AURA 2016
First Australian report on antimicrobial use and resistance in human health

Consumer Summary
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Introduction

Antimicrobial resistance (AMR) is an issue of great importance for health care in Australia and has been declared a significant threat to human health globally. AMR occurs when bacteria change to protect themselves from antimicrobials. This means that these antimicrobials are no longer effective in treating infections caused by particular bacteria. As a result, infections that could once be treated with, or prevented by, antimicrobials are becoming life-threatening once more.

The Australian Commission on Safety and Quality in Health Care (the Commission) is building a national surveillance system through the work of the Antimicrobial Use and Resistance in Australia (AURA) project. This system will provide data and information about AMR, and also about antimicrobial use (AU), to help develop effective strategies to combat AMR in Australia.

This information will be used to help clinicians, policy makers, program developers, health services, health service managers, state and territory governments, and the Australian Government take action.

1. What are microbes and antimicrobials?

Microbes are bacteria, parasites, viruses, fungi and other microorganisms. Antimicrobials are medicines that are designed to treat or prevent infections caused by bacteria, parasites, viruses or fungi. They kill microbes or stop them from multiplying.

Bacteria, in particular, are present on all of our body surfaces, including on our skin, and in our nose, throat and gut. Almost all of these bacteria are beneficial to our health, but some can cause us to become ill if given the opportunity, such as *Escherichia coli* – the bacterium that causes many urinary tract infections. Other bacteria that do not live on us are also capable of causing infection, such as *Clostridium tetani*, the cause of tetanus.

Antimicrobials include antibiotics (antibacterials), antiparasitics, antivirals and antifungals. The information in this document relates to antibiotics, which are used to treat infections caused by bacteria. Antibiotics are the most commonly prescribed type of antimicrobial.

If you are prescribed an antimicrobial – especially an antibiotic – it is important that you follow your healthcare provider’s instructions on how to take the antimicrobial and how long to take it.

There are different types of antibiotics. Each is designed to work on specific bacteria or a specific range of bacteria. If the antibiotic kills (or stops from multiplying) a small number of different types of bacteria, it is called ‘narrow spectrum’. If the antibiotic kills several different types of bacteria, it is called ‘broad spectrum’.

Using antibiotics when we don’t need them may mean that they won’t work when we do need them in the future.
2. **What is antimicrobial resistance?**

AMR is a general term for the situation in which a microbe has acquired a mechanism to defend itself against an antimicrobial agent that would normally work to treat infections caused by the microbe. Microbes can acquire resistance to one or several antimicrobials, or even whole classes (groups) of antimicrobials.

Different resistances to different antimicrobials can accumulate within bacteria. These are called multidrug-resistant bacteria or multidrug-resistant organisms (‘superbugs’). Methicillin-resistant *Staphylococcus aureus* (MRSA), sometimes known as ‘golden staph’ is an example of a multidrug-resistant bacterium.

It is important to understand that it is not you, as an individual, that becomes resistant to antibiotics – it is the bacteria that cause the infection that can become resistant to antibiotics.

AU is the main driver of AMR. The more we use antimicrobials, especially unnecessarily, for conditions for which they are of no benefit, the more microbes are exposed to the antimicrobial and have the chance to acquire resistance to it and spread. Antibiotics with a broad spectrum are more likely to cause AMR than those with a narrow spectrum.

Antimicrobial resistance results when bacteria shield themselves from the effects of an antibiotic. When bacteria shield themselves against many antibiotics, it is called multidrug resistance.

Resistance results in medications becoming ineffective at curing infections caused by these bacteria.

Some bacteria are now so resistant that there are no medications available to treat infections caused by them.

3. **Why should antimicrobial resistance be important to me?**

AMR affects your health by limiting the healthcare treatment options available to you.

Resistant microbes contribute to illness and death. They can also cause significant costs, both financially and health-wise, to you and the health system, and increase your length of stay in hospital.

Infections that are caused by resistant bacteria are harder to manage. The bacteria may require treatment with broad-spectrum rather than narrow-spectrum antimicrobials, or the use of antimicrobials which may have more side effects. You may even need to be treated in hospital with intravenous antibiotics because the bacteria causing your infection are resistant to all the medicines that can be given by mouth. If you pick up and carry a resistant organism, you may spread it to your family or other people close to you.

AMR puts modern medicine and medical procedures at risk by exposing patients to the risk of infections that available antimicrobials may not be able to treat. This is why AMR has been declared a significant threat to human health globally.

Unless the rate of AMR is slowed, by a range of means, and new antimicrobials are developed, the impact and cost of AMR will continue to increase because more people will be sicker for longer, and have infections and complications which are harder to treat.

If antimicrobials completely stop working on the microbes they have been designed to eradicate, it is possible that important healthcare treatments, such as surgery and chemotherapy, will become too risky because these procedures and treatments have an increased risk of infection. These treatments may therefore no longer be readily available.
4. What is AURA 2016?

If Australia is to reduce the amount and impact of AMR, we need to understand which microbes are becoming resistant to the antimicrobials designed to treat them, and how fast this resistance is changing.

The Commission’s AURA Surveillance System was developed to support a national approach to address AMR in Australia’s health and agriculture sectors, in an integrated and coordinated way. This national approach is called the National Antimicrobial Resistance Strategy 2015–2019.

The Commission’s report on antimicrobial use and resistance in human health (AURA 2016) is the first Australian report to provide a comprehensive picture of antimicrobial use, resistance rates and patterns across Australia. AURA 2016 includes data on:

- antimicrobial prescribing and dispensing in the community
- antimicrobial use in hospitals, residential aged care facilities and multipurpose services
- the appropriateness of antimicrobial prescribing in hospitals, general practice, residential aged care facilities and multipurpose services
- rates of resistance for a set of priority microbes against antimicrobials used for treatment.

Looking at these data collections, in an integrated way, shows which antimicrobials are being prescribed unnecessarily; which antimicrobials may be at risk of becoming less effective or ineffective; and, which bacteria are particularly threatening to people’s health.

Surveillance of antimicrobial use and resistance:

- measures the level of exposure (use), and the appropriateness of use, of antimicrobials in hospitals and the community
- detects antimicrobial resistances early to ensure that effective action can be taken to prevent their spread
- measures the size, burden, importance and, where possible, impact of antimicrobial resistance
- enables changes in antimicrobial use and resistance patterns to be monitored
- provides information on the effectiveness of measures to control antimicrobial use and contain antimicrobial resistance.
5. Australia’s use of antimicrobials

Australia has national guidelines to help healthcare professionals make decisions about whether to prescribe antimicrobials, which ones are appropriate, the appropriate dose, and the length of time for use. Despite these guidelines, antimicrobials are sometimes prescribed inappropriately – such as to treat viral infections (such as colds or flu) where they have no benefit, or when they are not recommended because the infection will get better by itself.

Antimicrobial use in hospitals

Information has been collected on prescribing practices in hospitals from two national surveys undertaken in 2014. This information shows that:

- across Australia, antimicrobial use in hospitals has slowly decreased since 2010
- on any day, around 38% of patients in a hospital are prescribed an antimicrobial
- the most commonly used antimicrobials in hospitals are from the two classes which cover a broad range of bacteria, called cephalosporins and β-lactamase inhibitor combinations; these antimicrobials treat conditions such as surgical wound infection
- approximately 23% of prescriptions in hospitals are judged to be inappropriate; these are mostly related to prescriptions for lower respiratory tract infections, and for preventing and reducing the risk of infection after surgery.

Defined daily dose (DDD) is a measure to allow data collected from different populations to be compared. DDD/1000 population/day gives an approximate measure of how many people are taking an antibiotic on any given day.

Occupied bed days refer to the number of patients in hospital overnight.

Figure 1 illustrates the usage rates of the different types of antimicrobials, broken down by state and territory.
Antimicrobial use in the community

Information about the use of antimicrobials in the community comes from a 2014 analysis of data collected on prescribing in general practice, and records of prescriptions dispensed under the Pharmaceutical Benefits Scheme and Repatriation Pharmaceutical Benefits Scheme. This data highlights that:

- Australians had more than 30 million prescriptions for antibiotics filled in 2014, with approximately 46% of people having at least one prescription filled
- antimicrobials of the penicillin and cephalosporin classes were the most commonly prescribed antimicrobials in the community setting
- more than 50% of people with colds and upper respiratory tract infections were prescribed antimicrobials when they are not recommended by current prescribing guidelines
- some antimicrobials were prescribed much more in winter, which suggests that they are being used to treat colds and flu, for which they have no benefit
- the use of antimicrobials varies from state to state across Australia, and between local areas; the reasons for these differences are being investigated.

Figure 2 shows the number of antibiotic prescriptions filled per year for the 20-year period 1994–2014.

Most of the antibiotics of interest are categorised as ‘J01’ by the World Health Organization to distinguish them from numerous other categories of medicines. They do not include topical preparations (for example, ointments, eye drops and ear drops).

The data shows a rise in the number of antibiotics dispensed in 2003, and again in 2006; it has remained relatively steady since then. The Commission is working with peak bodies to determine the reasons for these rises, to improve the appropriateness of antibiotic prescribing in the future.

Figure 2: Volume of antimicrobials dispensed under the Pharmaceutical Benefits Scheme/Repatriation Pharmaceutical Benefits Scheme per year, 1994–2014

Notes:
1. J01 is the code for antibacterials for systemic use.
2. Before April 2012, includes estimates of under co-payment and private dispensing; after April 2012, includes actual under co-payment data, but no estimate from private dispensing. The DDD/1000 inhabitants/day exclude some items for which there is no DDD.
Source: Drug Utilisation Sub Committee database, October 2015
Antimicrobial use in residential aged care facilities

Information about antimicrobial use in residential aged care facilities comes from the 2015 Aged Care National Antimicrobial Prescribing Survey pilot which provided results of antimicrobial prescribing and infections in Australian residential aged care facilities. This pilot survey was conducted by the National Centre for Antimicrobial Stewardship.

Among the 186 residential aged care facilities and multipurpose services in Australia which participated, it is clear that:

• antimicrobials were being used for conditions where they were not required, such as urinary tract, soft tissue and skin infections
• for the period of the survey, only 4.5% of residents in residential aged care facilities had a suspected or confirmed infection, but more than 11% of residents were prescribed an antimicrobial
• 22% of antimicrobial prescriptions were written for residents who had no signs and symptoms of infection in the week before starting the course of antimicrobials
• of the residents who did have signs and symptoms of an infection, only 33% of the prescriptions issued were for infections that required treatment with an antimicrobial.

6. How much antimicrobial resistance is there in Australia?

Twelve bacteria, or bacterial families, have been identified as the most important for monitoring in Australia. Some of these bacteria are important to monitor because they are a common cause of infection or spread easily, while others are important to monitor because they can have a significant impact on a person’s health when they do cause infection.

Resistant bacteria can spread easily between people in the community, hospitals, other health services and residential aged care facilities. The spread of these bacteria often happens quickly and may go unnoticed until an infection has developed. Therefore, it is important that Australia identifies and monitors resistant bacteria so that action can be taken to prevent them from spreading.

Antimicrobial resistance in key microbes

Data on rates of resistance in key microbes in 2014 comes from laboratory data from Queensland, and a specially targeted national survey. The effects of resistance rates will depend on the severity of infection:

• High resistance rates means that the antimicrobial is very unlikely to be effective for any type of infection.
• Moderate resistance rates will have little impact on bacterial infections that tend to get better by themselves. However, the resistance rate will have a major impact on the choice of treatment for a serious or life-threatening infection.
• Low resistance rates are only important to consider in serious or life-threatening infections. Most of the bacteria listed below can cause either minor or serious infections, depending on the site of infection and whether the infected patient has underlying complications, such as a compromised immune system.
Acinetobacter baumannii
This organism is associated with pneumonia and wound infection. It is particularly important in intensive care units and burns units.

The resistance rates for the important antimicrobials used for treatment of infections with this organism are low, at less than 5%.

Mycobacterium tuberculosis
This is the organism that causes tuberculosis. Although multidrug resistance is currently low in Australia, resistance rates have very gradually been increasing.

Enterobacteriaceae
This is a large family of bacteria that includes Escherichia coli (E. coli), Klebsiella pneumoniae and Enterobacter cloacae complex. They cause urinary tract infections, infections after surgery and blood poisoning (also known as septicemia).

Some E. coli strains are resistant to third-generation cephalosporins, which are very important antimicrobials that are used for treating serious infection – for instance, when E. coli causes septicemia during a kidney infection.

Resistance in Enterobacteriaceae is an increasing problem for community infections, because these bacteria are often resistant to several classes of antimicrobials. Infections caused by them need to be treated in hospital because of a lack of effective antimicrobials that can be taken orally in the community.

Neisseria gonorrhoeae
This organism causes gonorrhoea, a sexually transmitted infection.

The organism’s resistance levels to the antimicrobials designed to eradicate it (benzylpenicillin and ciprofloxacin) are at approximately 30%, but have been stable for some time. This means that Neisseria gonorrhoeae infections now need to be treated with a third-generation cephalosporin antimicrobial called ceftriaxone.

Resistance to ceftriaxone is rare at present, but this is being closely monitored.

Enterococcus species
This group includes Enterococcus faecium and E. faecalis. These bacteria can cause infections in people in hospitals after surgery or in people requiring treatment involving invasive devices, such as catheters.

Australia has one of the highest rates of vancomycin resistance in E. faecium in the world.

Rates of resistance to key antimicrobial agents are currently very low in E. faecalis, but high to very high in E. faecium.

Neisseria meningitidis
This organism causes so-called invasive meningococcal disease (mostly septicaemia and meningitis), which can kill rapidly.

Resistance rates in this organism to key antimicrobials are low, at less than 5%.
Pseudomonas aeruginosa
This organism mainly affects hospitalised patients or patients with compromised immune systems. It can cause urinary tract infections, and infections in burns and other wounds.
Resistance rates to key antimicrobials are around 10% or less.

Salmonella species
These species are an important cause of infections such as gastroenteritis, and are spread in contaminated foods. The so-called typhoidal Salmonella species also cause a condition called enteric (typhoid) fever, which can be fatal if left untreated.
Rates of resistance to the fluoroquinolone class of antibiotics in these species are very low (1%) in the non-typhoidal Salmonella species, but are more than 12% in the typhoidal Salmonella species. This antibiotic class is very important for treatment.

Staphylococcus aureus
This is a common organism carried by many people. Also known as ‘golden staph’, it causes a wide range of infections, such as boils, impetigo (school sores), wound infections, bone and joint infections, inflammation of the lining of the heart (endocarditis), and blood poisoning (septicaemia).
Between 16% and 17% of isolates are methicillin-resistant S. aureus (MRSA). This means that they are resistant to the most common antibiotics used to treat infection, including all members of the penicillin class and almost all members of the cephalosporin class.
Strains of MRSA that arise in the community now cause a significant level of infection in both the community and hospital settings, especially with the increased movement of patients.

Shigella species
These organisms are an uncommon but significant cause of gastroenteritis. They can be easily transmitted between people.
Data on resistance is limited, but the level of resistance to fluoroquinolones of around 10% for Shigella sonnei isolates is of concern.

Streptococcus agalactiae
This is an important cause of life-threatening infection in newborn babies. Antimicrobials are given at the time of delivery to mothers who carry the organism (without any symptoms).
There is resistance to the backup class of antibiotics, at a rate of 20%.

Streptococcus pneumoniae
This is an important pathogen that causes middle ear infection (otitis media), acute sinusitis, pneumonia and blood poisoning (septicaemia).
Rates of resistance to the main treatment (benzylpenicillin) are low, at less than 5%, but resistance to other key antimicrobials is between 21% and 26%. 
7. How does Australia compare with the rest of the world?

Antimicrobial use in the Australian community is high compared with many other countries. Figure 3 shows that some countries (including Greece, France and Italy) have a higher use of antimicrobials than Australia, but, of 29 countries illustrated, Australia is in the top 20%.

Numerous factors contribute to Australia’s relative antimicrobial use, including differences in the way antimicrobials are prescribed and varying community expectations about the use of antimicrobials.

Further investigation and analysis are needed to explore these reasons in more depth, and identify where action can be taken to improve antimicrobial use in Australia.

Figure 3: Comparison of community antimicrobial use in Australia and 28 European countries, 2014

Sources: Pharmaceutical Benefits Scheme (Australia); European Surveillance of Antimicrobial Consumption Network (Europe)
Bacteria can be classified into two broad groups based on their response to a specific laboratory test called a Gram stain. They are referred to as Gram-positive or Gram-negative. Rates of resistance in Gram-negative organisms, such as *E. coli* and *K. pneumoniae*, are low in Australia compared with other countries. However, rates of resistance in Gram-positive organisms, such as *S. aureus* and *E. faecium*, range from high to very high, with Australia having one of the highest rates in the world of AMR for *E. faecium*. For example, Figure 4 shows vancomycin resistance in *E. faecium*.

Importantly, Australia has low rates of resistance to an important group of antimicrobials called fluoroquinolones compared with other countries, as a result of Australia implementing restrictions around the use fluoroquinolones. This indicates that restrictions on antimicrobial prescribing can positively influence rates of resistance that develop among some microbes.

**Figure 4: Vancomycin resistance in Enterococcus faecium in Australia and European countries, 2014**

Sources: Australian Group on Antimicrobial Resistance, 2014; EARS-Net, 2014 (Polish data is from 2013)
8. What action can I take to slow antimicrobial resistance?

As a consumer of health services and antimicrobials, it is important that you know that not all infections require treatment with antimicrobials. Antibiotics will be needed to treat some bacterial infections, but for many common conditions, such as colds and flu, they are not effective at all.

For your own personal health, you should only take antibiotics for infections caused by bacteria. Antibiotics will have no benefit at all if you have a viral infection, and you run the risk of experiencing side effects.

You can prevent antibiotic resistance by:

• understanding that antibiotics aren’t required for colds and flu because they are caused by viruses
• telling your doctor you only want an antibiotic if it is really necessary
• taking the right dose of your antibiotic at the right time, as prescribed by your doctor
• taking your antibiotics for as long as your doctor tells you to
• taking simple steps to avoid infections and prevent them from spreading.

You can take steps to prevent the spread of infection by regularly washing your hands thoroughly with soap and running water, or rubbing them with an alcohol-based handrub. This is particularly important after using the toilet and before eating or preparing food.

If you are sick, it is especially important that you wash your hands after sneezing, coughing or touching your own eyes, nose or mouth, to prevent your infection persisting or becoming worse, and to prevent it from spreading to others around you.

It is also important that you talk to your healthcare provider about the signs and symptoms of your illness, so you both have the information you need to make the best decision about your treatment.

You should dispose of old antimicrobials after you have recovered from your illness. Unused antimicrobials should be returned to a pharmacy for disposal.

Do not use previously prescribed antimicrobials at a later date, and do not give them to others to use, because this could compromise your own health or the health of others.

It is important to remember that the antimicrobial that you take for your condition may not work for a different condition later on, or for someone else, as a result of resistance developing in the bacteria you are carrying.

You also need to be mindful that taking any course of antibiotics (which are one type of antimicrobial) will, along with targeting the bad bacteria, also kill your body’s good bacteria, which may make you more at risk of developing infections.
9. What can health services do?

The Commission’s AURA Surveillance System will provide a comprehensive picture of patterns and trends in AU and resistance rates in Australia. Prescribing patterns, resistance rates and trends over time will guide quality improvements for how health services manage infection control, antimicrobial stewardship and antimicrobial prescribing.

Clinicians can use the information from AURA 2016 to better understand which microbes may be developing resistance to antimicrobials and which conditions therefore may require a different treatment or medication approach.

Health services and system managers will be able to use information from AURA 2016 and their own organisational data to identify where their organisation may be using antimicrobials differently from others, and where they may not be prescribing or using antimicrobials consistently with national guidelines.

Analysing data at this level helps identify where variation in antimicrobial use is occurring and inform organisational quality improvement projects.

10. Where next?

Information and data from the AURA Surveillance System will be used to support ‘calls to action’ to better understand the risk of AMR in modern medicine and develop response strategies.

The AURA Surveillance System will also contribute to national responses to build awareness and understanding with healthcare consumers, and to provide information of the risks of AMR and what action you can take as an individual.

The Commission will continue to collaborate with partner organisations such as NPS MedicineWise to ensure communication with healthcare consumers is targeted and meaningful.

A series of information sheets, reports and animations that form part of the Commission’s AURA project can be found at: