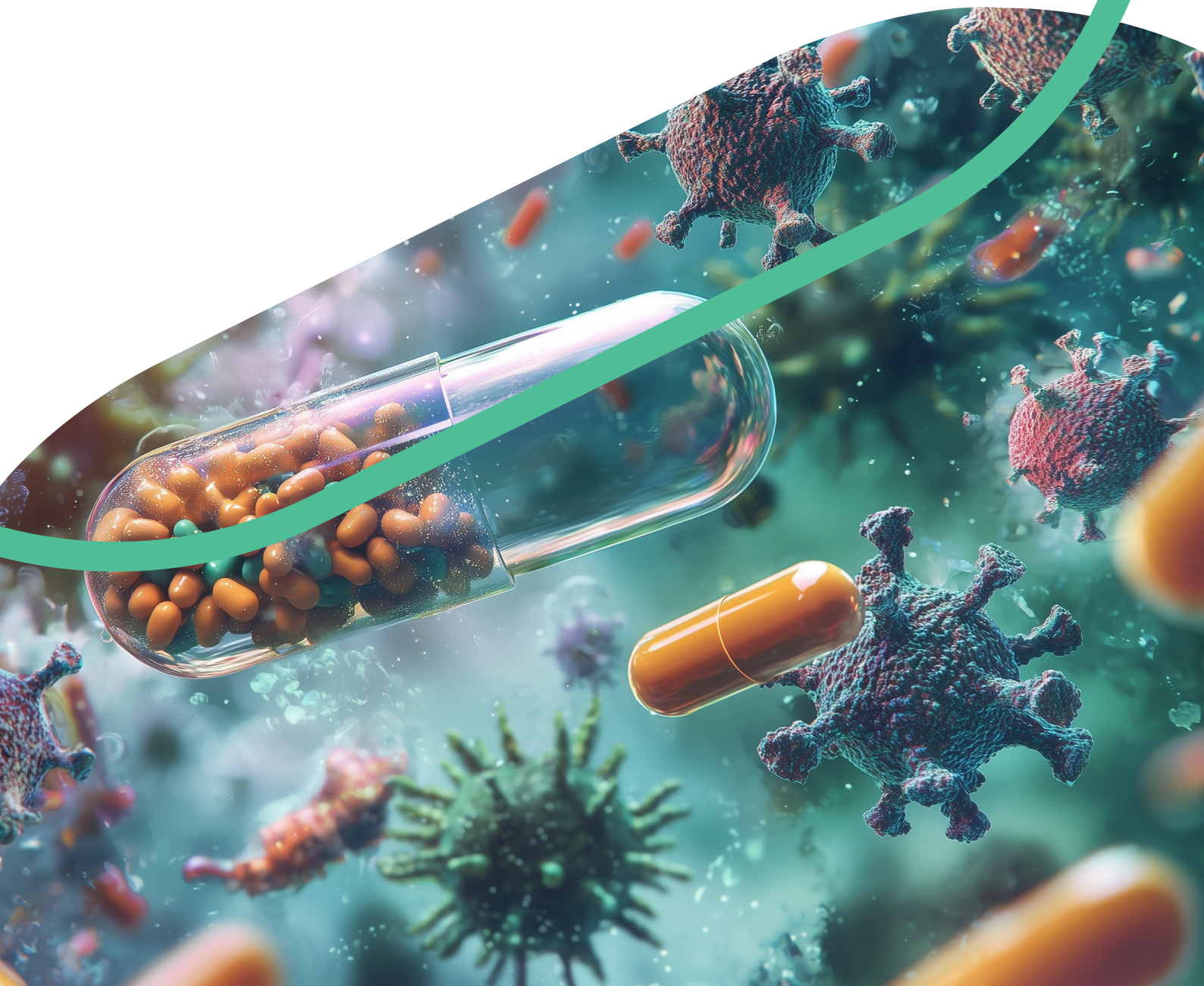
Australian Centre for Disease Control

AURA REPORT

Sixth Australian report on antimicrobial use and resistance in human health



Title: AURA REPORT: Sixth Australian report on antimicrobial use and resistance in human health

ISBN: 978-1-74186-092-4

Enquiries

Enquiries regarding any other use of this publication should be addressed to the Communication and Public Information Section, Strategy and Engagement Branch, Australian Centre for Disease Control, GPO Box 798, Canberra ACT 2601, or via e-mail to CDCComms@cdc.gov.au.

Table of Contents

List of figures

List of tables

Acknowledgements

On behalf of the Australian Centre for Disease Control, we thank all contributing Antimicrobial Use and Resistance in Australia (AURA) program partners and other contributors for their collaboration in collecting, analysing and contributing data for the AURA surveillance program and to this report. We recognise and appreciate their efforts, expertise and continued commitment to improving patient safety and addressing antimicrobial resistance (AMR) across the Australian healthcare system.

Appendix 3 presents a list of organisations and individuals who have contributed to this report.

Summary

Antimicrobial resistance (AMR) is one of the most urgent public health threats facing Australia and the world. It undermines our ability to treat infections, making routine care riskier and less effective. Continued action is needed to preserve the effectiveness of antimicrobials — a foundation of modern health care.

Antimicrobials are medicines that kill or inhibit the growth of microorganisms, which include bacteria, fungi, viruses and parasites. AMR occurs when microorganisms adapt to survive antimicrobial treatments, so that these medicines become ineffective and no longer work. This means infections caused by these microorganisms can stay in the body longer, as they are difficult or impossible to treat, and can be passed more easily to other people. These are also known as 'drug-resistant' infections.

The use of antimicrobials is accelerating the pace at which resistance is developing. AMR spreads more easily when antimicrobials are used too much or not as intended in people, animals and farming. Poor hygiene and sanitation, and ineffective infection prevention and control can also contribute to the rise in AMR.

To help prevent AMR and ensure effective antimicrobials remain available in the future, antimicrobials must be used appropriately. This means that the correct antimicrobial is prescribed for an infection, and it is administered at the correct dose and for the correct length of time.

While all microorganisms can develop resistance, bacterial resistance to antibiotics poses the most urgent global public health challenge. Fungal resistance to antifungals is also emerging as a serious public health concern.

Impact of antimicrobial resistance

AMR is present in all countries worldwide. Projections estimate that by 2050, deaths where AMR plays a role may reach 8.22 million, with 1.91 million deaths directly attributable to AMR. In 2021, there were 4.71 million deaths associated with antibiotic-resistant infections globally, and 1.14 million of these were directly caused by bacterial resistance [1].

Without effective antimicrobials:

- common infections and minor injuries can become life-threatening
- routine surgeries and medical procedures — such as caesarean sections, eye surgeries, cancer care and knee replacements — may become too risky to perform safely
- healthcare-associated infections, which are acquired while receiving medical care, such as during a hospital stay, could increase, endangering patients and spreading these infections from hospitals to the community
- infections in animals and plants could become harder to treat, affecting animal welfare, food supply and nutrition.

Antimicrobial use and resistance in human health report

National surveillance of antimicrobial use (AU) and AMR is essential to support Australia's efforts to prevent and contain AMR and ensure the availability of effective antimicrobials. The Australian Government has developed and invested in longstanding and established surveillance systems for AU and AMR in human health. These are brought together under the umbrella of the Antimicrobial Use and Resistance in Australia (AURA) surveillance program.

The AURA surveillance program collects and analyses data on AU and AMR across Australian public and private hospitals, and the community, which includes frontline health services (e.g. general practice and community health services) and aged care.

AU data are used by antimicrobial stewardship (AMS) programs, which include organised efforts in health service organisations and the community to make sure that antimicrobials are used appropriately.

AMR data are used to monitor resistance patterns in Australia, inform treatment guidelines and measure the success of efforts to reduce resistance.

Biennial national Australian reports on AU and resistance in human health have provided comprehensive surveillance data and trend analysis for several years. These reports offer comprehensive and consolidated sources of information on AU and resistance patterns in Australia.

This *Sixth Australian report on antimicrobial use and resistance in human health* is a compilation of data gathered by the AURA systems between 2022 and 2024. This report provides a snapshot of information from hospitals, aged care facilities, and the community. It also includes examples that demonstrate the use of surveillance data in safeguarding public health in Australia.

This report serves to emphasise that mitigating AMR requires a collective effort. Healthcare professionals and the public play a crucial role in ensuring the responsible use of antimicrobials. Continuous action is necessary to safeguard the future health and wellbeing of Australians.

Key findings: antimicrobial use and appropriateness

Hospitals

- A combined analysis of usage and appropriateness data shows that participating hospitals are complying with guidelines on restricting the use of last-resort type of antimicrobials with a usage rate of 6.7 defined daily dose (DDD)/1,000 occupied bed days (OBD) and a rate 88.1% of appropriate prescribing.
- There is opportunity to improve antimicrobial prescribing in hospitals, especially for those antimicrobials used as first or second option treatment. Antibiotics in these groups are prescribed correctly about 72% and 73% of the time, respectively.
- Prescriber practices varied for antimicrobial classes: narrow-spectrum penicillins had lower usage (25.5 and 69.7 DDD/1,000 OBD) and higher appropriateness (83.5% and 84.2%), while broad-spectrum penicillins showed higher use (57.0 and 136.5 DDD/1,000 OBD) and lower appropriateness (78.8% and 67.2%).
- In the case of cephalosporins, use of narrow-spectrum antimicrobials was higher (119.6 DDD/1,000 OBD) than broad-spectrum antimicrobials (58.6 DDD/1,000 OBD); however, appropriateness rates were similar for both classes (64.3% and 69.7%).

Surgeries in hospitals

- Although the overall appropriateness of antimicrobial prescribing for surgical procedures increased from 55.3% in 2022 to 57.3% in 2023, the rates remain low.
- Of all antimicrobials given during surgeries, 61.5% were deemed appropriate; by contrast, only 45.0% of those prescribed postoperatively met appropriateness criteria.
- Inappropriate prescribing exceeding 80% was identified for 2 of the most frequently used antimicrobials for post-procedural prophylactic antibiotics, cefalexin and amoxicillin–clavulanic acid.

Antifungals in hospitals

- Antifungal prescriptions were classified as appropriate in 77.1% of audits, with prophylactic prescriptions showing the highest appropriateness rate at 85.1%.These data are available following the establishment of the Antifungal National Prescribing Survey in 2023.
- Fluconazole was the most prescribed antifungal in acute hospital settings in 2022 (49.9%) and 2023 (50.5%).

Community

- The supply of antimicrobials under the Pharmaceutical Benefits Scheme and Repatriation Pharmaceutical Benefits Scheme has increased slowly since 2022, but remains below the volume dispensed in 2015.
- In 2024, 23.2 million antimicrobial prescriptions were supplied under the PBS and RPBS, representing a 4.8% increase from 2023, but still 13% lower than in 2019 and 20.8% lower than in 2015.
- The 4 most frequently dispensed antimicrobials in the community in 2024 were: amoxicillin (22.0%), cefalexin (21.7%), amoxicillin–clavulanic acid (14.6%) and doxycycline (11.5%), accounting for 69.8% of all prescriptions.

Residential aged care homes

- In 2024, 659,767 antimicrobial prescriptions were dispensed to aged care home residents, an increase of 14.4% since 2023.
- Older Australians living in aged care homes received more than double the number of prescriptions of antibiotics under the PBS (3.1 average annual prescriptions) compared to their peers living at home (1.48 average annual prescriptions) in 2024.
- While 11.9% of residents of aged care homes participating in the Aged Care Antimicrobial Prescribing Survey were prescribed an antimicrobial, only 3.6% showed signs or symptoms of a suspected infection.
- In aged care homes, 34.7% of antimicrobials prescribed to residents were used for prolonged periods (over 6 months), suggesting a lack of regular medication review and reassessment.

Key findings: antimicrobial resistance

Reports of critical antimicrobial resistances increased by 25.2% between 2023 (n=2,706) and 2024 (n=3,389).

Carbapenemase-producing *Enterobacterales* was the most frequently reported critical antimicrobial resistance (45.1%) in 2024.

Reports of *Enterococcus* resistance to linezolid increased from 17 in 2022 to 51 in 2023, and to 118 in 2024.

Between 2022 and 2024, *Shigella* species with resistance to third-generation cephalosporin antibiotics rose from 13% to 40%, and resistance to fluoroquinolone antibiotics rose from 20% to 46%.

From 2023 to 2024, there was a slight increase in the number of reports of carbapenemase-producing *Pseudomonas aeruginosa* and carbapenemase-producing *Acinetobacter baumannii* complex.

In 2024, high-level resistance to azithromycin was identified in 46 isolates of *Neisseria gonorrhoeae*, the highest number ever reported by the Australian Gonococcal Surveillance Programme. This number rose from 27 isolates in 2023.

The proportion of methicillin-resistant *Staphylococcus aureus* remained stable at 17.1% in 2024 and 17.2% in 2023; however, rates varied greatly across Australia and increased with remoteness from major cities.

In 2023, 15.9% of *Enterobacterales* infections in children with bloodstream infections were resistant to third-generation cephalosporin antibiotics, the highest proportion ever recorded by the Australian Group on Antimicrobial Resistance in 11 years of surveillance.

Multidrug-resistant bacteria were present in 12.2% (n=222) of bloodstream infections in children.

Insights and implications

Within hospital settings and the wider community, prescribing practices vary; some areas demonstrate robust adherence to clinical guidelines, while others indicate a need for considerable improvement. A focus on appropriateness, not just volume, of prescribing is key to driving improvements needed.

The continued emergence and spread of AMR threats within Australia place pressure on the health system and highlight the need for continued surveillance.

The key findings in this report highlight the need for strengthening AMS practices, improved prescribing practices, enhanced infection prevention measures, and increased public awareness of AMR. Addressing these challenges requires a coordinated effort across healthcare settings, government agencies and the public.

Chapter 1: Introduction

Antimicrobial resistance in Australia

Australia's healthcare system is among the best in the world, but antimicrobial resistance (AMR) threatens its foundation: the ability to provide safe, effective and high-quality care.

AMR can impact individuals of all ages, from newborns to older adults. It spreads across borders, facilitated by global travel. AMR can be transmitted among members of the community, people in hospitals and in aged care homes, and between these settings.

AMR is not a distant threat — it is already happening. A recent Australian study directly attributed 1,031 Australian deaths to five resistant bacterial infections in 2020 alone [2].

Australia's response to antimicrobial resistance

Multiple drivers impact the development and spread of AMR. These include human, animal and agricultural overuse and misuse of antimicrobials, inadequate health services infrastructure, gaps in infection prevention and control, poor sanitation and hygiene, and environmental contamination [3].

Curbing the rise of AMR requires a 'One Health' approach, meaning coordinated action across agriculture, animal health, the environment, food and human health sectors.

In 2020, the Australian Government released Australia's second strategy on AMR, *Australia's National AMR Strategy — 2020 and Beyond* [4]. It presented a 20-year vision that broadened the focus of Australia's first strategy in 2015 to include all antimicrobials across the One Health sectors.

Australia joined other world leaders at the 79th United Nations General Assembly **High-Level Meeting on AMR** and adopted the Political Declaration [5].

The Antimicrobial Use and Resistance in Australia (AURA) surveillance program is Australia's nationally coordinated system for monitoring antimicrobial use (AU) and AMR in human health. This program is funded by the Australian Government through the Australian Centre for Disease Control.

AURA surveillance program overview

Effective surveillance and monitoring of Australia's antimicrobial usage and resistance are essential to understand the burden of AMR and to inform response strategies.

The AURA surveillance program aims to provide high-quality evidence to support strategies to stop the development and spread of AMR. It uses a combination of passive and targeted surveillance to identify trends in AU and AMR:

- **passive surveillance data** are data already collected for other reasons, such as hospitals recording antibiotics that are dispensed for billing or stock control
- **targeted surveillance data** are data collected specifically for AMR monitoring, such as collecting laboratory samples specifically to identify resistant infections.

Sixth Australian report on antimicrobial use and resistance in human health

The *Sixth Australian report on antimicrobial use and resistance in human health* builds on the previous Australian reports, which were produced by the Australian Commission on Safety and Quality in Health Care. This report was prepared by the Australian Centre for Disease Control (CDC).

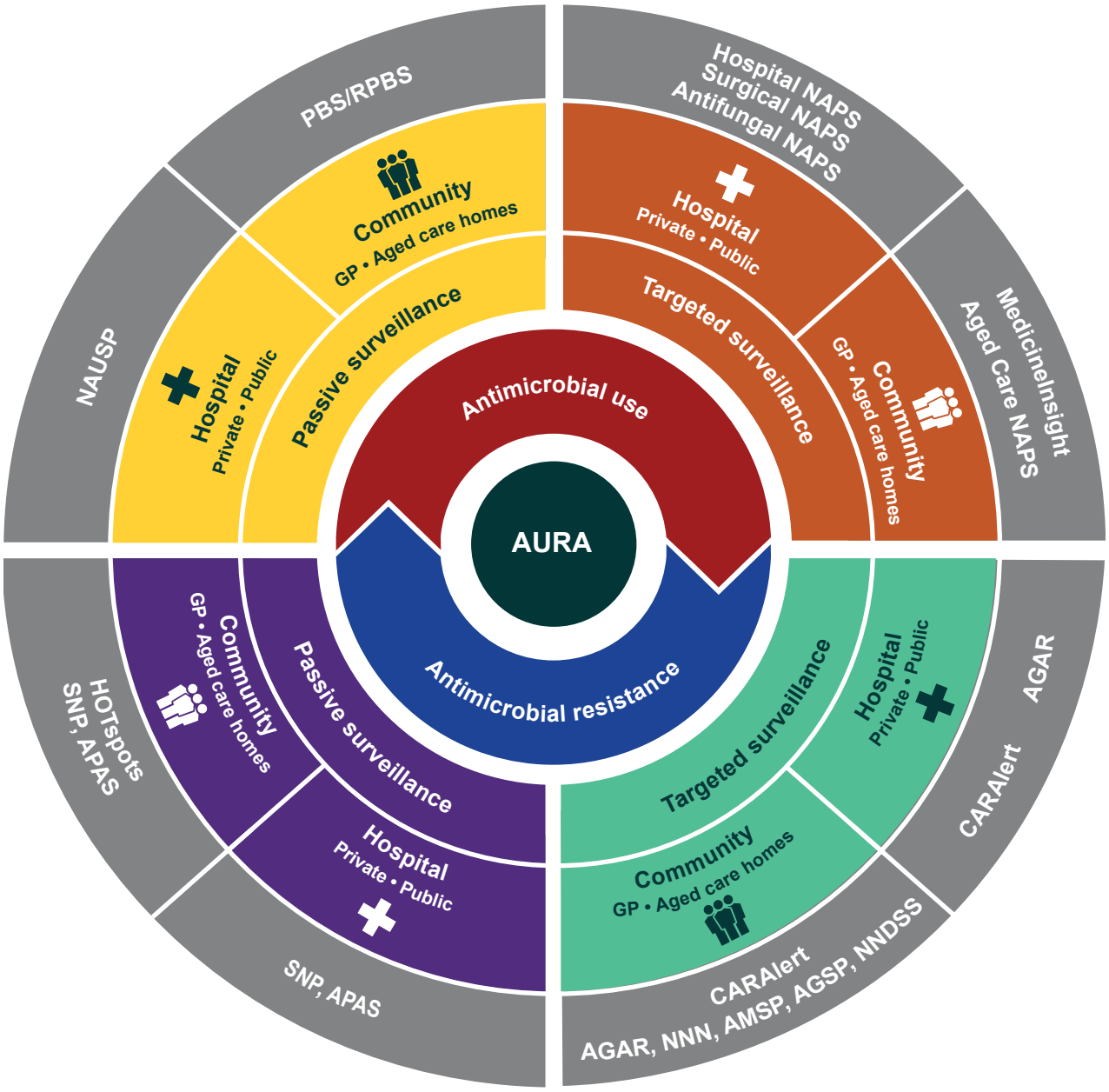
This report reflects the collaborative work of the CDC, teams from AURA program partners and additional contributors to present AURA surveillance data in a concise and accessible format suitable for diverse audiences. It provides evidence to guide clinical practice, public health strategies and future research directions, and raises awareness of the critical issue of AMR.

AURA program partners

AURA programs collect data from hospitals, laboratories and the community, which includes frontline health services (e.g. general practice and community health services) and residential aged care homes.

Figure 1.1 illustrates the components of AURA. **Appendix 1** provides further details on the surveillance types, settings and coverage of AURA data sources.

Figure 1.1: Components of the AURA surveillance program, including program partners and other potential contributors



Abbreviations: AGAR=Australian Group on Antimicrobial Resistance; AMSP=Australian Meningococcal Surveillance Programme; AGSP=Australian Gonococcal Surveillance Programme. APAS=Australian Passive Antimicrobial Resistance Surveillance; CARAlert=National Alert System for Critical Antimicrobial Resistances; HOTspots=HOTspots surveillance and response program; NAPS=National Antimicrobial Prescribing Survey; NAUSP=National Antimicrobial Utilisation Surveillance Program; NNDSS=National Notifiable Diseases Surveillance System; NNN=National Neisseria Network; PBS=Pharmaceutical Benefits Scheme; RPBS=Repatriation Pharmaceutical Benefits Scheme; SNP=Sullivan Nicolaides Pathology
Note: While AURA program partners and other historical and potential data sources are indicated in the outer circle, not all have contributed data to this report.

AURA monitors AU and appropriateness of prescribing based on data collected by 4 programs: the National Antimicrobial Prescribing Survey (NAPS), the National Antimicrobial Utilisation Surveillance Program (NAUSP), the Pharmaceutical Benefits Scheme (PBS) and the Repatriation Pharmaceutical Benefits Scheme (RPBS). Chapter 2 provides detailed descriptions of these programs and presents highlights from the data on AU and prescribing appropriateness.

AURA also monitors the proportions of resistance for priority microorganisms and trends over time through targeted and passive surveillance. AMR data is collected through 6 key sources: Australian Group on Antimicrobial Resistance (AGAR), Australian Passive AMR Surveillance (APAS), National Alert System for Critical Antimicrobial Resistances (CARAlert), HOTspots surveillance and response program, National Neisseria Network (NNN) and National Notifiable Diseases Surveillance System (NNDSS). Descriptions and highlights of the AMR data sources are presented in Chapter 3.

Australian Centre for Disease Control

This report was prepared by the Australian CDC. On 1 January 2026, the Australian Government launched the CDC. The CDC was established to strengthen Australia's capacity to prevent, detect and respond to public health threats.

The CDC serves as a central source of public health leadership and expertise, supporting national coordination, surveillance and emergency response. It plays a vital role in improving national preparedness and protecting Australians from future health threats. The creation of the Australian CDC marks a transformative shift in Australia's public health landscape.

AURA contributes to the CDC's broader public health surveillance activities by enabling evidence-based responses to AMR.

Embedding AURA as a foundational program within the CDC will support Australia's efforts to contain AMR, improve AU and protect the health of future generations.

Key AMR-related initiatives led by the CDC include:

- supporting the implementation of ***Australia's National AMR Strategy — 2020 and Beyond*** [4]
- coordinating and funding AURA surveillance programs
- supporting a One Health approach
- exploring options for One Health AMR and AU surveillance.

Read more about the **Australian CDC**.

How to prevent the spread of antimicrobial resistance

While it is not possible to entirely eliminate the risk of infection from an AMR microorganism, there are proven ways to reduce the risk of getting or spreading these infections.

For community members

	**Clean hands**	wash hands with soap and water after coughing or sneezing, before and after preparing food, before eating and after using the bathroom.
	**Healthy skin**	keep cuts and broken skin clean and covered until healed, and manage chronic conditions, such as diabetes and heart disease.
	**Vaccinations**	get vaccinated to prevent infections and reduce the need for antibiotics.
	**Use antimicrobials appropriately**	take antimicrobials only as directed for the correct dose, time and reason. Do not dispose of medicine in the trash or toilet. Return unwanted medicine to the pharmacy for safe disposal.
	**Seek diagnosis and treatment**	practice prevention if unwell, and get screened and treated to prevent infections from spreading to others.
	**Safer sex**	use protection (e.g. condoms) during sex to stop the spread of sexually transmitted infections.
	**Food safety**	make sure that food and water consumed abroad is clean and safe, to minimise the risk of illness and carrying infections.

For healthcare professionals

	**Antibiotic alternatives**	consider safe alternatives to immediate antibiotic prescriptions and for symptom management.
	**Talk with patients**	explain the importance of appropriate AU, the dangers of AMR and the role patients can play in preventing infections and their spread.
	**Infection prevention and control**	use standard and transmission-based precautions (e.g. hand hygiene, personal protective equipment and environmental cleaning) and vaccination to reduce the spread of infections between patients, staff and facilities.
	**Track and improve appropriate AU**	participate in surveillance programs, and use surveillance data and clinical guidelines to guide appropriate antimicrobial prescribing and stewardship interventions.

Chapter 2: Antimicrobial use and appropriateness of prescribing

Using antimicrobials appropriately is essential for good patient care and is one of the most important ways to slow the development and spread of antimicrobial resistance (AMR).

To understand antimicrobial use (AU) in Australia, the Antimicrobial Use and Resistance in Australia (AURA) surveillance program collects data on the level of antimicrobial usage and the appropriateness of prescribing (using the correct antimicrobial for the infection, at the correct dose and for the correct length of time).

Surveillance of AU helps track trends, identify areas for improvement and guide action. The more antimicrobials are used — especially when they are not needed — the more likely it is that resistance develops.

The terms antimicrobial, antibiotic and antibacterial are often used interchangeably, but have distinct meanings that are important to understand.

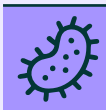
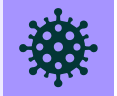
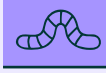
Antimicrobials vs antibiotics: an explainer (see Appendix 2)

Antimicrobials are medications that treat infections caused by a range of microorganisms, such as bacteria, viruses, fungi and parasites. Antimicrobials include antibiotics, antivirals, antifungals and antiparasitic medicines.

AMR arises when microorganisms adapt to survive antimicrobial treatments, which are also known as 'drug-resistant infections'.

Antibiotics and antibacterials have the same meaning and refer to medications that target bacteria. Antibiotics are the most widely known type of antimicrobial.

Types of antimicrobials

	**Antibiotics** treat infections caused by bacteria e.g. urinary tract infection
	**Antivirals** treat infections caused by viruses e.g. Coronavirus disease 2019 (COVID-19)
	**Antifungals** treat infections caused by fungi e.g. thrush
	**Antiparasitics** treat infections caused by parasites e.g. malaria

Using antibiotics safely and effectively

Healthcare professionals prescribe antibiotics when the benefits of treatment outweigh the risks. While antibiotics target infection, usually in a specific area of the body, they can also disrupt the delicate balance of beneficial microorganisms that live in the gut and other places. This can lead to an overgrowth of harmful bacteria and cause side effects, such as diarrhoea.

To ensure antibiotics work safely and effectively, they must be taken as prescribed — used according to the instructions, at the correct dose and for the intended length of treatment.

Measuring antimicrobial use

Combining data on consumption and appropriateness provides a clearer picture of how antimicrobials are used and identifies areas that need improvement. It also allows the assessment of the impact of antimicrobial stewardship (AMS) programs.

Consumption and appropriateness

Consumption refers to the volume (amount) of antimicrobials prescribed. Monitoring antibiotic consumption helps track usage patterns, prescription numbers and utilisation. This information can be used for developing guidelines and planning or assessing efforts to improve AU and control resistance. Consumption data also allow comparison of usage across different settings, such as hospitals, regions or countries.

However, consumption alone does not provide the full picture. It does not reveal whether prescribing is appropriate.

Monitoring appropriateness goes beyond measuring the volume of antimicrobials used; it evaluates whether the right drug, dose, route and duration were prescribed for the right indication, based on clinical guidelines and patient-specific factors. This is a core component of AMS programs, which work to ensure optimal therapies are used and reduce resistance.

Appropriateness assesses whether antimicrobials are prescribed correctly by looking at:

- whether the right treatment was chosen for the infection (e.g. using antibiotics for a bacterial infection and not a viral infection)
- whether the dosage and duration were correct (e.g. not too much, too little or too long).

Appropriateness offers a more patient-centred view of prescribing and shows whether clinical decisions align with guidelines and local resistance patterns. Inappropriate use of antimicrobials promotes the development of AMR and can lead to patient harm or unwanted side effects.

Antimicrobial stewardship programs

AMS programs are organised efforts in hospitals, aged care and the community to ensure that antimicrobials are used appropriately. They support antimicrobial prescribing by healthcare professionals by giving prescribers access to clinical guidelines, prescription reviews and feedback, and microbiology services to diagnose infection.

In hospitals, AMS programs are part of clinical governance (systems to ensure safe and high-quality care). The effectiveness of AMS programs is demonstrated by decreased treatment failures, fewer adverse drug reactions and secondary infections, reduced unnecessary or inappropriate AU, and overall declines in the emergence and spread of AMR.

Key quality indicators

Evaluating the effectiveness of AMS programs requires meaningful and measurable outcome measures. To ensure antimicrobials are used appropriately, key prescribing details should be documented:

- **indication:** the reason why an antimicrobial was prescribed
- **review or stop date:** when treatment should be reassessed or stopped.

These indicators support timely review of treatment, reduce unnecessary AU and help improve patient care.

Antimicrobial use in hospitals

Australia tracks how antimicrobials are used in hospitals through 2 national surveillance programs, the National Antimicrobial Utilisation Surveillance Program (NAUSP) and the National Antimicrobial Prescribing Survey (NAPS).

National Antimicrobial Utilisation Surveillance Program

The NAUSP was established in 2004; it monitors AU in adults admitted to public and private hospitals. NAUSP collects hospital pharmacy dispensing data continuously and reports trends nationally and by state twice a year. Participating hospitals can review their antimicrobial prescribing trends through regular reports.

NAUSP monitors and reports on the volume of antimicrobials used across more than 300 Australian hospitals and healthcare facilities that participate voluntarily in the program. Data are expressed as standardised rates to enable comparison of usage.

NAUSP is coordinated by South Australia Health. Details of the NAUSP methodology and reports can be found at **NAUSP**.

National Antimicrobial Prescribing Survey

The NAPS was established in 2013; it collects data on prescribing appropriateness. NAPS consists of 4 distinct auditing modules: Hospital NAPS, Surgical NAPS, Antifungal NAPS and Aged Care NAPS. Annually, over 450 hospitals and over 900 residential aged care homes contribute to the program.

The Hospital NAPS provides snapshots of which antimicrobials are prescribed and how appropriate they are using a point prevalence methodology. Surgical NAPS and Antifungal NAPS have a more flexible methodology and can be used as period prevalence audits to investigate specific areas of prescribing, as they follow a patient's journey. Aged Care NAPS provides a view of antimicrobial prescribing practices in aged care homes. These insights support local and national AMS efforts.

The NAPS program is coordinated by the Royal Melbourne Hospital Guidance Group and the National Centre for Antimicrobial Stewardship (NCAS). Details on the NAPS methodology can be found in the **National Antimicrobial Prescribing Survey 2023: technical supplement** [6]. The series of annual NAPS reports can be found at **NAPS**.

Combined consumption and appropriateness analysis

This report presents a combined analysis of antimicrobial volume and appropriateness from a group of hospitals participating in both NAUSP and Hospital NAPS for the first time. This analysis provides a clearer view of antimicrobial prescribing practices in Australia.

While both the NAUSP and NAPS are longstanding national surveillance programs, combining their data for measuring consumption and appropriateness is challenging, as they use different data sources and methodologies. NAUSP captures monthly dispensing data from hospital pharmacies, while Hospital NAPS uses prescription data on a single survey day and has been used to estimate annual prescribing in 2023.

For the hospitals that participated in both programs, NAUSP data were extracted from the NAUSP database in June 2025 and analysed using defined daily doses (DDDs) per 1,000 occupied bed days (OBDs). Hospital NAPS data were analysed at the prescription level for appropriateness. Patterns of AU and appropriateness were analysed according to the World Health Organization (WHO) AWaRe classification as described in the next section.

A total of 192 hospitals (147 public and 45 private) contributed data to both programs, resulting in 21,017 antimicrobial prescriptions from the Hospital NAPS dataset and antimicrobial usage representing 12 million OBDs from the NAUSP dataset.

Figure 2.1 illustrates a comparison between antibiotic usage rates and the appropriateness of prescribing in a cohort of Australian hospitals participating in both NAUSP and Hospital NAPS in 2023. The combined analysis of 2023 NAUSP and Hospital NAPS data provides valuable insights into prescribing patterns in Australian hospitals and areas for improvement.

World Health Organization AWaRe classification: a tool for measuring antibiotic use

The AWaRe classification of antibiotics was developed in 2017 by the WHO Expert Committee on the Selection and Use of Essential Medicines [7]. AWaRe antibiotics are classified into 3 groups based on the impact of their use on AMR. The classifications are updated every 2 years.

ACCESS group: antibiotics that are effective against a range of common bacteria and have a lower risk of promoting resistance. These are usually recommended as first-line treatments e.g. flucloxacillin, doxycycline, nitrofurantoin and cefazolin.

WATCH group: antibiotics with a higher potential to cause resistance and should only be used for specific, limited conditions with careful monitoring e.g. azithromycin, ceftriaxone, ciprofloxacin, piperacillin–tazobactam and vancomycin.

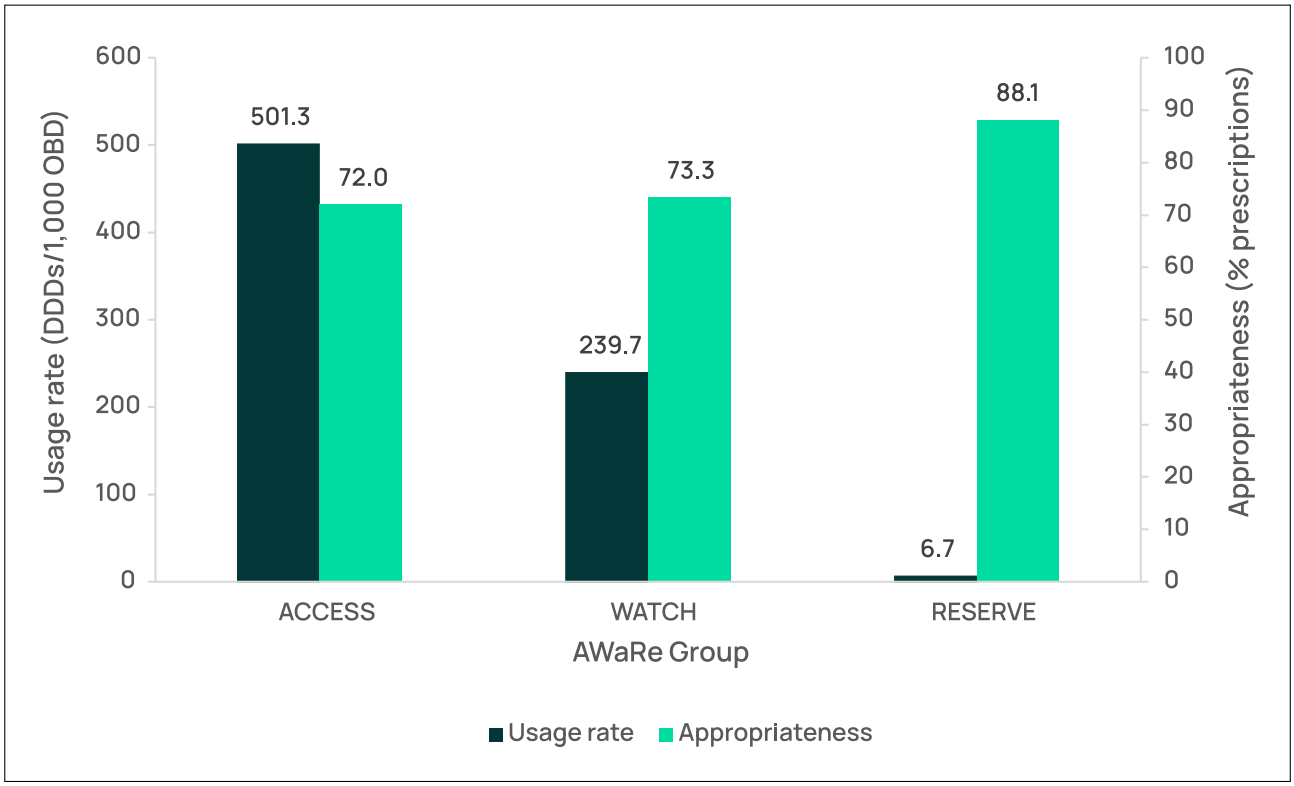
RESERVE group: last-line antibiotics (used when the commonly used antibiotics fail to treat an infection due to antibiotic resistance) that are used to treat infections caused by microorganisms with at least one or more type of AMR. Their use should be highly restricted and closely monitored e.g. meropenem and linezolid.

Key findings

AWaRe group in select Australian hospitals

- ACCESS was the most used group of antibiotics. Despite being lower risk for resistance, their high usage rate and moderate appropriateness rates suggest that overuse and misuse still occur.
- WATCH group antibiotics were used less often than ACCESS group antibiotics, but showed only slight improvements in appropriateness. This suggests that a portion of medium risk WATCH group antibiotics are being used inappropriately, despite tighter control and monitoring.
- RESERVE group antibiotics were rarely used and had high rates of appropriateness, suggesting that AMS strategies are helping conserve these critical treatments for use only when they are truly needed – in limited, high-risk situations.
- These findings show the need to improve prescribing even for lower risk ACCESS antibiotics and maintain strict controls over WATCH and RESERVE antibiotics.

Figure 2.1: Antibiotic usage rate and appropriateness by AWaRe group in select Australian hospitals^, 2023



DDD=defined daily dose; OBD=occupied bed day

Source: NAUSP and NAPS

^Hospitals that participated in both NAUSP and NAPS in 2023 (n=192; 147 public and 45 private hospitals).

Note: Only includes adult inpatient data.

Trends by antimicrobial class

The combined use and appropriateness analysis shows important variations in prescriber practices across different antimicrobial classes.

Penicillins

Penicillins are widely used antibiotics that belong to the beta-lactam class. They are grouped based on how they interact with beta-lactamase, an enzyme produced by bacteria that can deactivate these drugs.

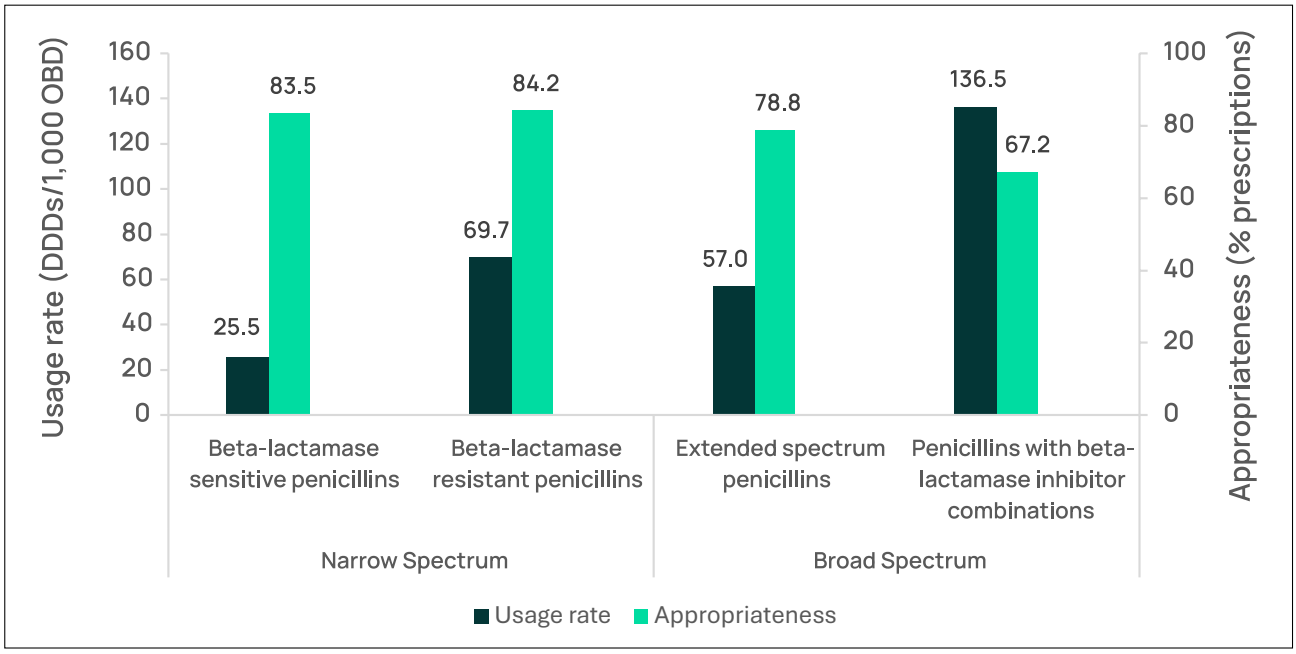
- **Beta-lactamase-sensitive penicillins** (e.g. benzylpenicillin) are narrow-spectrum antibiotics (can treat a limited and very serious range of bacterial infections). These penicillins are not effective against bacteria that produce the beta-lactamase enzyme, which destroys the antibiotic.
- **Beta-lactamase-resistant penicillins** (e.g. flucloxacillin) are also narrow-spectrum but are chemically designed to resist beta-lactamase. This makes them effective against bacteria that produce the enzyme.
- **Extended-spectrum penicillins** (e.g. amoxicillin) are broad-spectrum antibiotics (can treat a wider range of bacteria). However, they are still vulnerable to beta-lactamase, so they may not be effective against bacteria that produce this enzyme unless combined with a beta-lactamase inhibitor.
- **Penicillin with beta-lactamase inhibitors** (e.g. amoxicillin–clavulanic acid) combines a penicillin with another ingredient that blocks beta-lactamase. This protects the antibiotic from being destroyed and allows it to work against a broader range of bacteria, including those that would normally resist it.

Key findings

In 2023, narrow-spectrum penicillins had a low rate of use (25.5 and 69.7 DDD/1,000 OBD) and a high rate of appropriate prescribing (83.5% and 84.2%) **(Figure 2.2)**.

Broad-spectrum penicillins, especially those combined with beta-lactamase inhibitors, had a higher rate of use (57.0 and 136.5 DDD/1,000 OBD) compared with narrow-spectrum penicillins and were less appropriately prescribed (78.8% and 67.2%) **(Figure 2.2)**. This suggests that there may have been overuse of some broad-spectrum treatments when narrow-spectrum options could have been used.

Figure 2.2: Penicillin use in select Australian hospitals^, 2023



DDD=defined daily dose; OBD=occupied bed day
Source: NAUSP and NAPS
^Hospitals that participated in both NAUSP and NAPS in 2023 (n=192; 147 public and 45 private hospitals).
Notes: Only includes adult inpatient data.

Cephalosporins

Cephalosporins are another group of beta-lactam antibiotics. These antibiotics are grouped into different generations, from first to fifth, based on the timeline of drug development and their antimicrobial properties. The most used types are:

- **First-generation cephalosporins** (e.g. cefazolin and cefalexin) are narrow-spectrum antibiotics solely active against gram-positive microorganisms. These are commonly utilised to treat skin and soft tissue infections and to prevent surgical site infections.
- **Third-generation cephalosporins** (e.g. ceftriaxone) are the most commonly prescribed group of cephalosporins. These are broad-spectrum antibiotics that work against a wide range of bacteria.

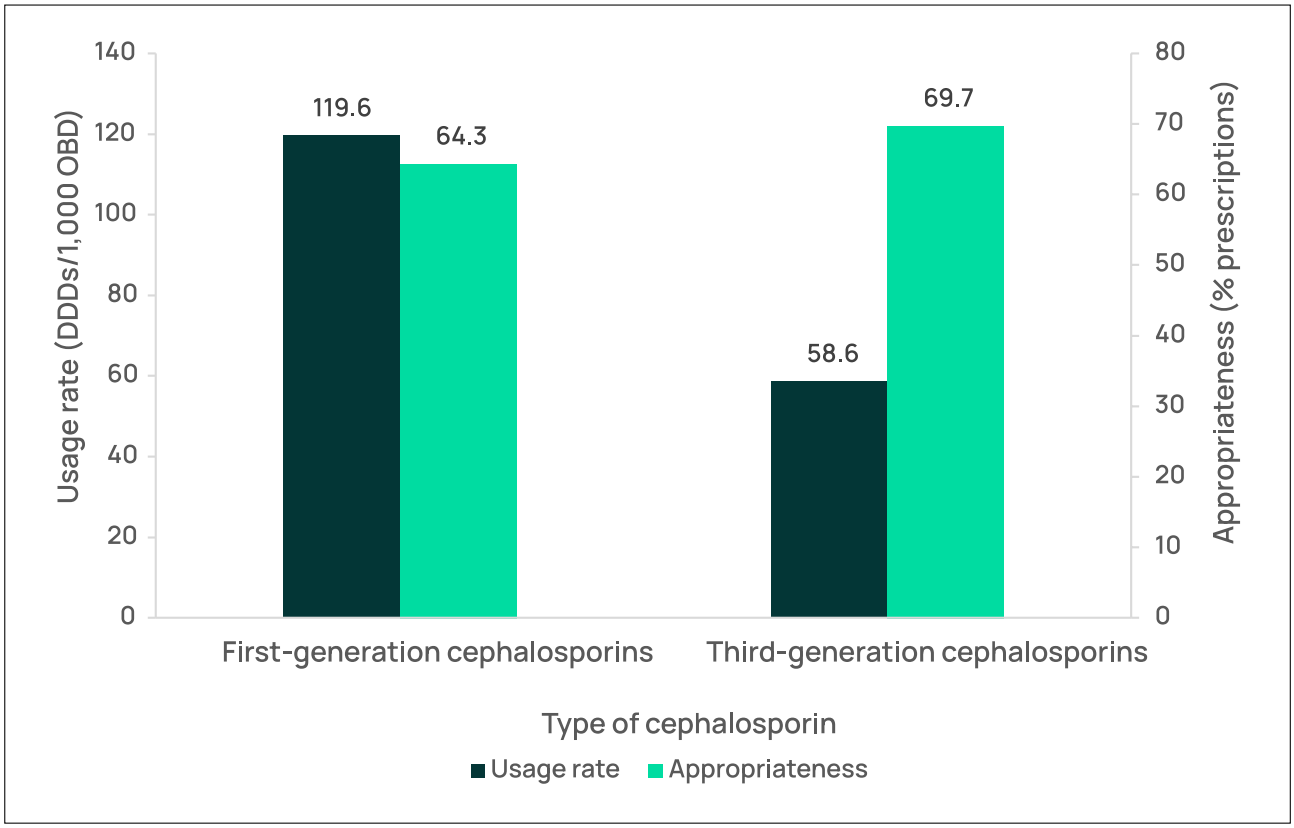
Key findings

First-generation cephalosporins had high use (119.6 DDD/1,000 OBD) and an appropriateness of 64.3%, which indicates that a considerable proportion of prescriptions were inappropriate **(Figure 2.3)**.

Third-generation cephalosporins had a lower usage rate (58.6 DDD/1,000 OBD) and slightly higher appropriateness rate (69.7%) than first-generation cephalosporins **(Figure 2.3)**.

These results indicate that prescribing practices for both broad-spectrum and narrow-spectrum cephalosporins continue to exhibit some inappropriate use. First-generation cephalosporins are included in the WHO ACCESS category as antimicrobials with lower potential for resistance, while third-generation cephalosporins are in the WATCH category, with a higher risk of resistance. Although the use of the most restricted group was lower, inappropriate use rates were similar, highlighting the need to improve AMS in hospitals in both categories.

Figure 2.3: Cephalosporin use in select Australian hospitals^, 2023



DDD=defined daily dose; OBD=occupied bed day

Source: NAUSP and NAPS

^Hospitals that participated in both NAUSP and NAPS in 2023 (n=192; 147 public and 45 private hospitals).

Notes: Only includes adult inpatient data.

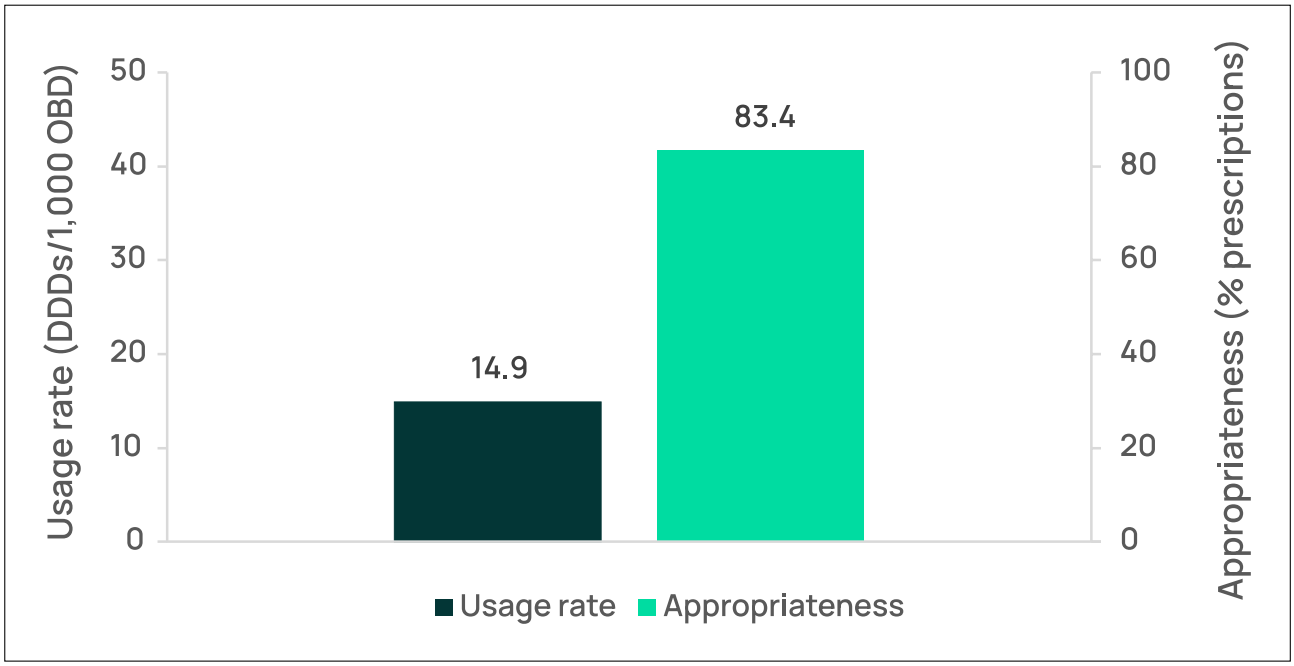
Carbapenems

Carbapenems are a group of broad-spectrum antibiotics (e.g. meropenem) that are effective against several gram-negative and gram-positive bacteria. They are used when patients with infections become seriously ill and do not respond to standard antibiotic therapy or are suspected of having resistant bacteria. Carbapenems are considered a last resort antibiotic.

Key findings

Carbapenems were used less often than other antibiotic classes and with a high rate of appropriateness (83.4%). This indicates that hospitals followed clinical guidelines to reserve them for severe or resistant infections **(Figure 2.4)**.

Figure 2.4: Carbapenem use in select Australian hospitals^, 2023



DDD=defined daily dose; OBD=occupied bed day
Source: NAUSP and NAPS
^Hospitals that participated in both NAUSP and NAPS in 2023 (n=192; 147 public and 45 private hospitals).
Notes: Only includes adult inpatient data.

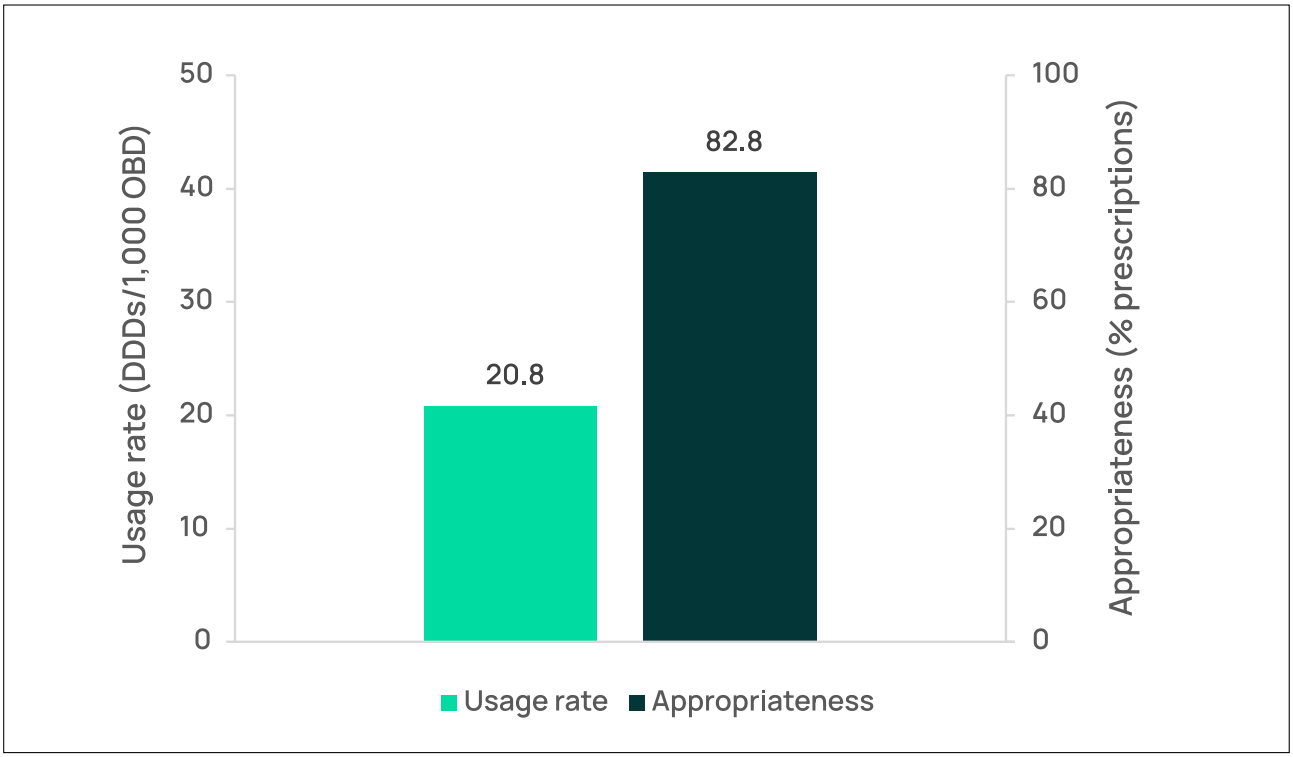
Glycopeptides

Glycopeptides (e.g. vancomycin) are a class of antibiotics that are primarily used to treat infections caused by gram-positive bacteria. These antibiotics are crucial for addressing severe infections, especially when other treatments have failed.

Key findings

Glycopeptides were used less frequently than other antibiotic classes, with high appropriateness (82.8%), suggesting alignment with clinical guidelines (Figure 2.5).

Figure 2.5: Glycopeptide use in select Australian hospitals^, 2023



DDD=defined daily dose; OBD=occupied bed day

Source: NAUSP and NAPS

^Hospitals that participated in both NAUSP and NAPS in 2023 (n=192; 147 public and 45 private hospitals).

Notes: Only includes adult inpatient data.

Trends in surgical antimicrobial use

AU in surgery is a key area of focus for AMS programs. Since 2021, hospitals reporting to NAUSP have been able to separate data for theatre and recovery settings. This targeted surveillance helps identify high-use areas where inappropriate prescribing is common.

NAUSP theatre surveillance includes antimicrobials administered to patients before, during and after surgery while they are in the operating theatre and recovery area. It does not capture doses given to patients when they are in the hospital wards, either before or after surgery. Doses administered in other wards are reported separately. This limitation restricts direct comparisons with NAPS data, but it still provides important insights for AMS programs in surgical settings.

The Surgical NAPS audits antimicrobial prescribing throughout the patient's surgical episode, especially when antimicrobials are given for prophylaxis (to prevent infection). These antimicrobials are recorded as:

- **procedural prophylaxis antimicrobials,** which are given just before or during surgery
- **post-procedural prophylaxis antimicrobials,** which are given after the procedure.

Key indicators for best practice include recording the incision (skin cutting) time and the time when antimicrobials are given. Administering antimicrobials at an appropriate time is crucial to achieve optimal drug concentrations at the moment of surgical incision, when the risk of microorganisms entering the body is highest.

The Surgical NAPS [8] showed some improvements in antimicrobial prescribing in 2023, but also highlighted persistent challenges, especially in documentation and compliance with clinical guidelines.

In 2023, 201 facilities (93 public and 108 private) participated in Surgical NAPS and submitted data on 11,516 surgical episodes with 9,620 procedural doses and 4,272 post-procedural prophylaxis prescriptions.

Key findings

% For hospitals participating in the 2023 Surgical NAPS, the overall appropriateness of antimicrobial prescribing for surgical procedures was low (57.3%). This was a continuation of the low appropriateness reported in 2022 (55.3%).

Procedural prescribing (antimicrobials given just before or during surgery)

National guidelines recommend a single dose of antimicrobials for most surgical procedures before the skin is cut. These are known as 'procedural antimicrobials'.

Key findings

- In 2023, 61.5% (5,914/9,620) of all procedural doses were assessed as appropriate.
- 42.5% (1,231/2,894) of procedural doses deemed inappropriate were assessed as not required.
- Of procedural doses where antimicrobials were recommended by clinical guidelines (n=8,366), 19.9% (n=1,663) were deemed inappropriate. These doses were deemed inappropriate for reasons such as, timing, antimicrobial choice and dose.
- Incorrect timing was the most common reason for inappropriate prescribing; 38.7% (644/1,663) of recommended procedural doses were administered at the incorrect time.
- The second most common reason for inappropriate prescribing was the spectrum of the antimicrobial; 24.2% (403/1,663) of procedural doses included an antimicrobial with a spectrum deemed too broad.

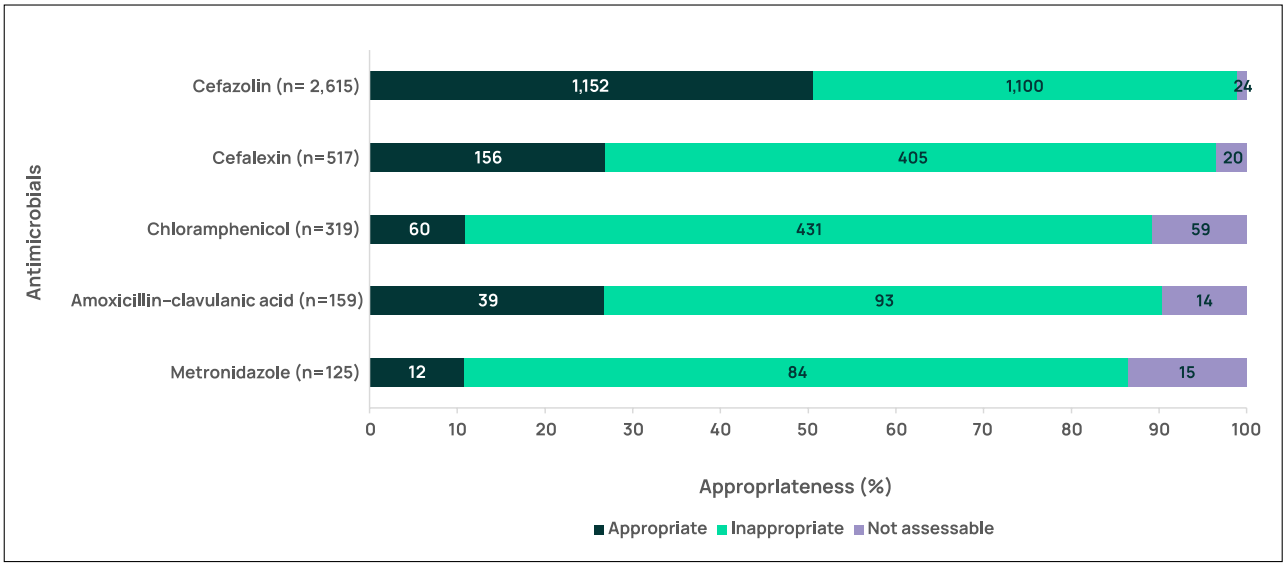
Post-procedural prescribing (antimicrobials given after surgery)

A high proportion of post-procedural prophylaxis prescriptions (antimicrobials prescribed after a procedure to prevent infection) were inappropriate, most commonly due to being used for too long after surgery. This can increase the risk of AMR development, harm patients and increase healthcare costs.

Key findings

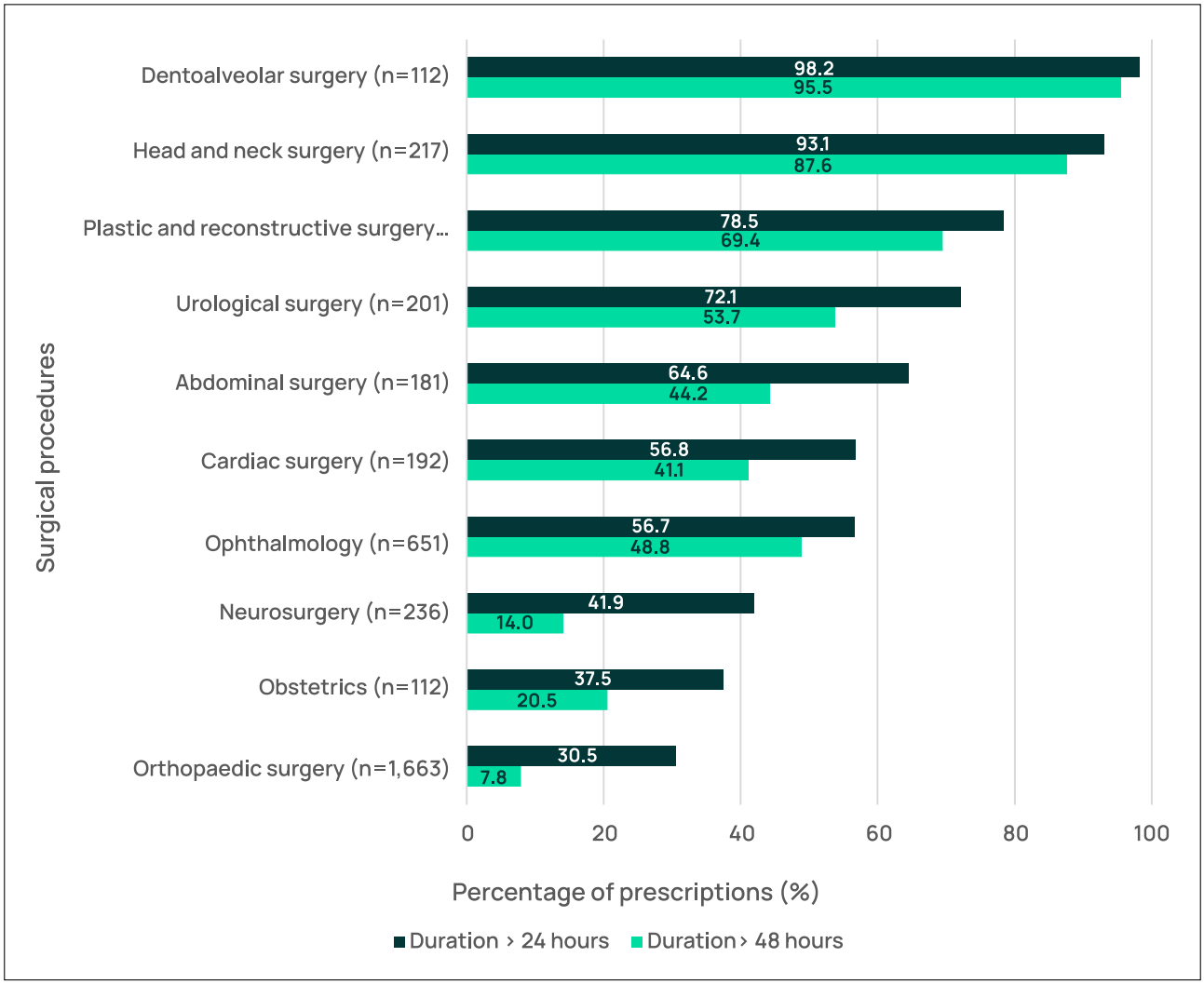
- Of the 4,272 prescribed post-procedural prophylaxis prescriptions, 45.0% (n=1,922) were deemed appropriate. The majority of inappropriate prescriptions were due to incorrect duration (77.6%).
- Of all post-procedural prophylaxis prescriptions, 34.2% (n=1,462) continued for a duration longer than 48 hours.
- For post-procedural prophylactic prescriptions, where prophylaxis was recommended by guidelines (n=2,817), 29.0% were deemed inappropriate (n=816).
- For the surgical episodes where no post-procedural antimicrobials were prescribed (6,633/11,516) most were deemed appropriate (98.0%, n=6,499)
- Antimicrobials were prescribed for post-procedural prophylaxis when not required for 10.3% (1,186/11,516) of surgical episodes.
- The top 5 antimicrobials prescribed for post-procedural prophylaxis in 2023 were: cefazolin, cefalexin, chloramphenicol, amoxicillin–clavulanic acid and metronidazole. The rate of inappropriate prescribing was over 80% for cefalexin and amoxicillin–clavulanic acid (**Figure 2.6**).
- Antimicrobials used for longer than the recommended duration (often beyond 48 hours) occurred most often in dentoalveolar (95.5%), head and neck (87.6%), and plastic and reconstructive (69.4%) surgeries **(Figure 2.7)**.

Figure 2.6: Top 5 antimicrobials used after surgery in Australian hospitals, 2023



Source: Adapted from 2023 Surgical NAPS
Note: n=number of prescriptions.

Figure 2.7: Prolonged antimicrobial use after surgery in Australian hospitals, 2023



Source: Adapted from 2023 Surgical NAPS
Note: n=number of prescriptions.

Trends in antifungal use in hospitals

Antifungals are essential for preventing and treating fungal infections, particularly in vulnerable patients, such as those receiving chemotherapy or organ and stem cell transplants.

Inappropriate use of antifungals can drive resistance, reduce treatment options and harm patients. Antifungal surveillance is now a core part of AMS programs to ensure these essential medicines remain effective. NAUSP has tracked antifungal use in Australian hospitals since 2017.

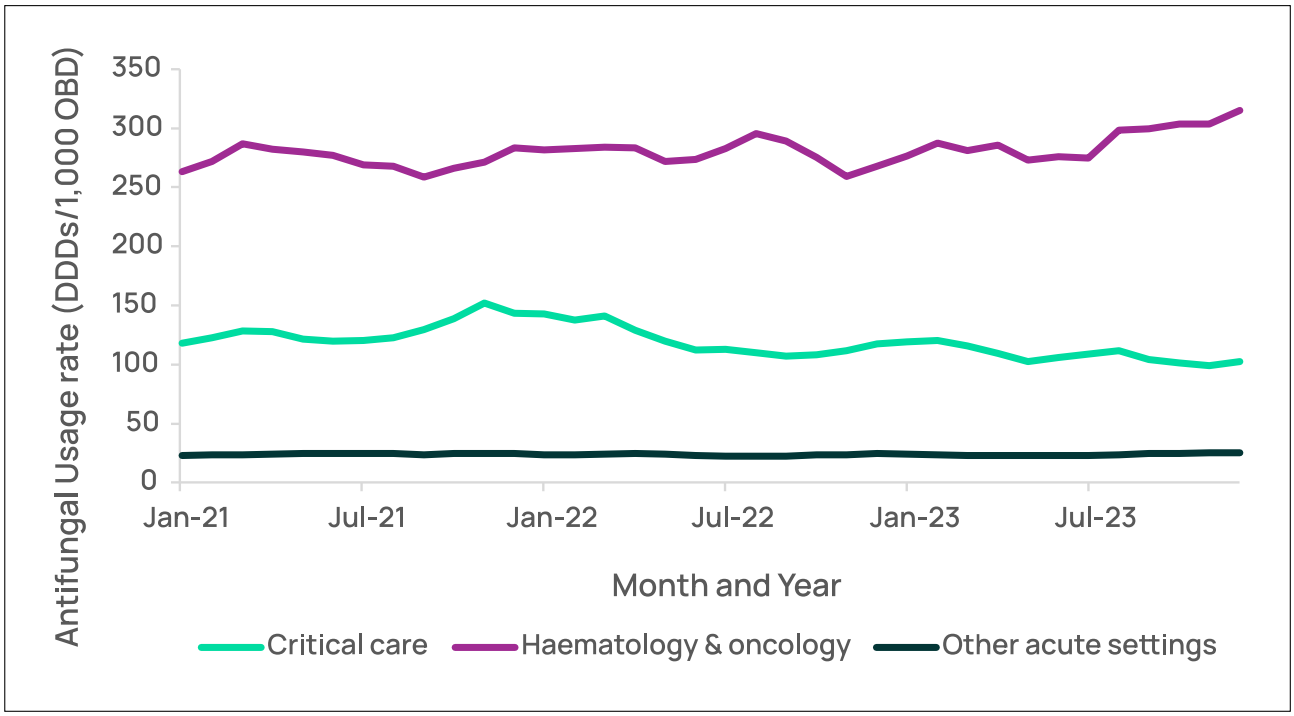
Key findings

Between 2021 and 2023, the highest antifungal use in hospitals occurred in haematology (blood disorders) and oncology (cancer) wards, at usage rates twice as high as in critical care (intensive care) and 10 times higher than in other hospital areas combined.

Between 2021 and 2023, the overall use of antifungals in hospitals remained stable, but use in haematology and oncology increased **(Figure 2.8)**.

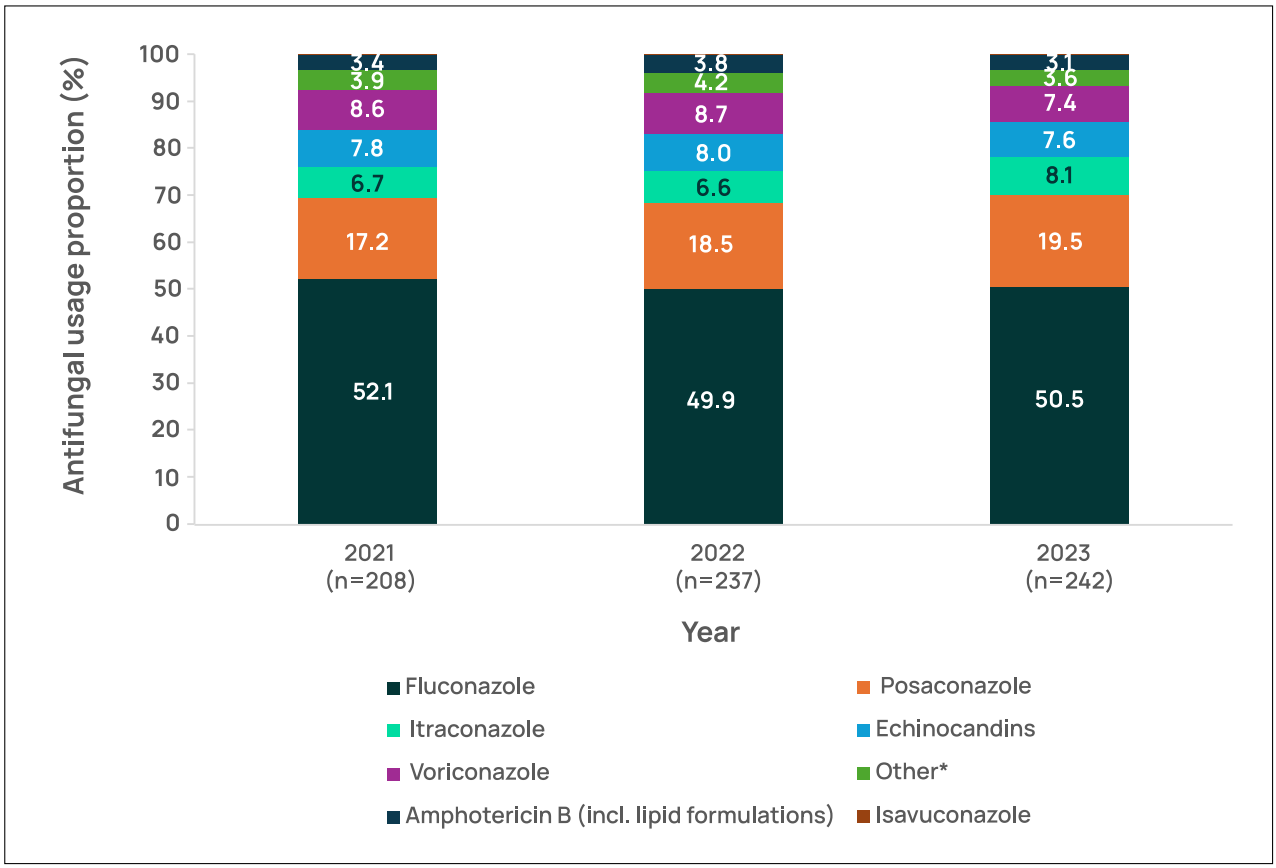
Fluconazole remained the most prescribed systemic antifungal in acute hospital settings in 2023 (50.5%) **(Figure 2.9)**.

Figure 2.8: Antifungal use in Australian hospitals, by setting, 2021–2023



Source: NAUSP, 2023

Figure 2.9: Proportion of antifungals dispensed in Australian hospitals, 2021–2023



Source: NAUSP, 2023
Note: n=number of prescriptions from NAUSP-contributor hospitals.
*Other consists of flucytosine, griseofulvin, ketoconazole and terbinafine.

Inaugural Antifungal National Antimicrobial Prescribing Survey

The first Antifungal NAPS was launched in October 2022 as a tool to help hospitals assess antifungal prescribing quality [9] using internationally recognised stewardship metrics [10]. Hospitals could review all antifungals or focus on specific antifungals or patient groups. Eleven facilities participated, providing data on 516 antifungal prescriptions. Antifungal NAPS data revealed insights into antifungal prescribing in Australian hospitals in 2022 and 2023.

Key findings

77.1% (n=398) of antifungal prescriptions were appropriately prescribed, with prophylactic prescriptions having the highest rate of appropriateness of 85.1% (189/222).

Fluconazole was the most frequently prescribed antifungal, accounting for 40.5% (n=209) of all prescriptions. This finding is consistent with NAUSP data.

In the inaugural audit, 63.2% (n=132) of fluconazole prescriptions were deemed appropriate.

The most common reasons for inappropriate prescribing were: antifungal not required (35%), incorrect dose or frequency (28%) and incorrect duration (24%).

Use of antifungals for the treatment of urinary tract and intra-abdominal infections without confirmation of the presence of a fungal organism was common. These are conditions where antifungals are rarely needed.

Antimicrobial use in the community

The Pharmaceutical Benefits Scheme (PBS) and the Repatriation Pharmaceutical Benefits Scheme (RPBS) provide data on the volume of subsidised antimicrobials dispensed in the community. The PBS was created in 1948, and is managed by the Department of Health, Disability and Ageing and administered by Services Australia. The RPBS is administered by the Department of Veterans' Affairs. Read more about the PBS and RPBS.

The main source of antimicrobial dispensing data in the community (general practice, aged care homes and community health services) in Australia is the PBS/RPBS. These data capture around 90% of antibacterials prescribed in the community and show what is dispensed, but do not cover all antibacterials that are supplied or consumed.

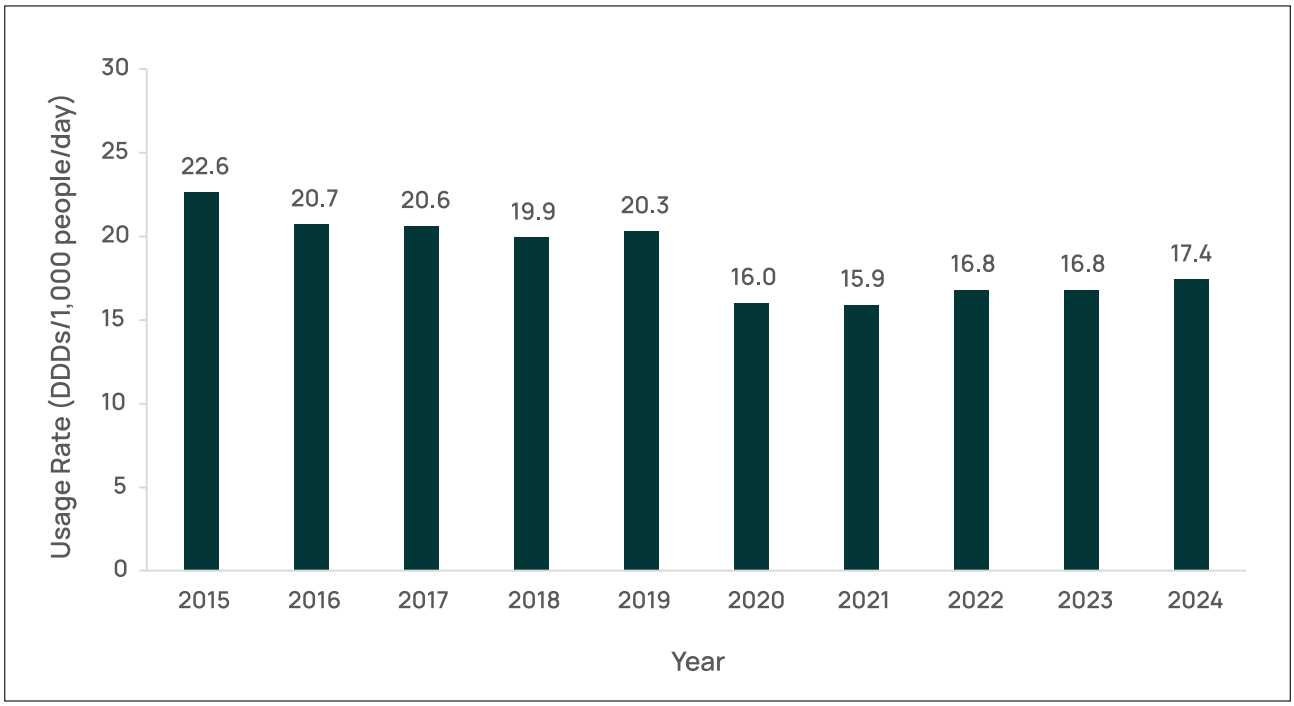
PBS/RPBS data exclude private prescriptions (not subsidised under the PBS or RPBS), over-the-counter sales and medicines provided through some community health services. Currently, there is no national monitoring or reporting system for antimicrobials dispensed outside the PBS/RPBS.

Australians are using fewer antimicrobials than a decade ago. Antimicrobial use in the community: 2024 revealed an overall downward trend in AU in the community supplied under PBS/RPBS; however, the level of dispensing for residents of aged care homes and for older Australians aged 65 years and over continues to increase [11].

Key findings

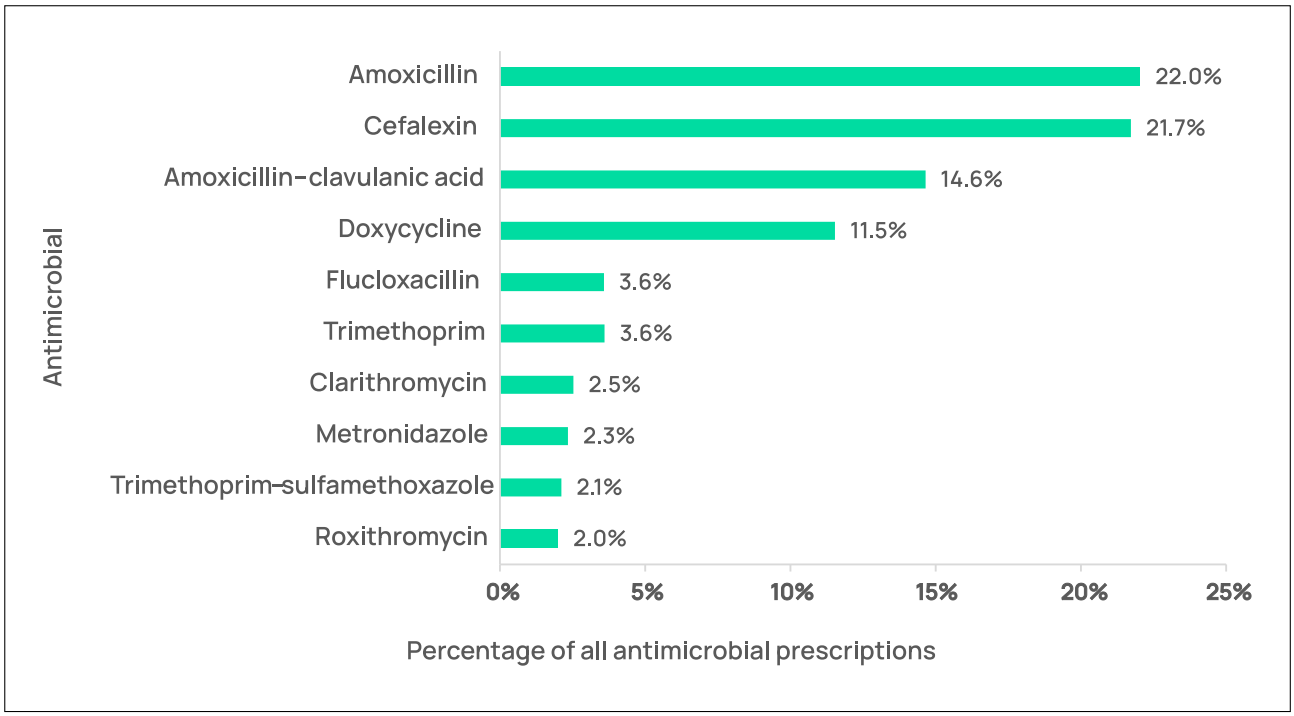
- Over the last decade, the number of antimicrobial prescriptions supplied in the community declined by 20.8%.
- In 2024, 23.2 million antimicrobial prescriptions were supplied under the PBS (n=23,190,360), a 4.8% increase from 2023, but still 13% lower than in 2019 and 20.8% lower than in 2015.
- The rate of antimicrobials dispensed per person in DDD per 1,000 people per day increased slightly from 16.8 in 2023 to 17.4 in 2024; however, there has been an overall decline since 2015 **(Figure 2.10)**.
- In 2024, 37.1% (n=10,105,562) of the Australian population had at least one antimicrobial dispensed in the community under the PBS. This was a slight increase from 36.4% (n=9.699,404) of Australians in 2023.
- Of those who received antimicrobials under the PBS, each person was supplied at least 2 antimicrobial prescriptions per year on average in 2023 (2.28) and 2024 (2.29).
- Under the PBS, the 4 most frequently dispensed antimicrobials in the community in 2024 were: amoxicillin (22.0%), cefalexin (21.7%), amoxicillin–clavulanic acid (14.6%) and doxycycline (11.5%) (**Figure 2.11**).
- Most antimicrobial prescriptions in the community were supplied in winter (June to August), likely reflecting seasonal trends in respiratory infections.
- Most antimicrobials in the community were prescribed through the PBS/RPBS by general practitioners (87.3% in 2023; 87.4% in 2024), followed by medical specialists (7.9% in 2023; 7.4% in 2024) and dentists (4.2% in 2023; 4.4% in 2024).

Figure 2.10: Rate of PBS/RPBS antimicrobial prescriptions dispensed in Australia, 2015–2024



DDD=defined daily dose; PBS=Pharmaceutical Benefits Scheme; RPBS=Repatriation Pharmaceutical Benefits Scheme
Adapted from Australian Commission on Safety and Quality in Health Care, Antimicrobial use in the community: 2024, Sydney: ACSQHC, 2025 [11].

Figure 2.11: Top 10 most commonly dispensed PBS antimicrobials in Australia, 2024



PBS=Pharmaceutical Benefits Scheme
Adapted from Australian Commission on Safety and Quality in Health Care, Antimicrobial use in the community: 2024, Sydney: ACSQHC, 2025 [11].

Antimicrobial use in residential aged care homes

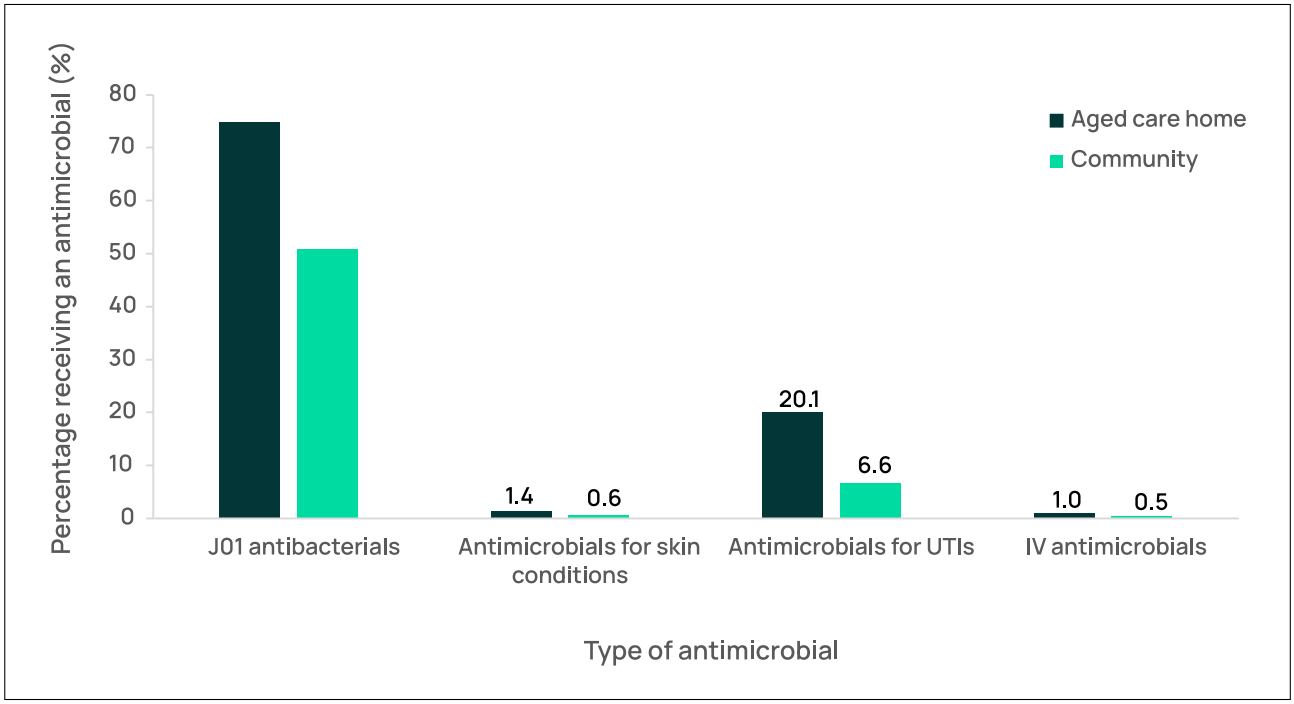
Aged care home residents are more susceptible to infections due to their advanced age, likelihood of other health conditions and reduced immunity. Frequent hospital transfers can increase the risk of AMR spreading to aged care homes. Monitoring AU and appropriateness in residential aged care homes is an important safety measure.

The **Antimicrobial use in the community: 2024** report showed that there is a high and increasing level of antimicrobials dispensed under the PBS/RPBS for residents of aged care homes [11].

Key findings

- In 2024, 659,767 antimicrobial prescriptions were dispensed to aged care home residents, an increase of 14.4% since 2023.
- Prescriptions to aged care home residents accounted for 2.8% of all PBS antimicrobials supplied in Australia (23.2 million), despite aged care home residents accounting for approximately 0.7% of the total Australian population.
- 79.5% (n=157,430) of aged care home residents received at least one antimicrobial prescription in 2024, compared to 72.6% (n=141,588) in 2023.
- From 2021 to 2024, the 10 most frequently dispensed antimicrobials made up 86.5% of all antimicrobials supplied to aged care home residents.
- Cefalexin was the most frequently prescribed antimicrobial in aged care homes, making up 35.2% of prescriptions in 2024.
- In 2024, of aged care home residents who were dispensed a topical antifungal under the PBS, 72.9% received 1 prescription, 16.4% received 2 prescriptions, and more than 3% received 6 or more prescriptions.
- In 2024, 74.4% of older Australians (aged 65 and over) living in aged care homes received systemic antimicrobials (those that affect the whole body) under the PBS, compared to 50.8% of older Australians living in the community (**Figure 2.12**).
- Older Australians living in aged care homes received more than double the number of prescriptions of systemic antimicrobials under the PBS (3.1 per person) compared to their peers living at home (1.48 per person), which was similar to 2023 (2.76 compared to 1.34, respectively).
- Cefalexin was the most frequently dispensed antimicrobial for older Australians in aged care homes. It was more likely to be supplied to aged care home residents (35.2% n=213,264) than to older Australians living in the community (25.7%, n=1,716,875).

Figure 2.12: Antimicrobial prescriptions for Australians aged 65 years and over, 2024



J01=antibacterials for systemic use* (affect the whole body); UTI=urinary tract infection; IV=intravenous; PBS=Pharmaceutical Benefits Scheme; *Per World Health Organization Anatomical Therapeutic Chemical Classification and PBS listings.
Notes:
1. PBS data do not indicate the diagnosis or condition of the patient or the indication for prescription. Antimicrobials for UTIs include methenamine hippurate, nitrofurantoin, norfloxacin and trimethoprim. Other antimicrobials, including J01 antibacterials for systemic use, may also be used for UTIs, but this cannot be determined from the dataset.
2. Many antimicrobials for skin conditions are available over-the-counter without a prescription, so are not captured by the PBS.
Adapted from Australian Commission on Safety and Quality in Health Care, Antimicrobial use in the community: 2024, Sydney: ACSQHC, 2025 [11]

Aged Care National Antimicrobial Prescribing Survey

Tracking community AU helps identify trends and the impact of AMS programs. The **2023 Aged Care NAPS** captured a snapshot of infections and AU in aged care homes on the day of the survey [12].

Residential aged care homes participating in the Aged Care NAPS each year since 2021 have shown improvements in documenting the indication for antimicrobial prescribing. In 2023, 852 aged care homes took part in the Aged Care NAPS, auditing 53,843 residents and 8,999 prescriptions. This is an increase from 744 aged care homes participating in 2022, indicating the value seen in participating in the point prevalence survey.

Key findings

While 11.9% (n=6,429) of aged care residents were being prescribed at least one antimicrobial, only 3.6% (n=1,941) showed signs or symptoms of a suspected infection. In total, aged care residents were documented with 2,037 suspected infections.

Most suspected infections were skin or soft tissue (47.6%), urinary tract (19.0%) and respiratory tract (17.1%); but only 36.1% of these cases were confirmed as infections.

Clotrimazole (21.6%, n=1,944) and cefalexin (21.1%, n=1,898) were the most frequently prescribed antimicrobials.

34.7% of antimicrobials prescribed on survey day in 2023 were being used for prolonged periods of more than 6 months, suggesting a lack of regular medication review and reassessment.

22.7% (n=2,039) of all antimicrobial prescriptions were for the prevention of infection, with cystitis being the most common reason for prescription (25.0%, n=1,301).

40.6% of all antimicrobials were prescribed for topical use on a localised area.

Recording the reason for antimicrobial prescriptions increased from 80.3% on survey day in 2022 (n=6,747) to 83% (n=7,472) on survey day in 2023; however, the review or stop date remained below the best practice target of 95%, at 56.8% (n=4,769) and 56.6% (n=5,097), respectively

Data champions: how AURA data shaped better treatment of meningitis

For almost 50 years, the *Therapeutic Guidelines: Antibiotic* has given Australian healthcare professionals clear, evidence-based advice for preventing and treating infections [13]. The guidelines cover more than 200 different infections, from common infections in primary care to serious illnesses needing intensive care.

Expert groups are central to the development of these guidelines. These groups review and interpret the latest evidence and adapt it to the Australian context.

For infectious diseases, AURA surveillance data on AMR and AU are essential to ensuring that recommendations are appropriate for Australian patients. Expert groups use these data to develop guidelines with the latest evidence and practical considerations, such as treatment accessibility. The following example shows how these data influence decisions.

Background

Since 1996, the *Therapeutic Guidelines: Antibiotic* recommendation for suspected meningococcal disease has been a single dose of benzylpenicillin before transfer to hospital [14]. This advice was based on research that suggested that early treatment saves lives. A high dose (2.4g) was recommended because some *Neisseria meningitidis* (*N. meningitidis*) bacteria were less susceptible to penicillin.

In the 2025 update of the Therapeutic Guidelines: Antibiotic, this recommendation has changed to administer ceftriaxone in preference to benzylpenicillin because of growing resistance in *N. meningitidis*. Data from the Australian Meningococcal Surveillance Programme (AMSP) showed that penicillin resistance in *N. meningitidis* has been increasing since 2015. By 2022, when the latest guideline update commenced, 13% of all *N. meningitidis* isolates were resistant to benzylpenicillin. Importantly, all isolates showed susceptibility to ceftriaxone.

Expert group decisions

Expert groups weighed this resistance data against the real-world evidence for benzylpenicillin and the lack of comparable real-world evidence for ceftriaxone. Based on experience in previous outbreaks, the group believed that high doses of benzylpenicillin may have been adequate for strains resistant to penicillin, but data were not available.

The group also considered AMS impacts, particularly the increased use of ceftriaxone in the community, and accessibility issues. Paramedics have access to ceftriaxone but not benzylpenicillin, and benzylpenicillin is available to be prescribed under the PBS, while ceftriaxone is not. They also considered the fact that ceftriaxone is effective against other bacteria that can cause meningitis.

Updated advice

From March 2025, the updated guidelines recommend ceftriaxone over benzylpenicillin for the treatment of suspected meningococcal disease in community settings.

Chapter 3: Antimicrobial resistance

Antimicrobial resistance (AMR) contributes to disease outbreaks, compromises patient safety, increases pressure on healthcare workers and burdens the health system.

Knowing which microorganisms are becoming resistant to antimicrobials helps healthcare professionals choose effective treatments and guides national priorities. Stopping the spread of microorganisms with AMR is important to prevent disease outbreaks.

AURA surveillance program partners

The AMR surveillance systems that contribute to the Antimicrobial Use and Resistance in Australia (AURA) surveillance program provide a comprehensive view of AMR threats in Australia. Rates of resistance for priority microorganisms and trends over time are monitored through targeted and passive surveillance.

Australian Group on Antimicrobial Resistance

The Australian Group on Antimicrobial Resistance (AGAR), a working group within the Australian Society for Antimicrobials, is a collaboration of clinicians and scientists from key microbiology laboratories around Australia. AGAR began in 1985 and now includes 33 laboratories that serve 57 hospitals.

AGAR conducts targeted AMR surveillance and annual reporting on bacteria known to cause important and life-threatening bloodstream infections through:

- Australian Enterococcal Surveillance Outcome Program (AESOP)
- Australian *Staphylococcus aureus* Surveillance Outcome Program (ASSOP)
- Gram-negative Surveillance Outcome Program (GnSOP).

Read more about **AGAR**.

Australian Passive AMR Surveillance

Australian Passive AMR Surveillance (APAS) collects de-identified patient-level resistance data from routine testing in hospitals and private laboratories.

APAS helps identify geographic and microorganism-specific trends, and informs local AMS and infection control strategies. APAS data are published in annual reports and technical reports.

Participating laboratories can create antibiograms (laboratory reports that show the susceptibility of microorganisms to antimicrobials) and review trends through an online portal. APAS was established in 2015 as part of AURA by the Australian Commission on Safety and Quality in Health Care.

Read more about **APAS**.

Sullivan Nicolaides Pathology (SNP) collects data on microorganisms and rates of AMR in the community, private hospital settings and aged care homes in Queensland and northern New South Wales. Data provided by SNP complements APAS and other AMR data presented in this report.

Read more about **SNP**.

HOTspots surveillance and response program

HOTspots surveillance and response program (HOTspots) collects de-identified patient-level resistance and demographic data from routine testing in hospitals and community clinics in Western Australia, the Northern Territory and Queensland. It monitors and works with clinicians and policy makers to respond to geographic and healthcare-setting variations in AMR.

The HOTspots digital surveillance platform visualises these trends, guides local antibiotic prescribing guidelines and supports clinical decision-making. The digital surveillance platform was implemented in 2019 and is coordinated by the Australian e-Health Research Centre, Commonwealth Scientific and Industrial Research Organisation (CSIRO).

Read more about **HOTspots**.

National Alert System for Critical Antimicrobial Resistances

National Alert System for Critical Antimicrobial Resistances (CARAlert) collects and analyses surveillance data for nationally agreed priority microorganisms with critical resistances that present a serious threat to the effectiveness of last-line antimicrobials (last resort treatments used when other antimicrobials are ineffective).

CARAlert has the potential to act as an early warning system, identifying outbreaks and detecting seasonal or geographic trends to inform responses. Although participation in CARAlert is voluntary for Australian laboratories, it provides broadly representative data.

CARAlert was established in 2016 as part of AURA by the Australian Commission on Safety and Quality in Health Care.

Read more about **CARAlert.**

National Neisseria Network

The National Neisseria Network (NNN) is a collaborative association of laboratories that contribute to passive surveillance of disease-causing *Neisseria* species, *Neisseria gonorrhoeae* and *Neisseria meningitidis*.

The NNN has been operating since 1979 and conducts 2 programs: the Australian Gonococcal Surveillance Programme (AGSP) and the Australian Meningococcal Surveillance Programme (AMSP).

Read more about the **NNN**.

National Notifiable Diseases Surveillance System

The National Notifiable Diseases Surveillance System (NNDSS), established in 1991, coordinates data on over 70 national notifiable diseases that present a risk to public health in Australia, including tuberculosis and its associated AMR. The NNDSS is coordinated by the Australian CDC.

Read more about the **NNDSS**.

How antimicrobial resistance arises

Microorganisms constantly adapt to survive antimicrobials by developing new defence strategies. These resistance mechanisms are usually genetic and are either acquired through mutation or gained from other microorganisms.

AMR occurs when a microorganism can no longer be killed or controlled by standard dosages of a drug that used to work. AMR increases due to:

- exposure to antimicrobials
- spread of resistant microorganisms
- transfer of resistance genes between microorganisms.

Once resistance is developed or acquired, it can be passed on to subsequent generations of microorganisms.

While any microorganism can develop AMR, bacterial resistance to antibiotics is an urgent and serious global challenge. Fungal resistance to antifungals is also emerging as a concerning AMR threat.

Key antimicrobial resistance terminology (see Appendix 2)

Acquired resistance: resistance to an antimicrobial that is gained from other microorganisms or through mutation (usually genetic).

Antimicrobial susceptibility testing: laboratory testing that determines if resistance is present in a microorganism and whether an antimicrobial treatment is likely to be effective.

Critical antimicrobial resistances (CARs): priority microorganisms with critical resistance to last-line antimicrobials.

Extensively drug-resistant (XDR) microorganisms: microorganisms with resistance to all or almost all available treatments.

High-level resistance: an infection that has become so resistant to an antimicrobial that the drug no longer works at all, even at very high doses.

Last-line antimicrobials: a group of antibiotics used when the commonly used antibiotics fail to treat an infection due to antibiotic resistance. These are a final treatment option for severe AMR infections and are often used to treat multidrug-resistant infections.

Multidrug-resistant (MDR) microorganisms: microorganisms that are resistant to one or more antimicrobials in 3 or more classes of antimicrobials and are difficult to treat with existing drugs.

Reduced susceptibility microorganisms: microorganisms that have acquired resistance mechanisms but have not yet been shown to be resistant to treatment.

Resistant microorganisms: microorganisms that are either resistant or less susceptible to at least one antimicrobial, which makes it likely that treatment will fail.

Susceptible microorganisms: microorganisms that remain treatable.

Key antibiotic terminology

Beta-lactam antibiotics: a class of antibiotics that share a common beta-lactam ring in their chemical structure. This ring is crucial for their antibacterial activity as it disrupts the bacteria's ability to form a cell wall, which is needed for protection and survival.

Penicillin was the first beta-lactam discovered. Other major beta-lactam classes include cephalosporins and carbapenems.

Carbapenem antibiotics: commonly used for infections caused by MDR bacteria. Bacteria that produce carbapenemase enzymes are often resistant to other important antibiotic types and can spread their resistance to others.

Extended-spectrum beta-lactamase (ESBL) phenotype bacteria: an enzyme that is produced by some gram-negative bacteria and can break down and destroy beta-lactam antibiotics.

Australia's priority microorganisms

National surveillance focuses on priority microorganisms with high public health importance to Australia due to their prevalence, impact, treatability and risk of spread in hospitals and the community. Priority microorganisms monitored in Australia are also informed by global priority lists **(Table 3.1).**

World Health Organization Bacterial Priority Pathogen List

The World Health Organization (WHO) Bacterial Priority Pathogen List (BPPL) is a list of 24 AMR bacteria that are considered global public health threats [15]. These are categorised into critical, high and medium priority groups.

These bacteria represent a high global burden. While not all are a concern for Australia, they are closely monitored as there is a risk that they could become a concern.

World Health Organization Fungal Priority Pathogen List

In 2022, the WHO released the WHO Fungal Priority Pathogens List (FPPL), the first global effort to prioritise fungal microorganisms based on their public health impact [16]. It categorises 19 fungal AMR microorganisms into critical, high and medium priority groups.

Table 3.1: Australian surveillance systems monitoring antimicrobial resistance threats

Microorganism	Global threat classification	Resistance	Surveillance systems
Acinetobacter baumannii complex	GLASS priority WHO critical priority	Carbapenem	AGAR, APAS, CARAlert, SNP, HOTspots
Enterobacterales (Escherichia coli and Klebsiella pneumoniae)	GLASS priority WHO critical priority	Carbapenem and/ or third-generation cephalosporin	AGAR, APAS, CARAlert, SNP, HOTspots
Mycobacterium tuberculosis	WHO critical priority	Rifampicin	NNDSS, CARAlert
Salmonella species	GLASS priority WHO high priority	fluoroquinolone	AGAR, APAS, CARAlert, SNP
Shigella species	GLASS priority WHO high priority	fluoroquinolone	AGAR, CARAlert, SNP
Enterococcus species	WHO high priority	Vancomycin	AGAR, APAS, SNP, HOTspots
Pseudomonas aeruginosa	WHO high priority	Carbapenem	AGAR, APAS, CARAlert, SNP, HOTspots

Microorganism	Global threat classification	Resistance	Surveillance systems
Neisseria gonorrhoeae	WHO high priority	Third-generation cephalosporin and/or fluoroquinolone	AGSP, APAS, CARAlert
Staphylococcus aureus	GLASS priority WHO high priority	Methicillin Vancomycin Linezolid	AGAR, APAS, SNP, HOTspots
Streptococcus pyogenes (Group A Streptococcus)	WHO medium priority	Macrolide Penicillin	AGAR, APAS, HOTspots, SNP
Streptococcus pneumoniae	GLASS priority WHO medium priority	Macrolide	AGAR, APAS, SNP
Haemophilus influenzae	WHO medium priority	Ampicillin	APAS
Streptococcus agalactiae (Group B Streptococcus)	WHO medium priority	Penicillin	AGAR, APAS, SNP
Neisseria meningitidis	GLASS priority	Ciprofloxacin	AMSP, APAS, CARAlert
Candidozyma (previously Candida) auris	WHO critical priority	Resistant to multiple drugs	CARAlert

AGAR=Australian Group on Antimicrobial Resistance (national public and private hospitals); AGSP=Australian Gonococcal Surveillance Programme (national hospitals and community health services); AMSP=Australian Meningococcal Surveillance Programme (national hospitals and community health services); APAS=Australian Passive AMR Surveillance (national public hospitals and health services [except the Northern Territory], private pathology service Queensland, private hospitals in South Australia); CARAlert=National Alert System for Critical Antimicrobial Resistances; GLASS=Global Antimicrobial Resistance and Use Surveillance System; HOTspots (public and private hospitals and community health services in the Northern Territory); NNDSS=National Notifiable Diseases Surveillance System (national hospitals and community health services); SNP=Sullivan Nicolaides Pathology (Queensland and northern New South Wales communities, private hospitals and aged care homes); WHO=World Health Organization

Global Antimicrobial Resistance and Use Surveillance System: the first global AMR surveillance system

Launched by the WHO in 2015, the Global Antimicrobial Resistance and Use Surveillance System (GLASS) is the global surveillance system for AMR and antimicrobial usage (AU) data. GLASS-AMR provides a standardised approach to collecting, analysing, interpreting and sharing AMR data on selected microorganisms that cause common human infections.

GLASS data:

- inform national, regional and global decision-making, strategies and advocacy

- support capacity building and monitor the status of existing and new national surveillance systems.

Read more about **GLASS**.

Australia's GLASS-AMR contributions

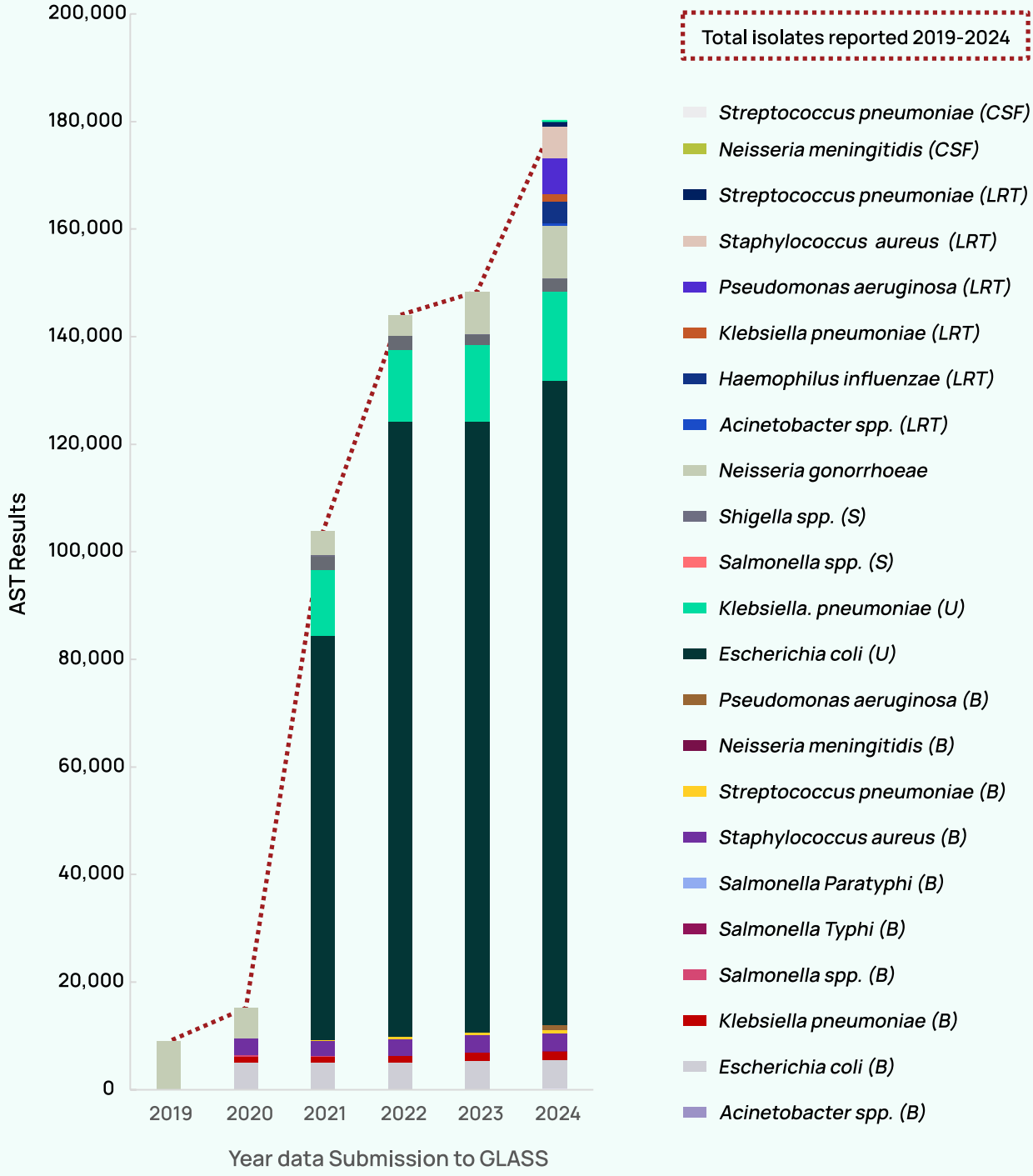
Australia has longstanding surveillance systems that capture data on WHO priority microorganisms. In 2019, Australia enrolled in GLASS-AMR. The WHO Collaborating Centre for Sexually Transmitted Infections and AMR (WHO CC for STI and AMR) in New South Wales is Australia's first GLASS national coordinating centre. It has collected and submitted AMR data from Australia's national surveillance systems for 6 years.

The Department of Health, Disability and Ageing and the WHO CC for STI and AMR provided valuable input to an update of the *GLASS manual for antimicrobial resistance surveillance in common bacteria causing human infection*. This manual defines the microorganisms, specimen sites (body sites where samples are taken from) and antimicrobials for data submissions to GLASS.

Australia's GLASS coverage has significantly expanded since enrolling in GLASS. In 2024, Australia submitted AMR data from 180,156 isolates from 5 surveillance programs: AGAR, AGSP, AMSP, APAS and SNP. **These data covered** all 13 GLASS priority microorganisms and all 9 GLASS priority specimen sites **(Figure 3.1)**.

This is a significant achievement that reflects decades of investment in AMR surveillance and highlights Australia's role as a key contributor to global AMR monitoring.

Figure 3.1: Australia's growing contribution to GLASS-AMR, 2019–2024



Specimen types: blood=(B), cerebrospinal fluid=(CSF), lower respiratory tract=(LRT), stool=(S), urine=(U) and urethral, cervical, rectal, and pharyngeal swabs=(UG+PH+AN); AST=antimicrobial susceptibility testing
Notes: AST determines if resistance is present in a microorganism.

Critical antimicrobial resistances

Critical antimicrobial resistances (CARs) are microorganisms that are known to be a serious threat to the effectiveness of last-line antimicrobial agents. CARs affect patient care and safety, as infections caused by CARs are difficult or impossible to treat. These infections are linked to longer hospital stays for patients and increased risk of long-term illness and death.

CARs are reported by the National Alert System for Critical Antimicrobial Resistances (CARAlert). Data on confirmed CARs for 2022 and 2023 are presented in the **2023** and **2024 CARAlert annual reports**, respectively [17, 18].

In 2024, a total of 3,389 CARs from 74 originating laboratories across Australia were entered into CARAlert by 22 of the 27 participating confirming laboratories.

Key findings

The number of CARs reported increased by 87.1% from 2022 (n=1,446) to 2023 (n=2,706), followed by a further increase of 25.2% from 2023 to 2024 (n=3,389) [17, 18].

Between 2022 and 2024, community cases of *N. gonorrhoeae, Shigella* and *Salmonella* increased, coinciding with the relaxation of travel restrictions after the COVID-19 pandemic [17, 18].

Australia's top antimicrobial resistance threats: 2024 snapshot

Each year, more Australians are infected with AMR microorganisms, requiring more complex treatment, causing longer hospital stays and threatening lives. Australia's most serious AMR threats are listed below.

Enterobacterales: Escherichia coli and *Klebsiella pneumoniae*

Enterobacterales is a large group of bacteria, of which many cause infections in humans. *Escherichia coli (E. coli)* and *Klebsiella pneumoniae (K. pneumoniae)* complex are the most common species of *Enterobacterales*. These bacteria cause infections in hospitals and the community, including urinary tract infections, infections after surgery and septicaemia (bloodstream infections).

Why it matters

Third-generation cephalosporins are a group of antibiotics commonly used to treat infections caused by gram-negative bacteria (recognised by their appearance after Gram staining and appearance under a microscope). Many bacteria, especially *Enterobacterales*, have resistance to third-generation cephalosporins.

Some strains of *Enterobacterales* produce carbapenemase enzymes and are resistant to carbapenem antibiotics. These carbapenemase-producing *Enterobacterales* (CPE) are a particularly serious public health threat. CPE infections are resistant to nearly all antibiotics, leaving only toxic or less effective options for treatment and impacting patient care and safety.

CPE infections can have several types of carbapenemase-producing resistance genes. Multidrug-resistant (MDR) CPE are very difficult to treat.

Who is most at risk

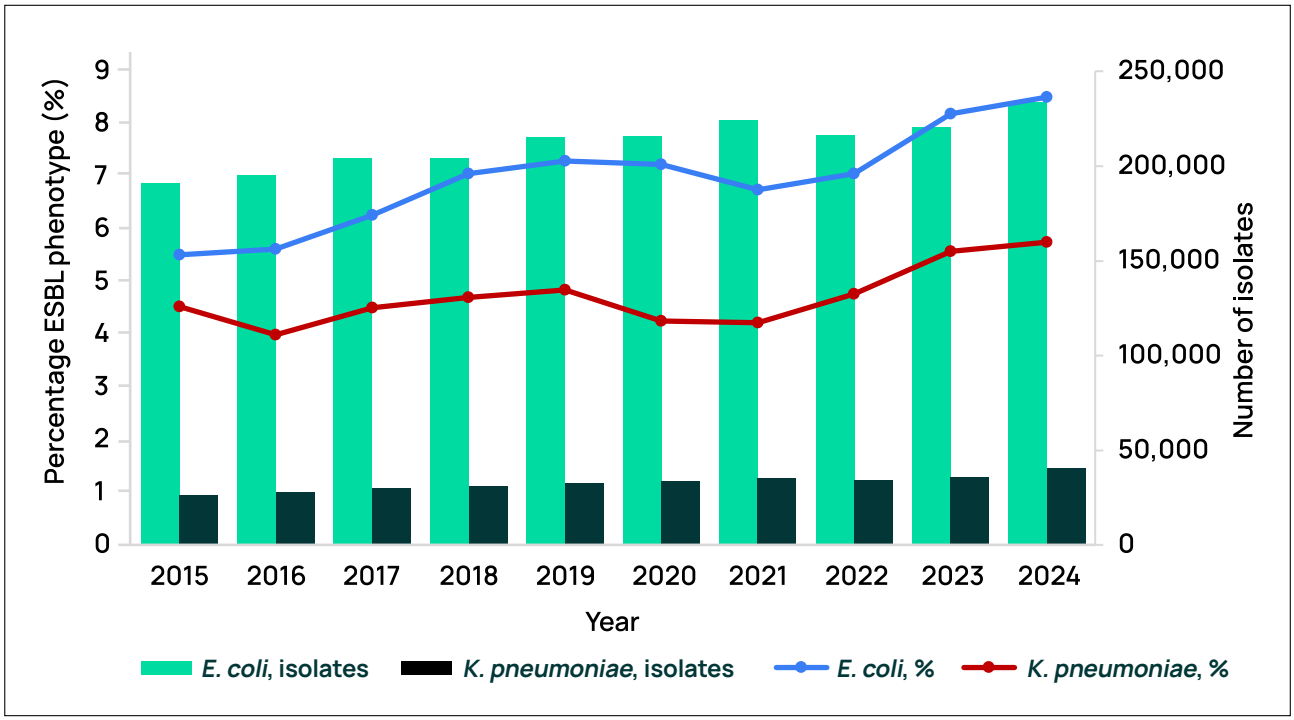
Hospital patients and aged care residents, especially those with underlying health conditions, weakened immune systems or who have invasive devices (e.g. catheters) are most at risk of infection.

Key findings

Key findings

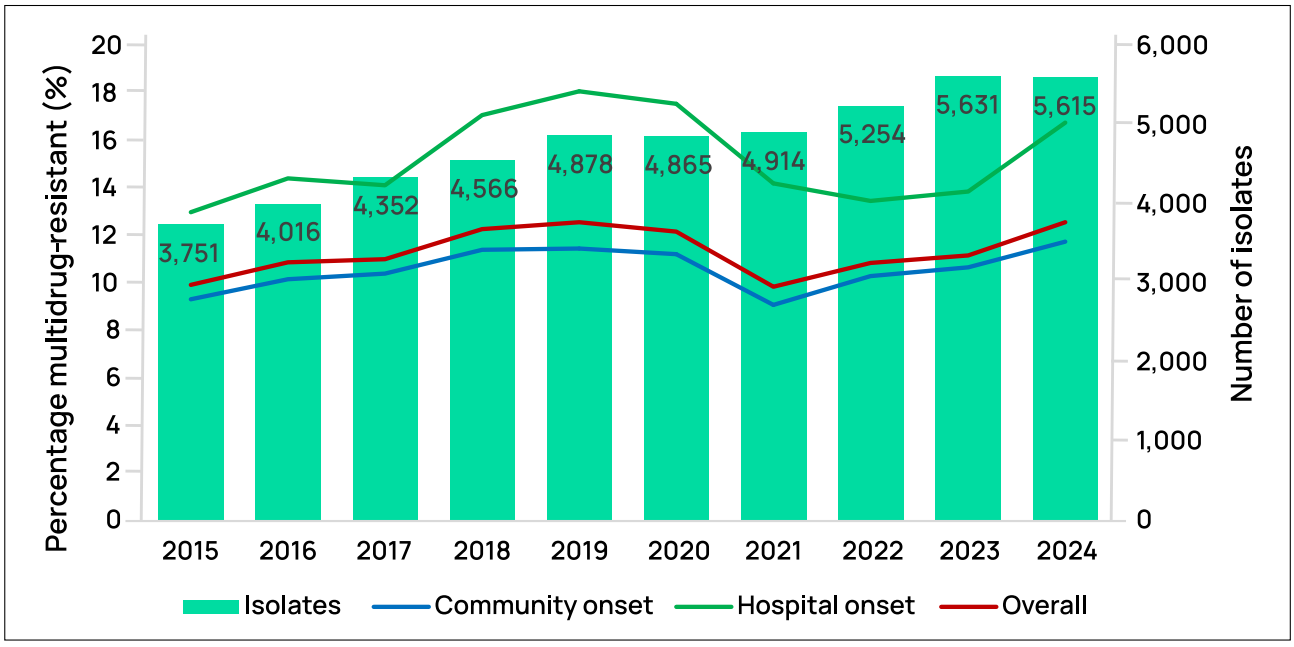
- Resistance to beta-lactam antibiotics (such as third-generation cephalosporins) in *Enterobacterales* has increased in Australia since 2015. The rate decreased during the COVID-19 pandemic and then increased following the easing of restrictions from 2022 to 2024 **(Figure 3.2)**.
- Resistance to third-generation cephalosporin antibiotics (an essential type of antibiotics that treats a broad range of infections) in *E. coli* rose from 7.1% in 2022 to 8.5% in 2024, and resistance in *K. pneumoniae* complex rose from 4.8% in 2022 to 5.8% in 2024 **(Figure 3.2)**.
- The percentage of MDR *E. coli* in bloodstream infections rose from 10.9% in 2022 to 12.6% (n=5,615) in 2024 **(Figure 3.3)**.
- CPE was the most frequently reported CAR (1,527/3,389, 45.1%) in 2024, compared to 2023 (n=1,204). There was a 26.8% increase in overall reports of CPE [17, 18].
- The rates of CPE rose between 2022 and 2024, following a gradual decline from 2019 to 2021 during the COVID-19 pandemic **(Figure 3.4)**.
- In life-threatening bloodstream infections, *E. coli* resistance to ciprofloxacin (an important fluoroquinolone antibiotic that treats a range of infections) rose from 13.7% in 2022 to 15.4% in 2024, and *K. pneumoniae* complex resistance to ciprofloxacin rose from 7.8% in 2022 to 9.7% in 2024 (AGAR data, see Supplementary data).
- The proportions of the 5 most common carbapenemase resistance genes in CPE changed in 2023: NDM types increased while IMP types remained stable (Figure 3.4).
- Resistance to ceftriaxone in *E. coli* showed variation across northern Australian regions, with resistance ranging from 3.9% in the east to 23.4% in central and 10.1% in the west in 2022 [19].

Figure 3.2: Trends in *Escherichia coli* and *Klebsiella pneumoniae* resistance to third-generation cephalosporins, Australia, 2015–2024



Sources: APAS (New South Wales, Victoria, Queensland, South Australia, Western Australia, Tasmania, Australian Capital Territory), 2025; SNP (Queensland, northern New South Wales), 2025.

Figure 3.3: Trends in multidrug-resistant *Escherichia coli* from bloodstream infections, Australia, 2015–2024

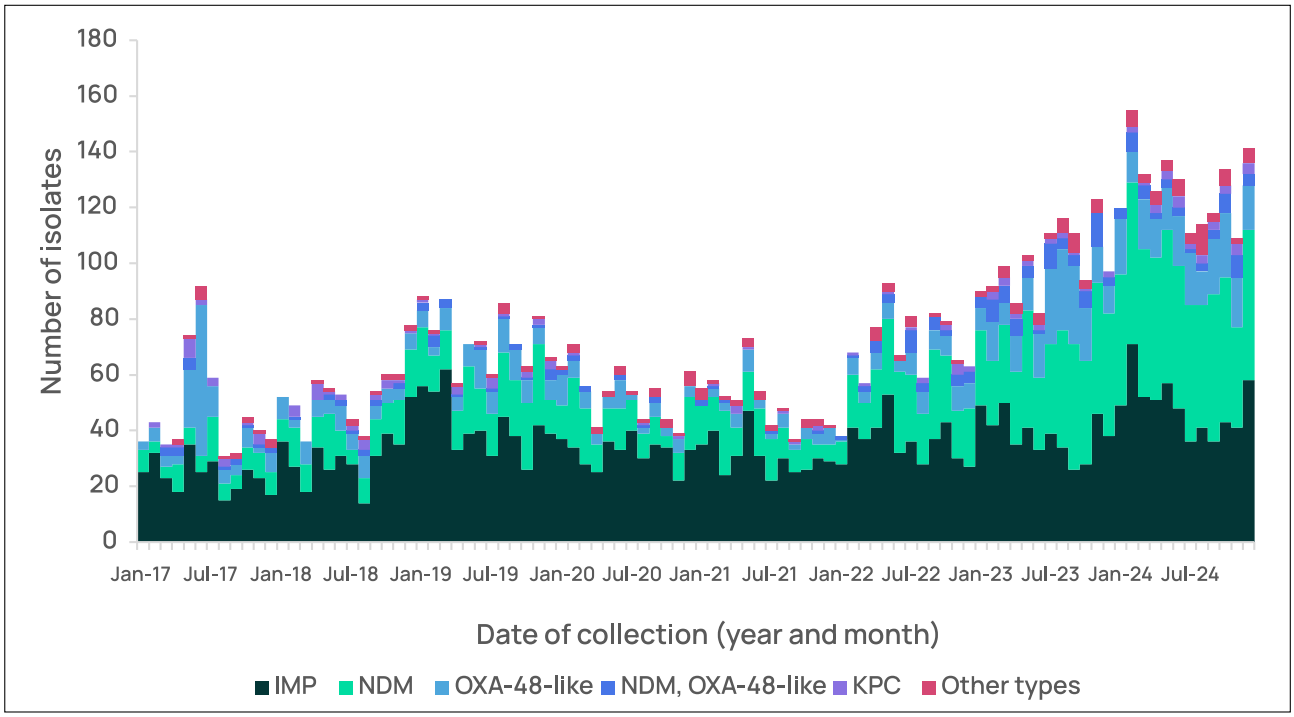


Notes:

1. Multidrug-resistant microorganisms with resistance to at least 1 or more agents in 3 or more of the following antimicrobial groups: aminoglycosides (gentamicin and/or tobramycin), carbapenems (meropenem), extended-spectrum cephalosporins (ceftriaxone and/or ceftazidime), fluoroquinolones (ciprofloxacin), and aminopenicillins (ampicillin).
2. Community-onset=infections acquired by people in the community or in the first 48 hours of admission to hospital.
3. Hospital-onset=infections acquired by a patient at least 48 hours after admission to hospital.

Source: AGAR (national), 2025

Figure 3.4: Trends in carbapenemase resistance genes in *Enterobacterales,* Australia, by month, 2017–2024



Source: CARAlert, 2025

Enterococcus species

These bacteria cause serious infections in patients in hospitals and residents in aged care homes, including bloodstream, surgical site and urinary tract infections.

Why it matters

Enterococci are resistant to several common antimicrobials. Vancomycin-resistant enterococci (VRE), such as *Enterococcus faecium (E. faecium)* and *Enterococcus faecalis (E. faecalis)*, are particularly serious public health threats as they are resistant to almost all available treatments.

Over the past 20 years, *E. faecium* has developed high levels of resistance to ampicillin globally, including in Australia. Vancomycin resistance has increased with the increased use of vancomycin.

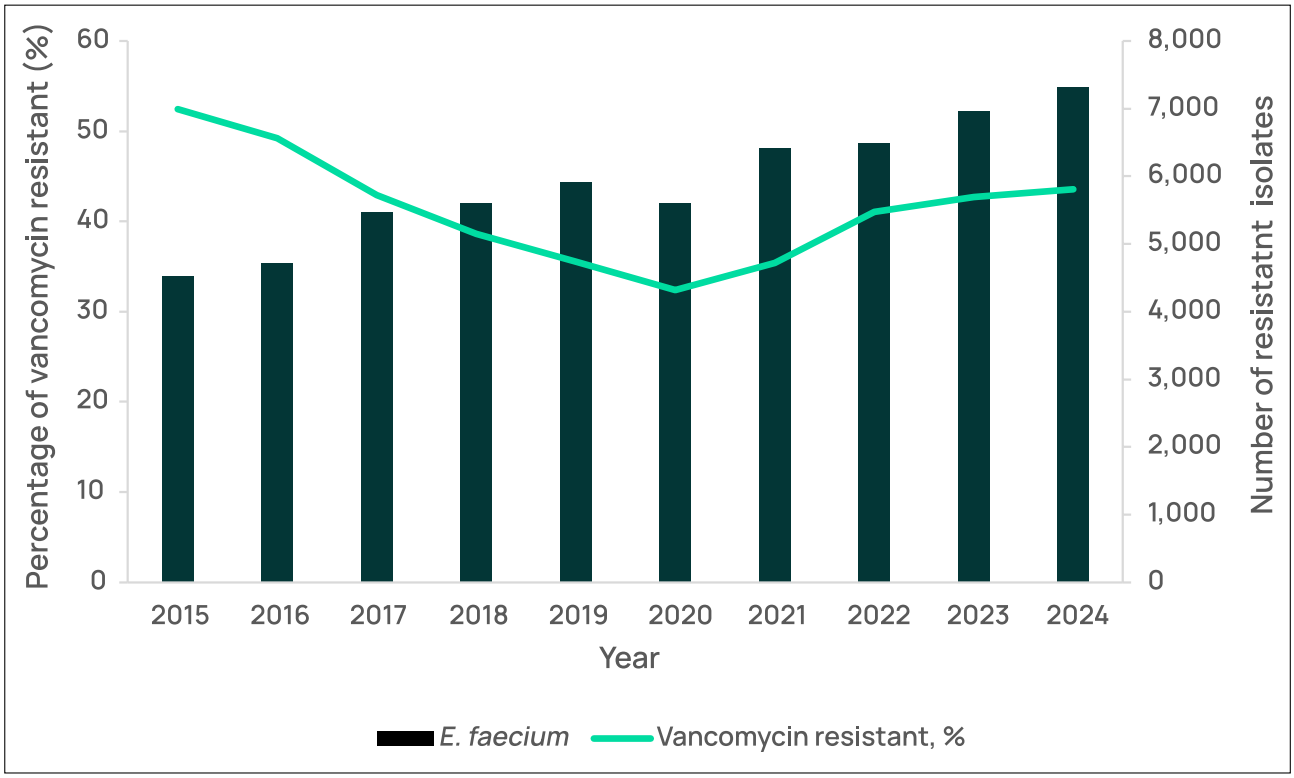
Who is most at risk

Hospital patients and aged care residents, especially those with invasive devices such as catheters are most at risk of infection.

Key findings

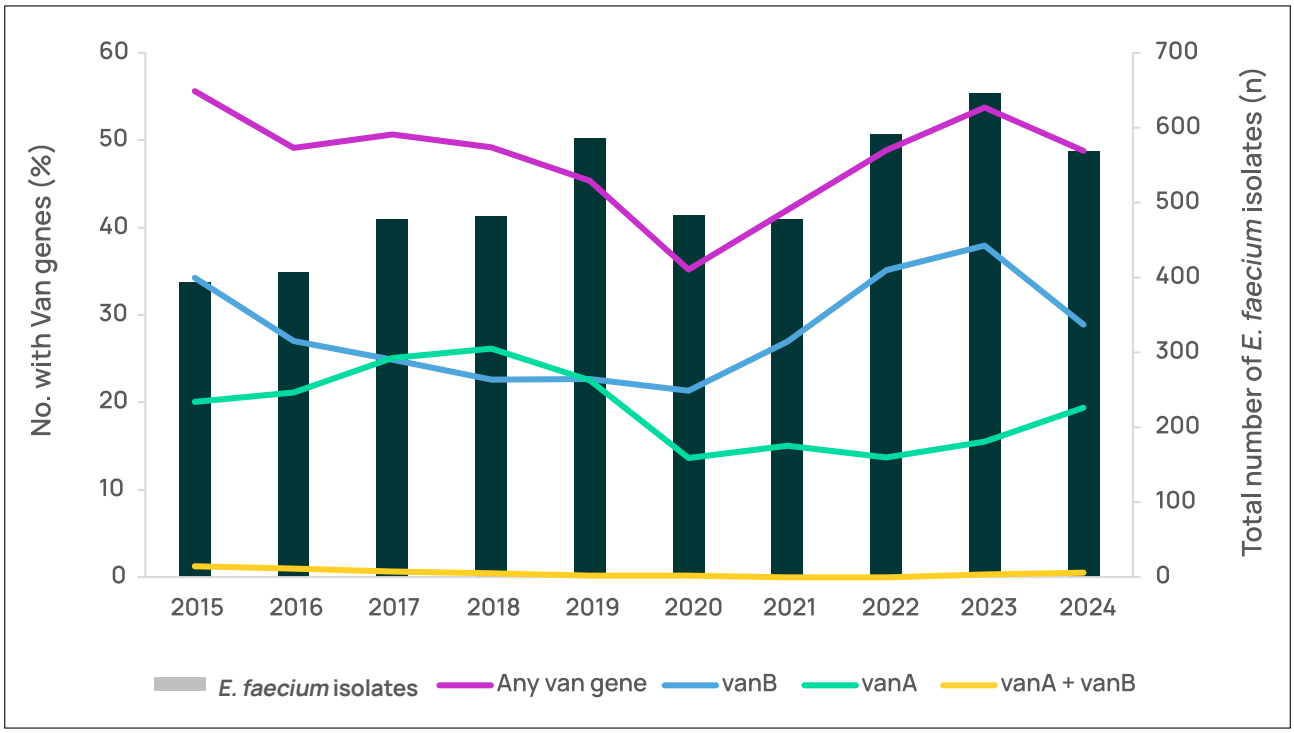
- VRE decreased in Australia from 2015 to 2020, increased from 2020 to 2022 and remained steady at around 42% from 2022 to 2024 **(Figure 3.5)**.
- VRE in life-threatening bloodstream infections increased annually from 2020 to 2023 and dropped from 50.4% (n=657) in 2023 to 44.4% (n=599) in 2024 (AGAR data, see Supplementary data).
- Reports to CARAlert of resistance in *Enterococcus* species to linezolid (an antibiotic used to treat VRE) increased from 17 reports in 2022 to 51 reports in 2023 and to 118 reports in 2024 [17, 18].
- The proportion of *E. faecium* from bloodstream infections with vancomycin-resistant (*van*) genes decreased from 53.7% (n=347) in 2023 to 48.8% (n=277) in 2024, and the makeup of those genes changed in that time (*vanA* 15.5% to 19.4%; *vanB* 37.9% to 28.9%) (**Figure 3.6**).
- In 2022, Australia ranked amongst the highest in VRE rates when compared to the European Antimicrobial Resistance Surveillance Network (EARs-NET) countries [20].

Figure 3.5: Trends in vancomycin resistance in *Enterococcus faecium*, Australia, 2015–2024



Source: APAS (New South Wales, Victoria, Queensland, South Australia, Western Australia, Tasmania, Australian Capital Territory), 2025; SNP (Queensland, northern New South Wales), 2025; NNDSS, 2025

Figure 3.6: Trends in *Enterococcus faecium* resistance genes, Australia 2015–2024



Source: AGAR (national), 2025

Neisseria gonorrhoeae

Neisseria gonorrhoeae (N. gonorrhoeae) causes gonorrhoea, a sexually transmitted infection. The infection can also be transmitted from mother to baby during childbirth if the mother is infected.

Why it matters

Gonorrhoea can be asymptomatic (without symptoms) and spreads easily, often among people who are unaware of their infection. Untreated infections may cause reproductive complications such as ectopic pregnancy, infertility and increased risk of human immunodeficiency virus (HIV) infection.

Ceftriaxone is the recommended treatment for gonorrhoea in Australia, but since 2014, it has been recommended in combination with azithromycin. This change happened because the bacteria that cause gonorrhoea, *N. gonorrhoeae*, started to become resistant to ceftriaxone alone. Sometimes, these bacteria can also become resistant to azithromycin. When *N. gonorrhoeae* shows strong resistance to azithromycin, it becomes much harder to treat gonorrhoea. This raises concerns about the risk of developing forms of the disease that are resistant to many kinds of treatments.

N. gonorrhoeae with high-level resistance to azithromycin and ceftriaxone is known as 'extensively drug-resistant' (XDR) gonorrhoea. It was first reported in Australia and the United Kingdom in 2018 [22], and again in 2022, when cases were reported in Europe, the United Kingdom and Australia [23]. XDR gonorrhoea infections are more challenging to treat, with the possibility that antimicrobials may no longer be effective, even at elevated doses.

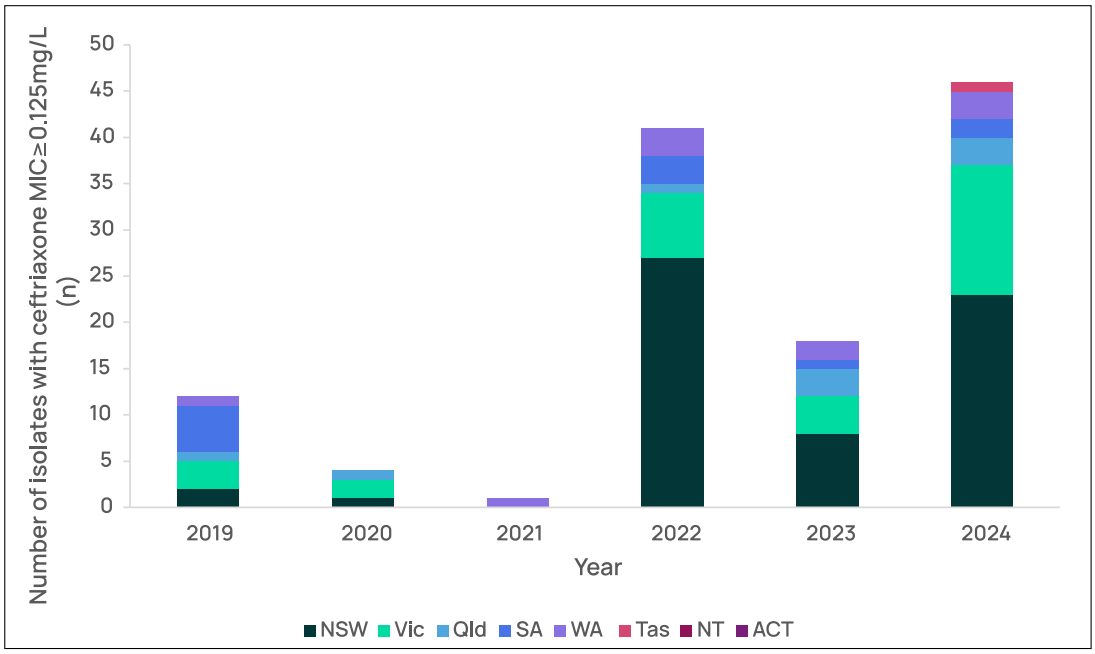
Who is most at risk

People who have unprotected vaginal, anal or oral sex (without a condom or dental dam) or share sex toys with someone who has the infection are most at risk of infection.

Key findings

- The proportion of *N. gonorrhoeae* isolates with azithromycin resistance remained relatively stable (less than 5%) between 2019 and 2024 (3.9–4.6%) [24].
- In 2024, high-level resistance to azithromycin (MIC≥256 mg/L) was identified in 46 isolates of *N. gonorrhoeae*, marking the second year of record cases. This number rose from 27 isolates in 2023 and 9 isolates in 2022 [24].
- In 2024, 55 *N. gonorrhoeae* isolates with decreased susceptibility to ceftriaxone (MIC≥0.125 mg/L) were identified, compared to 18 isolates in 2023 and 41 isolates in 2022 **(Figure 3.7)** [24].
- In 2024, 9 XDR *N. gonorrhoeae* isolates were reported with decreased susceptibility to ceftriaxone, resistance to penicillin and ciprofloxacin, and high-level resistance to azithromycin (MIC≥256 mg/L) [24].

Figure 3.7: Trends in decreased susceptibility to ceftriaxone in *Neisseria gonorrhoeae*, Australia, 2019–2024



NSW=New South Wales, Vic=Victoria, Qld=Queensland, SA=South Australia, WA=Western Australia, Tas=Tasmania, NT=Northern Territory, ACT=Australian Capital Territory

Notes:

The WHO criterion for decreased susceptibility to ceftriaxone in *N. gonorrhoeae* is defined as a minimum inhibitory concentration (MIC) ≥0.125 mg/L. This is monitored by the AGSP.

Source: AGSP annual reports, 2019–2024 [24-29]

Shigella species

Shigella species infection, also known as 'shigellosis', causes diarrhoea, fever and abdominal pain.

Why it matters

Shigella spreads easily through contaminated food, water, shared surfaces and sexual activity, and is a common cause of gastroenteritis outbreaks.

Most healthy people recover without antibiotics. Antibiotics are recommended for severe cases or people with weakened immunity. Resistance to older antibiotics (e.g. azithromycin and ciprofloxacin) is common. As a result, third-generation cephalosporin antibiotics are now recommended. MDR *Shigella* is a particular public health threat.

Who is most at risk

People who are immunocompromised, older people, men who have sex with men, young children aged less than 5 years and their household contacts, travellers to high-burden countries or areas with restricted access to potable water, sewage treatment or adequate sanitation, and sexual contacts and carers of those who are infected are most at risk of infection.

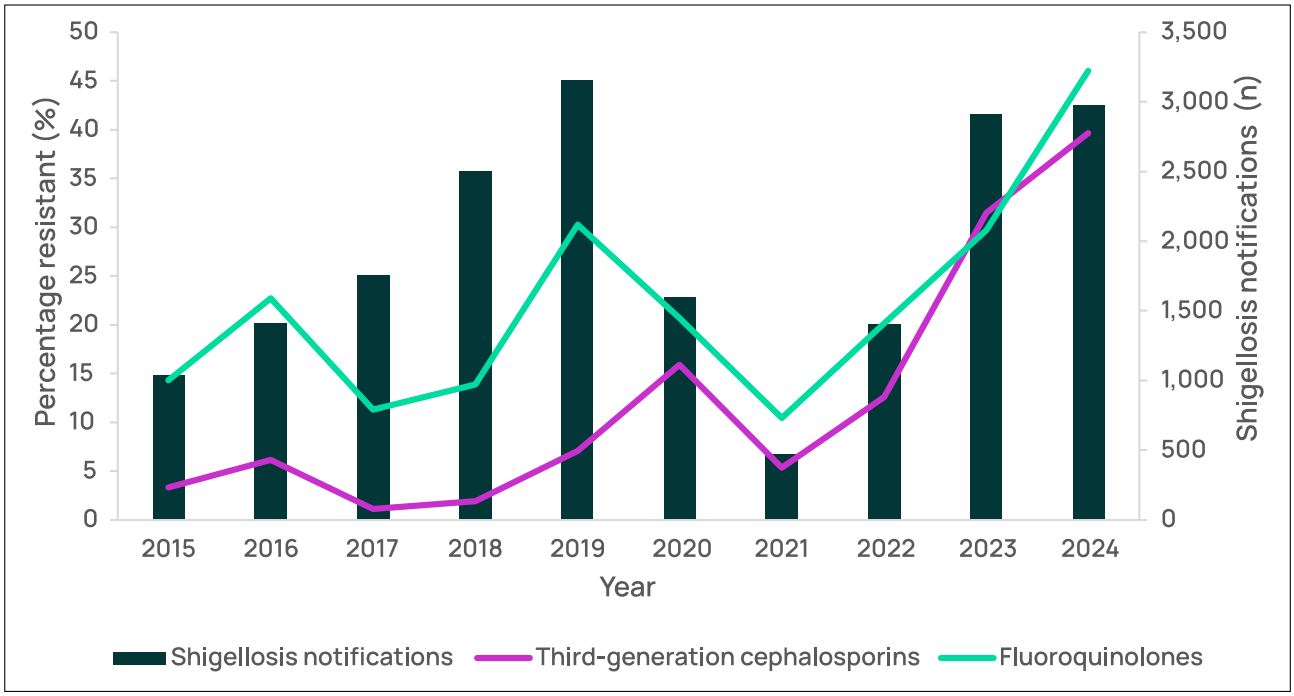
Key findings

Following the easing of COVID-19 restrictions, both the incidence of *Shigella* infections and the proportion with resistance increased between 2021 and 2024 **(Figure 3.8)**.

By 2024, *Shigella* resistance to third-generation cephalosporins reached 40% and resistance to fluoroquinolones rose to 46% **(Figure 3.8)**.

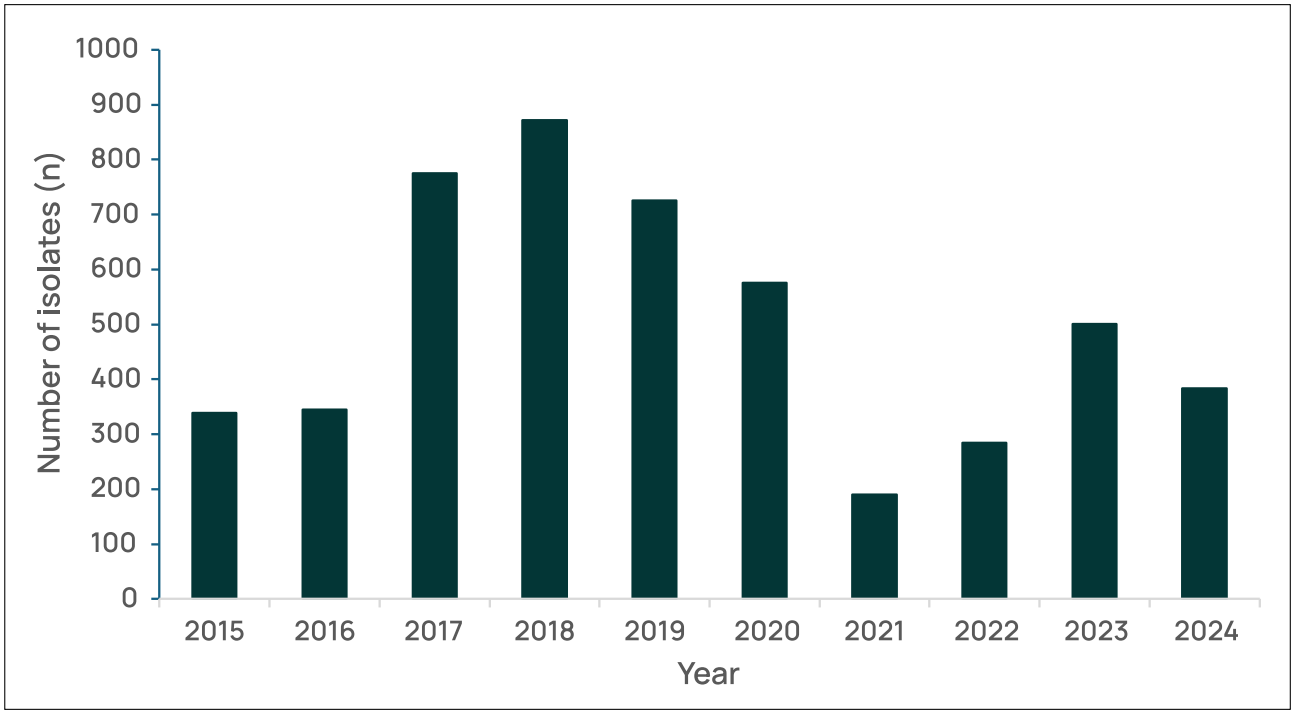
In 2024, there was a decrease in the number of MDR *Shigella* reports compared to 2023 (n=369 in 2024; n=469 in 2023) **(Figure 3.9)** [17, 18].

Figure 3.8: Trends in resistance in *Shigella*, Australia, 2015–2024



Sources: APAS (New South Wales, Victoria, Queensland, South Australia, Western Australia, Tasmania, Australian Capital Territory), 2025; SNP (Queensland, northern New South Wales), 2025; NNDSS, 2025

Figure 3.9: Trends in multidrug-resistant *Shigella*, Australia, 2015–2024



Source: CARAlert, 2016–2024

Staphylococcus aureus

Staphylococcus aureus (S. aureus) are gram-positive bacteria that can cause a wide range of infections of varying severity, from mild skin infections (e.g. boils and impetigo) to more serious infections (e.g. cellulitis) and life-threatening infections (e.g. pneumonia, bloodstream infections and joint or soft tissue infections).

S. aureus infections can also be referred to as 'staph' or 'golden staph'.

Why it matters

S. aureus spreads easily in hospitals and the community. Resistance to methicillin in *S. aureus* (MRSA) is a key issue for this species. All MRSA are resistant to first-line beta-lactams and require alternative therapy.

There are 2 types of MRSA infections, both spread by touching an infected body area or touching surfaces that have touched an infected body area (e.g. towels, bedding or razors):

- **community-associated MRSA strains** are known to cause infections in people living in the community and can affect anyone, including healthy people
- **healthcare-associated MRSA strains** occur in people who have been in hospitals or other healthcare facilities.

While previously considered an infection largely found in hospitals, MRSA has come under control within hospitals in Australia through infection control measures, saving many lives. Community-associated MRSA emerged in the 1980s and is now the dominant strain of *S. aureus* in the community and hospitals. Around 85–90% of *S. aureus* strains in the community are resistant to penicillin [30].

Who is most at risk

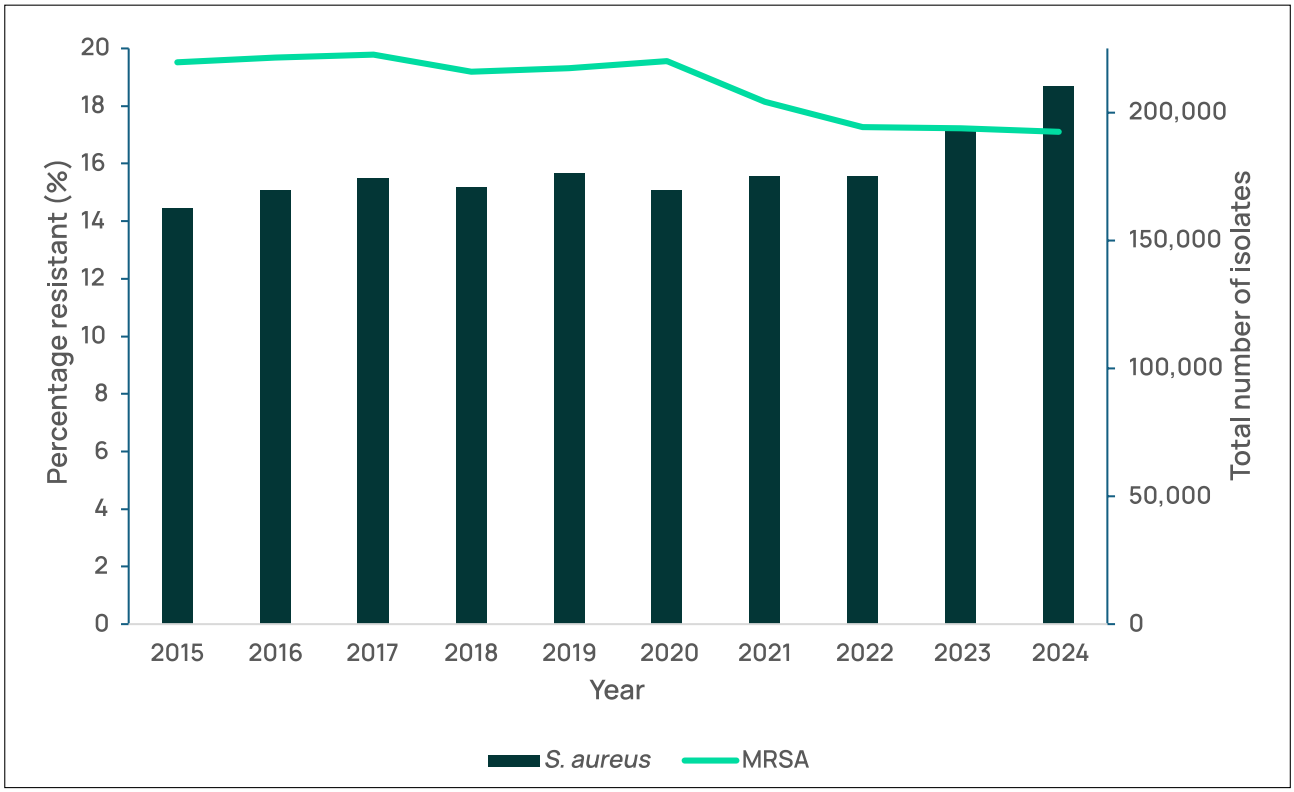
In the community, people in crowded spaces or who have frequent skin-to-skin contact (e.g. households, schools, childcares and jails) and people who have chronic health conditions, broken skin or weakened immune systems are most at risk of infection.

In hospitals, people with weakened immune systems or who have invasive devices such as catheters are most at risk of infection

Key findings

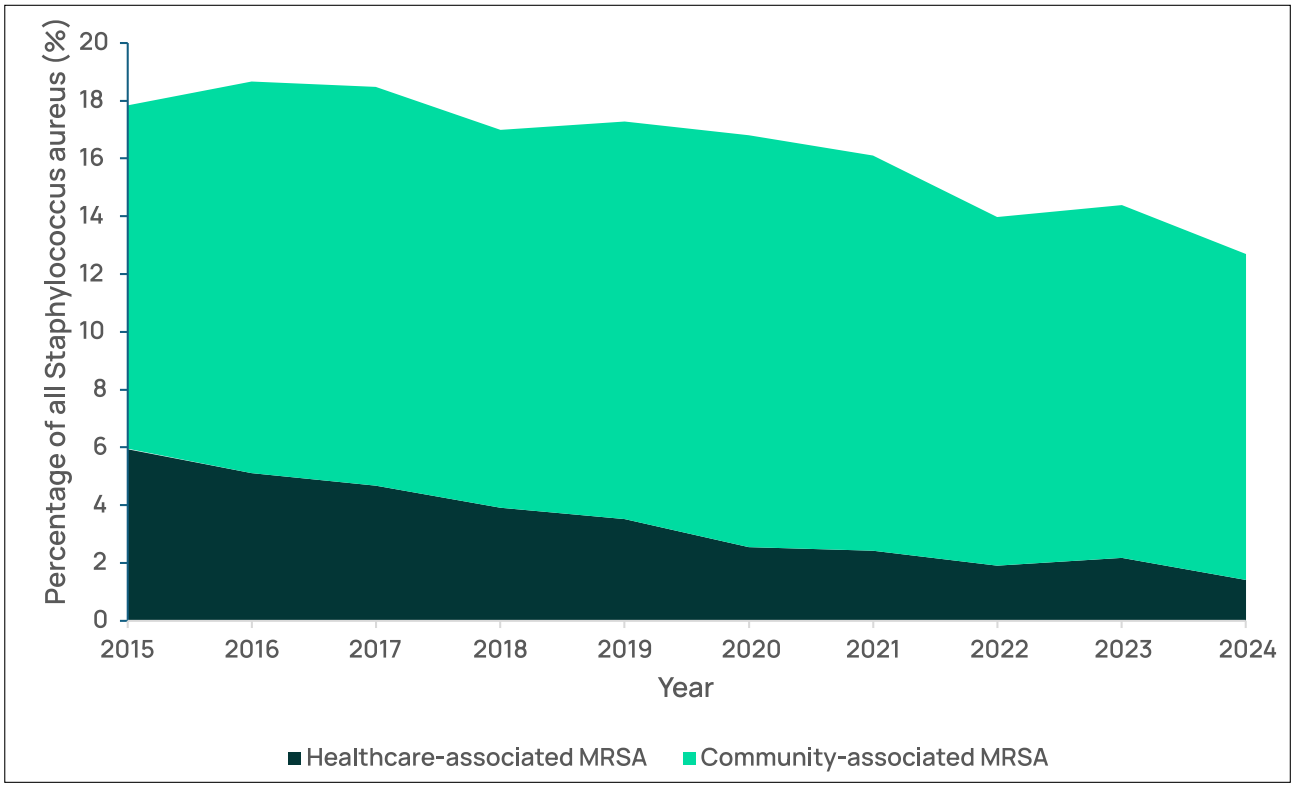
- The proportion of MRSA remained stable at 20% between 2015 and 2020 and declined to 17.1% (n=35,992) in 2024 **(Figure 3.10)**.
- In bloodstream infections, community-associated MRSA increased while healthcare-associated MRSA decreased between 2015 and 2024 **(Figure 3.11)**.
- Rates of MRSA varied greatly across Australia in 2024 and increased with remoteness from major cities **(Figure 3.12)**.
- Vancomycin is used to treat serious MRSA infections, and linezolid is used when vancomycin cannot be used for clinical reasons. No vancomycin-nonsusceptible or linezolid-nonsusceptible *S. aureus* were reported to CARAlert in 2024, and only one vancomycin-nonsusceptible *S. aureus* was reported in 2023 [17, 18].

Figure 3.10: Trends in methicillin resistance in *Staphylococcus aureus*, Australia, 2015–2024



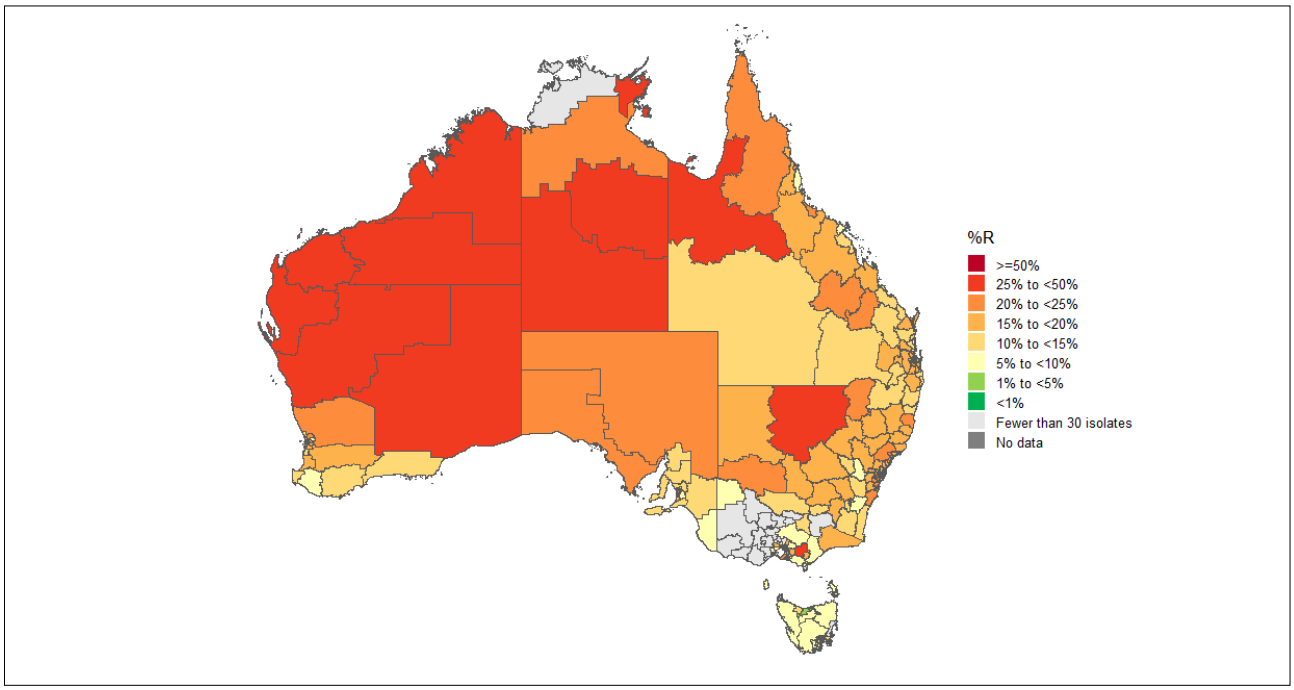
Sources: APAS (New South Wales, Victoria, Queensland, South Australia, Western Australia, Tasmania, Australian Capital Territory), 2025; SNP (Queensland, northern New South Wales), 2025

Figure 3.11: Trends in the sources of methicillin-resistant *Staphylococcus aureus* in bloodstream infections, Australia, 2015–2024



MRSA= methicillin-resistant *Staphylococcus aureus*
Source: AGAR (national), 2025

Figure 3.12: Proportion of methicillin resistance in *Staphylococcus aureus* by Statistical Area Level 3^, Australia, 2024



R=resistance
Notes: ^Statistical Area Level 3 refers to geographic areas designed for analysing regional data.
Sources: APAS (New South Wales, Victoria, Queensland, South Australia, Western Australia, Tasmania, Australian Capital Territory), HOTspots (Northern Territory).

Australia's concerning antimicrobial resistance threats: 2024 snapshot

The following microorganisms under national surveillance are concerning but are less of a threat to Australia at present. Most of these are bacteria except for the fungal microorganism, *Candidozyma* (previously *Candida) auris*.

Acinetobacter baumannii complex

Acinetobacter baumannii (A. baumannii) complex causes healthcare-associated infections in immunocompromised people. These bacteria can survive on surfaces for long periods and have a high level of natural antibiotic resistance.

Why it matters

Carbapenem-resistant *Acinetobacter baumannii* are difficult to treat and may require antibiotics that can be toxic to patients. Carbapenemase-producing *A. baumannii* complex was added as a CAR for reporting in July 2019.

Key findings

Carbapenem resistance in *A. baumannii* was rare; however, reports to CARAlert increased from 23 in 2022 to 37 in 2023 and increased again to 47 in 2024 [17, 18].

Neisseria meningitidis

Neisseria meningitidis (N. meningitidis) can cause septicaemia and meningitis, also known as 'invasive meningococcal disease'.

Why it matters

Invasive meningococcal disease is rare but can rapidly progress to become fatal. People who survive this disease can have long-term health effects, such as loss of a limb, hearing loss and learning difficulties.

Timely treatment with antibiotics is critical. Resistance is very rare in Australia but is increasingly reported overseas. The AMSP has continuously monitored AMR in *N. meningitidis* since 1996.

Key findings

Ciprofloxacin-nonsusceptible *N. meningitidis* was added to CARAlert in 2023, and low numbers were reported in 2023 (n=4) and in 2024 (n=5) [17, 18].

Mycobacterium tuberculosis

Mycobacterium tuberculosis causes tuberculosis (TB), a serious disease that damages the lungs or other parts of the body and is primarily spread through the air. TB is a nationally notifiable disease in Australia and is monitored by the NNDSS [31].

Why it matters

TB is one of the world's most deadly infectious diseases and is a major public health issue in many countries. Australia has one of the lowest rates of TB in the world [32].

Multidrug-resistant TB (MDR-TB) is a concerning public health threat, with limited treatment options available. As drug resistance increases, TB treatment becomes longer and harder for patients to tolerate, treatment success rates drop and costs increase.

Key findings

MDR-TB remains rare in Australia. The proportion of notified cases of MDR-TB in 2023 and 2024 remained within the historical average, with 2.3% (n=22 cases/962 isolates) reported in 2023 and 2.0% (n=23 cases/1,148 isolates) reported in 2024 (see Supplementary data).

Salmonella species

Salmonella can cause diarrhoea, fever and abdominal cramps, with most cases acquired through food.

Why it matters

Some *Salmonella* strains are resistant to multiple antibiotics, limiting treatment options. There are two types of *Salmonella* infections, which can both cause life-threatening complications:

- **non-typhoidal *Salmonella* species** can spread to the blood
- **typhoidal *Salmonella* species (Typhi and Paratyphi)** cause typhoid fever.

Key findings

Ceftriaxone-nonsusceptible Salmonella CAR reports increased from 51 in 2022 to 95 in 2023 and increased again to 104 in 2024 [17, 18].

Pseudomonas aeruginosa

Pseudomonas aeruginosa (P. aeruginosa) cause many types of healthcare-associated infections, including pneumonia, bloodstream infections and surgical site infections.

Why it matters

P. aeruginosa primarily affects hospitalised patients and those with weakened immune systems. Some MDR infections are resistant to nearly all antibiotics, limiting treatment options.

Key findings

Carbapenemase-producing *P. aeruginosa* reports to CARAlert increased from 57 in 2022 to 75 in 2023 and to 97 in 2024 [17, 18].

First-line treatment options for *P. aeruginosa* infections include piperacillin–tazobactam, ceftazidime and meropenem antibiotics. Resistance rates to piperacillin–tazobactam in *P. aeruginosa* remained relatively stable, recorded at 7.5% (n=1,720) in 2022, 7.9% (n=1,733) in 2023, and 7.0% (n=1,727) in 2024 (APAS data, see Supplementary data).

Candidozyma (previously *Candida) auris*

Candida auris (C. auris) is a type of yeast that causes fungal infections.

Why it matters

C. auris spreads easily among hospitalised patients and aged care residents, and can cause severe illness and death. The proportion of bloodstream infections caused by *Candida* species and resistance to antifungal medications are increasing [33]. Reporting to CARAlert for *C. auris* began in July 2019.

Key findings

Reports of *C. auris* to CARAlert remained low, with 9 reports in 2022, which increased to 17 in 2023 and 16 reports in 2024 [17, 18].

Group A *Streptococcus*

Group *A Streptococcus,* also known as *'Streptococcus pyogenes' (S. pyogenes),* commonly causes strep throat, as well as skin and soft tissue infections.

Why it matters

S. pyogenes can also cause serious and life-threatening infections such as scarlet fever, bloodstream infections, bone and joint infections and pneumonia. Acute rheumatic fever and rheumatic heart disease can occur as a complication of infection with *S. pyogenes*, leading to chronic health complications.

Acute rheumatic fever and rheumatic heart disease disproportionately impact certain populations, including Aboriginal and Torres Strait Islander peoples, increasing health disparities.

Key findings

Erythromycin resistance in *S. pyogenes* was 9.5% in 2022, dropped to 6.5% in 2023 and increased to 7.9% (n=2,497) in 2024 (see Supplementary data).

Erythromycin resistance in *S. pyogenes* was more prevalent in major Australian cities [34].

Group B *Streptococcus*

Group B *Streptococcus* (GBS), also known as *'Streptococcus agalactiae' (S. agalactiae*), can cause serious and potentially life-threatening infections.

Why it matters

GBS can cause dangerous infections in people with chronic conditions, weakened immune systems, newborns and pregnant women.

Although the majority of *S. agalactiae* isolates remain susceptible to penicillin, resistance to erythromycin and clindamycin is increasing. This has implications for preventing infections in patients with penicillin allergies.

Key findings

Erythromycin resistance in *S. agalactiae* increased from 34.6% in 2021 to 40.1% (n=4,123) in 2024, and clindamycin resistance in *S. agalactiae* increased from 33.0% in 2021 to 37.1% (n=3,377) in 2024 (see Supplementary data).

Haemophilus influenzae

Haemophilus influenzae (H. influenzae) can cause many different types of respiratory infections, including bronchitis and pneumonia, as well as bloodstream infections and meningitis.

Why it matters

Ampicillin resistance in *H. influenzae* is concerning and limits treatment options.

Key findings

Ampicillin resistance in *H. influenzae* increased from 35.8% in 2022 to 42.7% (n=4,941) in 2024. Amoxicillin–clavulanic acid resistance in *H. influenzae* increased from 15.7% in 2022 to 20.6% (n=1,631) in 2024 (see Supplementary data).

Streptococcus pneumoniae

Streptococcus pneumoniae (S. pneumoniae) can cause middle ear infections, sinusitis, pneumonia, meningitis and bloodstream infections.

Why it matters

Resistant *S. pneumoniae* can be life-threatening in serious infections, such as pneumonia, meningitis and bloodstream infections, as treatment can become ineffective.

Key findings

Erythromycin resistance in *S. pneumoniae* increased from 20.4% in 2022 to 25.4% (n=1,470) in 2024 (see Supplementary data).

Penicillin resistance in *S. pneumoniae* remained fairly stable at 1.9% in 2022 and 1.7% (n=94) in 2024.

Treatment options for resistant *S. pneumoniae* infections include clindamycin (if susceptible to erythromycin) and trimethoprim–sulfamethoxazole antibiotics. Resistance to clindamycin decreased from 16.7% in 2022 to 14.9% (n=615) in 2024. Resistance to trimethoprim–sulfamethoxazole decreased from 20.5% in 2022 to 17.9% (n=669) in 2024 (see Supplementary data).

AGAR Kids: a snapshot

Tracking AMR in Australian children (those aged 0 to 17 years) supports age-specific treatment guidelines and antimicrobial stewardship (AMS). Children experience different infections and AMR patterns compared to adults.

To address these differences, AGAR Kids was established in 2022. It presents paediatric AMR data from the AGAR surveillance programs, responding to calls from global experts, including the World Society for Paediatric Infectious Diseases (WSPID), to focus on AMR in children [35, 36]. The first **AGAR Kids Report: 2020 and 2021** looked at life-threatening bloodstream infections from 2020 to 2021 [37, 38]. This was followed by an analysis of Australian AMR trends in children from 2013 to 2021 [39-41].

The **AGAR Kids Biennial Report No.2: 2022–2023** analysed 1,827 infections from 1,745 children [42]. It found notable differences in AMR patterns between children and adults, reinforcing the importance of surveillance in kids **(Table 3.2)**.

Table 3.2: Number and proportion of the most commonly reported bloodstream infections with antimicrobial resistance in children and adults, Australia, 2022–2023

Children (0–17 years)	Number (n)	Proportion (%)
S. aureus	601	32.9
E. coli	457	25.0
E. faecalis	136	7.4
K. pneumoniae complex	107	5.9
E. cloacae complex	91	5.0
Salmonella (non-Typhi)	85	4.7
P. aeruginosa	68	3.7
Salmonella Typhi	50	2.7
S. marcescens	35	1.9
E. faecium	33	1.8
Adults (≥18 years)	Number (n)	**Proportion (%)**
E. coli	10,521	37.4
S. aureus	6,035	21.5
K. pneumoniae complex	2,730	9.7
P. aeruginosa	1,578	5.6
E. faecalis	1,504	5.3
E. faecium	1,237	4.4
E. cloacae complex	944	3.4
P. mirabilis	669	2.4
K. oxytoca	580	2.1
S. marcescens	464	1.6

Key findings

AMR bloodstream infection rates in Australian children remained consistent from 2022 to 2023, showing no significant change compared to the previous 2020 to 2021 report.

Over half of all infections under surveillance in children were caused by 2 microorganisms: *S. aureus*, accounting for 32.9% (n=601); and *E. coli*, accounting for 25.0% (n=457) **(Table 3.2)**.

In 2023, 15.9% (n=130) of *Enterobacterales* in children with bloodstream infections were resistant to third-generation cephalosporins, the highest proportion ever recorded by AGAR in 11 years of surveillance. The proportion of *Enterobacterales* resistant to first-line antibiotics in children has gradually increased since 2013.

MDR bacteria were present in 12.2% (n=222) of bloodstream infections in children.

The proportion of MRSA in children remained stable at 14% of all *S. aureus* isolates (82/601), with rates at 12.2% in 2022 and 14.9% in 2023, with variation across Australia.

Advocating for policy change

The National Notifiable Disease List (NNDL), established under the *National Health Security Act 2007,* provides the legislative basis for disease tracking at a national level and health information sharing between governments.

The Minister for Health can add or remove diseases from the NNDL following consultation with health authorities in all states and territories. In 2014, the Communicable Diseases Network Australia (CDNA) created a **protocol** for deciding which diseases should be added to the NNDL.

In 2024, the interim CDC nominated CPE to CDNA for inclusion on the NNDL due to the growing need for coordinated national action. A panel of multidisciplinary experts assessed CPE against the protocol criteria and recommended that it sufficiently met the threshold for addition to the NNDL.

The public health threat

CPE infections can cause disability, prolonged hospital stays and death. These bacteria break down carbapenems — reliable last-line antibiotics — leaving very few treatment options. There is global acknowledgement of the public health threat of CPE.

The WHO classified CPE as a critical priority on the **WHO Bacterial Priority Pathogen List (BPPL)** for research and development of new antibiotics [15].

The situation in Australia

In Australia, reports of CPE have consistently increased since 2021, increasing by 27% between 2023 and 2024. The current voluntary surveillance system, CARAlert, is not sufficient to drive public health action. Without efforts to control CPE, it is anticipated that this trend will continue.

Making CPE notifiable:

- **provides the legal authority for health information sharing between governments for effective public health surveillance**
- **enables coordinated and consistent surveillance and national responses**
- **supports the development of national guidelines to direct public health actions.**

Impact

At the time of this report's publication, consultations continue to inform the Minister's decision on adding CPE to the NNDL. Should this go ahead, national surveillance for CPE will be primarily laboratory-based. State and territory health authorities will collect and send de-identified data to the NNDSS, which will monitor disease trends, assess the effectiveness of public health interventions and inform policy development to reduce the impact of CPE.

Implementation requires new legislation and collaboration across public health units and hospitals. Subject to the passage of supporting legislation, reporting is expected to commence from 1 January 2027, following implementation activities through 2026.

Data champions: HOTspots program in the Northern Territory

Antibiotics are the most commonly prescribed medications in remote Australian Aboriginal and Torres Strait Islander communities. They are essential for treating the prevalent and serious infections in these regions. The HOTspots program delivers local AMR surveillance and reporting, which vary by geographic region **(Figure 3.12)**. Healthcare professionals visit the HOTspots digital surveillance platform more than 2,000 times each year.

This snapshot focuses on the Northern Territory (NT), a vast and remote region with unique challenges: high rates of infectious diseases and AMR, limited access to microbiology laboratories and high staff turnover [43]. It fills in a gap in the APAS program.

The HOTspots platform provides practical tools, such as antibiograms (laboratory reports that show the susceptibility of microorganisms to antimicrobials), resistance maps and trends for both hospitals and community settings **(Figure 3.13)**. These tools help clinicians, AMS teams and Aboriginal health professionals to choose the right antibiotics quickly at the time of treatment, supporting effective AMS.

Antimicrobial resistance in the Northern Territory

Resistance patterns in the NT differ from the rest of Australia, particularly for *S. aureus* and *E. coli*. Resistance has remained stable in some microorganisms but is increasing in others, creating particular challenges for infection management in the NT.

S. aureus

- MRSA rates in hospitals were steady at 43.0% and fell in the community from 35.0% in 2022 to 31.3% in 2023.
- Clindamycin resistance remained steady at 22.5% in hospitals and at 18.8% in the community from 2022 to 2023.

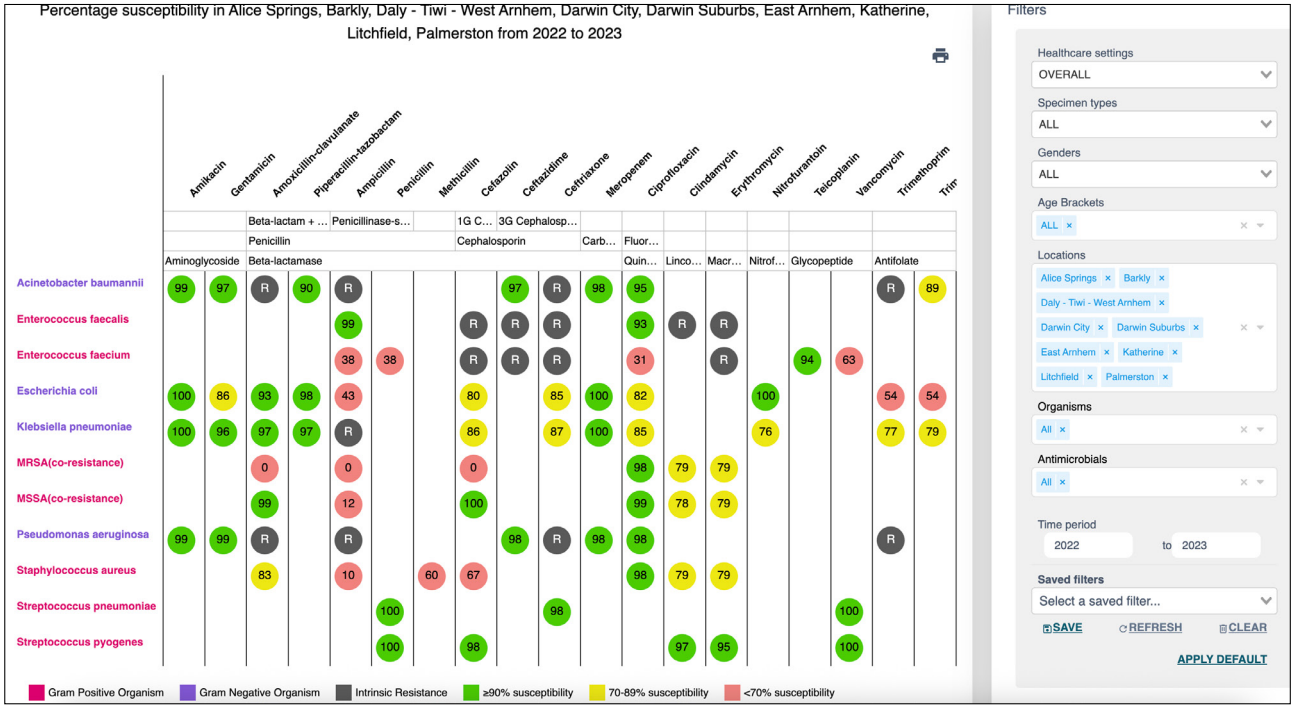
E. coli

- Resistance continued to increase from 2022 to 2023, creating increasing challenges for treatment.
- Ceftriaxone resistance rose in hospitals from 16.3% in 2022 to 18.5% in 2023, and also rose in the community from 10.6% in 2022 to 12.2% in 2023.
- In 2023, 47% of all *E. coli* infections were resistant to trimethoprim and trimethoprim+sulfamethoxazole. Some community clinics reported resistance rates of up to 66.9% for trimethoprim and 59.7% for trimethoprim+sulfamethoxazole.

HOTspots in action

The HOTspots data support better prescribing by avoiding unnecessary use of broad-spectrum antibiotics in areas where resistance is low and narrow-spectrum agents remain effective. In remote NT areas, where limited diagnostic capabilities can result in testing and reporting delays, access to timely HOTspots data is especially important.

Figure 3.13: Antibiogram for the Northern Territory, 2022–2023



HOTspots data has recently informed updates to urinary tract infection treatment guidelines in the Central Australian Rural Practitioners Association (CARPA) *Standard Treatment Manual* [44] [45] and updates to the *Tropical Health Orientation Manual 2025* [46].

Building skills and partnerships

HOTspots conducts in-person and virtual scenario-based education sessions in collaboration with the Northern Territory Primary Health Network, National Aboriginal Community Controlled Health Organisation (NACCHO) and other key stakeholders to build a strong network of antimicrobial stewards.

The NACCHO Antimicrobial Stewardship Academy, run in collaboration with HOTspots, is a 6-month program that equips healthcare workers with essential skills in antibiotic use and resistance. To date, over 40 organisations have taken part in HOTspots education sessions, including GPs, nurses and guideline developers. Additional data can be found on the **HOTspots digital platform**.

Fungal infections: emerging public health threats

While much attention has been placed on antibiotic-resistant bacteria, antifungal resistance is a growing and often overlooked global health threat.

The incidence of fungal infections is rising, accompanied by an increase in antifungal drug resistance. Fungal diseases affect an estimated 6.5 million people globally each year, causing around 3.8 million deaths, of which 2.5 million deaths are directly attributable to fungal infection [47]. This death toll exceeds deaths from tuberculosis and malaria combined.

A notable instance of antifungal resistance is the emergence of *Aspergillus fumigatus* strains that are resistant to the azole class of antifungals (critical antifungal treatments), rendering these treatments ineffective.

The drivers of growing antifungal resistance are multifactorial. Overuse or improper use of antifungals (particularly azoles) in both human health and agriculture contributes to resistance. These developments reinforce the need for a One Health approach that integrates agriculture, animal health, environmental and human health sectors.

Antifungal resistance in Australia

Although national surveillance is limited and precise estimates of various fungal diseases have not been measured, at least 2,000 Australians are diagnosed with invasive fungal disease each year. These are severe fungal infections that spread deep into the body, typically affecting the lungs, blood or internal organs. They are notoriously hard to treat and often fatal.

A 20-year Queensland study from 1 January 2000 to 31 December 2019 showed that invasive candidiasis (*Candida* bloodstream infection) occurred in ~3 people per 100,000 population, with higher rates in infants [33, 48, 49].

Over the past decade in Australia:

- candidaemia cases caused by *Candida glabrata (Nakaseomyces glabratus*), doubled [33, 48]
- resistance to fluconazole (the mainstay and first-line antifungal) in *Candida tropicalis* increased sharply, from less than 2% to 25% [33, 48]
- invasive aspergillosis, particularly in people with blood cancers or transplants, now affects up to 10% of patients and carries an all-cause mortality rate of 30% [50]
- while *Aspergillus fumigatus* is the most common species, other non-*fumigatus* species are increasing [51]
- a new infection, COVID-19-associated aspergillosis, has emerged
- Australia has substantial non-*Aspergillus* mould infections (e.g. *Scedosporium* and *Lomentospora* species) with high death rates of 70–90% [52]
- *Trichophyton indotineae*, a highly drug-resistant skin fungus, has been detected in Australia [53]; resistance in this fungus is largely driven by widespread use of over-the-counter creams containing combinations of antifungals and steroids.

While people with weakened immune systems have an increased risk of fungal infections, people with chronic illnesses, viral respiratory infections (e.g. COVID-19) and traumatic injuries can also be affected.

Priorities for surveillance of antifungal resistance

Effective surveillance is critical to detect, treat and slow the spread of antifungal resistance. Currently, only around half of Australian laboratories routinely test for antifungal resistance [49].

Australia has benefited from data collected by the Australia and New Zealand Mycoses Interest Group (ANZMIG) under the Australasian Society for Infectious Diseases over the last 30 years, yet there is no nationally coordinated surveillance system for antifungal resistance.

Surveillance priorities should include:

- standardised fungal identification and resistance testing methods
- centralised, nationally accessible database
- surveillance to detect rising antifungal resistance patterns
- surveillance in both hospital and community settings, as fungal infections in the community are not detected by current hospital surveillance systems.

Surveillance priorities have been compiled by ANZMIG according to the drug resistance and clinical consequences of each infection and are listed in **Table 3.3**.

Table 3.3: Antifungal surveillance priorities for Australia

Fungal infection	Resistance level	Surveillance priority
Invasive candidiasis and candidaemia		
Nakaseomyces glabratus	10–15% azole resistance	High: increasing cases
Candidozyma auris	>95% fluconazole resistance	High: emerging AMR threat; monitor
Candida tropicalis	25% azole resistance	Very high: increase in azole resistance concerning; revisit preferred treatment
Candida parapsilosis	<5% newly detected azole resistance	Very high: new emergence of azole resistance

Fungal infection	Resistance level	Surveillance priority
Invasive aspergillosis		
Aspergillus fumigatus	<7% azole resistance	Very high: systematic surveillance essential and is not performed
Other types of fungal infections		
Trichophyton indotineae	Terbinafine-resistant (i.e. to first-line and mainstay treatment)	High to very high (new disease, with person-to-person transmission)
Lomentospora prolificans	>90% to all licensed antifungal agents	Medium
Mucormycetes	Resistance rates to amphotericin B, posaconazole, isavuconazole unknown	Medium

Source: ANZMIG

Key findings

Candida infections are the top priority for surveillance, as they are the most common invasive fungal infection and are becoming increasingly resistant to treatments.

Azole resistance, especially in *Aspergillus,* requires urgent attention as standard treatments will not be effective if the rate of resistance exceeds 10% (currently at 7%). If rates exceed 10%, azole monotherapy, currently used in Australasia, will not be suitable, necessitating updated antifungal recommendations for vulnerable populations.

Trichophyton indotineae requires urgent attention due to resistance to both first- and second-line treatments, as resistance is increasing overseas and cases in Australia are likely under-reported.

Chapter 4: Insights and implications

The Sixth AURA report provides a summary of the principal findings from the AURA surveillance program, serving as a valuable reference for understanding antimicrobial use and resistance in Australia from 2022 to 2024. This chapter examines the key concerns and implications arising from these findings and identifies priority areas where targeted interventions are needed.

Antimicrobial use

Hospitals

A combined analysis of data from the 2023 National Antimicrobial Utilisation Surveillance Program (NAUSP) and the National Antimicrobial Prescribing Survey (NAPS), presented for the first time in this report, provides valuable insights into antimicrobial prescribing patterns of participating hospitals.

The findings indicate that ACCESS group antibiotics, which have a lower risk for promoting resistance, are prescribed most frequently; however, their appropriateness is lowest. This shows the need to improve prescribing of ACCESS group antibiotics in hospitals. Antibiotics in the WATCH group were used less often; however, there were only slight improvements in their appropriateness. This suggests that despite tighter controls and monitoring around their use, WATCH group antibiotics are being inappropriately used and there is room for improvement.

Overall appropriateness of antimicrobial prescribing in surgical settings is low and has not shown improvement from previous years. There continues to be a noticeable difference between the appropriateness of antibiotics administered prophylactically (just before or during surgery) versus those administered after a procedure, with antibiotics administered after surgery more often deemed inappropriate. Issues remain, including incorrect duration and overuse of broad-spectrum antibiotics.

The inclusion of antifungal prescribing quality surveillance provides hospitals with new opportunities to monitor both the usage and appropriateness of prescribing. This is an area that has historically received less attention than antibacterial prescribing. Current data reveal significant variability in antifungal appropriateness across a small number of participating hospitals.

Not just informative at the national level, surveillance of antimicrobial consumption and appropriateness support antimicrobial stewardship (AMS) within individual hospitals by enabling benchmarking and identifying areas for improvement within a facility. Opportunities for focused efforts of action emerging from the analysis include:

- Enhancing education and support for prescribers to promote more appropriate prescribing decisions, particularly around ACCESS and WATCH group antibiotics,
- Strengthening stewardship protocols for surgical procedures,

- Ensuring accurate documentation of incision times and antimicrobial administration around surgeries.

There is an opportunity to improve stewardship across all antimicrobials and at every stage of prescribing within hospital settings. Continued participation and support for NAPS and NAUSP programs sustains a consistent national approach to informing and monitoring AMS.

Community

Primary care is the first point of contact for most Australians seeking healthcare and includes general practice, community health services, Aboriginal Community Controlled Health Organisations and aged care. Primary care remains the largest source of antimicrobial prescribing in Australia, and targeted action is essential to reduce inappropriate antimicrobial use and prevent resistance.

The 2024 analysis of antimicrobial use in Australia's community settings provides a national perspective on prescribing trends. More than a third of all Australians were prescribed at least one antimicrobial under the PBS in 2024, indicating the importance of ensuring effective antimicrobials remain available to the community. General practitioners prescribe the vast majority of antimicrobials under the PBS.

Antimicrobial use in the community declined from 2015 to 2024, especially after 2020, showing that sustained reductions are achievable. While this decrease coincided with the response to the COVID-19 pandemic in Australia the sustained decline likely reflects changes to PBS/RPBS repeat prescription policies and shifts in prescriber preferences. However, a recent increase in use is concerning and highlights the importance of continued vigilance.

Although aged care homes represent a small share of total community use, the dispensing rate per resident is very high. Older Australians in aged care receive more antimicrobials than those living at home. Data from the Aged Care NAPS indicate that documentation and prescribing practices in these settings need improvement to meet best practice standards.

Opportunities for focused efforts of action in the community sector include:

- Strengthening communication between healthcare providers, patients, and families regarding the risks of unnecessary antimicrobial use and promote shared decision making with clear, accessible information.
- Increasing public awareness of the benefits of reducing inappropriate antimicrobial use to ensure the sustainability of healthcare.
- Strengthening AMS practices in primary care settings and aged care homes with a focus on:
  - Access to and increased adherence to antimicrobial guidelines.
  - Improved assessment of treatment duration, infection confirmation, and documentation.
  - Targeted AMS initiatives such as prescriber training, prescribing audits and decision support tools to improve appropriateness and reduce unnecessary use.

Supporting GPs is key to driving sustainable change in prescribing behaviour in the community. The *Therapeutic Guidelines: Antibiotic* and the *CARPA Standard Treatment Manual* provide evidence-based advice for preventing and treating infections [13] [45].

Antimicrobial resistance

Australia's ongoing surveillance of AMR enables the monitoring of the emergence and spread of resistant microorganisms. National surveillance focuses on priority microorganisms of public health importance to Australia, due to their prevalence, impact, treatability, and risk of spread in hospitals and the community. Within Australia's top AMR threats:

- Carbapenemase-*producing Enterobacterales* (CPE) is becoming increasingly prevalent in Australia. Infections caused by CPE are associated with high rates of morbidity and mortality due to the difficulty of treating them, with the limited remaining antibiotic options often associated with significant side effects. Those at greatest risk are the vulnerable – people in hospitals and residential aged care homes, especially those with underlying health conditions, weakened immune systems or who have invasive devices.
- Vancomycin-resistant enterococci (VRE) are resistant to almost all available treatments. Linezolid is used to treat infections causes by VRE. While the proportion of enterococci resistant to vancomycin was relatively stable in the last two years, the number of linezolid-resistant *Enterococcus* species increased six-fold over the same period.
- Increased detection of drug-resistant *Neisseria gonorrhoeae* within Australia, along with growing resistance worldwide, are a significant concern. The continued effectiveness of the current recommended treatment is under threat, with no ideal alternate treatment identified.
- The increasing proportion of *Shigella* species with resistance has become a significant concern. Changes in populations at increased risk for shigellosis have also been observed. As a result, shigellosis is now recognised as both a foodborne illness, as well as transmitted sexually [55]. This highlights the need for agile surveillance systems to understand emerging threats and to adapt the public health response effectively.
- Resistance to methicillin in *Staphylococcus aureus* (MRSA) declined nationally in recent years. However, the proportion of MRSA varied greatly across Australia and increased with remoteness from major cities. MRSA in Australia is a reminder that AMR presents different challenges in remote communities.

The overall increase in the number of critical antimicrobial resistance (CAR) to more than double the number seen 2 years prior, provides an indication of increased burden on patients and pressures to the health system, due to AMR. Behind every CAR is a patient with prolonged infection and illness, potentially subject to more toxic and longer treatments. Increased numbers of CARs indicates that the Australian health system is experiencing greater demand for health services, more complex care, extended hospital stays, and increased resource requirements. Increased CARs place pressure on diagnostic and pharmaceutical services, general practice, emergency departments and inpatient services, as well as residential care services.

This AURA report highlights a complex landscape of rising antimicrobial resistance in some microorganisms, while others have remained stable and some resistance has declined. The continued emergence and spread of AMR threats within Australia suggests that there are further opportunities for prevention of and response to AMR.

Australia's National AMR Strategy — 2020 and Beyond identifies the prevention and control of infections

and the spread of resistance as a pillar objective in addressing AMR. There is opportunity to strengthen infection prevention and control across all settings within the human health sector in Australia. This includes ensuring IPC programs are aligned with national guidelines and standards, including implementing core prevention strategies such as hand hygiene, appropriate personal protective equipment use, environmental cleaning. It is also important to improve public health communication by delivering targeted messages to high-risk groups to encourage positive behaviours that minimise the risk of transmission, promote early detection, and facilitate timely and appropriate treatment.

In the control and response to outbreaks, adoption of relevant guidelines is encouraged, such as **The Recommendations for the control of carbapenemase-producing Enterobacterales** and CDNA's Series of National Guidelines.

A Call to Enhance Surveillance and Integrated Reporting

Australia's approach to AMR surveillance provides essential evidence to improve the public health response to AMR. Whilst robust, there are gaps in surveillance that require addressing.

In AU surveillance, PBS/RPBS data do not include private prescriptions, those dispensed by Aboriginal and Torres Strait Islander health services, or over-the-counter medicines supplied without a prescription. Emerging models of service delivery such as community pharmacy prescribing present an important and growing gap. The absence of systems to record and monitor these prescriptions remains a significant blind spot in Australia's antimicrobial use surveillance.

In AMR surveillance, data on critical AMR resistance is collected based on voluntary reporting. This results in an under ascertainment of cases. Inconsistencies in reported data can also occur when contributors do not participate consistently. This makes comparing trends over time difficult. Geographical representation is always the goal, but not always achievable. Beyond completeness of reporting, public health responses to growing AMR threats may be better informed through the integration of microbiological data with risk factor data.

Addressing these gaps and increasing integration is essential to improve our understanding and ability to respond to AMR threats across Australia.

Ensuring Preparedness: The Importance of AURA's Ongoing Work

The AURA surveillance program remains central to Australia's capacity to monitor and respond to antimicrobial resistance, bringing together data from across hospitals, laboratories, community health services, and aged care. By integrating surveillance of both antimicrobial use and resistance, AURA provides the robust evidence base needed to inform clinical practice, guide public health policy, and drive national strategies. This report demonstrates the immense value of such coordinated efforts, offering insights that are essential for safeguarding the effectiveness of antimicrobials now and into the future.

As antimicrobial resistance continues to evolve and new challenges emerge, it is vital that the AURA surveillance program is maintained and strengthened. Ongoing collection, analysis and reporting of data on AMR and AU will ensure Australia remains equipped to detect emerging threats early, evaluate the impact of interventions, and protect the health of future generations.

References

1. Naghavi M, Vollset SE, Ikuta KS, et al. Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050. The Lancet. 2024;404(10459):1199–1226.

2. Wozniak T, Dyda A, Merlo G, Hall L. Disease burden, associated mortality and economic impact of antimicrobial resistant infections in Australia. The Lancet Regional Health – Western Pacific. 2022;27:100521.

3. World Health Organization, Food and Agriculture Organization of the United Nations, United Nations Environment Programme, World Organisation for Animal Health. Implementing the global action plan on antimicrobial resistance: First quadripartite biennial report [Internet]. Geneva: WHO; 2023 [cited 22 August 2025]; Available from: **https://iris.who.int/server/api/core/bitstreams/af8a5f2b-70a8-4bcb-92b4-5f6f2bf9f0d6/content.**

4. Australian Government Department of Health and Aged Care, Australian Government Department of Agriculture, Fisheries and Forestry. Australia's National Antimicrobial Resistance Strategy – 2020 and Beyond. [Internet] Canberra: Commonwealth of Australia [cited 27 August 2025]; Available from: **https://www.amr.gov.au/resources/australias-national-antimicrobial-resistance-strategy-2020-and-beyond.**

5. United Nations General Assembly. Political declaration of the high-level meeting of the General Assembly on antimicrobial resistance: Resolution A/71/L.2. [Internet] [cited 27 August 2025]; Available from: **https://www.un.org/pga/wp-content/uploads/sites/108/2024/09/FINAL-Text-AMR-to-PGA.pdf.**

6. Royal Melbourne Hospital and the National Centre for Antimicrobial Stewardship. National Antimicrobial Prescribing Survey: Technical Supplement 2023. Canberra: Department of Health, Disability and Ageing; 2025.

7. World Health Organization (WHO). The WHO AwaRe (Access, Watch, Reserve) antibiotic book. [Internet] Geneva: World Health Organization; 2022. [cited 1 August 2025]; Available from **https://www.who.int/publications/i/item/9789240062382**.

8. Royal Melbourne Hospital and the National Centre for Antimicrobial Stewardship. Surgical prophylaxis prescribing in Australian hospitals. Results of the 2023 Surgical National Antimicrobial Prescribing Survey. Canberra: Department of Health, Disability and Ageing; 2025.

9. Khanina A, Slavin N, James R, Kong DCM, Slavin MA, Thursky KA. Assessing the appropriateness of antifungal prescribing: Key results from the implementation of a novel audit tool in Australian hospitals. Journal of Antimicrobial Chemotherapy. 2025;80(4):1127-1136. doi:10.1093/jac/dkaf044.

10. Khanina A, Urbancic KF, Haeusler GM, et al. Establishing essential metrics for antifungal stewardship in hospitals: the results of an international Delphi survey. Journal of Antimicrobial Chemotherapy. 2021;76(1):253-262. doi:10.1093/jac/dkaa409.

11. Australian Commission on Safety and Quality in Health Care. Antimicrobial use in the community: 2024. Sydney; ACSQHC, 2025.

12. Royal Melbourne Hospital and the National Centre for Antimicrobial Stewardship. Infections and antimicrobial prescribing in Australian residential aged care homes. Results of the 2023 Aged Care National Antimicrobial Prescribing Survey. Canberra: Department of Health, Disability and Ageing; 2025.

13. Antibiotic Expert Group. Therapeutic guidelines: antibiotic. 16th ed. [Internet] Melbourne: Therapeutic Guidelines Limited; 2019 [cited 22 August 2025] Available from: **https://www.tg.org.au.**

14. Antibiotic Expert Groups. Prehospital management of suspected meningitis, in *Therapeutic Guidelines:* Antibiotic. [Internet] Melbourne: Therapeutic Guidelines Limited, 2025. [cited 22 August 2025] Available from: **https://www.tg.org.au.**

15. World Health Organization. Bacterial Priority Pathogens List, 2024: Bacterial pathogens of public health importance to guide research, development and strategies to prevent and control antimicrobial resistance. [Internet] Geneva: World Health Organization, 2024. [cited 27 August 2025] Available from: **https://www.who.int/publications/i/item/9789240093461.**

16. World Health Organization (WHO). WHO fungal priority pathogens list to guide research, development and public health action. [Internet] Geneva: WHO; 2022. [cited 2025 27 August]; Available from **https://www.who.int/publications/i/item/9789240060241.**

17. Australian Commission on Safety and Quality in Health Care. CARAlert annual report: 2023. Sydney; ACSQHC, 2024.

18. Australian Commission on Safety and Quality in Health Care. CARAlert annual report: 2024. Sydney; ACSQHC, 2025.

19. Wozniak T, Yu A, Shausan A, Legg A, Leung MJ, Coulter SA, et al. Antimicrobial resistance in northern Australia: The HOTspots surveillance and response program annual epidemiology report 2022. Communicable Diseases Intelligence (2018), 2025;49 doi:10.33321/cdi.2025.49.030.

20. Coombs GW, Bell JM, Blyth CC, Bond K, Daley D, Cooley L, Gottlieb T, Iredell J, Warner M, Robson J, and van Hal S on behalf of the Australian Commission on Safety and Quality in Health Care. Australian Group on Antimicrobial Resistance Surveillance Outcomes Programs. Bloodstream infections: 2023 Report. Sydney; ACSQHC, 2024.

21. European Centre for Disease Prevention and Control. Rapid risk assessment: Extensively drug-resistant (XDR) *Neisseria gonorrhoeae* in the United Kingdom and Australia – 7 May 2018. Stockholm: ECDC, 2018.

22. van Hal SJ, Slavin N, Coombs G, Mowlaboccus S, Whiley DM, Lahra MM. Emergence of an extensively drug-resistant *Neisseria gonorrhoeae* clone. Lancet Infectious Diseases. 2024;24(9), e547–e548. doi: 10.1016/S1473-3099(24)00486-9.

23. Lahra MM, Hogan S, van Hal S, Hogan TR. Australian Gonococcal Surveillance Programme Annual Report, 2024. Communicable Diseases Intelligence (2018), 2025;49. doi:10.33321/cdi.2025.49.001. Electronic publication date: 22 January 2025; (in press).

24. Lahra, MM, Shoustari, M, George, R, Armstrong BH, Hogan TR. Australian Gonococcal Surveillance Programme Annual Report, 2019, Communicable Diseases Intelligence (2018), 2020;44. doi.org/10.33321/cdi.2020.44.58.

25. Lahra MM, Hogan TR, Shoushtari M, Armstrong BH. Australian Gonococcal Surveillance Programme Annual Report, 2020. Communicable Diseases Intelligence (2018), 2021;45. doi:10.33321/cdi.2021.45.24.

26. Lahra MM, Hogan TR, and Armstrong BH. Australian Gonococcal Surveillance Program Annual Report, 2021. Communicable Diseases Intelligence (2018), 2022;46. doi: 10.33321/cdi.2022.46.52.

27. Lahra MM, Van Hal S, Hogan TR. Australian Gonococcal Surveillance Programme Annual Report, 2022. Communicable Diseases Intelligence (2018), 2023;47. doi: 10.33321/cdi.2023.47.45.

28. Lahra MM, van Hal S, Hogan TR. Australian Gonococcal Surveillance Programme Annual Report, 2023. Communicable Diseases Intelligence (2018), 2025;49. doi: 10.33321/cdi.2025.49.007.

29. Australian Commission on Safety and Quality in Health Care (ACSQHC). AURA 2023: Fifth Australian report on antimicrobial use and resistance in human health. Sydney: ACSQHC, 2023.

30. Australian Government Department of Health, Disability and Ageing. National Communicable Disease Surveillance Dashboard. [Website.] Canberra: Australian Government Department of Health, Disability and Ageing; 2025. Available from: **https://nindss.health.gov.au/pbi-dashboard/.**

31. Bright A, Denholm J, Coulter C, Waring J, Stapledon R, National Tuberculosis Advisory Committee. Tuberculosis notifications in Australia, 2015–2018. Communicable Diseases Intelligence (2018), 2020;44. p.1-39. doi.org/10.33321/cdi.2020.44.88.

32. Chapman B, Slavin M, Marriott D, et al. Australian and New Zealand Mycoses Interest Group. Changing epidemiology of candidaemia in Australia. Journal of Antimicrobial Chemotherapy, 2017;72(4), 1103–1108. doi: 10.1093/jac/dkw422.

33. Australian Commission on Safety and Quality in Health Care. Australian Passive AMR Surveillance: Trends in macrolide resistance in *Streptococcus agalactiae* and S*treptococcus pyogenes* – 2006 to 2023. Sydney; ACSQHC, 2024.

34. Buttery J, Yang Y, Sharland M and World Society for Pediatric Infectious Diseases. World Society for Pediatric Infectious Diseases declaration on combating antimicrobial resistance in children. World Journal of Pediatrics, 2018;14(6):523–524 doi:10.1007/s12519-018-0195-x.

35. World Health Organization. Global Antimicrobial Resistance Surveillance System (GLASS) report, early implementation 2016-17, [Internet] Geneva: World Health Organisation. [cited 2025 17 July]; Available from **http://www.who.int/glass/resources/publications/early-implementation-report/en/**

36. Williams A, Coombs GW, Bell J, Daley D, Mowlaboccus S, Bryant PA, et al. Australian Group on Antimicrobial Research Surveillance Outcome Programs – Bloodstream Infections and Antimicrobial Resistance Patterns from Patients Less Than 18 Years of Age, January 2020 – December 2021. Communicable Diseases Intelligence (2018), 2024;48. doi: 10.33321/cdi.2024.48.32.

37. Williams A, Coombs G, Bell J, Daley D, Mowlaboccus S, Bryant PA, et al. AGAR Kids Report: 2020 and 2021 Surveillance Outcome Programs - Bloodstream Infections from Patients <18 Years, January 2020 - December 2021. [Internet] Perth: Australian Group on Antimicrobial Resistance. 2023. [cited 2025 17 July]; Available from **https://agargroup.org.au/agar-publications.**

38. Williams A, Coombs GW, Bell J, Daley DA, Mowlaboccus S, et al. Antimicrobial resistance in Bacteraemic Isolates from Paediatric Patients in Australia, 2013-2021, Australian Group on Antimicrobial Resistance. [Internet] Perth. 2023 [cited 2025 17 July]; Available at: **https://agargroup.org.au/agar-publications/.**

39. Williams A, Coombs GW, Bell JM, Daley DA, Mowlaboccus S, et al. Antimicrobial Resistance in Enterobacterales, *Acinetobacter* spp. and *Pseudomonas aeruginosa* Isolates From Bloodstream Infections in Australian Children, 2013–2021, Journal of the Pediatric Infectious Diseases Society, 2024;13(12):617–625.

40. Williams A, C.G., Bell JM, Daley DA, Mowlaboccus S, Bryant PA, et al. Antimicrobial Resistance in *Staphylococcus aureus* and *Enterococcus* spp. Isolates From Bloodstream Infections in Australian Children, 2013–2021. Journal of the Pediatric Infectious Diseases Society, 2025;14(2)110.

41. Williams A, C.G., Bell J, Daley DA, Mowlaboccus S… Blyth CC et al. AGAR Kids Surveillance Outcome Programs - Bloodstream Infections from Patients <18 Years, January 2022 - December 2023. Australian Group on Antimicrobial Resistance: [Internet] Perth. 2025 [cited 2025 17 July]; Available from: **https://agargroup.org.au/agar-publications/**

42. Eustace MB, Hall L, Patel B, Wozniak TM. Responding to the AMR threat: data and information needs of stakeholders working in regional and remote Australia. Antimicrobial Stewardship & Healthcare Epidemiology. 2024 4(1):e94 doi: 10.1017/ash.2024.87.

43. Remote Primary Health Care Manuals. CARPA Standard Treatment Manual (8th edition): [Internet] Alice Springs, NT: Flinders University, 2022. [cited 27 August 2025]; Available from: **https://remotephcmanuals.com.au/manuals.html#fragment-6.**

44. Pharmaceutical Society of Australia. Urinary Tract Infections (UTI) NT Resources, [Internet] 2025. [cited 27 August 2025]; Available from: **https://www.psa.org.au/resource/uti-resources-nt/#:~:text=From%2028%20October%202024%2C%20pharmacists,Substance%20Treatment%20Protocol%20(SSTP).**

45. Menzies School of Health Research. 2025 Tropical Health Orientation Manual. [Internet] Darwin, Northern Territory. [cited 27 August 2025]. Available from: https://www.menzies.edu.au/icms_docs/343389_Tropical_Health_Orientation_Manual_THOM_2025_-_DIGITAL.pdf

46. Denning DW. Global incidence and mortality of severe fungal disease. *Lancet Infectious Diseases*. 2024;24(7):e428-e438. doi: 10.1016/S1473-3099(23)00692-8.

47. Chen S, Slavin M, Nguyen Q, Marriott D, Playford EG, et al. Australian Candidemia Study. Active surveillance for candidemia. Emerging Infectious Diseases, 2006;12(10), 1508–1516, doi: 10.3201/eid1210.060389.

48. Stewart AG, Laupland KB, Edwards F, Koo S, Hammond SP, et al. Population-based longitudinal study over two decades of Candida and Candida-like species bloodstream infection reveals gender and species differences in mortality, recurrence and resistance. The Journal of Infection, 2025;91(1), doi: 10.1016/j.jinf.2025.106513.

49. Chen S, Slavin M, Morrissey O, et al. Burden of fungal infections in Australia. 2014. ICAAC 2014. Abstract.

50. Tio SY, Chen Sc, Hamilton K, Heath CH, Pradhan A et al. Invasive aspergillosis in adult patients in Australia and New Zealand: 2017-2020. The Lancet regional health. Western Pacific. 2023;40, doi:10.1016/j.lanwpc.2023.100888.

51. Heath CH, Slavin MA, Sorrell TC, Handke R, Harun A, et al. & Australian *Scedosporium* Study Group. Population-based surveillance for scedosporiosis in Australia: epidemiology, disease manifestations and emergence of *Scedosporium aurantiacum* infection. Clinical microbiology and infection: the official publication of the European Society of Clinical Microbiology and Infectious Diseases. 2009;15(7), 689–693 doi:10.1111/j.1469-0691.2009.02802.x

52. Chua KY, Halliday CL, Chen SC, et al. Treatment-resistant tinea caused by *Trichophyton indotineae* in Australia. The Medical Journal of Australia, 2024;221(4), 192–194 doi:10.5694/mja2.52386.

53. Australian Commission on Safety and Quality in Health Care. National Safety and Quality Health Service Standards. 2nd ed. version 2, Sydney: ACSQHC; 2021.

54. Australian Bureau of Statistics. Australian Statistical Geography Standard (ASGS): volume 1 – main structure and greater capital city statistical areas. [Internet] Canberra: ABS; 2016 [20 August 2025] Available from: **https://www.abs.gov.au/ausstats/abs@.nsf/mf/1270.0.55.001.**

55 Williamson D, Ingle D, Howden B. Extensively drug-resistant shigellosis in Australia among men who have sex with men. N Engl J Med, 2019, 381:2477–2479

Appendix 1: Data sources

Table A.1 summarises key surveillance sources, including data type, setting and national coverage by year.

Table A.1: Data sources for this report

Surveillance area	Data source	Data type	Setting	Coverage (years and sample sizes)
Antimicrobial use (targeted, hospital)	Hospital National Antimicrobial Prescribing Survey (Hospital NAPS)	Appropriateness, prescribing volume	Australian aged care homes and multi-purpose services	All states and territories, public and private hospitals; 2017: 319 hospitals (233 public, 86 private); 2018: 327 hospitals (234 public, 93 private); 2019: 378 hospitals (268 public, 110 private); 2020: 409 hospitals (285 public, 124 private); 2021: 407 hospitals (291 public, 116 private); 2022: 414 hospitals (300 public, 114 private); 2023: 420 hospitals (298 public, 122 private)
Antimicrobial use (targeted, hospital)	Surgical National Antimicrobial Prescribing Survey (Surgical NAPS)	Appropriateness, prescribing volume	Australian public and private hospitals	All states and territories, public and private hospitals; 2017: 110 hospitals (59 public, 51 private); 2018: 115 hospitals (66 public, 49 private); 2019: 150 hospitals (79 public, 71 private); 2020: 160 hospitals (75 public, 82 private); 2021: 181 hospitals (90 public, 91 private); 2022: 197 hospitals (110 public, 87 private); 2023: 201 hospitals (93 public, 108 private)

Surveillance area	Data source	Data type	Setting	Coverage (years and sample sizes)
Antimicrobial use (passive, community)	Pharmaceutical Benefits Scheme and Repatriation Pharmaceutical Benefits Scheme (PBS/RPBS)	Dispensed volume, trends	Australian general practices and community health services	National antimicrobial prescriptions 2015: 29,264,932 prescriptions; 2016: 27,324,648 prescriptions; 2017: 26,553,451 prescriptions; 2018: 26,229,366 prescriptions; 2019: 26,669,561 prescriptions; 2020: 20,095,926 prescriptions; 2021: 19,931,271 prescriptions; 2022: 21,848,005; 2023: 22,126,604 antimicrobial prescriptions; 2024: 23,190,360 prescriptions;
Antimicrobial use (passive, hospital)	National Antimicrobial Utilisation Surveillance Program (NAUSP)	Dispensed volume	Australian public and private hospitals	All states and territories, public and private contributor hospitals; 2016: 169 hospitals; 2017: 191 hospitals; 2018: 212 hospitals; 2019: 219 hospitals; 2021: 200 hospitals; 2022: 234 hospitals; 2023: 242 hospitals;

Surveillance area	Data source	Data type	Setting	Coverage (years and sample sizes)
Antimicrobial resistance (targeted, community)	Australian Group on Antimicrobial Resistance (AGAR)	Rates of resistance, 30-day all-cause mortality	Australian public and private hospitals (community-onset)	All states and territories, public and private hospitals; 2016: 27 laboratories servicing 45 hospitals and their communities; 2017: 28 laboratories servicing 49 hospitals and their communities; 2018: 28 laboratories servicing 49 hospitals and their communities; 2019: 30 laboratories servicing 52 hospitals and their communities; 2020: 30 laboratories servicing 52 hospitals and their communities; 2021: 30 laboratories servicing 51 hospitals and their communities. 2022: 32 laboratories servicing 56 hospitals; 2023: 33 laboratories servicing 57 hospitals; 2024: 32 laboratories servicing 55 hospitals
Antimicrobial resistance (targeted, community)	National Alert System for Critical Antimicrobial Resistances (CARAlert)	Rates of resistance for priority microorganisms	Australian general practices, aged care homes, community health services and hospital non-admitted care services	National; 28 confirming laboratories; 23 of 26 confirming laboratories (2023); 22 of 27 confirming laboratories (2024)
Antimicrobial resistance (targeted, community)	National Notifiable Diseases Surveillance System (NNDSS)	Rates of resistance and trends for Mycobacterium tuberculosis	Australian general practices, community health services and hospital non-admitted care services	National; 5 reference laboratories

Surveillance area	Data source	Data type	Setting	Coverage (years and sample sizes)
Antimicrobial resistance (targeted, community)	National Neisseria Network (NNN)	Rates of resistance and trends for Neisseria gonorrhoeae (N. gonorrhoeae) and N. meningitidis	Australian general practices, community health services and hospital non-admitted care services	National; 9 reference laboratories
Antimicrobial resistance (targeted, hospital)	Australian Group on Antimicrobial Resistance (AGAR)	Rates of resistance, 30-day all-cause mortality	Australian public and private hospitals (hospital-onset)	All states and territories, public and private hospitals; 2016: 27 laboratories servicing 45 hospitals and their communities; 2017: 28 laboratories servicing 49 hospitals and their communities; 2018: 28 laboratories servicing 49 hospitals and their communities; 2019: 30 laboratories servicing 52 hospitals and their communities; 2020: 30 laboratories servicing 52 hospitals and their communities; 2021: 30 laboratories servicing 51 hospitals and their communities. 2022: 32 laboratories servicing 56 hospitals; 2023: 33 laboratories servicing 57 hospitals; 2024: 32 laboratories servicing 55 hospitals
Antimicrobial resistance (targeted, hospital)	National Alert System for Critical Antimicrobial Resistances (CARAlert)	Rates of resistance for priority microorganisms	Australian public and private hospitals	National; 28 confirming laboratories; 23 of 26 confirming laboratories (2023); 22 of 27 confirming laboratories (2024)

Surveillance area	Data source	Data type	Setting	Coverage (years and sample sizes)
Antimicrobial resistance (passive, community)	Australian Passive AMR Surveillance (APAS)	Rates of resistance	Community and aged care homes	Each of the laboratory services provides access to a range of resistance testing for primary care and non-admitted hospital patients
Antimicrobial resistance (passive, community)	HOTspots	Proportion of resistance	Aged care, prisons and community clinics	Northern Territory, Queensland and Western Australia aged care, prisons and community clinics
Antimicrobial resistance (passive, community)	Sullivan Nicolaides Pathology (SNP)	Rates of resistance	Community and aged care homes	Queensland and northern New South Wales
Antimicrobial resistance (passive, hospital)	Australian Passive AMR Surveillance (APAS)	Rates of resistance	Australian Capital Territory, New South Wales, Queensland, South Australia, Tasmania, Victoria, Western Australia	All Queensland public hospitals; Mater Pathology Brisbane (selected private hospitals, Queensland); all public hospitals and private hospitals in South Australia; selected public hospitals and health services in the Australian Capital Territory, New South Wales, Tasmania, Victoria and Western Australia
Antimicrobial resistance (passive, hospital)	HOTspots	Rates of resistance	Hospitals	All Northern Territory private and public hospitals; All Queensland public hospitals; All Western Australian public hospitals
Antimicrobial resistance (passive, hospital)	Sullivan Nicolaides Pathology (SNP)	Rates of resistance	Queensland and northern New South Wales	Queensland and northern New South Wales

Appendix 2: Terminology

Abbreviations

Term	Definition
AESOP	Australian Enterococcal Surveillance Outcome Program
AGAR	Australian Group on Antimicrobial Resistance
AGSP	Australian Gonococcal Surveillance Programme
AMR	Antimicrobial resistance
AMS	Antimicrobial stewardship
AMSP	Australian Meningococcal Surveillance Programme
ANZMIG	Australia and New Zealand Mycoses Interest Group
APAS	Australian Passive AMR Surveillance
ASSOP	Australian *Staphylococcus aureus* Surveillance Outcome Program
AST	Antimicrobial susceptibility testing
AU	Antimicrobial use
AURA	Antimicrobial Use and Resistance in Australia
AWaRe	ACCESS, WATCH and RESERVE
BPPL	Bacterial Priority Pathogen List
CAR	Critical antimicrobial resistance
CARAlert	National Alert System for Critical Antimicrobial Resistances
CARPA	Central Australian Rural Practitioners Association
CDNA	Communicable Diseases Network Australia
COVID-19	Coronavirus disease 2019
CPE	Carbapenemase-producing *Enterobacterales*
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DDD	Defined daily dose
ESBL	Extended-spectrum beta-lactamase
FPPL	Fungal Priority Pathogens List
GBS	Group B *Streptococcus*

Term	Definition
GLASS	Global Antimicrobial Resistance Surveillance System
GnSOP	Gram-negative Surveillance Outcome Program
GP	General practitioner
HOTspots	HOTspots surveillance and response program
Australian CDC	Australian Centre for Disease Control
IPC	Infection prevention and control
MDR	Multidrug-resistant
MIC	Minimum inhibitory concentration
MRSA	Methicillin-resistant *Staphylococcus aureus*
NACCHO	National Aboriginal Community Controlled Health Organisation
NAPS	National Antimicrobial Prescribing Survey
NAUSP	National Antimicrobial Utilisation Surveillance Program
NCAS	National Centre for Antimicrobial Stewardship
NNDL	National Notifiable Disease List
NNDSS	National Notifiable Diseases Surveillance System
NNN	National Neisseria Network
NT	Northern Territory
OBD	Occupied bed day
PBS	Pharmaceutical Benefits Scheme
RPBS	Repatriation Pharmaceutical Benefits Scheme
PPE	Personal protective equipment
SNP	Sullivan Nicolaides Pathology
UTI	Urinary tract infection
VRE	Vancomycin-resistant enterococci
WHO	World Health Organization
WSPID	World Society for Paediatric Infectious Diseases
XDR	Extensively drug-resistant

Common terms

Term	Definition
Acquired resistance	Resistance to an antimicrobial (or reduction in susceptibility to an antimicrobial) that is gained from other microorganisms or through mutation (usually genetic).
Antibiotics	Antimicrobials developed from an organic source that treat infections caused by bacteria e.g. urinary tract infection.
Antifungals	Antimicrobials that treat infections caused by fungal infections e.g. thrush.
Antimicrobials	Medications that treat infections by inhibiting the growth of or killing microorganisms, such as bacteria, viruses, fungi and parasites.
Antiparasitics	Antimicrobials that treat infections caused by parasites e.g. malaria.
Antivirals	Antimicrobials that treat infections caused by viruses e.g. Coronavirus disease 2019 (COVID-19).
Antimicrobial resistance (AMR)	Failure of an antimicrobial to inhibit or kill a microorganism at standard dosages that used to work.
Antimicrobial stewardship (AMS)	Organised effort by health service organisations to promote appropriate antimicrobial use and extend the effectiveness of antimicrobial treatments. It may incorporate a broad range of strategies.
Antimicrobial susceptibility testing	Laboratory testing that determines if resistance is present in a microorganism and whether an antimicrobial treatment is likely to be effective.
Appropriateness (appropriate use)	Prescribing the correct antimicrobial for the infection, at the correct dose and for the correct length of time.
Beta-lactam antibiotics	A class of antibiotics that share a common beta-lactam ring in their chemical structure. This ring is crucial for their antibacterial activity as it disrupts the bacteria's ability to form a cell wall, which is needed for protection and survival. Penicillin, cephalosporins and carbapenems are examples of beta-lactam classes.
Broad-spectrum antimicrobials	A type of antimicrobial that affects many microorganisms.
Carbapenem antibiotics	Commonly used antimicrobials for infections caused by multidrug-resistant bacteria. Bacteria that produce carbapenemase enzymes are often resistant to other important antibiotic types and can spread their resistance to others.

Term	Definition
Community-onset	Description applied to a microorganism that is acquired by a patient at least 48 hours before they are admitted to a hospital, or to specimens collected in the community, outpatient clinics or emergency departments.
Critical antimicrobial resistances (CARs)	Priority microorganisms with critical resistance to last-line antimicrobials.
Defined daily dose (DDD)	The assumed average maintenance dose per day to treat the main condition for an average adult patient, as defined by the World Health Organization. The DDD is a technical unit of measurement that is widely accepted in international surveillance programs because it enables comparison of antimicrobial use within and between countries.
DDDs per 1,000 people per day	Sales or prescription data about medication use in the community can be expressed as DDDs per 1,000 people per day to give a population estimate for that medicine. For example, 10 DDDs per 1,000 people per day means that, on a given day, 1% of the population received a medicine (or group of medicines). This estimate is most useful for medicines that treat chronic illnesses for which the DDD and the average prescribed daily dose are similar.
DDDs per 1,000 occupied bed days (OBDs)	Antimicrobial use in hospitals is usually measured as a rate using OBDs whereby antimicrobial use (in DDDs) is the 'numerator' and bed occupancy is the 'denominator'. Bed occupancy is a measure of clinical activity in the hospital. The definition of a bed day may differ between hospitals or countries, and bed days should be adjusted for occupancy rate. In hospitals that contribute to the National Antimicrobial Utilisation Surveillance Program, occupied bed days are the total number of hospital inpatient bed days during the period of interest (for example, a month), taken from a count of hospital inpatients every day at about midnight.
Drug-resistant microorganisms	Microorganisms that have a high likelihood of treatment failure are either resistant or less susceptible to at least one antimicrobial.
Extended-spectrum beta-lactamase (ESBL)	An enzyme that can break down and destroy beta-lactam antibiotics. Bacteria that produce these enzymes are usually found in the bowel and urinary tract, and are often considered to be multidrug-resistant organisms because they are resistant to several antibiotics.
Extensively drug-resistant (XDR)	Microorganisms that are resistant to all or almost all available antimicrobial treatments.
High-level resistance	An infection that has become so resistant to an antimicrobial that the drug no longer works at all, even at very high doses.

Term	Definition
Hospital	All public, private, acute and psychiatric hospitals; free-standing day hospital services; and alcohol and drug treatment centres. Includes hospitals specialising in dentistry, ophthalmology and other acute medical or surgical care. It may also include hospitals run by the Australian Defence Force and corrections authorities. It excludes outpatient clinics and emergency departments.
Hospital-onset	Description applied to a microorganism that is acquired by a patient at least 48 hours after being admitted to a hospital.
Isolate	A microorganism that is grown in a laboratory culture from a patient sample.
Last-line antimicrobials	A group of antibiotics used when the commonly used antibiotics fail to treat an infection due to antibiotic resistance. These are a final treatment option for severe antimicrobial resistant infections and are often used to treat multidrug-resistant infections.
Multidrug-resistant (MDR) microorganism	Microorganisms that are resistant to 1 or more antimicrobials in 3 or more classes of antimicrobials.
Narrow-spectrum antimicrobials	A single antimicrobial or class of antimicrobials that affects few microorganisms and contributes less to antimicrobial resistance than broad-spectrum antimicrobials.
Nonsusceptible (reduced susceptibility) microorganisms	Have acquired resistance mechanisms but aren't yet shown to be resistant to treatment.
Occupied bed days (OBDs)	The total number of bed days of all admitted patients accommodated during the reporting period, taken from a count of inpatients at about midnight each day. For hospitals contributing to the National Antimicrobial Utilisation Surveillance Program (NAUSP), subacute beds are excluded from the calculation of OBDs.
Passive surveillance	Use of data that are already collected and designed for a broader purpose that are also used for secondary analysis. In this report, it refers to broader collections from which data on antimicrobial use and resistance can be extracted.
Pharmaceutical Benefits Scheme (PBS)	An Australian Government program that subsidises medicines.

Term	Definition
Reduced susceptibility microorganisms	Microorganisms that have acquired resistance mechanisms but have not yet been shown to be resistant to treatment.
Repatriation Pharmaceutical Benefits Scheme (RPBS)	An Australian Government program that subsidises medicines for veterans.
Residential aged care home	A special-purpose facility that provides accommodation and other types of support to aged residents, including care and assistance with day-to-day living.
Resistant microorganisms	Microorganisms that are either resistant or less susceptible to at least one antimicrobial, which makes it likely that treatment will fail.
Statistical Area Level 3 (SA3)	Geographical areas designed for the output of regional data, including 2016 Census data. SA3s create a standard framework for analysing Australian Bureau of Statistics data at the regional level by clustering groups of Statistical Areas Level 2 (SA2) that have similar regional characteristics [55].
Susceptible microorganisms	These microorganisms do not have acquired resistance and remain treatable using a standard dosing regimen.
Systemic (medication)	A medication that works throughout the body.
Targeted surveillance	Data collection designed for a specific and targeted purpose. In this report, it refers to collections specifically designed for the surveillance of antimicrobial resistant microorganisms.
Topical (medication)	A medication that works in an area of the body is applied to body surfaces such as the skin; includes creams, foams, gels, lotions and ointments.

Appendix 3: Report contributors

Contributor	Section	Affiliation/ Surveillance system
Christina Bareja, Angela Mina Vargas, Robyn Leader, Tony Podpera, Kewal Shah	All chapters	Australian Government, Australian Centre for Disease Control
Erin Connor, Dorsa Maher, Ajmal Dalwai	Chapter 2	NAUSP
Rodney James, Karin Thursky, Caroline Chen, Courtney Ierano, Josephine Wen, Lisa Hall, Noleen Bennett	Chapter 2	NAPS
Jessica Gibney, Lisa Waddell, Madeleine Lakey	Chapter 2 Data champions: How AURA data shaped better treatment of meningitis	Therapeutic Guidelines
John Turnidge, Kim Stewart, Brighid Carey	Chapter 2 and Chapter 3	Australian Commission on Safety and Quality in Health Care, APAS, CARAlert, PBS/ RPBS
Jan Bell	Chapter 3	Australian Commission on Safety and Quality in Health Care, APAS, CARAlert, AGAR
Monica Lahra, Tiffany Hogan	Chapter 3	GLASS, NNN (AGSP, AMSP)
Sebastiaan Van Hal	Chapter 3	NNN (AGSP)
Daniel Miller	Chapter 3	NNDSS
Jenny Robson	Chapter 3	SNP

Contributor	Section	Affiliation/ Surveillance system
Geoffrey Coombs, IDenise Daley	Chapter 3	AGAR, AGAR Kids
Anita Williams, Christopher Blyth, Shakeel Mowlaboccus, Penelope Bryant, Anita Campbell, Louise Cooley, Jon Iredell, Adam Irwin, Annaleise Howard-Jones, Brendan McMullan, Morgyn Warner, Phoebe Williams	Chapter 3	AGAR Kids
Teresa Wozniak, Majella Murphy	Chapter 3 Data champions: HOTspots program in the Northern Territory	HOTspots
Sharon Chen, Justin Beardsley, Catriona Halliday, Sarah Kidd, Tania Sorrell	Chapter 3 Fungal infections: emerging public health threats	ANZMIG
Melissa Waine	All chapters	Writer

All information in this publication is correct as at January 2026.

amr.gov.au