



**13** Role of general practice in antimicrobial stewardship

# Antimicrobial Stewardship in Australian Health Care

2020

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.

# Chapter contents

<b>Acronyms and abbreviations</b>	296
<b>13.1 Introduction</b>	297
13.1.1 Antimicrobial resistance in the community	298
13.1.2 Antimicrobial use in the community	298
13.1.3 Antimicrobial use and general practice	299
<b>13.2 Factors that influence antimicrobial prescribing in general practice</b>	299
13.2.1 General practice characteristics	299
13.2.2 Patient characteristics	300
13.2.3 Indigenous populations	300
13.2.4 Residential aged care facilities	300
13.2.5 Patient expectations	300
13.2.6 Diagnostic uncertainty	301
<b>13.3 Antimicrobial stewardship strategies for general practice</b>	301
13.3.1 Before the consultation	302
13.3.2 During the consultation	303
13.3.2 After the consultation	304
<b>13.4 Clinical governance and leadership for antimicrobial stewardship</b>	307
13.4.1 Professional leadership	307
13.4.2 National leadership	307
13.4.3 Regional leadership	307
13.4.4 Practice leadership	307
<b>Resources</b>	308
<b>References</b>	309

## Acronyms and abbreviations

Abbreviation	Definition
ACSQHC	Australian Commission on Safety and Quality in Health Care
AMR	antimicrobial resistance
AMS	antimicrobial stewardship
AURA	Antimicrobial Use and Resistan
COPD	chronic obstructive pulmonary disease
eTG	Therapeutic Guidelines
GAPS	General practitioners Antimicrobial Stewardship Programme Study
GP	general practitioner
MRSA	Methicillin-resistant <i>Staphylococcus aureus</i>
NAPS	National Antimicrobial Prescribing Survey
NSQHS	National Safety and Quality Health Service
OECD	Organisation for Economic Co-operation and Development
PBAC	Pharmaceutical Benefits Advisory Committee
PBS	Pharmaceutical Benefits Scheme
PHN	Primary Health Network
RACF	residential aged care facility
RACGP	Royal Australian College of General Practitioners
RPBS	Repatriation Pharmaceutical Benefits Scheme

## Key points

- Antimicrobial resistance is increasingly evident in our community. Organisms of particular concern in the community include methicillin-resistant *Staphylococcus aureus* (MRSA) and extended-spectrum  $\beta$ -lactamase-producing *Escherichia coli*.
- In 2017, 41.5% of the Australian population had at least one systemic antibiotic dispensed under the Pharmaceutical Benefits Scheme or Repatriation Pharmaceutical Benefits Scheme.
- The development of new antimicrobials has slowed significantly.
- Rates of antimicrobial use in Australia are high compared with data for international usage.
- The most commonly supplied antibiotics under the Pharmaceutical Benefits Scheme and Repatriation Pharmaceutical Benefits Scheme are cefalexin, amoxicillin, and amoxicillin with clavulanic acid. This represents heavy reliance on broad-spectrum  $\beta$ -lactam antibiotics in the community setting, which have greater potential to select for resistance to multiple drug classes.
- General practice has a crucial role in reducing antimicrobial use and antimicrobial resistance in the community.
- Effective antimicrobial stewardship in general practice encompasses interventions across three periods: before, during and after the consultation.
  - **Before** a consultation, strategies include increasing GP awareness of their antibiotic prescribing behaviours in comparison with their peers; providing antimicrobial stewardship education; demonstrating antimicrobial stewardship commitment to patients; promoting antimicrobial stewardship to consumers; and implementing the quality statements of the Antimicrobial Stewardship Clinical Care Standard within general practice.
  - **During** the consultation, strategies include optimising antimicrobial prescription; embedding antimicrobial guidelines into practice workflows; shared decision-making with consumers; and delaying prescribing.
  - **After** the consultation, strategies include supporting patient self-management; and, antimicrobial audit and feedback in general practice.
- Leadership for antimicrobial stewardship within primary care occurs at the national, regional and practice levels. Each is important for a nationally-coordinated, effective response to reduce antimicrobial prescribing and antimicrobial resistance.
- The Royal Australian College of General Practitioners Standards for General Practice (5<sup>th</sup> Edition) describe the role of antimicrobial stewardship in general practice to maintain the effectiveness of antimicrobials and decrease preventable healthcare associated infections.

## 13.1 Introduction

Antimicrobial resistance (AMR) is a global healthcare issue that has been described as one of the principal health concerns of this century.<sup>1</sup> Australia is contributing to the global problem of AMR, with Australian antibiotic consumption in primary care above the OECD (Organisation for Economic Co-operation and Development) average.<sup>2</sup> Australia's National Antimicrobial Resistance Strategy 2020 and Beyond describes national priority actions to address this growing public health threat.<sup>1</sup>

The Antimicrobial Stewardship in Australian Health Care book (the AMS Book) was published in 2018 to provide an overarching resource for antimicrobial stewardship programs in Australia. The AMS Book is available at [www.safetyandquality.gov.au/our-work/healthcare-associated-infection/antimicrobial-stewardship/book/](http://www.safetyandquality.gov.au/our-work/healthcare-associated-infection/antimicrobial-stewardship/book/).

Additional chapters of the AMS Book are planned to further support antimicrobial stewardship (AMS) in Australia. As additional chapters are completed, they will be published to supplement the AMS Book.

*The role of general practice in antimicrobial stewardship* is the latest addition to the Book. This chapter discusses AMS in general practice and:

- describes the factors that influence general practitioner decisions to prescribe antimicrobials;
- identifies resources to support appropriate prescribing of antimicrobials;
- provides practical strategies that can be implemented in general practice to improve AMS; and
- discusses the role of clinical governance and leadership in AMS.

This chapter supports general practice to implement AMS components of the Royal Australian College of General Practitioners (RACGP) Standards for General Practice (5<sup>th</sup> Edition).<sup>3</sup>

### 13.1.1 Antimicrobial resistance in the community

Antimicrobial overuse and misuse, including in general practice, is a key driver of AMR. AMR is a risk to patient safety because it reduces the range of antimicrobials available to treat infections. AMR increases morbidity and mortality associated with infections caused by multidrug-resistant organisms.<sup>4</sup>

The AURA (Antimicrobial Use and Resistance in Australia) Surveillance System monitors AMR and antimicrobial use in Australia.<sup>4</sup> This system is coordinated by the Australian Commission on Safety and Quality in Health Care (the Commission) and provides national data on antimicrobial use across a range of Australian healthcare settings, including general practice.

AURA data show AMR is increasingly evident in the community in Australia. Organisms of concern in the community include methicillin-resistant *Staphylococcus aureus* and extended-spectrum  $\beta$ -lactamase-producing *Escherichia coli*.<sup>5</sup> Also of concern is the non-susceptibility of organisms more broadly to fluoroquinolones, third generation cephalosporins, aminoglycosides and carbapenems.<sup>5</sup>

Rates of methicillin-resistance in *S. aureus* were stable at around 20% in New South Wales, Queensland and South Australia for the decade 2006–2015. However, resistance rates have slowly increased nationally since then, with rates of 21.6% in 2015 and 22.5% in 2017.<sup>6</sup>

Rates of *E. coli* not susceptible to fluoroquinolones increased from 2% in 2006 to 11.8% in 2017, despite significant restriction of fluoroquinolones

in hospitals and the community. This trend is most apparent in major cities and rates of resistance have risen in all regions of Australia.<sup>6</sup>

AMR also occurs at an individual level. Individuals treated with antibiotics for respiratory tract and urinary tract infections have been shown to carry antimicrobial-resistant organisms at one month, two months and 12 months after antimicrobial treatment.<sup>7</sup>

### 13.1.2 Antimicrobial use in the community

In 2017, 41.5% of the Australian population had at least one systemic antibiotic dispensed under the Pharmaceutical Benefits Scheme (PBS) and the Repatriation Pharmaceutical Benefits Scheme (RPBS).<sup>4</sup> A large proportion are prescribed in general practice.<sup>4</sup>

The 2019 AURA report revealed that the rate of antibiotic dispensing under the PBS and the RPBS declined in 2016 and 2017. This is the first decline since the late 1990s. Despite this recent improvement, rates of antimicrobial use in Australia remain high.

Available data show substantial geographical variation in antimicrobial use. In Australia, geographical variation in healthcare use is reported in the Australian Atlas of Healthcare Variation series. According to the Australian Atlas of Healthcare Variation, in 2016–17, the dispensing rate of antimicrobial prescriptions varied substantially across Australia. There was a 4.8-fold difference in antimicrobial dispensing across geographical areas.<sup>8</sup>

Antimicrobials are overprescribed in general practice compared with guideline recommendations. For example, antibiotics are prescribed for acute respiratory infections in Australian general practice at rates four to nine times higher than current clinical practice guidelines recommend.<sup>9</sup> Antibiotics continue to be prescribed in general practice to patients with health problems for which there is no clinical benefit, including for influenza (52.2% of patients) and acute bronchitis (92.4% of patients).<sup>4</sup>

The most commonly dispensed antibiotics under the PBS and RPBS are cefalexin, amoxicillin, and amoxicillin with clavulanic acid. These antimicrobials accounted for more than half of all prescriptions dispensed in 2017.<sup>4</sup> This represents a heavy reliance on broad-spectrum  $\beta$ -lactams in the community setting, which have greater potential to select for resistance to multiple drug classes.<sup>4</sup>

Use of antimicrobials in general practice is more common in the youngest and oldest age groups. In patients aged less than 65 years, the highest rate of dispensing is in children aged 2–4 years.

Antimicrobial use in children in Australia is high compared with international usage rates.<sup>8</sup>

### 13.1.3 Antimicrobial stewardship and general practice

AMS programs are evidence-based multicomponent strategies that aim to increase judicious use of antimicrobials in order to improve patient outcomes and decrease AMR.<sup>1</sup>

AMS is a core component of the National Safety and Quality Health Service (NSQHS) Standards.<sup>10</sup> The Standards are used by hospitals and other health facilities. The Preventing and Controlling Healthcare-associated Infection NSQHS Standard aims to improve the measures designed to help prevent infections and the spread of antimicrobial resistance, through appropriate prescribing and use of antimicrobials.

AMS in general practice is different to hospitals, for which the Standards were primarily developed. Hospital AMS involves a multidisciplinary team of infectious diseases physicians, clinical pharmacists and clinical microbiologists working in collaboration with hospital administrators and other clinicians. The purpose of collaboration is to improve decision-making about antimicrobial use and to monitor antimicrobial use and resistance.<sup>11</sup>

AMS in general practice needs to consider the different context within which antimicrobial prescribing decisions are made, the nature of patient encounters and presentations and the different support and infrastructure available in general practice compared with hospitals. The AMS team in general practice is different to that in hospitals. Team members include GPs, practice nurses and practice administrative personnel. Allied health providers including pharmacists may also participate in AMS in general practice. Pharmacists also have an important role in supporting team-based AMS in residential aged care. Pathology providers support AMS in general practice by supporting GPs in the appropriate ordering of pathology specimens and in providing AMS information in reporting results.

Each team member has a different role in reducing antimicrobial use and AMR in the community through continued improvements in antimicrobial prescribing practices.<sup>3</sup> Members of the AMS team can also have a positive influence on the beliefs of

individual patients and the broader community regarding antimicrobial use and AMR.

Within general practice, the RACGP Standards for General Practice (5<sup>th</sup> Edition) describe the role of general practice-based AMS programs to maintain the effectiveness of antimicrobials and decrease preventable infection associated with healthcare.<sup>3</sup> AMS in general practice is also an important component of Australia's National Antimicrobial Resistance Strategy - 2020 and Beyond.<sup>1</sup>

An estimated 85 percent of the Australian population visit a general practice each year. Most people visit the general practice more than once. General practice play an important role in influencing the general practice through information about the appropriate use of antimicrobials, antimicrobial resistance, and supporting antimicrobial stewardship practice.

## 13.2 Factors that influence antimicrobial prescribing in general practice

The main factors that influence general practitioner decisions to prescribe antimicrobials for individual patients are general practice characteristics, patient characteristics, patient expectations and diagnostic uncertainty. Each factor is described below. In addition, hospital antimicrobial prescribing practices influence GP's prescribing patterns.

### 13.2.1 General practice characteristics

Both individual general practitioner (GP) characteristics and the general practice work environment influence GP decisions to prescribe antimicrobials. GP characteristics associated with higher levels of antimicrobial prescribing include: being older than 45 years, more years in practice, and being an international medical graduate.<sup>12-15</sup> Factors that may contribute to higher antimicrobial prescribing by international medical graduates include: differences in training environments, continuing to prescribe antibiotics in accordance with cultural expectations, or the probability of bacterial infections in their country of training.<sup>12</sup>

Time constraints within patient consultations appear to influence antimicrobial prescribing. The GP workday is divided into 'sessions' of 3.5 to 4.5 hours' duration. The likelihood that a GP will



prescribe antimicrobials increases as the session progresses.<sup>16</sup> Further, in some studies, shorter appointment times are associated with higher rates of antimicrobial prescribing. This is attributed to the GP having less time to discuss with the patient whether or not antimicrobials are needed.<sup>13,15-18</sup>

### 13.2.2 Patient characteristics

Rates of antimicrobial dispensing are higher in some populations, including in patients with specific chronic diseases, who are immunosuppressed, in remote Indigenous populations, in communities with lower socio-economic status, and in residential aged care facilities.<sup>4,8</sup> Antimicrobial dispensing rates are generally lower in rural areas compared with urban areas.<sup>8</sup>

### 13.2.3 Indigenous populations

Prescribing rates may be higher in some Indigenous populations because of differences in the epidemiology and microbiology of infectious diseases and the consequences of infections.<sup>19</sup> In remote Australian Indigenous communities there are different patterns of infectious disease and bacterial infections are very common.<sup>20</sup> At any one time in some remote Indigenous populations, 45% of children will have impetigo, up to 80% of infants aged under one year will be hospitalised for a lower respiratory tract infection, 66% of children will present with otitis media before five years of age and 75% of all community members present with skin and soft tissue infections each year.<sup>20</sup> In adults, resistant skin infections and sexually transmitted infections remain highly prevalent in some communities. Sepsis rates resulting in hospitalisation and intensive care admission are four-fold higher in Indigenous than in non-Indigenous Australians in northern Australia.<sup>20</sup>

Due to this infective illness burden, high frequency but appropriate antimicrobial use often occurs in remote Australian Indigenous communities.<sup>19,20</sup> By their first birthday, an estimated 95% of children in some communities receive at least one antibiotic prescription and 47% receive at least six antibiotic prescriptions.<sup>21</sup> Antimicrobials are also used more often for sore throat treatment to prevent serious complications such as rheumatic heart disease.<sup>19</sup> However, other factors may contribute to inappropriate antimicrobial use including the absence of senior clinical staff, high staff turnover rates, lack of diagnostic capability, and living in remote areas, where lack of treatment may precipitate the need for retrieval to a distant hospital.<sup>20</sup>

As a result of the complex interplay of these factors, AMR is a growing problem in some remote Australian Indigenous communities. Rising rates of MRSA, azithromycin resistance in *Streptococcus pneumoniae* and emerging gram-negative resistance in urinary tract pathogens have been observed.<sup>20</sup>

### 13.2.4 Residential aged care facilities

Residential aged care facilities (RACFs) are an important setting for AMS. Residents of RACFs are vulnerable to infections because of frailty, poor functional status, multiple comorbidities and compromised immune systems.<sup>22</sup> The close living proximity and frequent nurse-to-resident and resident-to-resident contact can facilitate the spread of organisms in the RACF setting.<sup>22</sup>

Widespread antibiotic prescribing, including use of topical antimicrobial preparations, is observed in RACFs.<sup>22,23</sup> Nationally, the annual Aged Care National Antimicrobial Prescribing Survey demonstrates exposure to at least one course of antimicrobials occurs in 50–75% of RACF residents annually and more than one in 10 residents are in receipt of an antimicrobial at any given time.<sup>24</sup> Antimicrobials may be prescribed through telephone-based orders, without the resident being reviewed by the treating doctor or investigations being ordered.<sup>22,23</sup>

Between 40% and 75% of antibiotic use in RACFs is considered inappropriate i.e. not consistent with clinical practice guidelines.<sup>22</sup> Inappropriate prescribing is associated with increased harm to residents, including serious drug-related adverse events, *Clostridium difficile* colonisation and the development of AMR among residents.<sup>25</sup> An estimated 30.6% of Australian RACFs have infection-control trained staff on site. Few facilities have AMS policies and approximately 14% have antimicrobial prescribing restrictions.<sup>26</sup>

AMS interventions are needed to improve antibiotic use in RACFs. Interventions require GPs, pharmacists and RACF nursing staff to work together to identify strategies to improve AMS.<sup>22</sup> The RACGP Aged Care Clinical Guide (Silver Book) provides guidelines for general practice for AMS in infection and sepsis care in RACFs.

### 13.2.5 Patient expectations

In general, patients tend to overestimate the benefits of medical treatment and underestimate the harm.<sup>27</sup> Patients may not understand that antibiotics don't help viral illnesses or that the net benefit of antimicrobials on symptom resolution is less than 24 hours for common bacterial respiratory infections.



Patients may expect to receive a prescription for antimicrobials to treat their infection. This influences the antimicrobial prescribing decisions of many GPs in treating upper and lower respiratory infections in particular,<sup>28-31</sup> and for infections in general.<sup>32,33</sup>

Shared decision-making regarding antimicrobial prescribing is therefore essential to ensure patients are fully informed about the pros and cons of antimicrobial use.<sup>34</sup> Chapter 7 of Antimicrobial Stewardship in Australian Health Care (2018) has more information about shared decision-making and consumer understanding of when antimicrobials are needed.

Evidence also shows that the provider's perceptions about patient expectations are a stronger determinant of prescribing than actual patient expectation.<sup>35</sup> Patients who expect medication to be prescribed are nearly three times more likely to receive a prescription than patients who do not.

However, when the GP thinks that the patient expects medication (regardless of whether they actually do or not), the patient is 10 times more likely to receive a prescription.<sup>29,31,35,36</sup>

Prescribers tend to overestimate patient expectations for antimicrobials. Approximately 75% of the time GPs correctly identify when parents do not expect antimicrobials for their child.

However, they are only correct about 50% of the time about when parents do expect antimicrobials.<sup>37</sup>

### 13.2.6 Diagnostic uncertainty

Diagnostic uncertainty influences clinical decisions to prescribe antibiotics, particularly for respiratory tract infections. It is difficult for clinicians to differentiate between a bacterial and a viral infection, particularly in the early stages.<sup>38</sup> Diagnostic uncertainty is more common in some patient groups, including older people, patients with complex comorbidities and patients who are immunosuppressed. In the face of diagnostic uncertainty, GPs weigh up different clinical factors to determine whether to prescribe.<sup>20,29,39-42</sup>

Antimicrobials offer little to reduce symptoms and complications for most acute respiratory tract infections in primary care. Evidence shows that if a general practice with 7,000 patients reduced prescribing antimicrobials for respiratory tract infections by 10%, the practice might see just 1.1 more cases of pneumonia each year and 0.9 more cases of peritonsillar abscess each decade. There is no evidence that the complications of mastoiditis,

empyema, meningitis, intracranial abscess or Lemierre's syndrome are more frequent with low antibiotic prescribing practices.<sup>43</sup>

For patients with chronic obstructive pulmonary disease (COPD), diagnostic uncertainty is common. Current clinical practice guidelines recommend early management of infective exacerbations of COPD that are characterised by increased volume and change in colour of sputum or fever with antibiotics.<sup>44</sup> This is because infective exacerbations of COPD due to bacterial infection are associated with adverse impacts on illness trajectory. However, exacerbations can also be caused by common viral pathogens or urban air pollutants.<sup>44</sup>

Availability of testing for timely identification of the underlying cause of exacerbations is limited in general practice. Treatment of exacerbations therefore commonly occurs without determining the underlying cause.<sup>44</sup>

## 13.3 Antimicrobial stewardship strategies for general practice

Antimicrobial stewardship (AMS) strategies for general practice need to consider the practice workflow and professional responsibilities of individual general practice staff.

Chapter 10 of Antimicrobial Stewardship in Australian Health Care (2018) contains general information about AMS prescribing principles for prescribers. AMS strategies in general practice can be allocated into three time periods – before the consultation occurs, during the consultation and after the consultation.

### 13.3.1 Before the consultation

AMS strategies that may be effective in general practice in the period before a consultation occurs include:

- a. increasing provider awareness of antibiotic prescribing behaviours in comparison with peers
- b. providing AMS education
- c. health care professionals demonstrating AMS commitment to patients
- d. promoting AMS to consumers
- e. demonstrating practice consistent with the Antimicrobial Stewardship Clinical Care Standard

- a. Increasing provider awareness of antibiotic prescribing behaviours in comparison with peers

Providing GPs with data comparing their antibiotic prescribing rates with the prescribing rates of their peers is an effective strategy to reduce antibiotic use. The NPS MedicineWise has previously provided GPs with data comparing their antimicrobial prescribing with their peers. In addition, a letter from the Australian Chief Medical Officer sent in 2017 to the top 30% of antibiotic prescribers in general practice and containing peer comparisons was associated with a reduction in antibiotic prescribing of 12.3% within six months.<sup>45</sup>

- b. Providing antimicrobial stewardship education

Education can influence antibiotic prescribing in general practice. However, education alone has limited impact on antibiotic prescribing behaviours of GPs.<sup>43</sup> Education is most effective when incorporated into a multicomponent AMS strategy within general practice.

Education interventions that have been demonstrated to be effective

include:<sup>46,47</sup>

and infective exacerbations of chronic obstructive pulmonary disease;

- facilitated multidisciplinary case-based meetings;
- case-based learning;
- online learning modules, including antimicrobial prescribing courses; and

- including AMS education in publications with a broad GP readership.

- c. Demonstrating antimicrobial stewardship commitment to patients

Individuals who make public commitments to specific behaviours are more likely to follow through with these expressed intentions.<sup>48</sup> Demonstrating commitment is effective in improving appropriate prescribing of antimicrobials.<sup>48</sup>

Resources to use in general practice to raise awareness and demonstrate professional commitment to reducing AMR are available to download and use within general practice. Links are included in the Resources section at the end of this chapter.

- d. Promoting antimicrobial stewardship to consumers

Consumer expectations play a major role in antimicrobial prescribing in general practice. Resources such as posters, leaflets and videos in waiting rooms on topics such as immunisation, hand hygiene and AMR can raise awareness and prepare consumers to discuss AMS before a consultation.

Chapter 7 of Antimicrobial Stewardship in Australian Health Care (2018) has more information about shared decision-making and consumer understanding of when antimicrobials are needed.

- e. Demonstrating practice consistent with the Antimicrobial Stewardship Clinical Care Standard

The Antimicrobial Stewardship Clinical Care Standard aims to ensure that a patient with an infection receives optimal treatment.<sup>49</sup> This means the right antibiotic, at the right dose, by the right route, for the right duration based on accurate assessment and timely review.

Elements of the Antimicrobial Stewardship Clinical Care Standard that are of particular relevance to GPs include:

- When a patient is prescribed antibiotics, whether empirical or directed, this occurs in accordance with the current version of the Therapeutic Guidelines (or local antibiotic formulary).
- When a patient is prescribed antibiotics, information about when, how and for how long to take them, potential side effects and a review plan, are discussed with the patient or their carer.
- When a patient is prescribed antibiotics, the reason, drug name, dose, route of administration,

intended duration and review plan are documented in the patient's health record.

### 13.3.2 During the consultation

AMS strategies that have been demonstrated to be effective in general practice during the consultation include:

- a. optimising antimicrobial prescription
- b. embedding antimicrobial guidelines into practice workflows
- c. shared decision-making with consumers
- d. delaying prescribing
- e. multicomponent approaches.

#### a. Optimising antimicrobial prescription

Antimicrobial prescribing in Australian general practice is strongly influenced by the availability of antimicrobials on the PBS / RPBS. Clinical decision support functions embedded in clinical practice software also influence prescribing. Prescribers should document the reason for prescribing antimicrobials, dates of commencement and planned cessation in the patient record. This should include topical antimicrobials.

Prescriptions for commonly prescribed antimicrobials often include repeat prescriptions. However, common infections almost never require repeat prescriptions, and in many cases, shorter antibiotic courses can be used safely for common bacterial infections.<sup>50</sup> PBS data show most repeat prescriptions are not dispensed. Of those that are dispensed, some are dispensed long after the date of the original prescription.<sup>51</sup>

The Australian Pharmaceutical Benefits Advisory Committee (PBAC) has reviewed the PBS listing for high-volume antibiotics prescribed with repeats. The PBAC has recommended the removal of repeat options in line with Australian Therapeutic Guidelines to improve AMS and to assist in the reduction of AMR. This came into effect on 1 April 2020. See the [PBS website](#) for full details.

There are sometimes significant differences between what may be recommended in clinical practice guidelines and the pack sizes that are dispensed on the PBS/RPBS.<sup>52</sup> Prescribers should be encouraged to

specify the duration of use on the prescription rather than prescribing according to available pack sizes.

Computer-based point-of-care reminders have been shown to improve appropriate prescribing for otitis media, sore throat and urinary tract infections.<sup>53-55</sup> [Chapter 4](#) of Antimicrobial Stewardship in Australian Health Care (2018) has more information about information technology to support AMS.

Where pathology tests are ordered, general practice staff should review sensitivities and confirm appropriate antibiotic selection.

- b. Embedding antimicrobial guidelines into practice workflows

Clinical practice guidelines for antimicrobial use are readily accepted and widely available in Australia. The Antimicrobial Stewardship Clinical Care Standard specifies that all antimicrobials should be prescribed in accordance with *Therapeutic guidelines: Antibiotic* (eTG).<sup>38</sup>

Automated clinical decision support is more likely to improve prescribing than systems that have to be actively initiated by the GP.<sup>56</sup> Clinical practice guidelines can be embedded within computer-aided clinical decision support systems to improve antibiotic prescribing in general practice.

In addition, Therapeutic Guidelines has produced a summary table *Antibiotic prescribing in primary care: Therapeutic Guidelines summary table 2019* that provides a desktop reference for GPs and summarises recommendations within eTG regarding managing common infections in primary care.

#### c. Sharing decision-making with consumers

Shared decision-making involves clinicians and patients jointly participating in making a health decision. It means discussing the options, the benefits and harms of each option, and considering the patient's values, preferences and circumstances.<sup>57</sup> For most infections encountered in general practice, the choice about whether or not to treat with antibiotics involves weighing the benefits of antibiotics against potential harms.<sup>57</sup> This makes consultations for antibiotic prescribing ideally-suited to shared decision-making.

Shared decision-making helps address consumer expectations and concerns. Written decision aids used by the GP in consultation with the patient to share decisions about antibiotic prescribing have been shown to enable more effective shared decision-making.<sup>57</sup>

Chapter 7 of Antimicrobial Stewardship in Australian Health Care (2018) has more information about shared decision-making and consumer understanding of when antimicrobials are needed.

Prescriber resources and more information are included at the end of this chapter, including the Commission's

#### d. Delaying prescribing

Delayed prescribing has been shown to reduce antimicrobial use without adversely affecting clinical outcomes or patient satisfaction.<sup>58</sup> Delayed use of antimicrobials is recommended as a means of demonstrating to consumers that antimicrobials are not always necessary.

If the GP does not think antibiotics are necessary at the time of the consultation, they can discuss with the patient when they may be needed. The GP can provide the patient with an antibiotic prescription with advice to only have prescription filled after a few days if symptoms do not improve, or if they get worse. Appropriate information should be given to the consumer so they understand if and when antimicrobials are needed, or if it is more appropriate to return to the healthcare provider.<sup>58,59</sup>

The *General practitioners Antimicrobial Stewardship Programme Study* (GAPS) has booklets which can be used to support discussion with patients about delayed antibiotic prescribing for acute respiratory infections.<sup>60</sup> Links are included in the Resources section at the end of this chapter.

Where pathology tests are ordered, prescribers may choose to delay antibiotic prescribing until results are received. Laboratories may provide providers with advice regarding the most appropriate prescribing of antimicrobials for the pathogen identified.

Prescribers can also annotate antimicrobial prescriptions to state the prescription is only valid for a specified time – for example, one month from the date of issue. This can prevent the consumer keeping the prescription for use at a later time for a different problem.

Another strategy for delayed prescribing is making the prescription available at the clinic reception at an agreed time (to be picked up if symptoms do not improve or get worse). However, this option may be

considered less satisfactory by patients as the patient has to make another visit to the practice.<sup>58,59</sup>

Regardless of the approach, practices with multiple GPs should discuss their approach to AMS to ensure uniformity for patients regarding antibiotic prescribing.

#### e. Multicomponent approaches

Multicomponent approaches have been associated with decreased antimicrobial dispensing to patients.<sup>60</sup>

Multicomponent AMS interventions provide GPs with a suite of tools they can select from and tailor to each consultation. Tools may include:

- delayed prescribing protocol
- access to point-of-care testing for common infections
- patient decision aids to support shared decision-making
- GP education and training in communication within the consultation
- promotional materials describing the general practice policy for prescribing antimicrobials.

AMS strategies that have been demonstrated to be effective in the period after the consultation include:

- a. supporting patient self-management
- b. antimicrobial audit and feedback in general practice.

### 13.3.3 After the consultation

#### a. Supporting patient self-management

Self-management is about patients managing their own health. Patients need to be supported with information that can assist them in self-management and decision-making after the consultation.

Patients should receive relevant advice including:<sup>61</sup>

- Prevent infections by regularly washing your hands and keeping up to date with vaccinations.



- Prevent food-borne infections by washing fruits and vegetables, and cooking food properly.
- Understand that antibiotics only work against bacteria. They do not work for colds and flu which are caused by viruses.
- Do not insist on antibiotics from your health professional if they say you do not need them. Ask about other ways to relieve your symptoms.
- Only take antibiotics when they are prescribed for you. Do not use or share leftover antibiotics.

A plain English infographic for consumers is available at <https://www.amr.gov.au/resources/infographic-what-you-can-do> that explains how to prevent antibiotic resistance (Figure 1).

- Follow your health professional's instructions when you are prescribed antibiotics.

GPs should also provide self-care instructions, information on when people should stay home from school or work, and correct cough and sneeze etiquette.<sup>62</sup>

*General practice has a key role in achieving high rates of immunisation.*

Uptake of pneumococcal and influenza vaccines in the community influences disease patterns and helps reduce overall antibiotic use, particularly for people with chronic diseases.<sup>62,63</sup>

Childhood immunisations is associated with a decrease in the prevalence of childhood diseases such as otitis media, which may also help to decrease antimicrobial use.<sup>64-66</sup>

Figure 1: Australian Government Infographic: What you can do



b. Antimicrobial audit and feedback in general practice

General practices should monitor and review their antimicrobial prescribing on an ongoing basis as part of their broader continuous quality improvement activities.<sup>67</sup> Audit and feedback is a method that allows for target patient populations to be defined and monitored for enhanced AMS efforts. Comparisons need to be localised to the setting within which the GP works.

There are tools available to support general practice audit and feedback activities. Links to available tools are included in the Resources section at the end of this chapter.

Strategies may include reviewing the use of intravenous antibiotics, with the view to change to the oral route of administration as soon clinically appropriate or to an agent with high oral bioavailability. Areas where this could apply include in residential aged care facilities and in regional and remote hospitals where GPs are the primary prescribing clinician.

---

**Box 1:** Antimicrobial stewardship strategies for general practice

---

Practice	AMS strategies
Before the consultation	<ul style="list-style-type: none"><li>• Provide GPs with data comparing their antibiotic prescribing rates</li><li>• Promote AMS to patients with posters, leaflets and videos in waiting rooms.</li><li>• Demonstrate to patients a commitment to antimicrobial stewardship</li><li>• Use a multicomponent AMS strategy into general practice.</li></ul>
During the consultation	<ul style="list-style-type: none"><li>• Optimise antimicrobial use by specifying the duration of use on the prescription rather than prescribing according to available pack sizes.</li><li>• Embed the Clinical Practice Guidelines into computer-aided clinical decision support systems.</li><li>• Share the decision-making with patients by discussing the options, the benefits and harms of each option.</li><li>• Use delayed prescribing to demonstrate to consumers that antimicrobials are not always necessary</li></ul>
After the consultation	<ul style="list-style-type: none"><li>• Support patient self-management by providing advice and information about managing infections.</li><li>• Monitor and review antimicrobial prescribing on an ongoing basis as part of continuous quality improvement activities</li></ul>

---

Reviewing long term antimicrobial use, including topical antimicrobial, should be regularly considered after the initial consultation. Primary Health Networks (PHNs), through their provider support role, facilitate quality improvement within general practices in topic areas of the GP's choosing. GPs may choose AMS as an area for improvement. GPs may find resources customised to their prescribing patterns and targeting local issues of value. Formal programs such as the NPS MedicineWise general practice MedicineInsight program can also provide helpful data to prescribers.<sup>a</sup>

<sup>a</sup> In the most recent NPS MedicineWise national primary care data program, MedicineInsight, report (2017-18), data were available from 474 general practice sites, incorporating 532 general practices. This represents 6.6% of general practices nationally. There is significant variation in the proportion of practices by location. Approximately 26% of practices in Tasmania participate, compared with participation by general practices in South Australia (1.8% coverage) and Victoria (4.9% coverage).

## 13.4 Clinical governance and leadership for antimicrobial stewardship

### 13.4.1 Professional leadership

The RACGP advocates for a collaborative multi-sectoral approach to support appropriate antimicrobial use and reduce AMR in Australia. The RACGP endorses interventions which prevent AMR while minimising harm, morbidity and mortality from infectious disease.

The RACGP *Response to antimicrobial resistance in primary care* (November 2017) outlines the RACGP response to the threat of AMR in accordance with the Australian Government's National Antimicrobial Resistance Strategy 2015–2019.<sup>68</sup>

Key areas of focus for the RACGP are community education, clinical governance, GP education, infection control, outcome monitoring and research.

### 13.4.2 National leadership

The Australian Commission on Safety and Quality in Health Care (the Commission) provides national leadership in AMS. The aim of the Commission's work on AMS is to improve the safe and appropriate use of antimicrobials, reduce patient harm and decrease the incidence of AMR in Australia.

- the *Preventing and Controlling Healthcare-Associated Infection Standard*
- maintaining the *Antimicrobial Stewardship in Australian Health Care* publication
- providing antimicrobial prescribing e-learning modules and videos for clinicians
- conducting surveillance of antimicrobial use through the Antimicrobial Use and Resistance in Australia (AURA) surveillance system
- supporting the National Antimicrobial Prescribing Survey (NAPS)
- funding and supporting the National Antimicrobial Utilisation Surveillance Program (NAUSP).

The Commission provides many resources for health services that support antimicrobial stewardship including:

### 13.4.3 Regional leadership

PHNs were established with the aim of increasing the efficiency and effectiveness of medical services provided to patients by supporting general practice in achieving optimal safety and quality in health care.

PHNs play a significant role in supporting quality improvement in general practice and in facilitating audit activities within general practice.

GPs can call upon PHNs for support in quality improvement, including AMS. PHNs can provide GP education and training in AMS, infection control and immunisation, and maintaining health pathways that guide appropriate use of antibiotics.

### 13.4.4 Practice leadership

Clinician leaders in general practices have an important role in promoting and implementing AMS strategies that will help their practice workforce reduce unnecessary use of antimicrobials.<sup>1,68</sup>

This leadership can:

- encourage the general practice workforce to be accountable for the appropriate use of antimicrobials
- identify multicomponent AMS strategies to implement and maintain within the practice
- monitor antimicrobial use over time.

Chapter 2 of *Antimicrobial Stewardship in Australian Health Care* (2018) has more information about approaches to clinical leadership to establish and sustain an antimicrobial stewardship program in clinical practice.



# Resources

- AMR – Antimicrobial stewardship for GPs: <https://www.amr.gov.au/what-you-can-do/general-practice/prescribing-antibiotics>
- Australia's National Antimicrobial Resistance Strategy - 2020 and Beyond - <https://www.amr.gov.au/resources/australias-national-antimicrobial-resistance-strategy-2020-and-beyond>
- RACGP Aged Care Clinical Guide (silver book): <https://www.racgp.org.au/clinical-resources/clinical-guidelines/key-racgp-guidelines/view-all-racgp-guidelines/silver-book/part-a/infection-and-sepsis>
- RACGP Standards for General Practices. 5th Edition: <https://www.racgp.org.au/running-a-practice/practice-standards/standards-5th-edition>

## Consultation resources

- Australian Government. Infographic – What you can do: <https://www.amr.gov.au/resources/infographic-what-you-can-do>
- General Practitioners Antimicrobial Stewardship Programme study (GAPS) resources: <https://public-health.uq.edu.au/gaps>
- NPS MedicineWise antibiotic resistance resources: <https://www.nps.org.au/professionals/reducing-antibiotic-resistance>
- NPS MedicineWise patient resource: Respiratory Tract Infection Action Plan. <https://www.nps.org.au/professionals/reducing-antibiotic-resistance#resources>
- Therapeutic Guidelines: Antibiotic – Antibiotic prescribing in primary care: Therapeutic Guidelines summary table 2019: <https://www.tg.org.au/news/antibiotic-summary-table/>
- University of Queensland Managing your Respiratory Tract Infection resource: <https://public-health.uq.edu.au/files/5609/Managing-your-respiratory-tract-infection.pdf>

## Australian Commission on Safety and Quality in Health Care resources

- AMS resources: <https://www.safetyandquality.gov.au/our-work/healthcare-associated-infection/ams-and-hai-resources-and-links/>
- Antimicrobial Stewardship Clinical Care Standard: <https://www.safetyandquality.gov.au/publications/antimicrobial-stewardship-clinical-care-standard/>
- Preventing and Controlling Healthcare-Associated Infection Standard: <https://www.safetyandquality.gov.au/standards/nsqhs-standards/preventing-and-controlling-healthcare-associated-infection-standard>
- Primary Care resources: <https://www.safetyandquality.gov.au/our-work/antimicrobial-stewardship/antimicrobial-stewardship-primary-care>
- Shared decision-making: <https://www.safetyandquality.gov.au/our-work/shared-decision-making/>

## International resources

- Core Elements of Outpatient Antibiotic Stewardship: <https://www.cdc.gov/antibiotic-use/community/improving-prescribing/core-elements/core-outpatient-stewardship.html>
- Health Improvement Scotland. Optimising antibiotic use: <https://www.sapg.scot/quality-improvement/primary-care/optimising-antibiotic-use/>
- TARGET Antibiotic Toolkit: <http://www.rcgp.org.uk/clinical-and-research/resources/toolkits/target-antibiotic-toolkit.aspx>

# References

1. Commonwealth of Australia. Australia's National Antimicrobial Resistance Strategy – 2020 and Beyond. Canberra: Commonwealth of Australia; 2020.
2. OECD. Health at a Glance 2019.
3. The Royal Australian College of General Practitioners. Standards for general practices (5th edition). East Melbourne, Victoria: RACGP; 2020.
4. Australian Commission on Safety and Quality in Health Care. AURA 2019: Third Australian Report on Antimicrobial Use and Resistance in Human Health. Sydney: ACSQHC; 2019.
5. Coombs G, Bell JM, Daley D, et al. Australian Group on Antimicrobial Resistance Sepsis Outcomes Programs: 2018 Report. Sydney: ACSQHC; 2019.
6. Australian Commission on Safety and Quality in Health Care. Australian Passive Antimicrobial Resistance Surveillance. First report: multi-resistant organisms. Sydney: ACSQHC; 2018.
7. Costelloe C, Metcalfe C, Lovering A, Mant D, Hay AD. Effect of antibiotic prescribing in primary care on antimicrobial resistance in individual patients: systematic review and meta-analysis. *BMJ* 2010;340:c2096.
8. Australian Commission on Safety and Quality in Health Care and Australian Institute of Health and Welfare. The Third Australian Atlas of Healthcare Variation. Sydney: ACSQHC; 2018.
9. McCullough AR, Pollack AJ, Plejdrup Hansen M, et al. Antibiotics for acute respiratory infections in general practice: comparison of prescribing rates with guideline recommendations. *Med J Aust* 2017;207:65-9.
10. Australian Commission on Safety and Quality in Health Care. National Safety and Quality Health Service Standards. 2nd ed. Sydney: ACSQHC; 2017.
11. Drekonja DM, Filice GA, Greer N, et al. Antimicrobial stewardship in outpatient settings: a systematic review. *Infect Control Hosp Epidemiol* 2015;36:142-52.
12. Cadieux G, Tamblyn R, Dauphinee D, Libman M. Predictors of inappropriate antibiotic prescribing among primary care physicians. *CMAJ* 2007;177:877-83.
13. Wang KY, Seed P, Schofield P, Ibrahim S, Ashworth M. Which practices are high antibiotic prescribers? A cross-sectional analysis. *Br J Gen Pract* 2009;59:e315-20.
14. Akkerman AE, Kuyvenhoven MM, van der Wouden JC, Verheij TJ. Prescribing antibiotics for respiratory tract infections by GPs: management and prescriber characteristics. *Br J Gen Pract* 2005;55:114-8.
15. van Duijn H, Kuyvenhoven MM, Tiebosch HM, Schellevis FG, Verheij TJ. Diagnostic labelling as determinant of antibiotic prescribing for acute respiratory tract episodes in general practice. *BMC Family Practice* 2007;8:55.
16. Del Mar CB, Scott AM, Glasziou PP, et al. Reducing antibiotic prescribing in Australian general practice: time for a national strategy. *Med J Aust* 2017;207:401-6.
17. Kumar S, Little P, Britten N. Why do general practitioners prescribe antibiotics for sore throat? Grounded theory interview study. *BMJ* 2003;326:138.
18. Linder JA, Doctor JN, Friedberg MW, et al. Time of day and the decision to prescribe antibiotics. *JAMA Intern Med* 2014;174:2029-31.
19. Murray R. Prescribing issues for Aboriginal people. *Australian Prescriber* 2003;26:106-9.
20. Bowen AC, Daveson K, Anderson L, Tong SY. An urgent need for antimicrobial stewardship in Indigenous rural and remote primary health care. *Med J Aust* 2019;211:9-11 e1.
21. Cuningham W, McVernon J, Lydeamore MJ, et al. High burden of infectious disease and antibiotic use in early life in Australian Aboriginal communities. *Australian and New Zealand journal of public health* 2019;43:149-55.
22. Lim CJ, Stuart RL, Kong DC. Antibiotic use in residential aged care facilities. *Aust Fam Physician* 2015;44:192-6.
23. Daneman N, Gruneir A, Bronskill SE, et al. Prolonged antibiotic treatment in long-term care: role of the prescriber. *JAMA Intern Med* 2013;173:673-82.

24. National Centre for Antimicrobial Stewardship and Australian Commission on Safety and Quality in Health Care. Antimicrobial Prescribing and Infections in Australian Aged Care Homes: Results of the 2018 Aged Care National Antimicrobial Prescribing Survey. Sydney: ACSQHC; 2019.
25. Nguyen HQ, Tunney MM, Hughes CM. Interventions to Improve Antimicrobial Stewardship for Older People in Care Homes: A Systematic Review. *Drugs Aging* 2019;36:355-69.
26. Stuart RL, Marshall C, Orr E, et al. Survey of infection control and antimicrobial stewardship practices in Australian residential aged-care facilities. *Intern Med J* 2015;45:576-80.
27. Hoffmann TC, Del Mar C. Patients' expectations of the benefits and harms of treatments, screening, and tests: a systematic review. *JAMA Intern Med* 2015;175:274-86.
28. Coenen S, Michiels B, Renard D, Denekens J, Van Royen P. Antibiotic prescribing for acute cough: the effect of perceived patient demand. *Br J Gen Pract* 2006;56:183-90.
29. Sung L, Arroll J, Arroll B, Goodyear-Smith F, Kerse N, Norris P. Antibiotic use for upper respiratory tract infections before and after a education campaign as reported by general practitioners in New Zealand. *The New Zealand medical journal* 2006;119:U1956.
30. Mangione-Smith R, Elliott MN, Stivers T, McDonald LL, Heritage J. Ruling out the need for antibiotics: are we sending the right message? *Archives of pediatrics & adolescent medicine* 2006;160:945-52.
31. McIsaac WJ, To T. Antibiotics for lower respiratory tract infections. Still too frequently prescribed? *Canadian family physician Medecin de famille canadien* 2004;50:569-75.
32. Grossman Z, del Torso S, Hadjipanayis A, van Esso D, Drabik A, Sharland M. Antibiotic prescribing for upper respiratory infections: European primary paediatricians' knowledge, attitudes and practice. *Acta paediatrica (Oslo, Norway : 1992)* 2012;101:935-40.
33. Petursson P. GPs' reasons for "non-pharmacological" prescribing of antibiotics. A phenomenological study. *Scand J Prim Health Care* 2005;23:120-5.
34. Hoffmann TC, Legare F, Simmons MB, et al. Shared decision making: what do clinicians need to know and why should they bother? *Med J Aust* 2014;201:35-9.
35. Little P, Dorward M, Warner G, Stephens K, Senior J, Moore M. Importance of patient pressure and perceived pressure and perceived medical need for investigations, referral, and prescribing in primary care: nested observational study. *BMJ* 2004;328:444.
36. Akkerman AE, Kuyvenhoven MM, van der Wouden JC, Verheij TJ. Analysis of under- and overprescribing of antibiotics in acute otitis media in general practice. *The Journal of antimicrobial chemotherapy* 2005;56:569-74.
37. Mangione-Smith R, McGlynn EA, Elliott MN, Krogstad P, Brook RH. The relationship between perceived parental expectations and pediatrician antimicrobial prescribing behavior. *Pediatrics* 1999;103:711-8.
38. Antibiotic Expert Group. Therapeutic guidelines: antibiotic. Melbourne: Therapeutic Guidelines Limited; 2019.
39. Akkerman AE, Kuyvenhoven MM, van der Wouden JC, Verheij TJ. Determinants of antibiotic overprescribing in respiratory tract infections in general practice. *The Journal of antimicrobial chemotherapy* 2005;56:930-6.
40. Butler CC, Kelly MJ, Hood K, et al. Antibiotic prescribing for discoloured sputum in acute cough/lower respiratory tract infection. *Eur Respir J* 2011;38:119-25.
41. Fischer T, Fischer S, Kochen MM, Hummers-Pradier E. Influence of patient symptoms and physical findings on general practitioners' treatment of respiratory tract infections: a direct observation study. *BMC Fam Pract* 2005;6:6.
42. Wigton RS, Darr CA, Corbett KK, Nickol DR, Gonzales R. How do community practitioners decide whether to prescribe antibiotics for acute respiratory tract infections? *Journal of general internal medicine* 2008;23:1615-20.
43. Steinke DT, Bain DJ, MacDonald TM, Davey PG. Practice factors that influence antibiotic prescribing in general practice in Tayside. *The Journal of antimicrobial chemotherapy* 2000;46:509-12.
44. Yang IA BJ, George J, Jenkins S, McDonald CF, McDonald V, Smith B, Zwar N, Dabscheck E. The COPD-X Plan: Australian and New Zealand Guidelines for the management of Chronic Obstructive Pulmonary Disease 2019. December 2019.
45. Australian Government DoH, Department of the Prime Minister and Cabinet, . Nudge vs Superbugs: A behavioural economics trial to reduce the overprescribing of antibiotics. 2018.

46. McKenzie D, Rawlins M, Del Mar C. Antimicrobial stewardship: what's it all about? *Australian Prescriber* 2013;36:116-20.
47. Wu J, Taylor D, Ovchinikova L, et al. Relationship between antimicrobial-resistance programs and antibiotic dispensing for upper respiratory tract infection: An analysis of Australian data between 2004 and 2015. *J Int Med Res* 2018;46:1326-38.
48. Meeker D, Knight TK, Friedberg MW, et al. Nudging guideline-concordant antibiotic prescribing: a randomized clinical trial. *JAMA Intern Med* 2014;174:425-31.
49. Australian Commission on Safety and Quality in Health Care. *Antimicrobial Stewardship Clinical Care Standard*. Sydney: ACSQHC; 2014.
50. Wilson HL, Daveson K, Del Mar CB. Optimal antimicrobial duration for common bacterial infections. *Aust Prescr* 2019;42:5-9.
51. Drug Utilisation Sub-Committee. *Antibiotics: PBS/RPBS utilisation*. Public Release Document, October 2014 and February 2015 DUSC Meetings. Canberra: DUSC; 2018.
52. McGuire TM, Smith J, Del Mar C. The match between common antibiotics packaging and guidelines for their use in Australia. *Australian and New Zealand journal of public health* 2015;39:569-72.
53. Thursky K. Use of computerized decision support systems to improve antibiotic prescribing. *Expert review of anti-infective therapy* 2006;4:491-507.
54. Christakis DA, Zimmerman FJ, Wright JA, Garrison MM, Rivara FP, Davis RL. A randomized controlled trial of point-of-care evidence to improve the antibiotic prescribing practices for otitis media in children. *Pediatrics* 2001;107:E15.
55. Flottorp S, Oxman AD, Havelsrud K, Treweek S, Herrin J. Cluster randomised controlled trial of tailored interventions to improve the management of urinary tract infections in women and sore throat. *BMJ* 2002;325:367.
56. Holstiege J, Mathes T, Pieper D. Effects of computer-aided clinical decision support systems in improving antibiotic prescribing by primary care providers: a systematic review. *Journal of the American Medical Informatics Association : JAMIA* 2015;22:236-42.
57. Bakhit M, Del Mar C, Gibson E, Hoffmann T. Shared decision making and antibiotic benefit-harm conversations: an observational study of consultations between general practitioners and patients with acute respiratory infections. *BMC Fam Pract* 2018;19:165.
58. Spurling GK, Del Mar CB, Dooley L, Foxlee R, Farley R. Delayed antibiotic prescriptions for respiratory infections. *The Cochrane database of systematic reviews* 2017;9:CD004417.
59. Little P, Moore M, Kelly J, et al. Delayed antibiotic prescribing strategies for respiratory tract infections in primary care: pragmatic, factorial, randomised controlled trial. *BMJ* 2014;348:g1606.
60. University of Queensland. *General Practitioner Antimicrobial Stewardship Programme Study (GAPS): Department of Health final summary report 2016*.
61. Australian Government. *Infographic - What you can do*. November 2017.
62. *Australian Guidelines for the Prevention and Control of Infection in Healthcare*. Canberra: National Health and Medical Research Council; 2019.
63. Royal Australian College of General Practitioners. *Infection prevention and control standards for general practices and other office-based and community-based practices (5th edition)*. Melbourne: RACGP; 2016.
64. Norhayati MN, Ho JJ, Azman MY. Influenza vaccines for preventing acute otitis media in infants and children. *The Cochrane database of systematic reviews* 2017;10:CD010089.
65. Fortanier AC, Venekamp RP, Boonacker CW, et al. Pneumococcal conjugate vaccines for preventing otitis media. *The Cochrane database of systematic reviews* 2014:CD001480.
66. Cohen R. The need for prudent use of antibiotics and routine use of vaccines. *Clinical microbiology and infection : the official publication of the European Society of Clinical Microbiology and Infectious Diseases* 2009;15 Suppl 3:21-3.
67. Ivers N, Jamtvedt G, Flottorp S, et al. Audit and feedback: effects on professional practice and healthcare outcomes. *The Cochrane database of systematic reviews* 2012:CD000259.
68. Australian Government DoH, Department of Agriculture, National Antimicrobial Resistance Strategy 2015-2019. Canberra: Commonwealth of Australia; 2015.

