



Antimicrobial resistance curriculum assessment tool for **medical education**



World Health
Organization

Antimicrobial resistance
curriculum assessment
tool for **medical
education**



World Health
Organization

Antimicrobial resistance curriculum assessment tool for medical education

ISBN 978-92-4-009822-0 (electronic version)

ISBN 978-92-4-009823-7 (print version)

© **World Health Organization 2024.**

Some rights reserved. This work is available under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 IGO licence (CC BY-NC-SA 3.0 IGO; <https://creativecommons.org/licenses/by-nc-sa/3.0/igo>).

Under the terms of this licence, you may copy, redistribute and adapt the work for non-commercial purposes, provided the work is appropriately cited, as indicated below. In any use of this work, there should be no suggestion that WHO endorses any specific organization, products or services. The use of the WHO logo is not permitted. If you adapt the work, then you must license your work under the same or equivalent Creative Commons licence. If you create a translation of this work, you should add the following disclaimer along with the suggested citation: "This translation was not created by the World Health Organization (WHO). WHO is not responsible for the content or accuracy of this translation. The original English edition shall be the binding and authentic edition".

Any mediation relating to disputes arising under the licence shall be conducted in accordance with the mediation rules of the World Intellectual Property Organization (<http://www.wipo.int/amc/en/mediation/rules/>).

Suggested citation. Antimicrobial resistance curriculum assessment tool for medical education. Geneva: World Health Organization; 2024. Licence: [CC BY-NC-SA 3.0 IGO](https://creativecommons.org/licenses/by-nc-sa/3.0/igo).

Cataloguing-in-Publication (CIP) data. CIP data are available at <https://iris.who.int/>.

Sales, rights and licensing. To purchase WHO publications, see <https://www.who.int/publications/book-orders>. To submit requests for commercial use and queries on rights and licensing, see <https://www.who.int/copyright>.

Third-party materials. If you wish to reuse material from this work that is attributed to a third party, such as tables, figures or images, it is your responsibility to determine whether permission is needed for that reuse and to obtain permission from the copyright holder. The risk of claims resulting from infringement of any third-party-owned component in the work rests solely with the user.

General disclaimers. The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by WHO in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

All reasonable precautions have been taken by WHO to verify the information contained in this publication. However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall WHO be liable for damages arising from its use.

Contents

Acknowledgements	iv
Abbreviations	v
Glossary	vi
1 Introduction	1
2 Objectives	1
3 Approach to development	2
4 Setting up curriculum assessment	2
5 Curriculum Assessment Tool	4
5.1 Contextual information	4
5.2 Curriculum content and scope	5
5.3 Institutional readiness assessment	12
6 Remedial measures	14
References	15
Further reading	15

Acknowledgements

The World Health Organization (WHO) would like to thank the many individuals who contributed to development of this tool.

The tool was written by Philip Mathew under the overall guidance of Thomas Joseph (Global Coordination and Partnership Department, AMR Division, WHO)

The following external contributors were involved in drafting the tool:

Sujith John Chandy (ICARS-International Center for Antimicrobial Resistance Solutions, Denmark), Sabiha Essack (University of KwaZulu Natal, South Africa), Li Yang Hsu (National University of Singapore, Singapore), Souha Kanj (American University of Beirut Medical Center, Lebanon), Abhilasha Karkey (Oxford University Clinical Research Unit, Nepal), Nancy Virginia Sandoval Paiz (Hospital Roosevelt de Guatemala, Guatemala) and Arjun Srinivasan (Centers for Disease Control and Prevention, United States of America).

The following experts peer-reviewed the tool: Jaran Eriksen (Karolinska Institutet, Sweden), Marisa Holubar (Stanford University School of Medicine, United States of America), Onur Karatuna (European Union Committee of Antimicrobial Susceptibility Testing Development Laboratory, Sweden) and Direk Limmathurotsakul (Mahidol Oxford Research Unit, Thailand).

The following experts pilot-tested the tool in selected universities: Selam Bogale Gissa (Yekatit 12 Hospital Medical College, Ethiopia), Tadesse Kebede (College of Health Sciences, Addis Ababa University, Ethiopia), Niguse Tsegay (Ayder Comprehensive Specialized Hospital-Mekelle University College of Health Sciences, Ethiopia) and Shewatatek Gedamu Wonde (Jimma University, Ethiopia).

The following WHO staff provided inputs to this document: Onyema Ajuebor (Health Workforce Department), Chad Centner (Surveillance Prevention and Control Department, AMR Division), Stephen Osborne Nurse Findlay (WHO Regional Office for the Americas), Engy Hamed (WHO Regional Office for the Eastern Mediterranean), Benedikt Huttner (Surveillance Prevention and Control Department, AMR Division), Kotoji Iwamoto (WHO Regional Office for Europe), Ketevan Kandelaki (WHO Regional Office for Europe), Mimi (Meheret) Melles-Brewer (Global Coordination and Partnership Department, AMR Division), Diriba Mosissa (Global Coordination and Partnership Department, AMR Division), Ahmad Tareq (WHO Country Office for Ethiopia) and Deborah Tong (Surveillance Prevention and Control Department, AMR Division).

Funding for development of the Tool was kindly provided by the Fleming Fund and the Kingdom of Saudi Arabia.

Abbreviations

AMR antimicrobial resistance

AMS antimicrobial stewardship

AMU antimicrobial use

AWaRe access, watch and reserve

HAI health-care-associated infection

IPC infection prevention and control

SSI surgical-site infection

STI sexually transmitted infection

Glossary

Ability:	an inherent or acquired faculty for doing or achieving something. In typical educational practice, the terms “abilities” and “aptitudes” are used interchangeably to denote an individual’s potential for acquiring and applying new knowledge or skills (1).
Antimicrobial resistance (AMR):	occurs when bacteria, viruses, fungi or parasites no longer respond to antimicrobial agents. As a result of drug resistance, antibiotics and other antimicrobial agents become ineffective and infections become difficult or impossible to treat, increasing the risk of disease spread, severe illness and death (2).
Antimicrobial:	agent used to prevent, control and treat infectious diseases in humans, animals and plants. They include antibiotics, fungicides, antiviral agents and parasiticides. Disinfectants, antiseptics, other pharmaceuticals and natural products may also have antimicrobial properties (2).
Attitude:	a learnt tendency or readiness to evaluate or react to some ideas, people or situations in certain ways, either consciously or unconsciously (1).
Basic skill:	fundamental knowledge (declarative and procedural) and operational aspects of knowledge necessary for learning, work and life. In a curriculum, literacy and numeracy are usually considered essential or basic skills. The term can include various skills that individuals require to perform their work successfully in contemporary society (1).
Clinical competence:	mastery of relevant knowledge and acquisition of relevant skills at a satisfactory level, including interpersonal, clinical and technical components at a certain time of education, e.g. at graduation from an educational establishment. In clinical training based mainly on an apprenticeship model, teachers define what the student is expected to do and test their ability to do it. Competence itself is of value only as a prerequisite for performance in a real clinical setting and is not always strongly correlated with performance in practice (3).
Clinical skill:	includes taking a history, physical examination, communication skills, procedures and investigations, emergency practices and prescription and treatment practices (3).
Competence:	the ability of a person to integrate knowledge, skills and attitudes into their performance of tasks in a given context. Competence is durable, can be taught and, through the expression of behaviour, is measurable (4).
Competency-based curriculum:	a curriculum that emphasizes the complex outcomes of learning rather than what learners are expected to learn in terms of traditionally defined subject content. In principle, such a curriculum is learner-centred and adaptive to the changing needs of students, teachers and society. Learning activities and environments are chosen so that learners can acquire and apply the knowledge, skills and attitudes to situations that they encounter in work environments (1).
Core curriculum:	the body of knowledge, skills and attitudes expected to be learnt by all students, generally a set of subjects and learning areas that are common to all students (1).

Curriculum:	a description of what, why, how and how well students should learn in a systematic, intentional way. The curriculum is not an end in itself but rather a means to fostering high-quality learning (7).
Curriculum evaluation:	measuring and judging the extent to which planned courses, programmes, learning activities and opportunities as expressed in a formal curriculum actually produce the expected results. If the evaluation is effective, it can allow decisions to be made about improvements and future progress (7).
Evidence-informed decision-making:	decisions based on the best available evidence from research, as well as other factors such as context, public opinion, equity, feasibility of implementation, affordability, sustainability and acceptability to stakeholders. It is a systematic and transparent approach in which structured, replicable methods are used to identify, appraise and make use of evidence in all decision-making, including for implementation (5).
Infection prevention and control (IPC):	a practical, evidence-based approach to prevent harm to patients and health workers from avoidable infections (6).
Learning objective:	Specification of learning to be achieved upon completion of an educational programme or an activity. Can be specified for a lesson, a theme, a year or an entire course (7).
Learning outcome:	the totality of information, knowledge, understanding, attitudes, values, skills, competencies or behaviour a learner has mastered after successful completion of an educational programme (7).
Skill:	the ability, proficiency or dexterity to carry out tasks provided by education, training, practice or experience (7).
Transdisciplinary approach:	an approach to curriculum integration in which the boundaries between conventional disciplines are dissolved and teaching and learning are organized through construction of meaning in the context of real-world problems or themes (7).

1 Introduction

AMR occurs when bacteria, viruses, fungi and parasites change over time and no longer respond to antimicrobial medicines, making infections more difficult to treat and increasing the risk of disease spread, severe illness and death (2). It also increases the cost of treatment, exacerbates the scarcity of health-care delivery capacity and decreases trust in formal health-care systems. It is estimated that 1.27 million deaths were attributable to AMR in 2019 alone, with 4.95 million associated deaths (7), further emphasizing the need for urgent, coordinated action.

AMR is an issue of both health and development, with drivers in many sectors. The main drivers are increased and inappropriate use of antimicrobials in human health, animal health and agriculture and improper environmental management of wastes that may contain antimicrobial residues (8). There are limited novel antimicrobials in the research and development pipeline, due to commercial and scientific considerations. Therefore, preserving the long-term efficacy of existing antimicrobials through appropriate use is a priority.

Health workers, especially prescribers, play an important role in making a correct diagnosis through appropriate clinical and diagnostic pathways, assessing the necessity of antimicrobials, the choice and regimen, and escalation, de-escalation or discontinuation of antimicrobials that may be used, deciding on the appropriate duration of treatment with antimicrobials for various infections and acting as role models for proper infection control practices to ensure that pathogens do not spread. Therefore, prescribers are a critical stakeholder group in efforts to mitigate and contain the AMR problem. This has been recognized in landmark global policy documents on AMR. The [Global Action Plan on Antimicrobial Resistance](#) (9) includes AMR education and awareness as key elements for strengthening the AMR competence of all health-care professionals. The United Nations [Interagency Coordination Group on AMR](#) (10) also called for strengthening professional education as a means of improving the AMR situation and the consequent health outcomes for individuals and populations.

In 2018, WHO published the [Competency framework for health workers' education and training on antimicrobial resistance](#) (11) to help academic institutions and regulatory agencies ensure pre-service and in-service training to equip health workers with adequate competencies to address AMR. This was followed by [Health workers' training and education on AMR: curricula guide](#) (12) to ensure quality and standards in improving the competencies of health workers on AMR-sensitive and -specific issues. The two documents describe adequate standards of practice to mitigate AMR by health workers in their roles and functions. This curriculum assessment tool for undergraduate medical students complements other WHO documents by providing guidance to medical schools and universities on the expectations for AMR-specific and -sensitive curricular elements.

2 Objectives

The objectives of the curriculum assessment tool and the assessment are to:

- facilitate assessment of the curriculum for training medical students in a university or national context. This includes its robustness for teaching content that covers the core competencies listed in the WHO Competency Framework for Health Workers' Education and Training on Antimicrobial Resistance (13);
- assist in designing a strategy or reviewing existing processes and structures to enhance AMR-specific and -sensitive content in a curriculum for training medical students, in a university or a national context; and
- stimulate or facilitate periodic, structured discussions on AMR and health worker competencies among the faculty of medical universities and relevant stakeholders.

3 Approach to development

The first draft of the document was prepared by the AMR division of WHO, with inputs from various other WHO departments, including the Health Workforce Department. Seven external global experts in AMR and medical education were recruited according to due process and regional representation, and the draft tool was further revised with their feedback. The tool was also peer-reviewed by other independent experts. The feedback from both reviews was used by the external contributors, and the revised tool was pilot-tested in selected universities in Ethiopia, after which minor modifications were made.

Declarations of interest were collected from all external contributors, and assessment of the declarations revealed no conflicts of interest.

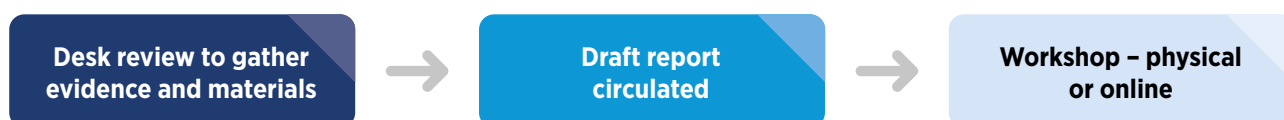
4 Setting up curriculum assessment

Curriculum assessment is not a one-time activity; rather, it is the beginning of strengthening the capacity of a university to effectively deliver training on AMR in the context of the management of infectious diseases. It should be started with full support and agreement from the senior management of the university or the regulatory agency for medical education, whichever is applicable.

Curriculum assessment involves two steps, starting with a desk review to systematically collect the necessary documents and materials (Fig. 1) and analyse the information and data, including from internal and external documents, publications and credible Internet sites.

The assessment can be followed by an online or offline workshop, whichever is convenient.

Fig 1.
Curriculum assessment



Desktop review

The curriculum assessment should start with a desk review by a small team of at least two medical faculty who collect data from published curricula for medical education, the syllabus of the university or curricula used by the medical school to identify any gaps or areas that should be modified. A team of two is suggested to conduct the review to reduce subjectivity in a consensus-based approach. The review should include the entire undergraduate medical curriculum, from basic sciences to clinical courses. We anticipate that this could be completed within 10 person-hours.

- It is suggested that the desk review be led by an expert in medical education and AMR with methodological skills and experience in conducting reviews of secondary data.
- The official version of the curriculum or the syllabus should be available for this exercise.
- Any missing information in the official version of the curriculum or syllabus can be provided by teaching faculty in the relevant department.
- The information can be complemented by data on curriculum planning or session titles from relevant sources.
- Parts 1 and 2 of the curriculum assessment tool can be populated with information collected during the desktop review.
- Justification should be given for each score in part 2 of the Curriculum Assessment Tool.

- A draft report of the curriculum assessment should be circulated to the respective departments for their input before proceeding to the workshop stage.
- The report of the curriculum review should be shared in a timely manner with prospective attendees at the workshop.

Workshop

The suggested duration of the workshop is one half day for a physical format and 3 h if conducted online. In both scenarios, there should be provision for breakout discussion among representatives of each department to arrive at a consensus on the scores.

- Ideally, the workshop should include representatives from the following teaching departments:

Core departments:

- microbiology
- pharmacology
- public health medicine
- internal medicine
- paediatrics
- obstetrics and gynaecology
- general surgery
- family medicine (if available)
- infectious diseases (if available)
- infection prevention and control (if available)
- social medicine (if available)
- critical care medicine
- orthopedics

Optional departments:

- emergency medicine
- medical oncology
- dermatology
- otorhinolaryngology
- ophthalmology

- It is suggested that two or three representatives of each department, especially the core departments, be available so that consensus can be reached in verifying the information in Part 2 of the assessment tool.
- Representation from social sciences, pharmacy and nursing departments is also encouraged, as these disciplines are involved in clinical training of medical undergraduates in several countries.
- The specific and intended learning outcomes on AMR-related topics, if available, should be discussed at the workshop.
- The following structure is recommended for a workshop to review curricula:
 - introductory session to set the objectives of the assessment and plans for using the information;
 - decision on the method for resolving disagreements during the assessment;
 - breakout discussions with representatives of all departments on the themes and sub-themes in part 2 of the tool;
 - presentation of the findings of the breakout discussions in plenary;
 - decision on a strategy to fill any gaps in the curriculum and programme identified during the workshop; and
 - review and population of part 3 (Institutional Readiness Assessment Tool) as a group.
- The responses can be colour-coded and the results projected on a screen for the benefit of all the workshop participants.
- The findings of the workshop should be documented in a concise report for presentation to the university management.
- A follow-up meeting should be held 6 months later to assess progress in the remediation measures taken on the basis of the report.

5 Curriculum Assessment Tool for medical education

The Tool has three parts:

PART 1.

Contextual information

PART 2.

Curriculum content, scope and assessment tool

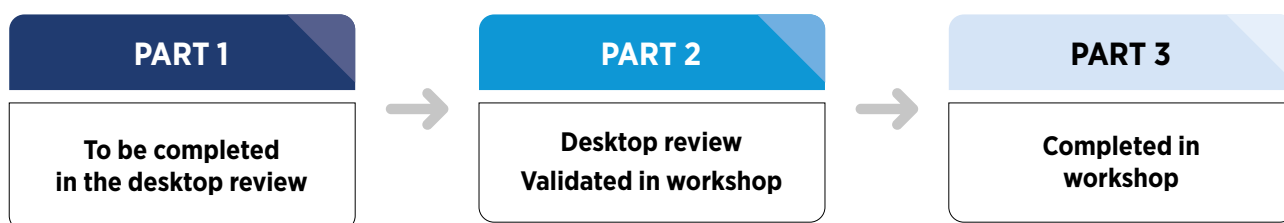
PART 3.

Institutional readiness assessment tool.

The stages at which each part is be populated are outlined in Fig. 2.

Fig 2.

Recommendations for the parts of the assessment tool



5.1 Contextual information

Question	Response
Name of institution or university	
Country	
Year of establishment	
Number of medical students currently enrolled in the institution or university	
Other health professional streams being trained in the institution or university	
Whether the institution or university has the autonomy to design the curriculum for medical undergraduate education	
Whether the curriculum has to be approved by a regulatory body	
If the answer to the above question is No, who designs the curriculum for medical undergraduate education for the institution or university?	
Whether the institution or university has a unit dedicated to improving the quality of medical education	
Whether the institution or university is accredited for academic quality by any system	

5.2 Assessment of curriculum content and scope

Instructions: Qualitative responses should be provided for each theme according to the four options available. Sub-themes are only for guidance or reference, and responses are not necessary for each.

Legend:

- A Well covered
 B Covered but needs minor improvement
 C Covered but needs major improvement
 D Not covered

No.	Theme	Sub-themes	Response	Comments
1	Microbiology			
1.1	Basic concepts of microbiology and infection	<ul style="list-style-type: none"> General microbiology, including cell structure and Gram staining of common pathogens General concept of infection and modes of transmission Basic concepts of immune response Normal flora, colonization and microbiome 		
1.2	Mechanisms and epidemiology of AMR	<ul style="list-style-type: none"> Introduction to AMR and its impact Genetic mechanisms of AMR Modes of transmission of resistance (macro: person-to-person, food-borne, aerosols, body fluids, touch, surfaces; micro: conjugation, transduction, transformation, vertical) General concept of infection, AMR infection, microbiome, colonization and colonization with drug-resistant microorganisms Epidemiology of AMR Importance of surveillance of resistant infections Common terms such as AMR, multidrug-resistant, methicillin-resistant <i>Staphylococcus aureus</i>, extended-spectrum beta lactamase, carbapenam-resistant Enterobacteriaceae, vancomycin-resistant Enterococcus 		
1.3	Isolation and identification of bacteria	<ul style="list-style-type: none"> Methods of culture, including those used commonly in the setting Automated and manual culture methods Automated and manual species identification 		
1.4	Principles of antimicrobial susceptibility testing	<ul style="list-style-type: none"> requirement for antimicrobial susceptibility testing automated and manual methods for susceptibility testing international guidelines for susceptibility testing, such as those of the Clinical and Laboratory Standards Institute and the European Union Committee on Antimicrobial Susceptibility Testing clinical break-points and epidemiological cut-off values expected resistant and susceptible phenotypes phenotypic and molecular methods for detecting important resistance mechanisms 		
1.5	Infection control practices and use of personal protective equipment	<ul style="list-style-type: none"> importance of IPC in preventing health-care-associated infections (HAIs) sterile supplies in health-care facilities and procedures used, including linen management infection control practices at the bedside, including the “five moments of hand hygiene” and universal precautions for health-care workers at all levels purpose and efficiency of commonly used personal protective equipment, such as masks, gloves, goggles, hazmat suits principles of choosing appropriate personal protective equipment 		

No.	Theme	Sub-themes	Response	Comments
1.6	Principles and prevention of HAIs	<ul style="list-style-type: none"> • definition of HAIs – causes and consequences • impact of HAIs on health-care delivery • methods for reducing HAIs • importance of antimicrobial stewardship (AMS) in reducing health-care-associated AMR infection • common causative organisms and treatment of HAIs • common HAIs, such as surgical-site infection (SSI), central line-associated bloodstream infection, ventilator-associated pneumonia, catheter-associated urinary tract infection and <i>Clostridium difficile</i> • outbreaks of HAIs and how to manage them 		
1.7	Choice of appropriate tests in diagnosing infections (diagnostic stewardship)	<ul style="list-style-type: none"> • pre-test suspicion or probability of infection • utility of investigations such as white blood cell count, neutrophil-lymphocyte ratio, C-reactive protein, procalcitonin and microbial culture susceptibility • sensitivity and specificity of commonly used tests • basic concepts of positive and negative predictive values • molecular diagnostic tests for infections 		
1.8	Collection of samples for microbiological investigations to diagnose infectious conditions (diagnostic stewardship)	<ul style="list-style-type: none"> • timing of sample collection for culture • precautions in collection of samples for culture-susceptibility testing, including good practices for blood cultures • precautions in collecting samples for molecular diagnostics • storage, transport and turn-around-time for commonly used tests 		
1.9	Interpreting the results of microbiological investigations to diagnose and monitor infectious conditions	<ul style="list-style-type: none"> • interpreting reports of test negativity, test positivity and antibiotic susceptibility testing and choosing appropriate treatment (including escalation, de-escalation and discontinuation of antimicrobials) • distinguishing between a positive result, contamination and colonization • concept of susceptibility categories: susceptible with normal exposure (S), susceptible with increased exposure (I) and resistant (R) • use of minimum inhibitory concentration values • clinical implications of results 		
1.10	Rapid and point-of-care diagnostic tests for infectious conditions	<ul style="list-style-type: none"> • rapid tests for specific conditions, such as malaria rapid diagnostic test, rapid streptococcal antigen test, urine dipsticks, urinary lipoarabinomannan assay and lateral flow assays • tests to differentiate between bacterial and viral infections, such as biomarkers for myxovirus A, TNF-related apoptosis-inducing ligand • molecular diagnostics such as multiplex polymerase chain reaction systems that can run a panel of tests 		

No.	Theme	Sub-themes	Response	Comments
2	Pharmacology			
2.1	Basic concepts of antimicrobials, including antibiotics	<ul style="list-style-type: none"> principal antibiotic classes, their mode of action and mechanisms of bacterial resistance against them indications for antibiotic use: prophylaxis, empiric, definitive, pre-emptive importance of appropriate use to minimize AMR and improve patient outcomes 		
2.2	Principles of choice of antimicrobials for acute infections	<ul style="list-style-type: none"> antimicrobial spectrum and activity against key human pathogens penetration of antibiotics into targeted tissue duration of antimicrobial therapy concept of therapeutic drug monitoring impact of resistance on individuals and populations in choice of antimicrobials writing a prescription for an antimicrobial 		
2.3	Empiric antimicrobial therapy for common infections in community settings	<ul style="list-style-type: none"> choice of antimicrobials for common infections encountered in clinical practice pharmacological management of self-limiting or mild infections that do not require antimicrobials introduction to WHO Antibiotic book (14) and standard treatment guidelines for infections in countries and facilities difference between community and hospital management of infections 		
2.4	Antimicrobial stewardship programme for health-care facilities	<ul style="list-style-type: none"> audit and feedback on appropriate use of antimicrobials escalation/or de-escalation of antimicrobial therapy switch from intravenous to oral administration of antimicrobial therapy formulary restriction or pre-authorization compliance with guidelines clinical decision support software introduction to WHO AWaRe classification of antibiotics (14) duration of treatment 		
2.5	Monitoring and quantifying antimicrobial consumption and use in health-care facilities	<ul style="list-style-type: none"> defined daily doses and days of therapy; prescription audits for appropriateness of antimicrobial use (AMU) utility of antimicrobial consumption surveillance 		
2.6	Communicating effectively with patients on use of antimicrobial agents	<ul style="list-style-type: none"> importance of medical advice before prescribing, dispensing or using antimicrobials types of infections or inflammation managed with and without antimicrobials possible adverse effects, including allergies, during or after AMU and report them differentiating types of hypersensitivity reactions 		
2.7	Safety profile of antibiotics in special conditions	<ul style="list-style-type: none"> antibiotic use in pregnancy antibiotic use in renal insufficiency antibiotic use in hepatic insufficiency antibiotic use in a patient with a history of severe allergic reactions to medicines pharmacovigilance for adverse drug reactions assessing antibiotic allergy concept of drug interactions 		

No.	Theme	Sub-themes	Response	Comments
3	Internal medicine			
3.1	Assessment and management of patients presenting with fever	<ul style="list-style-type: none"> differential diagnosis between viral, parasitic and bacterial infections (based on e.g. local incidence, endemicity, symptoms, signs) pyrexia of unknown origin investigating and managing a patient with fever (with or without sepsis) establishing a diagnosis when etiology is not immediately evident 		
3.2	Assessment and management of patients presenting with cough and other respiratory symptoms	<ul style="list-style-type: none"> upper and lower respiratory tract infections and their etiology rapid diagnostic tests for respiratory infections radiological investigations and their interpretation for lower respiratory tract infections pharmacological (including symptomatic) management of respiratory tract infections 		
3.3	Assessment and management of patients presenting with acute diarrhoea	<ul style="list-style-type: none"> acute diarrhoea and its etiology diagnosing and managing cholera diagnosing and managing <i>C. difficile</i> infection managing dysentery due to <i>Salmonella</i>, <i>Shigella</i> and <i>Entamoeba histolytica</i> pharmacological (including symptomatic management of uncomplicated diarrhoea) management of severe dehydration due to diarrhoea 		
3.4	Assessment and management of patients presenting with acute urinary tract symptoms	<ul style="list-style-type: none"> epidemiology of lower and upper urinary tract infections laboratory and radiological investigations for urinary tract infections differentiating and managing upper urinary tract infections differentiating and managing lower urinary tract infections asymptomatic bacteriuria 		
3.5	Assessment and management of patients presenting with signs of sexually transmitted infections (STIs)	<ul style="list-style-type: none"> epidemiology of STIs investigating patients presenting with genital discharge and/or genital ulcers diagnosing and managing gonorrhoea diagnosing and managing syphilis syndromic management of STIs 		
3.6	Assessment and management of patients presenting with sepsis and bloodstream infections	<ul style="list-style-type: none"> definition and pathophysiology of sepsis, septic shock and bloodstream infections, including current definitions diagnosing, investigating and managing a patient with sepsis in health-care facilities pharmacological management and supportive care of sepsis and septic shock empirical and targeted antimicrobial therapy in sepsis 		
3.7	Assessment and management of patients presenting with signs of meningitis	<ul style="list-style-type: none"> epidemiology of acute bacterial meningitis, viral and aseptic meningitis and tuberculous meningitis diagnosing meningitis and its etiology pharmacological management of acute bacterial meningitis prevention of meningitis, including vaccines and post-exposure prophylaxis 		
3.8	Interpreting and using standard treatment guidelines for infectious diseases	<ul style="list-style-type: none"> method used in compiling standard treatment guidelines using empirical and targeted treatments for infections sources of standard treatment guidelines 		

No.	Theme	Sub-themes	Response	Comments
3.9	Interpretation of laboratory reports for diagnosing and managing infections	<ul style="list-style-type: none"> selecting an appropriate antibiotic from an antimicrobial susceptibility testing report according to clinical presentation interpretation of minimum inhibitory concentrations in reports on AMR appropriate use of biomarkers such as C-reactive protein and procalcitonin 		
3.10	Counselling patients on use of antimicrobials and on appropriate use	<ul style="list-style-type: none"> importance and unique properties of antimicrobials shared decision-making with patients misuse and overuse of antimicrobials and AMR possible adverse effects, including allergies, during AMU and how to report them 		
3.11	Strategies for rationalizing AMU in clinical care	<ul style="list-style-type: none"> avoiding antimicrobial prescriptions for uncomplicated and self-limiting infections favouring "Access" antibiotics when possible adaptation of antimicrobial treatment to microbiological results and clinical evolution switch from intravenous to oral therapy with antimicrobial agents selecting and following guidelines for duration of therapy 		
3.12	Management of acute infections in immunocompromised individuals	<ul style="list-style-type: none"> epidemiology of common opportunistic infections in immunocompromised individuals diagnosis of opportunistic infections preventive therapy for opportunistic infections pharmacological management of common acute infections in immunocompromised individuals 		

No.	Theme	Sub-themes	Response	Comments
4	General surgery			
4.1	Surgical antibiotic prophylaxis for routine procedures	<ul style="list-style-type: none"> principles of surgical antibiotic prophylaxis choice of antibiotics; timing and duration in common operations; and WHO Global guidelines for the prevention of surgical site infection (75) pre-operative, intra-operative and post-operative care to prevent SSIs importance of IPC in preventing SSIs 		
4.2	Assessment and management of patients with SSIs	<ul style="list-style-type: none"> epidemiology and clinical presentation of SSIs common causative organisms and treatment of SSIs collection of clinical samples, culture and antibiotic susceptibility testing for SSIs targeted pharmacological management of SSIs 		
4.3	Assessment and management of patients with skin and soft tissue infections	<ul style="list-style-type: none"> impetigo, erysipelas, folliculitis, cellulitis, abscesses and necrotizing fasciitis diagnosing and managing skin and soft tissue infections surgical interventions for necrotizing fasciitis 		
4.4	Assessment and management of patients with intra-abdominal infections	<ul style="list-style-type: none"> clinical presentation of intra-abdominal infections laboratory and radiological investigations for intra-abdominal infections antimicrobial therapy for intra-abdominal infections duration of antimicrobial therapy after source control in intra-abdominal infections 		

No.	Theme	Sub-themes	Response	Comments
5	Obstetrics and gynaecology			
5.1	Assessment and management of patients with vaginal discharge	<ul style="list-style-type: none"> epidemiology of common STIs, including bacterial vaginosis, trichomoniasis and gonorrhoeae investigating a patient with vaginal discharge pharmacological management of vaginal discharge 		
5.2	Principles for choosing antibiotics during pregnancy and breastfeeding	<ul style="list-style-type: none"> safety profile of commonly used antibiotics during pregnancy choice of antibiotics for common infectious conditions for women known to be pregnant choice of antibiotics for common infectious conditions for breastfeeding women 		
5.3	Antibiotic use during childbirth and caesarean section	<ul style="list-style-type: none"> antibiotic prophylaxis in special conditions for prevention of peripartum infections. third- or fourth-degree vaginal tear, manual removal of placenta, preterm pre-labour rupture of membranes choice and timing of antibiotics for single-dose prophylaxis for caesarean section: penicillin or first-generation cephalosporin choice and timing of antibiotics for single-dose prophylaxis for operative vaginal birth routine antibiotic prophylaxis not recommended for women with an uncomplicated vaginal birth 		
5.4	Assessment and management of women with signs of urinary tract infection in pregnancy	<ul style="list-style-type: none"> symptomatic urinary tract infection and asymptomatic bacteriuria during pregnancy diagnosing and managing urinary tract infection diagnosing and managing asymptomatic bacteriuria 		
5.5	Assessment and management of patients with signs of puerperal sepsis	<ul style="list-style-type: none"> postpartum infections diagnosis and management of puerperal sepsis antenatal, intra-partum and post-partum measures to prevent puerperal sepsis 		
5.6	Antibiotic use in medical and surgical abortions	<ul style="list-style-type: none"> infections and infection prevention in medical and surgical abortion single-dose antibiotic prophylaxis for surgical abortion diagnosis and management of post-abortion infection 		

No.	Theme	Sub-themes	Response	Comments
6	Paediatrics			
6.1	Assessment and management of children presenting with fever	<ul style="list-style-type: none"> differential diagnosis of viral, parasitic, fungal and bacterial infections (based on local incidence, endemicity) investigating a child with fever establishing a diagnosis when etiology is not immediately evident 		
6.2	Assessment and management of children presenting with cough and other respiratory symptoms	<ul style="list-style-type: none"> epidemiology of upper and lower respiratory tract infections radiological investigations and their interpretation for lower respiratory tract infections pharmacological (including symptomatic) management of respiratory tract infections 		
6.3	Assessment and management of children presenting with acute diarrhoea	<ul style="list-style-type: none"> acute diarrhoea and its etiology pharmacological (including symptomatic) management of uncomplicated diarrhoea management of severe dehydration due to diarrhoea 		

No.	Theme	Sub-themes	Response	Comments
6.4	Assessment and management of neonatal sepsis	<ul style="list-style-type: none"> diagnosing and managing sepsis in neonates etiology and antimicrobial therapy in neonatal sepsis septic shock in children and its management 		
6.5	Assessment and management of skin and soft tissue infections in children	<ul style="list-style-type: none"> impetigo, erysipelas, folliculitis, cellulitis and abscesses AMU in parasitic skin infestations skin manifestations of systemic infections 		

No.	Theme	Sub-themes	Response	Comments
7	Public health medicine and/or community medicine			
7.1	Primary health care and primary health centres	<ul style="list-style-type: none"> scope of infectious disease-related health care services delivered in primary health care Integrated management of childhood illness (16) diagnostic tests for infectious diseases in primary care 		
7.2	National infectious disease surveillance systems	<ul style="list-style-type: none"> essential features and functions of infectious disease surveillance and health-care-associated infection surveillance systems examples of functional national infectious disease surveillance systems Global Antimicrobial Resistance and Use Surveillance System (GLASS) basic principles of an outbreak investigation 		
7.3	Water, sanitation and hygiene in communities	<ul style="list-style-type: none"> basic principles of water purification and sewage treatment drinking-water disinfection and temporary toilet facilities in emergencies control of waterborne diseases outbreaks of infections and AMU in extreme weather events such as floods and droughts 		
7.4	National vaccination programmes	<ul style="list-style-type: none"> national immunization schedule or list of compulsory and recommended vaccines newer vaccines against bacterial diseases 		
7.5	Principles of behavioural change and behavioural change communication	<ul style="list-style-type: none"> basic concepts of behavioural change theories social and professional role of prescribers in AMR, AMS and IPC in both community and health-care facilities AMR-appropriate behaviour by health-care workers and behavioural change interventions in health-care facilities planning awareness and behavioural change programmes on AMR for the public 		
7.6	Waste management in health-care facilities	<ul style="list-style-type: none"> principles of biomedical waste management segregation at source and disposal of infectious waste from health-care facilities decontamination and safe disposal of antibiotics 		
7.7	National action plan on AMR	<ul style="list-style-type: none"> national action plan on AMR and its implementation drivers of AMR in the health system One Health approach for AMR prevention and containment 		
7.8	One Health approach for AMR prevention and mitigation	<ul style="list-style-type: none"> AMU in veterinary practice and agriculture the environment as a disseminator and possible amplifier of AMR multisectoral nature of interventions to contain AMR 		

5.3 Institutional Readiness Assessment Tool for AMR curricula

Note: This section is to be completed only in a medical school or university

Legend:

A Yes, fully in place | **B** Yes, partial | **C** Planned | **D** No, but a priority | **E** No | **F** Uncertain

No.	Question	Response
Policies on AMR education and training		
1.1	Is there a mandatory or recommended policy or guidance requirement for all prescribing staff to be trained in AMR?	
1.2	Is there a national, subnational or local strategy or policy on AMR education to which your institution refers?	
1.3	Is there current, evidence-based standard treatment guidance for management of infectious conditions to which your institution refers?	
1.4	Does the institution conduct regular training in AMR, AMS and IPC for different cadres of health-care workers?	

No.	Question	Response
Infrastructure for delivering AMR education and training		
2.1	Does your institution have a functional clinical microbiology laboratory for practical, hands-on training for students?	
2.2	Does your institution have an adequate patient load and infectious disease burden to train students in clinical management of infections, including drug-resistant infections?	
2.3	Does your institution have a functional biomedical waste management system, with segregation at source, to demonstrate to students?	
2.4	Does your institution have access to e-learning platforms that may have content or courses on AMR, AMS and IPC?	
2.5	Does your institution have a functional hospital infection control committee and an IPC programme for learning by students?	
2.6	Does your institution have a functional AMS or antibiotic policy committee and/or a drugs and therapeutics committee to deliver practical, hands-on training in AMS to students?	

No.	Question	Response
Human resources for AMR education and training		
3.1	Does your institution have an adequately staffed clinical microbiology department that delivers training in AMR, AMS and IPC?	
3.2	Does your institution have an adequately staffed pharmacy and/or pharmacology department that delivers training in AMR, AMS and IPC?	
3.3	Does your institution have an adequately staffed public health department that delivers training in AMR and its mitigation?	
3.4	Does your institution have adequate clinical personnel to provide training in infectious diseases, AMR, AMS and IPC?	

No.	Question	Response
Prioritization of AMR and AMU education and training		
4.1	Does your institution have an earmarked budget for events, workshops or meetings on AMR?	
4.2	Does your institution have a tailored curriculum for training students in appropriate use of antimicrobials?	
4.3	Does your institution have any integrated teaching programmes or courses on AMR and AMU for undergraduate medical students?	
4.4	Does your institution participate in any routine reporting or surveillance system on AMR and AMU?	

No.	Question	Response
Assessment of AMR education and training		
5.1	Is there a system for assessing the capability of staff to conduct training in AMR and AMU?	
5.2	Are the AMR and AMU knowledge and competencies of learners assessed formatively and summarized?	
5.3	Is there a system for providing systematic feedback to learners in aspects related to AMR and appropriate use of antimicrobials?	
5.4	Is there adequate attendance at AMR training events and courses?	

6 Remedial measures for improvement

Curriculum assessment

Any gaps in the AMR curriculum identified during assessment should be discussed with the relevant departments. Each department should be able to make a brief, short-term remedial plan with specific learning objectives and intended learning outcomes to fill the gaps identified during the assessment.

Many medical education systems deliver competency-based medical education. If the university or medical school is using such a system, the gaps identified should be filled with specific competencies. Competencies can be identified from the [Competency Framework for Health Workers' Education and Training on Antimicrobial Resistance \(11\)](#). Updated guidance on adapting competency-based education to outcomes can be found in the [WHO Global Competency and Outcomes Framework for Universal Health Coverage \(13\)](#).

Integrated curricula have been introduced widely to avoid compartmentalization in delivery of medical education. Several departments conduct inter-departmental courses and sessions, with specific learning objectives and outcomes at programme and institutional levels. Curriculum mapping is useful for visualizing the process and defining institutional, programme, course and session learning outcomes. A **curriculum map** can be prepared at a workshop involving all relevant departments to discuss the expectations from the curriculum assessment tool and the gaps identified (17).

The medium-term, most sustainable solution is integration of AMR themes and sub-themes into the curriculum recommended for medical students by the institution, university or national regulatory body. If curricula setting is centralized, assessments should be conducted in several universities or institutions and the results used for advocacy.

Institutional readiness

Some deficiencies identified in the assessment tool for institutional readiness can be remediated through interventions by the management of the institution or university. For example, an institutional policy could be established for training staff in AMR and AMU, or a standard treatment guideline could be adopted for infectious diseases, such as the WHO AWaRe Antibiotic Book (14). A list of interventions that could be made without significant investment could be prepared, discussed and submitted to the management.

Deficiencies in infrastructure and human resources require careful planning and resource mobilization. A costed plan for remediating the deficiencies should be prepared and submitted to the management of the institution or university. The plan should present clear reasons for prioritizing resources for AMR, citing global, national and local statistics.

References

1. Glossary of curriculum terminology (IBE/2013/KPM/PI/01). Paris: United Nations Educational, Social and Cultural Organization, International Bureau of Education; 2013 (<https://unesdoc.unesco.org/ark:/48223/pf0000223059>).
2. Antimicrobial resistance factsheet. Geneva: World Health Organization; 2024 (<https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance>).
3. Glossary of medical education terms. Brussels: European Education and Culture Executive Agency; undated ([http://www.ecaqa.org/doxs/Glossary%20of%20Medical%20Education%20Terms%20\(engl\).pdf](http://www.ecaqa.org/doxs/Glossary%20of%20Medical%20Education%20Terms%20(engl).pdf)).
4. Mills JA, Middleton JW, Schafer A, Fitzpatrick S, Short S, Cieza A. Proposing a re-conceptualisation of competency framework terminology for health: a scoping review. *Hum Resour Health*. 2020;18(1):15. doi:10.1186/s12960-019-0443-8.
5. Evidence, policy, impact. WHO guide for evidence-informed decision-making. Geneva: World Health Organization; 2022 (<https://www.who.int/publications/i/item/9789240039872>).
6. Infection prevention and control. Geneva: World Health Organization; 2024 (https://www.who.int/health-topics/infection-prevention-and-control#tab=tab_1).
7. Antimicrobial Resistance Collaborators. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. *Lancet*. 2022;399(10325):629–55. doi:10.1016/S0140-6736(21)02724-0.
8. Ferri M, Ranucci E, Romagnoli P, Giaccone V. Antimicrobial resistance: a global emerging threat to public health systems. *Crit Rev Food Sci Nutr*. 2017;57(13):2857–76. doi:10.1080/10408398.2015.1077192.
9. Global Action Plan on Antimicrobial Resistance. Geneva: World Health Organization; 2016 (<https://www.who.int/publications/i/item/9789241509763>).
10. Interagency Coordination Group on Antimicrobial Resistance. New York: United Nations; 2017 (<https://www.un.org/sg/en/content/sg/personnel-appointments/2017-03-17/interagency-coordination-group-antimicrobial-resistance>).
11. WHO competency framework for health workers' education and training on antimicrobial resistance. Geneva: World Health Organization; 2018 (<https://www.who.int/publications/i/item/who-competency-framework-for-health-workers%E2%80%99-education-and-training-on-antimicrobial-resistance>).
12. Health workers' training and education on AMR: curricula guide. Geneva: World Health Organization; 2019 (<https://iris.who.int/handle/10665/329380>).
13. Global competency and outcomes framework for universal health coverage. Geneva: World Health Organization; 2022 (<https://www.who.int/publications/i/item/9789240034662>).
14. The WHO AWaRe (Access, Watch, Reserve) antibiotic book. Geneva: World Health Organization; 2022 (<https://www.who.int/publications/i/item/9789240062382>).
15. WHO Global guidelines for the prevention of surgical site infection. Geneva: World Health Organization; 2018 (<https://www.who.int/publications/i/item/9789241550475>).
16. Handbook: IMCI integrated management of childhood illness. Geneva: World Health Organization; 2005 (<https://iris.who.int/handle/10665/42939>).
17. Al-Eyd G, Achike F, Agarwal M, Atamna H, Atapattu DN, Castro L et al. Curriculum mapping as a tool to facilitate curriculum development: a new School of Medicine experience. *BMC Med Educ*. 2018;18(1):185. doi:10.1186/s12909-018-1289-9.

Further reading

- Abortion care guideline. Geneva: World Health Organization; 2022 (<https://www.who.int/publications/i/item/9789240039483>).
- Global guidelines for the prevention of surgical site infection. Second edition. Geneva: World Health Organization; 2018 (<https://www.who.int/publications/i/item/9789241550475>).
- Guidelines for the management of symptomatic sexually transmitted infections. Geneva: World Health Organization; 2021 (<https://www.who.int/publications/i/item/9789240024168>).
- Guidelines on core components of infection prevention and control programmes at the national and acute health care facility level. Geneva: World Health Organization; 2016 (<https://www.who.int/publications/i/item/9789241549929>).
- Health Workers' Training and Education on AMR: curricula guide. Geneva: World Health Organization; 2019 (<https://iris.who.int/handle/10665/329380>).
- WHO AWaRe (Access, Watch, Reserve) antibiotic book. Geneva: World Health Organization; 2016. (<https://www.who.int/publications/i/item/9789240062382>).
- WHO Competency Framework for Health Workers' Education and Training on Antimicrobial Resistance. Geneva: World Health Organization; 2018 (<https://www.who.int/publications/i/item/who-competency-framework-for-health-workers%E2%80%99-education-and-training-on-antimicrobial-resistance>).
- WHO recommendation on routine antibiotic prophylaxis for women undergoing operative vaginal birth. Geneva: World Health Organization; 2021 (<https://www.who.int/publications/i/item/9789240027992>).
- WHO recommendation on prophylactic antibiotics for women undergoing caesarean section. Geneva: World Health Organization; 2021 (<https://www.who.int/publications/i/item/9789240028012>).



World Health Organization
Antimicrobial Resistance Division
20, Avenue Appia
1211 Geneva 27
Switzerland
www.who.int

