microbiologists, midwives, optometrists, podiatrists and other health care professionals, depending on local regulations and scope of practice.

**Reflective portfolio:** A set of writings that summarizes the insights and experiences a student has gained from practical assignments.

**Socially accountable education:** The responsibility to direct education, research and service activities towards addressing the priority health concerns of the community, region and/or nation mandated to be served.

**Submodule:** As applied in this tool, refers to a singular learning objective under a module and the learning outcomes contained thereunder.

**Training portfolio:** Contains a mandated collection of acquired skills and competencies, in a fixed format, with some reflective comments on selected evidence.



## REFERENCES

1. International Bank for Reconstruction and Development/World Bank. Drug-resistant infections: a threat to our economic future. Washington (DC): World Bank; 2017 (<http://www.worldbank.org/en/topic/health/publication/drug-resistant-infections-a-threat-to-our-economic-future>, accessed 18 June 2019).
2. Ntirenganya C, Muvunyi CM, Manzi O, Ogbuagu O. High prevalence of antimicrobial resistance among common bacterial isolates in a tertiary healthcare facility in Rwanda. *Am J Trop Med Hyg.* 2015;92(4):865–70 (<http://www.ajtmh.org/content/journals/10.4269/ajtmh.14-0607>, accessed 18 June 2019).
3. Dyar OJ, Pulcini C, Howard P, Nathwani D, ESGAP (ESCMID [European Society of Clinical Microbiology, Infectious Diseases] Study Group for Antibiotic Policies). European medical students: a first multicentre study of knowledge, attitudes and perceptions of antibiotic prescribing and antibiotic resistance. *J Antimicrob Chemother.* 2014;69(3):842–6 (<http://www.ncbi.nlm.nih.gov/pubmed/24191307>, accessed 18 June 2019).
4. Dyar OJ, Howard P, Nathwani D, Pulcini C, ESGAP (ESCMID [European Society of Clinical Microbiology, Infectious Diseases] Study Group for Antibiotic Policies). Knowledge, attitudes, and beliefs of French medical students about antibiotic prescribing and resistance. *Médecine Mal Infect.* 2013;43(10):423–30 (<http://www.ncbi.nlm.nih.gov/pubmed/24016770>, accessed 18 June 2019).
5. Minen MT, Duquaine D, Marx MA, Weiss D. A survey of knowledge, attitudes, and beliefs of medical students concerning antimicrobial use and resistance. *Microb Drug Resist.* 2010;16(4):285–9 (<http://www.liebertpub.com/doi/10.1089/mdr.2010.0009>, accessed 18 June 2019).
6. Abbo LM, Cosgrove SE, Pottinger PS, Pereyra M, Sinkowitz-Cochran R, Srinivasan A et al. Medical students' perceptions and knowledge about antimicrobial stewardship: how are we educating our future prescribers? *Clin Infect Dis.* 2013;57(5):631–8 (<http://www.ncbi.nlm.nih.gov/pubmed/23728148>, accessed 18 June 2019).
7. WHO. Expert consultation meeting on health workforce education and antimicrobial resistance control, 23–24 March 2017. Geneva: World Health Organization; 2017 ([https://www.who.int/hrh/news/2017/expert\\_consultation\\_workforce\\_education\\_amr/en/](https://www.who.int/hrh/news/2017/expert_consultation_workforce_education_amr/en/), accessed 18 June 2019).
8. WHO. Mapping educational opportunities and resources for health-care workers to learn about antimicrobial resistance and stewardship. Human Resources for Health Observer Series, No. 21. Geneva: World Health Organization; 2017 (<https://apps.who.int/iris/bitstream/handle/10665/259362/9789241512787-eng.pdf;jsessionid=93C96726D691F5659248A56620C5AB72?sequence=1>, accessed 18 June 2019).
9. WHO. Global action plan on antimicrobial resistance. Geneva: World Health Organization; 2015 ([http://apps.who.int/iris/bitstream/10665/193736/1/9789241509763\\_eng.pdf?ua=1](http://apps.who.int/iris/bitstream/10665/193736/1/9789241509763_eng.pdf?ua=1), accessed 18 June 2019).

10. WHO. Global strategy on human resources for health: workforce 2030. Geneva: World Health Organization; 2016 (<https://apps.who.int/iris/bitstream/handle/10665/250368/9789241511131-eng.pdf?sequence=1>, accessed 18 June 2019).
11. WHO. Factsheet on antimicrobial resistance [website]. Geneva: World Health Organization; 2018 (<http://www.who.int/mediacentre/factsheets/fs194/en/>, accessed 18 June 2019).
12. Dyar OJ, Huttner B, Schouten J, Pulcini C, ESGAP (ESCMID [European Society of Clinical Microbiology, Infectious Diseases] Study Group for Antimicrobial Stewardship). What is antimicrobial stewardship? *Clin Microbiol Infect*. 2017;23(11):793–8 (<http://www.ncbi.nlm.nih.gov/pubmed/28882725>, accessed 18 June 2019).
13. WHO. Transforming and scaling up health professionals' education and training. Geneva: World Health Organization; 2013 ([https://www.who.int/hrh/resources/transf\\_scaling\\_hpet/en/](https://www.who.int/hrh/resources/transf_scaling_hpet/en/), accessed 18 June 2019).
14. Gauthier TP, Sherman EM, Unger NR. An elective course on antimicrobial stewardship. *Am J Pharm Educ*. 2015;79(10):157 (<http://www.ncbi.nlm.nih.gov/pubmed/26889069>, accessed 18 June 2019).
15. Falcione BA, Meyer SM. Development of an antimicrobial stewardship-based infectious diseases elective that incorporates human patient simulation technology. *Am J Pharm Educ*. 2014;78(8):151 (<http://www.ncbi.nlm.nih.gov/pubmed/25386016>, accessed 18 June 2019).
16. WHO. Antimicrobial stewardship: a competency-based approach [website]. Geneva: World Health Organization; 2018 (<https://openwho.org/courses/AMR-competency>, accessed 18 June 2019).
17. Kyaw BM, Tudor Car L, van Galen LS, van Agtmael MA, Costelloe CE, Ajuebor O et al. Health professions digital education on antibiotic management: a systematic review and meta-analysis by the Digital Health Education Collaboration. *J Med Internet Res*. 2019. doi 10.2196/14984.
18. HEE. HEE Quality framework 2016/17. Leeds: Health Education England; 2016 ([https://www.eastmidlandsdeanery.nhs.uk/sites/default/files/14696067832\\_quality\\_framework.pdf](https://www.eastmidlandsdeanery.nhs.uk/sites/default/files/14696067832_quality_framework.pdf), accessed 18 June 2019).
19. WHO. WHO Competency framework for health workers' education and training on antimicrobial resistance. Geneva: World Health Organization; 2018 (<https://apps.who.int/iris/bitstream/handle/10665/272766/WHO-HIS-HWF-AMR-2018.1-eng.pdf?ua=1>, accessed 18 June 2019).
20. PHE. Antimicrobial prescribing and stewardship competencies. London: Public Health England; 2013 ([https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/253094/ARHAIprescrcompetencies\\_\\_2\\_.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/253094/ARHAIprescrcompetencies__2_.pdf), accessed 18 June 2019).
21. Khan KZ, Ramachandran S, Gaunt K, Pushkar P. The objective structured clinical examination (OSCE): AMEE Guide No. 81. Part I: an historical and theoretical perspective. *Med Teach*. 2013;35(9):e1437–46 (<http://www.ncbi.nlm.nih.gov/pubmed/23968323>, accessed 18 June 2019).



22. WHO. Patient safety curriculum guide. Multi-professional edition. Geneva: World Health Organization; 2011 ([http://apps.who.int/iris/bitstream/10665/44641/1/9789241501958\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/44641/1/9789241501958_eng.pdf), accessed 19 June 2019).
23. National Centre for Antimicrobial Stewardship. Training framework for antimicrobial stewardship program implementation for the Western Pacific Region. Melbourne, Australia: National Centre for Antimicrobial Stewardship; 2016.
24. Cosgrove SE, Hermsen ED, Rybak MJ, File TM Jr, Parker SK, Barlam TF et al. Guidance for the knowledge and skills required for antimicrobial stewardship leaders. *Infect Control Hosp Epidemiol.* 2014;35(12):1444–51 (<http://www.ncbi.nlm.nih.gov/pubmed/25419765>, accessed 19 June 2019).
25. Royal Pharmaceutical Society. A competency framework for all prescribers. London: Royal Pharmaceutical Society; 2016 ([https://www.rpharms.com/Portals/0/RPS document library/Open access/Professional standards/Prescribing competency framework/prescribing-competency-framework.pdf](https://www.rpharms.com/Portals/0/RPS%20document%20library/Open%20access/Professional%20standards/Prescribing%20competency%20framework/prescribing-competency-framework.pdf), accessed 19 June 2019).
26. World Federation for Medical Education. Postgraduate medical education: global standards for quality improvement. University of Copenhagen, Denmark: World Federation for Medical Education; 2015 (<https://wfme.org/download/wfme-global-standards-for-quality-improvement-pgme-2015/?wpdmdl=884&refresh=5cd552adddd321557484205>, accessed 19 June 2019).
27. FIP. Pharmacy Education Taskforce: a global competency framework version 1. The Hague, the Netherlands: International Pharmaceutical Federation; 2012 ([https://www.fip.org/files/fip/PharmacyEducation/GbCF\\_v1.pdf](https://www.fip.org/files/fip/PharmacyEducation/GbCF_v1.pdf), accessed 19 June 2019).
28. ECDC. Proposals for EU guidelines on the prudent use of antimicrobials in humans. Solna, Sweden: European Centre for Disease Prevention and Control; 2017 (<https://ecdc.europa.eu/en/publications-data/proposals-eu-guidelines-prudent-use-antimicrobials-humans#no-link>, accessed 19 June 2019).
29. Dyar OJ, Beović B, Pulcini C, Tacconelli E, Hulscher M, Cookson B et al. ESCMID generic competencies in antimicrobial prescribing and stewardship: towards a European consensus. *Clin Microbiol Infect.* 2019;25(1):13–9 (<http://www.ncbi.nlm.nih.gov/pubmed/30414817>, accessed 19 June 2019).
30. ECDC. Core competencies for infection control and hospital hygiene professionals in the European Union. Stockholm, Sweden: European Centre for Disease Prevention and Control; 2013 (<https://ecdc.europa.eu/sites/portal/files/media/en/publications/Publications/infection-control-core-competencies.pdf>, accessed 19 June 2019).
31. IPAC. Infection prevention and control core competencies for health care workers: a consensus document. Winnipeg, Canada: Infection Prevention and Control Canada; 2016 ([https://ipac-canada.org/photos/custom/pdf/HCW\\_Core\\_Competency\\_Category\\_Table-2016November\(2\).pdf](https://ipac-canada.org/photos/custom/pdf/HCW_Core_Competency_Category_Table-2016November(2).pdf), accessed 19 June 2019).

32. Australian Commission on Safety and Quality in Health Care. Antimicrobial stewardship in Australian health care. Chapter 11: Role of the pharmacist and pharmacy services in antimicrobial stewardship. Sydney: Australian Commission on Safety and Quality in Health Care; 2018 (<https://www.safetyandquality.gov.au/wp-content/uploads/2018/04/Chapter11-Role-of-the-pharmacist-and-pharmacy-services-in-antimicrobial-stewardship.pdf>, accessed 20 June 2019).
33. EAHP. Identifying and defining competencies: a clear map for scientific and professional competencies as applied to hospital pharmacy. Brussels: European Association of Hospital Pharmacists; 2011 (<https://www.pharmine.org/wp-content/uploads/2014/05/WP4-Final-report-identifying-and-defining-competences-for-hospital-pharmacists.pdf>, accessed 20 June 2019).
34. ANA. Redefining the antibiotic stewardship team: recommendations from the American Nurses Association/ Centers for Disease Control and Prevention Workgroup on the Role of Registered Nurses in Hospital Antibiotic Stewardship Practices. Silver Springs (MD): American Nurses Association; 2017 (<https://www.cdc.gov/antibiotic-use/healthcare/pdfs/ANA-CDC-whitepaper.pdf>, accessed 20 June 2019).
35. ICN. Position statement: antimicrobial resistance. Geneva: International Council of Nurses; 2009 ([https://www.icn.ch/sites/default/files/inline-files/ICN\\_PS\\_Antimicrobial\\_resistance.pdf](https://www.icn.ch/sites/default/files/inline-files/ICN_PS_Antimicrobial_resistance.pdf), accessed 20 June 2019).
36. RCPATH and JRCPTB. Curriculum for specialty training in medical microbiology incorporating combined infection training, developed in conjunction with the JRCPTB. London: Royal College of Pathologists and Joint Royal Colleges of Physicians Training Board; 2014 ([https://www.gmc-uk.org/-/media/documents/FINAL\\_MICROBIOLOGY\\_CURRICULUM\\_June14.pdf\\_59461137.pdf](https://www.gmc-uk.org/-/media/documents/FINAL_MICROBIOLOGY_CURRICULUM_June14.pdf_59461137.pdf), accessed 20 June 2019).
37. RCN. National curriculum and competency framework. Emergency nursing (level 2). London: Royal College of Nursing; 2017 (<https://www.rcn.org.uk/-/media/royal-college-of-nursing/documents/publications/2017/june/pub-005923.pdf>, accessed 20 June 2019).
38. Courtenay M, Lim R, Castro-Sanchez E, Deslandes R, Hodson K, Morris G et al. Development of consensus-based national antimicrobial stewardship competencies for UK undergraduate healthcare professional education. *J Hosp Infect.* 2018;100(3):245–56 (<https://www.ncbi.nlm.nih.gov/pubmed/29966757>, accessed 20 June 2019).
39. RPS. Infection and antimicrobial stewardship: expert professional curriculum. London: Royal Pharmaceutical Society; 2014 (<http://bsac.org.uk/wp-content/uploads/2014/10/Professional-Curriculum-Infection-and-Antimicrobial-Stewardship.pdf>, accessed 20 June 2019).
40. IBMS. Guidance for candidates, training officers and external verifiers. London: Institute of Biomedical Science; 2017 (<https://www.ibms.org/resources/documents/guidance-for-candidates/>, accessed 20 June 2019).



41. Olans RN, Olans RD, DeMaria A Jr. The critical role of the staff nurse in antimicrobial stewardship – unrecognized, but already there: table 1. Goldstein EJC, editor. *Clin Infect Dis*. 2016;62(1):84–9 (<http://www.ncbi.nlm.nih.gov/pubmed/26265496>, accessed 20 June 2019).
42. WHO. Laboratory Quality Stepwise Implementation tool [website]. Geneva: World Health Organization; 2019 (<https://extranet.who.int/lqsi/content/homepage>, accessed 20 June 2019).
43. WHO. Infection prevention and control. Evidence, guidelines and publications [website]. Geneva: World Health Organization; 2019 (<https://www.who.int/infection-prevention/publications/en/>, accessed 20 June 2019).
44. WHO. WHO Model list of essential medicines (20th list). Geneva: World Health Organization; 2017 ([https://www.who.int/medicines/publications/essentialmedicines/20th\\_EML2017\\_FINAL\\_amendedAug2017.pdf](https://www.who.int/medicines/publications/essentialmedicines/20th_EML2017_FINAL_amendedAug2017.pdf), accessed 20 June 2019).
45. WHO. Critically important antimicrobials for human medicine: ranking of medically important antimicrobials for risk management of antimicrobial resistance due to non-human use. Geneva: World Health Organization; 2016 (<https://apps.who.int/iris/bitstream/handle/10665/255027/9789241512220-eng.pdf?sequence=1>, accessed 20 June 2019).
46. WHO. Diagnostic stewardship: a guide to implementation in antimicrobial resistance surveillance sites. Geneva: World Health Organization; 2016 (<https://apps.who.int/iris/bitstream/handle/10665/251553/WHO-DGO-AMR-2016.3-eng.pdf?sequence=1>, accessed 20 June 2019).
47. WHO. The selection and use of essential medicines 2017. Report of the 21st WHO Expert Committee on the Selection and Use of Essential Medicines. Geneva: World Health Organization; 2017 ([https://www.who.int/medicines/publications/essentialmedicines/EML\\_2017\\_ExecutiveSummary.pdf](https://www.who.int/medicines/publications/essentialmedicines/EML_2017_ExecutiveSummary.pdf), accessed 20 June 2019).
48. Sharland M, Pulcini C, Harbarth S, Zeng M, Gandra S, Mathur S et al. Classifying antibiotics in the WHO Essential medicines list for optimal use-be AWaRe. *Lancet Infect Dis*. 2018;18(1):18–20 (<http://www.ncbi.nlm.nih.gov/pubmed/29303731>, accessed 20 June 2019).
49. Wenzel R, Bearman G, Brewer T, Butzler J-P. A guide to infection control in the hospital (fourth edition). Boston (MA): International Society for Infectious Diseases; 2008 (<http://beta.isid.org/downloads/GuideInfControlHospital4thEd.pdf>, accessed 20 June 2019).
50. ASHP. ASHP statement on the Pharmacy and Therapeutics Committee and the formulary system position. Bethesda (MD): American Society of Health-System Pharmacists; 2008 (<https://www.ashp.org/-/media/assets/policy-guidelines/docs/statements/pharmacy-and-therapeutics-committee-and-formulary-system.ashx>, accessed 20 June 2019).

51. Abazia DT, Anderson P, Azzopardi LM, Baker KR, Besier JL, Bootman JL et al. ASHP statement on the Pharmacy and Therapeutics Committee and the formulary system. *Am J Heal Pharm.* 2008;65(24):2384–6 (<https://academic.oup.com/ajhp/article/65/24/2384/5129503>, accessed 20 June 2019).
52. Martinez-Martinez L, Cantón R, Stefani S, Skov R, Glupczynski Y, Nordmann P et al. EUCAST guidelines for detection of resistance mechanisms and specific resistances of clinical and/or epidemiological importance. European Committee on Antimicrobial Susceptibility Testing; 2017 ([http://www.eucast.org/fileadmin/src/media/PDFs/EUCAST\\_files/Resistance\\_mechanisms/EUCAST\\_detection\\_of\\_resistance\\_mechanisms\\_170711.pdf](http://www.eucast.org/fileadmin/src/media/PDFs/EUCAST_files/Resistance_mechanisms/EUCAST_detection_of_resistance_mechanisms_170711.pdf), accessed 20 June 2019).
53. CLSI. Performance standards for antimicrobial susceptibility testing (29th edition). Wayne (PA): Clinical and Laboratory Standards Institute; 2019.
54. HSE. The Control of Substances Hazardous to Health regulations 2002 (as amended) (sixth edition). United Kingdom of Great Britain and Northern Ireland: Health and Safety Executive; 2013 (<http://www.hse.gov.uk/pubns/priced/l5.pdf>, accessed 20 June 2019).
55. HEE. Professional development framework for educators. Leeds: Health Education England; 2016 (<https://faculty.londondeanery.ac.uk/new-multiprofessional-framework-for-educators/professional-development-framework-for-educators-2018>, accessed 20 June 2019).
56. SIAPS. Revising preservice curriculum to incorporate rational medicine use topics: a guide. Submitted to the US Agency for International Development by the Systems for Improved Access to Pharmaceuticals and Services program. Arlington (VA): Management Sciences for Health; 2013 ([https://www.globalhealthlearning.org/sites/default/files/page-files/AMR%20RMU\\_Preservice-Curriculum-Reform-Final.pdf](https://www.globalhealthlearning.org/sites/default/files/page-files/AMR%20RMU_Preservice-Curriculum-Reform-Final.pdf), accessed 20 June 2019).

**For ease of reference the suggested assessment methods (SAMs) are repeated here.**

The following SAMs are used throughout the curricula and referenced with the code in the second column. In the curricula, the SAMs are not assigned to individual learning outcomes, rather they are grouped together for users to deploy as they wish.

<b>Suggested assessment methods</b>	<b>Code</b>
Written essay/single best answer/multiple choice questions	SAM 1
OSPE or OSCE	SAM 2
Bedside competency assessment	SAM 3
Case-based discussions	SAM 4
One-to-one meetings/guided reflections	SAM 5
Multisource feedback	SAM 6
Apprenticeship	SAM 7
Field/other project report assessment	SAM 8
Written assignments	SAM 9
Simulation exercises	SAM 10
Problem-solving exercises	SAM 11
Directly observed procedures	SAM 12
Assessment of small group discussions	SAM 13
Reflective portfolio	SAM 14
Training portfolio	SAM 15
Critical analysis of literature/data	SAM 16
Report on quality improvement programmes	SAM 17
Root cause analysis report	SAM 18
Serious incident report	SAM 19
Preparation of a report translating evidence to policy	SAM 20
Preparation of: <ul style="list-style-type: none"><li>• concept notes</li><li>• briefing notes</li><li>• options appraisals</li><li>• situation and gap analyses</li><li>• business cases.</li></ul>	SAM 21



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