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Antimicrobial stewardship education
for clinicians

Antimicrobial Stewardship in Australian Health Care

2018

Please note that revised antimicrobial stewardship actions are included in the Preventing and Controlling Infections Standard, which was released in May 2021. This version of the Standard supersedes the 2017 Preventing and Controlling Healthcare-Associated Infection Standard. The AMS Book will be updated to incorporate reference to the 2021 Standard.

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Acronyms and abbreviations

Acronym	Abbreviation
AMR	antimicrobial resistance
AMS	antimicrobial stewardship
ID	infectious diseases

Key points

- All clinicians caring for patients (including medical, dental and other non-medical prescribers, such as pharmacists, nurses and midwives) need to be educated about antimicrobial resistance (AMR), optimal antimicrobial use and principles of antimicrobial stewardship (AMS).
- Education on appropriate antimicrobial prescribing and use, AMR and the principles of AMS is an essential element of any AMS program.
- The goal of education in AMS is not only to reduce the total use of antimicrobials by an individual but to ensure that, when an antimicrobial is indicated, it is the right medicine at the right dose, via the right route and for the right duration.
- Education of all clinicians involved in prescribing, dispensing or administering antimicrobials should begin at undergraduate level, and be refreshed and consolidated with further training throughout their careers.
- Multifaceted interventions that combine clinician, patient and public education in several formats have been found to be the most successful approach to reducing unnecessary and inappropriate prescribing.
- Education strategies that incorporate behaviour change principles such as audit and feedback, along with more active strategies including academic detailing, consensus-building sessions and educational workshops, are more effective in changing behaviour than the passive dissemination of information alone.
- Pharmaceutical industry-sponsored activities have been shown to negatively influence the prescribing behaviour of clinicians, and AMS education should raise awareness of this issue.
- Evaluation of education should monitor not only the number of courses and participants but also the impact of education on knowledge and behaviour.
- A wide range of resources are available to assist with AMS training, and the use of website information and online training materials can be especially cost- and time-effective for many organisations.
- There are a number of key enablers for effective AMS education that should be considered when planning and implementing education programs.

5.1 Introduction

All clinicians caring for patients (including medical, dental and other non-medical prescribers, such as pharmacists, nurses and midwives) need to be educated about antimicrobial resistance (AMR), optimal antimicrobial use and principles of antimicrobial stewardship (AMS). They also need to be able to communicate effectively with patients to inform them, and manage their concerns and expectations about the supply (or non-supply) of an antimicrobial prescription.

Education can provide the foundation of knowledge to improve the implementation and acceptance of AMS strategies.¹ Its aim is to improve clinicians' knowledge, and to change attitudes and beliefs about antimicrobial prescribing and use. Education

has therefore been described as a cornerstone of AMS programs and integral to their success.¹⁻³

Teaching and education can be:

- **Passive** – such as didactic lectures or tutorials, the distribution of printed material and some online learning programs. Although passive learning alone has little effect on antimicrobial use^{4,5}, recent data indicate that passive education can increase the effectiveness of other interventions^{6,5,7}
- **Active** – such as interactive small-group or one-on-one sessions, interactive online learning programs, audit and feedback, and reminders.^{2,6,8,9} Although resource intensive⁶, active education has been shown to be more effective and to have greater and more lasting effects on prescribing behaviour than passive techniques^{1,2,5,10}

- **Combined and multifaceted** — including passive and active strategies tailored to different audiences. Several systematic reviews have examined the effectiveness of education in supporting improvements in antimicrobial prescribing and conclude that highly interactive learning methods are the most effective.^{5,11,12} Multifaceted interventions that combine clinician, patient and consumer education in different venues and formats have been found to be the most successful approach to reducing inappropriate prescribing.¹¹

This chapter focuses on the education of clinicians, which should begin at the undergraduate level and continue throughout their careers. The chapter is relevant to all health service organisations; private, and rural and remote hospitals may find the section on [Websites and online learning resources](#) especially useful. The education of consumers is addressed in Chapter 7: '[Involving consumers in antimicrobial stewardship](#)'.

Issues that are especially relevant for certain settings – rural and remote hospitals, private hospitals and aged care – are tagged as R, P and AC, respectively, throughout the text.



5.2 Key elements of antimicrobial stewardship education

Effective AMS education should be targeted to its audiences, and should consider the learning needs of the organisation and the local context. Evaluation of educational activities and their impact will be an important way to measure and drive ongoing change.

5.2.1 Audiences

Education for clinicians should include information about microorganisms and usual susceptibilities, antimicrobials and their mechanism of action, and the prevalence of AMR. Clinicians should also have an understanding of the benefits of using antimicrobials to treat different conditions, the principles of AMS, symptom management and the use of microbiology test results. They also need training in effective communication to equip them

to inform patients and manage their expectations relating to the supply of an antimicrobial prescription.^{9,13} Providing regular education throughout the clinician's career will help them to safely and appropriately use antimicrobials in their practice, and also contribute more fully to AMS. All clinicians who prescribe antimicrobials within their scope of practice require ongoing AMS education and support.

In Australia, most antimicrobial prescribing (97%) is by medical practitioners.^{14,15} Because prescribing by junior doctors is influenced by senior doctors^{16,17}, it is important that both senior and junior doctors are educated about optimal prescribing and are made aware of the local AMS program, including the relevant policies and guidelines. They should also be informed of the availability of AMS team members, and the processes for obtaining expert infectious diseases (ID), microbiology or pharmacist advice, whether on site or remotely.

Management of antimicrobials requires teamwork between clinicians. Pharmacists working in the community, hospital and aged care settings play an important role in the process by reviewing and supplying antimicrobials, providing medication information and advising patients about their medicines.⁸ Similarly, nurses and midwives are responsible for several patient management activities that incorporate and support safe and effective antimicrobial use. This highlights the importance of including pharmacists, nurses and midwives in continuing education about antimicrobial use and AMS strategies.⁸ They need to develop an understanding of their role in prescribing and know that prescribing is also their business. Importantly, they need the knowledge to enable them to speak up and question orders for antimicrobials they believe are not in line with local policies and guidelines. (See Chapter 11: '[Role of the pharmacist and pharmacy services in antimicrobial stewardship](#)' and Chapter 12: '[Role of nurses, midwives and infection control practitioners in antimicrobial stewardship](#)'.)

Patients and consumers also have an important role in appropriate and safe antimicrobial use, and in addressing AMR for the safety of themselves, their families, other patients and health care in the future. Clinicians need to develop the skills to communicate effectively with patients to manage their concerns and expectations, and discuss why an antimicrobial prescription may not be appropriate for their condition. If an antimicrobial is prescribed, they need to educate consumers about how, when and for how long to take the antimicrobial.¹⁸ Shared decision-making tools may support patient



education. General practitioners trained in communication skills – and specifically in shared decision making – have been shown to prescribe significantly fewer antimicrobials than general practitioners without this training.¹⁹ (See Chapter 7: [‘Involving consumers in antimicrobial stewardship’](#).)

5.2.2 Principles of education on antimicrobial stewardship

*The goal of education in antimicrobial stewardship is not only to reduce the total use of antibiotics by an individual, but to ensure that, when an antibiotic is truly indicated, it is the right drug and the right dose, via the right route, and for the proper duration.*⁶

Considering the objectives, potential approaches and content of education can help to ensure that educational activities are appropriately targeted and effective.

Education objectives

The purpose of AMS education is not only to improve knowledge but to change clinicians’ attitudes towards the management of infection and their antimicrobial prescribing behaviour.⁶

Prescribing behaviour is affected by different factors, including attitudes, beliefs and experience (see Section 10.2 in Chapter 10: [‘Role of prescribers in antimicrobial stewardship’](#)). Improving knowledge alone does not necessarily lead to improved clinician behaviour.⁶ An education program that considers the local determinants of prescribing and uses one or more of the active (behaviour-changing) educational activities is more likely to be successful in shifting attitudes and beliefs, and changing antimicrobial prescribing practices.^{5,6,20,21}

Education approaches

Combined or multifaceted education strategies tailored to the target audience, and organised to complement and support other strategies in the AMS program have been shown to be more effective than single interventions (see [Introduction](#)). Studies combining educational activities with audit and feedback or prescribing guidelines have demonstrated improvements in antimicrobial prescribing in community, dental and hospital settings.^{9,11,22} In a systematic review, Lee et al. reported that multiple interventions were more often effective in reducing the rate of antimicrobial prescribing than interventions using education alone.⁹ Clinical education combined with audit and

feedback was the most effective, achieving a 72% reduction in antimicrobial prescriptions. Education combined with clinical reminder and decision support systems achieved a 57% reduction. Least effective was patient education (a 14% reduction).⁹ Many AMS guidelines for hospitals advocate combining multifaceted education interventions with other effective AMS strategies.⁴

Education content

The content of an AMS education program will depend on the audience, their place of practice and their professional development status. Required elements for educating clinicians about prudent antimicrobial use have been described (Table 5.1).⁸ These elements can be used to determine topics, principles and learning outcomes to include in an undergraduate core curriculum, intern and clinical training, and specialty and professional training. They can also be used to derive competencies required for appropriate antimicrobial prescribing.

5.2.3 Antimicrobial stewardship competencies and standards

Competency standards describe the skills, attitudes and other attributes (including values and beliefs) attained by an individual based on knowledge (gained through study at university) and experience (gained through subsequent practice), which together enable the individual to practise effectively in their profession.²³

Australia has a generic prescribing competency framework for all prescribers. The framework has seven competency areas and attributes that are essential for judicious and appropriate prescribing of medicines, including antimicrobials.²⁴

In the United Kingdom, generic prescribing competencies are complemented by specific competencies for AMS, designed to be used by any individual prescriber to develop their antimicrobial prescribing practice.²⁵ There are five competency areas:

- Competency 1 – infection prevention and control
- Competency 2 – antimicrobial resistance and antimicrobials
- Competency 3 – prescribing antimicrobials
- Competency 4 – antimicrobial stewardship
- Competency 5 – monitoring and learning.

These competencies can be used by education providers and professional bodies to inform standards, guidance, the development of training

Table 5.1: Elements of education for antimicrobial prescribing

Topic	Concepts	Principles, learning outcomes and competencies
Antimicrobial resistance	Selection, mutation	<ul style="list-style-type: none"> • Extent and causes of resistance in pathogens (low antimicrobial concentration and prolonged exposure of microorganisms to antimicrobials is driving resistance) • Extent and causes of resistance in commensals, and the phenomenon of overgrowth (e.g. <i>Clostridium difficile</i> infection, yeast infection) • Epidemiology of resistance, accounting for local variations and importance of surveillance (e.g. differences between wards, countries)
	Infection prevention and control	<ul style="list-style-type: none"> • Spread of resistant organisms
Antimicrobials	Mechanisms of action of antimicrobials and antimicrobial resistance, toxicity, costs	<ul style="list-style-type: none"> • Broad-spectrum versus narrow-spectrum antimicrobials; preferred choice of narrow-spectrum agents • Combination therapy (synergy, limiting emergence of resistance; broaden the spectrum) • Collateral damage of antimicrobial use (toxicity, cost) • Consequences of bacterial resistance • Lack of development of new antimicrobials (limited arsenal)
Diagnosing infection	Infection, inflammation	<ul style="list-style-type: none"> • Interpretation of clinical and laboratory biological markers • Fever and C-reactive protein elevation are signs of inflammation, not necessarily indicative of an infection
	Isolation and identification of bacteria, viruses and fungi	<ul style="list-style-type: none"> • Practical use of point-of-care tests • Importance of taking microbiological samples for culture before starting antimicrobial therapy
	Susceptibility to antimicrobials	<ul style="list-style-type: none"> • Interpretation of basic microbiological investigations (e.g. Gram stain, culture, polymerase chain reaction, serology)
Treating infection	Indication for antimicrobials	<ul style="list-style-type: none"> • Definitions of, and indications for, empirical/directed therapy versus prophylaxis • Clinical situations when an antimicrobial should not be prescribed • Colonisation versus infection (e.g. asymptomatic bacteriuria) • Viral infections (e.g. acute bronchitis) • Inflammation versus infection (e.g. fever without a definite diagnosis in a patient with no severity criteria)
Preventing infection	Indication for antimicrobials	<ul style="list-style-type: none"> • Surgical antibiotic prophylaxis: indication, choice, duration (<24 hours), timing

Topic	Concepts	Principles, learning outcomes and competencies
Medical record keeping	Choice, duration, timing	<ul style="list-style-type: none"> • Documentation of antimicrobial indication in clinical notes • Recording (planned) duration or stop date
Prescribing antimicrobials: initially	Empirical therapy (local guide, antimicrobial booklet), diagnostic uncertainty	<ul style="list-style-type: none"> • Best bacteriological guess for empirical therapy • Choice of empirical therapy in patients with previous antimicrobial treatment • Managing penicillin allergy • Choosing the dose and interval of administration (basic principles of pharmacokinetics and pharmacodynamics) • Estimating the shortest possible adequate duration
Prescribing antimicrobials: targeted therapy	Communication with the microbiology laboratory, value of specialist consultation in infectious diseases or microbiology	<ul style="list-style-type: none"> • Reassessment of intravenous antimicrobial prescription after 48–72 hours • Streamlining or de-escalation once microbiological results are known • Intravenous-to-oral switching (bioavailability of antimicrobials) • Therapeutic drug monitoring to ensure adequate medicine levels (e.g. vancomycin)
Prescribing antimicrobials: standard of care	Importance of guidelines in clinical practice	<ul style="list-style-type: none"> • Prescribing antimicrobial therapy according to national or local practice guidelines • Using <i>Therapeutic Guidelines: Antibiotic</i>
	Quality indicators of antimicrobial use	<ul style="list-style-type: none"> • Audit and feedback to assess prescribing practice using quality indicators
Communication skills	Discussion techniques	<ul style="list-style-type: none"> • Explaining to the patient the absence of an antimicrobial prescription • Education of patients regarding appropriate antimicrobial use (e.g. comply with the clinician's prescription, no self-medication)

Source: Adapted from Pulcini and Gyssens⁸

(such as through curriculum development, or designing education and training courses and other materials) and the assessment of competency.³

In addition to meeting professional competency standards, all registered clinicians in Australia must undertake continuing professional development. For most clinicians, a continuing education record or portfolio must be maintained. This record generally needs to show participation in different activities to maintain, improve and broaden knowledge, skills and performance to help clinicians deliver appropriate and safe care.²⁶ Participation in any of the AMS educational activities described in this chapter could be documented in the clinician's record.

5.2.4 Influence of the pharmaceutical industry

As commercial entities, pharmaceutical companies employ a range of strategies to market their products to clinicians. These may include sponsorship to attend educational events, production of educational materials and free samples, speaker and consulting fees, participation in advisory board meetings, food and beverages, and small gifts.

Literature indicates that interactions between the pharmaceutical industry and medical practitioners can influence prescribing practices, leading to increased medicine costs, prescribing that is not concordant with guidelines, a preference for new medicines, and decreased prescribing of generic medicines.^{27,28}

In Australia, the relationship between medical practitioners and pharmaceutical companies is self-regulated through industry codes. The Medical Board of Australia Code of Conduct requires medical practitioners to recognise that pharmaceutical and other medical marketing may influence clinicians, and to be aware of ways in which their practice may be influenced.²⁹ Medicines Australia, the representative body of the pharmaceutical industry, requires member companies to report fees and support paid to Australian clinicians. These reports are published on the [Medicines Australia website](#).

It is important that all clinicians who care for patients receiving antimicrobials are educated about unbiased sources of information, and that local policies on interactions with the pharmaceutical industry are applied to all clinicians. Medical schools and teaching hospitals have an important role to play in preparing future medical practitioners to recognise potential bias and appropriately manage conflicts of interest.³⁰ Policies regulating interaction with the pharmaceutical industry can assist students to maintain a level of independence from industry bias and may promote better educational outcomes.^{31,32} Guidelines for managing conflict of interest, including interactions with the pharmaceutical industry, have been developed by professional societies and colleges, some academic institutions, and state and territory health departments (see [Appendix A](#)). Issues of influence by the pharmaceutical industry also need to be considered for other members of the health workforce.

5.2.5 Evaluation of educational activities

Good governance requires organisations to monitor both the type and the frequency of education provided, and the extent of participation, to confirm that all clinicians are provided with education and training that will enable them to deliver safe care.³³ For this reason, organisations should keep appropriate records of AMS education provided and, if mandatory, records of attendance. If individual clinicians are required to complete online training modules, certificates of completion may be submitted; existing systems or structures within a hospital or across a network may assist with this. For example, many hospitals have education and quality improvement systems in place for monitoring attendance; in Primary Health Networks or practices, there may be individuals who are responsible for monitoring education provided, and

who can assist with maintaining records and sources of data for evaluation.

A comprehensive approach to evaluating educational activities is encouraged. Surveying clinicians about their knowledge of antimicrobial management, and about their perceptions before and after an education intervention can also be a useful way to evaluate educational activities.³⁴

Knowledge assessments alone are not enough to evaluate the effectiveness of education interventions.³⁵ Teams can undertake impact (immediate reaction to education) and outcome (resulting changes in practice) evaluations by following up participants, if resources allow. Counting the hits on the organisation's website resources will provide information on how often guidelines and other resources are accessed. Other sources of evaluation might include results of audits, and more qualitative observations of increased attendance or engagement in learning activities, or in the number of teams or individuals seeking advice from the AMS team.

5.3 Antimicrobial stewardship education for different groups and stages

A firm educational grounding for undergraduates, consolidated with further training throughout their careers, has been recommended to achieve optimal prescribing and use of antimicrobials (Figure 5.1).^{8,9} During the undergraduate and intern (foundation) years – when knowledge, attitudes and behaviours of clinicians are being shaped – education should focus on building a solid knowledge base for future practice. For example, a surgeon who is taught the principles of guideline development and antimicrobial prophylaxis will be more likely to follow the organisation's prophylaxis guidelines.⁸ Because attitudes and behaviours can change over time, it is important that educational messages are regularly repeated.^{9,36}

5.3.1 Undergraduate training

AMS is likely to be more successful if education begins early in the undergraduate curriculum.⁸ For professions such as pharmacy, a strong foundation in the undergraduate curriculum is

especially important, as many pharmacy graduates will not have the opportunity to obtain formal postgraduate training.³⁷

International studies show that many undergraduate healthcare students do not receive the level of education required to safely and effectively prescribe, review, dispense or administer antimicrobials; understand AMR; and understand the principles of AMS.^{38,39} Most students surveyed in the studies wanted more education on choosing antimicrobial treatments and appropriate prescribing, and many felt ill-equipped to manage patients requesting unnecessary antimicrobials and to prescribe in cases of diagnostic uncertainty.^{37,40} The results of a survey on knowledge and attitudes of Australian doctors at three Australian hospitals indicate that medical interns have gaps in antimicrobial prescribing knowledge.¹⁷

Topics for inclusion in undergraduate education programs for clinicians include principles of microbiology, ID and clinical pharmacology, with emphasis on appropriate antimicrobial prescribing and use.⁴¹ Dyar et al. suggest including more cases of diagnostic uncertainty in medical undergraduate education and using successes such as prevention of methicillin-resistant *Staphylococcus aureus* as evidence for the importance of AMS interventions.⁴² Managing the demands of patients can be included in communication skills sessions.⁸

Because AMS relies on the expertise and engagement of all team members, it is well suited to being taught within a multidisciplinary learning environment.³⁷ A United States study reported a better understanding of, and attitude to, the different clinicians' roles and collaborative approaches to AMS when pharmacy and medical students learned about AMS together.⁴³ Problem-based learning that allows interactive

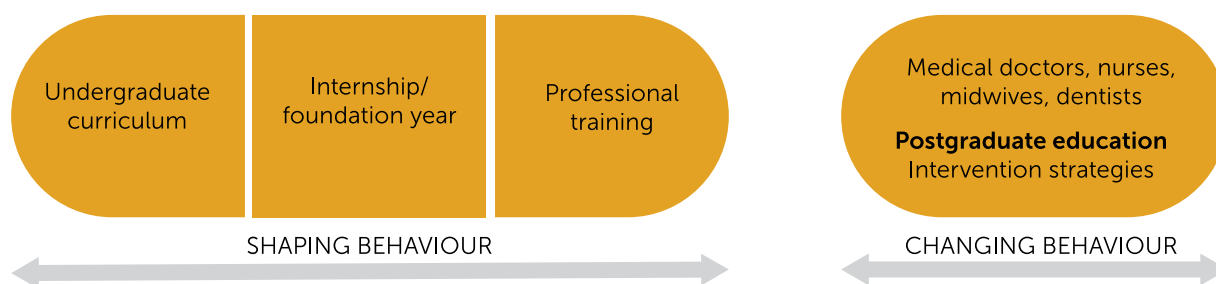
learning in small groups is recommended for teaching AMS concepts.⁸ (See also [Resources.](#))

5.3.2 Early-career development

Prescribers often acquire their antimicrobial prescribing habits from the practice of colleagues and senior workforce members, recommendations in antimicrobial handbooks, and information from representatives of the pharmaceutical industry.² Learning about the purpose of AMS and the importance of appropriate antimicrobial prescribing early in career development may help to shape attitudes and behaviours of future prescribers and other clinicians, and better equip them with the knowledge and skills needed to incorporate AMS principles in their practice.

Education should be provided early in employment and continue at regular intervals. An annual cycle of learning and development is suggested, although sessions may need to be repeated more often to take into account workforce changes and rotations. In addition to an introductory session on AMS provided during orientation, essential training in prudent antimicrobial use is mandatory for doctors, nurses, midwives and pharmacists working in United Kingdom hospitals, and must be repeated every three years.^{13,44} This approach is supported by international studies showing that education sessions are one of the most helpful interventions for improving prescribing among junior doctors.¹³ Box 5.1 lists topics for inclusion in an AMS training program. Such a program will cover some of the common causes of inappropriate prescribing among medical interns, such as gaps in antimicrobial prescribing knowledge and lack of awareness about which antimicrobials are restricted.¹⁷

Figure 5.1: Time line for educating clinicians on optimal antimicrobial use and principles of antimicrobial stewardship



Source: Adapted from Pulcini and Gyssens⁸

AMS messages can also be incorporated into other early-career training activities – for example, highlighting the importance of reviewing and documenting decisions about antimicrobial therapy at transitions of care (between wards and facilities, and at the community–hospital interface), as part of clinical handover and medication reconciliation training. The importance of documenting arrangements for contacting patients for follow-up after discharge if changes to antimicrobial treatment are needed in the light of microbiology results could also be discussed.

Involving students and early-career professionals in team-based quality improvement projects for AMS can improve clinical care and build the capability and capacity of the workforce in both quality improvement and AMS. It can also help people understand the complexity of health systems and appreciate the roles of different clinicians and teams in patient care.⁴⁵ Davey suggests that there is a:

*need to rethink professional education to embrace complexity and enable teams to learn in practice. Workplace-based learning of improvement science will enable students and early-career professionals to become change agents and transform training from a burden on clinical teams into a driver for improvement.*⁴⁵

5.3.3 Continuing education and professional development

AMS education needs to be available for clinicians to access on an ongoing basis throughout their careers to ensure that antimicrobial use is based on current evidence, and is safe and effective, and that patients are not harmed by unnecessary or inappropriate prescribing.

Continuing education for AMS should build on the knowledge and skills gained during undergraduate and early-career training. AMS continuing education may be provided in a number of different formats, and organisations may select a mix of passive and active educational activities relevant to their situation and resources (see [Introduction](#)). Some practical examples of engaging clinicians in educational activities are provided below.

Lectures, tutorials, in-service and grand rounds sessions

Demonstrating the relevance of AMS to clinical practice by using case studies, and focusing education on complications of antimicrobial management and implications for patient care can

help to engage clinicians. For tutorials or workshops, interactive sessions using problem-based learning with case vignettes are recommended.

Using local data can be a powerful way to convince clinicians about problems with resistance and inappropriate use. For example, national, state and territory surveillance data from sources such as the [Antimicrobial Use and Resistance in Australia Surveillance System](#) can be used to show the extent of problems with AMR and to inform local AMS programs.^{14,15} Local data on antimicrobial use and the appropriateness of prescribing (from sources such as the [National Antimicrobial Prescribing Survey](#), the [Aged Care National Antimicrobial Prescribing Survey](#) and the [National Antimicrobial Utilisation Surveillance Program](#)) are useful for showing variations in volume and appropriateness of use compared with peer health services, and for clinicians working in aged care services. In general practice, local data sources could include [MedicineInsight practice reports](#) from NPS MedicineWise, and information on variation in prescribing across local areas, states and territories from the [Australian Atlas of Healthcare Variation](#).⁴⁶ Understanding the audience is helpful in determining what type of data to use and how to present them. For example, some groups may be motivated by evidence, whereas others may be more influenced by case studies.

Department or practice meetings, morbidity and mortality meetings

Discussions during morbidity and mortality meetings, or unit, department or practice meetings, where the management of individual patients can be discussed within clinical teams or with peers, can help to engage clinicians from different disciplines by making AMS relevant to patient management.⁴⁵ Department meetings are also a good forum for providing feedback on the results of audits, with recommendations for improving prescribing behaviour. These activities can be supplemented with electronic messages, posters and online resources (see [Case study 5.1](#)).

Academic detailing

Academic detailing or education outreach involves one-on-one educational sessions between a clinician educator (usual a pharmacist or clinician) and a prescriber. Such sessions have been shown to have greater and more lasting effects on changing prescriber behaviour than printed materials or group interactions.¹⁰ A systematic review of interventions to improve antimicrobial prescribing in hospital inpatients reported that 20 of 21 studies

Box 5.1: Topics for inclusion in antimicrobial stewardship training programs

- Extent and causes of antimicrobial resistance, including the role of antimicrobials in driving resistance
- Role of infection prevention and control
- General principles of antimicrobial therapy
- Interpretation of antimicrobial susceptibility reports and local antibiograms
- Allergies to antimicrobials
- Therapeutic drug monitoring
- Antimicrobial stewardship (AMS) prescribing principles and the Antimicrobial Stewardship Clinical Care Standard
- Purpose of AMS and details about the functions of the local AMS program, including:
 - availability of national and local diagnostic and treatment guidelines
 - organisational policies on antimicrobial prescribing
 - clinical decision support systems
 - local restrictions and approval systems
 - who to go to for advice
- Factors influencing the behaviour of prescribers and other healthcare professionals regarding antimicrobial use, including the effect of promotional activities conducted by the pharmaceutical industry.

Source: Nathwani et al.³

on academic detailing were associated with an improvement in prescribing, with median effect sizes of between 20% and 46.3%.⁵

Academic detailing is often combined with audit and feedback, and guideline promotion in hospitals and community settings. Maxwell et al. describe a set of interventions that included academic detailing, feedback of audit results and point-of-prescribing prompts to improve antimicrobial prescribing in the management of community-acquired pneumonia in Australian emergency departments. An overall 1.5-fold improvement in guideline-concordant prescribing was reported.⁴⁷

One-on-one patient-directed education

There are many opportunities for informal one-on-one education at the individual patient level in the workplace, especially in teaching hospitals – for example, during the approval process, as feedback following reviews of prescribing by the AMS team, or during an ID consultation. Petrak et al. describe an ID consultation that is ‘written, verbally discussed, supported by literature and refocused as the case evolves’ as the perfect model for educating the clinical workforce.⁴⁸ The medical workforce in an Australian teaching hospital reported that the patient-level advice provided by a telephone-approval system managed by the ID unit was educational and useful.⁴⁹

Online learning

Online learning modules with an interactive component are an effective mechanism for learning (see [Resources](#)). For example, an internet-based training program for general practitioners on improving patient communication skills and using C-reactive protein testing improved prescribing for acute respiratory tract infections in a multinational trial.⁵⁰

This mode of delivery can occur at a time convenient to the workforce, and may suit senior prescribers, general practitioners and junior clinicians. Ideally, such education includes questions during or on completion of the module that enable the clinician to reflect on and measure their learning.

Repeated education to reinforce the message is very important. Time-spaced learning, in which education is provided regularly in short bursts but spaced over time, reduces the need for clinicians to spend large blocks of time away from the workplace. Relearning the material at spaced intervals has also been shown to help learners remember over time. An example of a time-spaced learning program is

Case study 5.1: Antimicrobial stewardship continuing professional education in hospitals

Clinicians were surveyed at a large tertiary referral hospital to assess their knowledge and explore their attitudes to antimicrobial use. The results indicated that basic information was required, because clinicians had forgotten what they had learned in undergraduate training. Education was therefore pitched at a level that assumed only minimal knowledge.

Once or twice a month, a 'did you know?' email is sent to junior medical officers and registrars, as well as nurse educators, nurses and pharmacists. These usually cover one topic that the AMS team has come across during ward rounds. They are short, sharp and clinically focused (see [Appendix B](#)). People can read them in their own time and are encouraged to email questions back if the advice is not clear. They have been well received.

The emails are saved on the hospital intranet page for future access. Topics are recycled each year to catch new doctors and reinforce repeated problem areas. The emails are complemented by posters, online resources, and talks at unit meetings (although the talks may happen only once every few years).

the AMS Massive Open Online Course developed by Scottish medical schools and the British Society for Antimicrobial Chemotherapy (see [Websites and online learning resources](#)).

Education combined with other antimicrobial stewardship activities

Combining education with other AMS activities can increase the effectiveness of the intervention. For example, feedback of individual prescribing data combined with educational messages, or as part of an academic detailing session, has been shown to be effective in reducing antimicrobial prescribing in general and dental practices. In Australia, NPS MedicineWise provides feedback to general practitioners on their own prescribing relative to their peers, including points of reflection for the prescriber.

[Antibiotic Awareness Week](#) can be a good time to focus on continuing education activities.

Another strategy used to promote guideline-concordant antimicrobial prescribing is 'nudging'. Meeker et al. reported a 19.7% reduction in inappropriate antimicrobial prescribing by using a behavioural nudge based on a public commitment to avoiding inappropriate prescribing of antibiotics for acute respiratory tract infections.⁵¹

5.3.4 Education and training for antimicrobial stewardship teams

Leading an AMS program requires a range of skills and knowledge beyond ID and microbiology⁵², and clinicians interested in leading AMS programs should be encouraged to develop these skills (see [Continuing education and professional development](#)). In addition to the skills required for improving the prescribing and use of antimicrobials, members of AMS teams need to be knowledgeable about quality improvement techniques and measuring the success of a program. Skills in quality improvement methods will help the team work together to determine areas for improvement, identify barriers, and select and evaluate interventions that are more likely to change prescribing behaviour.

The Society for Healthcare Epidemiology of America has partnered with the Infectious Diseases Society of America and other organisations to develop a [summary description](#) of the core knowledge and skills required for AMS professionals engaged with building, leading and evaluating AMS programs.⁵² These requirements can be used by AMS teams or organisations to identify gaps in training, to assess education needs when developing AMS courses and curriculums, and as a framework for determining knowledge and skills needed for developing AMS programs.

Some states and territories conduct training days for AMS teams in hospitals. The training days provide team members with skills in AMS principles, and practical advice on implementing and evaluating AMS programs. They also provide a good forum for discussing difficult issues, such as dealing with prescribers who are resistant to change. Pulcini and Gyssens have published a set of [learning outcomes](#) that can be used as a basis to design AMS workshops for AMS team members.⁸

Several professional organisations host online forums that provide opportunities for clinicians

Box 5.2: Australian antimicrobial stewardship online networking forums

- [Infexion Connexion Discussion List](#), facilitated by the [Australasian College for Infection Prevention and Control](#)
- Antimicrobial stewardship online [monthly journal club meeting](#), facilitated by the [National Centre for Antimicrobial Stewardship](#)
- [Infectious Diseases Specialty Practice Stream](#), facilitated by the [Society of Hospital Pharmacists of Australia](#)
- [Ozbug network](#), facilitated by the [Australasian Society for Infectious Diseases](#)

working in AMS to network and canvass specific AMS issues (Box 5.2).

5.3.5 Specialist training

Postgraduate specialist education can consolidate learning gained during undergraduate education and postgraduate clinical experience. Specialist programs should include education on the implications of AMR for specific patient groups, the types of infections commonly seen, and the antimicrobials that are used more often in specialist settings relevant to the professional group.

Professional colleges and associations can take a proactive role in supporting AMS – for example, by updating their members about changes to guidelines and providing continuing education or discussion forums. This is especially important for specialist groups that are responsible for prescribing antimicrobials as an adjunct to their roles (for example, surgeons, anaesthetists, dentists).

Postgraduate training of ID physicians, clinical microbiologists and AMS pharmacists should incorporate specific, detailed education on AMS to enable trainees to develop the knowledge and skills necessary to actively contribute to AMS efforts. The requirements detailed by [Cosgrove et al.](#)⁵² can be used by trainees to assess their own education needs, and by colleges and professional organisations to develop AMS courses and curriculums. A number

of online education programs and external training courses are available for trainees (see [Resources](#)).

Some details of profession-specific training are provided in Chapter 8: '[Role of the infectious diseases service in antimicrobial stewardship](#)', Chapter 11: '[Role of the pharmacist and pharmacy services in antimicrobial stewardship](#)' and Chapter 12: '[Role of nurses, midwives and infection control practitioners in antimicrobial stewardship](#)'.

5.4 Education resources

A range of Australian and international resources are available to assist with AMS training. Australian resources on antimicrobial prescribing and resistance are preferred because they are based on national guidelines, Australian susceptibility data and antimicrobials available in Australia.

5.4.1 Guidelines

Evidence-based clinical guidelines are a popular educational tool for clinicians and have become a major feature of health care.⁵³ They can form the basis for educating prescribers and other clinicians on accepted practice for antimicrobial prescribing in the organisation (see Section 3.2 in Chapter 3: '[Strategies and tools for antimicrobial stewardship](#)'). *Therapeutic Guidelines: Antibiotic*⁵⁴ is recognised as the national best-practice guideline for antimicrobial prescribing in Australia, and is considered by doctors and other clinicians to be an enabler of appropriate prescribing.¹⁷

Educational activities are often used to improve the uptake of guidelines. They include awareness-raising activities and audits of compliance with guidelines, with feedback to prescribers and clinical departments.

5.4.2 Websites and online learning resources

In recent years, technology has enabled education to be delivered in a range of different formats, such as online learning modules and video- and web-supported continuing education programs. Online learning offers access to learning materials developed by experts that may not otherwise be readily accessible to all clinicians, especially those working in smaller, rural or remote centres.



Mobile technology, such as smartphones, is also increasingly being used to access resources on antimicrobial prescribing, including antimicrobial guidelines.^{37,55} In a study of emergency department doctors, 89% were found to use mobile technology for antimicrobial prescribing decisions.⁵⁶ The rapid uptake in the use of smartphones to access information to aid antimicrobial decision-making provides an opportunity for health service organisations to improve access to national and local antimicrobial prescribing guidelines and other relevant antimicrobial prescribing information.^{37,55}

Online Australian resources that are available for use in hospital and community practice include videos, online learning courses, the electronic version of *Therapeutic Guidelines: Antibiotic*⁵⁴, case studies, and many publications, including *MedicineWise News*, with a focus on specific antimicrobial topics. The antimicrobial online learning modules developed by *NPS MedicineWise* and the Australian Commission on Safety and Quality in Health Care provide an introduction to prescribing antimicrobials and case-based scenarios on prescribing for common hospital infections. All medical interns and overseas-trained doctors should finish these modules early in their training.

A range of resources are also available from overseas websites, including:

- [Future Learn](#) online course on AMS in hospitals, which provides the opportunity to learn in a novel way with participants from around the world⁵⁷
- Training materials developed by the [Scottish Antimicrobial Prescribing Group](#) with NHS Education for Scotland to support continuing professional development in both hospital and community settings.

However, not all resources available electronically are appropriate to Australian practice. The source of resources should be considered when searching the internet for treatment guidelines or dosage regimens, or when accessing material via social media. International guidelines may not be relevant to the Australian context or consistent with recommended Australian treatment guidelines.

Prescribers must be educated to use credible sources of information and supported to use appropriate resources. This can be achieved by establishing an up-to-date website on the internet or organisational intranet that provides easy access to:

- Information on the local AMS program and current strategies⁵⁸

- Local prescribing guidelines and *Therapeutic Guidelines: Antibiotic*⁵⁴
- Links to appropriate websites and apps that have been endorsed by the local AMS committee.

In the hospital sector, making such websites publicly available facilitates the sharing of ideas and may assist other hospitals to implement similar programs.^{58,59} Many AMS websites provide useful information and educational resources for designing and implementing AMS programs and for educating clinicians (see [Resources](#)).

5.4.3 Educators

It is important that education is from a credible source and is tailored to the audience; the prescriber needs to have confidence in the advice. The person or group providing education needs to be respected by the clinician – that is, someone who is viewed as a peer, understands the clinical situation that they are talking about, knows the evidence and can justify the advice. This is especially important when convincing senior doctors to change their prescribing habits.

A multidisciplinary group that includes ID physicians, clinical microbiologists, clinical pharmacists, nurses, midwives and infection control practitioners, or the AMS team, should be responsible for planning, developing and delivering a local education program. This will help to ensure that the approach to education is suitable for the intended audience and relevant to the local practice context.^{8,60} Consideration should be given to providing education sessions in multidisciplinary team environments and to clinician-specific groups, given the multidisciplinary nature of AMS activities.

Members of the AMS team can also provide AMS education (see Chapter 8: '[Role of the infectious diseases service in antimicrobial stewardship](#)', Chapter 9: '[Role of the clinical microbiology service in antimicrobial stewardship](#)', Chapter 11: '[Role of the pharmacist and pharmacy services in antimicrobial stewardship](#)' and Chapter 12: '[Role of nurses, midwives and infection control practitioners in antimicrobial stewardship](#)'). In the community, *NPS MedicineWise* provides multifaceted, nationally coordinated education programs (including academic detailing) to general practitioners.

Resources

Online education resources include:

- [NPS MedicineWise](#)
 - Antimicrobial online learning modules (antimicrobial prescribing courses, management of urinary tract infections in aged care)
 - Case studies
 - Clinical e-audits
 - Medicines use reviews
- Online course on AMS in hospitals: [Future Learn](#)
- Scottish Antimicrobial Prescribing Group: [training materials](#) to support continuing professional development
- Australian Commission on Safety and Quality in Health Care
 - [video presentations](#) on antimicrobials and AMS in hospitals
 - materials to promote [Antibiotic Awareness Week](#)
- British Society for Antimicrobial Chemotherapy: [Antimicrobial Stewardship: From principles to practice](#)
- Australian AMS online networking forums
 - [Infexion Connexion Discussion List](#), facilitated by the [Australasian College for Infection Prevention and Control](#)
 - AMS online monthly [journal club](#), facilitated by the [National Centre for Antimicrobial Stewardship](#)
 - [Infectious Diseases Specialty Practice Stream](#), facilitated by the [Society of Hospital Pharmacists of Australia](#)
 - [Ozbug network](#), facilitated by the [Australasian Society for Infectious Diseases](#)
- Prescribing curriculums and competencies
 - NPS MedicineWise [National Prescribing Curriculum](#)
 - NPS MedicineWise [Prescribing Competencies Framework](#)
 - Department of Health and Public Health England [Antimicrobial Prescribing and Stewardship Competencies](#)

Other resources:

- Tools and resources from the [General Practitioner Antimicrobial Stewardship Programme Study](#)
- Conflict of interest guidelines, codes of conduct and position statements ([Appendix A](#))
- Example of a 'Did you know' email for clinicians ([Appendix B](#)).

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Appendix A: Managing conflicts of interest and relationships with the pharmaceutical industry – further reading and links

National guidance

Australian Government Department of Health

- [Therapeutic Goods Advertising Code \(2015\)](#)
- [National Medicines Policy \(2000\)](#)

State and territory guidance

- **ACT Government:** [Gifts, Benefits & Hospitality Policy \(2016\)](#)
- **NSW Therapeutic Advisory Group Inc.:** [Pharmaceutical Industry and Hospital Staff Liaison in Public Hospitals](#)
- **SA Health:** [Gifts and Benefits Policy Directive \(2016\)](#)
- **VicHealth:** [Gifts, Benefits and Hospitality Policy \(2017\)](#)
- **Western Australian Therapeutic Advisory Group:** [Guidance Document for Western Australian Public Hospitals and Health Services and their Staff on Liaison with the Pharmaceutical Industry \(2010\)](#)

Professional association codes, guidance and policies

- **Medicines Australia:** [Code of Conduct \(2015\)](#)
- **Pharmaceutical Society of Australia:** [Code of Ethics for Pharmacists \(2017\)](#)
- **Medical Board of Australia:** [Good Medical Practice: A code of conduct for doctors in Australia \(2014\)](#)
- **Nursing and Midwifery Board of Australia:** [Professional standards web page](#)
- **Royal Australasian College of Physicians:** [Code of Conduct \(2013\)](#)
- **Royal Australasian College of Surgeons:** [Conflict of Interest Policy \(2016\)](#)
- **Royal Australian College of General Practitioners:** [Conflict of Interest Policy \(2015\)](#)
- **Australian Medical Association:** [Medical Practitioners' Relationships with Industry \[position statement\] \(2012\) \(currently under review\)](#)

- **Australian Dental Association:** [Policy Statement 5.12 – The Relationship between Dentists and the Pharmaceutical Industry \(2014\)](#)

Further reading

- NPS MedicineWise. [Identifying and managing competing interests \(panel discussion\)](#). In: Phillips S, Komesaroff P, Kerridge I, Hemming M. Independent therapeutic advice: how achievable is it? *Aust Prescr* 2013;36(Suppl 2):S1–48.
- Mintzker Y, Braunack-Mayer A, Rogers W. [General practice ethics: continuing medical education and the pharmaceutical industry](#). *Aust Fam Physician* 2015;44(11): 846–8.
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Appendix B: Example of a 'Did you know' email for clinicians

Source: Antimicrobial Stewardship Pharmacist, The Royal Melbourne Hospital – City Campus, Pharmacy Department, Grattan Street, Parkville Victoria 3050

These emails usually cover one topic identified by the AMS team during ward rounds. They are short,

sharp and clinically focused. People can read them in their own time and are encouraged to email questions back if the advice is not clear. Other topics that have been included in these emails are intravenous-to-oral switching and vancomycin.

DID YOU KNOW?

Management of *Enterococcus* urinary tract infections

General tips

- Only request urine cultures if the patient **has clinical signs of a urinary infection**
- **Catheter urine samples** almost always have *white blood cells* present and are colonised by bacteria; these do NOT need to be treated with antibiotics if the patient is otherwise well. If treatment is necessary, infection will not clear without changing the catheter (*in many cases this is all that is required*).

Enterococcus susceptibility and treatment options

- Enterococci are gram-positive cocci that are common commensal organisms of the gastrointestinal tract
- *Enterococcus faecalis* isolates are almost always SUSCEPTIBLE to **amoxicillin**
- *Enterococcus faecium* isolates are almost always RESISTANT to amoxicillin
- Note that amoxicillin-resistant isolates will be resistant to amoxicillin/clavulanate also
- Both *E. faecalis* and *E. faecium* are usually susceptible to **vancomycin**, which must be administered intravenously
- If the enterococci are resistant to vancomycin (VRE) in a patient with a true infection, contact VIDS for advice.

Oral options for penicillin-intolerant patients (check that the patient is TRULY penicillin intolerant by asking details of 'allergy' first).

Nitrofurantoin:

- is a reasonable option for uncomplicated cystitis due to *E. faecalis*, and some *E. faecium* isolates
- should NOT be used for systemic infection or prostatitis
- should NOT be used if the patient has renal impairment.

Fosfomycin:

- is an oral antibiotic option that may be prescribed only after consultation with VIDS
- has fewer toxicity issues compared with nitrofurantoin
- is also NOT suitable for systemic infection in general
- can have susceptibility testing performed by our Microbiology team on request.

Why is ciprofloxacin not a good option?

- Quinolones (including ciprofloxacin) have intrinsically *reduced activity* against enterococci, compared with gram-negative organisms, e.g. members of the Enterobacteriaceae
- Quinolones are generally **not recommended** for infections due to *Enterococcus* spp.
- Quinolones have a BROAD spectrum of activity, and so the potential for adverse consequences of using these agents is substantial – e.g. *Clostridium difficile* risk or subsequent infection with multidrug-resistant bacteria.

Always remember to chase up susceptibility results to determine the most appropriate narrowest-spectrum agent.

Remember that the Microbiology registrars are always available and will be delighted to discuss testing/treatment options!

