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Contents

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Abbreviations

AMR	antimicrobial (or antibiotic) resistance
AMS	antimicrobial stewardship
AMU	antimicrobial (or antibiotic) use
AWaRe	Access, Watch and Reserve
CNS	central nervous system
GLASS	Global Antimicrobial Resistance and Use Surveillance System
IPC	infection prevention and control
SSI	surgical-site infections
STI	sexually transmitted infection
WHO	World Health Organization

Glossary

Ability: An inherent or acquired faculty for doing or achieving something. In typical educational practice, the terms "ability" and "aptitude" are often used interchangeably; however, aptitude refers to an individual's potential to learn or develop new knowledge or skills, while ability refers to the current level of skill or competence *(1)*.

Academic detailing: A personalized, educational outreach strategy in which trained health-care professionals (often pharmacists or clinicians) visit prescribers in their practices to provide evidence-based information about medications, clinical guidelines or therapeutic interventions *(2)*.

Access, Watch and Reserve (AWaRe): A WHO system that categorizes antibiotics into Access, Watch, Reserve and Not Recommended groups according to their risk of selecting for antibiotic resistance. **Access** antibiotics are recommended for most common infections. **Watch** antibiotics have a higher potential for resistance, are usually associated with more side-effects and are recommended for specific or more serious infections. **Reserve** antibiotics are reserved for last-resort treatment of infections caused by multidrug-resistant organisms. **Not recommended** antibiotics are fixed-dose combinations the use of which is not evidence-based and which are not recommended in high-quality international guidelines *(3)*.

Antibiotic time-out: A deliberate, structured review of the antibiotic therapy a patient is receiving, usually conducted 48–72 h after initiation. Its purpose is to reassess the necessity, choice, dose, route and duration of antimicrobial use (AMU) as indicated by clinical response, laboratory, microbiology and radiological results and guidelines, with the goal of optimizing therapy and reducing unnecessary AMU *(4)*.

Antimicrobial resistance (AMR): Occurs when bacteria, viruses, fungi and parasites do not respond to antimicrobial medicines. As a result of AMR, antibiotics and other antimicrobial medicines are ineffective, and infections become difficult or impossible to treat, increasing the risks of disease spread, severe illness and death *(5)*.

Antimicrobial stewardship (AMS): A coherent set of actions for promoting responsible use of antimicrobials. The definition can be applied to individual, national and global activities in human, animal and environmental health *(6)*.

Antimicrobial susceptibility testing: A laboratory procedure used to determine the sensitivity of microorganisms to specific antimicrobial medicines. It guides clinicians in selecting the most effective antimicrobial treatment for specific infections *(7)*.

Antimicrobials: Medicines used to prevent and treat infectious diseases in humans, animals and plants. They include antibiotics (antibacterials), antifungals, antivirals and antiparasitics. Disinfectants, antiseptics and other pharmaceuticals and natural products may also have antimicrobial properties *(5)*.

Attitude: A learnt tendency or readiness to evaluate or react to ideas, people or situations in certain ways, either consciously or unconsciously *(1)*.

Basic skills: The fundamental knowledge (i.e. declarative and procedural) and operational aspects of the knowledge necessary for learning, work and life. In this curriculum, literacy and numeracy are considered to be fundamental, essential or basic skills. The term includes all the skills that individuals require to perform their work successfully in contemporary society *(1)*.

Behaviour: The observable actions, responses or conduct of an individual, which are often shaped by attitudes, values and social norms, in learning environments and interactions. It encompasses how students act, engage and regulate themselves in relation to others and to learning tasks *(8)*.

Capability: Integrated combination of knowledge, skills, behaviour and disposition that students demonstrate when applying what they have learnt in authentic and complex situations. They include literacy, numeracy, information and communications technology capability, critical and creative thinking, personal and social capability, ethical understanding, and intercultural understanding. They represent a student's capacity to use understanding effectively and appropriately in different subjects and contexts, showing not just what students know, but how well they can transfer and apply that knowledge in practice *(8)*.

Clinical competence: Mastery of relevant knowledge and acquisition of relevant skills at a satisfactory level, including interpersonal, clinical and technical components, at graduation. In clinical training, which is based mainly on an apprenticeship model, teachers outline the expected competences and assess students' ability to perform them. Competence is a foundation for performance in real-world practice, although demonstrated competence in training is not always directly correlated with actual clinical performance *(9)*.

Clinical skill: The specific, observable abilities that contribute to clinical competence and are required to deliver person-centred care. Clinical skills in pharmacy include communication skills, physical assessment, assessment of laboratory and diagnostic information as well as patient case presentation, therapeutic planning, medicines review and reconciliation, advice on regimen optimization, monitoring of medicines intake and response, identification and management of medicines-related problems and documentation and follow-up *(10,11)*.

Competence: The ability of a person to integrate knowledge, skills and attitudes in their performance of tasks in a given context. Competence is durable, trainable and, through the expression of behaviour, measurable *(12)*.

Competence framework: An organized, structured representation of a set of interrelated and purposeful competences that outlines the essential skills, knowledge and behaviour required for a specific occupational role. It includes components such as core competence, performance indicators and assessment guidelines *(12,13)*.

Competence-based curriculum: A curriculum that emphasizes development of specific skills, knowledge and attitude (called competences) that students must demonstrate in order to progress rather than focusing mainly on 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 and society. It implies that learning activities and environments are chosen so that learners can acquire and apply the appropriate knowledge, skills and attitudes to situations they encounter in work environments *(1)*.

Community-acquired infection: Infection contracted by a person outside a health-care setting or that manifest within 48 h of hospital admission, as a pragmatic, arbitrary time-based cut-off, in patients with no recent exposure to health care. Such infections are caused by pathogens circulating in the community rather than those typically associated with health-care environments *(14)*.

Continuing pharmacy education: A structured educational activity designed or intended for continuing development of pharmacists and other members of the pharmacy workforce to maintain and enhance their competence for safe practice. Continuing pharmacy education should promote problem-solving and critical thinking, be applicable to the provision of optimal services in pharmacy practice and be based on lifelong learning and reflective practice *(15)*.

Core curriculum: The body of knowledge, skills and attitudes expected to be learnt by all students, generally related to a common set of subjects and learning areas *(1)*.

Curriculum: All planned educational experiences and learning environments designed to achieve specific learning outcomes. The curriculum compromises selection and sequencing of content; the design of learning activities and teaching methods; use of formative and summative assessments; and ongoing processes for quality assurance and programme evaluation *(1)*.

Curriculum evaluation: Systematic process for determining how effectively well-planned courses, programmes, learning activities and opportunities outlined in the formal curriculum achieve the intended learning outcomes. When done effectively, this can guide decisions about improvements and future development *(1)*.

De-escalation: Switching from a broad-spectrum antibiotic to a narrower-spectrum or targeted antibiotic or discontinuing antibiotic therapy altogether in accordance with microbiological data, evidence of clinical improvement or negative culture results *(16)*.

Delayed or deferred antibiotic prescribing: A clinical strategy in which a prescription for antibiotics is provided to a patient but is intended to be used only if symptoms persist, worsen or fail to improve after a defined period. The aim of the approach is to reduce unnecessary AMU while ensuring treatment if the infection progresses *(17)*.

Diagnostic stewardship: Coordinated guidance and interventions to improve appropriate use of microbiological diagnostics to guide therapeutic decisions. It should promote appropriate, timely diagnostic testing, including specimen collection, pathogen identification and accurate, timely reporting of results to guide patient treatment *(18)*.

Escalation: Switching from a narrow-spectrum to a broader-spectrum antibiotic that covers a wider range of bacteria when the patient's infection does not respond to initial therapy or when microbiological results indicate a more resistant pathogen than initially expected *(16)*.

Evidence-informed practice: Use of the best available evidence, adapted to the local context and resources, with the knowledge and considered judgements of stakeholders and experts, translated into practice and experience that meet the needs of a population or society *(19)*.

Formative assessment: Regular appraisal of a student's progress, with feedback, to help improve the student's performance *(20)*.

Green pharmacy: A concept and practice for minimizing the environmental impact of pharmaceuticals throughout their life cycle, from design and manufacturing to use and disposal *(21)*.

Health care-associated infection: Infection acquired by a patient during care (including preventive, diagnostic and treatment services) in a hospital or other health-care facility that were not present or incubating at the time of admission. May also appear after discharge or be acquired by health-care workers during care, as well as by visitors *(22)*.

Infection prevention and control (IPC): A practical, evidence-based approach for preventing harm to patients and health workers by avoidable infections or transmission of the infections to patients and/or other health workers *(23)*.

In-service training: Training provided to employed workers to develop or update their skills and knowledge for their current job *(24)*.

Interprofessional education: An approach in which students in two or more professions learn about, from and with each other to improve collaboration and health outcomes. The goal is to

prepare students to work effectively as members of a collaborative, person-centred health-care team by building skills in communication, teamwork and understanding roles *(25)*.

Learning objective: Specification of learning to be achieved upon completion of an educational programme or activity. May be specific to a lesson, theme or an entire course *(1)*.

Learning outcome: The totality of information, knowledge, understanding, attitudes, values, skills, competence or behaviour that a learner has mastered upon successful completion of an education programme *(1)*.

One Health: An integrated, unifying approach to sustainable balance and optimization of the health of people, animals and ecosystems based on recognition that the health of humans, domestic and wild animals, plants and the wider environment, including ecosystems, are closely linked and interdependent *(26)*.

Outpatient parenteral antimicrobial therapy: Administration of intravenous (parenteral) antimicrobial therapy to patients outside a hospital setting, usually at home, in ambulatory infusion centres or other outpatient facilities. Used for patients who are clinically stable and require prolonged intravenous antimicrobial treatment but not inpatient hospitalization. It is more cost-effective than inpatient treatment, reduces the risk of health-care-associated infections and improves patient comfort *(27)*.

Pharmacist collaborative agreement: A formal, written agreement between a licensed pharmacist and a physician (or other authorized prescriber) that allows the pharmacist to assume professional responsibility for certain patient care functions under defined protocols. Such agreements usually authorize pharmacists to initiate, modify or monitor medication independently; order laboratory tests; and provide patient education in the scope agreed upon by the collaborating health-care provider to improve patient care *(28)*.

Point-of-care testing: Diagnostic testing performed near or at the site of patient care, rather than in a central laboratory. Such testing may be conducted in clinics, emergency departments, ambulances, pharmacies and patients' homes. Point-of-care testing can be subdivided into (i) rapid point-of-care testing, which provides results at the same clinical encounter and enables immediate clinical decisions, and (ii) near-patient testing with delayed turnaround time, in which results are available only after the encounter and therefore have limited impact on initial treatment decisions *(29)*.

Practice activity: A core function of health practice comprising a group of related tasks. Practice activities are time limited, trainable and, by the performance of tasks, measurable. Individuals may be certified to perform practice activities *(12)*.

Pre-service education: Any structured learning activity before and as a prerequisite for employment in a service setting *(12)*.

"Push-and-pull" system: A "push" system or "forecast-based supply" is a supply chain approach in which production and inventory replenishment are driven by forecasted demand. Organizations estimate future customer requirements and "push" products through the supply chain accordingly. A "pull" system or demand-based supply is a supply chain approach in which production and replenishment are driven by actual customer demand. Products are produced or ordered only when there is a real, observable requirement, whereby demand "pulls" items through the supply chain *(30)*.

Skill: A specific cognitive or motor ability usually developed through training and practice in no specific context *(1)*.

Substandard and falsified medical products: Substandard medical products fail to meet quality standards or specifications set by national regulatory authorities, due to poor manufacturing, degradation or quality-control failures. Falsified medical products are those of which the identity, composition or source is deliberately or fraudulently misrepresented *(31)*.

Summative assessment: Appraisal of a student's work that determines or contributes to a final grade or score *(20)*.

Transdisciplinary approach: An approach to integrating a curriculum in which the boundaries between conventional disciplines and teaching and learning are organized by constructing meaning in the context of real-world problems or themes *(1)*.

1. Introduction

Antimicrobial resistance (AMR) occurs when bacteria, viruses, fungi or parasites do not respond to antimicrobial medicines. As a result of AMR, these medicines are ineffective and infections become difficult or impossible to treat *(5)*. AMR is a global health challenge, driven by inappropriate use of antimicrobials in human and animal health, their widespread use in livestock production, aquaculture and agriculture, lack of infection prevention and control (IPC) and water, sanitation and hygiene measures, and poor environmental management of waste containing antimicrobial residues *(32,33)*. AMR increases the risk of disease spread and the severity of illness and death, prolongs recovery time, increases treatment costs, strains already limited health-care resources and undermines public confidence in health-care systems. In 2021, bacterial AMR was estimated to have caused 1.14 million deaths directly and was associated with over 4.7 million deaths worldwide, indicating the urgency of coordinated global and national responses to prevent, detect and control its spread *(34)*. The development of new antimicrobials remains, however, limited due to scientific, regulatory and commercial barriers and the inherent shortcomings of the traditional research and development model *(35)*. Substandard and falsified antimicrobials are a further significant global problem, particularly in low- and middle-income countries, resulting in inadequate treatment and potentially accelerating the spread of AMR *(31)*. It is critical to protect the quality and effectiveness of antimicrobials by ensuring their appropriate production, distribution and use.

A central strategy to tackle AMR and promoting appropriate use of antimicrobials is equipping health professionals with the necessary competence through education and training. This priority is addressed in several major global policy documents: Global Action Plan on Antimicrobial Resistance (GAP-AMR) *(36)*, No time to Wait: Securing the future from drug-resistant infections *(37)*, World Health Organization (WHO) people centred approach to addressing AMR in human health *(38)* and the Political Declaration of the second United Nations General Assembly High-level Meeting on AMR. In 2018, WHO published a Competency Framework for Health Workers' Education and Training on Antimicrobial Resistance, which was designed to support academic institutions and regulatory bodies in ensuring that health professionals receive both pre-service and in-service training to develop the competence necessary to address AMR *(39)*. This was later complemented by the Health workers' education and training on antimicrobial resistance: curricula guide (2019), which provides quality standards for strengthening AMR-related competence among health professions *(40)*. Together, these documents outline the expected standards of practice in the different roles and responsibilities of health workers in mitigating AMR. The Global Competency and Outcomes Framework for Universal Health Coverage (2022) described the competences necessary to ensure appropriate use of medicines, including antimicrobials, as pivotal to achieving universal health coverage *(12)*. In 2024, WHO introduced the Antimicrobial resistance curriculum assessment tool for medical education to guide medical schools and universities in integrating AMR-related content into their curricula *(41)*. Expansion of AMR-related content to the curricula of other relevant health professions is imperative.

Pharmacists are often the first point of contact and the most accessible health workers. They also play a vital role in ensuring the safety of medicines and act as gatekeepers for AMU. They play crucial roles in containing AMR by: (i) ensuring appropriate, prescription-based antimicrobial dispensing, (ii) educating and counselling patients, promoting appropriate use of antimicrobials and increasing awareness about AMR; (iii) leading and conducting antimicrobial stewardship (AMS) programmes, policies and interventions; (iv) training other health professionals in AMS; (v) ensuring the quality and safety of antimicrobials; (vi) ensuring supply chain integrity and access to quality-assured antimicrobials and their safe disposal; (vii) leading research on drug use and

surveillance of AMU; (viii) participating in research and development and regulatory oversight of antimicrobials, (ix) providing support for vaccination and IPC; (x) monitoring and implementing AMR policies and treatment guidelines; and (xi) advocating for regulatory and policy changes for appropriate AMU. It is therefore essential that AMR content be integrated effectively into pre-service pharmacy educational curricula and that pharmacy students and trainees be equipped with the relevant competence to address AMR.

2. Scope and objectives

This curriculum assessment tool is designed for use in institutions that provide pre-service pharmacy education and training, including universities, pharmacy schools, teaching hospitals, health-care institutions and any organization that offers pharmacy curricula at the national or university level.

The aim of the tool is to:

- enable rapid, systematic assessment of a pharmacy curriculum, including its robustness for teaching and learning that covers the core competencies listed in the WHO Competency Framework for Health Workers' Education and Training on Antimicrobial Resistance *(39)*;
- assist in designing a strategy or reviewing existing processes and structures to enhance the AMR-specific and sensitive content of a curriculum for pharmacy students and trainees; and
- stimulate and facilitate structured dialogue on AMR-specific and -sensitive content among faculty and relevant stakeholders in pharmacy education.

The curriculum assessment tool is not intended to serve as a standard guideline for pharmacy education but rather as a self-assessment tool for AMR-specific and -sensitive content in pharmacy education. It is also not intended to be used for assessing students' competence nor for benchmarking one institution against another.

3. Approach to development

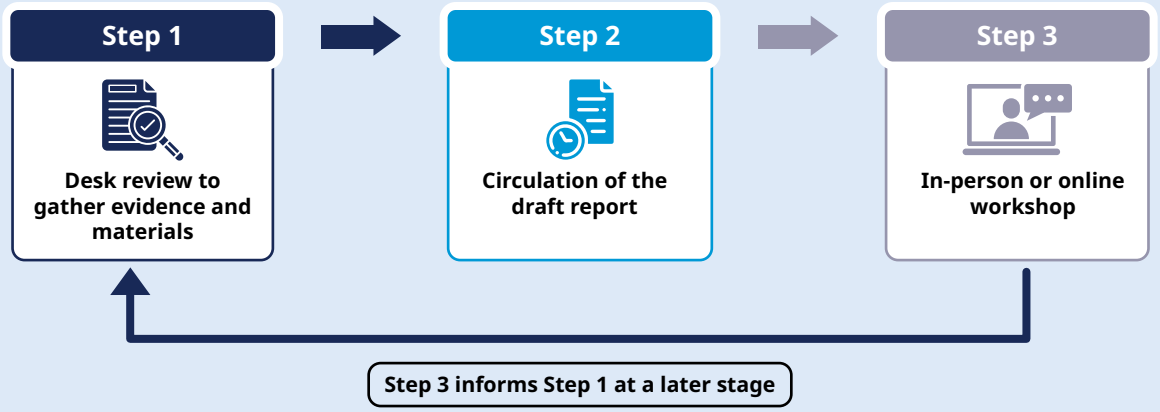
The first draft of the document was prepared by the AMR department of WHO, with inputs from various other WHO departments and regional offices. Fifteen external global experts in AMR and pharmacy education were recruited according to due process and regional representation, and the draft tool was further revised with their feedback. The tool was pilot tested in selected universities in Egypt, since the country is a regional leader in pharmacy education. The tool was revised based on qualitative insights and suggestions during the piloting. The tool was peer-reviewed by four independent experts before publication.

4. Setting up curriculum assessment

Curriculum assessment should be approached as a continuous quality improvement cycle rather than as a one-off exercise. Its primary goal is to strengthen the institutional capacity and capability to effectively deliver training on AMR, AMS, IPC, the identification and management of infectious diseases, and health-care waste management in an iterative manner. Initiation of curriculum assessment requires the full support and endorsement of senior management from the institution or, where applicable, the relevant regulatory authority for pharmacy education, while its continuity depends on the sustained commitment of faculty.

The assessment itself involves three steps (Fig. 1): (1) a desk review to collect and analyse all relevant documents and materials, (2) circulation of a draft report and (3) an in-person or online workshop, depending on which is most practical. This should be followed by remedial measures, to be implemented with the support of all stakeholders. The results of remedial measures and improvement in curricula can be reassessed after an agreed interval.

Fig. 1. Curriculum assessment



4.1 Desk review

The curriculum assessment should begin with a desk review, which should be planned, for example, 2–3 weeks before the workshop. The desk review should be done by at least two academics to ensure objectivity, in a consensus approach. The official version of the institution's curriculum should be the primary data source, supplemented as necessary by session titles and teaching and assessment materials. Data are collected to identify gaps and areas that require modification. This step can usually be completed within approximately 10 person-hours.

- It is recommended that the desk review be led by a focal point, i.e. an expert in pharmacy education with methodological expertise and experience in reviewing secondary data. The person should ideally be a faculty member in one of the core departments or subjects (e.g. pharmacology) or clinical practice and, if possible, have expertise in infectious disease management, AMS or AMR or have overseen teaching on infection, AMS and AMR (such as a topic "guardian" or module leader).

- The official version of the curriculum or syllabus should be used as the primary reference for this exercise. Any missing information in the curriculum or syllabus can be supplemented by evidence-supported input from the teaching faculty in the relevant department or subject and by information on curriculum planning or session titles from appropriate sources.
- The data collected during the desk review should be used to complete parts 1 and 2 of the curriculum assessment tool, with clear justifications provided for each score assigned in part 2.

The desk review provides the background for mapping and auditing the overall pharmacy curriculum and facilitating any future curriculum assessment.

4.2 Draft report

A draft curriculum assessment report should be sent to representatives of the relevant departments or subjects for their feedback. Enough time (e.g. 1–2 weeks) should be allocated for prospective workshop participants to review and comment on the draft report and to add any missing information. The final review report should then be distributed in a timely manner to all prospective workshop participants.

4.3 Workshop

The objective of the workshop is review and scoring of the curriculum by subject matter experts to identify any major gaps in AMR-specific and -sensitive curricular content. Another aim of the workshop is to assess institutional readiness to address any curricular gaps identified and to develop remedial plans. The suggested scoring system is outlined in the instructions and legends in parts 2 and 3 of the tool. The specific learning objectives and intended learning outcomes for each theme in part 2 of the tool, if available, should be discussed during the workshop.

The workshop is recommended to last half a day if conducted in person or approximately 3 h if held online. In both formats, time should be allocated for discussions among departmental representatives to reach consensus on scoring and remedial plans. Ideally, the workshop should bring together representatives of the following core subjects or departments:

- microbiology, including diagnostic sciences;
- pathophysiology, including infectious diseases;
- pharmacology, including pharmacokinetics, pharmacodynamics and pharmacogenomics;
- pharmaceutical and medicinal chemistry, including pharmaceutical analysis;
- pharmaceutics, industrial pharmacy, pharmaceutical technology, including vaccinology (if available);
- pharmacy practice, including pharmaceutical and person-centred care, pharmacy communication and consultation skills, IPC, pharmacoeconomics, pharmacy legislation and ethics;
- clinical pharmacy and/or pharmacotherapeutics, pharmacotherapy, including pharmacoepidemiology and research methods (if available);
- pharmaceutical public health, community pharmacy, population health, social and preventive pharmacy, health and wellness (if available); and
- infectious diseases clinical pharmacy (if available),

The optional subjects, if stand-alone courses are available:

- immunology;
- vaccinology;
- pharmacogenomics;
- pharmacy legislation and regulatory affairs
- pharmacy administration, pharmacoeconomics and health and pharmaceutical policy;
- social pharmacy and ethics;
- pharmacoepidemiology;
- pharmacognosy;
- research methodology; and
- interprofessional education.

Depending on the country, the institution and the structure of the pharmacy curriculum, departments and courses may be named or structured differently, and some general subjects may be subdivided into more specialized courses, which may be offered during training or residency or as part of postgraduate education. While some general subjects may include concepts relevant to all diseases and medicines, this tool is limited to management of infectious diseases, antimicrobials and general concepts associated with AMR and AMS. Such concepts may be taught and repeated in different departments and courses, each approaching them from a similar or distinct perspective. If the institution has an integrated, transdisciplinary or mixed curriculum, workshop participants should review and assess all core subjects and their corresponding themes in part 2 of this assessment tool to ensure that they are adequately covered.

- It is recommended that at least two representatives of each subject or department join the workshop to allow a consensus-based approach to verifying information in part 2 of the assessment tool.
- Inclusion of AMS or infectious diseases pharmacists who are currently practising is recommended to ensure relevance and alignment with local clinical practice. In many countries, they participate in training pharmacy students.
- Inclusion of representatives from medical and nursing schools (with expertise in IPC) and from allied health and social sciences is recommended, as they often participate in training pharmacy students in many countries and reflect the multidisciplinary nature of AMR and AMS.
- Inclusion of student representatives is also encouraged to ensure that their perspectives are represented and to verify whether they recall being taught AMR-specific and -sensitive content.

The following structure is suggested for the workshop. (The suggested agenda is given in Annex 1.):

    - an introductory session to outline the objectives of the assessment, familiarize participants with the tool, explain the instructions and scoring criteria, and present plans for using the findings, with the focal point to lead the introductory session and a rapporteur to document the discussions;
    - agreement on a method for resolving disagreements during the assessment;

- breakout discussions with departmental or subject representatives to deliberate on the themes and sub-themes in part 2 of the tool;
- presentation of the findings of breakout discussions in a plenary session;
- development of a strategy to address any gaps in curricula and programmes identified; and
- collaborative review and completion of Part 3 (Institutional readiness assessment tool).

The findings of the workshop should be documented in a concise report and submitted to the university management or the relevant authority for regulation of pharmacy education. The report should include a summary of the identified gaps and areas requiring major improvement, the agreed priorities and the assigned actions.

Follow-up meetings should be held approximately 6 and 12 months later to evaluate the progress of remediation measures proposed in the report.

5. AMR curriculum assessment tool for pharmacy education

The tool consists of three parts:

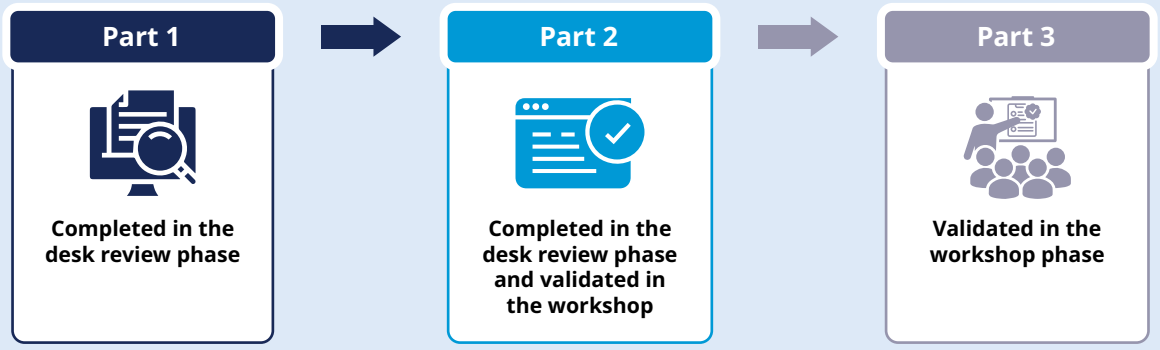
Part 1. Contextual information

Part 2. Assessment of curriculum content and scope

Part 3. Institutional readiness assessment tool

The stages at which each part should be completed are outlined in Fig. 2.

Fig. 2. Recommended phases for completing each part of the curriculum assessment tool



5.1 Part 1. Contextual information

Question		Responses and comments
1.	Name of institution or university	Simple and widely available; enables per capita comparisons
2.	Country	
3.	Year of establishment of pharmacy education programme	
4.	Current number of pharmacy students or trainees enrolled in the institution or university	
5.	Degree(s) offered upon completion (e.g. BPharm, PharmD, MPharm, DPharm) and corresponding duration(s) of pharmacy education	
6.	Curriculum model(s) in the institution or university (check all that apply)	☐ Didactic ☐ Integrated ☐ Transdisciplinary ☐ Interprofessional ☐ Competency-based ☐ Simulation-based ☐ Problem-based ☐ Discipline-based ☐ Case-based ☐ Clinical training ☐ Mixed ☐ Other_____
7.	Does the institution or university offer education in other health professional disciplines? If "Yes", please specify.	☐ Yes ☐ No
8.	Is the pharmacy education programme in the institution or university affiliated with a teaching hospital or other health-care institution?	☐ Yes ☐ No
9.	If the answer to question No. 8 is "Yes", is there an AMS committee (or equivalent) that could participate in the curriculum assessment?	☐ Yes ☐ No
10.	What is the level of institutional or university responsibility in pharmacy curriculum design, development and revision? Please specify.	☐ Full responsibility at institutional level ☐ Shared responsibility with regulatory or ministerial bodies ☐ Responsibility determined primarily by external authorities
11.	Must the curriculum be approved by a ministry or regulatory body? If "Yes", please specify.	☐ Yes ☐ No
12.	Has the institution or university a structure, unit or committee dedicated to improving the quality of pharmacy education? If "Yes", please specify.	☐ Yes ☐ No
13.	Is the institution or university accredited by any system for academic quality? If "Yes", please specify.	☐ Yes ☐ No
14.	Number of publications (e.g. papers, posters, guidelines) referring to infectious diseases, AMR, AMS or IPC published by faculty members of the institution or university in the past 5 years	
15.	Number of AMR-, AMS- or IPC-related public health awareness activities (e.g. media articles, social media posts, campaigns, webinars) conducted or produced by faculty members or students of the institution or university in the past 5 years	

5.2 Part 2. Tool for assessing curriculum content and scope

Instructions: For each theme, provide a qualitative rating on the scale below. Include a brief justification for each rating, and, when possible, cite syllabus pages or session titles.

Note: Assessment is qualitative and consensus-based, interpreted in the context of each setting. Reviewers should aim for consensus; any divergent ratings should be briefly explained.

The sub-themes are provided as guidance and reference only, and responses are not required for each. They represent recommendations, not mandatory content.

Legend:

A. Well covered: Themes that are taught in sufficient depth, frequency and clarity to ensure that students and trainees gain the intended knowledge. Thus, a theme is taught in sufficient depth when key principles are fully explained, learners can apply the concepts, instruction is not superficial and assessments demonstrate mastery. A theme is taught at sufficient frequency when it occurs in several courses or modules, is reinforced with various teaching methods and is assessed more than once.

B. Covered, minor improvement necessary: Themes are included in the curriculum but could benefit from small updates or adjustments to better achieve specific and intended learning outcomes.

C. Covered, major improvement necessary: Themes are included in the curriculum but require substantial structural revisions to improve their relevance, accuracy, frequency or depth, as most specific and intended learning outcomes are not being achieved.

D. Not covered. Themes that are entirely absent from the course content, teaching materials and instruction.

No.	Theme	Sub-themes	Response	Comments
1	**Microbiology, including diagnostic sciences**			
1.1	Fundamentals of microbiology	• Classification and key characteristics of microorganisms • Microbial cell structure, morphology and proliferation mechanisms • Bacterial metabolism, including catabolism (aerobic and anaerobic) and anabolism • Genetic mechanisms in bacteria, including gene transfer • Bacterial toxins and their biological effects • Staining as an identification technique, including Gram staining		
1.2	Fundamentals of infection and immunity	• Concepts of infection, including sources, routes and modes of transmission (including translocation) • Concepts of immunity, including immune system, immune responses and immune reactions • Basic principles of microbial pathogenicity, including colonization, infection, immunity and the role of the normal flora or microbiome • Resident and transient flora and their role in the human microbiome		

No.	Theme	Sub-themes	Response	Comments
1.3	Mechanisms of AMR	• Introduction to AMR • Intrinsic or innate and acquired resistance • Genetic mechanisms of AMR and selection pressure • Modes of transmission of resistance • Common concepts and terminology, such as carbapenem-resistant Enterobacterales, extended-spectrum beta-lactamase-producing Enterobacterales, carbapenem-resistant *Acinetobacter baumannii,* multidrug-resistant tuberculosis, vancomycin-resistant *Enterococcus,* methicillin-resistant *Staphylococcus aureus,* azole-resistant fungi		
1.4	Epidemiology of AMR	• Drivers of AMR • Impact of AMR on morbidity and mortality (burden of AMR) • Epidemiology of AMR, including local, national, regional AMR epidemiology, if available		
1.5	Disinfection and sterilization	• Concepts, principles and mechanisms of sterilization and disinfection • Typical physical and chemical sterilization methods • Indicators for sterilization • Typical disinfection methods and their effectiveness		
1.6	Diagnosis of infections, isolation and identification of bacteria	• Principal diagnostic methods and point-of-care testing for diagnosis and management of infections, including microbiology, molecular, haematology, biochemistry, immunology and imaging tests • Utility and limitations of investigations such as white blood cell counts, neutrophil:lymphocyte ratio, C-reactive protein and microbiological tests (including antimicrobial susceptibility testing) • Diagnostic accuracy measures (e.g. specificity, sensitivity and positive or negative predictive value) of commonly used tests • Turn-around time of commonly used tests • Principles and timing of sample collection for culture • Principal automated and manual culture methods and species identification • Concept of diagnostic stewardship		
1.7	Interpretation of the results of microbiological investigations to diagnose and monitor infections	• Interpretation of reports of test negativity, test positivity and antimicrobial susceptibility testing • Concept of categories of susceptibility: susceptible with normal exposure, susceptible with increased exposure and resistant • Use of minimum inhibitory and minimum bactericidal concentrations		

No.	Theme	Sub-themes	Response	Comments
		• Collaboration with prescribers in use of microbiological results for clinical management and to determine optimal treatment regimens • Alerts or appropriate communication of microbiological results, indicating carbapenem-resistant *Acinetobacter baumannii,* multidrug-resistant tuberculosis, vancomycin-resistant *Enterococcus,* methicillin-resistant *Staphylococcus aureus*		
1.8	Principles and utility of AMR surveillance	• Importance of AMR surveillance and antibiograms, their application in routine clinical care, development of local guidelines and considerations for careful data interpretation • Flow of microbiological data from specimen receipt to antimicrobial susceptibility testing and reporting to a data repository • AMR surveillance networks, including the Global Antimicrobial Resistance and Use Surveillance System (GLASS) and relevant (sub)national and regional surveillance networks (if available) • Priority pathogens list and its utility		

No.	Theme	Sub-themes	Response	Comments
2	**Pathophysiology, including Infectious diseases**			
2.1	Fundamentals of infectious diseases	• Host–pathogen interactions • Principles of diagnosing common infectious diseases and syndromes according to established criteria, clinical scores and guidelines • Transmission and prevention of common infectious diseases • Health-care-associated and community-acquired infections • Self-limiting or mild infections that do not require antimicrobials		
2.2	Fundamentals of respiratory infections	• Etiology and epidemiology of upper (including ear, nose and throat) and lower respiratory tract infections, including tuberculosis • Clinical manifestations and natural evolution of respiratory tract infections, including symptoms that indicate urgent referral • Differentiation between bacterial and viral etiology (and associated challenges) • Pharmacological (including symptomatic) treatment of respiratory infections • Management of upper respiratory self-limiting viral infections that do not require antimicrobials • Empirical and targeted antimicrobial therapy for respiratory infections		

No.	Theme	Sub-themes	Response	Comments
2.3	Fundamentals of gastrointestinal and intra-abdominal infections	• Etiology and epidemiology of gastrointestinal and intra-abdominal infections • Clinical manifestations of gastrointestinal and intra-abdominal infections, including symptoms that indicate urgent referral • Pharmacological (including symptomatic) treatment of gastrointestinal and intra-abdominal infections • Management of gastrointestinal infections that do not require antimicrobials • Empirical and targeted antimicrobial therapy for gastrointestinal and intra-abdominal infections		
2.4	Fundamentals of genital and urinary tract infections	• Etiology and epidemiology of genital tract infections (including obstetric infections) and upper and lower urinary tract infections • Clinical manifestations of genital and urinary tract infections, including symptoms that indicate urgent referral • Asymptomatic bacteriuria • Pharmacological (including symptomatic) treatment of genital and urinary tract infections • Empirical and targeted antimicrobial therapy for genital and urinary tract infections • Prevention of recurrent urinary tract infection by non-pharmacological methods		
2.5	Fundamentals of sexually transmitted infections (STIs)	• Etiology and epidemiology of STIs • Clinical manifestations of STIs, including symptoms that indicate urgent referral • Prevention of STIs • Pharmacological (including symptomatic) treatment of STIs • Syndromic management of STIs • Empirical and targeted antimicrobial therapy of STIs		
2.6	Fundamentals of bloodstream and systemic infections	• Etiology and epidemiology of bloodstream and systemic infections, including sepsis and septic shock • Clinical manifestations of bloodstream and systemic infections, including symptoms that indicate urgent referral • Pharmacological (including symptomatic) treatment of bloodstream and systemic infections • Empirical and targeted antimicrobial therapy in sepsis, including AMS principle in management of sepsis		
2.7	Fundamentals of cardiovascular system infections	• Etiology and epidemiology of cardiovascular infections (e.g. endocarditis, vascular infections, rheumatic heart disease)		

No.	Theme	Sub-themes	Response	Comments
		• Clinical manifestations of cardiovascular infections, including symptoms that indicate urgent referral • Pharmacological (including symptomatic) treatment of cardiovascular infections • Empirical and targeted antimicrobial therapy in rheumatic fever and heart disease and long-term prophylaxis		
2.8	Fundamentals of central nervous system (CNS) infections	• Etiology and epidemiology of CNS infections (e.g. meningitis, encephalitis) • Clinical manifestations of CNS infections, including symptoms that indicate urgent referral • Pharmacological (including symptomatic) treatment of CNS infections • Empirical and targeted antimicrobial therapy in bacterial meningitis and viral encephalitis		
2.9	Fundamentals of bone and joint infections	• Etiology and epidemiology of bone and joint infections • Clinical manifestations of bone and joint infections, including symptoms that indicate urgent referral • Pharmacological (including symptomatic) treatment of bone and joint infections • Empirical and targeted antimicrobial therapy of bone and joint infections		
2.10	Fundamentals of skin and soft tissue infections	• Etiology and epidemiology of skin and soft tissue infections • Clinical manifestations of skin and soft tissue infections, including symptoms that indicate urgent referral • Pharmacological (including symptomatic and topical) treatment of skin and soft tissue infections • Empirical and targeted antimicrobial therapy for skin and soft tissue infections • Prevention of skin and soft tissue infectious with non-pharmacological methods		
2.11	Fundamentals of surgical-site infections (SSI)	• Etiology and epidemiology of SSI • Clinical manifestations of SSI • Prevention of SSI, including IPC measures and surgical antibiotic prophylaxis • Principles of surgical antibiotic prophylaxis, including choice, timing, dosing and duration of antibiotics according to evidence-based recommendations • WHO global guidelines for the prevention of SSI *(42)* • Targeted pharmacological treatment of SSI		

No.	Theme	Sub-themes	Response	Comments
2.12	Infections in immunocompromised patients	• Etiology, clinical manifestation and epidemiology of common opportunistic infections in immunocompromised patients • Preventive therapy for opportunistic infections • Pharmacological (including symptomatic) treatment of common opportunistic infections in immunocompromised patients		

No.	Theme	Sub-themes	Response	Comments
3	**Pharmacology, including pharmacokinetics, pharmacodynamics and pharmacogenomics**			
3.1	Fundamental concepts of antimicrobials	• Classification of antimicrobials • Antimicrobial mechanism of action and mechanisms of resistance to them • Antimicrobial spectrum and activity against key human pathogens • Bacteriostatic versus bactericidal antibiotics		
3.2	Clinical use and principles of antimicrobial selection	• Clinical use and indications for use of antimicrobials: prophylactic, empiric, syndromic and targeted • Selection of antimicrobials for common infections • Contraindications for use of specific antibiotics • Alternatives to antimicrobials (e.g. vaccines, pre-and probiotics, natural products with antimicrobial properties), including experimental therapy, such as phage therapy, host-directed therapy, immunotherapy (May be covered in other subjects or courses.) • Introduction to WHO Access, Watch and Reserve (AWaRe) antibiotic book *(3)* and evidence-based standard treatment guidelines for management of infections • Impact of resistance on individuals and populations in selection of antimicrobials • Embedding AMS principles in all stages of AMU, from initiation and review to cessation		
3.3	Pharmacokinetics of antimicrobials	• Membrane transport mechanisms and antimicrobial penetration to target sites • Absorption, distribution, metabolism and excretion of antimicrobials • Routes of administration, frequency and duration of antimicrobial therapy • Bioavailability and bioequivalence of antimicrobials • Pharmacokinetics parameters: elimination half-time, volume of distribution, clearance, absorption and elimination rate constants		

No.	Theme	Sub-themes	Response	Comments
		• Pharmacokinetics of drug interactions • Implications of pharmacokinetics on antimicrobial selection and dosing • Principles of therapeutic drug monitoring		
3.4	Pharmacodynamics and therapeutic effects of antimicrobials	• Binding of antimicrobials to their molecular targets, including mechanisms of action and strategies to overcome resistance • Dose–response relationship • "Drug–bug" combinations in terms of concentration–time relationships (concentration-dependent versus time-dependent antimicrobials) • Therapeutic index • Physiological, biochemical and therapeutic effects • Pharmacodynamics of drug interactions • Therapeutic rationale and mechanism of action of antimicrobial fixed-dose combinations, including not recommended fixed-dose combinations		
3.5	Pharmacodynamics, adverse effects and safety profile of antimicrobials	• Tissue and organ adverse effects • Toxicity of antimicrobials and approaches to harm minimization • Safety profile of antimicrobials in special conditions: pregnancy and lactation, renal and hepatic impairment, neonatal and paediatric populations, geriatrics, nutritional extremes, comorbidity, immunodeficiency, allergic or intolerance reactions • Interpretation of allergic reactions and intolerance • Effects of antimicrobials on normal microbial flora and the risk of secondary bacterial or fungal infections		
3.6	Fundamentals of pharmacogenomics in antimicrobial pharmacotherapy	• Pharmacogenomic principles in antimicrobial therapy, including the impact of cytochrome P450 polymorphisms on doses of medicine and selection pressure for resistance • Application of pharmacogenomic testing to guide individualized antimicrobial selection and dosing • Utility and limitations of pharmacogenomic testing in AMS, illustrated by real-world examples		

No.	Theme	Sub-themes	Response	Comments
4	**Pharmaceutical and medicinal chemistry, including pharmaceutical analysis**			
4.1	Properties of antimicrobials	• Nomenclature, including International Nonproprietary Names, and classification of antimicrobials • Physicochemical and organoleptic properties of antimicrobials • Stereochemistry and structure–activity relationship of antimicrobials, including interactions between antimicrobial structures with microbial targets • Basis of selectivity and resistance mechanisms • Chemical degradation of antimicrobials • Stability of antimicrobials • Therapeutic equivalence of antimicrobials		
4.2	Research and development of antimicrobials	• Isolation and synthesis of antimicrobials • Development of antimicrobials, including increasing spectrum and resistance to bacterial enzymes • Principles of antimicrobial design and discovery • Antimicrobial drug repurposing • Principles of lead optimization, preclinical development and clinical trials		

No.	Theme	Sub-themes	Response	Comments
5	**Pharmaceutics. industrial pharmacy, pharmaceutical technology, including vaccinology**			
5.1	Pharmaceutical dosage forms and formulations	• Influence of pharmaceutical dosage forms on pharmacokinetics and stability of antimicrobials • Influence of pharmaceutical dosage forms on route of administration, patient safety and adherence • Appropriate formulation and preparation (e.g. compounding) of antimicrobial therapy for special populations • Formulation of antimicrobial fixed-dose combinations		
5.2	Quality-assurance of medical products, including antimicrobials	• Quality of antimicrobials • Quality-control testing, including assay of antimicrobials • Stability testing of antimicrobials • Bioequivalence of generic antimicrobials • Sterile and non-sterile compounding of antimicrobials • Principles of good manufacturing and laboratory practices		

No.	Theme	Sub-themes	Response	Comments
5.3	Identification of substandard and falsified medical products, including antimicrobials	• Principal methods for identification of substandard and falsified medical products, including antimicrobials • Prevalence and risks of substandard and falsified medical products, including antimicrobials • National and global reporting systems for sub-standard and falsified medical products, including antimicrobials		
5.4	Fundamentals of vaccinology	• Types of immunity and immune reactions • General principles of immunization • Overview of vaccine-preventable diseases and indications for vaccination • Types of vaccines • Principles of vaccine development and design • Stability of vaccines • Adverse effects after immunization and pharmacovigilance		

No.	Theme	Sub-themes	Response	Comments
6	**Pharmacy practice, including pharmaceutical and person-centred care, pharmacy communication and consultation skills, IPC, pharmacoeconomics and pharmacy legislation and ethics**			
6.1	Pharmaceutical and person-centred care in use of antimicrobials	• Review of appropriateness of prescriptions for antimicrobial therapy, adherence to indication and antimicrobial selection, route, dose, frequency and duration of therapy to evidence-based treatment guidelines • Antimicrobial selection and dosing adjustment according to patient factors, e.g. age, weight, pregnancy and lactation, allergies, intolerances, comorbidities, immunodeficiency, renal and hepatic function • Identification and resolution of therapeutic contraindications and drug interactions • Review of medication use and management of duplication of therapy and polypharmacy • Appropriate packaging and labelling of antimicrobials during dispensing • Documentation and recording relevant health and prescription data, including allergy status • Therapeutic monitoring of antimicrobial treatment		
6.2	Patient counselling, education and engagement in appropriate AMU	• Treatment indication and relevant patient history • Safe, appropriate use of antimicrobials (dose, frequency, duration), when and how to take medicines (e.g. before or after a meal)		

No.	Theme	Sub-themes	Response	Comments
		• Drug interactions • Possible adverse effects, including allergy and intolerance, during and after use of antimicrobials and how to document and report them • Expected course of illness and when to follow up or seek medical attention • Importance of adherence to prescribed regimen, with deviations only according to medical advice • Pharmacological and/or symptomatic management of self-limiting infections that do not require antimicrobials (e.g. upper respiratory tract infections) • Managing patient expectations and requests for antibiotics for self-limiting infections • Risks of self-medication and misuse of antimicrobials, including sharing prescribed medicines with friends and family and use of leftovers • Storage, return and safe disposal of antimicrobials		
6.3	Pharmacy consultation and communication skills	• Effective, respectful, inclusive communication strategies • Respect for patients' privacy and confidentiality • Empathy and rapport-building • Patient-as-partner in health • Evidence-based strategies to increase understanding of condition and adherence to therapy • Cultural sensitivity and non-judgemental communication of stigmatized conditions		
6.4	Interprofessional collaboration in AMS and optimization of antimicrobial therapy	• Concepts of high-quality, person-centred care and continuity of care • Principles of AMS as an initiative for patient safety and quality • Roles of community and clinical pharmacists and other health professionals in AMS and drug and therapeutics committees • Prescription review and consulting prescribers to clarify dosing regimens, therapeutic contraindications, drug interactions or adverse effects • Adherence to up-to-date evidence-based treatment guidelines and lists of essential medicines • Evidence-based collaboration in developing antibiotic guidelines, IPC and management of health-care-associated infections • AMR and AMU surveillance (see 1.8 and 7.6) • Identification, reporting and resolution of medication errors • Planning, implementing and evaluating AMS interventions		

No.	Theme	Sub-themes	Response	Comments
6.5	AMS in primary and community health care (See 7.4 for AMS in secondary and tertiary health care.)	• Principles of person-centred pharmaceutical care on use of antimicrobials (see also 6.1) • Patient counselling, education and engagement in appropriate use of antimicrobials (see also 6.2) • Relevant diagnostic criteria, scores and guidelines for pharmacists (when applicable) • Delayed or deferred antibiotic prescribing • Good prescribing and dispensing practices for antimicrobials • AWaRe antibiotic book and standard treatment guidelines • Dispensing the exact quantity of prescribed antimicrobials (when relevant) • Audit and feedback on antimicrobial prescriptions, and AMU surveillance • Raising awareness of AMR among health professionals, patients and the public (see 8.2) • Concept of collaborative practice agreement for pharmacists (when relevant) • Concept of outpatient service for parenteral antimicrobial therapy (when relevant) • Point-of-care testing and triage in treatment protocols for local referral and prescribing (when relevant)		
6.6	Procurement and supply chain management of medical products, including antimicrobials, diagnostics and vaccines	• Concept of national essential medicines list and facility formulary • Principles of pharmacy stock inventory and management • Principles of quantification and forecasting of medical supplies, including antimicrobials • Good practices for procurement of quality-assured, cost-effective medical products, including antimicrobials, diagnostics and vaccines • Concept of push–pull supply system (forecast-based versus demand-based supply) • Systems for reporting and addressing medicines shortages, including contingency plans for antimicrobial shortages (if available) • Good storage and distribution practices for antimicrobials • Principal market access strategies including pricing mechanisms, for antimicrobials • National health financing system (if available)		

No.	Theme	Sub-themes	Response	Comments
6.7	Legislation, regulation, policy and ethics in pharmacy practice	• National health and medicines policy • Laws and regulations to ensure quality, efficacy and safety of medicines, including antimicrobials • National regulations on procurement, storage, distribution and dispensing of medicines, including antimicrobials • Prescription versus over-the-counter medicines for infection management • National regulation of over-the-counter and online antimicrobial sales • Regulations on market incentives for prescription of antimicrobials (if available) • Pharmacovigilance and reporting of adverse effects to regulatory authorities • Reporting of substandard and falsified medicines, including antimicrobials, to regulatory authorities • Recall of medical products, including antimicrobials • Good clinical practice, drug development stages and requirements (preclinical, clinical, approval, marketing, post-marketing) for antimicrobials • Regulatory review and marketing authorization • Health data protection policy • Code of ethics for pharmacists		
6.8	Fundamentals of IPC and standard precautions	• Concept and significance of IPC • Principles of infection transmission and approaches to breaking the chain in clinical practice • Risk assessment of patients and settings • Standard and transmission-based precautions • Hand hygiene, including “five moments of hand hygiene” and appropriate use of hand-rubs • Appropriate use of personal protective equipment • Respiratory hygiene and cough etiquette • Prevention of community- and health-care-associated infections, including SSI • Role of environmental reservoirs on health-care-associated outbreaks of disease • Concept, basic principles and importance of water, sanitation and hygiene		

No.	Theme	Sub-themes	Response	Comments
6.9	IPC in pharmacy practice	• Infection control standards in pharmacy (e.g. laminar air flow, personal protective equipment, hand hygiene, clean room, clean counting trays, countertops and equipment) • Aseptic and sterile techniques in preparation and handling of medicines • Applications, preparation and optimal concentrations of representative disinfectants • Handling of single- and multiple-dose vials • Injection safety, needle stick injuries and sharps safety programmes (when relevant) • Surveillance system for medicines contamination • Link between IPC and AMS		
6.10	Waste management in health-care facilities	• Principles of biomedical waste management • Segregation at source and disposal of infectious waste from health-care facilities • Decontamination and safe disposal of antimicrobials • Green pharmacy principles		

No.	Theme	Sub-themes	Response	Comments
7	**Clinical pharmacy and/or pharmacotherapeutics, pharmacotherapy, including pharmacoepidemiology, and research methodology**			
7.1	Optimization of antimicrobial pharmacotherapy	• Route, dose, frequency and duration of antimicrobial therapy • Pharmacokinetics and pharmacodynamics of antibiotics and use of the area under the curve of plasma drug concentration–time and minimum inhibitory concentrations to calculate the pharmacokinetics of optimization of antibiotic selection, dosing and administration • Adjustment of antimicrobial selection and dosing in pregnancy and lactation, renal or hepatic impairment, comorbidities, neonatology and paediatrics, geriatrics, immunodeficiency, obese and malnourished patients • Principles and criteria for escalation, de-escalation and discontinuation of therapy • Oral route optimization and switch from intravenous to oral antimicrobial therapy • Development of pharmaceutical care plan based on review of medication use		

No.	Theme	Sub-themes	Response	Comments
7.2	Antimicrobial treatment monitoring	• Detection and prevention of drug interactions (drug–drug, drug–food or alcohol, drug-disease) • Management of duplication of therapy and polypharmacy • Assessing and documenting history of antimicrobial allergy and intolerance, including (spurious) penicillin allergy label • Types of hypersensitivity reactions (immediate, non-life-threatening and life-threatening) • Adverse drug effects and pharmacovigilance • Clinical manifestation of antimicrobial toxicity and its management • Therapeutic drug monitoring, including indications, timing of sampling and interpretation of results • Adverse effects of antimicrobials on normal microbial flora • Alternative regimes in case of toxicity, hypersensitivity, drug interactions or adverse effects		
7.3	Interpretation of laboratory parameters and reports for management of infections	• Collaborative, evidence-based selection of antimicrobial therapy based on relevant laboratory results and clinical progression • Monitoring and interpretation of laboratory parameters to adjust or optimize antimicrobial therapy • Interpretation of dose–response relations such as minimum inhibitory concentrations in reports on AMR		
7.4	AMS in secondary and tertiary health care (For AMS in primary and community care, see 6.5)	• Optimization and monitoring of antimicrobial treatment (see 7.1, 7.2 and 7.3) • Interprofessional collaboration in AMS (see 6.4) • Antibiotic time-outs • Formulary restriction or preauthorization • Audit, feedback and surveillance of AMU • Use of decision-support tools (paper-based or electronic)		

No.	Theme	Sub-themes	Response	Comments
7.5	AMS governance in health-care facilities	• AMS programme implementation according to national or international guidance (e.g. WHO AMS toolkit) *(6)* • Adherence to up-to-date evidence-based lists of essential medicines, treatment guidelines and guidelines for perioperative surgical prophylaxis • Favouring "Access" and cost-effective antibiotics when possible *(3)* • Safe introduction of new, broader-spectrum and/or last-resort "Reserve" antibiotics into treatment regimens • Quality and representativeness of local AMR data and their influence on updating empiric regimens, drug formularies and evidence-based treatment guidelines • Principles of quality improvement and interventions in AMS • Evaluation of AMS interventions		
7.6	Monitoring and quantification of AMU and data on cost and expenditure	• Utility and importance of AMU and cost/expenditure surveillance • Types and methods for collecting and analysing data on AMU and surveillance of cost and expenditure • Classification and identification of medicines, including Anatomical Therapeutic Chemical classification, generic or International Nonproprietary Name and local product codes (if any) • International Classification of Diseases • Standard indicators and measures of drug use, such as defined daily dose and days of therapy • Importance and best practices for audits of prescriptions for appropriateness of AMU (e.g. point-prevalence surveys), including performance indicators • National and international AMU surveillance networks, including GLASS-AMU • Analysis of AMU according to the WHO AWaRe classification and global target of 70% use of Access drugs *(3)* • Use of AMU data for cost–effectiveness analysis • Interpretation and use of data on AMU and cost-effectiveness for planning and monitoring AMS interventions and policy decisions		

No.	Theme	Sub-themes	Response	Comments
7.7	Conducting research on antimicrobials, AMR and AMS	• Role of pharmacists in conducting quantitative and qualitative research on antimicrobials, AMR and AMS in health care or industry • Principles of research on drug use • Importance of patient participation in research • Interpretation of clinical trial data for superiority, non-inferiority, equivalence and adverse effects • Overview and examples of local, national and global research priorities and agendas, including WHO research agendas and priorities on AMR and One Health *(43,44)*		

No.	Theme	Sub-themes	Response	Comments
8	**Pharmaceutical public health, community health, population health, social and preventive pharmacy, health and wellness**			
8.1	National vaccination programmes	• National immunization programmes or lists of compulsory and recommended vaccines • Timing, schedule and routes of administration of recommended vaccines • Benefits and risks of vaccination • Adverse effects after immunization and pharmacovigilance • Awareness and cultural sensitivities • Impact of vaccination on reducing disease burden, AMU and AMR • Addressing vaccine hesitancy such as by motivational interviewing • Overview of pharmacy delivery of vaccines (if applicable)		
8.2	Awareness of AMR by health professionals, patients and public	• Importance of safe, appropriate use of antimicrobials and addressing drivers of AMR • Communication of evidence-based infection management, use of antimicrobials and AMS principles, including adherence to prescribed therapy and safe storage and disposal of antimicrobials • Importance of quality-assured antimicrobials • Promotion of vaccination and IPC • Delivery of tailored academic training in AMS • WHO AWaRe classification of antibiotics *(3)* • World AMR Awareness Week campaign • Patient participation or people-centred approach to AMR		

No.	Theme	Sub-themes	Response	Comments
8.3	Principles of health behaviour and promotion, behavioural change and behavioural change communication	• Fundamental understanding of factors (e.g. socioeconomic, cultural) that influence health and health-seeking behaviour • Determinants of health • Health promotion and evidence-based ways of increasing IPC and healthy habits • Basic concepts of behavioural change theories • Social and professional role of pharmacists in AMR, AMS and IPC in communities and health-care settings • AMR-appropriate behaviour of health professionals and behavioural change interventions in health-care facilities • Planning awareness and behavioural change programmes on AMR for health professionals and the public		
8.4	Health inequity and AMR	• Concept of health inequality versus inequity and factors that lead to health inequity • Impact of health system weaknesses on AMR • Interconnectedness of health inequity and AMR • Inadequate access to health services as a driver of AMR • Overview of vulnerable populations at higher risk of AMR (e.g. women, children, caregivers, elderly, forcibly displaced people) • United Nations Sustainable Development Goals • Concept of universal health coverage as a solution to AMR and other health problems		
8.5	National action plan and strategies on AMR	• National action plan on AMR and its implementation • Priority health interventions in national action plan • Other relevant health sector plans and strategies on AMR		
8.6	One Health approach to AMR prevention and mitigation	• Concept of One Health • Drivers of AMR from a One Health perspective • Basic principles of use of antimicrobials, AMS and IPC in animal health, the agrifood sector and aquaculture • Environment as a disseminator and possible amplifier of AMR • Multisectoral interventions to mitigate AMR		

5.3 Part 3. Institutional readiness assessment tool

Note: This section should be completed only when the curriculum assessment workshop is conducted in a pharmacy school, an educational institution, an affiliated teaching hospital or a university.

Legend:

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

No.	Question	Response	Comments
1	**Policies on AMR education in pharmacy studies**		
1.1	Is there a mandatory or recommended policy requiring students in the pharmacy faculty of your educational institution, affiliated hospital or health-care institution to receive training in AMR, AMS and IPC?		
1.2	Is there a national, sub-national or local strategy or policy on AMR, AMS and IPC education for pharmacists to which your educational institution or affiliated hospital or health-care institution refers?		
1.3	Is there current, evidence-based, standard treatment guidance for management of infectious conditions to which your educational institution or affiliated hospital or health-care institution refers in training pharmacists?		
2	**Infrastructural resources for delivering education on AMR in pharmacy institutions**		
2.1	Does your educational institution or affiliated hospital or health-care institution have a functional clinical, research or educational microbiology laboratory for practical, hands-on training of pharmacy students and trainees?		
2.2	Do pharmacy students and trainees in your educational institution or affiliated hospital or health-care institution receive adequate clinical exposure to learn to prevent and manage infections?		
2.3	Does your educational institution or affiliated hospital or health-care institution have a functioning biomedical waste management system, including segregation at source, that can be demonstrated to pharmacy students and trainees? If not, does your educational institution organize visits to functional biomedical waste management units in health-care institutions?		
2.4	Does your educational institution have access to national or international e-learning platforms that provide content or courses on AMR, AMS and IPC for pharmacy students and trainees?		
2.5	Does your affiliated hospital or health-care institution have a functional IPC committee and an IPC programme for access by pharmacy students and trainees?		
2.6	Does your affiliated hospital or health-care institution have a functional committee for AMS or antibiotic policy and/or drugs and therapeutics to provide practical, hands-on training in AMS to pharmacy students and trainees?		

No.	Question	Response	Comments
3	**Human resources for AMR education in pharmacy**		
3.1	Does your educational institution have an adequately staffed and trained pharmacology department to deliver training in AMR and AMS to pharmacy students and trainees?		
3.2	Does your educational institution have an adequately staffed and trained microbiology department to deliver training in AMR and IPC to pharmacy students and trainees?		
3.3	Does your educational institution have an adequately staffed and trained clinical pharmacy department to deliver training in AMR, AMS and AMU to pharmacy students and trainees?		
3.4	Does your educational institution have an adequately staffed and trained public health, community health or similar pharmacy department to deliver training in AMR and its mitigation to pharmacy students and trainees?		
3.5	Does your educational institution or affiliated hospital or health-care institution have adequate clinical personnel (e.g. physicians, clinical pharmacists, nurses, clinical microbiologists) to provide training in infectious diseases, AMR, AMS and IPC to pharmacy students and trainees?		
4	**Integration of AMS into pharmacy education**		
4.1	Does your educational institution or affiliated hospital or health-care institution organize regular training and events on AMR, AMS, AMU and IPC for pharmacy faculty and students and trainees?		
4.2	Does your educational institution have an allocated budget for AMR-, AMS-, AMU- and IPC-related training and events in the pharmacy programme?		
4.3	Are AMR, AMS, AMU and IPC integrated into the core pharmacy curriculum of your educational institution?		
4.4	Does your educational institution or affiliated hospital or health-care institution provide case-based or clinically contextualized training in AMR, AMS, AMU and IPC for pharmacy students and trainees?		
4.5	Does your educational institution or affiliated hospital or health-care institution provide interprofessional education or training in AMR, AMS, AMU and IPC for pharmacy students and trainees?		
4.6	Does your affiliated hospital or health-care institution participate in any routine reporting or surveillance system on AMR, AMU and/or IPC?		
4.7	Does your educational institution collaborate with national or international partners (e.g. public health agencies, nongovernmental organizations, WHO or professional associations) to increase education or training on AMR, AMS, AMU and/or IPC for the pharmacy faculty and/or students and trainees?		
5	**Assessment of AMR education and training**		
5.1	Is there a system in place to assess the capability of faculty staff to deliver training in AMR, AMS, AMU and IPC?		
5.2	Is there a system in place to provide pharmacy students and trainees with structured feedback on their knowledge and competence about AMR, AMS, AMU and IPC?		
5.3	Is there adequate attendance at training events and courses on AMR, AMS, AMU and IPC (if provided, see question 4.1)?		

6. Remedial measures

Curriculum assessment

Any gaps in the AMR curricula identified in the assessment should be reviewed with the relevant departments and course leaders. Priority should be given to AMR-specific and -sensitive themes that were identified as not covered (rating D) or as covered but requiring major improvement (rating C). Each department is expected to develop a brief short-term remedial plan, outlining specific learning objectives and intended learning outcomes to directly address the gaps highlighted in the assessment. The plans should be coordinated with those of other departments involved in AMR education to ensure transdisciplinary learning and to contribute to overall improvement of the curriculum at the institution. The results of the curricular assessment should be archived systematically and used for comparison with subsequent assessments.

Integrated teaching programmes or curricula have been widely adopted to prevent compartmentalization in the pre-service education of health professionals. This approach combines content from different disciplines into a cohesive learning experience, rather than teaching them in isolation. Several departments collaborate to deliver inter-departmental courses and sessions that contribute to defined learning outcomes at institutional and programme levels. Given the multidisciplinary nature of AMR, integration of relevant interprofessional subjects into pre-service health professional education is recommended to strengthen interprofessional collaboration, enhance understanding of roles and promote effective teamwork.

Curriculum mapping is valuable for visualizing transdisciplinary links and the learning outcomes of institutional programmes, courses and sessions *(45)*. The curriculum could be mapped in a workshop involving all relevant departments and course leaders, guided by the findings of the curriculum assessment tool and the gaps identified *(46)*.

In the medium term, the most sustainable approach is to integrate AMR-specific and -sensitive themes into the pharmacy curriculum as recommended by the institution, university or national regulatory body, after a thorough evaluation of the AMR-, AMS- and IPC-related competence expected of pharmacists *(47)*. Integration of AMR-specific and -sensitive themes should be aligned with the overall structure and design of the pharmacy curriculum. When curriculum development is centralized at national level, it is essential to conduct assessments in several universities or institutions and to use the findings for advocacy.

If the university is already using competence-based education, the identified gaps should be mapped to specific competencies, which can be identified in the WHO Competency Framework for Health Workers' Education and Training on Antimicrobial Resistance *(39)*. Additional guidance on adapting competence-based education and outcomes can be found in the WHO Global Competency and Outcomes Framework for Universal Health Coverage *(12)*.

Institutional readiness

Deficiencies identified in the institutional readiness assessment can be addressed by active leadership in the institution or university. For instance, a policy to train staff in AMR could easily be established, or a standard treatment guideline for infectious diseases could be adopted, such as The WHO AWaRe antibiotic book *(3)*. A list of management actions that require minimal investment can be developed, discussed and submitted to the leadership for implementation.

Addressing deficiencies in infrastructure and human resources requires careful planning and effective resource mobilization. A costed plan for bridging gaps should be developed and presented to the institution's leadership, with clear justifications for prioritizing AMR, supported by global, national and local data.

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Further resources

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Annex. Suggested agenda for the workshop

Session	Objectives	Online (2.5–3 h)	In-person (4–5 h)
Introduction	• Outline objectives. • Introduce the tool and its components. • Explain the instructions and scoring criteria. • Present plans for using the findings.	10 min	20 min
Agreement on method for resolving disagreements	Discuss consensus and voting approaches to resolving disagreements, and agree on one.	3–5 min	5 min
Break-out discussions with department or course representatives	Discuss themes and sub-themes to be debated.	1–1.5 h	1.5–2 h
Plenary to discuss Part 2 of the tool	• Present findings of break-out discussions. • Ask and answer questions about the responses.	30 min	45–50 min
Definition of a remedial strategy	Define steps for addressing the curricular and programme gaps identified.	20–25 min	30–45 min
Review of Part 3 of the tool	Complete the Institutional Readiness Assessment Tool as a group.	20–25 min	30–45 min
Plan documentation of the workshop findings.	Summarize identified gaps and areas that require major improvement, agree on priorities, and assign actions.	5 min	10–20 min

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