

# 11

Role of the pharmacist and pharmacy services in antimicrobial stewardship

## Antimicrobial Stewardship in Australian Health Care

2018



# Chapter contents

<b>Acronyms and abbreviations</b>	<b>256</b>
<b>11.1 Introduction</b>	<b>257</b>
<b>11.2 Pharmacists and antimicrobial stewardship</b>	<b>257</b>
11.2.1 Activities in different settings	258
11.2.2 Pharmacy managers	261
11.2.3 Roles of antimicrobial stewardship pharmacists	262
<b>11.3 Leadership</b>	<b>262</b>
11.3.1 Promoting uptake and compliance with national standards for antimicrobial stewardship	263
11.3.2 Developing and maintaining antimicrobial guidelines	263
<b>11.4 Expert advice</b>	<b>263</b>
11.4.1 Providing expert advice to clinicians, patients and carers	263
11.4.2 Participating in antimicrobial stewardship ward rounds	263
11.4.3 Initiating point-of-care interventions	264
<b>11.5 Formularies and approval systems</b>	<b>264</b>
<b>11.6 Monitoring antimicrobial use and evaluating interventions</b>	<b>264</b>
<b>11.7 Liaison</b>	<b>265</b>
<b>11.8 Education</b>	<b>265</b>
11.8.1 Antimicrobial stewardship education for pharmacists	265
11.8.2 Pharmacists' role in education	267
<b>Resources</b>	<b>268</b>
<b>References</b>	<b>269</b>
<b>Appendix A: Examples of training and educational opportunities for AMS pharmacists</b>	<b>271</b>

## Acronyms and abbreviations

Abbreviation	Definition
AMR	antimicrobial resistance
AMS	antimicrobial stewardship
DUE	drug use evaluation
ID	infectious diseases
LHD	Local Health District
LHN	Local Hospital Network
NSQHS	National Safety and Quality Health Service

## Key points

- Pharmacists play a key role in antimicrobial stewardship (AMS) in hospitals, aged care homes and the community.
- A pharmacist with experience and training in AMS performs an important leadership role and is an important resource for the AMS team. In some health service organisations, the AMS pharmacist may lead the AMS program.
- Ideally, the AMS pharmacist should be an experienced clinical pharmacist with expertise in antimicrobials and the therapeutic management of infectious diseases.
- The AMS pharmacist is in a position to promote the uptake and implementation of the National Safety and Quality Health Service Preventing and Controlling Healthcare-Associated Infection Standard and the Antimicrobial Stewardship Clinical Care Standard as part of routine patient care.
- Studies in hospitals have shown that pharmacists' interventions, including routine reviews of antimicrobial prescriptions, can improve the appropriate use of antimicrobials and reduce costs.
- In addition to clinically reviewing and dispensing antimicrobial prescriptions, community pharmacists should educate patients and carers about the appropriate use of antimicrobials.
- Pharmacists providing home medication reviews or residential medication management reviews can also contribute to AMS activities.

## 11.1 Introduction

All pharmacists have a role in antimicrobial stewardship (AMS), whether they work in hospitals, aged care homes or the community. This input is essential to the success of AMS programs (see Section 2.3 in Chapter 2: 'Establishing and sustaining an antimicrobial stewardship program').<sup>1-4</sup> The pharmacist's roles and responsibilities can encompass activities at the individual patient level and at the system level.<sup>2,3,5-12</sup> At the patient level, the pharmacist's role may include:

- Optimising antimicrobial therapy by recommending an appropriate antimicrobial, dose regimen and duration of therapy
- Recommending intravenous-to-oral switching
- Therapeutic drug monitoring
- Instructing patients and their families and carers on appropriate use of antimicrobials.

At the system level, the pharmacist's role may include planning and implementing AMS programs and other initiatives that encourage appropriate antimicrobial use.

This chapter outlines the role of pharmacists providing clinical or dispensary services to people in the community, hospital and aged care homes. It also describes the roles of designated AMS pharmacists and pharmacy managers.

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.



## 11.2 Pharmacists and antimicrobial stewardship

Pharmacists providing clinical or dispensary services to patients have an important role in supporting AMS activities, regardless of the setting they work in (see Activities in different settings). This includes responding to the requirements of the National Safety and Quality Health Service (NSQHS) Preventing and Controlling Healthcare-Associated Infection Standard and promoting the uptake of the Antimicrobial Stewardship Clinical Care Standard as part of routine patient care.<sup>13</sup> Reviewing antimicrobial therapy, and providing information and feedback to prescribers about optimal antimicrobial prescribing are key roles, and all pharmacists need to have the skills to perform these tasks.<sup>14</sup>

### 11.2.1 Activities in different settings

Studies in hospitals have shown that pharmacists' interventions improve appropriate antimicrobial use and reduce costs.<sup>15-17</sup> Typical interventions are patient-specific recommendations on therapy; the implementation of policies, education and therapeutic drug monitoring; and participation in AMS ward rounds. Hospitals with pharmacist-managed aminoglycoside or vancomycin therapy had 6.7% lower death rates and 12.3% shorter length of stay than hospitals that did not have such a program.<sup>18</sup> A study in the United States demonstrated that pharmacists can provide cost-saving interventions and can implement AMS programs in hospitals that have limited infectious diseases (ID) resources. Two years after implementing a pharmacist-driven antimicrobial program without the support of an ID physician, one organisation had saved an estimated US\$355,000.<sup>15</sup> The implementation of a 24-hour pharmacist-coordinated AMS service in a community hospital reduced antimicrobial expenditure from US\$14.46 per adjusted patient day to US\$11.22 per adjusted patient day after 12 months.<sup>19</sup>

The roles of community pharmacists in AMS and the opportunity for them to contribute to AMS have recently been articulated by the [International Pharmaceutical Federation](#).<sup>9</sup> In addition to clinically reviewing and dispensing antimicrobial prescriptions, community pharmacists can educate patients and carers about using antimicrobials appropriately. Pharmacists providing medication management reviews can also contribute to AMS activities. In Scotland, specialist AMS pharmacists work across hospital and community care, and have a role in activities designed to influence the prescribing behaviour of general practitioners.<sup>20</sup> AMS pharmacists in England are considered leaders in implementing AMS interventions across the primary care and hospital sectors.<sup>21</sup> In Australia, Local Hospital Networks (LHNs) or Local Health Districts (LHDs), and Primary Health Networks may be able to identify opportunities through integrated care programs to implement strategies similar to those overseas.

The following sections include examples of how pharmacists can support AMS in different healthcare settings. For further details on the roles of pharmacy managers and AMS pharmacists, see [Pharmacy managers](#) and [Roles of antimicrobial stewardship pharmacists](#).

### Hospitals

Pharmacists can support AMS in hospitals in the following ways.

Review and assessment:

- Review prescribed antimicrobials for their appropriateness (for example, choice, dose, route, frequency, duration; history of allergies and adverse drug reactions to antimicrobials; drug interactions) and, if necessary, refer or intervene (for example, contact prescriber to discuss)
- Conduct subsequent reviews at 48 hours, on the documented review date, on transfer to another ward and on discharge
- Where applicable
  - recommend switch from intravenous to oral therapy, or appropriate therapeutic substitution(s)
  - review antimicrobial susceptibility results and provide advice (for example, streamlining therapy to narrow-spectrum agents, changing therapy if the microorganism is resistant)
  - notify prescriber if multiple antimicrobials that have overlapping spectrums of activity are prescribed
  - review therapeutic drug monitoring results for antimicrobials and provide advice
- Regularly review antimicrobials that are kept on ward imprest and in the pharmacy to limit access to restricted antimicrobials.

Supply and access:

- Ensure the adequate supply of, and timely access to, antimicrobials.

Counselling and advice:

- Counsel patients and their families or carers on the appropriate use of antimicrobials
- If appropriate, provide advice to prescribers of antimicrobials
- Act as liaison between the AMS team or AMS pharmacist and clinicians to advise on optimising the use of some antimicrobials (for example, colistin, fosfomycin).

Monitoring and feedback:

- Contribute to surveillance activities (for example, the [National Antimicrobial Prescribing Survey](#) and [National Antimicrobial Utilisation Surveillance Program](#))
- Support or lead drug use evaluation studies, or quality audits, and provide feedback on antimicrobial use
- Provide relevant feedback to the AMS pharmacist and team.

#### Participation:

- Participate in health promotion and infection prevention measures (for example, Antibiotic Awareness Week)
- Participate in relevant committees (for example, drug and therapeutics, medication safety, infection control) and advise on the use of antimicrobials at the facility
- Contribute, where appropriate, to the development of antimicrobial prescribing guidelines and algorithms
- Lead or participate in AMS research.

#### Promotion and advocacy:

- Promote the use of the Antimicrobial Stewardship Clinical Care Standard
- Advocate appropriate documentation relating to antimicrobial prescribing (for example, start dates, stop or review dates, indications)
- Promote hand hygiene and other relevant infection prevention measures
- Advocate that formulary restrictions and practice guidelines are followed.

#### Education:

- Educate prescribers and others about the optimal use of antimicrobials.

This list was compiled from statements published by the Society of Hospital Pharmacists of Australia<sup>2</sup> and the American Society of Health System Pharmacists Council on Pharmacy Practice.<sup>6</sup>

### Aged care homes

AC

Pharmacists can support AMS in aged care homes in the following ways.

#### Review and assessment:

- Review prescribed antimicrobials for their appropriateness (for example, choice, dose, route, frequency, duration; history of allergies and adverse drug reactions to antimicrobials; drug interactions) and, if necessary, refer or intervene (for example, contact prescriber to discuss)
- Conduct subsequent reviews at a documented review date
- Question the need for antimicrobial prescriptions that are for long-term or chronic use (for example, for several months).

#### Supply and access:

- Ensure the adequate supply of, and timely access to, antimicrobials.

#### Counselling and advice:

- Counsel patients and their families or carers on the appropriate use of antimicrobials
- If appropriate, provide advice to prescribers of antimicrobials.

#### Monitoring and feedback:

- Contribute to surveillance activities (for example, the Aged Care National Antimicrobial Prescribing Survey)
- Monitor antimicrobial use within the facility, and provide feedback and reporting to facility executives (for example, on antimicrobial use for urinary tract infections).

#### Participation:

- Participate in health promotion and infection prevention measures (for example, Antibiotic Awareness Week)
- Participate in relevant committees (for example, medication advisory committee) and advise on antimicrobial use at the facility
- Develop, support and maintain antimicrobial guidelines, algorithms, formularies and policies for the facility.

#### Promotion and advocacy:

- Promote the use of the Antimicrobial Stewardship Clinical Care Standard
- Advocate appropriate documentation relating to antimicrobial prescribing (for example, start dates, stop or review dates, indications)
- Promote the safe disposal of unwanted antimicrobials (for example, through the National Return and Disposal of Unwanted Medicines [NatRUM] program)
- Promote hand hygiene and other relevant infection prevention measures
- Promote and advise on immunisation (for example, influenza vaccination).

#### Education:

- Educate prescribers and others about the optimal use of antimicrobials.

### Community

Pharmacists can support AMS in the community in the following ways.

#### Review and assessment:

- Review prescribed antimicrobials for their appropriateness (for example, choice, dose, route, frequency, duration; history of allergies and adverse drug reactions to antimicrobials; drug interactions) and, if necessary, refer or intervene (for example, contact prescriber to discuss)

- Question or investigate the need for antimicrobials that are for long-term or chronic use (for example, for several months)
- Question individuals who return with a repeat prescription after a long period, at which point the original infection would be expected to be resolved
- Assess the need for over-the-counter products containing antimicrobials when providing primary care advice to consumers and, if appropriate, refer them to their general practitioners
- Recommend alternatives to antimicrobials when antimicrobials are not indicated (for example, analgesics or decongestants for viral infections).

#### Supply and access:

- Ensure the adequate supply of, and timely access to, antimicrobials.

#### Counselling and advice:

- Counsel patients and their families or carers on the appropriate use of antimicrobials
- If appropriate, provide advice to prescribers of antimicrobials
- Advise patients to correctly dispose of unused antimicrobials
- Advise patients on the symptomatic management of coughs, colds and influenza.

#### Monitoring and feedback:

- If possible, monitor antimicrobial use and provide feedback to prescribers.

#### Participation:

- Participate in health promotion and infection prevention measures (for example, Antibiotic Awareness Week).

#### Promotion and advocacy:

- Promote the use of the Antimicrobial Stewardship Clinical Care Standard
- Promote the safe disposal of unwanted antimicrobials (for example, through the NatRUM program)
- Promote hand hygiene and other relevant infection prevention measures
- Promote and advise on immunisation (for example, influenza vaccination) and access to vaccination services.

#### Education:

- Educate prescribers and others about the optimal use of antimicrobials.

### Home medicines reviews and residential medication management reviews

Pharmacists can support AMS in medication management reviews in the community sector in the following ways.

#### Review and assessment:

- Review prescribed antimicrobials for their appropriateness (for example, choice, dose, route, frequency, duration; history of allergies and adverse drug reactions to antimicrobials; drug interactions) and, if necessary, refer or intervene (for example, contact prescriber to discuss)
- Question or investigate the need for antimicrobials that are for long-term or chronic use (for example, for several months) and take action if use is inappropriate.

#### Supply and access:

- Ensure the adequate supply of, and timely access to, antimicrobials.

#### Counselling and advice:

- Counsel patients, and their families or carers about the appropriate use of antimicrobials
- If appropriate, provide advice to prescribers of antimicrobials.

#### Monitoring and feedback:

- If applicable, monitor antimicrobial use and provide feedback to the facility's executive.

#### Participation:

- Participate in health promotion and infection prevention measures (for example, Antibiotic Awareness Week).

#### Promotion and advocacy:

- Promote the use of the Antimicrobial Stewardship Clinical Care Standard
- Promote the safe disposal of unwanted antimicrobials (for example, through the NatRUM program)
- Promote hand hygiene and other relevant infection prevention measures
- Promote and advise on immunisation (for example, influenza vaccination) and access to vaccination services.

#### Education:

- Educate prescribers and others about the optimal use of antimicrobials.



## 11.2.2 Pharmacy managers

Pharmacy managers in hospital and community pharmacy practice have an important part to play in supporting AMS activities.

### Hospitals

In the hospital setting, the pharmacy manager or their nominee has an important role in:

- Establishing communication and collaboration between the pharmacy workforce, microbiology and ID services, and the infection prevention and control service
- Maintaining the health service organisation's formulary
- Supporting the activities of relevant committees (for example, drug and therapeutics committee, medication advisory committee) in evaluating antimicrobials for inclusion in the organisation's formulary
- Ensuring the effective implementation of antimicrobial restriction systems
- Monitoring and reporting on antimicrobial use
- Ensuring that enough priority is given to the AMS program, including a suitable pharmacy workforce.

Different organisational models for AMS programs are in place in Australian hospitals. The AMS pharmacist generally has multiple lines of direct and indirect reporting and communication. These may include reporting to the heads of the departments of pharmacy, ID or infection prevention and microbiology, or to the chair of the AMS committee. Leadership responsibility for AMS generally resides with the pharmacy, ID or clinical microbiology department.

### Community and aged care homes

Pharmacy managers in community pharmacy and those responsible for the provision of services to aged care homes can set up processes to ensure that:

- Antimicrobial prescriptions are reviewed for appropriateness (that is, the most appropriate agent, dose, frequency, duration and indication), and checked for drug interactions, allergies and previous adverse drug reactions
- Antimicrobial prescriptions are written in line with prescribing policy (for example, the requirements of the Pharmaceutical Benefits Scheme and the Repatriation Pharmaceutical Benefits Scheme, or health service organisation policy)

- Antimicrobial prescriptions are correctly documented in the patient's dispensing history<sup>13</sup>
- Antimicrobial use is regularly monitored, and feedback is provided to prescribers and the management of aged care homes.

Pharmacists should consider whether there is still a clinical need to fill all prescriptions presented – for example, original and repeat prescriptions that are presented for dispensing several months after they were written (when it would be expected that the original infection would have resolved), or prescriptions for long-term use (for example, for several months). Such prescriptions should only be dispensed if the pharmacist is satisfied that the use is appropriate. If not, there should be discussion with the prescriber.

Community pharmacy is an important site of community education and activities for AMS in primary care because of the ease and frequency of the public's access to community pharmacists compared with other clinicians.<sup>9</sup> Community pharmacy managers are ideally placed to educate – or set up processes to educate – patients, carers and the pharmacy workforce about appropriate antimicrobial use, the problem of antimicrobial resistance (AMR), and infection prevention strategies.

It should be routine practice that consumers who have been dispensed antimicrobials, or their carers, are<sup>22</sup>:

- Counselling on the correct administration and storage of antimicrobials and the duration of therapy
- Informed of any potential adverse reactions or drug interactions – for example, between rifampicin and hormone contraceptives – and how to manage them
- Offered access to consumer medicines information and other written information (if appropriate), with the opportunity to ask questions
- Advised not to keep any unused antimicrobials, but to return them to a pharmacy for disposal.

In the pharmacy, processes should also be in place to ensure that antimicrobials are dispensed safely and in a timely manner, and stored and disposed of appropriately (for example, through the NatRUM program).

In Australia, pharmacy services to aged care homes are mostly provided by community pharmacies and pharmacists providing residential medication management reviews. Managers of those services should foster good communication and collaboration between pharmacy staff, the general practitioner, and the facility's executive and workforce to ensure optimal antimicrobial use. They can also lead or enable processes to:

- Set up and maintain an antimicrobial prescribing policy or formulary
- Review antimicrobial prescribing and antimicrobial use regularly
- Educate the workforce, residents, and their families and carers about using antimicrobials appropriately.

Pharmacists who pack dose administration aids for aged care homes can also identify inappropriate use, such as long-term continuation of therapy, and follow such use up with the prescriber.<sup>23</sup>

### 11.2.3 Roles of antimicrobial stewardship pharmacists

The main roles of an AMS pharmacist are to lead the AMS program or collaborate with the AMS program leader and others to coordinate the activities of the health service organisation's AMS program. More and more pharmacists are taking the lead role in hospital and community AMS programs, especially where there is no on-site ID physician or clinical microbiologist.<sup>15,21,24</sup>

Most of the evidence for the roles of AMS pharmacists is from the hospital sector, and the roles described relate mainly to hospitals with an on-site pharmacy service. However, these roles can be adapted by health service organisations that do not have an on-site pharmacy (for example, small hospitals, community health services and aged care homes), and by LHNs/LHDs or hospital groups establishing an AMS program across several sites.

Depending on demand, the AMS pharmacist may be full time or part time, and may have a role across the LHN or LHD. In the latter situation, the AMS pharmacist may be responsible for supporting a range of AMS activities across several hospitals and community services (see Case study 2.1 in Chapter 2: 'Establishing and sustaining an antimicrobial stewardship program'). At the individual hospital level, AMS pharmacists may provide clinical services to patients in addition to contributing to

AMS program activities.<sup>25</sup> Other models include incorporating AMS activities into the roles and responsibilities of the pharmacist responsible for drug use evaluation (DUE) studies or the quality use of medicines.

In small hospitals or aged care homes, the pharmacist providing services may also be responsible for AMS. Where there is no pharmacist on site, AMS support may be provided by the LHN/LHD AMS pharmacist or the AMS pharmacist at the regional hospital (see Case study 2.1 in Chapter 2: 'Establishing and sustaining an antimicrobial stewardship program' and Case study 3.1 in Chapter 3: 'Strategies and tools for antimicrobial stewardship'). Regardless of the various roles and responsibilities, it is important that enough time and resources are provided for pharmacists to support AMS activities.<sup>1,26</sup>

Other roles and responsibilities of pharmacists with direct responsibility for AMS activities are discussed in Sections 11.3–11.8. These may provide a basis for a position description for an AMS pharmacist working across various settings.

## 11.3 Leadership

AMS pharmacists should show leadership in the AMS program, and advocate the implementation of activities that aim to improve the prescribing and quality use of antimicrobials. This may include being involved in health promotion and awareness campaigns (such as Antibiotic Awareness Week) and representing the health service organisation in forums relating to AMS.

Leadership may also include leading the AMS program in community-based health services or small hospitals, and providing leadership or expertise at the LHN/LHD, state or territory, or national level. AMS pharmacists should also support the pharmacy workforce and other clinicians on issues related to the local AMS program – for example, by resolving differences of opinion about antimicrobial prescribing practices or when there is a failure to comply with restrictions.<sup>27</sup>

AMS pharmacists should keep abreast of the current literature on AMS and new or revised prescribing guidelines, and advise the AMS committee on new interventions and guideline revisions.

AC

R

P

AC

AC

R

P

AC

R

P

AC

R

P

### 11.3.1 Promoting uptake and compliance with national standards for antimicrobial stewardship

The AMS pharmacist can promote the uptake or implementation of the [Antimicrobial Stewardship Clinical Care Standard](#) as part of routine patient care.<sup>13</sup>

The AMS pharmacist should play a key role in the health service organisation's efforts to implement and evaluate an AMS program that meets the AMS criterion in the NSQHS [Preventing and Controlling Healthcare-Associated Infection Standard](#).<sup>28</sup> They should be familiar with the requirements for AMS in the standard, and work with the AMS committee to ensure that evidence demonstrating compliance is available and that its currency is maintained. A number of [Resources](#) are available to assist health service organisations to implement the NSQHS Standards.

### 11.3.2 Developing and maintaining antimicrobial guidelines

The AMS pharmacist should work with the microbiology, ID and other departments to develop and maintain:

- Antimicrobial prescribing guidelines, including unit protocols (for example, guidelines for antimicrobial use for febrile neutropenia)<sup>2,6,11</sup> (see Section 3.2 in Chapter 3: '[Strategies and tools for antimicrobial stewardship](#)')
- Policies for therapeutic drug monitoring of antimicrobials (for example, aminoglycosides, glycopeptides, azole antifungals), and training for clinicians about safe and effective dosing practices<sup>27</sup>
- Access to the latest versions of [Therapeutic Guidelines: Antibiotic](#)<sup>29</sup> and endorsed local prescribing guidelines, both hard copy and electronic.

## 11.4 Expert advice

AMS pharmacists can provide expert advice to assist in individual patient care or for AMS more generally.

### 11.4.1 Providing expert advice to clinicians, patients and carers

AMS pharmacists can advise other pharmacists and prescribers on the management of antimicrobial therapy in individual patients. The advice may be on the choice, dose, route and duration of antimicrobial therapy.<sup>1,2,6</sup> Dose optimisation – based on individual patient characteristics, causative organisms, the site of infection, pharmacokinetic and pharmacodynamic characteristics of the antimicrobial, and therapeutic drug monitoring – has been cited as an important part of AMS<sup>1</sup> and one that AMS pharmacists are well placed to advise on. Prospective review of antimicrobial orders and timely follow-up with the prescriber by an AMS pharmacist can reduce inappropriate antimicrobial prescribing and improve clinical outcomes.<sup>1,7</sup> AMS pharmacists can also assess those cases that require input from clinical microbiologists or (AMS) ID physicians.<sup>27</sup>

Providing expert advice includes informing senior management and relevant medical units about the AMS program and activities within the organisation and, where applicable, counselling patients or their carers on the appropriate use of antimicrobials (see [Community and aged care homes](#)).

### 11.4.2 Participating in antimicrobial stewardship ward rounds

AMS pharmacists in hospitals should actively participate in ward rounds with the AMS team. Their inclusion has been shown to decrease antimicrobial consumption and expenditure.<sup>17,30,31</sup> This may include regular rounds in units with complex antimicrobial management issues, such as intensive care or haematology units<sup>27</sup>, as well as reviews of individual patients referred to the AMS team or identified by the AMS pharmacist. The latter may include patients who have been prescribed specific antimicrobials, who are receiving therapy not supported by microbiological tests or who have documented treatment failure.<sup>30</sup> Where information technology systems are available, patients may be identified through electronic clinical decision support systems and electronic healthcare records (see Section 4.2.3 in Chapter 4: '[Information technology tools to support antimicrobial stewardship](#)').<sup>32-35</sup>

During the ward round, the pharmacist and the AMS team should review the patient's microbiological,

pathology and diagnostic imaging results, and the medicines prescribed (see Section 3.4 in Chapter 3: '[Strategies and tools for antimicrobial stewardship](#)'). The AMS pharmacist can provide expert advice relating to the ongoing management of the patient's antimicrobial therapy.

### 11.4.3 Initiating point-of-care interventions

AMS pharmacists can play a leading role in implementing policies and activities that promote safe and appropriate antimicrobial use at the point of care at the bedside or in the community pharmacy (see Section 3.5 in Chapter 3: '[Strategies and tools for antimicrobial stewardship](#)'). These interventions are able to be performed in health service organisations where there are no on-site ID or clinical microbiology services.<sup>24,36</sup> Interventions include:

- Streamlining therapy to narrow-spectrum agents when culture and sensitivity results are available<sup>1,25</sup>
- Identifying therapy to which the targeted microorganism is resistant<sup>24,36</sup>
- Therapeutic substitution of antimicrobials<sup>25</sup>
- Dose optimisation
- Antimicrobial stop orders<sup>25</sup>
- Promoting switching from intravenous to oral antimicrobials, when this is safe and appropriate for the patient<sup>1,27,37</sup>
- Supporting systems for obtaining and recording approvals for restricted antimicrobials, such as mandatory order forms, or telephone or online approval systems<sup>1,38</sup>
- Notifying prescribers of multiple antimicrobials with overlapping spectrums of activity
- Developing and disseminating clinical decision support tools, such as antimicrobial dosing cards for common infections, or facilitating their uptake into electronic systems.

An appropriately trained AMS pharmacist, working within their scope of practice, may be involved in ordering laboratory diagnostic tests relating to the management of infection in a patient (for example, therapeutic drug monitoring for vancomycin, aminoglycosides and azole antifungals), or may have the authority to approve the use of restricted antimicrobials. The pharmacist may also use, or provide input into the application of, tests for acute-phase reactants such as C-reactive protein and procalcitonin in monitoring and potentially decreasing the duration of antimicrobial therapy.

## 11.5 Formularies and approval systems

Restricted formularies and antimicrobial approval systems are effective in improving antimicrobial use (see Section 3.3 in Chapter 3: '[Strategies and tools for antimicrobial stewardship](#)'). AMS pharmacists can support and help to maintain the organisation's antimicrobial restriction systems by:

- Participating in the management of the antimicrobial formulary (for example, reviewing the evidence for the inclusion of new antimicrobials in, or the deletion of existing antimicrobials from, the formulary)
- Reviewing and approving or declining requests for restricted antimicrobials; where an ID physician is available, the pharmacist may refer more complex or non-standard requests to the physician, thereby performing a 'triage' process for requests for restricted antimicrobials
- Updating the medicines formulary and antimicrobial prescribing guidelines in line with decisions of the drug and therapeutics committee or medication advisory committee (for example, updating information and alerts within clinical decision support systems for electronic prescribing, dispensing and antimicrobial approval systems; see Chapter 4: '[Information technology to support antimicrobial stewardship](#)')
- Educating and supporting other pharmacists who provide the clinical and dispensary services to enforce antimicrobial prescribing programs and policies, and to encourage compliance with prescribing guidelines<sup>2,6</sup> (for example, providing advice, with support from the AMS team, if clinicians wish to prescribe outside the guidelines<sup>25</sup>)
- Monitoring compliance with the organisation's antimicrobial prescribing policies (see Chapter 6: '[Measuring performance and evaluating antimicrobial stewardship programs](#)'), and liaising (where appropriate) with clinical microbiologists, ID physicians and other relevant individuals.

## 11.6 Monitoring antimicrobial use and evaluating interventions

Pharmacy data can inform local and national AMS programs (see Chapter 6: '[Measuring performance and evaluating antimicrobial stewardship programs](#)').



AMS pharmacists should generate and collate reports on antimicrobial use for the AMS team; the drug and therapeutics, medication advisory and infection control committees; health service organisation executives or administrators; and the heads of clinical units. The reports may include:

- Regular reports of antimicrobial use and expenditure from pharmacy records, such as total use, use of restricted antimicrobials, or use of specific antimicrobial groups at the hospital or clinical unit level
- Hospital antimicrobial use rates (for example, in defined daily doses per 1,000 occupied bed days) compared with relevant peer group averages for hospitals participating in the [National Antimicrobial Utilisation Surveillance Program](#), or state or territory surveillance programs.

AMS pharmacists may also be involved in activities to assess and improve the quality of antimicrobial use, such as:

- Point prevalence or quality improvement surveys – the National Antimicrobial Prescribing Survey (NAPS), the Surgical NAPS or the Aged Care NAPS
- DUE studies and audits of a specific antimicrobial or group of antimicrobials against *Therapeutic Guidelines: Antibiotic*<sup>29</sup> or endorsed local prescribing guidelines – for example, indications for prescribing, sensitivity to the antimicrobial, use as empirical therapy versus treatment, doses prescribed, duration of therapy
- Measuring and monitoring indicators, including structure, process, outcome and balancing measures
- Local or collaborative projects, such as those organised by states, territories or the National Centre for Antimicrobial Stewardship.

If possible, the AMS pharmacist should also be actively involved in leading, coordinating or participating in research and practice development activities relating to AMS.<sup>27</sup> The AMS pharmacist should be encouraged and supported to publish the results of AMS initiatives in peer-reviewed publications and to present at conferences.<sup>27</sup>

## 11.7 Liaison

AMS pharmacists can facilitate interaction between the pharmacy and the microbiology or ID departments.<sup>27</sup> Liaising with other departments and committees on behalf of the pharmacy department

or AMS service is an important role for AMS pharmacists (Table 11.1).<sup>2,6</sup>

Pharmacists responsible for AMS can liaise with colleagues and AMS experts through professional organisations (see Section 1.5 in Chapter 1: '[Evidence for antimicrobial stewardship](#)').

## 11.8 Education

Pharmacists with AMS roles will need specific training, and can also train other clinicians.

### 11.8.1 Antimicrobial stewardship education for pharmacists

Pharmacists working in the community, aged care homes and hospitals are encouraged to complete continuing professional education on managing common infections, using antimicrobials appropriately and reducing the risk of AMR. NPS MedicineWise provides a range of tools and resources for pharmacists to develop and maintain these skills, such as national case studies and pharmacy practice reviews (see [Appendix A](#)).

Specialist AMS pharmacists should be experienced clinical pharmacists with expertise in antimicrobials and the therapeutic management of infectious diseases.<sup>25,27</sup> Postgraduate training in ID or AMS and the ability to effectively interact with senior clinicians are highly desirable attributes for an AMS pharmacist.<sup>25,39</sup> Skills or knowledge in quality improvement and interventions that influence prescriber behaviour are also desirable.

Formalised training programs and courses for pharmacists to specialise in AMS in Australia are limited. Most AMS pharmacists have gained their knowledge and expertise through on-the-job training with ID physicians and clinical microbiologists, or with pharmacist mentors. However, educational opportunities – from seminars and university units to online courses – are increasingly becoming available to help Australian pharmacists to improve their knowledge and skills in ID and AMS (see [Appendix A](#)). Guidance on knowledge and skills required for AMS leaders has been published and can be used by individual pharmacists to identify gaps in their knowledge and practice (see Chapter 5: '[Antimicrobial stewardship education for clinicians](#)').<sup>40</sup>



**Table 11.1:** Pharmacy liaison with departments and committees within a health service organisation

Department or committee	Liaison activity
Microbiology, infectious diseases and other departments	<ul style="list-style-type: none"> <li>• Maintaining antimicrobial formularies</li> <li>• Introducing new antimicrobials</li> <li>• Monitoring for unexpected changes in antimicrobial use patterns</li> <li>• Developing policies related to AMS activities<sup>11,25</sup></li> <li>• Managing antimicrobial shortages and out-of-stock occurrences</li> <li>• Managing the supply of unregistered antimicrobials</li> <li>• Updating hospital antimicrobial prescribing guidelines</li> <li>• Describing changes in antimicrobial sensitivities</li> <li>• Developing antibiograms</li> </ul>
Committees and management	<ul style="list-style-type: none"> <li>• Reporting on antimicrobial use</li> <li>• Communicating results from prescribing audits and DUE studies</li> <li>• Ensuring compliance with national standards</li> <li>• Communicating outcomes of specific AMS intervention strategies</li> <li>• Participating in relevant committees, such as the               <ul style="list-style-type: none"> <li>– AMS committee or the antimicrobial subcommittee of the drug and therapeutics committee<sup>25</sup>, for which the AMS pharmacist may provide secretarial support</li> <li>– infection prevention and control committee<sup>25</sup></li> <li>– medication safety committee</li> </ul> </li> </ul>
Information technology	<ul style="list-style-type: none"> <li>• Being involved in advising on the functional specifications and implementation of electronic decision support systems for AMS</li> <li>• Developing standard reports on antimicrobial use</li> <li>• Developing alerts/reports from EHR systems that identify patients for review<sup>33</sup></li> <li>• Developing and maintaining alerts within EHRs or clinical decision support software systems to target inappropriate prescribing<sup>32</sup></li> <li>• Developing and maintaining order sets, order forms and dose-checking alerts in electronic medication management systems<sup>32</sup></li> <li>• Developing tools to communicate and record AMS recommendations and interventions<sup>32</sup></li> </ul>

AMS = antimicrobial stewardship; DUE = drug use evaluation; EHR = electronic healthcare record

## 11.8.2 Pharmacists' role in education

The AMS pharmacist's role in educating clinicians and consumers may involve:

- Educating clinical staff and students on the principles of appropriate antimicrobial prescribing and AMS, the AMS criterion in the NSQHS Preventing and Controlling Healthcare-Associated Infection Standard, the quality statements in the Antimicrobial Stewardship Clinical Care Standard, and the concept of AMR<sup>2,27</sup>
- Informing prescribers about antimicrobial prescribing guidelines and policies, including educating junior doctors during their orientation, reinforcing information at roster changes, and presenting results of clinical audits and DUE studies in forums such as medical teaching rounds<sup>27</sup>
- Using active educational techniques, such as academic detailing, which uses one-on-one education sessions with clinicians<sup>7,41</sup>(see Chapter 5: 'Antimicrobial stewardship education for clinicians')
- Providing feedback to clinicians and hospital executives on the results of prescribing audits and measurement of indicators (see Chapter 6: 'Measuring performance and evaluating antimicrobial stewardship programs')
- Educating and providing information to consumers, patients and carers (see Chapter 7: 'Involving consumers in antimicrobial stewardship').

# Resources

## Pharmacists and antimicrobial stewardship

- Society of Hospital Pharmacists of Australia: *Antimicrobial Stewardship – Prevent and reduce infections and antimicrobial resistance* fact sheet
- International Pharmaceutical Federation: *Fighting Antimicrobial Resistance: The contribution of pharmacists*
- Royal Pharmaceutical Society: *The Pharmacy Contribution to Antimicrobial Stewardship*
- Royal Pharmaceutical Society: *Antimicrobial resistance and stewardship*
- Society of Infectious Diseases Pharmacists: *Resources*
- American Society of Health-System Pharmacists: *ASHP Statement on the Pharmacist's Role in Antimicrobial Stewardship and Infection Prevention and Control*

## Education

- Training and educational resources for pharmacists: see [Appendix A](#)
- Royal Pharmaceutical Society: *Infection and Antimicrobial Stewardship: Expert professional practice curriculum*

## Other resources

- *Infectious Diseases Specialty Practice Stream*, facilitated by the *Society of Hospital Pharmacists of Australia*
- *National Return and Disposal of Unwanted Medicines program*



# References

1. Dellit HT, Owens RC, McGowan JE, Gerding DN, Weinstein RA, Burke JP, et al. Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. *Clin Infect Dis* 2007;44(2):159–77.
2. Society of Hospital Pharmacists of Australia. Antimicrobial stewardship: prevent and reduce infections and antimicrobial resistance. SHPA; 2017.
3. Fishman N. Policy statement on antimicrobial stewardship by the Society for Healthcare Epidemiology of America (SHEA), the Infectious Diseases Society of America (IDSA), and the Pediatric Infectious Diseases Society (PIDS). *Infect Control Hosp Epidemiol* 2012;33(4):322–7.
4. National Institute for Health and Care Excellence. Antimicrobial stewardship: systems and processes for effective antimicrobial medicine use. London: NICE; 2015.
5. Canadian Society of Hospital Pharmacists. Antimicrobial stewardship: statement on the role of the pharmacist. Ottawa: CSHP; 2014.
6. American Society of Health System Pharmacists Council on Pharmacy Practice. ASHP statement on the pharmacist's role in antimicrobial stewardship and infection prevention and control. *Am J Health Syst Pharm* 2010;67(7):575–7.
7. MacDougall C, Polk R. Antimicrobial stewardship programs in health care systems. *Clin Microbiol Rev* 2005;18(4):638–56.
8. Paskovaty A, Pflomm JM, Myke N, Seo SK. A multidisciplinary approach to antimicrobial stewardship: evolution into the 21st century. *Int J Antimicrob Agents* 2005;25(1):1–10.
9. International Pharmaceutical Federation. Fighting antimicrobial resistance: the contribution of pharmacists. The Hague: IPF; 2015.
10. Tauman A, Robicsek A, Roberson J, Boyce J. Health care-associated infection prevention and control: pharmacists' role in meeting national patient safety goal 7. *Hosp Pharm* 2009;44(5):401–11.
11. Wickens HJ, Farrell S, Ashiru-Oredope DAI, Jacklin A, Holmes A, Antimicrobial Stewardship Group of the Department of Health Advisory Committee on Antimicrobial Resistance and Health Care Associated Infections (ASG-ARHAI). The increasing role of pharmacists in antimicrobial stewardship in English hospitals. *J Antimicrob Chemother*, 2013;68(11):2675–81.
12. Ashiru-Oredope D, Fleming N, Ladenheim D. The role of the pharmacist in antimicrobial stewardship. *Hospital Pharmacy Europe* 2015;78.
13. Australian Commission on Safety and Quality in Health Care. Antimicrobial Stewardship Clinical Care Standard. Sydney: ACSQHC; 2014.
14. Nathwani D, Scottish Medicines Consortium, Short Life Working Group, Scottish Executive Health Department Healthcare Associated Infection Task Force. Antimicrobial prescribing policy and practice in Scotland: recommendations for good antimicrobial practice in acute hospitals. *J Antimicrob Chemother* 2006;57(6):1189–96.
15. Waters CD. Pharmacist-driven antimicrobial stewardship program in an institution without infectious diseases physician support. *Am J Health Syst Pharm* 2015;72(6):466–8.
16. von Gunten V, Reymond J-P, Beney J. Clinical and economic outcomes of pharmaceutical services related to antibiotic use: a literature review. *Pharm World Sci* 2007;29(3):146–63.
17. Boyles TH, Whitelaw A, Bamford C, Moodley M, Bonorchis K, Morris V, et al. Antibiotic stewardship ward rounds and a dedicated prescription chart reduce antibiotic consumption and pharmacy costs without affecting inpatient mortality or re-admission rates. *PLoS ONE* 2013;8(12):e79747.
18. Bond CA, Raehl CL. Clinical and economic outcomes of pharmacist-managed aminoglycoside or vancomycin therapy. *Am J Health Syst Pharm* 2005;62(15):1596–605.
19. Davis S, Newcomer D, Bhayani N. Development and evolution of a 24-hour pharmacist-coordinated antimicrobial stewardship service in a community hospital. *Hosp Pharm* 2014;49(8):685–8.

20. Gilchrist M, Wade P, Ashiru-Oredope D, Howard P, Sneddon J, Whitney L, et al. Antimicrobial stewardship from policy to practice: experiences from UK antimicrobial pharmacists. *Infect Dis Ther* 2015;4(Suppl 1):51–64.
21. Ashiru-Oredope D, Budd EL, Bhattacharya A, Din N, McNulty CAM, Micallef C, et al. Implementation of antimicrobial stewardship interventions recommended by national toolkits in primary and secondary healthcare sectors in England: TARGET and Start Smart Then Focus. *J Antimicrob Chemother* 2016;71(5):1408–14.
22. Pharmaceutical Society of Australia. Professional practice standards, version 4. Canberra: PSA; 2010.
23. AIMED. Clinical pharmacist led antimicrobial stewardship. Newcastle (NSW): AIMED; 2016 [cited 2017 May 15].
24. Brink AJ, Messina AP, Feldman C, Richards GA, Becker PJ, Goff DA, et al. Antimicrobial stewardship across 47 South African hospitals: an implementation study. *Lancet Infect Dis* 2016;16(9):1017–25.
25. Hand K, Lawson W. A career as a specialist microbiology pharmacist. *Hospital Pharmacist* 2004;11:459–64.
26. Nathwani D, Sneddon J. A practical guide to antimicrobial stewardship in hospitals. Marcy l'Etoile: BioMérieux SA; 2013.
27. Hand K. Antibiotic pharmacists in the ascendancy. *J Antimicrob Chemother* 2007;60(Suppl 1):73–6.
28. Australian Commission on Safety and Quality in Health Care. National Safety and Quality Health Service Standards. 2nd ed. Sydney: ACSQHC; 2017.
29. Writing group for Therapeutic Guidelines: Antibiotic. Therapeutic guidelines: antibiotic. Version 15. Melbourne: Therapeutic Guidelines; 2014.
30. Yu K, Rho J, Morcos M, Nomura J, Kaplan D, Sakamoto K, et al. Evaluation of dedicated infectious diseases pharmacists on antimicrobial stewardship teams. *Am J Health Syst Pharm* 2014;71(12):1019–28.
31. Magedanz L, Silliprandi EM, dos Santos RP. Impact of the pharmacist on a multidisciplinary team in an antimicrobial stewardship program: a quasi-experimental study. *Int J Clin Pharm* 2012;34(2):290–4.
32. Kullar R, Goff DA, Schulz LT, Fox BC, Rose WE. The 'epic' challenge of optimizing antimicrobial stewardship: the role of electronic medical records and technology. *Clin Infect Dis* 2013;57(7):1005–13.
33. Dik J-WH, Hendrix R, Lo-Ten-Foe JR, Wilting KR, Panday PN, van Gemert-Pijnen LE, et al. Automatic day-2 intervention by a multidisciplinary antimicrobial stewardship-team leads to multiple positive effects. *Front Microbiol* 2015;6:546.
34. Smith T, Philmon CL, Johnson GD, Ward WS, Rivers LL, Williamson SA, et al. Antimicrobial stewardship in a community hospital: attacking the more difficult problems. *Hosp Pharm* 2014;49(9):839–46.
35. Hermsen ED, VanSchooneveld TC, Sayles H, Rupp ME. Implementation of a clinical decision support system for antimicrobial stewardship. *Infect Control Hosp Epidemiol* 2012;33(4):412–15.
36. Tamma PD, Cosgrove SE. Antimicrobial stewardship. *Infect Dis Clin North Am* 2011;25(1):245–60.
37. McMullan BJ, Andresen D, Blyth CC, Avent ML, Bowen AC, Britton PN, et al. Antibiotic duration and timing of the switch from intravenous to oral route for bacterial infections in children: systematic review and guidelines. *Lancet Infect Dis* 2016;16(8):e139–52.
38. Girotti MJ, Fodoruk S, Irvine-Meek J, Rotstein OD. Antibiotic handbook and pre-printed perioperative order forms for surgical antibiotic prophylaxis: do they work? *Can J Surg* 1990;33(5):385–8.
39. Drew RH, White R, MacDougall C, Hermsen ED, Owens RC. Insights from the Society of Infectious Diseases Pharmacists on antimicrobial stewardship guidelines from the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. *Pharmacotherapy* 2009;29(5):593–607.
40. Cosgrove SE, Hermsen ED, Rybak MJ, File TMJ, Parker SK, Barlam TF, et al. Guidance for the knowledge and skills required for antimicrobial stewardship leaders. *Infect Control Hosp Epidemiol* 2014;35(12):1444–51.
41. Davey P, Marwick CA, Scott CL, Charani E, McNeil K, Brown E, et al. Interventions to improve antibiotic prescribing practices for hospital inpatients. *Cochrane Database Syst Rev* 2017;(2):CD003543.

# Appendix A: Examples of training and educational opportunities for AMS pharmacists

Setting	Institution	Course type
Australian	National Centre for Antimicrobial Stewardship	AMS seminars for specific professionals
	Society of Hospital Pharmacists of Australia	Introduction to Infectious Diseases Clinical Seminar
	NPS MedicineWise	Online learning modules relating to antimicrobial use, case studies and pharmacy practice review audits
	Monash University	Accredited unit in Infectious Diseases Pharmacotherapy
International	Society of Infectious Diseases Pharmacists, USA	Antimicrobial Stewardship Certificate programs for: <ul style="list-style-type: none"> <li>• Acute care</li> <li>• Long-term care</li> </ul>
	Stanford University, USA	Antimicrobial Stewardship: Optimization of Antibiotic Practices
	European Society of Clinical Microbiology and Infectious Diseases	Various AMS training courses
	British Society for Antimicrobial Chemotherapy, University of Dundee and Future Learn	Massive Open Online Course (MOOC) – Antimicrobial Stewardship: Managing Antibiotic Resistance

