



WHO COMPETENCY FRAMEWORK FOR HEALTH WORKERS' EDUCATION AND TRAINING ON ANTIMICROBIAL RESISTANCE



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Foreword

Antimicrobial resistance (AMR) represents a major health and socioeconomic threat, with the potential for devastating consequences to the health of millions of people globally if concrete steps are not taken to address it. The appropriate use of antimicrobial medicines for preventive and curative measures is vital to ensure continued success with common and complex medical interventions, and to slow or reverse the progress of resistance. Since the adoption of the WHO Global Action Plan on Antimicrobial Resistance by Member States in May 2015, remarkable progress has been made by all stakeholders to ensure that AMR is getting the attention it deserves and is a priority on the health action agenda in countries. Global programmes and events, such as the World Antibiotics Awareness Week, continue to help raise public awareness and understanding to scale up action.

The misuse and overuse of antimicrobials in human medicine and food production have contributed to the increase in the prevalence of AMR. In the human health sector, a major reason given by health workers and students for the misuse of antimicrobials is the lack of understanding and adequate expertise to address AMR. A key approach to address this challenge and ensure the appropriate use of antimicrobials is to ensure that health workers acquire, through their education and training, the competencies required to prevent and combat AMR, as stated in the first objective of the WHO Global Action Plan on AMR. Although most countries have a national action plan to address AMR, the variability in quality and uneven coverage of initiatives to strengthen education and training of health workers on AMR require a standardization of educational resources for AMR that reflects global evidence and best practices but can be adapted locally. Education and training capacity and resources are currently known to differ markedly across regions and settings. This WHO competency framework for education on AMR is strategic and timely, given the widespread perception among health workers of insufficient knowledge and expertise on the topic, resulting in inappropriate antimicrobial prescription and use practices. This competency framework is intended to serve as a reference for academic institutions, educators, accreditation bodies, regulatory agencies and other users to help ensure that pre-service education and in-service training equip health workers with the requisite competencies to address AMR. It complements other relevant existing WHO guidance on AMR and lays the foundation for the development of more in-depth educational resources and AMR curricula.

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Abbreviations and acronyms

AMR	antimicrobial resistance
AMR GAP	Global Action Plan on Antimicrobial Resistance (WHO)
AWaRE	access, watch and reserve
EML/EMLc	WHO Model List of Essential Medicines/for Children
GReVP	good review practices
HAI	health care-associated infection
IPC	infection prevention and control
MDR	multidrug-resistant
SDGs	Sustainable Development Goals
WASH	water, sanitation and hygiene
WHO	World Health Organization



Executive summary

In 2015, the World Health Organization (WHO) launched the global action plan to fight antimicrobial resistance (AMR). The first objective of the plan calls for measures to improve health workers' education and training on AMR.

This WHO competency framework for health workers' education and training on AMR provides foundational normative guidance to help countries ensure that health workers are properly equipped with the competencies they need to combat the spread of AMR. Target users of this document include pre-service and in-service health education and training institutions; accreditation and licensing bodies; and health policy- and decision-making authorities.

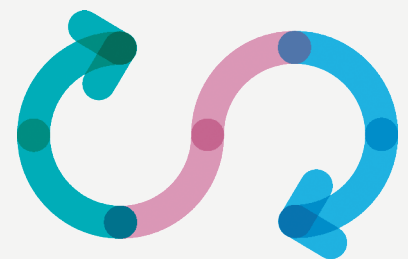
The framework is configured in a tabular matrix format, containing core and additional AMR competencies, which have been organized across four domain areas and four categories of health workers. The domain areas include: foundations that build awareness of antimicrobial resistance, appropriate use of antimicrobial agents, infection prevention and control (IPC), and diagnostic stewardship and surveillance. The four categories of health worker groupings identify competencies that are required for: all health workers, prescribers, non-prescribers and public health officers/health services managers. This framework provides users with a reference tool to guide the analysis, framing and adaptation of locally relevant education and training materials on AMR.



Introduction

Addressing the issue of antimicrobial resistance is critical to achieving the Sustainable Development Goals (SDGs). Antimicrobial resistance is a significant public health and environmental threat. Left unchecked, common infections and minor injuries could once again become frequent killers. The scale of the AMR threat is such that no single country is free from its health and socioeconomic impact: efforts to tackle the problem will require collaboration across national and continental boundaries. AMR occurs when microbes become resistant to medicines to which they were initially susceptible. This risk is fuelled by the reduced availability of new and effective antimicrobials to treat resistant microbes (1,2). The development of drug-resistance applies to antimicrobials for a wide variety of diseases, including, among others, HIV and tuberculosis.

Globally, major gaps still exist in knowledge and awareness of AMR, as well as in the availability of quality technical resources to address the challenge (3–6). In the case of health workers, a variety of factors can result in the misuse or overuse of antimicrobials, including: a lack of knowledge or up-to-date information, inability to identify the type of infection, yielding to patient pressure to prescribe antibiotics, and a preponderance of situations that allow for financial benefit from the supply of medicines. Inadequate hygiene, sanitation in community settings and IPC measures in health facilities also facilitate the spread of infections and increase the use of antimicrobials (7). Measures to tackle these challenges through a collaboration of various stakeholders are required to avert the increasing occurrence of resistance, particularly in resource-constrained settings (8). To address this challenge, the first objective of the WHO Global Action Plan on Antimicrobial Resistance (AMR GAP) calls for raising awareness and educating and training health workers to improve antimicrobial prescribing and dispensing behaviours (9). On a similar policy level, the Global Strategy on Human Resources for Health: Workforce 2030 (10) complements the AMR GAP by offering policy guidance options on broader policies and approaches to optimize health worker education and training. WHO's role in collating and making available AMR education and training resources is crucial to support educators, decision-makers and health policy planners in implementing effective policies to guide actions on AMR control (11).





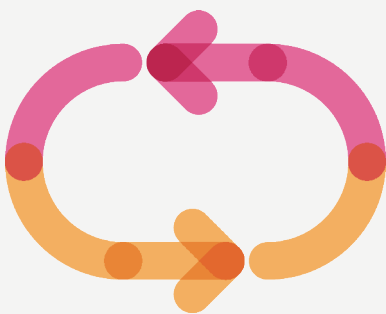
Objectives and application of the AMR competency framework

The main purpose of this document is to strengthen efforts at the country level to address AMR by outlining a set of core and additional competencies to guide the education and training of health workers.

The competency framework serves as a reference tool to be applied according to local priorities and needs. Given the comprehensive nature and interprofessional structure of the competency framework, certain competencies outlined in this document may not apply to some settings or work environments, depending on factors such as the availability of health workers with an advanced training or technological capacity. For users in such settings, the framework provides for a selective approach to implementation whilst allowing for scale up of health worker competencies whenever additional needs are identified and resources made available. The AMR competency framework is not a scope of practice for specific occupational groups and should not be interpreted as such; rather, the competencies that it identifies should be interpreted and applied in the context of the defined roles and responsibilities in a specific jurisdiction, according to local regulations and practices.

The competency framework is aimed primarily at pre-service and in-service health education and training institutions, accreditation and regulatory bodies and health policy- and decision-making authorities. It is structured to benefit all health workers, including both prescribers and non-prescribers of antimicrobials. It also includes public health and health services managers who lead institutions or have roles that influence decision- and policy-making to deliver AMR-related education and training, or have broader responsibilities through health services management and public health regulations with a bearing on antimicrobial prescription and use practices. The competency framework may be used to plan for AMR skills auditing and strengthening, and optimization of antimicrobial stewardship roles or functions.

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Methods

The development of this AMR competency framework has evolved through a combination of a review of AMR competencies obtained from a mapping of education and training resources around the world (12), and a series of refinement steps conducted through consultation exercises with a WHO expert consultation group (13), other AMR research topic experts and key health professional associations.

Building on the first objective of the WHO Global Action Plan on AMR, an informal meeting was held in March 2016 between WHO and health professional associations to describe the needs and challenges health workers face in addressing AMR (14). One of the outcomes from the meeting was an agreement to map existing AMR-related educational resources in order to identify currently available resources, provide information on needs and propose ways to address the gaps. A draft version of the AMR-education mapping report was subsequently prepared, serving as the main background document for the WHO expert consultation meeting on AMR and health workforce education and training held in March 2017.

Key findings of the report revealed a variance across settings in the availability, comprehensiveness, quality, standards and accessibility of currently available tools to address AMR education and training. The mapping report also highlighted best practice models to build upon (15). A recommendation was then made by the group on the basis of these findings to develop a global competency framework for AMR as part of measures to help address the situation of AMR education and training.

In developing the core material, evidence and guidance was extracted from the literature related to competency frameworks on appropriate prescribing and other AMR-related competency domains (16–29). The framework is adapted for human health and is holistic in approach as it brings together the different domains in complementary technical areas such as IPC, diagnostic stewardship and surveillance, leadership, and awareness and appropriate use of antimicrobials. It also features references to recent complementary policy frameworks on the appropriate use of antibiotics such as the AwaRE categorization described in the 2017 WHO Model List of Essential Medicines/for Children (EML/EMLc) (30). The WHO AwaRE system groups antibiotics into three categories – ACCESS, WATCH and RESERVE. The ACCESS group includes antibiotics recommended as empiric, first or second choice treatment options for common infectious syndromes and are listed in the EML/EMLc with the syndromes for which they are recommended. The WATCH group includes antibiotic classes that are considered generally to have higher resistance potential and that are still recommended as first or second choice treatments but for a limited number of indications. The RESERVE group includes antibiotics that should be treated as “last resort” options, or tailored to highly specific patients and settings, and when other alternatives would be inadequate or have already failed (e.g. serious life-threatening infections due to multi-drug resistant bacteria). The aim is to enhance treatment outcomes, reduce the development of drug-resistant bacteria, and preserve the effectiveness of “last resort” antibiotics by ensuring that the right antibiotics are available and prescribed for the right infections.

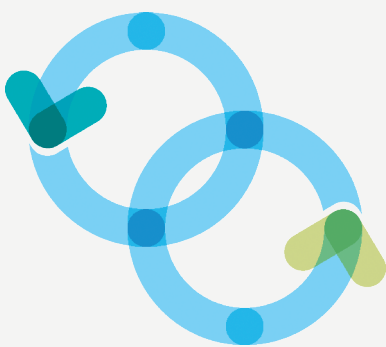


Structure of the AMR competency framework

The AMR competency framework is a tabular matrix of the AMR domains, health worker categories and the competencies (the knowledge, skills and attitudes) necessary to effectively address AMR in practice settings. The framework is organized across four broad categories of health workers and four domains of AMR-related competencies. For the purpose of this framework, the competencies are broadly divided into two types – core and additional. The core competencies are the essential knowledge, skills attitudes that a health worker in a particular category is expected to have. The additional competencies (see italic text in Table 1) are the desirable knowledge skills and attitudes that a health worker may have, depending on factors such as need, relevance to practice setting, and the availability of required resources and capacity to utilize the competency.

The framework adopts an interprofessional approach based on the principle that addressing AMR requires a shared understanding, and effective collaboration and communication among health workers. Given that a number of different health workers are involved in the sequence of events and scenarios leading to the prescription and use of antimicrobials, the categorization of health workers has been structured to reflect, in a comprehensive manner, the most significant roles impacting antimicrobial prescription and use.

As AMR is a complex public health and environmental issue, a systems approach combined with population and patient-centred strategies (including behavioural change elements) are vital to achieve the objectives of the competency framework. Essential competencies in cross-cutting areas, such as leadership, communication, law and ethics, are also important for adequately understanding, monitoring and responding to AMR. Where relevant, these competencies are embedded within related areas of the framework. A glossary is attached to help guide understanding, implementation and application.





Statement of shared goal

Maintaining a shared commitment to address AMR and protect patients in practice settings can enhance action by health policy-makers and promote collaboration among health workers. The AMR competency framework provides foundational guidance that can be adapted to different health care and resource contexts to foster appropriate prescribing and other AMR-related competencies. The use of the competency framework in health worker education and training should be grounded in a shared commitment by all stakeholders, including health workers. Such commitments may be ingrained in practice through the use of joint vision statements, as exemplified in Box 1. Similar statements, adapted to local settings, may be used in national advocacy and communication activities to support the inclusion of relevant AMR elements in educational curricula or licensing and regulatory mechanisms to ensure greater compliance and a culture of collective responsibility.

Box 1. **Sample joint vision statement for fighting AMR**

We, the health care workers, accept the responsibility to improve patient care and health outcomes by protecting against the emergence and spread of antimicrobial resistance for patients and society, now and in the future. We shall achieve this goal by acquiring and maintaining the competencies related to AMR control including through improving leadership, awareness, knowledge, skills, attitudes and behavioural change regarding the appropriate prescription, dispensing and use of antimicrobials, and implementing better infection prevention and control and diagnostic stewardship.



Table 1. AMR competency framework

Antimicrobial resistance domains ^a	Category 1: All health workers ^b				Category 2: Prescribers ^c		Category 3: Non-prescribers ^d		Category 4: Public health officers/health services managers ^e	
	Nurses		Pharmacists		Laboratory scientists/technicians		Pharmacists		Laboratory scientists/technicians	
<p>Foundations that build awareness of antimicrobial resistance</p> <p>Competency statement: Health worker demonstrates that they have the knowledge and awareness of effective approaches to control AMR, and has the skills/attitudes to implement change according to role and level of training.</p>	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand the development and main causes of AMR. Understand the basic principles of infection prevention and control, i.e. hand hygiene to prevent transmission of infections. Understand the impact of resistance on choice of antimicrobial therapy for treating infections. Understand the morbidity, mortality and economic threat of AMR to human health. Know the importance of optimizing use of antimicrobials in the human and animal sectors to prevent development of resistance. <p>Skills:</p> <ol style="list-style-type: none"> Ability to interpret and communicate the use of appropriate policy guidelines on AMR. <p>Attitudes:</p> <ol style="list-style-type: none"> Promote awareness of AMR and appropriate antimicrobial use amongst all health care workers, patient communities and the general public. Act to protect the effectiveness of antimicrobials as an ethical imperative and a public good. 	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand the importance of antimicrobial choice, dosage, interval, duration, preparation and administration of antimicrobials. Know the principles of microbiology in identifying pathogens from clinical samples. Know the basic diagnostic role of the microbiology laboratory. Understand local AMR epidemiology, resistance and susceptibility patterns and use of guidelines. Patient counselling etiquettes, discussion techniques and psychology for patient communication. Understand the principles of <i>empiric, syndromic or culture-based treatment options in relation to the selection of antimicrobials.</i> <p>Skills:</p> <ol style="list-style-type: none"> Appropriate use of antimicrobials to treat and/or prevent common infections and syndromes. Ability to communicate with patients on the appropriate use of antibiotics. Ability to collect microbiology samples. <p>Attitudes:</p> <ol style="list-style-type: none"> Promote a standard for the appropriate use of antimicrobials and manage patient expectations and demands especially when the use of antimicrobials is not indicated. 	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand the role of bedside nursing in antimicrobial stewardship programmes. <p>Skills:</p> <ol style="list-style-type: none"> Assess the source of infection and identify appropriate measures. Obtain allergy history, perform medication reconciliation, and record this in the medical record. <p>Attitudes:</p> <ol style="list-style-type: none"> Contribute to a patient-centred focus in the clinical team, and monitor and communicate daily patient progress. Contribute to public health literacy and general advocacy on the importance of infection prevention. 	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand the significance of antimicrobial choice, dosage, duration and preparation in the treatment of infections. <p>Skills:</p> <ol style="list-style-type: none"> Advise patients and prescribers on the appropriate use of antimicrobials. Practise safe disposal of unused antimicrobial medicines. <p>Attitudes:</p> <ol style="list-style-type: none"> Advocate for patient safety and compliance in the prescription and use of antimicrobials in compliance with formulary protocols. Critically assess information and pharmaceutical products as part of good procurement practices. 	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand the diagnostic role of the microbiology laboratory in detecting infections, resistance patterns, guiding patient management and informing AMR control strategies. <p>Skills:</p> <ol style="list-style-type: none"> Collect and report data on antimicrobial product quality and sensitivity to national drug registration bodies. Advise prescribers on correct microbiological testing procedures. Ability to carry out bacterial isolation, identification, susceptibility testing and reporting. Provide facility-specific cumulative susceptibility reports for common bacterial pathogens against antibiotics that are recommended in the local or national guidelines. Generate profiles of antimicrobial resistance for identified antimicrobial microorganism for public health decision-making. <p>Attitudes:</p> <ol style="list-style-type: none"> Advocate for and comply with laboratory and public health guidelines regarding antimicrobial susceptibility testing. 	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand the use of quality improvement frameworks to address gaps in AMR education. Understand the potential for cost savings and health gains associated with effective infection control and appropriate antimicrobial use. Understand the roles and responsibilities of different stakeholders in antimicrobial stewardship teams. Members of the team could include, but are not limited to, the roles of physicians, pharmacists, infection preventionists, microbiologists, nurses and hospital administrators or others. <p>Skills:</p> <ol style="list-style-type: none"> Ability to determine and implement best approaches to antimicrobial stewardship interventions on the basis of context. Ability to carry out resource allocation to implement and sustain antimicrobial stewardship programmes. Develop policy advocacy and enforcement to manage AMR programmes. <p>Attitudes:</p> <ol style="list-style-type: none"> Promote AMR awareness at health system, hospital and community levels. 				



Antimicrobial resistance domains ^a	Category 1: All health workers ^b			Category 2: Prescribers ^c		Category 3: Non-prescribers ^d			Category 4: Public health officers/health services managers ^e
				Nurses	Pharmacists	Laboratory scientists/technicians			
Foundations that build awareness of antimicrobial resistance				2. According to settings and where appropriate, encourage adherence to antimicrobial formulary/protocol restrictions. 3. Understand basic principles of behaviour change in the context of prescribing antimicrobials and model good prescribing behaviour to colleagues.					2. Establish and enforce compliance with antimicrobial formulary/protocol restrictions at local and national levels according to country policies. 3. Together with civil society, advocate for the responsible development of new antimicrobials and ensure the correct promotion of existing ones.

^a This framework assumes that knowledge contents are similar for pre-service education and in-service training though emphasis shifts to improving skills and attitudes for in-service training.

^b Denotes the basic AMR competencies that all health care workers should have.

^c Includes medical doctors and dentists. Note that pharmacists, nurses and midwives are also included in this category in settings where they are allowed to prescribe antimicrobials by regulation. The extent to which the prescribing competencies are relevant to the different cadres may vary according to scopes of practice and local regulation.

^d Non-prescribers include health workers that are not allowed by regulation to prescribe antimicrobials. (Note that in some settings, pharmacists, nurses and midwives are allowed by regulation to prescribe antimicrobials.)

^e This category may include personnel from the prescribing and non-prescribing occupational groups who have a leadership role or authority in managing AMR control.

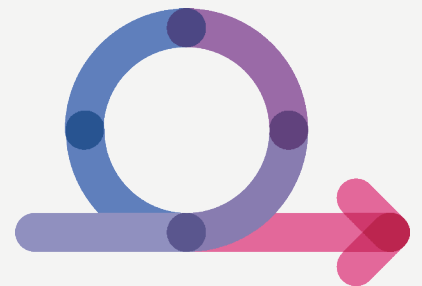


Table 1. AMR competency framework, continued

Antimicrobial resistance domains ^a	Category 1: All health workers ^b	Category 2: Prescribers ^c	Nurses	Pharmacists	Laboratory scientists/ technicians	Category 4: Public health officers/ health services managers ^e
<p>Appropriate use of antimicrobial agents</p> <p>Competency statement: Health worker demonstrates that they have the knowledge and understanding, according to their field and level of expertise, to facilitate optimal and safe use of antimicrobial agents for management of infections.</p>	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand that antimicrobials have different resistance potential (AWaRE categories). Understand the specific roles of other health care workers. Understand the consequences (intended and unintended) of the use of antimicrobial therapy in humans. <p>Skills:</p> <ol style="list-style-type: none"> Ensure effective management of antimicrobials (according to scope of practice) in infection therapy. <p>Attitudes:</p> <ol style="list-style-type: none"> Encourage patient and peer professional interactions on antimicrobial prescription and therapy. Ensure timely and appropriate feedback to prescribers and other care groups. Willingness to participate in quality improvement programmes for antimicrobial use. Willingness to communicate the risk of development and transmission of AMR spread within and outside of multidisciplinary antimicrobial teams. 	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Diagnosis of disease including the ability to discriminate diseases of different infectious pathology. Indication for antimicrobial therapy, including assessment of the severity of the infection (sepsis syndrome recognition) to inform urgency for therapy. Understand that travel, recent hospitalization or previous microbiology findings of resistant bacteria are factors that predispose to colonization/ infection with a resistant pathogen. Understand common drug interactions between antimicrobials and other therapeutic agents, and between antimicrobials and food. Understand their clinical significance and the strategies to avoid interactions. Appreciate the risk, benefits and limitations of the antimicrobial treatment in the context of the patient and setting. Understand the concept of broad- and narrow-spectrum antibiotics and the importance of avoiding their unnecessary use, especially those with broad-spectrum activity. Understand the use of antimicrobials in special care groups (e.g. paediatrics, pregnancy, breastfeeding, renal diseases and obese persons). Understand the mechanisms of actions of the different antimicrobial drugs classes. Understand how to develop a hospital formulary. 	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand nurses' role in the therapeutic management of infectious diseases. <p>Skills:</p> <ol style="list-style-type: none"> Administer and record antimicrobial medicines use including review of dose/time for accuracy. Perform allergy checks. Update clinical and laboratory results including renal function results, drug levels, and preliminary/final microbiology results. Monitor and report adverse events of antimicrobial treatment. Interact with other members of the stewardship team to promote optimal antimicrobial treatment in patients (teamwork). <p>Attitudes:</p> <ol style="list-style-type: none"> Educate patients and family, and perform discharge teaching. 	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand the significance of efficacy data for clinical benefit for each indication (magnitude of benefit estimated in clinical trials). Pharmacokinetics: route of therapy, concept of bioavailability, dosing frequency, therapeutic drug monitoring and clearance. Pharmacodynamics: tissue/organ adverse effects (e.g. abnormal liver function tests, renal toxicity). Allergy: immediate, non-life threatening, severe adverse drug reactions (e.g. Steven Johnson Syndrome). <p>Skills:</p> <ol style="list-style-type: none"> Assess prescriptions in accordance with local policies for antimicrobial use. Review antimicrobial choice, dose, interval, duration and route of administration. Give advice on dosage form, preparation and administration (especially for special patient cohorts such as children). Counsel individuals and populations on the safe and rational use of antimicrobials (including the selection, use, contraindications, storage, drug interactions and side effects). Accurately dispense prescribed antimicrobials for major and minor infections. 	<p>Relevance: Average</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand the use of the antibiotic in detecting and reporting AMR patterns in settings where antibiotics are commonly used. <p>Skills:</p> <ol style="list-style-type: none"> Recognize common mechanisms of resistance within an institution for different antimicrobial/organism combinations. Understand their impact on resistance to other antimicrobials. Conduct antibiotic spectrum of activity analysis using the antibiotic agent of highest efficacy. <p>Attitudes:</p> <ol style="list-style-type: none"> Provide laboratory users with guidance on the most appropriate tests and their limitations. Ensure ready access to the results and communication of results to clinicians – optimize clinical liaison. Ensure timeliness in the handling of microbiology samples and communication of susceptibility results. 	<p>Relevance: Average</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand where and how to search/retrieve best scientific evidence to support optimal use and therapy. Understand the importance of promoting appropriate antimicrobial use according to their AWaRE categories, in order to implement specific resistance-prevention actions for these antimicrobials. <p>Skills:</p> <ol style="list-style-type: none"> Develop a systematic approach to antimicrobial prescribing and design interventions to address gaps. Assess needs and respond to antimicrobial shortages. Address issues related to the availability of antimicrobials including the accelerated registration of quality, cost-effective essential antimicrobials as well as the use of good review practices (GReVP). <p>Attitudes:</p> <ol style="list-style-type: none"> Advocate for a conducive environment and management structure that prioritizes antimicrobial stewardship and encourages accountability for best practices on actions to improve appropriate antimicrobial use in hospitals and community settings. Ensure a regular supply of essential antimicrobials. Ensure the availability of adequate human and material resources for delivering health care.



Antimicrobial resistance domains ^a	Category 1: All health workers ^b	Category 2: Prescribers ^c		Category 3: Non-prescribers ^d			Category 4: Public health officers/health services managers ^e
		Nurses	Pharmacists	Laboratory scientists/technicians			
Appropriate use of antimicrobial agents		<p>10. <i>Understand the basics of antimicrobial product research, development, regulation and marketing.</i></p> <p>Skills:</p> <ol style="list-style-type: none"> 1. Select and prescribe antimicrobials in accordance with standard treatment guidelines and associated essential medicines lists (where applicable) keeping in mind the pathogen, dose, duration and route of administration. 2. Recognize the immediate and long-term patient and ecological consequences of inappropriate antimicrobial prescription. <p>Attitudes:</p> <ol style="list-style-type: none"> 1. Promote best practice approaches to prescribing antimicrobials and ensure adherence to guidelines. 2. Promote capacity to search for reliable sources of unbiased/unconflicted information on best use of antimicrobials. 3. Beware of market incentives to proliferate the prescription of antimicrobials against the understanding of prescribing guidelines and practical application. 	<p>6. Ensure timely supply of appropriate medicines.</p> <p>7. Ensure appropriate documentation of antimicrobials dispensed including route, time, dose, therapeutic drug monitoring and response for individual patients.</p> <p>Attitudes:</p> <ol style="list-style-type: none"> 1. Promote approaches to increase individual or community knowledge of using antimicrobials appropriately. 2. Promote the use of quality assured antimicrobials for patient treatment. 3. Promote AMR drug utilization studies. 4. Promote better patient understanding of all treatment issues such as safety concerns including alerts, and adherence. 			<ol style="list-style-type: none"> 4. Encourage the use of local and national metrics to audit/quality improvement and adherence to guidelines. 5. Provide clear mechanisms for the governance of antimicrobial stewardship including addressing responsibility and accountability for the quality and quantity of antimicrobials prescribed within a system. 6. Promote product quality. 7. Adopt a shared responsibility for maintaining product quality. 	

Table 1. AMR competency framework, continued

Antimicrobial resistance domains ^a	Category 1: All health workers ^b	Category 2: Prescribers ^c	Nurses	Pharmacists	Laboratory scientists/ technicians	Category 4: Public health officers/ health services managers ^e
<p>Infection prevention and control (IPC)</p> <p>Competency statement: Health worker understands and implements the principles of hygiene, sanitation and IPC to reduce the spread of AMR.</p>	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understands the infection chain especially the four components required for transmission of an infection: (organism, source, route of transmission and susceptible host). Understand the role of hand hygiene to prevent transmission of pathogens. Understand the principles of prevention of health care-associated infections (HAI), including surgical site infections, catheter-associated bloodstream and urinary tract infections. Importance of strategies to prevent infection at community and health facility levels, e.g. water, sanitation and hygiene (WASH), waste management and immunization. <i>Introduction to infectious diseases and role of the laboratory in identification of microbes and susceptibility testing to antimicrobials.</i> <p>Skills:</p> <ol style="list-style-type: none"> Practise hand hygiene at the right moment and with appropriate technique, according to WHO recommendations. Contribute to the design and implementation of procedures for crisis management in infection control: alert management, patient identification, recall of potentially contaminated equipment and supplies, reporting and exchange with relevant health care professionals. <i>Implement and practise universal precautions and transmission-based precautions in health care.</i> 	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> <i>Understand that prescribing antimicrobials to patients colonized with multidrug resistant (MDR) pathogens (e.g. MDR gram negative pathogens in urine or GIT), will not eradicate the pathogens and should therefore not be used as a preventive measure to stop transmission of the resistant pathogens to others.</i> <p>Skills:</p> <ol style="list-style-type: none"> <i>Apply methods and strategies to prevent and control HAIs, including surgical site infections, catheter-associated bloodstream and urinary tract infections, health care-acquired pneumonia, gastroenteritis.</i> <i>Identify and manage the specific local factors responsible for increased risk of HAI and AMR according to practice settings.</i> <i>Implement a plan that is focused on limiting cross-infection and contamination to reduce HAI and AMR in hospitals and community settings.</i> <p>Attitudes:</p> <ol style="list-style-type: none"> Promote principles of HAI prevention and control. Encourage the decontamination and sterilization of hospital equipment and patient areas. 	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand the role of nursing in IPC. <p>Skills:</p> <ol style="list-style-type: none"> Monitor patient response and initiate appropriate changes in isolation precautions. Provide patients and families with evidence-based, accurate and non-judgmental information on the benefits and importance of immunization for health outcomes. <p>Attitudes:</p> <ol style="list-style-type: none"> Promote hygiene best practices in health care facilities. Promote and monitor compliance with IPC and patient safety measures. 	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand the link between antimicrobial stewardship and IPC. Understands the difference and the impact of nosocomial infections compared with community-acquired infections. <p>Skills:</p> <ol style="list-style-type: none"> Ability to follow pharmacy infection control guidelines. Use hygienic and safety practices to control cross-transmission. Clean and disinfect equipment and surfaces. <p>Attitudes:</p> <ol style="list-style-type: none"> Promote the link between antimicrobial stewardship and IPC. Encourage engagement with other health professionals to reduce HAI and AMR. 	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> <i>Understand the role of the laboratory (i.e. identification of microbes, susceptibility testing, strain typing and results) in enabling IPC measures.</i> <p>Skills:</p> <ol style="list-style-type: none"> Provide accurate and timely laboratory information, using clear protocols, for IPC planning and implementation, including in outbreak settings. Contribute to alignment of antimicrobial stewardship, diagnostic stewardship and IPC planning and implementation efforts. Practise appropriate IPC measures in the laboratory. <p>Attitudes:</p> <ol style="list-style-type: none"> Promote the important role of the laboratory in IPC. 	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand the relationships between patient safety, IPC, HAI and AMR. <p>Skills:</p> <ol style="list-style-type: none"> Support the implementation of multi-modal strategies to achieve behavioural change in IPC practices including necessary resources, monitoring, audit and feedback. Propose appropriate infection control measures for the management of waste, air, water, laundry and food. Develop and update procedures related to decontamination and sterilization guidelines and standards. <p>Attitudes:</p> <ol style="list-style-type: none"> Promote the importance of prevention and control of HAI and AMR. Highlight the human, economic and wider public health concerns of HAI and AMR. Use data to illustrate the problem and communicate it to decision-makers and the affected communities. Take an active role in risk reduction during planning of renovations and new constructions in the health care organization.



Antimicrobial resistance domains ^a	Category 1- All health workers ^b	Category 2: Prescribers ^c	Category 3: Non-prescribers ^d			Category 4: Public health officers/ health services managers ^e
			Nurses	Pharmacists	Laboratory scientists/ technicians	
Infection prevention and control (IPC)	Attitudes: 1. Advocate and demonstrate action and accountability for the implementation of IPC and hygiene and sanitation best practices in health care facilities and community settings respectively. 2. Advocate for WASH and for scaling up vaccines against common infections caused by microorganisms such as pneumococcus, rotavirus and <i>Haemophilus influenzae</i> type b. 3. Understand how and when to contact the infection control professional for their facility or area. 4. Promote proper health care waste management. 5. Promote injection safety awareness and techniques.					

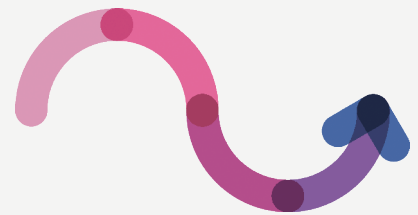


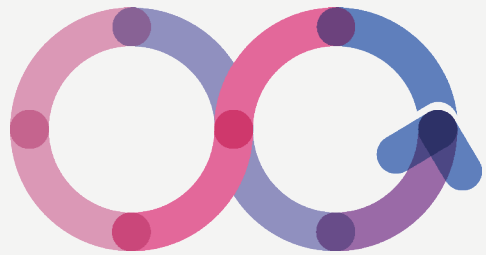


Table 1. AMR competency framework, continued

Antimicrobial resistance domains ^a	Category 1: All health workers ^b	Category 2: Prescribers ^c	Nurses	Pharmacists	Laboratory scientists/ technicians	Category 4: Public health officers/ health services managers ^e
<p>Diagnostic stewardship and surveillance</p> <p>Competency statement: The health worker demonstrates an understanding, relevant to their field and level of expertise, of the principles and processes of diagnostic stewardship, surveillance of AMR and antimicrobial stewardship that underpin prophylaxis and treatment guidelines and AMR control strategies.</p>	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand the role of national medicine regulatory authorities in the regulation of medicines: laws and regulations, registration, manufacturing, licensing, inspection and enforcement, pharmacovigilance, post-market surveillance, quality control, clinical trials, drug information. Understand the importance of reporting suspected poor quality products, therapeutic ineffectiveness, and adverse events as they may generate signals on the compromised quality of the antimicrobial products. Understand the importance of proper record keeping and use of drug codes (according to settings) for traceability of medicines. Understand importance of AMR surveillance for characterization of resistance trends and measuring impact and burden of AMR to guide policy-makers in developing treatment recommendations. <p>Skills:</p> <ol style="list-style-type: none"> Act as first line of surveillance to accurately identify and report suspicious, ineffective, and substandard antimicrobials to the appropriate authorities. <p>Attitudes:</p> <ol style="list-style-type: none"> Respect and protect the privacy and identity of individuals in supporting or carrying out surveillance activities for AMR control. 	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand the basic principles of antibiograms and other reporting tools and their interpretation. Understand principles of surveillance of AMR and antimicrobial use and the use of surveillance data. <p>Skills:</p> <ol style="list-style-type: none"> Ability to interpret and use antimicrobial susceptibility testing results (in settings where they are commonly used) and other microbiology testing tools. For infectious diseases experts, develop indicators for the rational use of antimicrobials. Ability to interpret and use AMR surveillance data. Ability to apply practice and procedures for specimen selection and collection and the completion of clinical, demographic and other epidemiological data that must accompany each specimen, correct storage and transportation of specimens to the laboratory. <p>Attitudes:</p> <ol style="list-style-type: none"> Promote the generation of relevant clinical, epidemiological and microbiological data to support AMR surveillance. 	<p>Relevance: Average</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand the role of nursing in the identification, collection, transportation and reporting of microbiological samples and test results. <p>Skills:</p> <ol style="list-style-type: none"> Obtain cultures and sends the cultures to the microbiology laboratory. Monitor culture results and report results to the physician. <p>Attitudes:</p> <ol style="list-style-type: none"> Promote the welfare of patients' post-discharge by ensuring optimal communication of for discharge or referral services. 	<p>Relevance: Low</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand methods for the identification of substandard and falsified medical products. Understand the measurement of antimicrobial consumption, quality and associated costs in health care settings and communities. <p>Skills:</p> <ol style="list-style-type: none"> Carry out monitoring of antimicrobial use through point prevalence surveys etc. Accurately report defective or substandard antimicrobial medicines to the appropriate authorities. <p>Attitudes:</p> <ol style="list-style-type: none"> Ensure a culture of risk awareness and ethical behaviour in the identification and reporting of AMR data. 	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand the principles and practice of diagnostic stewardship. Understand the relevant techniques and data required for effective surveillance of antimicrobial use and AMR in hospital and community. Understand the use of diagnostic data in AMR surveillance. <p>Skills:</p> <ol style="list-style-type: none"> Support implementation of diagnostic stewardship. Act as first line of surveillance in the correct use and reporting of microbiological tests and diagnostic tools. Contribute to hospital-specific antimicrobial susceptibility data. <p>Attitudes:</p> <ol style="list-style-type: none"> Embed a surveillance culture in theory and practice. Embrace the use of appropriate technology in AMR testing. Maintain effective communication and collaborative work with clinicians, IPC professionals, and hospital epidemiologists, and other health care workers involved in stewardship activities. 	<p>Relevance: High</p> <p>Knowledge:</p> <ol style="list-style-type: none"> Understand infectious diseases epidemiology. Understand principles and methods of public health surveillance. Understand AMR surveillance and data analysis methods and assessment of trends to inform interventions. Understand the importance of incorporating antimicrobial product quality assurance topics into relevant national policies and regulations including the national action plan for AMR and national regulations on antimicrobial prescription scheduling. Importance of adopting standard terminologies such as the AWaRE categories to develop drug statistics for in-country and inter-country comparison of antimicrobial utilization and outcomes. The benefit of risk assessment and risk management strategies for identifying and containing resistance. <p>Skills:</p> <ol style="list-style-type: none"> Ability to monitor and report on the performance of hospital and/or community AMR and related antimicrobial stewardship programmes. Identify and report of substandard and falsified medicines. Audit the quality of antimicrobial use through basic scientific methods.



Antimicrobial resistance domains ^a	Category 1: All health workers ^b	Category 2: Prescribers ^c	Category 3: Non-prescribers ^d			Category 4: Public health officers/health services managers ^e
			Nurses	Pharmacists	Laboratory scientists/technicians	
Diagnostic stewardship and surveillance						Attitudes: 1. Ensure adequate protection including a safe and conducive working environment for health care workers carrying out AMR surveillance activities.





Glossary

Antimicrobials: An agent or substance, derived from any source (microorganisms, plants, animals, synthetic or semisynthetic) that acts against any type of microorganism such as bacteria (antibacterial), mycobacteria (antimycobacterial), fungi (antifungal), parasite (antiparasitic) and viruses (antiviral). All antibiotics are antimicrobials, but not all antimicrobials are antibiotics (31).

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

Antimicrobial stewardship: Refers to how the appropriate use of antimicrobials can maximize both their current efficacy and the chances of their being efficacious for future generations. It embodies an organizational or health care system-wide approach to promoting and monitoring judicious use of antimicrobials to preserve their future effectiveness.

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, and pathogen identification and accurate, timely reporting of results to guide patient treatment (32).

Drug-resistant infections: Describes infections caused by organisms that are resistant to treatment, including those caused by bacteria that do not respond to antibiotics (33).

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

Curriculum: A set of learning goals articulated across different health care workers that outline the intended content and process goals at particular points in time and throughout their professional career. These goals in the context of AMR, are relevant at a personal and societal level.

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

Interprofessional collaboration: Collaborative practice happens when multiple health workers from different professional backgrounds work together with patients, families, carers and communities to deliver the highest quality of care (34).

Prescribers: All health care professionals qualified to prescribe antimicrobials. In addition to physicians of all specialties and dental practitioners, the term may refer to *inter alia* prescribing nurses, pharmacists (in some jurisdictions), clinical microbiologists, midwives, optometrists, podiatrists and other health care professionals, depending on local regulations.

Principle: Defined as “an accepted or professed rule of action or conduct or a fundamental, primary, or general truth from which others are derived,” or “a fundamental doctrine or truth.” Principles are core tenets that should be acceptable to all.

Surveillance of AMR and antimicrobial use: Collection, validation, analyses and reporting of relevant clinical, microbiological and epidemiological data on AMR in targeted pathogens from different sources (e.g. humans, animals, food, environment), and on relevant antimicrobial use in humans and animals, and then applying the results to slow down or halt the development of resistance.

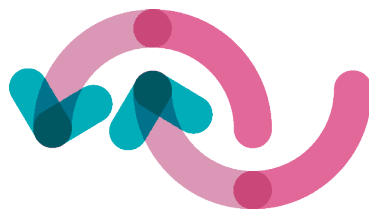
Significant and common infections: Refers to a collection of commonly and widely recognized infections occurring in the community or in a hospital setting.



References

- 1 Carlet J, Jarlier V, Harbarth S, Goossens H, Pittet D. Ready for a world without antibiotics? The Pensières Antibiotic Resistance Call to Action. *Antimicrob Resist Infect Control*. 2012;1:11.
- 2 Antimicrobial resistance: Global report on surveillance 2014. Geneva: World Health Organization; 2014.
- 3 Dyar OJ, Pulcini C, Howard P, Nathwani D. European medical students: A first multicentre study of knowledge, attitudes and perceptions of antibiotic prescribing and antibiotic resistance. *Antimicrob Chemother*. 2014;69(3):842–6. doi: 10.1093/jac/dkt440.
- 4 Dyar OJ, Howard P, Nathwani D, Pulcini C. Knowledge, attitudes, and beliefs of French medical students about antibiotic prescribing and resistance. *Med Mal Infect*. 2013;43(10):423–30. doi: 10.1016/j.medmal.2013.07.010.
- 5 Minen MT, Duquaine D, Marx MA, Weiss D. A survey of knowledge, attitudes, and beliefs of medical students concerning antimicrobial use and resistance. *Microb Drug Resist*. 2010;16(4):285–9. doi: 10.1089/mdr.2010.0009.
- 6 Abbo LM, Cosgrove SE, Pottinger PS, Pereyra M, Sinkowitz-Cochran R, Srinivasan A, et al. Medical students' perceptions and knowledge about antimicrobial stewardship: How are we educating our future prescribers? *Clinical Infectious Diseases*. 2013;57(5):631–8.
- 7 Global action plan on antimicrobial resistance. Geneva: World Health Organization; 2015.
- 8 World Bank. Drug-resistant infections: A threat to our economic future. Washington (DC): World Bank; 2017 (<http://documents.worldbank.org/curated/en/323311493396993758/final-report>, accessed 27 April 2018).
- 9 Global action plan on antimicrobial resistance. Geneva: World Health Organization; 2015 (http://apps.who.int/iris/bitstream/10665/193736/1/9789241509763_eng.pdf?ua=1, accessed 27 April 2018).
- 10 Global strategy on human resources for health: Workforce 2030. Geneva: World Health Organization; 2016 (<http://apps.who.int/iris/bitstream/10665/250368/1/9789241511131-eng.pdf?ua=1>, accessed 27 April 2018).
- 11 WHO fact sheet on antimicrobial resistance [website]. Geneva: World Health Organization; 2018 (<http://www.who.int/mediacentre/factsheets/fs194/en/>, accessed 27 April 2018).
- 12 Mapping educational opportunities and resources for health-care workers to learn about antimicrobial resistance and stewardship. Human Resources for Health Observer Series No. 21. Geneva: World Health Organization; 2017.
- 13 WHO expert consultation meeting report on health workforce education and AMR control. Geneva: World Health Organization; 2017 (http://www.who.int/hrh/news/2017/expert_consultation_workforce_education_amr/en/, accessed 27 April 2017).
- 14 WHO meeting on health education and antimicrobial resistance. Internal report. Geneva: World Health Organization; 2016.
- 15 Antimicrobial prescribing and stewardship competencies. London: Public Health England; 2013 (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/253094/ARHALprescrcompetencies__2_.pdf, accessed 27 April 2017).
- 16 Patient safety curriculum guide. Multi-professional edition. Geneva: World Health Organization; 2011 (http://apps.who.int/iris/bitstream/10665/44641/1/9789241501958_eng.pdf, accessed 27 April 2017).
- 17 Training framework for antimicrobial stewardship program implementation for the Western Pacific Region. Melbourne: National Centre for Antimicrobial Stewardship; June 2016.
- 18 Cosgrove SE, Hermsen ED, Rybak MJ, File TM, Parker SK, Barlam TF. Guidance for the knowledge and skills required for antimicrobial stewardship leaders. *Infect Control Hosp Epidemiol*. 2014;35(12):1444–51.

- 19 A competency framework for all prescribers. London: Royal Pharmaceutical Society; 2016 (<https://www.rpharms.com/Portals/0/RPS%20document%20library/Open%20access/Professional%20standards/Prescribing%20competency%20framework/prescribing-competency-framework.pdf>, accessed 27 April 2017).
- 20 WFME global standards for quality improvement. The 2015 revision. Ferney-Voltaire, France and Copenhagen, Denmark: World Federation for Medical Education (<http://wfme.org/standards/bme/78-new-version-2012-quality-improvement-in-basic-medical-education-english/file>, accessed 27 April 2017).
- 21 Proposals for EU guidelines on the prudent use of antimicrobials in humans. Stockholm: European Centre for Disease Prevention and Control; 2017.
- 22 Pharmacy Education Taskforce: A global competency framework (Version 1). The Hague: International Pharmaceutical Federation; 2012 (https://www.fip.org/files/fip/PharmacyEducation/GbCF_v1.pdf, accessed 27 April 2017).
- 23 ESCMID competencies for antimicrobial prescribing and stewardship (forthcoming).
- 24 Core competencies for infection control and hospital hygiene professionals in the European Union. Stockholm: European Centre for Disease Prevention and Control; 2013.
- 25 Infection prevention and control core competencies for health care workers: A consensus document. November 2016. Winnipeg: Infection Prevention and Control Canada ([https://ipac-canada.org/photos/custom/pdf/HCW_Core_Competency_Category_Table-2016November\(2\).pdf](https://ipac-canada.org/photos/custom/pdf/HCW_Core_Competency_Category_Table-2016November(2).pdf), accessed 27 April 2017).
- 26 SIRCINF001 - Use pharmacy practices for infection control (Release 1) [website]. Australian Government Department of Education and Training; 2018 (<https://training.gov.au/Training/Details/SIRCINF001#>, accessed 27 April 2017).
- 27 Identifying and defining competencies – A clear map for scientific and professional competencies as applied to hospital pharmacy. WP4 final report. Pharmine: Pharmacy Education in Europe; 2011 (<https://www.pharmine.org/wp-content/uploads/2014/05/WP4-Final-report-identifying-and-defining-competences-for-hospital-pharmacists.pdf>, accessed 27 April 2017).
- 28 Redefining the antibiotic stewardship team: Recommendations from the American Nurses Association/ Centers for Disease Control and Prevention Workgroup on the Role of Registered Nurses in Hospital Antibiotic Stewardship Practices. American Association of Nurses; 2017 (<https://www.cdc.gov/getsmart/healthcare/pdfs/ANA-CDC-whitepaper.pdf>, accessed 27 April 2017).
- 29 ICN position statement on AMR. Geneva: International Council of Nurses, 2009 (http://www.icn.ch/images/stories/documents/publications/position_statements/ICN_PS_Antimicrobial_resistance.pdf, accessed 27 April 2017).
- 30 WHO model list of essential medicines – 20th list. Geneva: World Health Organization; 2017 (http://www.who.int/medicines/publications/essentialmedicines/20th_EML2017_FINAL_amendedAug2017.pdf?ua=1, accessed 27 April 2017).
- 31 Critically important antimicrobials for human medicine. 5th revision. Geneva: World Health Organization; 2017 (<http://apps.who.int/iris/bitstream/10665/255027/1/9789241512220-eng.pdf?ua=1>, accessed 27 April 2017).
- 32 Diagnostic stewardship: A guide to implementation in antimicrobial resistance surveillance sites. Geneva: World Health Organization; 2016 (<http://apps.who.int/iris/bitstream/10665/251553/1/WHO-DGO-AMR-2016.3-eng.pdf>, accessed 27 April 2017).
- 33 Mendelson M, Balasegaram M, Jinks T, Pulcini C, Sharland M. Antibiotics resistance has a language problem. *Nature*. 2017;545(7652):23–25. doi: 10.1038/545023a.
- 34 Framework for action on interprofessional education and collaborative practice. Geneva: World Health Organization; 2010.



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