

15

Antimicrobial stewardship in the
Aboriginal and Torres Strait Islander
population

Antimicrobial Stewardship in Australian Health Care

2020

Contents

Contents	337
Acronyms and abbreviations	338
Key points	339
15.1 Introduction	340
15.1.1 Aboriginal and Torres Strait Islander demographic characteristics	340
15.1.2 Infectious diseases and Aboriginal and Torres Strait Islander peoples	340
15.2 Antimicrobial use.....	341
15.2.1 Impact of vaccination on antimicrobial use	342
15.2.2 Antimicrobial resistance	343
15.3 Antimicrobial stewardship.....	343
15.3.1 Social determinants of health and infectious diseases	343
15.3.2 Cultural considerations in antimicrobial stewardship	346
15.4 Antimicrobial stewardship and Aboriginal Community Controlled Health Organisations	347
15.4.1 Establishing Aboriginal Community Controlled Health Organisation antimicrobial stewardship programs	348
15.4.2 Community development	349
15.4.3 Governance	349
15.4.4 Standards, policies and guidelines	349
15.4.5 The antimicrobial stewardship team	350
15.4.6 Antimicrobial stewardship program strategies	350
15.4.7 Prescribing guidelines	350
15.4.8 Antimicrobial formulary.....	350
15.4.9 Monitoring of antimicrobial use and evaluation of the antimicrobial stewardship program	350
15.4.10 Surveillance of antimicrobial resistance and antibiograms	350
15.4.11 Audit and feedback	351
15.4.12 Staff education	351
15.4.13 Community and patient education	351
15.5 Conclusions	352
Resources	354
References	355

Acronyms and abbreviations

Abbreviation	Definition
ACCHO	Aboriginal Community Controlled Health Organisation
ACSQHC	Australian Commission on Safety and Quality in Health Care
AHP	Aboriginal Health Practitioner
AHW	Aboriginal Health Worker
AMR	antimicrobial resistance
APSGN	acute post-streptococcal glomerulonephritis
AURA	Antimicrobial Use and Resistance in Australia
CARPA	Central Australian Rural Practitioners Association
COPD	chronic obstructive pulmonary disease
CSOM	chronic suppurative otitis media
GAS	group A <i>streptococcus</i>
GP	general practitioner
Hib	<i>Haemophilus influenzae</i> type b
MRSA	methicillin-resistant <i>Staphylococcus aureus</i>
NAPS	National Antimicrobial Prescribing Survey
NPS	National Prescribing Service
NSQHS	National Safety and Quality Health Service
PBS	Pharmaceutical Benefits Scheme
PCV	pneumococcal conjugate vaccine
PHN	Primary Health Network
QI-NAPS	Quality Improvement National Prescribing Service
RAAHS	Remote Area Aboriginal Health Services
RPBS	Repatriation Pharmaceutical Benefits Scheme

Key points

- The burden of infections experienced by Aboriginal and Torres Strait Islander peoples contributes to higher overall rates of antimicrobial use compared with non-Indigenous populations.
- Antimicrobials are under-used in some Aboriginal and Torres Strait Islander populations. This increases the risk of serious complications from infectious diseases.
- Rates of antimicrobial resistance are increasing in some Aboriginal and Torres Strait Islander populations.
- Antimicrobial stewardship is important to reduce antimicrobial resistance (AMR) and improve infectious disease outcomes.
- Effective antimicrobial stewardship initiatives are community driven, culturally safe and address social determinants of health that contribute to the infectious diseases burden.
- Aboriginal and Torres Strait Islander Community Controlled Health Organisations (ACCHOs) have a crucial role in reducing AMR in Aboriginal and Torres Strait Islander communities.
- ACCHOs and other health services may draw upon a range of antimicrobial stewardship initiatives include developing and implementing localised prescribing guidelines, establishing and maintaining a corresponding antimicrobial formulary, monitoring antimicrobial use and resistance patterns, providing feedback and education to staff and delivering community and patient education in an accessible and targeted way.
- Antimicrobial guidelines may need to be adapted to local circumstances, depending on the local microbiology of infectious diseases and availability of health services.
- Most Aboriginal and Torres Strait Islander peoples live in urban and regional areas, however most published studies on antimicrobial stewardship and AMR have been conducted in rural and remote communities. Further research is needed on antimicrobial stewardship, especially in urban and regional settings.

15.1 Introduction

Australia's National Antimicrobial Resistance Strategy describes national priority actions to address the growing public health threat of antimicrobial resistance (AMR), a global public health problem.¹ Antimicrobial stewardship is a key component of the national strategy.

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

Additional chapters of the Antimicrobial Stewardship Book are being developed on specific topics to further support antimicrobial stewardship in Australia; as these are completed, they will be published to supplement the Antimicrobial Stewardship Book.

Antimicrobial Stewardship in the Aboriginal and Torres Strait Islander Population is the latest addition to the Antimicrobial Stewardship Book. This chapter:

- describes antimicrobial use and resistance in Aboriginal and Torres Strait Islander populations;
- identifies resources to support appropriate prescribing of antimicrobials;
- provides practical strategies that can be implemented to improve antimicrobial stewardship in Aboriginal and Torres Strait Islander communities; and
- discusses the critical role of Aboriginal Community Controlled Health Organisations (ACCHOs) in antimicrobial stewardship.

15.1.1 Aboriginal and Torres Strait Islander demographic characteristics

In 2016 there were an estimated 798,365 Aboriginal and Torres Strait Islander peoples in Australia, representing 3.3% of the total Australian population.² The Aboriginal and Torres Strait Islander population is projected to reach about 1.1 million people by 2031.³

This population has a relatively young age structure with a median age of 23 years compared with 37.8 years for non-Indigenous Australians.³

Although 81% of Aboriginal and Torres Strait Islander peoples live in major cities, inner regional

and outer regional areas, in remote Australia 18% of the population is Aboriginal or Torres Strait Islander and in very remote Australia 47% of the population is Aboriginal and Torres Strait Islander.^{3,4}

Aboriginal and Torres Strait Islander peoples speak about 150 languages and belong to many cultural groups. Aboriginal and Torres Strait Islander languages play an important role in maintaining and passing on cultural knowledge and practices and contributing to a stronger sense of identity and belonging.⁵

15.1.2 Infectious diseases and Aboriginal and Torres Strait Islander peoples

Aboriginal and Torres Strait Islander peoples experience a greater infectious disease burden than non-Indigenous Australians, regardless of where they live. Aboriginal and Torres Strait Islander peoples who live in rural and remote areas experience disproportionately higher rates of some infectious diseases than their urban counterparts. Antimicrobial stewardship is therefore important to ensure antimicrobials are used appropriately in Aboriginal and Torres Strait Islander peoples and contribute to improved health outcomes.

In Australia, children of Aboriginal and Torres Strait Islander background have higher rates of infectious diseases including skin, ear, respiratory and gastrointestinal infections, invasive infections, including bloodstream infections, pneumonia and bronchiectasis, and are more likely to be hospitalised for infectious diseases than non-Indigenous children.^{6,7} Acute and chronic otitis media and associated conductive hearing loss are more prevalent in remote communities compared with urban communities.⁸

Group A streptococcal (GAS) infections cause skin, soft tissue and throat infections, invasive disease and the autoimmune sequelae of acute rheumatic fever and acute post-streptococcal glomerulonephritis (APSGN).⁹ APSGN can lead to chronic renal failure and a requirement for renal dialysis. Mortality from rheumatic heart disease in Aboriginal and Torres Strait Islander Australians is the highest reported in the world.¹⁰

Skin infections are a major contributor to the burden of GAS. In remote communities, impetigo is predominantly caused by GAS and affects 45% of Aboriginal and Torres Strait Islander children at any one time. A high burden of scabies, affecting 50% of Aboriginal and Torres Strait Islander children, increases rates of impetigo.⁹ Adults in some remote communities also experience high

rates of skin and soft tissue infections, up to 75% each year.¹¹

Notifications of sexually transmissible infections, including chlamydia, gonorrhoea and syphilis are higher in some Aboriginal and Torres Strait Islander teenage and adult populations.¹²

Some chronic diseases increase risk of severe infections. Rates of type 2 diabetes are high in some remote communities. Diabetes contributes to respiratory tract infections, urinary tract infections, skin and soft tissue infections, ear infections and cholecystitis.¹³ Bronchiectasis and chronic obstructive pulmonary disease (COPD) are also common in some adult Aboriginal and Torres Strait Islander populations and contribute to increased hospitalisations and mortality.⁷

Serious infections resulting in sepsis are more common in some Aboriginal and Torres Strait Islander populations; rates of sepsis resulting in hospitalisation and intensive care admission are four-fold higher in Aboriginal and Torres Strait Islander than in non-Indigenous Australians.¹⁴

15.2 Antimicrobial use

Although most of Australia's Aboriginal and Torres Strait Islander population live in urban and regional areas¹⁵, studies of antimicrobial prescribing in Aboriginal and Torres Strait Islander populations have largely been conducted in rural and remote areas, leaving gaps in our understanding about antimicrobial stewardship in urban populations.

Available evidence suggests rates of antimicrobial use are appropriately higher in urban, rural and remote Aboriginal and Torres Strait Islander patients because infectious disease burden is greater.¹⁶ However, other factors contribute to high rates of antimicrobial use, including:¹⁶

- a lack of diagnostic capability in some care settings especially the remote health care sector and
- a lack of availability of treatment which may precipitate increased prescribing by the health care provider to mitigate the risk of worsening infection for which the patient cannot later access timely health care.

High workforce turnover and a lack of availability of senior clinical staff may also contribute to higher rates of antimicrobial prescribing due to lack of familiarity with some of the infections that are rarely seen elsewhere in Australia.¹⁶

Prescribing practices differ between remote Aboriginal and Torres Strait Islander communities and non-remote communities, largely due to differences in infectious disease burden.^{17,18} The s100 Remote Area Aboriginal Health Services program measure (RAAHS) accounts for 1% of

antimicrobials supplied through the Pharmaceutical Benefits Scheme (PBS). Amoxicillin is the most common antimicrobial supplied; azithromycin is the second most common. Azithromycin is used for the treatment of trachoma and uncomplicated urethritis which have higher rates in rural and remote Aboriginal and Torres Strait Islander communities.¹⁹ In comparison, the most commonly supplied antimicrobials through the PBS / RPBS are amoxicillin, cefalexin and amoxicillin-clavulanic acid.

Rural and remote Aboriginal and Torres Strait Islander children are prescribed antimicrobials more frequently than non-Indigenous children. According to the results of one study, by their first birthday an estimated 95% of Aboriginal and Torres Strait Islander children in some rural communities receive at least one antimicrobial prescription and 47% receive at least six antimicrobial prescriptions.²⁰ In another study of Aboriginal and Torres Strait Islander children aged less than two years in remote communities, the children received a median of five antimicrobial prescriptions in both their first and second years of life.²¹

Medical practitioners treat acute otitis media in Aboriginal children more frequently with antimicrobials and for longer periods than in non-Aboriginal children.²² Prescribing practices are generally consistent with clinical practice guidelines, with an estimated 8% of prescriptions for treatment of infections not aligned with relevant otitis media treatment guidelines.²⁰

Topical antimicrobials are prescribed in Aboriginal and Torres Strait Islander populations for the treatment of ear infections.²¹ Treatment with oral antimicrobials is not recommended and is usually less effective than topical antimicrobial treatment for chronic suppurative otitis media (CSOM). However, up to 75% of children with CSOM are prescribed oral amoxicillin.²³

Harm from acute rheumatic fever is reduced through secondary prophylaxis with antimicrobials, whereby people at risk of recurrent acute rheumatic fever (i.e. those who have previously been diagnosed with acute rheumatic fever or rheumatic heart disease) receive regular intramuscular injections of benzathine penicillin.²⁴ This strategy is important in reducing the burden of rheumatic heart disease. However, it only prevents the worsening of rheumatic heart disease in established cases. To prevent acute rheumatic fever, evidence supports providing prompt assessment and antimicrobial treatment of skin sores and sore throats as well as reducing crowding and socio-economic disadvantage.²⁴ Unfortunately, population efforts to rationalise the use of antimicrobials for sore throat may inadvertently be contributing to the inability to

prevent acute rheumatic fever through early treatment of sore throats.²⁴

Antimicrobials may be under-utilised for treatment of sore throat in some Aboriginal and Torres Strait Islander patient groups. Antimicrobials are indicated for the treatment of Aboriginal and Torres Strait Islander paediatric patients with upper respiratory tract infections (URTIs) due to a higher risk of developing non-suppurative (i.e. non-pus producing) complications. In remote Aboriginal and Torres Strait Islander populations higher rates of antimicrobial prescribing for URTIs are observed.²⁰ However, available data from urban general practice shows no significant difference in antimicrobial prescribing for Aboriginal and Torres Strait Islander and non-Indigenous patients with URTIs.^{25,26} Further, data from MedicineInsight (a large general practice dataset managed by NPS MedicineWise) show that in 2017, 29.2 per 100 Aboriginal and Torres Strait Islander patients were prescribed an antimicrobial in general practice compared with 27.7 per 100 non-Indigenous patients.²⁷ Aboriginal and Torres Strait Islander patients are under-identified in primary care data which may influence the reported rates of prescribing in general practice.²⁸

Appropriate use of antimicrobials is of the utmost importance in the management of skin and soft tissue infections in Aboriginal and Torres Strait Islander patients. Some studies show high antimicrobial prescribing rates for skin infections.²⁹ Available data from remote Aboriginal and Torres Strait Islander communities suggests that, by their first birthday, 51% of Aboriginal and Torres Strait Islander children had received one antimicrobial prescription where skin sores were the sole presenting condition.²⁰ Another study of children in their first two years of life found 63% of children with scabies infections are prescribed antimicrobials.²¹

The treatment of intestinal worm infection in some Aboriginal and Torres Strait Islander populations requires administration of, commonly, oral ivermectin. Mass drug administration of ivermectin for scabies has been trialled in remote, tropical Aboriginal communities where *Strongyloides stercoralis* is hyper-endemic. This resulted in a sustained and significant reduction in *Strongyloides* seroprevalence over 18 months.³⁰ Annual ivermectin prescription volume correlates negatively with *Strongyloides* seropositivity.³¹

15.2.1 Impact of vaccination on antimicrobial use

Vaccination is an important public health intervention to reduce the burden of infectious diseases in the Australian community. There have been significant decreases in the burden of viral hepatitis, rotavirus, varicella, meningococcal

disease, invasive pneumococcal disease and *Haemophilus influenzae* type b in the Australian population as a result of immunisation programs.³² Vaccination against *Streptococcus pneumoniae* and *Haemophilus influenzae* type b has been associated with changes in rates of infection and in antimicrobial use.^{33,34}

Pneumococcal conjugate vaccination (PCV) of infants at two, four and six months of age has been associated with an 80% vaccine effectiveness for all-cause invasive pneumococcal disease in Australian children and a 61% reduction in all-cause invasive pneumococcal disease in unvaccinated children, mainly due to strong herd immunity.³⁴ Paediatric hospitalisations for pneumonia have also decreased. Both bacterial and viral pneumonia hospitalisation rates declined in the general population, suggesting pneumococcus may also play a role in viral pneumonia.³⁵

Since the introduction of the *Haemophilus influenzae* type b (Hib) vaccine, invasive Hib disease notification rates have decreased by more than 99% in both Aboriginal and Torres Strait Islander and other Australian children aged <5 years.³² Rates of infection with non-B-encapsulated serotypes have not increased significantly since widespread immunisation against Hib. However, invasive Hib disease rates in Aboriginal and Torres Strait Islander children aged <5 years remain around 10 times higher than in non-Indigenous children, partly due to lower vaccination coverage rates.³² This highlights the continuing importance of ensuring adequate vaccine coverage in the paediatric population.³⁶

Both *S. pneumoniae* and *H. influenzae* are pathogens associated with otitis media infection. They may densely co-colonise the nasopharynx and infect the middle ear of Aboriginal and Torres Strait Islander infants from very early in life.³⁷ Early and dense colonisation of the nasopharynx increases the risk of acute otitis media substantially.³⁸

The administration of PCV may reduce or eliminate nasopharyngeal colonisation by *S. pneumoniae*, and subsequently reduce incidence of acute otitis media. In turn, PCV may also disrupt the progression from pneumococcal-associated otitis media to chronic, recurrent otitis media and thereby reduce subsequent and more complex disease caused by non-vaccine serotypes of *S. pneumoniae* and non-typeable *Haemophilus influenzae*.³³

Although there has been a reduced prevalence of severe otitis media attributed to introduction of PCV, incidence has not reduced in all vaccinated Aboriginal and Torres Strait Islander populations.³⁹ After the introduction of the first 7-valent pneumococcal conjugate vaccine (7vPCV), the overall incidence of invasive pneumococcal

disease decreased by 74% in all Australian children under 2 years of age.²⁴ However, similar reductions in common ear and respiratory diseases were not observed in Aboriginal and Torres Strait Islander children and invasive pneumococcal disease due to non-vaccine serotypes increased.⁴⁰ Serotype replacement was observed. The most common serotypes colonising infants at 2 months (serotypes 16F and 19A) were not serotypes covered by 7vPCV and were more likely to cause otitis media and lung disease as the infants matured. These serotypes were also more likely to be associated with β -lactam antimicrobial resistance.⁴¹

The later introduction of 13-valent pneumococcal conjugate vaccine was associated with further reductions in invasive pneumococcal disease in the general population but not in improvements in ear health or substantial improvement in invasive pneumococcal disease in vaccinated Aboriginal and Torres Strait Islander children.^{42,43}

Aboriginal and Torres Strait Islander pregnant women and infants less than 6 months old have a high baseline risk for pneumococcal disease compared with the general population, particularly in low resource settings.⁴⁴ To reduce the burden of respiratory disease in infants, pneumococcal vaccination given in pregnancy has been trialled. Available data suggest this approach is not effective. Increased risk of acute otitis media in the first six months of life and increased risk of premature birth with pneumococcal vaccination have been observed in published studies.^{45,46}

15.2.2 Antimicrobial resistance

High levels of infectious disease and resultant high levels of antimicrobial use contribute to increased rates of AMR in Aboriginal and Torres Strait Islander populations. AMR reduces the range of antimicrobials available to treat infections and increases morbidity and mortality associated with infections caused by multidrug-resistant organisms.²⁷

AMR is problematic and rising in remote Aboriginal and Torres Strait Islander communities.¹⁶ Examples include tuberculosis, methicillin-resistant *Staphylococcus aureus* (MRSA) rates of around 50% in some communities, azithromycin resistance in *S. pneumoniae* and emerging resistance in gram-negative urinary tract pathogens.^{47,48,49}

Emerging AMR is not isolated to remote Australia. In the past 20 years, the virulent ST93-MRSA clone has emerged from remote northern Australia and is now the most prominent community-associated MRSA throughout Australia.⁵⁰

Antimicrobial use has caused changing resistance and carriage patterns in organisms implicated in

high rates of ear and lung diseases, including *S. pneumoniae*, non-typeable *H. influenzae* and *Moraxella catarrhalis*.^{20,21,29,48,51}

AMR in *Neisseria gonorrhoeae* is recognised as a public health problem of importance in Australia. Rates of azithromycin resistance have increased significantly since 2015, and 9.3% of isolates were resistant in 2017. The total number of notifiable cases also continues to increase.²⁷ However, in Aboriginal and Torres Strait Islander populations, gonorrhoea is concentrated primarily in Aboriginal heterosexual persons living in remote areas of central and northern Australia.⁵² The most recent Australian Gonococcal Surveillance Program Annual Report indicates gonococcal AMR in these regions remains low in infections acquired locally.⁵³

Scabies disease, caused by *Sarcoptes scabiei*, affects up to one in five remote living Aboriginal children and adults. Effective treatments that are tolerable without the risk of emerging resistance are needed.⁵⁴

AMR is therefore a priority for action in Aboriginal and Torres Strait Islander populations due to its serious and growing impact on health.

15.3 Antimicrobial stewardship

Antimicrobial stewardship is a set of coordinated strategies to improve antimicrobial use, enhance patient outcomes, reduce AMR and decrease unnecessary costs.

Effective antimicrobial stewardship in Aboriginal and Torres Strait Islander populations is complex and must balance the need for timely antimicrobial treatments to address the substantial infectious disease burden with judicious use of antimicrobials.

Holistic, culturally tailored approaches to reducing the infectious disease burden are essential.

15.3.1 Social determinants of health and infectious diseases

The conditions in which people live, work, and play shape people's opportunities for health. These are social determinants of health and include factors such as housing, employment conditions, education, social relationships, income, poverty and the distribution of power and resources.⁵⁵

Access to health care is a significant determinant of health in its own right. Barriers to access relate to availability, affordability, acceptability and appropriateness. Poor access to health care is associated with presentations with more advanced infections and comorbid diseases.⁵⁶

Aboriginal and Torres Strait Islander peoples living in remote areas may face distinct challenges that contribute to excess infectious disease burden such as housing conditions, environmental health issues and food costs. Living in an overcrowded household increases the likelihood of health problems such as skin, ear and eye infections.⁵⁷

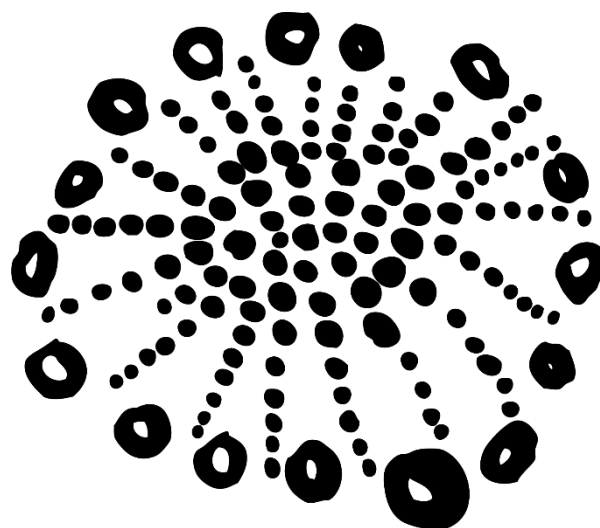
There is compelling evidence that improving the social determinants of health, including access to health services, reduces the incidence of some infectious diseases. For example, specific strategies for the treatment and prevention of bacterial skin infections in Aboriginal and Torres Strait Islander children that have reduced infections include: management of active infections and lesions; improving environmental and personal hygiene; the installation of swimming pools; screening and treatment.⁵⁸

Affordability of medicines may reduce compliance with treatment for infectious diseases. Improving access to affordable medicines is an important strategy to improve health. The PBS Closing the Gap co-payment measure reduces the cost of PBS medicines for eligible Aboriginal and Torres Strait Islander peoples living with, or at risk of, chronic disease.⁵⁹ When obtaining PBS medicines at their local pharmacy, eligible general patients who would normally pay the full PBS co-payment pay the concessional rate. Those who would normally pay the concessional price can receive their PBS medicines without being required to pay a PBS co-payment.

The burden of infectious disease among Aboriginal and Torres Strait Islander peoples can be reduced through improved housing conditions, adequate and timely housing repair and maintenance and the ability to perform healthy behaviours such as showering, toileting and safe food preparation.⁶⁰

Poorly maintained housing and the condition of food preparation and storage areas are associated with gastrointestinal infections. Skin infections and viral conditions such as influenza are associated with crowding. The excess burden of gastrointestinal, skin, ear, eye, and respiratory illnesses, are all related in various ways to poorly functioning health hardware (showers, toilets, electrical systems, taps and stoves), removal and treatment of sewage, crowding, presence of pests and vermin and the growth of mould and mildew.⁶⁰

Box 15.1 shows examples of successful holistic programs to improve overall health and wellbeing, along with reduced incidence of infection



Box 15.1: Holistic approaches to reduce infectious disease burden

New South Wales Housing for Health

The New South Wales Housing for Health program aims to assess, repair and replace health services to improve living conditions in Aboriginal communities. The program first ensures that houses are safe from life-threatening faults, then addresses the following nine healthy living practices in order of priority:⁶¹

- washing people
- washing clothes and bedding
- removing waste safely
- improving nutrition
- reducing overcrowding
- reducing the impact of animals, vermin and insects
- reducing dust
- controlling temperature
- reducing trauma.

The program trains and employs local Aboriginal and Torres Strait Islander peoples, and partners with health and environmental health teams to deliver comprehensive community-wide education campaigns. The program resulted in a 38% reduction in hospital separation rates for infectious diseases compared with the rural New South Wales Aboriginal population without Housing for Health interventions.

Linking health and environmental health in the Kimberley

In the Kimberley region of Western Australian, links between the health and environmental health services were strengthened by simple but timely referrals of infective conditions to environmental health teams. The changes resulted in resolution of issues in a timely manner, opportunities for Aboriginal environmental health workers to provide education about household maintenance and hygiene practices, and prevention of further infections.⁶²

15.3.2 Cultural considerations in antimicrobial stewardship

Connectedness to culture and caring for country are positive determinants of Aboriginal and Torres Strait Islander health.⁶³ Initiatives to improve antimicrobial stewardship within Aboriginal and Torres Strait Islander communities need to be culturally appropriate, community-developed and community-driven.⁶⁴ For example, housing programs where Aboriginal and Torres Strait Islander communities lead the design, construction and maintenance of housing have improved housing-related health outcomes, including infectious disease outcomes.⁶⁵

Culturally informed initiatives can better promote antimicrobial adherence, especially when combined with resources proven to support decisions by Aboriginal and Torres Strait Islander peoples. Some specific considerations include the following:

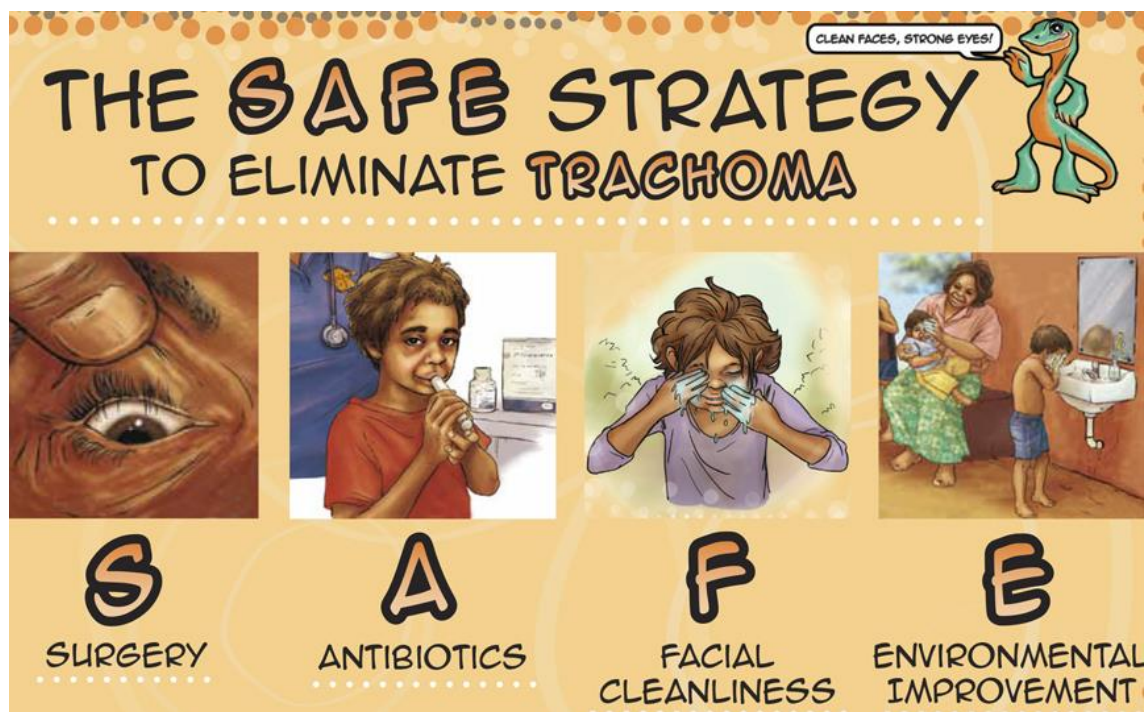
- There is a need to improve culturally tailored communication developed in partnership with Aboriginal and Torres Strait Islander peoples for Aboriginal and Torres Strait Islander peoples about antimicrobial stewardship. Many Aboriginal and Torres Strait Islander

peoples favour oral and visual communication.⁶⁶ However, availability of culturally specific resources to explain antimicrobials or antimicrobial resistance is limited.⁶⁷

- Drug formulations and dosing schedules can be modified to be more acceptable to Aboriginal and Torres Strait Islander patients. For example, a short course of oral co-trimoxazole for impetigo⁶⁸ or more patient-centred approaches to penicillin use and changes in penicillin formulations can improve adherence with secondary prophylaxis for rheumatic fever.⁶⁹
- Working with communities to understand data about antimicrobial resistance can facilitate community responses to AMR.⁶⁷
- Health services need to improve Aboriginal and Torres Strait Islander identification of patients. This improves individual patient management and the quality of community data about AMR.

Figure 1 below shows an example of culturally tailored communication about infections and antimicrobial use for trachoma.

Figure 1: University of Melbourne SAFE Strategy to eliminate trachoma



Improving access to primary health care for Aboriginal and Torres Strait Islander peoples is vital to making significant gains and closing the gap in health outcomes. Securing access to primary health care services requires close physical proximity, and ensuring health care without additional barriers including discrimination, racism and cultural inappropriateness.⁴ The role of ACCHOs in achieving this is discussed later in this chapter.

Culturally safe, responsive and flexible health care delivery needs to be the basis of any health service training and implementation. This encourages health professionals to effectively partner with Aboriginal and Torres Strait Islander patients, their carers and family, including responding to differing perceptions of health, wellbeing, illness, and the body.⁷⁰ All health care providers working with Aboriginal and Torres Strait Islander peoples should develop cultural responsiveness skills to allow them to provide care in a manner that is respectful of a person's culture and beliefs, and free from discrimination.⁷¹

Cultural safety is about overcoming the cultural power imbalances of places, people and policies to contribute to improvements in Aboriginal and Torres Strait Islander health.⁷² Health consumers are safest when clinicians have considered power relations, cultural differences and patients' rights. Part of this process requires clinicians to examine their own beliefs and attitudes.⁷³

Recognising that culture is a source of strength, resilience, happiness, identity and confidence for Aboriginal and Torres Strait Islander peoples, and that the protection of culture is linked to health and wellbeing, is essential for reducing the disparities in health experienced by Aboriginal and Torres Strait Islander peoples.⁷² Health care has been provided traditionally for millennia. Incorporating traditional knowledge and understanding into treatment of infections may also help in adherence to recommendations.

The NSQHS (National Safety and Quality Health Service Standards) specifically require organisations and governing bodies to:

- have strategies to improve the cultural awareness and cultural competency and cultural safety of the workforce to meet the needs of its Aboriginal and Torres Strait Islander patients
- demonstrate a welcoming environment that recognises the importance of the cultural beliefs and practices of Aboriginal and Torres Strait Islander patients
- ensure that the organisation's safety and quality priorities address the specific health needs of Aboriginal and Torres Strait Islander patients

- implement and monitor strategies to meet the organisation's safety and quality priorities for Aboriginal and Torres Strait Islander patients
- work in partnership with Aboriginal and Torres Strait Islander communities to meet their health care needs
- use communication mechanisms that are tailored to the diversity of the consumers who use its services and, where relevant, the diversity of the local community
- support clinicians to communicate with patients, carers, families and consumers about health and health care so that information is provided in a way that meets the needs of patients, carers, families and consumers
- discuss available treatment options with family members.⁷⁴

Antimicrobial stewardship initiatives must be tailored to the health literacy of the target population. Health literacy is 'the cognitive ability to understand and interpret the meaning of health information in the written, spoken and digital form as well as the ability to navigate through the health system' (see also Chapter 7).⁷⁵ Health literate antimicrobial stewardship initiatives should also give consideration to the context of history, language and culture of Aboriginal and Torres Strait Islander peoples.⁷⁶

15.4 Antimicrobial stewardship and Aboriginal Community Controlled Health Organisations

Government-funded ACCHOs are located across all Australian jurisdictions and provide primary health care and associated wellbeing services to Aboriginal and Torres Strait Islander peoples.⁷⁷ ACCHOs also provide access to a range of advocacy and support services in relation to the social determinants of health and accountability of mainstream services to provide culturally safe services and incorporate Aboriginal representation in health service governance.⁷⁷ ACCHOs have an important role to play in addressing the infectious disease burden experienced by Aboriginal and Torres Strait Islander peoples.

The evolution of Aboriginal primary health care services arose from mainstream health services being unable to adequately meet the needs of Aboriginal and Torres Strait Islander communities. Aboriginal and Torres Strait Islander peoples have often been excluded and marginalised from mainstream health services.⁷⁸ In 2017–18, 6.1 million client contacts were delivered by ACCHOs from 383 sites across Australia. One-third (32%)

provide services in very remote areas, 13% in remote areas, 23% in outer regional areas, 20% in inner regional areas and 12% in major cities.⁷⁷

ACCHOs work to improve the health of Aboriginal and Torres Strait Islander communities through comprehensive programs that incorporate treatment and management, prevention and health promotion.⁷⁸ They also play a significant role in training the medical workforce and employing Aboriginal and Torres Strait peoples.⁷⁹

ACCHOs address social determinants of health. In particular, ACCHO staff provide advocacy and support for housing for individual clients and the community as a whole.⁷⁸ When coupled with community-level hygiene programs, the burden of infectious diseases can be reduced.⁶⁰

Care delivered by ACCHOs is more likely to involve a range of health professionals. ACCHOs employ a wide variety of staff, including Aboriginal and Torres Strait Islander health workers, doctors, nurses, allied health professionals, social and emotional wellbeing staff, and medical specialists; just over half (54%) of employed staff are Aboriginal and Torres Strait Islander peoples.⁷⁷

There are different types of Aboriginal and Torres Strait Islander health workers and practitioners, each with a different role. Broadly, Aboriginal Health Practitioners (AHPs) provide direct clinical services to the Aboriginal and Torres Strait Islander community and are registered with the Aboriginal and Torres Strait Islander Health Practice Board of Australia supported by the Australian Health Practitioner Regulation Agency.⁸⁰ Aboriginal Health Workers (AHWs) have different roles and position titles across jurisdictions and organisations. Roles of AHWs may include to:⁸¹

- facilitate better access and liaison, and provide health promotion and preventive health services;
- provide advocacy, support and liaison within an acute-care health setting, such as hospitals and multipurpose services;
- promote hygiene behaviours in culturally and socially appropriate ways; provide internal and external maintenance services, promote home maintenance skills, and provide education on active lifestyles, healthy nutrition, cooking and safe food storage.

Aboriginal and Torres Strait Islander health workers and practitioners have health care training and facilitate effective communication. They perform a clear cultural brokerage role and should be embedded in all health care teams that provide services to Aboriginal and Torres Strait Islander peoples, particularly where other Aboriginal health practitioners do not identify themselves as Aboriginal and Torres Strait Islander.⁷⁶ AHWs play an essential role in

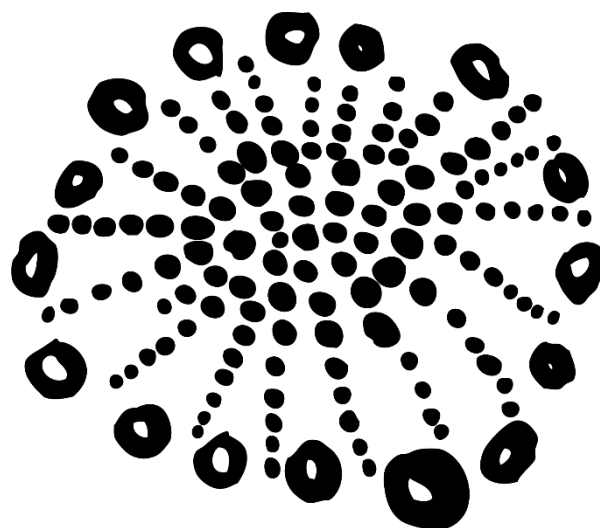
improving access to antimicrobials for Aboriginal and Torres Strait Islander peoples and in improving medication compliance.⁸²

Nurses and AHWs deliver the majority of care in regional, remote and very remote areas. Various state and territory laws in Australia allow certain health practitioners to possess, administer and supply certain scheduled substances and antimicrobials without a medical officer's order.⁸³ These arrangements allow people to access care and treatment for some common infectious diseases in a timely manner or if the medical condition of the person requires administration of antimicrobials without delay.

15.4.1 Establishing Aboriginal Community Controlled Health Organisation antimicrobial stewardship programs

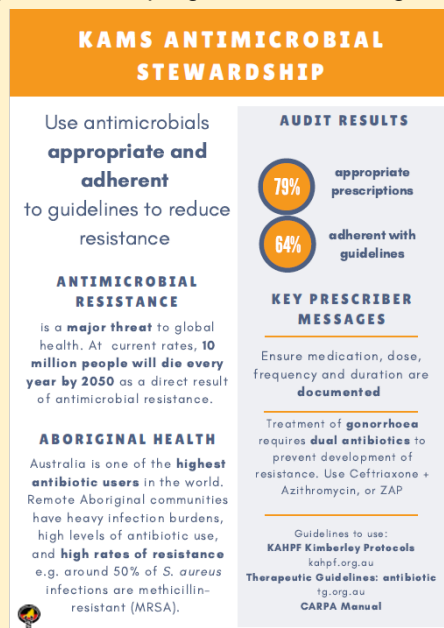
Although strategies for antimicrobial stewardship have been successfully applied in a range of settings (see Chapter 3 of this book), evidence is lacking about strategies in ACCHOs. It is therefore suggested that the same principles for implementing the key elements of antimicrobial stewardship discussed in other chapters be considered by ACCHOs, but specific factors and issues affecting Aboriginal and Torres Strait Islander peoples must be carefully considered if the program is to be successful. Each ACCHO will need to analyse the barriers and enablers for establishing an antimicrobial stewardship program based on their local environment.

Box 15.2 provides an example of an antimicrobial stewardship program in the Kimberley.



Box 15.2 An antimicrobial stewardship program in the Kimberley

Kimberley Aboriginal Medical Services (KAMS) has an evolving program of localised strategies to reduce antimicrobial resistance within the remote communities to whom primary health care is provided. Key pillars of the program include a regional formulary (the Kimberley Standard Drug List) which determines



clinic impress, and locally developed clinical protocols, through the Kimberley Aboriginal Health Planning Forum (KAHPF). Resources guide the management of conditions prevalent in the region. For example, [the skin infections in children protocol](#) provides treatment recommendations that address the high rates of MRSA in the Kimberley region.

A new feature of the program for KAMS is the antimicrobial stewardship audit tool. This tool has been developed to enable regular feedback to be provided to clinicians regarding adherence of prescriptions to KAHPF and other relevant guidelines.

Feedback is provided to each clinic at team meetings and via email, with an infographic poster containing three actionable key messages.

Clinic level feedback, rather than individual feedback, was chosen to foster a team approach to stewardship. Clinicians have reported that the quality improvement process has raised the profile of antimicrobial stewardship and promoted a sense of responsibility and accountability in their prescribing decisions.

15.4.2 Community development

A successful antimicrobial stewardship program takes a community development approach, providing advocacy and ensuring collaboration to improve the social determinants of health in the local community. Community development requires working in an environment that advocates the full and active participation of all community members, to assist the community to find solutions to the problems they have identified.^{62,64}

ACCHOs will have systems in place to identify the specific health problems and needs of the community they serve, and how these needs can be met. Needs specific to infectious disease and antimicrobial resistance may be considered by the ACCHO in identifying community priorities.

Population-based approaches to infection prevention and hygiene promotion often require activity across and beyond the health system. Communities can identify solutions to promote hand hygiene, personal hygiene and immunisation and to address priority social determinants of health.⁶³

15.4.3 Governance

The role of the governance and executive leaders in antimicrobial stewardship programs is discussed in Chapter 2. The best outcomes are achieved when accountability for antimicrobial use sits at the highest level of management, which

takes responsibility for ensuring that an antimicrobial stewardship program is developed and implemented, and its outcomes are evaluated.⁵⁸

The governance body may consider whether antimicrobial stewardship should be integrated with the ACCHO's quality and patient safety functions. Dedicated resources could be required for antimicrobial stewardship activities, education and measuring and monitoring antimicrobial use.

15.4.4 Standards, policies and guidelines

The inclusion of antimicrobial stewardship requirements in the NSQHS Standards has been a driver for establishing antimicrobial stewardship programs across health settings. Guidance for organisations establishing antimicrobial stewardship programs to meet the NSQHS Standards is available on the Commission's [website](#).

ACCHOs may choose to develop an overall antimicrobial stewardship policy (see Chapter 2) or draw upon other organisations or peak body resources. In addition, prescribing policies, guidelines and clinical pathways can be developed and implemented that are consistent with evidence-based guidelines and adapted to the ACCHO practice setting and local microbiology of infectious diseases.

Many evidence-based treatment guidelines in Australia have a lower threshold for antimicrobial

use in Aboriginal and Torres Strait Islander peoples. National treatment guidelines limiting the use of antimicrobials in certain conditions (such as pharyngitis and tonsillitis) may need to be localised to accommodate the additional risk factors experienced by Aboriginal and Torres Strait Islander peoples.

15.4.5 The antimicrobial stewardship team

The antimicrobial stewardship team provides clinical leadership for implementing antimicrobial stewardship activities within the organisation and monitoring success. Team membership is broad and can comprise medical, nursing, pharmacy, microbiologists and AHP/AHW members. Pharmacists have been essential to the success of antimicrobial stewardship programs in other settings because they have a positive effect on improving appropriate antimicrobial use, and patient care and safety.⁸⁴ The antimicrobial stewardship team may also need access to an infectious diseases physician to provide specialist advice (see Chapters 8 and 15).

There are 31 Primary Health Networks (PHNs) throughout Australia the role of which is to increase the efficiency and effectiveness of medical services for patients, particularly those at risk of poor health outcomes, and improve the coordination of care to ensure patients receive the right care in the right place at the right time. Aboriginal and Torres Strait Islander health is one of the seven priority areas established for PHNs by the Australian Government.⁸⁵ PHNs and State and Territory Governments may provide programs and services that support ACCHOs to implement antimicrobial stewardship strategies.

15.4.6 Antimicrobial stewardship program strategies

As with all antimicrobial stewardship programs, ACCHOs can select the antimicrobial stewardship strategies that will best help them to meet their goals. At a minimum, these might include prescribing guidelines, an antimicrobial formulary, surveillance of antimicrobial use and resistance, evaluation of the antimicrobial stewardship program, audit and prescriber feedback and education of staff and consumers.

15.4.7 Prescribing guidelines

ACCHOs may wish to consider providing easy access for clinicians to diagnosis and treatment protocols that have been adapted to the local microbiology of infectious diseases. Relevant guidelines from which local protocols may be adapted include *Therapeutic Guidelines*:

Antibiotic, the *Queensland Primary Clinical Care Manual* and the *Central Australian Rural Practitioners Association (CARPA) Standard treatment manual*.^{86,87,88} Guidelines differ, which is reflective of the target populations to which each guideline is relevant.

15.4.8 Antimicrobial formulary

ACCHOs can consider developing a standard imprest list of antimicrobials to be stocked for the management of acute infectious conditions. The list should be based on local susceptibility patterns and align with localised treatment protocols used by staff within the ACCHO. Staff may need to be made aware of the antimicrobials that are available.

For the rural/remote setting, it is important to consider the distance to an acute care facility in cases of severe infection and sepsis when considering which antimicrobials should be available locally.

15.4.9 Monitoring of antimicrobial use and evaluation of the antimicrobial stewardship program

Approaches to monitoring the volume and quality of antimicrobial use and measuring the effectiveness of antimicrobial stewardship programs are outlined in Chapter 5. The (Antimicrobial Use and Resistance in Australia) AURA surveillance system coordinates data from a range of sources to provide a comprehensive picture of patterns and trends of AMR and antimicrobial use in human health across Australia.⁸⁹

ACCHOs may choose to select a range of measures that will help them monitor targeted interventions and determine whether their antimicrobial stewardship efforts are successful. This will be influenced by available resources to support monitoring and the feasibility of monitoring in the ACCHO's practice setting. Organisations may need to monitor for potential unintended consequences of the interventions, such as making sure antimicrobial stewardship initiatives do not result in reduced appropriate treatment for infectious diseases.

15.4.10 Surveillance of antimicrobial resistance and antibiograms

Collection and distribution of surveillance data on resistant organisms and production of annual cumulative antibiograms to indicate susceptibility patterns for key pathogens can help clinicians make more appropriate empirical antimicrobial choices.⁸⁴ Access to diagnostic and laboratory testing may be limited in some settings. Point of

care testing may be used, which increases diagnostic accuracy, but does not provide information about antimicrobial resistance.

ACCHOs may need to review diagnosis and treatment protocols regularly to ensure guidance to staff regarding antimicrobial use remains consistent with current patterns of susceptibility and resistance. Collaboration with microbiologists can be important to ensure data are interpreted correctly.

State and Territory governments and private pathology providers may be able to support ACCHOs to receive timely information regarding antibiograms that describe sensitivity and resistance patterns.¹ The use of cascade reporting of antimicrobial susceptibility by pathology providers is encouraged as this has been shown to reduce the use of broad-spectrum antimicrobials (see Chapter 9).

The AURA Surveillance System includes Australian Passive AMR surveillance (APAS) which collects, analyses and reports on de-identified patient-level AMR data across Australia. AMR in isolates referred for testing from public and private hospitals, aged care homes and community settings. The Commission is working to expand participation in APAS in rural and remote settings.

Hot North provides data from surveillance of AMR in northern Australia. HOTspots, which is part of this project aims to support healthcare professionals to make empirical antibiotic therapy choices and to provide local and timely data to support the activities of antimicrobial stewardship programs, pathology providers (in the development of local antibiograms) and those updating therapeutic guidelines.

15.4.11 Audit and feedback

Clinicians rely on audit and feedback to monitor whether their prescribing patterns are consistent with their peers and with evidence-based guidelines and protocols. Audit and feedback of prescribing practices have been shown to reduce inappropriate antimicrobial prescribing in other settings.⁹⁰

Personalised prescriber feedback should be available to doctors, nurses, AHPs and any other clinicians who prescribe antimicrobials. Depending on available resources, ACCHOs may wish to support their staff to participate in national audit and feedback programs, such as the National Antimicrobial Prescribing Survey (NAPS) available at naps.org.au.

Audit and feedback within ACCHOs should compare clinician prescribing practices with protocols and treatment guidelines that are relevant to the local setting.⁹¹ The quality

improvement NAPS (QI-NAPS) is an appropriate tool for ACCHOs to use should they wish to consider this.

15.4.12 Staff education

Strategies to support antimicrobial stewardship education are described in Chapter 6, and information on resources and tools are described throughout this Chapter. ACCHO staff should be aware of infectious diseases relevant to their local community and associated diagnosis, treatment and referral pathways. Public health services can provide information to ACCHOs about local communicable disease epidemiology and trends.

ACCHOs may consider incorporating the recognition and management of infective conditions that are prevalent in the local area (e.g. acute streptococcal throat and skin infections where rheumatic heart disease is prevalent), and appropriate antimicrobial use for specific types of common infections (e.g. skin infections, otitis media, pneumonia, urinary tract infections, helminth and parasitic infections) into staff education and training. The potential complications of antimicrobial management and implications for care could also be included in staff education initiatives. PHN health pathways may also be used by staff to guide evidence-based decision making for patient assessment and management of infectious diseases.

15.4.13 Community and patient education

Community and patient education are essential elements of local antimicrobial stewardship programs. Educational resources and tools for consumer education are described in Chapter 7. To date, educational materials on the use and misuse of antimicrobials has been largely targeted at the general population, with only a few specific messages or materials for Aboriginal and Torres Strait Islander patients.

ACCHOs may need to adapt and/or translate education resources to meet local needs and circumstances as community and patient education should be aligned with local infectious disease burden, health literacy and cultural needs. Education materials may need to include messages that address causes of infections, the role of antimicrobials and other treatments such as hand hygiene and environmental interventions.

ACCHOs may wish to participate in national awareness campaigns for reducing the overuse of antimicrobials (such as Antimicrobial Awareness Week). However, organisations may need to develop materials that suit the specific needs of their community as local antimicrobial stewardship messages may differ from those in mainstream

materials due to differences in infectious diseases and their treatment.

Box 15.33 below provides an example of educational resources adapted to meet local needs.

Box 15.3 Consumer education about germ theory

The infectious diseases program of the Aboriginal Resource and Development Service in the Northern Territory aims to improve health literacy and people's understanding of germ theory.

The program uses microscopes to teach people about bacteria and viruses and uses this as a platform to talk about the causes, symptoms and treatment of bacterial infections of the skin and respiratory tract, bloodborne viruses and sexually transmissible infections.

The programs are delivered in Yolngu language, and a series of programs was also broadcast on [Yolngu Radio](#). The Nyumurrku' buwayak warrakan' mala-Small invisible animals/Germs-DVD is available [here](#).

There is also [Antibiotics-puy Dhäwu - Antibiotics Story DVD](#) which will benefit Aboriginal people particularly in northeast Arnhem Land

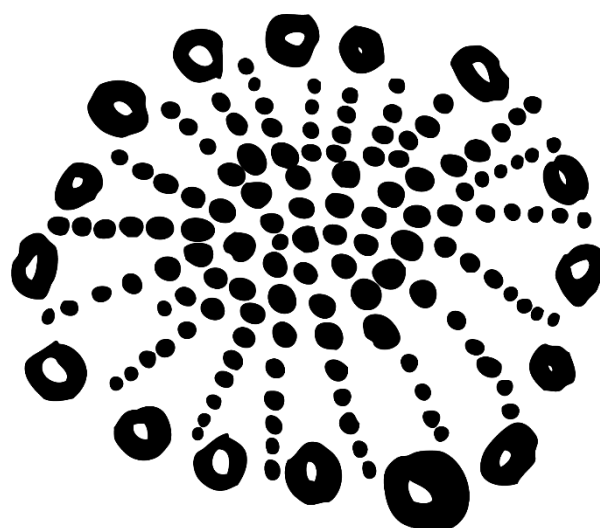
Social marketing and mass media campaigns targeting the overuse of antimicrobials and antimicrobial resistance in the general population have been effective in increasing consumer awareness (see Chapter 7). The effectiveness of these campaigns in Aboriginal and Torres Strait Islander populations has not been specifically evaluated.

15.5 Conclusions

The recommendations for antimicrobial stewardship programs described in other chapters of this book are also relevant to antimicrobial stewardship in Aboriginal and Torres Strait Islander communities. Antimicrobial stewardship initiatives should identify and address social and cultural factors that influence infectious diseases burden and antimicrobial use. Aboriginal and Torres Strait Islander leadership at local community level generating solutions led by Aboriginal and Torres Strait Islander people, is required to have a longer-term effect on reducing the infectious disease burden and reducing AMR.

ACCHOs play an important role in improving antimicrobial stewardship and reducing infectious diseases burden in Aboriginal and Torres Strait Islander communities. A range of antimicrobial stewardship strategies have been described that ACCHOs may consider in developing antimicrobial stewardship programs. In addition, ACCHOs should strongly consider adopting a community development approach to antimicrobial stewardship with strong organisational governance and accountability to ensure antimicrobial stewardship program success.

There are many evidence gaps that limit our understanding of effective antimicrobial stewardship approaches in Aboriginal and Torres Strait Islander populations. Further work led by Aboriginal and Torres Strait Islander peoples is required to better understand the infectious diseases burden and use of antimicrobials in Aboriginal and Torres Strait Islander populations, including areas where antimicrobials are being overused or misused, or where practice needs improvement. Research to inform our understanding of barriers and enablers to antimicrobial stewardship in Aboriginal and Torres Strait Islander populations and evaluation of the success of antimicrobial stewardship strategies is also required.



This logo that has been used throughout the chapter is a sea urchin design developed by a Worimi artist from the mid-north coast of NSW for use by the Commission.

Resources

- RACGP Cultural awareness and cultural safety training
<https://www.racgp.org.au/the-racgp/faculties/atsi/education/post-fellowship/cultural-awareness-and-cultural-safety-training>
- National Agreement on Closing the Gap
<https://www.closingthegap.gov.au/national-agreement-closing-gap-glance>
- NSQHS Standards Actions to meet the needs of Aboriginal and Torres Strait Islander peoples
<https://www.safetyandquality.gov.au/our-work/aboriginal-and-torres-strait-islander-peoples>
- Kimberley Aboriginal Medical Services
<https://kams.org.au/resources/health-promotion/>
- RHD Australia ARF RHD Guideline
<https://www.rhdaustralia.org.au/arf-rhd-guideline>
- Therapeutic Guidelines. Therapeutic guidelines: antibiotic, version 16. Melbourne: eTG; 2019.
- Queensland Health. Primary Clinical Care Manual 10th edition. Cairns: Rural and Remote Clinical Support Unit, Torres and Cape Hospital and Health Service; 2019.
- Central Australian Rural Practitioners Association (CARPA) Standard Treatment Manual, 7th edition. Alice Springs, NT: Centre for Remote Health; 2017.
- Australian Technical Advisory Group on Immunisation (ATAGI). Australian Immunisation Handbook, Australian Government Department of Health, Canberra, 2018, immunisationhandbook.health.gov.au.

References

- 1 Australian Government, Department of Health. Australia's national antimicrobial resistance strategy – 2020 and beyond [Internet]. Canberra: Department of Health; 2020. Available from <https://www.amr.gov.au/resources/australias-national-antimicrobial-resistance-strategy-2020-and-beyond>.
- 2 Australian Bureau of Statistics. Estimates of Aboriginal and Torres Strait Islander Australians, June 2016 [Internet]. Canberra: ABS; 2018. ABS cat. no. 3238.0.55.001. Available from <https://www.abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/estimates-aboriginal-and-torres-strait-islander-australians/latest-release>.
- 3 Australian Bureau of Statistics. Estimates and projections, Aboriginal and Torres Strait Islander Australians, 2006–2031 [Graph 1, Series B projections] [Internet]. Canberra: ABS; 2019. ABS cat. no. 3238.0. Available from <https://www.abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/estimates-and-projections-aboriginal-and-torres-strait-islander-australians/latest-release>.
- 4 Davy C, Harfield S, McArthur A, Munn Z, Brown A. Access to primary health care services for Indigenous peoples: a framework synthesis. *Int J Equity Health*. BioMed Central; 2016;15:163.
- 5 Australian Government, Productivity Commission. Report on government services 2018 [Internet]. Canberra: Productivity Commission; 2020. Available from <https://www.pc.gov.au/research/ongoing/report-on-government-services/2018>.
- 6 Ostrowski J, MacLaren G, Alexander J, Stewart P, Gune S, Francis JR, et al. The burden of invasive infections in critically ill Indigenous children in Australia. *Med J Aust* 2017; 206 (2): 78-84. doi: 10.5694/mja16.00595.
- 7 Thilini B, Morgan L, Chang A. The global burden of respiratory infections in indigenous children and adults: a review. *Respirology* 2017; 22:1518-1528.
- 8 Jervis-Bardy J, Carney AS, Duguid R, Leach AJ. Microbiology of otitis media in Indigenous Australian children. *The Journal of laryngology and otology*. 2017; 1;131:S2.
- 9 May P, Bowen A, Carapetis J. The inequitable burden of group A streptococcal diseases in Indigenous Australians. *Medical Journal of Australia* 2016; 205:201-203.
- 10 Jackson S, Steer A, Campbell H. Systematic review: estimation of global burden of non-suppurative sequelae of upper respiratory tract infection: rheumatic fever and post-streptococcal glomerulonephritis. *Trop Med Int Health* 2011; 16: 2-11.
- 11 Thomas L, Bowen A and Tong S. Complicated skin and soft tissue infections in remote indigenous communities. *Internal Medicine Journal* 2020; 50:752-754.
- 12 The Kirby Institute. Bloodborne viral and sexually transmissible infections in Aboriginal and Torres Strait Islander people: surveillance and evaluation report 2015 [Internet]. Sydney: The Kirby Institute, UNSW; 2015. Available from https://kirby.unsw.edu.au/sites/default/files/kirby/report/ATSIP_2015-Aboriginal-Surveillance-Report.pdf.
- 13 Ming L, McDermott R. High absolute risk of severe infections among Indigenous adults in rural northern Australia is amplified by diabetes—A 7 year follow up study. *Journal of Diabetes and its Complications*. 2016; 30:1069-1073.
- 14 Palasanthiran P, Bowen A. The excess burden of severe sepsis in Indigenous Australian children: can anything be done? *Med J Aust* 2017; 206:71-72.
- 15 Australian Bureau of Statistics. Estimates of Aboriginal and Torres Strait Islander Australians, June 2016 [Internet]. Canberra: ABS; 2018. ABS cat. no. 3238.0.55.001. Available from <https://www.abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/estimates-aboriginal-and-torres-strait-islander-australians/latest-release>.
- 16 Bowen AC, Daveson K, Anderson L, Tong SY. An urgent need for antimicrobial stewardship in Indigenous rural and remote primary health care. *The Medical Journal of Australia*. 2019;211(1):9-11.
- 17 Cuningham W, Anderson L, Bowen AC, Busing K, Connors C, Daveson K, Martin J, McNamara S, Patel B, James R, Shanks J, Wright K, Yarwood T, Tong SY, McVernon J. 2020. Antimicrobial stewardship in remote primary healthcare across northern Australia. *PeerJ* 8:e9409 <https://doi.org/10.7717/peerj.9409>

- 18 Australian Government, Services Australia [Internet]. Canberra: Services Australia; nd. Remote Area Aboriginal Health Services (RAAHS or AHS) and the Pharmaceutical Benefits Scheme [updated 2020 July 01]. Available from <https://www.humanservices.gov.au/health-professionals/services/medicare/remote-area-aboriginal-health-services-raahs-or-ahs-and-pharmaceutical-benefits-scheme>.
- 19 Pharmaceutical Benefits Scheme, Drug Utilisation Sub-Committee. Antibiotics: PBS/RPBS utilisation, October 2014 and February 2015 [Internet]. Canberra: DUSC; [updated 2015 May 29]. Available from <https://www.pbs.gov.au/pbs/industry/listing/participants/public-release-docs/antibiotics/antibiotics-oct-14-feb-15>.
- 20 Cuningham W, McVernon J, Lydeamore MJ, Andrews RM, Carapetis J, Kearns T, 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(2):149-155.
- 21 Howarth T, Brunette R, Davies T, Andrews RM, Patel BK, Tong S, et al. Antibiotic use for Australian Aboriginal children in three remote Northern Territory communities. *PLoS One* 2020;15:e0231798.
- 22 Gunasekera H, Morris PS, Daniels J, Couzos S, Craig JC. Management of children with otitis media: a survey of Australian Aboriginal Medical Service practitioners. *J Paediatr Child Health* 2009;45:457-63.
- 23 Wigger C, Leach AJ, Beissbarth J, Oguoma V, Lennox R, Nelson S, et al. Povidone-iodine ear wash and oral cotrimoxazole for chronic suppurative otitis media in Australian aboriginal children: study protocol for factorial design randomised controlled trial. *BMC Pharmacol Toxicol*. 2019;20(1):46.
- 24 Cannon J, Bessarab DC, Wyber R, Katzenellenbogen JM. Public health and economic perspectives on acute rheumatic fever and rheumatic heart disease. *Medical J Australia*. 2019;211(6):250-2.
- 25 Glenn H, Friedman J, Borecki AA, Bradshaw C, Grandjean-Thomsen N, Pickup H. Patient demographic and clinician factors in antibiotic prescribing for upper respiratory tract infections in the Australian Capital Territory from 2006–2015. *J Clin Diagn Res*. 2017;11(8):FC01–FC05.
- 26 Magin PJ, Morgan S, Tapley A, Henderson KM, Holliday EG, Ball J, et al. Changes in early-career family physicians' antibiotic prescribing for upper respiratory tract infection and acute bronchitis: a multicentre longitudinal study. *Family practice*. 2016;33(4):360-7.
- 27 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.
- 28 Australian Institute of Health and Welfare. National best practice guidelines for collecting Indigenous status in health data sets. Canberra: AIHW; 2010
- 29 Heal C, Gorges H, Van Driel ML, Tapley A, Davis J, Davey A, et al. Antibiotic stewardship in skin infections: a cross-sectional analysis of early-career GP's management of impetigo. *BMJ Open*. 2019;9(10):e031527.
- 30 Kearns TM, Currie BJ, Cheng AC, McCarthy J, Carapetis JR, Holt DC, et al. Strongyloides seroprevalence before and after an ivermectin mass drug administration in a remote Australian Aboriginal community. *PLoS Negl Trop Dis*. 2017;11(5):e0005607.
- 31 Paltridge M, Smith S, Traves A, McDermott R, Fang X, Blake C, et al. Rapid progress toward elimination of Strongyloidiasis in North Queensland, tropical Australia, 2000–2018. *The American Journal of Tropical Medicine and Hygiene*. 2020;102(2):339-45.
- 32 Ioannides S, Beard F, Larter N, Clark K, Wang H, Hendry A, et al. Vaccine preventable diseases and vaccination coverage in Aboriginal and Torres Strait Islander people, Australia, 2011–2015. *Communicable Diseases Intelligence*. 2019;43. doi.org/10.33321/cdi.2019.43.36
- 33 Dagan R, Pelton S, Bakaletz L. Prevention of early episodes of otitis media by pneumococcal vaccines might reduce progression to complex disease *Lancet Infectious Diseases* 2016;16:480-92.
- 34 Gidding HF, McCallum L, Fathima P, Moore HC, Snelling TL, Blyth CC, et al. Effectiveness of a 3+ 0 pneumococcal conjugate vaccine schedule against invasive pneumococcal disease among a birth cohort of 1.4 million children in Australia. *Vaccine*. 2018;36(19):2650-6.
- 35 Fathima P, Blyth CC, Lehmann D, Lim FJ, Abdalla T, De Klerk N, et al. The impact of pneumococcal vaccination on bacterial and viral pneumonia in Western Australian children: record linkage cohort study of 469589 births, 1996–2012. *Clin Infect Dis*. 2018;66(7):1075-85.
- 36 Cleland G, Leung C, Wan Sai Cheong J, Francis J, Heney C, Nourse C. Paediatric invasive *Haemophilus influenzae* in Queensland, Australia, 2002–2011: young

-
- Indigenous children remain at highest risk. *J Paed Child Health*. 2018;54(1):36-41.
- 37 Oguoma VM, Wilson N, Mulholland K, Santosham M, Torzillo P, McIntyre P, et al. 10-Valent pneumococcal non-typeable H. influenzae protein D conjugate vaccine (PHiD-CV10) versus 13-valent pneumococcal conjugate vaccine (PCV13) as a booster dose to broaden and strengthen protection from otitis media (PREVIX_BOOST) in Australian Aboriginal children: study protocol for a randomised controlled trial. *BMJ open*. 2020;10(5):e033511.
- 38 Schilder AG, Chonmaitree T, Cripps AW, Rosenfeld RM, Casselbrant ML, Haggard MP, et al. Otitis media. *Nature Reviews Disease Primers*. 2016;2(1):1-8.
- 39 Leach A, Morris P. Otitis media and hearing loss among Aboriginal and Torres Strait Islander children: a research summary. Australian Parliament's Standing Committee on Health, Aged Care and Sport Public hearing in reference to the Inquiry into the Hearing Health and Wellbeing of Australia. Darwin: Child Health and Development, Menzies School of Health Research; 2017.
- 40 Dunne EM, Carville K, Riley TV, Bowman J, Leach AJ, Cripps AW, et al. Aboriginal and non-Aboriginal children in Western Australia carry different serotypes of pneumococci with different antimicrobial susceptibility profiles. *Pneumonia*. 2016;8(1):15.
- 41 Leach AJ, Morris PS, McCallum GB, Wilson CA, Stubbs L, Beissbarth J, et al. Emerging pneumococcal carriage serotypes in a high-risk population receiving universal 7-valent pneumococcal conjugate vaccine and 23-valent polysaccharide vaccine since 2001. *BMC infectious diseases*. 2009;9(1):121.
- 42 Collins DA, Hoskins A, Snelling T, Senasinghe K, Bowman J, Stemberger NA, et al. Predictors of pneumococcal carriage and the effect of the 13-valent pneumococcal conjugate vaccination in the Western Australian Aboriginal population. *Pneumonia*. 2017 Dec 1;9(1):14.
- 43 Toms C, de Kluyver R. Invasive pneumococcal disease in Australia, 2011 and 2012. *Commun Dis Intell*. 2016;40(2):E267-84.
- 44 McHugh L, Binks M, Ware RS, Snelling T, Nelson S, Nelson J, et al. Birth outcomes in Aboriginal mother–infant pairs from the Northern Territory, Australia, who received 23-valent polysaccharide pneumococcal vaccination during pregnancy, 2006–2011: The PneuMum randomised controlled trial. *ANZ J Obstet Gynaecol*. 2020;60(1):82-7.
- 45 McHugh L, Binks M, Ware RS, Snelling T, Nelson S, Nelson J, et al. Birth outcomes in Aboriginal mother–infant pairs from the Northern Territory, Australia, who received 23-valent polysaccharide pneumococcal vaccination during pregnancy, 2006–2011: The PneuMum randomised controlled trial. *ANZ J Obstet Gynaecol*. 2020;60(1):82-7.
- 46 Daly KA, Giebink GS, Lindgren BR, Knox J, Haggerty BJ, Nordin J, et al. Maternal immunization with pneumococcal 9-valent conjugate vaccine and early infant otitis media. *Vaccine*. 2014;32(51):6948-55.
- 47 MacMorran E, Harch S, Athan E, Lane S, Tong S, Crawford L, et al. The rise of methicillin resistant *Staphylococcus aureus*: now the dominant cause of skin and soft tissue infection in Central Australia. *Epidemiol Infect*. 2017;145(13):2817-26.
- 48 Hare KM, Grimwood K, Chang AB, Chatfield MD, Valery PC, Leach AJ, et al. Nasopharyngeal carriage and macrolide resistance in Indigenous children with bronchiectasis randomized to long-term azithromycin or placebo. *Eur J Clin Microbiol Infect Dis*. 2015;34(11):2275-85.
- 49 Turnidge JD, Gottlieb T, Mitchell DH, Coombs GW, Daley DA, Bell JM. Community-onset Gram-negative Surveillance Program annual report, 2012. *Commun Dis Intell Q Rep*. 2014;38: E49-53.
- 50 van Hal SJ, Steinig EJ, Andersson P, Holden MT, Harris SR, Nimmo GR, et al. Global scale dissemination of ST93: a divergent *Staphylococcus aureus* epidemic lineage that has recently emerged from remote Northern Australia. *Front Microbiol*. 2018;9:1453.
- 51 Valery PC, Morris PS, Byrnes CA, Grimwood K, Torzillo PJ, Bauert PA, et al. Long-term azithromycin for Indigenous children with non-cystic-fibrosis bronchiectasis or chronic suppurative lung disease (Bronchiectasis Intervention Study): a multicentre, double-blind, randomised controlled trial. *Lancet Respir Med*. 2013;1(8):610-20.
- 52 Whiley DM, Trembizki E, Buckley C, Freeman K, Baird RW, Beaman M, et al. Molecular antimicrobial resistance surveillance for *Neisseria gonorrhoeae*, Northern Territory, Australia. *Emerg Infect Dis*. 2017;23(9):1478.
- 53 Lahra MM, Enriquez RP, George CR. Australian Gonococcal Surveillance Programme Annual Report, 2017. *Communicable Diseases Intelligence*. 2019;43. doi.org/10.33321/cdi.2019.43.13.
- 54 Lucy Davidson, Jessica Knight and Asha C Bowen *Med J Aust* 2020; 212 (5): 231-237. || doi: 10.5694/mja2.50361

- 55 World Health Organization [Internet]. Geneva: WHO; c2020; Social determinants of health. Available from https://www.who.int/social_determinants/sdh_definition/en/#:~:text=The%20social%20determinants%20of%20health,global%2C%20national%20and%20local%20levels.
- 56 Westphal DW, Lehmann D, Williams SA, Richmond PC, Lannigan FJ, Fathima P, et al. Australian Aboriginal children have higher hospitalization rates for otitis media but lower surgical procedures than non-Aboriginal children: A record linkage population-based cohort study. *PLoS one*. 2019;14(4):e0215483.
- 57 Flinders Health and Medical Research Institute. Social determinants of Indigenous health and Closing the Gap, policy brief. South Australia: Southgate Institute for Health, Society and Equity; 2019.
- 58 Nepal S, Thomas SL, Franklin RC, Taylor KA, Massey PD. Systematic literature review to identify methods for treating and preventing bacterial skin infections in Indigenous children. *Australasian J Dermatol*. 2018;59(3):194-200.
- 59 Pharmaceutical Benefits Scheme [Internet]. Canberra: PBS; nd. The Closing the Gap – PBS co-payment measure [updated 2020 Jan 13]. Available from <https://www.pbs.gov.au/info/publication/factsheets/closing-the-gap-pbs-co-payment-measure>.
- 60 Ali SH, Foster T, Hall NL. The relationship between infectious diseases and housing maintenance in Indigenous Australian households. *International Journal of Environmental Research and Public Health*. 2018;15(12):2827.
- 61 New South Wales Department of Health. Closing the gap: 10 years of Housing for Health in NSW: an evaluation of a healthy housing intervention. St Leonards NSW: Aboriginal Environmental Health Unit, NSW Health; 2010.
- 62 Bailie RS, McDonald EL, Stevens M, Guthridge S, Brewster DR. Evaluation of an Australian indigenous housing programme: community level impact on crowding, infrastructure function and hygiene. *J Epidemiol Community Health*. 2011;65(5):432-7.
- 63 Flinders Health and Medical Research Institute. Social determinants of Indigenous health and Closing the Gap, policy brief. South Australia: Southgate Institute for Health, Society and Equity; 2019.
- 64 McDonald EL, Bailie RS and Morris PS. Participatory systems approach to health improvement in Australian Aboriginal children. *Health Promotion International* 2017; 32: 62–72.
- 65 Ware V. Housing strategies that improve Indigenous health outcomes. Canberra: Australian Institute of Health and Welfare; 2013.
- 66 Kendall E, Barnett L. Principles for the development of Aboriginal health interventions: Culturally appropriate methods through systemic empathy. *Ethnic Health*. 2015;20(5):437–452.
- 67 Oliver SJ, Cush J, Ward JE. Community-based prescribing for impetigo in remote Australia: an opportunity for antimicrobial stewardship. *Front Pub Health*. 2017;5:158.
- 68 Bowen AC, Tong SY, Andrews RM, O'Meara IM, McDonald MI, Chatfield MD, et al. Short-course oral co-trimoxazole versus intramuscular benzathine benzylpenicillin for impetigo in a highly endemic region: an open-label, randomised, controlled, non-inferiority trial. *Lancet*. 2014;384(9960):2132–40. doi:10.1016/S0140-6736(14)60841-2.
- 69 Wyber R, Boyd BJ, Colquhoun S, Currie BJ, Engel M, Kado J, et al. Preliminary consultation on preferred product characteristics of benzathine penicillin G for secondary prophylaxis of rheumatic fever. *Drug Deliv Transl Res*. 2016;6(5):572-8.
- 70 Vallesi S, Wood L, Dimer L, Zada M. “In their own voice”—incorporating underlying social determinants into aboriginal health promotion programs. *International Journal of Environmental Research and Public Health*. 2018;15(7):1514.
- 71 Bainbridge R, McCalman J, Clifford A, Tsey K. Cultural competency in the delivery of health services for Indigenous people. Issues paper no. 13. Closing the Gap Clearinghouse; 2015.
- 72 Australian Indigenous Doctors' Association. Position paper: Cultural safety for Aboriginal And Torres Strait Islander doctors, medical students and patients. Canberra: Australian Indigenous Doctors' Association; 2017.
- 73 Australian Commission on Safety and Quality in Health Care. User guide for Aboriginal and Torres Strait Islander health: National Safety and Quality Health Service Standards. Sydney: ACSQHC; 2016.
- 74 Australian Commission on Safety and Quality in Health Care. National Safety and Quality Health Service Standards. Second edition. Sydney: ACSQHC; 2017.
- 75 Patel B. Communicating across cultures: proceedings of a workshop to assess health literacy and cross-cultural communication

-
- skills. *Journal of Pharmacy Practice and Research* 2015;45:49-56.
- 76 Warwick S, Atkinson D, Kitaura T, LeLievre M, Marley JV. Young Aboriginal people's perspective on access to health care in remote Australia: hearing their voices. *Progress in Community Health Partnerships: Research, Education, and Action*. 2019;13(2):171-81. doi:10.1353/cpr.2019.0017.
- 77 Australian Institute of Health and Welfare. Aboriginal and Torres Strait Islander health organisations: online services report — key results 2017–18 [Internet]. Canberra: AIHW; 2019. Available from <https://www.aihw.gov.au/reports/indigenous-australians/atsi-health-organisation-osr-key-results-2017-18>.
- 78 Harfield SG, Davy C, McArthur A, Munn Z, Brown A, Brown N. Characteristics of Indigenous primary health care service delivery models: a systematic scoping review. *Global Health*. 2018;14(1):12.
- 79 Reeve C, Humphreys J, Wakerman J, Carter M, Carroll V, Reeve D. Strengthening primary health care: achieving health gains in a remote region of Australia. *MJA*. 2015;202(9):483-7.
- 80 Aboriginal and Torres Strait Islander Health Practice Board, Ahpra [Internet]. Canberra; ATSIHPA [updated 2020 Sep 18]. Available from <https://www.atsihealthpracticeboard.gov.au/>.
- 81 National Aboriginal and Torres Strait Islander Health Worker Association. The Aboriginal and Torres Strait Islander health worker professional practice framework. Phillip, ACT: NATSIHWA; 2012. Available from <https://www.natsihwa.org.au/aboriginal-and-torres-strait-islander-health-worker-professional-practice-framework>.
- 82 Swain L, Barclay L. Medication reviews are useful, but the model needs to be changed: perspectives of Aboriginal Health Service health professionals on Home Medicines Reviews. *BMC Health Serv Res*. 2015;15(1):366.
- 83 Pennington KR, Clark KD, Knight S. A bitter pill to swallow: registered nurses and medicines regulation in remote Australia. *Rural and Remote Health* 2020; 20: 6020.
- 84 Australian Commission on Safety and Quality in Health Care. Antimicrobial stewardship in Australian Health Care: Sydney: ACSQHC; 2018.
- 85 Australian Government Department of Health [Internet]. Canberra: Department of Health; 2020. Primary Health Networks [last updated 2020 Jan 12]. Available from <https://www1.health.gov.au/internet/main/publishing.nsf/Content/PHN-Home>.
- 86 Therapeutic Guidelines. Therapeutic guidelines: antibiotic, version 16. Melbourne: eTG; 2019.
- 87 Queensland Health. Primary Clinical Care Manual 10th edition. Cairns: Rural and Remote Clinical Support Unit, Torres and Cape Hospital and Health Service; 2019.
- 88 Central Australian Rural Practitioners Association (CARPA) Standard Treatment Manual, 7th edition. Alice Springs, NT: Centre for Remote Health; 2017.
- 89 Australian Commission on Safety and Quality in Health Care [Internet]. Sydney. ACSQHC; c2019. About Aura. Available from <https://www.safetyandquality.gov.au/our-work/antimicrobial-resistance/antimicrobial-use-and-resistance-australia-surveillance-system-aura/about-aura>.
- 90 McCallum GB, Morris PS, Chang AB. Antibiotics for persistent cough or wheeze following acute bronchiolitis in children. *Cochrane Database Syst Rev* 2012;12:CD009834.
- 91 Cuningham W, Anderson L, Bowen AC, et al. Antimicrobial stewardship in remote primary healthcare across northern Australia. *PeerJ*. 2020;8:e9409. Published 2020 Jul 22. doi:10.7717/peerj.9409