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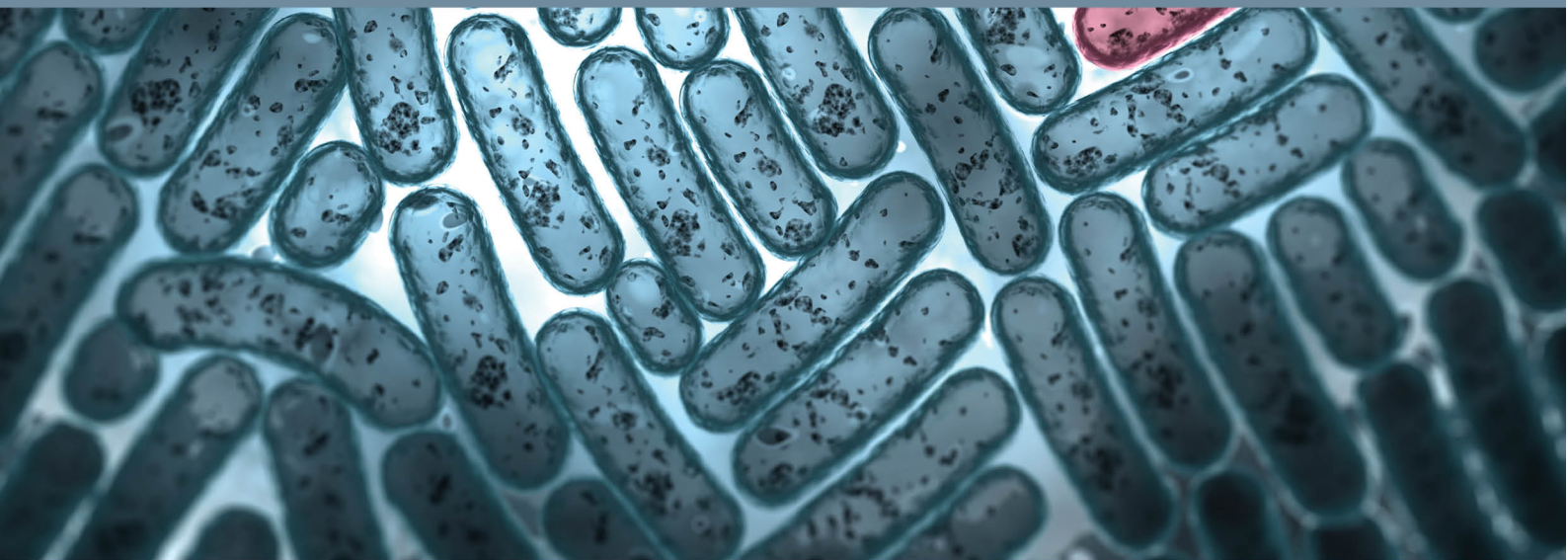


Australian Government
Department of Agriculture,
Water and the Environment



FINAL PROGRESS REPORT

Australia's First National Antimicrobial Resistance Strategy 2015-2019



February 2021

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FOREWORD

The COVID-19 crisis has presented Australia, and the rest of the world, with a myriad of challenges, highlighting the potential widespread impacts of a global health crisis and the potential lack of effective medical interventions. No part of society has been immune to the effects of the pandemic, and the health sector has been under considerable sustained pressure. In this context, the role of antimicrobial medicines is receiving renewed attention.

Antimicrobial resistance – or AMR – is one of the greatest health challenges we face. The inappropriate use (including overuse, misuse and sub-therapeutic dosages) of antimicrobials increases the level of resistance and can reduce the subsequent effectiveness of our current antimicrobial medicines. AMR is happening more quickly than we can develop new antimicrobial medicines. We all need to use antimicrobial medicines, especially antibiotics, more carefully to ensure they remain effective into the future.

While AMR is a significant and increasing human health issue, it can also affect food animal production, food security and producers' livelihoods. Therefore, Australia's response needs action in all sectors where antimicrobials are used – a One Health approach that recognises the interconnectedness between humans, animals and the environment, and is based on collaboration and actions across all these sectors. A coordinated approach over the long term will help attain and maintain low levels of AMR in Australia.

This is not just an issue for governments. We all need to take responsibility and reduce our use of these important medicines where it is safe and appropriate to do so. This includes human and animal health professionals, livestock farmers as well as everyday Australians.

Australia's First National Antimicrobial Strategy 2015–2019 was developed to drive collaborative efforts in the human and animal health sectors to improve the appropriate use of antimicrobials and minimise the occurrence of resistance in Australia. This final progress report outlines a number of key activities that government and non-government One Health stakeholders have implemented to address the Strategy's goal of minimising the development and spread of AMR and ensure the continued availability of effective antimicrobials.

Going forward, we need to expand our focus to better understand the role of AMR in the environment, plant and food sectors. We also need to broaden our lens from antibiotics to other antimicrobials—antivirals, antifungals and antiparasitics—where resistance can also occur. In addition, we need to improve the community's understanding of how every individual plays a role in reducing the occurrence and spread of AMR. Finally, we need to improve coordination of efforts across sectors, and support our One Health implementation partners to continuously improve their capacity and capability to develop, implement and monitor their actions. As always, we look to collaborate with our international counterparts to share and learn from their experience and knowledge.

Australia's new national strategy, *Australia's National Antimicrobial Resistance Strategy – 2020 and Beyond*, presents a 20-year framework that builds on our progress under our first national AMR strategy and aims to address many of the remaining challenges.

The relationships established while implementing *Australia's First National Antimicrobial Strategy 2015–2019* will assist us with this endeavour and support continued collaborative efforts to identify effective and innovative ways to prevent, detect, contain and respond to AMR into the future.

Professor Paul Kelly

Australian Government Chief Medical Officer

Dr Mark Schipp

Australian Chief Veterinary Officer

President of the World Organisation for Animal Health World Assembly



EXECUTIVE SUMMARY






Effective antimicrobials, such as antibiotics, underpin modern medicine. While microbes develop resistance naturally, human activity is accelerating the rate and amount at which resistance is occurring. The inappropriate use (overuse and misuse) of antimicrobials has resulted in some existing antimicrobials becoming less effective. This is termed antimicrobial resistance (AMR), and it is one of the most concerning global health threats. If current trends continue, routine medical procedures, such as chemotherapy and joint replacements, may no longer be safe, and infections, such as pneumonia and urinary tract infections, may become difficult to treat.

Australia’s First Antimicrobial Resistance Strategy 2015–2019 (the Strategy) reflected a commitment by governments and stakeholders across all the One Health sectors—human and animal health, food and the environment—to work collaboratively to develop and implement best practices, strengthen existing activities and implement new initiatives to minimise the occurrence of AMR in Australia.

This Report is the second and final Progress Report (the Report) for the Strategy. It highlights the scope and diversity of contributions made by governments and One Health partners, including medical and veterinary boards, professional colleges and societies, accreditation bodies, industry organisations and other non-government stakeholders, individually or collaboratively, towards achieving the shared goal of the Strategy: to minimise the development and spread of AMR and ensure the continued availability of effective antimicrobials.

This Report presents progress against each objective of the Strategy in chapters. The following table includes key highlights. The Appendix provides details on these and other selected AMR initiatives undertaken in Australia between 2017 and 2019. The Report does not evaluate the success of the individual activities or initiatives presented.

OBJECTIVES		KEY HIGHLIGHTS
OBJECTIVE 1 	AWARENESS AND UNDERSTANDING OF AMR Increase awareness and understanding of AMR, its implications and actions to combat it, through effective communication, education and training	<ul style="list-style-type: none"> • The One Health government website was launched in 2017 to provide information on AMR and Australia’s response. • Communication approaches to enable behaviour change were researched by the Australian Government and private organisations. • Professional forums were held to encourage collaboration and information sharing with a One Health focus. • Information and practical stewardship guidance were developed by Australian governments, industry organisations and research institutions.
OBJECTIVE 2 	ANTIMICROBIAL STEWARDSHIP Implement effective antimicrobial stewardship practices across human health and animal care settings to ensure the appropriate and judicious prescribing, dispensing and administering of antimicrobials	<ul style="list-style-type: none"> • Collaboration occurred across animal industries to develop and publish prescribing guidelines and stewardship frameworks. • Changes were introduced to antibiotic listings on the Pharmaceutical Benefits Scheme (PBS) to restrict maximum quantities and remove unnecessary repeats. • The Importance Ratings and Summary of Antibacterial Uses in Human and Animal Health in Australia was updated. • The very few growth promotion claims on currently registered animal antimicrobials that are medically important for human health were removed. • Mandatory antimicrobial stewardship requirements were linked to accreditation in all hospital, day procedure and residential aged care settings. • Education resources and tools in both the human and animal health sectors were implemented to support antimicrobial stewardship.

OBJECTIVES		KEY HIGHLIGHTS
<p>OBJECTIVE 3</p> 	<p>SURVEILLANCE</p> <p>Develop nationally coordinated One Health surveillance of AMR and antimicrobial usage</p>	<ul style="list-style-type: none"> • The Australian Government published three national surveillance reports on antimicrobial resistance and usage in human health. • Three proof-of-concept AMR surveys in the food-producing animal sectors were completed and showed nil or low levels of AMR across a range of indicator bacteria and specified antimicrobials. • A literature review of AMR in the food production, processing and retail sectors for animal and horticultural products in Australia and New Zealand was published. • Research activities were commenced about AMR bacteria and their genes, focused around wastewater treatment and reuse.
<p>OBJECTIVE 4</p> 	<p>INFECTION PREVENTION AND CONTROL</p> <p>Improve infection prevention and control measures across human health and animal care settings to help prevent infections and the spread of resistance</p>	<ul style="list-style-type: none"> • Several infection control guidelines were developed at national and jurisdictional levels for managing pathogens of significant concern in human health. • Ongoing assurance programs and strengthened standards occurred in the animal sector.
<p>OBJECTIVE 5</p> 	<p>RESEARCH</p> <p>Agree a national research agenda and promote investment in the discovery and development of new products and approaches to prevent, detect and contain AMR</p>	<ul style="list-style-type: none"> • Antimicrobial resistance continued to be a research priority under the Medical Research Future Fund, with a One Health focus. • Animal industries contributed to funding and other resources for further evidence-based guidance to support members and surveillance data on resistances. • Whole genome sequencing received increasing attention as a research priority.
<p>OBJECTIVE 6</p> 	<p>INTERNATIONAL PARTNERSHIPS AND COLLABORATION</p> <p>Strengthen international partnerships and collaboration on regional and global efforts to respond to AMR</p>	<ul style="list-style-type: none"> • Australia continued to contribute data to the annual World Organisation for Animal Health's (OIE) survey on the use of antimicrobial agents intended for use in animals. • Australia commenced contributing to the WHO Global Antimicrobial Resistance Surveillance System for human health. • Australia became a foundation member of the Global Antimicrobial Resistance Research and Development Hub, which was established in 2018 under the auspices of the G20. • Australia contributed to the revision and development of Codex standard texts for foodborne AMR. • The Australian Government, through the Indo-Pacific Centre for Health Security [1] funded a number of research institutions, and private sector initiatives continued the development and implementation of practical support tools and capacity building in the Asia-Pacific region.
<p>OBJECTIVE 7</p> 	<p>GOVERNANCE</p> <p>Establish and support clear governance arrangements at the local, jurisdictional, national and international levels to ensure leadership, engagement and accountability for actions to combat AMR</p>	<ul style="list-style-type: none"> • AMR was raised to the highest priority level by Australia's Health Ministers, acknowledging it as an issue of national significance requiring cooperation of all jurisdictions. • The Australian Animal Sector National Antimicrobial Resistance Plan 2018 was co-developed and released by the Australian Government and major animal sector stakeholders. • Jurisdictions developed One Health strategies or policies for AMR. • Membership of the Australian Strategic and Technical Advisory Group on Antimicrobial Resistance (ASTAG) was strengthened by inclusion of environmental and general practice expertise. • Review of current Australian regulation relating to AMR was commenced.

Responding to the AMR issue requires a long-term coordinated and collaborative commitment. The current national strategy—*Australia's National Antimicrobial Resistance Strategy – 2020 and Beyond* (2020 Strategy)—was endorsed by the Council of Australian Governments (COAG) in March 2020, signifying a commitment to

collectively address Australia’s response to this cross-sector global crisis. The 2020 Strategy identifies priorities for continued focus, including some that were not fully achieved under the first national AMR Strategy.

The 2020 Strategy continues to be based on seven key objectives to guide activities across all sectors:

IMAGE	TITLE OF 2020 STRATEGY OBJECTIVES
	Objective 1: CLEAR GOVERNANCE FOR ANTIMICROBIAL RESISTANCE INITIATIVES
	Objective 2: PREVENTION AND CONTROL OF INFECTIONS AND THE SPREAD OF RESISTANCE
	Objective 3: GREATER ENGAGEMENT IN THE COMBAT AGAINST RESISTANCE
	Objective 4: APPROPRIATE USAGE AND STEWARDSHIP PRACTICES
	Objective 5: INTEGRATED SURVEILLANCE AND RESPONSE TO RESISTANCE AND USAGE
	Objective 6: A STRONG COLLABORATIVE RESEARCH AGENDA ACROSS ALL SECTORS
	Objective 7: STRENGTHEN GLOBAL COLLABORATION AND PARTNERSHIPS

AMR IS ONE OF AUSTRALIA'S BIGGEST HEALTH CHALLENGES

Antimicrobial medicines underpin modern health care for humans and animals. Since the 1930s, antimicrobial medicines, which include antibiotics, antivirals, antifungals and anti-parasitics, have been used to treat infections. All infections are caused by microorganisms, including bacteria, viruses, fungi and parasites, in humans and animals. Problems arise when these antimicrobials lose effectiveness. This is antimicrobial resistance (AMR).

Why AMR needs to be addressed

AMR describes pathogens that are resistant to drugs such as antibiotics, antivirals, anti-parasitics and antifungals. The widespread and often inappropriate use of antibiotics in humans and animals has contributed to the development of microbial resistance across the globe. No country is immune. AMR infections can move across borders and between health care and community settings, including aged care facilities, and challenge the safety of routine medical procedures, such as hip replacements and chemotherapy. AMR infections can arise from overprescribing in human medicine and from the transfer of resistant organisms from animals to people through direct contact, through the environment (such as through wastewater) or potentially through foodborne transmission.

AMR is an increasing and serious threat to global public health and requires action across all government sectors to protect human health. The World Health Organization (WHO) has described AMR as one of the biggest threats to global health and has warned that without further action the world faces a post-antibiotic era where common infections may become increasingly difficult and more expensive to treat, and hospitalisation rates and unnecessary deaths increase [2]. Antimicrobials are a finite resource that must be preserved.

AMR has the potential to affect Australia both socially and economically [3]. All Australians; food producing, companion and performance animals; and the environment are at risk of harm from increasing rates of drug-resistant organisms. AMR also affects food animal production, food security and producers' livelihoods. AMR is becoming increasingly prominent in livestock and aquaculture production, and in companion and performance animals due to their close proximity to humans.

Growing pressure will mount on the healthcare system if antimicrobials can no longer effectively treat common infections. Prolonged duration of illness and treatment could lead to higher healthcare costs and reduce societal productivity [3]. By 2050, the Organisation for Economic Co-operation and Development (OECD) has estimated additional annual health care costs related to AMR in Australia of US\$370 million (approximately AUD\$500 million) and that 10,430 Australians will die due to infections from just eight resistant bacteria [4].

Rates of resistant infections are increasing in the Australian community (AURA 2019) [5]. Associated costs for governments are also growing through increased primary care visits, lengthier hospital stays, more intensive care required and risk of death. Australia filled over 27 million PBS/RPBS prescriptions for systemic antibiotics in the 2016–2017 financial year and is identified as the ninth highest antibiotic user, by volume, of the OECD countries [6]. Australia's high use of antibiotics increases the chance of organisms developing resistance, as the more they are used – appropriately or not – the less effective they become.

Outside the health sector, costs could rise due to decline in livestock production and animal welfare because of a lack of effective antimicrobials in animal health, and potential trade issues.

The **Organisation for Economic Co-operation and Development (OECD)** has estimated about

290 people die every year in Australia from just

8 resistant bacteria.

If we look forward to 2050, an estimated

10,430

Australians are expected to die from

infections that cannot be treated.

In addition, there is a **large financial cost**

associated with AMR – between 2015 and 2050, **AMR**

will cost the Australian healthcare system an additional

\$500 million

per year.

(From OECD 2018, *Stemming the superbug tide in Australia* [7])

Australia's approach to addressing AMR

Australia's response to AMR recognises the need for actions in all sectors where antimicrobials are used. Australia recognised the need for a framework to guide a coordinated response to the challenges of AMR across sectors, levels of government and in collaboration with non-government partners.

Australia's First National Antimicrobial Resistance Strategy 2015–2019 (the Strategy) was developed in response. It built on a range of existing successful initiatives and identified areas where additional activity could strengthen Australia's efforts to meet the Strategy's goal of minimising the development and spread of AMR and ensuring the continued availability of effective medicines to treat infections in humans and animals.

Extensive stakeholder engagement informed the development of the Strategy and Implementation Plan, and was an essential component of ensuring a One Health approach and coordination across sectors.

A One Health approach considers interdependencies between:



Throughout the course of the Strategy, we have seen:



come together.

The Strategy was structured around seven objectives that identify the broad areas where coordinated action is required for an effective national response. It broadly aligned with the WHO Global Action Plan on AMR, which was published after Australia's strategy. It acknowledged the importance of collaboration within and across One Health sectors as there are many interrelated and specific actions in one area that could contribute to the achievement of multiple objectives.

To support the Strategy's vision of a society in which antimicrobials are recognised and managed as a valuable shared resource, each objective identified priority areas for action (PAA). The PAAs identified activities that could further strengthen Australia's response to AMR.

The PAAs are included in the following table.

						
<p>Objective One: Increase awareness and understanding of AMR, its implications, and actions to combat it through effective communication, education and training.</p>	<p>Objective Two: Implement effective antimicrobial stewardship practices across human health and animal care settings to ensure the appropriate and judicious prescribing, dispensing and administering of antimicrobials.</p>	<p>Objective Three: Develop nationally coordinated One Health surveillance of AMR and antimicrobial usage.</p>	<p>Objective Four: Improve infection prevention and control measures across human health and animal care settings to help prevent infections and the spread of AMR.</p>	<p>Objective Five: Agree a national research agenda and promote investment in the discovery and development of new products and approaches to prevent, detect and contain AMR.</p>	<p>Objective Six: Strengthen international partnerships and collaboration on regional and global efforts to respond to AMR.</p>	<p>Objective Seven: Establish and support clear governance arrangements at the local, jurisdictional, national and international levels to ensure leadership, engagement and accountability for actions to combat AMR.</p>
<p>PAA 1.1: Strengthen consumer awareness initiatives to improve understanding of antimicrobial resistance and the importance of using antibiotics appropriately.</p> <p>PAA 1.2: Increase support for human and animal health professionals in reinforcing key messages with patients and clients.</p> <p>PAA 1.3: Strengthen communication and education initiatives for health professionals and health care team members.</p> <p>PAA 1.4: Develop a stakeholder engagement and communication plan to support whole-of-society awareness of, and participation in implementing the Strategy.</p>	<p>PAA 2.1: Ensure that tailored, evidence-based antibiotic prescribing guidelines are available for all sectors.</p> <p>PAA 2.2: Ensure the availability of evidence-based, best-practice and nationally consistent approaches to AMS across human health and animal care settings.</p> <p>PAA 2.3: Develop tailored, evidence-based resources to support the implementation of AMS programmes.</p> <p>PAA 2.4: Review existing accreditation and quality assurance programmes to ensure they appropriately support and encourage compliance with best-practice AMS approaches.</p> <p>PAA 2.5: Strengthen existing measures to better support appropriate and judicious use.</p>	<p>PAA 3.1: Establish the for national One Health surveillance.</p> <p>PAA 3.2: Agree the objectives of surveillance for each sector, ensuring they align with the overarching objectives for the national One Health surveillance system.</p> <p>PAA 3.3: Develop lists of priority organisms and associated antimicrobials for national reporting.</p> <p>PAA 3.4: Agree and implement a uniform standard for laboratory testing methods for antibacterial susceptibility.</p> <p>PAA 3.5: Improve human health surveillance.</p> <p>PAA 3.6: Improve animal health and agriculture surveillance.</p> <p>PAA 3.7: Investigate requirements for surveillance in food.</p>	<p>PAA 4.1: Ensure the availability of evidence-based, best-practice and nationally consistent standards for IPC across human health and animal care settings.</p> <p>PAA 4.2: Review existing accreditation and quality assurance programmes to ensure they appropriately support and encourage compliance with best practice IPC measures.</p> <p>PAA 4.3: Develop additional initiatives and resources to strengthen IPC in all human health care settings.</p> <p>PAA 4.4: Further develop initiatives and resources to strengthen IPC in the livestock industry.</p> <p>PAA 4.5: Further develop resources to strengthen IPC in veterinary practice.</p> <p>PAA 4.6: Encourage continued increases in vaccination rates to prevent infections.</p>	<p>PAA 5.1: Identify current gaps and agree national research and development priorities.</p> <p>PAA 5.2: Coordinate national research activities and the sharing of information.</p> <p>PAA 5.3: Explore opportunities to increase support for research and development, including incentives for greater private sector investment.</p> <p>PAA 5.4: Explore opportunities to support the translation of promising research findings into new products, policies and approaches.</p>	<p>PAA 6.1: Lead regional initiatives to increase capacity to respond to antimicrobial resistance.</p> <p>PAA 6.2: Learn from international best practice.</p> <p>PAA 6.3: Participate in international surveillance initiatives.</p> <p>PAA 6.4: Establish closer ties with international collaborations to link Australia's national research agenda with what is happening internationally.</p>	<p>PAA 7.1: Identify, establish and maintain linkages between implementation partners across all sectors.</p> <p>PAA 7.2: Work with stakeholders to develop an Implementation Plan for the Strategy.</p> <p>PAA 7.3: Establish baseline measures to inform monitoring and evaluation of the Strategy.</p> <p>PAA 7.4: Review regulation (legislated and other) relevant to antimicrobial resistance and antibiotic usage.</p>

AMR IN AUSTRALIA: WHAT DOES THE DATA SHOW?

Australia has adopted one of the most conservative approaches to using antimicrobials in food producing animals. A review conducted in 2015, *Antimicrobials in Agriculture and the Environment: Reducing Unnecessary Use and Waste* [8] found that out of 29 countries, Australia was the fifth-lowest user of antibiotics in agriculture.

However, in relation to human health, Australians use a lot of antibiotics. The OECD reported in 2019 that Australia had the ninth-highest prescription volume of antibiotics out of 31 OECD countries [6]. About two in five Australians (41.5%) had at least one antimicrobial dispensed in 2017 under the Pharmaceutical Benefits Scheme (PBS) / Repatriation Pharmaceuticals Benefit Scheme (RPBS) [5].

AMR and human health

During the Strategy, the Antimicrobial Use and Resistance Surveillance System (AURA) continued to collect, analyse and report human health data on antimicrobial resistance, antimicrobial use and the appropriateness of antimicrobial prescribing in Australian hospitals, aged care, general practice and the community.

Key findings from the AURA 2019 report [5] included:

- Resistance rates in Australia generally remain low compared with rates in most European countries.
- Some resistance rates have increased compared to various countries, such as for fluoroquinolones. This indicates the need for a particular focus on those treatments to reduce potentially significant future impacts.
- Rates of resistance in key gram-positive pathogens are also moderate to high in Australia compared with European countries. For example, prevalence of vancomycin resistance in *Enterococcus faecium* (*E. faecium*) remains higher in Australia than in any European country and the absolute number continues to increase.
- In *Escherichia coli* (*E. coli*), resistances to common treatments continue to increase despite restriction of access to ciprofloxacin and other fluoroquinolones on the PBS. These changes in resistance may mean increasing treatment failures and greater reliance on last-line treatments, such as carbapenems.
- In *Staphylococcus aureus* (*S. aureus*; 'Golden Staph'), patterns of methicillin resistance continue to evolve, with community-associated methicillin-resistant *S. aureus* (MRSA) becoming prominent in remote and very remote regions of Australia.
- The most frequently reported critical antimicrobial resistance (CAR) was carbapenemase-producing Enterobacterales (CPE): a broad grouping of gram-negative bacteria likely to be resistant to most antibiotics. CPE represents 81% of all CARs reported and a 13% increase from 2017 to 2018. CPE were predominantly in either hospitalised patients or hospital outpatients.
- There were sporadic community cases of ceftriaxone-nonsusceptible *Neisseria gonorrhoeae* in 2018, which indicates the need for ongoing surveillance and continuation of targeted prevention and control programs as the total number of notifiable cases continued to increase in 2017 and 2018.

Antimicrobial (antibiotic) use in human health

Targeted and passive surveillance provides data to AURA on human use of antibiotics in Australia.

Data are provided through the National Antimicrobial Prescribing Survey (NAPS) in hospital, surgical and aged care settings, NPS MedicineWise MedicinesInsight program, and the National Antimicrobial Utilisation Surveillance Program (NAUSP). These data are drawn from public and private organisations and rely on voluntary contribution of data through agreements with the states and territories and the private sector.

Dispensing data from the Pharmaceutical Benefits Scheme (PBS)/Repatriation PBS (RPBS) are used for rates of prescribing in the community; it is estimated this captures approximately 90% of prescriptions written in the community as private prescriptions are not captured by PBS data.

Key findings from the AURA 2019 report [5] include the following:

In the community (primary care and aged care homes)

- Australia's antibiotic dispensing rates are steadily decreasing in the community; in 2017, there was a decrease of approximately 13% since a peak in 2015. This represents a reduction of approximately two million prescriptions dispensed.
- The highest rates of dispensing are for patients over 65 years and children aged between two and four years.
- Penicillins with extended spectrum and β -lactimase inhibitor combinations and tetracyclines were the most commonly dispensed classes of antimicrobials. The three most commonly dispensed antibiotics were cefalexin, amoxicillin, and amoxicillin–clavulanic acid.
- Around 50% of antibiotic prescriptions were ordered with repeats, of which only approximately half were filled within 10 days of the original prescription.
- In aged care settings surveyed, NAPS assessed there was a high rate of use of antimicrobials for unconfirmed infections and for conditions where they are not required.

In hospitals

- The total-hospital antibiotic use in NAUSP contributor hospitals increased in 2017 for the first time since 2013.
- Nearly one-quarter of the prescriptions assessed in surveyed hospitals were found to be inappropriate. This overall rate of inappropriate prescribing has been static since 2013.
- The highest rates of inappropriate prescribing occur with the most commonly prescribed antibiotics: amoxicillin-clavulanic acid, cefazolin, flucloxacillin, doxycycline, amoxicillin.
- The proportion of surgical prophylaxis prescriptions that extended beyond the recommended 24 hours has dropped from 41.1% in 2013 to 30.5% in 2017.
- A national shortage of piperacillin-tazobactam in 2017 had a considerable impact on patterns of antibiotic use in NAUSP contributor hospitals, including increased use of cephalosporins.

Refer to AURA 2019 for more comprehensive data and supporting analysis.

AMR and animal health

The risk of AMR from animals in Australia is considered low. This is due to factors such as strict regulation on registration on veterinary medical products, low levels of antimicrobial use in food-producing animals, high levels of biosecurity, and extensive farming systems that do not favour bacterial disease. AMR surveillance undertaken to date in food-producing animals generally supports this view, noting that there are some areas for improvement.

Three recent proof-of-concept AMR surveys conducted in Australian pigs [9], meat chickens [10] and chicken eggs [11] (*Salmonella* spp. only) were funded by the Australian Government. These surveys determined the current prevalence of resistance against specified antimicrobials in one or more indicator organisms (*E. coli*, *Salmonella* spp., *Enterococcus* spp. and/or *Campylobacter* spp.). All surveys took into account the OIE standards for AMR surveillance in food-producing animals.

The main highlights are:

- From the *Salmonella* spp. results that spanned all three industries, susceptibility was shown to ceftiofur, colistin and ceftriaxone.
- Chicken meat surveillance showed an absence of vancomycin resistance in *Enterococcus* spp., and susceptibility to a majority of antimicrobials tested along with no detection of multi-drug resistance in *Salmonella* spp. This survey demonstrated either nil, or substantially low, carriage of resistance to antimicrobials used in human medicine. The findings are extremely favourable compared to resistance profiles for chicken isolates described internationally.

- There were low levels of AMR in *Salmonella* from the chicken egg environments, particularly in antimicrobials of a high importance rating in Australia. The results confirm the low AMR status of *Salmonella* spp. isolated from Australian caged and free-range layer farm environments, which likely reflects the combination of restrictions on antimicrobial use, disease control and biosecurity policies.
- In pigs, no colistin resistance was found. Furthermore, no azithromycin, ceftiofur and ceftriaxone resistance among *Salmonella* spp., and no vancomycin resistance was detected by whole genome sequencing among *E. faecium* isolates.

The complete results of these AMR surveys are available online.

Meat and Livestock Australia has also published AMR surveys in cattle, focusing on *Enterococcus faecium* and *Enterococcus faecalis* [12] *Escherichia coli* and *Salmonella* spp. [13]; and pathogenic Shiga toxin producing *E. coli* (pathogenic STEC) and AMR bacteria in sheep [14].

The main findings are:

- The low level of AMR in *Enterococcus* found in Australian cattle is likely a result from comprehensive controls around the use of antimicrobials in food-production animals. In this study on *Enterococcus* spp. in Australian cattle at slaughter, resistance to antibiotics considered critically or highly important to human medicine such as tigecycline, daptomycin, vancomycin and linezolid were not present. There were high levels of resistance to antimicrobials that are not critically or highly important to human medicine routinely observed to lincomycin (85.4–94.2%) and flavomycin (80.2%), respectively. These results are consistent with published studies on enterococci from cattle and likely stem from intrinsic resistance.
- With *E. coli* and *Salmonella*, the results of antimicrobial resistance testing in Australian cattle corroborate previous Australian animal and retail food surveys, which have indicated a low level of antimicrobial resistance. Multi-drug resistance in *Salmonella* isolates from beef cattle was detected infrequently. However, resistance was found to antimicrobials of low importance in human medicine. The low level of antimicrobial resistance in bacteria from Australian cattle is likely a result of strict regulation of antimicrobials in food animals in Australia and animal management systems that do not favour bacterial disease.
- The proportion of sheep isolates showing antimicrobial resistance was low across *E. coli*, *Enterococcus* and *Salmonella* suggesting that sheep production practices are likely to have minimal impact on the development of resistance to antimicrobials considered to be of highest priority critically important to human medicine.

PROGRESS AGAINST OBJECTIVES OF THE STRATEGY



Objective One

Awareness and Understanding of AMR

Increase awareness and understanding of antimicrobial resistance, its implications and actions to combat it, through effective communication, education, and training

The challenge

Increasing support for animal and human health professionals and improving consumer awareness of appropriate antibiotic use were key priorities under Objective One, which recognised that everyone has a role in reducing the development and spread of AMR.

It is generally understood that consumer demand, time pressures and diagnostic uncertainty all contribute to increases in antibiotic prescribing. Tailored communication and education initiatives were identified as essential to engage consumers and professionals in driving behaviour change.

Further exploration is required to understand the factors that influence consumer, prescriber and other key professionals' behaviours and what strategies and activities are effective in educating and raising awareness. This remains a priority area for action in the 2020 Strategy.

Progress in addressing the challenge

Australia's participation in, and promotion of, World Antibiotic Awareness Week (WAAW) continues to increase the profile of AMR and the importance of appropriate prescribing across all sectors and the community. This annual event is coordinated by the Tripartite organisations: the Food and Agriculture Organization of the United Nations, the World Organisation for Animal Health (OIE) and the World Health Organization. During this week, organisations from around the globe come together to speak with one voice and take collective action on raising awareness and minimising the emergence and spread of AMR from a One Health perspective.

Since implementation of the Strategy, a variety of activities have been undertaken by a range of stakeholders to increase awareness and understanding of AMR, including through media publications, forums, high-level meetings between government and non-government experts, information sharing, public campaigns, and training seminars and workshops.

Human and animal health professionals have also been assisted in reinforcing key messages that promote and support appropriate antibiotic prescribing with patients and clients, through the development of a range of resources. Research to better understand the drivers for antibiotic use is also underway and will inform future initiatives aimed at achieving and sustaining behavioural change.

Improving human and animal health professionals' knowledge of AMR and antimicrobial stewardship has also been addressed through the delivery of a range of education and training activities as well as conferences, seminars and workshops. These activities are being delivered across public and private sectors, from local hospitals to national organisations.





There were encouraging signs, during the life of the Strategy, that communications in relation to AMR are starting to penetrate deeper into communities and to be driven at a more grassroots level. There were new initiatives implemented to introduce AMR information to new consumer groups, such as the Rotary AMR Aware Campaign and the development of fact sheets for companion animal owners.

These achievements have involved various implementation partners such as academics, associations, consultancy firms/consultants, government bodies, industry bodies, local clubs, not-for-profits, peak bodies and research bodies. Over 40 representative initiatives are listed in the Appendix.

The activities undertaken were designed to address the following Priority Action Areas (PAAs):

- 1.1 Strengthen consumer awareness initiatives to improve understanding of antimicrobial resistance and the importance of using antibiotics appropriately.
- 1.2 Increase support for human and animal health professionals in reinforcing key messages with patients and clients.
- 1.3 Strengthen communication and education initiatives for health professionals and health care team members.
- 1.4 Develop a stakeholder engagement and communication plan to support whole-of-society awareness of, and participation in implementing the Strategy.

The following case studies highlight some key actions.





Case Study: The Australian Veterinary Antimicrobial Stewardship Conference (2018)		
	What does it involve?	The inaugural industry-initiated Australian Veterinary Antimicrobial Stewardship Conference was held over three days in November 2018, with dedicated sessions on 'Antimicrobial Use'.
	Who are the key stakeholders?	The conference brought together veterinarians, researchers, governments, industry, producers and university stakeholders.
	What was the impact?	This industry-led initiative for Australian veterinary stakeholders strengthened collaboration and veterinary antimicrobial stewardship initiatives and addressed barriers that might impede progress to further refinement of these antimicrobial stewardship efforts.
	What are the lessons and next steps?	This type of professional meetings and conferences enables opportunities for collaboration, sharing of information and development of best practice policies and procedures. The next conference will be held in late 2021 (rescheduled from November 2020 due to impact of COVID-19 pandemic).
PAAs addressed: 1.3		

Case Study: *Nudge vs Superbugs* behavioural economics project

	<p>What does it involve?</p>	<p>Behavioural insights were applied to design and examine impact of personalised letters from Australia's Chief Medical Officer (CMO) to high-prescribing GPs prompting them to consider whether there were opportunities to reduce antibiotic prescribing where appropriate and safe to do so. Four groups of GPs received different versions of the letters: an education letter, or one of three letters with peer comparison feedback. A fifth group received no letter (control group).</p> <p>The letters were sent on 9 June 2017, just before the rapid increase in prescribing which occurs during the cold and flu season. A follow-up occurred at 12 months to finalise the project.</p>
	<p>Who are the key stakeholders?</p>	<p>The project was a collaboration between the Department of Health and the Behavioural Economics Team of the Australian Government (Department of the Prime Minister and Cabinet).</p> <p>A total of 6,649 GPs across Australia whose antibiotic prescribing rates were in the top 30% of their geographic region were selected to participate.</p> <p>The Australian Medical Association, Royal Australian College of General Practitioners and the Australian College of Rural and Remote Medicine were consulted on the project.</p>
	<p>What was the impact?</p>	<p>In Australia, GPs prescribe more antibiotics than other health professionals due to the large volumes of patients and types of illnesses they see. The nudge helped GPs bring prescriptions down by:</p> <ul style="list-style-type: none"> - 9.3% to 12.4% after six months, and - 9% after one year. <p>The three letters with peer comparison information reduced prescription rates between 9.3% and 12.4% in the six months after the letters were sent, compared with a 2.4% reduction only for GPs who received the education letter. The most effective letter was a graph comparing GP's prescribing behaviour to their peers.</p> <p>The letters resulted in approximately 126,000 fewer antibiotic prescriptions over six months. A 12-month follow up demonstrated a sustained reduction, although at a smaller percentage than in the initial six months and an estimated overall reduction of 190,000 antibiotic prescriptions over the 12-month period. It is estimated that 280,000 fewer prescriptions would have been filled if all 6,649 high-prescribing GPs (including the 'no letter' group) had received the most effective letter.</p> <p>The results demonstrate a peer comparison letter from a respected authority can have large impacts on antibiotic prescribing by GPs and that some of the impact is sustained over a reasonable period of time.</p>
	<p>What are the lessons and next steps?</p>	<p>GPs are important partners in efforts to minimise AMR by helping limit community prescribing to clinical situations where evidence shows antibiotics to be of proven value. Reducing prescribing in primary care is challenging given the link between prescribing to a patient and its potential impact on AMR is not directly observable at the time of prescribing and AMR is a long-term consequence not yet widely seen in general practice.</p> <p>The results indicate there is scope to reduce antibiotic prescribing in primary healthcare settings and suggest antibiotic stewardship programs can maximise their effects by using peer comparison feedback to assist GPs to reflect on their prescribing practices.</p> <p>The results add to the large body of evidence that peer comparison can be a powerful behavioural tool for policy makers, particularly when using individual-level feedback.</p> <p>There is no plan to send further letters.</p>

PAAs addressed: 6.2

Case Study: One Health AMR Website - amr.gov.au

	<p>What does it involve?</p>	<p>The One Health AMR website was launched on 18 November 2017 to provide a central hub of information on Australia's response to AMR. The website was structured around the seven objectives of the Strategy. It details a broad range of resources from public and private organisations. These include Australian Government and stakeholder publications, such as standards and guidelines, and targeted information for the public and professionals, with links to stakeholder websites.</p>
	<p>Who are the key stakeholders?</p>	<p>It was developed as a collaborative initiative between the Australian Government Department of Health and Department of Agriculture, Water and the Environment, with extensive stakeholder consultation to establish a comprehensive source of information for everyone: the general public, animal owners, general practice, hospitals, aged care, pharmacy, veterinary practices and the agricultural industry. Researchers are encouraged to contribute summaries of their projects to the Activities and Research Directory to build it into a valuable resource.</p>
	<p>What was the impact?</p>	<p>The number of visitors increased between the first and second year by 100%, and by about 10% in the third year (37,800 visits), with an 18% annual increase of new visitors over the three-year period. Further analysis shows there was a substantial increase in the third year of users navigating to subject-specific information pages, including external stakeholder sites.</p> <p><i>Australia's National AMR Strategy – 2020 and Beyond</i> was viewed 5019 times between the release date of 16 March 2020 and 17 November 2020, with a peak in the first two weeks after publication. Analysis of the types of users viewing and downloading the strategy indicates a keen interest from our existing stakeholders as there was no noticeable trend in new visitors over that period. The data shows a 70% increase over the seven months compared to the amount of views and downloads of <i>Australia's First National AMR Strategy 2015–2019</i> over a 2.5-year period.</p> <p>The most popular downloads over the three-year period were the 2020 Strategy (even though only released in 2020) and the Australian Government Department of Health's YouTube clip titled: 'Antimicrobial resistance in Australia'.</p>
	<p>What are the lessons and next steps?</p>	<p>While the analytics show the website has been popular as a source of information on AMR, targeted promotion of the website could expand its reach. While there are over 100 subscribers to the website, the subscription function should be further promoted through stakeholder groups, and the Australian Government more regularly disseminating relevant information to these subscribers who have an interest in AMR.</p> <p>While the text-based website complies with Department of Health policy, the vibrant home page and the colourful animation attract greater attention from visitors, indicating the need to reconsider the format for official messaging to ensure it resonates with the public.</p> <p>The large size of the website and reliance on external links to websites and resources makes it challenging to maintain its currency. An easy process to encourage stakeholders to update their content could be further considered and promoted.</p>

PAA's addressed: 1.1, 1.2, 1.3, 1.4

Analytics: One Health AMR Website		
18 November 2017 – 17 November 2018	18 November 2018 – 17 November 2019	18 November 2019 – 17 November 2020
The AMR website was viewed approximately 58,400 times and the most visited top 3 pages are: <ul style="list-style-type: none"> – Antimicrobial Resistance (14,557 views) – What causes AMR? (3,032 views) – National AMR Strategy (728 views) 	The AMR website was viewed approximately 89,800 times and the most visited top 3 pages are: <ul style="list-style-type: none"> – Antimicrobial Resistance (15,156 views) – What causes AMR? (6,112 views) – Antimicrobial stewardship (3,570 views) 	The AMR website was viewed approximately 88,700 times and the most visited top 3 pages are: <ul style="list-style-type: none"> – Antimicrobial Resistance (12,007 views) – What causes AMR? (8,853) – AMR Strategy – 2020 and Beyond (published March 2020) (5,019 views)
When visiting the site, most types of clicks or downloads were: <ul style="list-style-type: none"> – WHO: 'What is antimicrobial resistance (AMR)?' (1,651 clicks/downloads) – YouTube – 'Antimicrobial resistance in Australia' (793 clicks/downloads) – Read speaker (351 clicks) 	When visiting the site, most types of clicks or downloads were: <ul style="list-style-type: none"> – YouTube – 'Antimicrobial Resistance in Australia' (642 clicks/downloads) – Readspeaker (642 clicks) – External Links – 'Therapeutic Guidelines: Antibiotic' (390 clicks/downloads) 	When visiting the site, most types of clicks or downloads were: <ul style="list-style-type: none"> – YouTube – 'Antimicrobial Resistance in Australia' (1,356 clicks/downloads) – Document Download – Strategy 2020 & Beyond (2,157 clicks) – Readspeaker (755 clicks/downloads)
Of the approximate 58,400 visitors to the site: <ul style="list-style-type: none"> – 16% were returning visitors; and – 84% were new visitors 	Of the approximate 86,580 visitors to the site: <ul style="list-style-type: none"> – 14% were returning visitors; and – 86% were new visitors 	Of the approximate 87,740 visitors to the site: <ul style="list-style-type: none"> – 13% were returning visitors; and – 87% were new visitors <p>New AMR Strategy 2020 and Beyond since its release in March 2020:</p> <ul style="list-style-type: none"> – The AMR Strategy page has been viewed 5,019 times – The AMR Strategy 2020 & Beyond document has been downloaded 2,157 times

Future challenges

Objective 3 of the 2020 Strategy continues to prioritise greater engagement with all Australians to improve their awareness and understanding of AMR and empower them to take ownership of the issue and share in the response.

A coordinated, One Health communications strategy with simple and consistent messaging that resonates with the community to address the challenges of AMR remains to be developed. The communication strategy could be built on the outcomes of successful initiatives implemented by governments and private stakeholders over the course of the Strategy. It could, for example:

- Incorporate further behavioural insights to reduce prescribing and use of antibiotics targeting particular stakeholders.
- Examine how to further promote the Australian Government AMR website to public and private organisations as an interesting and valuable source of authoritative information on AMR.
- Build on public information campaigns implemented in response to the COVID-19 pandemic to reinforce key messages around the importance of hand hygiene and educate people on the limitations of antimicrobials in the face of drug-resistant diseases.

Priority areas for action in the 2020 Strategy:

- 3.1 Develop and implement a coordinated, One Health communication strategy, as well as monitoring and evaluation, to support whole-of-society awareness and behavioural change.
- 3.2 Strengthen public and political awareness to champion and improve the understanding of the importance of combatting antimicrobial resistance.
- 3.3 Create new and different key antimicrobial resistance messages that resonate with society.
- 3.4 Drive education and training initiatives across all relevant sectors and increase accessibility to evidence-based best-practice information.



Objective Two

Antimicrobial Stewardship

Implement effective antimicrobial stewardship practices across human health and animal care settings to ensure the appropriate and judicious prescribing, dispensing and administering of antimicrobials

The challenge

Antimicrobial stewardship refers to coordinated actions designed to promote the appropriate use of antimicrobials. Judicious prescribing, dispensing and administering of antimicrobials across human and animal health settings is essential to slowing the emergence of resistance. The Strategy highlighted the importance of antimicrobial stewardship programs across all settings in which antibiotics are used. To support participation in these programs, up to date evidence-based and sector-specific guidelines and resources need to be available.

Progress in addressing the challenge

Building on decades of antimicrobial stewardship in animal health, Australia continues to refine and implement a range of activities to support effective antimicrobial stewardship in human and animal health settings.

Support for antimicrobial stewardship programs is achieved through the development, review and promotion of evidence-based sector-specific guidelines and resources for use by professionals. This includes *Therapeutic Guidelines: Antibiotic* in human health, and a range of veterinary antibiotic prescribing guidelines in animal health, including for companion animals and livestock.

The following activities have all contributed to the availability of evidence-based and nationally consistent approaches to antimicrobial stewardship:

- Updating of accreditation standards.
- Implementation of sector-specific antimicrobial stewardship frameworks.
- State and territory primary industry departments, veterinarians and industry collaborating to enhance veterinary stewardship programs.
- Building of an evidence base through research and program trials to improve antimicrobial stewardship. For example, the National Antimicrobial Prescribing Survey (NAPS), which measures the quality of antimicrobial prescribing, and now extends across human health and some veterinary settings (companion animals).

Efforts have also been made to strengthen existing measures to better support appropriate and judicious use, such as reviewing antibiotic listings in the Pharmaceutical Benefits Scheme, and the review and promotion of the *Importance Ratings and Summary of Antibacterial Uses in Human and Animal Health in Australia* (2018).





In the animal sector, Australia has one of the most conservative approaches to the use of antimicrobials in food-producing animals in the world. The Australian Pesticides and Veterinary Medicines Authority (APVMA) completed the removal of growth promotion claims from the labels of three macrolide antibiotics and added restraint statements requiring their prudent use. It also cancelled the registration of a single product from this class whose sole label claim was for growth promotion which could no longer be supported. These actions have led to Australia having no growth promotion claims made by currently registered antimicrobials that are medically important for human health.

In addition, a 2015 review, *Antimicrobials in Agriculture and the Environment: Reducing Unnecessary Use and Waste* [8] found that out of 29 countries, Australia was the fifth-lowest user of antibiotics in agriculture.





Over 45 representative initiatives are listed in the Appendix. Under this objective, initiatives have been undertaken to address the following PAAs:

- 2.1 Ensure that tailored, evidence-based antibiotic prescribing guidelines are available for all sectors.
- 2.2 Ensure the availability of evidence-based, best-practice and nationally consistent approaches to AMS across human health and animal care settings.
- 2.3 Develop tailored, evidence-based resources to support the implementation of AMS programmes.
- 2.4 Review existing accreditation and quality assurance programmes to ensure they appropriately support and encourage compliance with best practice AMS approaches.
- 2.5 Strengthen existing measures to better support appropriate and judicious use.

The following case studies highlight some key actions.





Case Study: Development of the Antimicrobial Prescribing Guidelines for Pigs		
	What does it involve?	Collaboration between industry groups and the Australian Government has resulted in the development of veterinary antibiotic prescribing guidelines for various livestock. One example is the development of the <i>Antimicrobial Prescribing Guidelines for Pigs</i> .
	Who are the key stakeholders?	The guidelines were developed through the collaboration of peak animal health industry groups, the Australian Veterinary Association, the pharmaceutical industry and the Australian Government. The Australian Government funded the pig guidelines along with Australian Pork Limited. Australian Pork Limited also had active participation in the development of these guidelines.
	What was the impact?	The guidelines are an important resource that provides best-practice prescribing and stewardship principles. It is primarily for veterinarians, as they prescribe antimicrobials.
	What are the lessons and next steps?	The collaborative experience provided the business model for developing guidelines for other livestock industries. For example, the development of guidelines for poultry (published in August 2020 with assistance from the Australian Chicken Meat Federation), sheep, and dairy beef and feedlot cattle have commenced through various collaborations.
PAAs addressed: 2.1, 2.2, 2.3		

Case study: Changes to the Pharmaceutical Benefits Scheme (PBS)

	What does it involve?	<p>From April 2020, changes were made to antibiotic listings on the PBS to restrict the maximum prescribed quantities and remove unnecessary repeats for the five most commonly prescribed antibiotics: amoxicillin, amoxicillin with clavulanic acid, cefalexin, doxycycline and roxithromycin.</p> <p>This initiative supports the Strategy's approach to reduce the risk of antibiotic resistance by optimising antibiotic use, particularly in the community healthcare setting.</p>
	Who are the key stakeholders?	Australian Government Department of Health developed the proposal, which was approved by the Pharmaceutical Benefits Advisory Committee.
	What was the impact?	<p>These changes aim to encourage clinicians to prescribe antibiotic repeats only when clinically indicated, by prompting them to consider whether a repeat prescription is necessary.</p> <p>In addition, this regulatory change provides the driver for software companies to amend prescribing software to correctly reflect the PBS listings, thereby supporting prescribers.</p>
	What are the lessons and next steps?	This highlights the advantages of coordinated action to design and implement appropriate guidelines and targeted approaches involving regulatory change to initiate more rapid changes to prescribing practices. Review of outcomes will be undertaken at a later date.

PAs addressed: 2.2, 2.4, 2.5

Case study: Importance Ratings and Summary of Antibacterial Uses in Human and Animal Health in Australia

	What does it involve?	<p>The Antibacterial Importance Ratings provides information and guidance to regulators and users of antibacterials on their importance in the treatment of infections in animals and humans, and the seriousness of the consequences should resistance emerge or be amplified, to inform decision making about the registration and use of antibacterial medicines in Australia. It also provides brief comments on the ways in which registered antibacterials are currently used in human and animal health. All agents with significant antibacterial activity are included, even if their primary use is not for treating or preventing bacterial infections.</p> <p>Revised ratings were published on the Australian Government AMR website in June 2018.</p>
	Who are the key stakeholders?	Australian Strategic and Technical Advisory Group on AMR (ASTAG) and individual experts from the Australian Government Departments of Health and Agriculture, Water and the Environment, the Therapeutic Goods Administration (TGA) and Australian Pesticides and Veterinary Medicines Authority (APVMA).
	What was the impact?	The Antibacterial Importance Ratings information is important as it provides a comprehensive picture of antibacterial use across human and animal health sectors in Australia, and the potential for resistance and cross-resistance to develop. It also helps to identify areas that might require close monitoring and/or intervention. It is relevant to the "severity of impact" of antibacterial resistance, which is an important element to overall risk characterisation. The ratings do not affect other parts of risk assessment including hazard, exposure or probability of disease as a result of exposure.
	What are the lessons and next steps?	The ratings will change over time as resistance levels change, new antibacterials are introduced, and optimum antibacterial choices for therapy and prophylaxis alter because of new evidence relevant to Australia. Consequently the table will be reviewed by ASTAG at regular intervals. Updates will be issued as appropriate.

PAs addressed: 2.1, 2.2, 2.4, 2.5

Future challenges

While a range of activities have been implemented to support effective antimicrobial stewardship, compliance with or uptake of antimicrobial prescribing guidelines across human and animal sectors remains a challenge. Improving support for appropriate prescribing and dispensing in human and animal health settings is essential. Antimicrobial stewardship activities need to be informed by targeted surveillance data on antimicrobial usage.

In primary health care, unnecessary prescribing for self-limiting conditions and the expectation of the community to receive antimicrobials drives over-medicalisation and inappropriate use in a cyclical fashion. In the absence of the strong drivers, such as accreditation, that exist in the hospital sector, inappropriate use of antibiotics in primary and residential aged care settings remains a concern. To improve compliance with best-practice antimicrobial stewardship approaches in these settings requires innovative approaches to auditing and feedback, availability of decision support tools and quality improvement programs that optimise antimicrobial prescribing and improve patient care.

In animal health, there has been an increasing availability of evidence-based prescribing guidelines. Wider uptake of these guidelines remains a challenge, particularly in the companion animal sector.

As we look forward, the appropriate use of antimicrobials and stewardship practices remain a key objective of the 2020 Strategy (Objective 4 – appropriate usage and stewardship practices; detail and relevant PAAs are listed below). The 2020 Strategy acknowledges that antimicrobial stewardship cannot be a “one size fits all” solution. Responses need to reflect the specific needs and challenges of each sector, the regulatory environment in which it operates, and the actions already taken to address antimicrobial resistance.

PAAs of Objective 4 – appropriate usage and stewardship practices – in the 2020 Strategy are:

- 4.1 Ensure that coordinated, evidence-based antimicrobial prescribing guidelines and best-practice supports are developed and made easily available, and encourage their use by prescribers.
- 4.2 Develop and implement effective mechanisms to monitor, reward and enforce compliance with standards and best-practice approaches for appropriate and judicious antimicrobial use.
- 4.3 Use data on antimicrobial usage to inform antimicrobial stewardship policy and support the development of targeted, timely and effective responses.



Objective Three

Surveillance

Develop nationally coordinated One Health surveillance of antimicrobial resistance and antimicrobial usage

The challenge

Coordinated surveillance is the key to addressing antimicrobial usage and AMR. Surveillance activities that occur locally, nationally or globally provide the evidence to support the development of best practices and policies for effectively responding to AMR. Analysed AMR surveillance data can identify emerging resistances and trends over time, determine associations between antimicrobial usage and resistance, inform immediate responses and identify gaps in knowledge. It also helps to evaluate policies and set priorities into the future.

A national One Health surveillance system is essential to deliver this: in hospitals, the community, animal health and agriculture production.

The long-term goal of implementing an integrated national One Health surveillance system is a complex process that requires a staged approach, including improving and expanding existing surveillance and other monitoring and information-sharing capabilities, as well as developing and piloting new approaches.

The 2017 World Health Organization's Joint External Evaluation of Australia's core *International Health Regulations (2005)* capacities assessed that Australia has a strong and continuously growing system in place for AMR detection and surveillance in the human health sector, and is moving forward in addressing surveillance of AMR and use in the animal health sector. It made recommendations for priority actions to strengthen areas in the system where challenges remain, such as:

- Extending detection, surveillance, IPC and stewardship into primary care and community settings.
- Aligning antimicrobial susceptibility testing methodology nationally.
- Establishing a plan for AMR surveillance and susceptibility testing in animal health and food, including mechanisms for reporting and information sharing between Health and Agriculture portfolios.
- Creating a mechanism for routine communication, coordination and collaboration for AMR-related assessment, planning and response across all jurisdictions and sectors.

Progress in addressing the challenge

The collaborative efforts of industries, government, researchers and the community on sector-specific surveillance programs and activities have contributed to the overall understanding of antimicrobial resistance and antimicrobial use in Australia.

During the Strategy, Australia has continued to establish the foundations for a national One Health surveillance system to integrate human, animal, food and environmental antimicrobial usage and resistance data.

- In human health, national surveillance for AMR and antimicrobial usage has continued to develop through the growth of the Antimicrobial Use and Resistance in Australia (AURA) Surveillance System via increased voluntary participation and other initiatives such as jurisdiction-wide surveillance programs. With national data reported in 2016, 2017 and 2019 by AURA, it is now possible to identify and track trends in AMR and antimicrobial usage in Australia.

- Surveillance of AMR in animal health has seen a number of proof of concept AMR surveys completed and others being progressed.
- In food, a review has been completed on the presence and extent of AMR in the food production, processing and the retail sector for a variety of products in Australia and New Zealand. This resource [15] is available on the AMR website.
- Research work on environmental AMR has commenced in Australia. Although the environment was not identified as a component of the national surveillance program in the Strategy, research to provide Australian-specific environmental AMR insight and baseline data is likely to assist with determining what environmental AMR data is needed to inform future policy and surveillance action.





Human health surveillance has improved through jurisdictional surveillance programs; the reviewing of priority critical antimicrobial resistances; and the integration of microbial genomics into public health. Work is also underway to develop rapid antimicrobial susceptibility testing and to better coordinate surveillance and response to the emergence of resistant organisms. This is evidenced by the commitment of jurisdiction health departments to work together to develop a national multi-drug resistant organism outbreak response capability.

Animal health surveillance has improved through the delivery of several AMR research projects, surveys and studies that have been conducted across government and industries, covering pigs, chicken meat, layer chickens and cattle, as well as wildlife and companion animals.





Over 50 representative initiatives are listed in the Appendix. Under this objective, initiatives have been undertaken to address the following PAAs:

- 3.1 Establish the foundations for national One Health surveillance.
- 3.2 Agree the objectives of surveillance for each sector, ensuring they align with the overarching objectives for the national One Health surveillance system.
- 3.3 Develop lists of priority organisms and associated antimicrobials for national reporting.
- 3.4 Agree and implement a uniform standard for laboratory testing methods for antibacterial susceptibility.
- 3.5 Improve human health surveillance.
- 3.6 Improve animal health and agriculture surveillance.
- 3.7 Investigate requirements for surveillance in food.

The following case studies highlight some key actions.

Case study: Pig, Chicken Meat and Chicken Egg AMR Surveillance		
	What does it involve?	The Australian Government and the pig, chicken meat and chicken egg industries collaborated on proof-of-concept AMR surveys. These surveys took into account the World Organisation for Animal Health (OIE) Standards for antimicrobial resistance surveillance in food-producing animals.
	Who are the key stakeholders?	The Australian Government, Australian Chicken Meat Federation, Australian Eggs Limited, Australian Pork Limited, and various universities.
	What was the impact?	These projects determined the current low prevalence of resistance against specified antimicrobials in one or more indicator organisms (<i>E. coli</i> , <i>Salmonella</i> spp., <i>Enterococcus</i> spp. and <i>Campylobacter</i> spp.). The outcomes provide ongoing evidence on the low levels of AMR in the food-producing animal sector.
	What are the lessons and next steps?	Surveillance in animal health is one component of addressing the AMR issue, and while AMR in the food-producing sector is currently low, AMR surveillance needs to continue to monitor resistance levels and inform policy and action.
PAAs addressed: 3.5, 3.6, 3.7		

Case study: Antimicrobial Use and Resistance in Australia (AURA) Surveillance System

	<p>What does it involve?</p>	<p>The AURA Surveillance System has continued to collect, analyse and report human health data on antimicrobial use and resistance and the appropriateness of antimicrobial prescribing in Australian hospitals, aged care, general practice and the community. Its purpose is to provide a comprehensive picture of patterns and trends of AMR and antimicrobial use across Australia.</p> <p>Three AURA reports have been published: in 2016, 2017, and 2019.</p>
	<p>Who are the key stakeholders?</p>	<p>Funded by the Australian Government, the Australian Commission on Safety and Quality in Health Care developed and managed the AURA Surveillance System on behalf of the Department of Health, and collaborated with a range of surveillance partners and programs who contributed data.</p>
	<p>What was the impact?</p>	<p>Since its establishment in 2014, the breadth and volume of data collected by the AURA Surveillance System have progressively increased, and the number of hospitals and aged care homes providing data on antimicrobial usage and appropriateness of use has doubled. Resistance data is available from the public sector in the majority of jurisdictions and from some private sector laboratories. A range of data sources on the volume and appropriateness of antimicrobial usage are providing a picture of prescribing patterns in different healthcare settings in Australia.</p>
	<p>What are the lessons and next steps?</p>	<p>A collaborative approach promoting voluntary participation has increased representativeness of the AURA data over time, which in turn better supports analysis of trends over time. To expand surveillance coverage and further increase data representativeness, smaller health services, particularly in rural and remote areas and aged care homes nationally, will be targeted to contribute antimicrobial use data. Participation in passive AMR surveillance will be encouraged for laboratories in the Northern Territory, Victoria and the private sector; and harmonisation of susceptibility testing methods will continue to be promoted.</p>
<p>PAs addressed: 3.1, 3.3, 3.5</p>		

Future challenges

Gaps in surveillance and inconsistencies in data collection, analysis and reporting, along with the use of different diagnostic systems for antimicrobial susceptibility testing, provide an incomplete picture of antimicrobial resistance and usage in Australia.

Australia will continue to progress its efforts towards the establishment of a national One Health surveillance system of antimicrobial resistance and antimicrobial usage, which could include:

- Further exploring capability for real-time aggregation, analysis and reporting of antimicrobial resistance and antimicrobial usage that is linked to public health response in jurisdictions.
- Progressing the alignment of antimicrobial susceptibility testing methodology and reporting across the country.
- Investigating whether data collected in the veterinary antimicrobial supply chain is an appropriate source of antimicrobial usage data in the animal health sector.
- Determining what antimicrobial resistance and antimicrobial usage data from the environment and food are needed to inform policy and action in Australia.
- Continuing to develop phenotypic surveillance and the use of genomic surveillance to better understand the spread of antimicrobial resistance in the animal and human health sectors.
- Analysing the relationship between animal, environmental, food and human isolates for emerging antimicrobial resistance organisms, and incorporate wildlife into larger surveillance efforts.
- Developing an agreed list of priority organisms and regularly reviewing it.

The 2020 Strategy continues to emphasise the importance of One Health surveillance (Objective 5 – integrated surveillance and response to resistance and usage). PAAs of Objective 5 – integrated surveillance and response to resistance and usage – in the 2020 Strategy are:

- 5.1 Create a sustainably funded national One Health surveillance system that integrates human, animal, food and environmental usage and resistance data.
- 5.2 Develop and regularly review lists of priority organisms and associated antimicrobials.
- 5.3 Implement national alignment of laboratory testing practices and reporting for antimicrobial resistance.
- 5.4 Use evidence-based surveillance and monitoring data to inform actions and responses to contain antimicrobial resistance.



Objective Four

Infection Prevention and Control

Improve infection prevention and control measures across human health and animal care settings to help prevent infections and the spread of resistance

The challenge

Infections are the core reason for antimicrobial use. Preventing infections and controlling transmission of infecting pathogens (infection prevention and control in human health and biosecurity in animal health) are an essential part of an effective response to AMR. Preventing the occurrence of infections in humans and animals through such practices as hand hygiene, equipment disinfection and vaccination reduces the need to use antimicrobial medicines and thereby reduces the opportunity for organisms to develop resistance.

The Strategy recognised the importance of promoting infection prevention and control (IPC) and biosecurity practices through evidence-based guidelines, accreditation standards, and quality assurance programs in healthcare settings, veterinary practice and food-producing animal industries. It also acknowledged that best-practice approaches in the context of AMR evolve over time as they are informed by research findings, surveillance data and new technologies.

Progress in addressing the challenge

Various initiatives to strengthen IPC in all human healthcare settings have been implemented. There was a focus on strengthening national evidence-based or best-practice IPC standards for human health, with several infection control guidelines developed at national and jurisdictional levels for managing pathogens of significant concern in human health. This includes release of the 2019 *Australian Guidelines for the Prevention and Control of Infection in Healthcare* by the National Health and Medical Research Council in collaboration with the Australian Commission on Safety and Quality in Healthcare.

Australia continued to strengthen the uptake of vaccinations in its population through enhancing promotional campaigns and availability of clinical resources, and prevent communicable diseases. Examples include the Australian Government-funded Primary Health Network (PHN) Immunisation Support Program – an online platform implemented by NPS MedicineWise and the National Centre for Immunisation Research and Surveillance to support consistent, reliable and fit-for-purpose immunisation services across PHNs.





There have been similar improvements in the animal health sector through the development of initiatives and resources in the food-producing animal industries and veterinary practice. For example, the Australian Chicken Meat Federation updated the National Farm Biosecurity Manual for Chicken Growers—the industry biosecurity reference guide—and accompanying biosecurity manuals, while the Australian Veterinary Association released the third edition of its Guidelines for Veterinary Personal Biosecurity and supporting material.





The introduction of further food safety requirements throughout the supply chain over the years, together with industry-led national quality assurance programs for producers, ensure that farmed meat has been produced safely.





A list of representative initiatives is in the Appendix. These address the following PAAs:

- 4.1 Ensure the availability of evidence-based, best-practice and nationally consistent standards for IPC across human health and animal care settings.
- 4.2 Review existing accreditation and quality assurance programmes to ensure they appropriately support and encourage compliance with best practice IPC measures.
- 4.3 Develop additional initiatives and resources to strengthen IPC in all human health care settings.
- 4.4 Further develop initiatives and resources to strengthen IPC in the livestock industry.
- 4.5 Further develop resources to strengthen IPC in veterinary practice.
- 4.6 Encourage continued increases in vaccination rates to prevent infections.

The following case studies highlight key activities.

Case study: Hand Hygiene Compliance Application (HHCApp)		
	What does it involve?	The HHCApp is an online web-based application developed by the Australian Commission on Safety and Quality in Health Care that enables Australian hospitals to collect and report hand hygiene compliance under Australia's National Hand Hygiene Initiative (NHHI), which includes a suite of initiatives to prevent and reduce healthcare-associated infections in Australia. The HHCApp is a portal to the NHHI database for data entry and reporting of all hand hygiene audit data, which replaces a previous manual audit process.
	Who are the key stakeholders?	Trained and validated hand hygiene auditors are authorised to collect and enter data in state and territory public health organisations and in many private health organisations using the HHCApp. These organisations have immediate access to their own compliance data, and can produce a range of standardised reports using their data. The Australian Commission on Safety and Quality in Health Care analyses and publishes national compliance data, and the Australian Institute of Health and Welfare publishes individual hospital compliance data on the MyHospitals website.
	What was the impact?	Data reported using the HHCApp show that national compliance averages 85% and exceeds the national benchmark of 80% set by the Australian Health Ministers' Advisory Council in 2017. In addition, a study published in 2018 that investigated the effects of the NHHI after eight years showed an association between improved hand hygiene compliance in Australia's largest public hospitals and a decline in the incidence of healthcare-associated <i>Staphylococcus aureus</i> bacteraemia.
	What are the lessons and next steps?	Regular and timely feedback helps to promote local area ownership of hand hygiene issues and should encourage changes to practice where indicated from the audit feedback. Adoption of technologies simplifies the auditing and compliance reporting processes, improves timeliness of analyses that can be used to sustain good practices and encourages continuous individual and institutional efforts to improve patient safety and prevent and control infections. The functionality of and access to the HHCApp continues to be refined to support states and territories and the private sector to integrate hand hygiene auditing and promotion into their broader infection prevention and control programs.
PAAs addressed: 4.1, 4.2, 4.3		

Case study: Livestock Production Assurance (LPA) Program		
	What does it involve?	The program includes a requirement to implement on-farm biosecurity measures to minimise the risk of infectious diseases being introduced to livestock production properties and the subsequent spread of any such disease. Online learning and other tools are available to assist with implementation. Biosecurity practices are auditable and will be part of the accreditation assessment process.
	Who are the key stakeholders?	The program is managed by a subsidiary of Meat and Livestock Australia and relevant industry professionals.
	What was the impact?	The program underpins market access for Australian red meat. LPA National Vendor Declarations (NVDs) provide evidence of livestock history and on-farm practices when transferring livestock through the value chain.
	What are the lessons and next steps?	Maintaining biosecurity and preventing entry of infectious diseases reduces the need to use antimicrobials. The next step is to do a stock take of current biosecurity initiatives/programs so further measures can be applied to prevent disease.
PAA's addressed: 4.4, 4.5, 4.6		

Case study: Agriculture Victoria distributed educational resources		
	What does it involve?	Agriculture Victoria produced and distributed educational resources to veterinarians and owners/farmers. Proactive animal health management, including biosecurity, hygiene and vaccination programs, was highlighted in reducing the spread of AMR.
	Who are the key stakeholders?	Agriculture Victoria led the project and engaged with veterinarians and relevant stakeholders.
	What was the impact?	Through education, the program can help change behaviours among veterinarians and biosecurity professionals. In doing so, we can prevent an increase in AMR in animals.
	What are the lessons and next steps?	The program increased the awareness and understanding of AMR, and the need for further education and communication in motivating behavioural changes.
PAA's addressed: 4.4, 4.5, 4.6		

Future challenges

There is limited data available on IPC in community settings, such as general practices and aged care homes, and on compliance with good antimicrobial stewardship practice. Standards are not as prescriptive as those for hospitals and do not specifically refer to the management of resistant organisms. The absence of an accreditation driver for change (as in the hospital sector) is a significant disadvantage.

Data collected through AURA show that the prevalence of community-acquired resistant bacteria is increasing

Next steps could include:

- Identify and implement innovative ways to maximise best practice IPC, consistent with the *Australian Guidelines for the Prevention and Control of Infection in Healthcare*. These could be incorporated more strongly into accreditation standards for primary care and residential aged care.
- Strengthen coordination and information sharing between the human and animal health sectors in terms of prevention and management.
- Explore the accreditation of veterinary practices, animal shelters and wildlife hospitals on how to implement best practice IPC.
- Consider incentives to improve access to, and manufacture of, animal vaccines and encourage the use of vaccines in both human and animal health as a prevention measure.

- Continue to improve quality and timeliness of surveillance data to enable the implementation of targeted and effective infection prevention and control measures.
- Conduct a stock take of current initiatives/programs supporting the implementation of animal sector specific infection prevention and control /biosecurity measures to prevent disease (e.g. national feedlot accreditation scheme; and quality assurance programs for feedlot cattle and pigs).
- Explore incentives for the development and uptake of early diagnostics in animal health by identifying and addressing diagnostic challenges.

It is important that Australia's biosecurity plans and standards are evidence based and nationally consistent. The ability to measure compliance is key to prevent the spread of resistance, as outlined in the 2020 Strategy (Objective 2 – prevention and control of infections and the spread of resistance). The PAAs for Objective 2 are:

- 2.1 Adopt evidence-based and nationally consistent standards for infection prevention and control and biosecurity.
- 2.2 Maximise compliance with best-practice infection prevention and control and biosecurity measures through adherence to applicable legislation, targets and accreditation standards.
- 2.3 Promote disease prevention practices to reduce infections and subsequent use of antimicrobials.
- 2.4 Share information on emerging antimicrobial resistance trends to inform responses.



Objective Five

Research

Agree a national research agenda and promote investment in the discovery and development of new products and approaches to prevent, detect and contain antimicrobial resistance

The challenge

Research builds the evidence base for understanding how AMR develops and spreads, and how best to prevent and contain it. This includes: the development of new antimicrobials and antimicrobial alternatives; diagnostic technologies for clinicians to identify microorganisms causing infections rapidly and prescribe antimicrobials appropriately. It also involves the development of other technologies, products or best practices around surveillance, detection, prevention and containment approaches.

AMR-related research receives specific funding nationally and internationally. However, duplication of efforts and gaps result from limited coordination of research priorities and initiatives. The Strategy recognised that coordination of research effort could be improved in Australia through an agreed national research agenda that stimulates collaboration between researchers and across sectors and identifies priority areas for research and development. The intention was that this would help focus attention on the gaps in Australia's evidence-base and target resources to areas where new discoveries and technological innovation are most needed to address the emergence and spread of AMR. Progress towards an agreed national research agenda remains a priority under the 2020 Strategy. This includes consideration of innovative ways for the public and private sectors to sustainably fund or stimulate the discovery, development and translation of promising research findings into new products, policies and approaches to prevent, detect and contain AMR.

Progress in addressing the challenge

Australian Government funding bodies or programs have continued to invest in AMR-related research across programs such as:

- Australian Research Council
- National Health and Medical Research Council
- Cooperative Research Centres Program
- Medical Research Future Fund
- Australia and Pacific Science Foundation
- Australian Government's Animal Biosecurity and Response Reform Program
- Australian Government's Rural Research and Development for Profit Program.

Animal industries contributed funding and resources to expand evidence-based guidance to members and support the collection and analysis of surveillance data on resistances.

AMR continued to be a research priority under the Medical Research Future Fund, with a One Health focus. The NHMRC funded 100 AMR-related projects between 2017 and 2019, totalling approximately \$82 million, and four Centres of Research Excellence focused on aspects of AMR, at approximately \$2.5 million each over their respective five-year period.





Some advances were made in the priority and neglected areas for research, such as adjunct or replacement therapies that aim to control infections caused by bacteria that have become resistant to multiple or all available antibiotics (commonly known as ‘superbugs’). In addition, human health research exploring the use of whole of genome sequencing demonstrated potential as a surveillance tool for monitoring the presence of resistant pathogens.





The Activity and Research Directory on the Australian Government AMR website provided a start for collaboration and information sharing, where researchers and other partners shared information on their research activities.

A list of representative research initiatives is in the Appendix. Under this objective, initiatives have been undertaken to address the following PAAs:

- 5.1 Identify current gaps and agree national research and development priorities.
- 5.2 Coordinate national research activities and the sharing of information.
- 5.3 Explore opportunities to increase support for research and development, including incentives for greater private sector investment.
- 5.4 Explore opportunities to support the translation of promising research findings into new products, policies and approaches.

The following case studies highlight some key activities.

Case study: Animal Industries’ Antimicrobial Stewardship Research, Development & Extension Strategy		
	What does it involve?	A collaborative mechanism for animal industries to identify common research, development and extension (RD&E) priorities for the effective monitoring of antimicrobial use (AMU) and surveillance of AMR to inform stewardship actions that meet Australia’s animal health and market access needs, without impacting food safety or human health.
	Who are the key stakeholders?	Australian red meat, dairy, pork and poultry industries, and Australian and jurisdictional governments.
	What was the impact?	Through this strategy, animal industries could maintain access to antimicrobials, so animal health and welfare was not impacted.
	What are the lessons and next steps?	Historical Australian initiatives have resulted in very low levels of AMR bacteria from food-producing animals. However, further progress is needed to ensure this situation remains and Australian industries are afforded relevant opportunities to capitalise on this status.
PAAs addressed: 5.2, 5.4		

Case study: National Health and Medical Research Council (NHMRC)		
	What does it involve?	The NHMRC supports investigator-initiated and targeted calls for research through its grant program, including on behalf of other programs such as the Medical Research Future Fund.
	Who are the key stakeholders?	Medical, scientific, public health and ethics researchers and research organisations, health care professionals, policy makers and the community.
	What was the impact?	<p>The NHMRC awarded approximately \$121.2 million in funding for 152 grants relevant to research into AMR between 2015 and 2019, predominantly for basic research, clinical medicine and science and public health.</p> <p>As part of NHMRC's portfolio, it also provides funding of around \$2.5 million each over five years for the establishment of Centres of Research Excellence (CREs). The objective of the CRE scheme is to improve health outcomes and promote or improve translation of research outcomes into policy and/or practice. The CRE scheme will also support researchers in capacity building activities, including in specific areas of need identified by NHMRC.</p> <p>Some examples of CREs that focused on different aspects of AMR are:</p> <ul style="list-style-type: none"> • <u>National Centre for Antimicrobial Stewardship (NCAS)</u>. NCAS investigates the gaps in what we know about the links between antibiotic use in humans and animals and antibiotic resistance; manages the National Antimicrobial Prescribing Survey; and also engages on stewardship in companion animal health. • <u>Centre for REdefining antibiotic use to reDUce ResistanCE and Prolong the Lives of Antibiotics (REDUCE)</u>. REDUCE conducts research to prolong the effectiveness of antimicrobials. It looks for new ways to treat conditions when current antibiotics stop working. • <u>Centre of Research Excellence in Minimising Antibiotic Resistance in the Community (CRE-MARC)</u>. CRE-MARC builds on CREMARA (<u>Centre for Research Excellence in Minimising Antibiotic Resistance for Acute Respiratory Infections</u>) and extends this research into a second phase of implementation and new work in urine and skin infections. • <u>Centre of Research Excellence in Protecting the Public from Emerging Infectious Diseases (CREID)</u>. CREID researches emerging infectious diseases as well as ones that re-appear to protect Australia and our region from emerging threats.
	What are the lessons and next steps?	The NHMRC has an important role in building research capacity in Australia and improving knowledge and translation of research on AMR. Through its grants programs, including the CREs, it supports research and collaborative partnerships that will provide valuable experience for the future development of a national AMR research and translation agenda.

PAA's addressed: 5.1, 5.3, 5.4

Future challenges

While information sharing and collaboration between Australia's research institutes has increased, development of an agreed national One Health AMR research agenda for Australia remains a priority. A national research agenda would reduce duplication of effort in research and development initiatives and inform future potential grant and funding opportunities offered by governments and private foundations. It would also guide coordination and collaboration across the academic and research community and assist with making decisions about priorities for research related to AMR and antimicrobial use. The Australian Government has allocated funding to Health in the 2020-21 Budget to address this priority area in the 2020 Strategy. Development of the research agenda will include extensive stakeholder engagement to harness expertise and knowledge to assist with identifying priority areas and current gaps where the greatest impacts of new research and development investment can be achieved.

Identifying sustainable sources of funding and ways to incentivise innovative research will be delivered through an initial scoping study that will examine pricing/reimbursement models (push mechanisms) and innovative market access mechanisms (pull mechanisms) that could be implemented in Australia to support innovative

AMR R&D, with a view to bringing novel products and best practices to market in Australia. This may include exploring funding models to secure dedicated funding to address AMR, particularly in the animal health sector.

The associated PAAs identified for Objective 6 - a strong collaborative research agenda across all sectors – in the 2020 Strategy are:

- 6.1 Set a flexible national antimicrobial resistance research and development agenda that strives for innovation.
- 6.2 Coordinate and share research and development activities.
- 6.3 Seek and maintain dedicated funding for the national research and development agenda, including private and public investment partnerships.
- 6.4 Support the translation of research findings into new approaches, applications and policies to combat antimicrobial resistance.



Objective Six

International Partnership and Collaboration

Strengthen international collaboration and partnerships on regional and global efforts to respond to antimicrobial resistance

The challenge

The Strategy identified international collaboration and alignment of efforts as essential for responding to the global challenges of AMR. By engaging in international partnerships, Australia can contribute to improving global coordination through sharing lessons learned and best practices implemented in different sectors, as well as to learn from other countries' experiences in implementing national and sector-specific AMR action plans and other initiatives to improve national responses. Engagement with international partners can also avoid duplication of effort and identify where limited resources can be targeted to deliver the most benefit.

Progress in addressing the challenge

Australia participated in a number of international surveillance initiatives, collaborated in information sharing across research networks and engaged with multilateral organisations and regional and global forums to progress the international response to AMR.

Australia supported regional activities on AMR to foster and facilitate research collaborations between governments and through public-private partnerships, with state and territory governments, industry representative organisations and research institutions also establishing important international collaborative relationships for sharing best practices.

Australia's active engagement in supporting countries in the Asia-Pacific region has been important for advancing regional health security. Australia led regional initiatives to increase capacity to respond to AMR, such as assisting the development of AMR strategies, tools and resources in the Asia and Pacific region. This included developing two new human health apps—Fiji Guidelines Host and Solomon Islands Guideline Host—which give clinicians access to locally-developed standard treatment guidelines.





Australia has also participated in international surveillance initiatives, such as the WHO Global Antimicrobial Resistance Surveillance System (GLASS), the annual Tripartite Country Self-Assessment Survey that has a One Health focus, and has contributed data to the annual OIE survey on antimicrobial agents intended for use in animals. Australia has been involved in enhancing cross-border capacity to track emergence and spread of resistance internationally, including through establishing a clinical research network across the Asia-Pacific region to evaluate the incidence and prevalence of AMR in priority populations.





A list of representative initiatives is in the Appendix. They address the following PAAs:

- 6.1 Active engagement with multilateral organisations and relevant forums to contribute to regional and global action on antimicrobial resistance.
- 6.2 Lead regional initiatives to increase capacity to respond to antimicrobial resistance.
- 6.3 Learn from international best practice.
- 6.4 Participate in international surveillance initiatives.

6.5 Establish closer ties with international collaborations to link Australia’s national research agenda with what is happening internationally.

The following case studies highlight key engagements.

Case study: Australia’s contribution to the World Health Organization’s (WHO) Global Antimicrobial Resistance Surveillance System (GLASS)		
	What does it involve?	<p>Australia boosted its international collaboration efforts in AMR during this period by enrolling in, and contributing to, WHO’s Global Antimicrobial Resistance Surveillance System (GLASS).</p> <p>Using data from established human health AMR surveillance programs, Australia submitted antimicrobial susceptibility data on one priority pathogen from one specimen site to GLASS in 2019.</p>
	Who are the key stakeholders?	<p>WHO Collaborating Centre for Sexually Transmitted Infections and Antimicrobial Resistance (WHOCC STI AMR), Sydney, is Australia’s GLASS National Coordinating Centre (NCC) and GLASS National Focal Point along with the Australian Government Department of Health.</p> <p>Australia’s participation is supported by:</p> <ul style="list-style-type: none"> • Laboratories that undertake the antimicrobial susceptibility testing and provide data to Australia’s established AMR surveillance programs • Australian surveillance programs that collect, analyse and prepare AMR data for submission to GLASS.
	What was the impact?	<p>Australia’s WHOCC STI AMR was involved in the establishment and development of the WHO GLASS program and continues to provide support to laboratories and surveillance programs in the region.</p> <p>Participating in GLASS has improved communication between Australia’s human health surveillance programs, made better use of data from these existing programs and enabled a contextual view of Australia’s data in the WHO Global Health Observatory [16].</p> <p>By enrolling in and contributing to GLASS, Australia joined other contributing Member States whose participation is significantly increasing the quantity of quality AMR data available globally. The GLASS data will be submitted to the WHO Global Health Observatory to monitor progress towards the Sustainable Development Goals.</p>
	What are the lessons and next steps?	<p>Australia has invested in multiple surveillance programs over many years for disease management, prevention and control. These programs have generated volumes of high quality data used to inform our practices in health over many decades. Importantly, these programs align with the GLASS targets for surveillance and, through coordination of these programs, Australia was able to enrol in GLASS and contribute high quality data. Australia’s contribution to GLASS will expand to include more indicators with optimised coordination of existing national surveillance activities and investigation of new opportunities to contribute to the global picture of AMR.</p>
PAA’s addressed: 6.1, 6.3, 6.4, 6.5		

Case study: Australia's participation in the Ad Hoc Codex Intergovernmental Task Force		
	What does it involve?	Food Standards Australia New Zealand and DAWE represented Australia at the Ad Hoc Codex Intergovernmental Task Force on Antimicrobial Resistance from 2017 to 2019. The Task Force is revising the <i>Code of Practice to Minimize and Contain Foodborne Antimicrobial Resistance</i> and the development of <i>Guidelines on Integrated Monitoring and Surveillance of Foodborne Antimicrobial Resistance</i> .
	Who are the key stakeholders?	Food Standards Australia New Zealand and DAWE have led the Australian approach. These agencies have been supported by key stakeholders involved with the authorisation, manufacture, sale and supply, prescription and use of antimicrobial agents in the food chain and those involved in the handling, preparation, food processing, storage, transport, wholesale and retail distribution and consumption of food.
	What was the impact?	Through the Task Force, two key agencies and their stakeholders were able to come together and collaborate to have an influence on international standard setting for food trade. As a result of their collaborative efforts, Australia was able to play a meaningful role in the global conversation on foodborne AMR.
	What are the lessons and next steps?	Australia's involvement in the Task Force supported sensible outcomes in the standard-setting process to date. Australia will continue this approach in upcoming work of the Task Force. In addition, it also created opportunities to develop useful international connections through this forum.
PAs addressed: 6.2		

Future challenges

There is further scope for Australia to increase its participation in international surveillance activities to support global AMR mitigation. For example:

- A nationally coordinated animal health approach is needed to collate and analyse antimicrobial use and AMR surveillance data to contribute to the OIE global surveillance system and future platforms, respectively. This information will need to be integrated with reported AMR surveillance data in the future.
- Australia will expand on the human health data sets it contributes to GLASS.

Other areas for focus include:

- Continue active engagement with the tripartite agencies (WHO, OIE and FAO) and other relevant international forums, to progress global and regional action on antimicrobial resistance.
- Continue to provide expertise and experience to WHO Joint External Evaluations in other countries within the immediate region.
- Identify appropriate forums to share human and animal health activities and initiatives at the international level.
- Continue contributions, support to and collaboration with, regional governments on capacity building and development of policies, antimicrobial stewardship and surveillance programs to address antimicrobial resistance in animal sectors. This will help with addressing international trade and market access issues, and create opportunities for education and training.

PAs of Objective 7 – strengthen global collaboration and partnerships in the 2020 Strategy are:

- 7.1 Influence the global antimicrobial resistance agenda by active engagement and collaboration with other countries, multilateral organisations and forums.
- 7.2 Promote the importance of antimicrobial resistance in the South East Asia and Pacific regions, and engage in related initiatives to build regulatory and other capacity.
- 7.3 Participate in international surveillance and monitoring initiatives.



Objective Seven

Governance

Establish and support clear governance arrangements at the local, jurisdictional, national and international levels to ensure leadership, engagement and accountability for actions to combat antimicrobial resistance for actions to combat antimicrobial resistance

The challenge

To support progress in addressing AMR in Australia, clear lines of responsibility and accountability at the national, jurisdictional and local levels, and coordination of effort across a wide range of implementation partners within and across the One Health sectors, were identified as essential elements for success in the Strategy. While the human and animal health sectors have benefited from many years of collaboration, challenges remain in relation to other sectors that are at earlier stages of addressing AMR as an issue of concern.

In addition, there is an ongoing need to raise the profile of AMR as a priority issue requiring dedicated funding and other resourcing, both globally and nationally.

Progress in addressing the challenge

There has been a strong focus on establishing and maintaining linkages between implementation partners across all sectors and at all levels, from local to national.

The Australian Government's national leadership and the commitment by state and territory governments' health and primary industry departments have played an important role in addressing the Strategy's priorities.

Equally, engagement and commitment of medical and veterinary boards, professional colleges and societies, accreditation and industry bodies and other non-government stakeholders and representative organisations should be recognised for strengthening existing arrangements and implementing new practices and policies to support the Strategy's objectives. This commitment has underpinned the AMR governance arrangements for Australia.

The Australian Government Chief Medical Officer and the Australian Chief Veterinary Officer continued to co-chair the Australian Strategic and Technical Advisory Group on Antimicrobial Resistance (ASTAG), comprised of representatives from across all sectors. Membership expanded to include environment and wildlife representatives to better reflect Australia's One Health approach to AMR and further strengthened linkages between governments, industry, professional bodies and other key stakeholders.

In October 2018, the Council of Australian Governments' Health Council (CHC) identified and agreed antimicrobial resistance as a top national priority that requires the cooperation of all jurisdictions for 2019–2020. Equally, the Agriculture Ministers' Forum provided endorsement for the 2020 Strategy. The flow-on effect from that agreement was endorsement of the 2020 AMR Strategy by the Council of Australian Governments in March 2020.

This occurred in parallel with the development of One Health jurisdictional strategies, policies and governance structures for AMR, with an operational focus on strengthening stewardship, infection prevention and control and biosecurity arrangements. Another example is the sector-specific action plans that are being developed. The

Australian Animal Sector National Antimicrobial Resistance Plan 2018 is highlighted as a case study in the development of this process.





There has been significant progress made within the animal sector. As outlined in the case study, the Australian Animal Sector National Antimicrobial Resistance Plan 2018 was finalised during the Strategy and the associated sector action plan is now under development. This aligns with the 2020 Strategy focus on planning and coordinating efforts through the drafting and implementation of sector-specific action plans.

In 2018, a workshop was conducted with the aim of identifying gaps, overlaps, inconsistencies and inefficiencies in Australia’s regulatory framework relevant to AMR and antibiotic usage. It brought together sixty stakeholders from federal and state governments, research institutions, industry bodies, peak representative organisations in human and animal health, regulators of therapeutic, agricultural and veterinary medicines, and experts in human and animal laboratories, microbiology and biosecurity. This analysis of Australia’s regulatory framework is ongoing.

Over 20 representative initiatives are listed in the Appendix. These address the following PAAs:

- 7.1 Identify, establish and maintain linkages between implementation partners across all sectors.
- 7.2 Work with stakeholders to develop an Implementation Plan for the Strategy.
- 7.3 Establish baseline measures to inform monitoring and evaluation of the Strategy.
- 7.4 Review regulation (legislated and other) relevant to antimicrobial resistance and antibiotic usage.

The following case study is an example of an initiative that address this objective.

Case study: Australian Animal Sector National Antimicrobial Resistance Plan 2018		
	What does it involve?	Animal sector stakeholders collaborated with the Australian Government to develop and release the <i>Australian Animal Sector National Antimicrobial Resistance Plan 2018</i> . The Plan supports the implementation of the national AMR strategy. The Plan considers a broad spectrum of animals, including aquatic animals, companion animals, food and fibre-producing animals, performance animals and wildlife.
	Who are the key stakeholders?	The Australian Government worked with several major animal sector stakeholders to develop the Plan.
	What was the impact?	The Plan aligns with the Strategy’s objectives, explaining the areas for action, challenges and next steps for each objective for the animal sector. Critically, the Plan helps to communicate the direction of the animal sector in addressing AMR. The Plan will also support Australia in the international arena, by providing evidence of the sector’s activities. This is valuable, as it is becoming increasingly recognised that AMR is likely to affect exports of food-producing animals and their products to international markets.
	What are the lessons and next steps?	The Plan highlighted the need for the animal sector to achieve its strategic objectives in a coordinated manner, to communicate the direction of the animal sector in addressing AMR, and to share information and provide consistent messaging. A sector-specific action plan is being developed to support this Plan and the 2020 Strategy.
PAAs addressed: 7.2		

Future challenges

Better understanding of current regulatory arrangements and the economic impact of antimicrobial resistance in Australia is required to identify and prioritise areas for action.

Next steps include:

- Continue to support relevant multilateral organisations such as the WHO, OIE and FAO to foster a global approach of responsibility and accountability on combatting antimicrobial resistance.
- Increased collaboration between Australian, state and territory governments.
- Produce an Australian Government monitoring and evaluation framework to accompany the next Strategy to drive accountability.
- Stakeholders across human health, animal health, agriculture, food and environment sectors, will be encouraged to develop and implement sector-specific action plans to provide clear accountability and plans for minimising antimicrobial resistance.
- Review ASTAG membership to ensure it includes adequate representation from all sectors, including food and environment.

In the 2020 Strategy, Objective 1 – clear governance for antimicrobial resistance initiatives – identifies that better understanding of current regulatory arrangements and the economic impact of antimicrobial resistance in Australia is required to prioritise areas for action, and the allocation of funding across sectors.

PAAs of Objective 1 – clear governance for antimicrobial resistance initiatives – in the 2020 Strategy are:

- 1.1 Create sustainable funding for combatting antimicrobial resistance based on evidence of economic and societal costs and benefits of different approaches in all sectors.
- 1.2 Develop, implement and/or maintain sector-specific action plans.
- 1.3 Maintain and expand linkages and opportunities between stakeholders across all sectors to provide a nationally coordinated approach to combatting antimicrobial resistance.
- 1.4 Monitor and review regulatory measures (legislated and other) relevant to antimicrobial usage and resistance.

WHERE TO FROM HERE?

As highlighted in the analysis provided under each objective, significant progress has been made over the last five years. Despite best efforts, a number of issues identified for action in the Strategy require ongoing or enhanced attention. These are reinstated in the 2020 Strategy.

When treatments are unavailable or lose effectiveness, infection becomes hard to treat. The failing development pipeline for new antimicrobials results in an increased reliance on existing medicines. As a result, one of the strategic approaches to manage the AMR issue involves encouraging innovation and development in relation to new antibiotics and rapid diagnostic methods. Meanwhile, the importance of hygiene from a prevention and infection control perspective remains a crucial strategy for reducing the spread of resistant organisms, as do stewardship programs to encourage correct usage of valuable antimicrobials.

Building on the achievement of the first strategy, the 2020 Strategy addresses many of these remaining challenges. In particular, the 2020 Strategy focuses on:

Surveillance

- Implementing a national One Health surveillance system that is sustainable and of value to everyone, a component of which involves developing nationally consistent susceptibility testing methods.

Communication, training and education

- Improving communication and engagement with the community and health professionals through education and effective communication will help people better understand their role in mitigating AMR, through both appropriate use of antimicrobials and good hygiene.

Collaboration in research

- Driving better engagement and connection between different sectors through a One Health approach built on collaboration between public, private and research organisations is important. This will help drive research, encourage development of innovative technologies and response approaches and improve information sharing along the pharmaceutical pipeline.

Food, plant health and the environment

- The 2020 Strategy incorporates or enhances the role of other One Health sectors (food, plant health and the environment), which are generally in earlier stages of considering AMR. These sectors would benefit from ongoing involvement in the national AMR governance structures to learn from experiences in the human and animal health sectors.

APPENDIX

Tables of Activities and Achievements by Objective

Objective One: Increase Awareness and Understanding of AMR

Increase awareness and understanding of antimicrobial resistance, its implications and actions to combat it, through effective communication, education, and training

Objective One Achievements: Increase awareness and understanding of AMR	Organisation Type
One Health	
<p>Australian Government Department of Health and Department of Agriculture, Water and the Environment</p> <ul style="list-style-type: none"> Maintained the One Health AMR website (www.amr.gov.au) - a central repository for trusted information and resources related to antibiotic use and antimicrobial resistance. 	Public Sector
<p>Environment Protection Authority Victoria</p> <ul style="list-style-type: none"> Conducted a seminar about antimicrobial resistance outside the hospital walls – understanding environmental hotspots, drivers and risks as part of Environmental Science Seminar Series. 	Public Sector
<p>National Centre for Antimicrobial Stewardship (NCAS)</p> <ul style="list-style-type: none"> Delivered various communication, education and training activities on antimicrobial stewardship to health and animal health professionals, including through the NCAS website and social media channels. Hosted the National Antimicrobial Resistance and Antimicrobial Stewardship forum in 2018 and partnered with national collaborators to deliver the same in 2019. 	Research Community
Human Health	
<p>Australian Government Australian Commission on Safety and Quality in Health Care</p> <ul style="list-style-type: none"> Published and disseminated a wide range of resources, which are also available on the Commission’s website. The reports and resources communicate the findings of the Antimicrobial Use and Resistance in Australia (AURA) Surveillance System and its surveillance partners, and promote good stewardship practices. For example, the publication of: <ul style="list-style-type: none"> Annual reports on AGAR, NAPS and CARAlert findings; Antimicrobial Stewardship in Australian Health Care 2018. Coordinated national Antibiotic Awareness Week activities for the human health setting. 	Public Sector
<p>Monash University (Project leads: A/Prof. Mark Davis and Prof. Andrea Whittaker)</p> <ul style="list-style-type: none"> Worked on delivering a public engagement project, ‘Antimicrobial Resistance: Science, Communication and Public Engagements (AMR-Scapes)’ with co-investigators Mia Lindgren (Swinburne University of Technology), Monika Djerf-Pierre (University of Gothenberg) and Paul Flowers (University of Glasgow) to research public engagements with advice regarding the rational and reduced use of antibiotics. Themes include examining news and health media messages, as well as exploring enablers and barriers to the enactment of antimicrobial resistance advice in everyday life (ARC Discovery Project Grant DP170100937). 	Research Community

Objective One Achievements: Increase awareness and understanding of AMR

Organisation Type

<p>Hand Hygiene Australia</p> <ul style="list-style-type: none"> Continued to implement the National Hand Hygiene Initiative and provide education, training and effective communication activities to improve infection prevention and control practices in healthcare settings. (Funded by the Australian Government’s Australian Commission on Safety and Quality in Health Care.) 	<p>Public Sector</p>
<p>NPS MedicineWise</p> <ul style="list-style-type: none"> Involved in, and promoted, World Antibiotic Awareness Week held in November each year. The 2018 campaign reached an estimated 1.4 million Australians. Incorporated AMR and antimicrobial stewardship related initiatives into national quality use of medicines (QUM) programs to educate consumers and health professionals on safe and appropriate use of medicines. This included: <ul style="list-style-type: none"> social marketing approach for consumers using multiple strategies (e.g. leveraging collectivism, nudge theory, celebrity endorsement and co-creation) and multiple communication channels (e.g. via electronic media, social media, print, radio, TV and health professionals); for health professionals, such as general practitioners and pharmacists, programs were evidence-based and multifaceted using education outreach with face-to-face interactions for general practitioners, feedback and audit, case studies, online learning and point of care materials. Released and promoted 14 ‘Choosing Wisely’ recommendations of 10 medical colleges and societies to help practitioners reduce inappropriate prescribing of antibiotics and help address AMR. 	<p>Professionals</p>
<p>The Peter Doherty Institute for Infection and Immunity</p> <ul style="list-style-type: none"> Trained and built capacity of public health microbiologists, epidemiologists and registrars in using genomics to respond to antimicrobial resistance. Co-organised, with Communicable Diseases Genomics Network, the View to the Future for Public Health and Personalised Infectious Disease Care Symposium to share information and promote genomics as a tool to detect and contain antimicrobial resistance. 	<p>Research Community</p>
<p>Rotary Club of Applecross (Project leads: Prof. Tim Inglis and Dr Barry Mendelawitz)</p> <ul style="list-style-type: none"> Formed not-for-profit organisation, ‘AMR Aware’, with the mission to promote antimicrobial resistance awareness and information. Supports a PhD program looking at social marketing of antimicrobial resistance messages. 	<p>Society</p>
<p>Royal Australian College of General Practitioners</p> <ul style="list-style-type: none"> Published a public position statement on antimicrobial stewardship. Worked on producing RACGP Aged Care Clinical Guide (Silver Book), which will address the topic of antibiotic prescribing and antimicrobial resistance in residential aged care facilities. 	<p>Professionals</p>
<p>State and territory governments</p> <ul style="list-style-type: none"> Participated in antimicrobial resistance awareness-raising initiatives such as World Antibiotic Awareness Week. Hosted jurisdiction-wide forums, education programs and workshops, for health facilities and workers, to raise awareness, build skills and develop guidelines and protocols. For example: <ul style="list-style-type: none"> Queensland, through the Queensland Statewide Antimicrobial Stewardship Program, delivered antimicrobial resistance and antimicrobial stewardship education programs targeting healthcare providers in rural and remote Queensland hospitals, including an online antimicrobial resistance education program and a library of educational resources; Tasmania held a statewide vancomycin-resistant enterococci forum with an emphasis on providing a consistent approach in both the public and private sectors across Tasmania. Published resources and guidelines to support consistent, best-practice approaches to antimicrobial stewardship, surveillance, and infection prevention and control across jurisdictions. For example: 	<p>Public Sector</p>

- **Victoria** released guidance on carbapenemase-producing Enterobacteriaceae in health care and residential aged care facilities that was accompanied by communications activities and stakeholder engagement across health and aged care sectors;
- **New South Wales**, through Health Protection NSW, developed resources for hospital staff and patients, including a guideline on the surveillance and management of carbapenemase-producing Enterobacteriaceae;
- **Queensland**, through Queensland Health, developed state guidelines and training packages including: *Candida auris* guideline for acute healthcare facilities; multidrug-resistant organisms factsheet for residential care facilities; and intravascular device management guideline for acute healthcare workers.

Animal Health / Agriculture

State and territory governments

Public Sector

Agriculture Victoria

- Produced multiple educational resources for veterinarians and animal owners/farmers about antimicrobial resistance, which promotes good antimicrobial stewardship.
- Distributed materials and communicated with industry by speaking at professional meetings, and with veterinarians through social media channels plus conference, field day and seminar sponsorship and attendance.
- Co-hosted animal sector stakeholder workshops with the then Australian Government Department of Agriculture to develop the *Australian Animal Sector National Antimicrobial Resistance Plan 2018* and assist with drafting an associated action plan.
- Produced materials that educate veterinarians about the Australian Strategic and Technical Advisory Group on Antimicrobial Resistance (ASTAG) endorsed Antibacterial Importance Ratings for use in animal health.
- Actively participated in antimicrobial resistance technical groups, such as ASTAG and the Harmonisation of Agricultural and Chemical Control of Use Task Group.

Department of Primary Industries and Regions (South Australia)

- Promoted awareness of the issue of antimicrobial resistance and prescribing guidelines amongst veterinary practitioners through organisation of and participation in local seminars.
- Engaged with local stakeholders on development of enhanced awareness of antimicrobial resistance research, activities and issues specific to South Australia, with the view to continued development of a state strategy.
- Developed online resources on antibiotics and vaccinations for poultry on the Department of Primary Industries and Regions, Government of South Australia's website.

Department of Agriculture and Fisheries (Queensland)

- Raised awareness of antimicrobial resistance, antimicrobial stewardship and prescribing guidelines amongst veterinarians via presentations at Australian Veterinary Association Branch meetings.
- Actively promoted resources developed by Agriculture Victoria to veterinarians.

Department of Primary Industries (New South Wales)

- Raised awareness about antimicrobial resistance and antimicrobial stewardship at seminars for veterinarians and veterinary students on 12 occasions.
- Raised awareness about antimicrobial resistance and antimicrobial stewardship through interaction with the leadership of animal-industry groups and organisations at the national level on 10 occasions.
- Participated in peak national scientific groups advising governments on antimicrobial resistance in animals and humans (since 2002).
- Continued chairing the Animal Health Antimicrobial Resistance Surveillance Task Group.

Objective One Achievements: Increase awareness and understanding of AMR

Organisation Type

<ul style="list-style-type: none"> Continued as an expert on the United Nations List of Experts for consultation on antimicrobial resistance in animals, and attends World Organisation of Animal Health (OIE) meetings. Contributed scientific expertise on project management, project design and reporting for surveillance of AMR in cattle, sheep, pigs, meat chickens, laying hens, salmon and barramundi. Contributed scientific advice on antimicrobial resistance and/or resources to six Australian and four foreign research organisations (university or government) Provided scientific expertise to United Nations, the OIE and international food service industry organisation on global management of AMR on four occasions. <p>Department of Industry, Tourism and Trade (Northern Territory)</p> <ul style="list-style-type: none"> Informed stakeholders (veterinarians, livestock industries, researchers and regulators) of AMR through face to face meetings, conference and newsletters. <p>Department of Primary Industries and Regional Development (Western Australia)</p> <ul style="list-style-type: none"> Raised awareness of antimicrobial resistance at conferences, field days and workshops across a range of sectors including farmers, veterinarians, environmental health and food safety, and the broader community. Raised awareness of antimicrobial stewardship and prescribing guidelines via face-to-face workshops with private veterinarians and provision of resources. 	
<p>Animal Medicines Australia</p> <ul style="list-style-type: none"> Developed and published fact sheets for animal owners to emphasise the responsibilities of animal owners to use antibiotics responsibly. 	Private Sector and Industry
<p>Australian Chicken Meat Federation</p> <ul style="list-style-type: none"> Led the coordination of the inaugural Australian Veterinary Antimicrobial Stewardship Conference in 2018. Communicated regularly with industry veterinarians on antimicrobial stewardship. Developed, adopted and promoted to members a revised policy for antimicrobial use and resistance. 	Private Sector and Industry
<p>Australian Lot Feeders Association</p> <ul style="list-style-type: none"> Conducted workshop series to support the expansion of knowledge and understanding of antimicrobials and their effective and judicious use. Released an online training platform for antimicrobial use, stewardship and resistance. 	Private Sector and Industry
<p>Australian Pork Limited</p> <ul style="list-style-type: none"> Continued coordination of a veterinary antimicrobial stewardship committee, which is driving industry antimicrobial stewardship uptake through resources such as the <i>Antimicrobial Prescribing Guidelines for Pigs</i> and key communications. Co-organised the Australian Veterinary Antimicrobial Stewardship (AV Antimicrobial Stewardship) Conference 2018. 	Private Sector and Industry
<p>Australian Veterinary Association</p> <ul style="list-style-type: none"> Continued to provide continuing education to veterinarians in antimicrobial resistance and antimicrobial stewardship, such as lectures, printed materials and fact sheets on appropriate antimicrobial prescribing and infection prevention. Provided materials and information to assist the development of the Australian Government's One Health antimicrobial resistance website. 	Professionals
<p>Meat and Livestock Australia</p> <ul style="list-style-type: none"> Co-organised the Australian Veterinary Antimicrobial Stewardship (AV Antimicrobial Stewardship) 2018 Conference. Released the Antimicrobial Stewardship Program and e-learning framework for training of cattle feedlot staff. 	Private Sector and Industry

Objective One Achievements: Increase awareness and understanding of AMR

Organisation Type

<p>Ross Cutler and Associates</p> <ul style="list-style-type: none"> • Chaired the antimicrobial stewardship veterinary stewardship steering group comprising main veterinary practice groups and two large pig production companies. • Organised the keynote speaker (who leads the United Kingdom (UK) industry antimicrobial stewardship program) for the 2019 Australian Pig Vets Group and associated series of regional areas meetings about antimicrobial use reduction. • Prepared monthly articles in the pig industry press. • Presented a paper on antimicrobial use case studies at an international meeting. • Supported activities through a contractual arrangement with Australian Pork Limited. 	<p>Professionals</p>
<p>Wildlife Health Australia</p> <ul style="list-style-type: none"> • Added antimicrobial resistance and considerations for use of antimicrobial agents in wildlife in a national set of wildlife biosecurity guidelines circulated to our members and key wildlife carer groups. • Produced factsheets and incorporated antimicrobial stewardship into national biosecurity guidelines. 	<p>Public Sector Private Sector and Industry Society</p>
<p>Animal Health Australia</p> <ul style="list-style-type: none"> • Developed educational content on the Animal Health Australia website that provides resources for the public on antimicrobial resistance and stewardship publications, including: <ul style="list-style-type: none"> – the report on Antimicrobial Stewardship in Australian Livestock Industries; – a list of contacts for antimicrobial stewardship in Australian livestock industries; – web pages relevant to antimicrobial resistance and stewardship; – a list of links to antimicrobial strategies and plans; – a list of links to prescribing and use guidelines. • Actively participated in antimicrobial resistance technical groups, such as ASTAG. 	<p>Public Sector Private Sector and Industry</p>

Objective Two: Effective Antimicrobial Stewardship

Implement effective antimicrobial stewardship practices across human health and animal care settings to ensure the appropriate and judicious prescribing, dispensing and administering of antimicrobials

Objective Two Achievements: Effective antimicrobial stewardship	Organisation Type
One Health	
<p>Australian Government Department of Health and Department of Agriculture, Water and the Environment</p> <ul style="list-style-type: none"> Revised the <i>Importance Ratings and Summary of Antibacterial Uses in Human and Animal Health in Australia (June 2018)</i>, which informs decision making about the registration and use of antibacterial medicines in Australia. 	Public Sector
<p>National Centre for Antimicrobial Stewardship</p> <ul style="list-style-type: none"> Developed and delivered antimicrobial stewardship resources for hospitals, aged care homes, veterinary practices and general practice clinics, including national prescribing assessment programs that focus on quality of antimicrobial use, remote stewardship support for hospitals and aged care homes, prescribing guidelines, policy templates, clinical and educational resources including medication shortage fact sheets, toolkits and webinars. Contributed to national efforts to establish and promote antimicrobial stewardship in companion animals and agriculture/production livestock. 	Research Community
Human Health	
<p>Australian Government Department of Health</p> <ul style="list-style-type: none"> Supported a variety of survey tools to collect stewardship-related data to promote quality improvement activities. Funded Melbourne Health to design and pilot the General Practitioner National Antimicrobial Prescribing Survey (GPNAPS). Provided funding to Melbourne Health to develop and pilot a shared decision-making tool for use in general practice. Commenced reviewing Pharmaceutical Benefits Scheme listings for repeat antibiotic prescriptions to identify ways to better support appropriate prescribing and dispensing in community settings. <p>Aged Care Quality and Safety Commission</p> <ul style="list-style-type: none"> From 1 July 2019, began assessment and monitoring of the quality of care and services provided by organisations providing Commonwealth subsidised aged care services against the Aged Care Quality Standards (Quality Standards): <ul style="list-style-type: none"> Standard 3 – Personal Care and Clinical Care requires an organisation to implement practices to promote appropriate antibiotic prescribing and use; Standard 8 – Organisational Governance requires that an organisation’s clinical governance framework include antimicrobial stewardship. <p>Australian Commission on Safety and Quality in Health Care:</p> <ul style="list-style-type: none"> Implementation of the second edition of the National Safety and Quality in Health Service Standards, which includes requirements for antimicrobial stewardship in human health in the Preventing and Controlling Healthcare-Associated Infection Standard. The publication of guides, factsheets, workbooks and online learning resources to support antimicrobial stewardship requirements of the NSQHS Standards, including: <ul style="list-style-type: none"> An antimicrobial stewardship Advisory on surgical prophylaxis (2018); Options for implementation of Antimicrobial Stewardship in different facilities (2018); Antimicrobial Stewardship Indicators to support Stewardship Programs (2018); 	Public Sector

Objective Two Achievements: Effective antimicrobial stewardship	Organisation Type
<ul style="list-style-type: none"> – Fact sheet – Improving antimicrobial prescribing through selective reporting of antimicrobials (2019). • Development and publication of a range of resources on surgical prophylaxis in collaboration with the Royal Australasian College of Surgeons in 2018. 	
<p>The Peter Doherty Institute for Infection and Immunity</p> <ul style="list-style-type: none"> • Worked to improve empiric use of broad-spectrum antimicrobials for suspected Carbapenemase Producing Organisms through state-wide antibiograms. 	Research Community
<p>State and territory governments</p> <ul style="list-style-type: none"> • Delivered antimicrobial stewardship programs in health care organisations as per accreditation standards. • Participated in antimicrobial usage surveys and/or surveillance, such as the National Antimicrobial Prescribing Survey (NAPS) or National Antimicrobial Utilisation Surveillance Program (NAUSP), and used these or similar programs to provide feedback on antimicrobial usage to health facilities. For example: <ul style="list-style-type: none"> – Tasmania has conducted annual antimicrobial use surveys across all Tasmanian rural hospitals with dissemination of reports to prescribers and facilities, and provision of education and resources to target areas requiring improvement. • Developed resources and implemented tools into their operating environment and governance structures to support the effective delivery of antimicrobial stewardship programs. For example: <ul style="list-style-type: none"> – New South Wales, through the NSW Clinical Excellence Commission, has developed a suite of resources to support health organisations implement, sustain and review effective locally-owned antimicrobial stewardship programs in NSW public hospital facilities. • Conducted local projects and initiatives to improve antimicrobial stewardship. For example: <ul style="list-style-type: none"> – Australian Capital Territory, through ACT Health, follows all joint surgery patients for three months following prescription of prophylactic antibiotics. Feedback regarding infection rates has been shared to the ACT antimicrobial stewardship program; – Queensland, through Statewide Antimicrobial Stewardship Program, has provided a number of antimicrobial stewardship initiatives, with particular focus on supporting clinicians in rural and remote facilities. This includes implementation of an innovative model of antimicrobial stewardship via telehealth, which has been delivered at scale across Queensland; and a hotline service for medical and pharmacy staff to provide real time support for antimicrobial stewardship interventions and direct patient care. 	Public Sector
<p>Therapeutic Guidelines Limited</p> <ul style="list-style-type: none"> • Published 16th version of <i>Therapeutic Guidelines: Antibiotic (April 2019)</i> in <i>eTG complete</i> – an online source of independent, practical advice on managing a wide range of clinical conditions, with a strong emphasis on antimicrobial stewardship. • Extended access to an app version of <i>eTG complete</i> to institutional subscribers. • Published Antibiotic Prescribing in Primary Care: Therapeutic Guidelines Summary Table 2019, which summarises information in <i>eTG complete</i> about the management of common infections in primary care; the Summary Table is freely available to help tackle over-prescription of antibiotics, but also to highlight the correct drug choice, dose and duration of therapy when antibiotic treatment is indicated. 	Private Sector and Industry Research Community

Animal Health / Agriculture	
<p>Australian Government</p> <p>Australian Pesticides and Veterinary Medicines Authority</p> <ul style="list-style-type: none"> Reconsideration of products containing the macrolide antibiotics kitasamycin, oleandomycin and tylosin and approvals of their associated labels was published in 2018. Through this process the APVMA removed all growth promotion claims from the labels of macrolide antibiotics and added restraint statements requiring prudent use of these antimicrobials. It also cancelled the registration of a single product from this class whose only label claim was for growth promotion which could no longer be supported. <p>Department of Agriculture, Water and the Environment</p> <ul style="list-style-type: none"> Funded a Veterinary Antimicrobial Stewardship Online Training Program through the Veterinary Schools of Australia and New Zealand on effective antimicrobial stewardship practices for clinical veterinarians. Continued national harmonisation of minimum veterinary prescribing and compounding regulatory requirements for veterinary practitioners treating livestock. 	Public Sector
<p>State and territory governments</p> <p>Agriculture Victoria</p> <ul style="list-style-type: none"> Updated and distributed, in conjunction with the University of Melbourne's Faculty of Veterinary and Agricultural Science and the National Centre for Antimicrobial Stewardship staff, veterinary antibiotic prescribing guidelines for dogs, cats, horses and cattle. Co-funded with Dairy Australia, a dairy producer extension project exploring antimicrobial stewardship in the dairy industry (being delivered by The Milk Road and incorporating expertise from the University of Melbourne). <p>Department of Primary Industries (New South Wales)</p> <ul style="list-style-type: none"> Continued provision of a Project Manager for the Australian Veterinary Association and Animal Medicines Australia project to develop guidelines for the prescribing of antimicrobials to livestock and horses. <p>Department of Industry, Tourism and Trade (Northern Territory)</p> <ul style="list-style-type: none"> Collaborated with the developing industries (Crocodilian and Aquaculture) to focus on enhancing biosecurity practices where limited registered antimicrobials are available for use. <p>Department of Primary Industries and Regions (South Australia)</p> <ul style="list-style-type: none"> Consulted with and assisted in the drafting of the Australian Veterinary Association antimicrobial prescribing guidelines for poultry. <p>Department of Primary Industries and Regional Development (Western Australia)</p> <ul style="list-style-type: none"> Participated in national efforts to harmonise veterinary chemical control of use legislation for food and trade species animals. Raised awareness of antimicrobial stewardship and prescribing guidelines via face-to-face workshops with private veterinarians and provision of resources. 	Public Sector
<p>Animal Health Australia</p> <ul style="list-style-type: none"> Development of the Animal Industries Antimicrobial Stewardship Research, Development and Extension Strategy in consultation with livestock industry representatives. The priority areas of this strategy are to serve the needs of industry in the areas of antimicrobial use, antimicrobial resistance and antimicrobial stewardship. These priorities will direct RD&E efforts with the broad aims to maintain market access, maintain social license to operate, protect human health and ensure the effective antimicrobial treatments are available for food producing animals. 	Public Sector Private Sector and Industry
<p>Animal Medicines Australia</p> <ul style="list-style-type: none"> Sponsored the inaugural Australian Veterinary Antimicrobial Stewardship Conference 2018. 	Professionals

Objective Two Achievements: Effective antimicrobial stewardship

Organisation Type

<p>Animal Medicines Australia</p> <ul style="list-style-type: none"> Continued to produce, with Australian Veterinary Association, antibiotic prescribing guidelines for all major livestock species in Australia (pigs, poultry, sheep, dairy, beef, and feedlot cattle, and horses). 	<p>Private Sector and Industry</p>
<p>Australian Chicken Meat Federation</p> <ul style="list-style-type: none"> Implemented an antimicrobial stewardship program in each of the major chicken meat processing companies that produce >90% of chicken meat in Australia. Continued development of a self-assessment tool to help improve antimicrobial stewardship efforts. Contributed to the process of developing antimicrobial prescribing guidelines for poultry. 	<p>Private Sector and Industry</p>
<p>Australian Eggs Limited</p> <ul style="list-style-type: none"> Continued rolling out the egg industry antimicrobial stewardship framework. Published the <i>Antimicrobial Stewardship in Australian Livestock Industries</i> report in November 2018 with Australia’s major animal production industries. 	<p>Private Sector and Industry</p>
<p>Australian Lot Feeders’ Association</p> <ul style="list-style-type: none"> Produced and published Antimicrobial Stewardship Guidelines for the Australian Cattle Feedlot Industry. 	<p>Private Sector and Industry</p>
<p>Australian Veterinary Association</p> <ul style="list-style-type: none"> Released 2019 Antimicrobial Prescribing Guidelines for Pigs in conjunction with Animal Medicines Australia based on funding from the then Australian Government Department of Agriculture, and Australian Pork Limited. Continued development of a further six antibiotic prescribing guidelines for poultry, sheep, dairy, beef, and feedlot cattle, and horses, which are due for completion by mid-2020. Released factsheets, developed with Animal Medicines Australia, about responsible antibiotic use—one for companion animals and one for livestock and horses. Conducted <i>Antimicrobial Stewardship Pilot Trial</i> among veterinary hospitals in the Australian Capital Territory. 	<p>Professionals</p>
<p>Meat and Livestock Australia</p> <ul style="list-style-type: none"> Continued production of prescribing guidelines for extensive and feedlot cattle, and sheep due to be released in first half of 2020. Co-released Antimicrobial Stewardship Guidelines for the Australian Cattle Feedlot Industry in 2018. 	<p>Private Sector and Industry</p>
<p>Zoetis Australia Pty Ltd</p> <ul style="list-style-type: none"> Reconvened the Australasian Infectious Diseases Advisory Panel to update the <i>Australasian Infectious Diseases Advisory Panel (AIDAP) Antibiotic Prescribing Detailed Guidelines</i> for dogs and cats. The current guideline is freely available to all veterinarians on the Australian Veterinary Association website. 	<p>Private Sector and Industry</p>
<p>Ridley Corporation</p> <ul style="list-style-type: none"> Provided fit-for-purpose feeds (physical feed form, nutritional composition including alternative non-antibiotic ingredients, feed safety and traceability) to assist the animal sectors reduce their reliance on antibiotics. 	<p>Private Sector and Industry</p>

Objective Three: One Health Surveillance

Develop nationally coordinated One Health surveillance of antimicrobial resistance and antimicrobial usage

Objective Three Achievements: One Health surveillance	Organisation Type
One Health	
<p>University of South Australia (Project lead: A/Prof. Erica Donner)</p> <ul style="list-style-type: none"> Commenced delivering project 'Transfer and control of antibiotic resistant bacteria and their genes during wastewater treatment and reuse' funded by the South Australian Government and University of South Australia (PRIF IRG 45), which has provided significant Australia-specific environmental antimicrobial resistance insight, methodological experience, and baseline data. 	Research Community
<p>University of Technology Sydney (Project lead: Prof. Steven Djordevic)</p> <ul style="list-style-type: none"> Commenced leading One-health Understanding Through Bacterial Resistance to Antibiotics Knowledge (OUTBREAK) – a project to develop an artificial intelligence-powered network to trace, track and tackle outbreaks of antimicrobial resistance nationwide. (Funded by the Australian Government Medical Research Future Fund.) 	Research Community
Human Health	
<p>Australian Government Department of Health</p> <ul style="list-style-type: none"> Supported a variety of national surveillance activities including provision of funding for the operation of the AURA Surveillance System and partner programs; funding to enhance the National Antimicrobial Prescribing Survey (NAPS) and for the operation of the Surgical NAPS (SNAPS) and the Quality Improvement NAPS (QINAPS); and funding to develop a surveillance and outbreak response model. Funded a review of published and grey literature to determine the extent to which antimicrobial resistance is present in food in Australia and New Zealand, which may inform requirements for future One Health surveillance. Published the <i>National Microbial Genomics Framework 2019-2022</i> that provides a consistent national view for integrating microbial genomics into the Australian public health system for disease surveillance, outbreak detection and response, including for antimicrobial resistance organisms. <p>Australian Commission on Safety and Quality in Health Care</p> <ul style="list-style-type: none"> Led the development and operation of the AURA, on behalf of the Department of Health, to provide nationally harmonised and coordinated surveillance of antimicrobial resistance and antimicrobial use in human health. AURA collects and reports data from programs which include: the Australian Group on Antimicrobial Resistance (AGAR); the National Antimicrobial Utilisation Surveillance Program (NAUSP); the National Antimicrobial Prescribing Survey (NAPS); the Australian Passive AMR Surveillance system (APAS); and the National Alert System for Critical Antimicrobial Resistances (CARAlert). Released Australian reports on antimicrobial use and resistance in human health (AURA 2017 and 2019). 	Public Sector
<p>Menzies School of Health Research</p> <ul style="list-style-type: none"> Commenced trialling an automated online surveillance tool, termed HOTspots to integrate existing but fragmented antimicrobial resistance information across northern Australia (north of the Tropic of Capricorn) for visualisation and analysis across space and time. 	Research Community

<p>National Centre for Antimicrobial Stewardship</p> <ul style="list-style-type: none"> Continued to deliver and expand the National Antimicrobial Prescribing Survey (NAPS), which measures the appropriateness of antimicrobial prescribing and supports antimicrobial stewardship programs and accreditation across a number of health care settings. NAPS programs include: hospital, surgical, aged care and general practice. Partnered with the National Centre for Infections in Cancer at the Peter MacCallum Cancer Centre to establish national surveillance of antifungal prescribing in high risk patient groups. 	Research Community
<p>NPS MedicineWise</p> <ul style="list-style-type: none"> Continued to collect longitudinal clinical data on prescribing from participating general practices – MedicineInsight data – which was included in AURA reports. 	Private Sector and Industry
<p>State and territory governments</p> <ul style="list-style-type: none"> Contributed surveillance data on antimicrobial resistant organisms and antimicrobial usage that informs both local and national reporting, policy development and quality improvement activities. Implementing surveillance and response mechanisms within their jurisdictions to address critical multi-drug resistance organisms (MROs), such as carbapenemase-producing Enterobacteriaceae and vancomycin-resistant enterococci. For example: <ul style="list-style-type: none"> New South Wales, through Health Protection NSW, made carbapenemase-producing Enterobacteriaceae a laboratory-notifiable condition in February 2019; Victoria has an integrated surveillance and response mechanism for carbapenemase-producing Enterobacteriaceae and <i>Candida auris</i>; New South Wales, through NSW Clinical Excellence Commission with Health Protection NSW, initiated a NSW hospital MRO network, which provides a forum for collaboration between jurisdictions across NSW about surveillance and management of MROs in health care facilities. Through public health laboratories, governments are working on harmonising antimicrobial susceptibility testing, investigating new detection methods and exploring the use of whole genome sequencing to investigate MRO outbreaks and the movement of MROs through the environment and food. For example: <ul style="list-style-type: none"> New South Wales, through Health Protection NSW, is routinely performing whole genome sequencing in NSW for carbapenemase-producing Enterobacteriaceae, TB, shigellosis, <i>Salmonella</i> Typhimurium, and meningococcus; Victoria has implemented a state-wide combined genomic and epidemiological surveillance system for carbapenemase-producing Enterobacteriaceae, which enables a relatively timely response mechanism to be implemented in the event of an outbreak; Western Australia, through PathWest Laboratory Medicine WA, continued developing a rapid antimicrobial susceptibility test (AST) validation, including concluding a year-long feasibility study, that may impact antimicrobial stewardship, surveillance and drug discovery; Victoria is working towards integrating environmental and food borne isolates into the existing surveillance databases to enable integrated surveillance and analysis, particularly for those organisms, which have undergone microbial genomic sequencing; New South Wales, through NSW Health, has also worked closely with NSW Department of Primary Industry, with an agreement to compile a joint salmonellosis surveillance report. 	Public Sector
<p>The Peter Doherty Institute for Infection and Immunity</p> <ul style="list-style-type: none"> Continued through the Microbiological Diagnostic Unit Public Health Laboratory facility to use combined genomic and epidemiological approaches to detect and monitor antimicrobial resistance pathogens. This included leading the Communicable Diseases Genomics Network in developing AusTrakka – a national 	Research Community

<p>system for genomic surveillance of pathogens including antimicrobial resistance; and piloting multi-jurisdictional genomic surveillance of vancomycin-resistant <i>E. faecium</i> and carbapenem-resistant Enterobacteriaceae.</p> <ul style="list-style-type: none"> Worked on enhancing capacity for outbreak detection and source tracking through the Microbiological Diagnostic Unit Public Health Laboratory by developing and implementing in-house and species-specific bioinformatics pipelines. 	
Animal Health / Agriculture	
<p>Australian Government</p> <p>Department of Agriculture, Water and the Environment</p> <ul style="list-style-type: none"> Supported three proof-of-concept antimicrobial resistance surveys, in collaboration with industry groups (pig, chicken meat, and layer chicken industries) by mid-2018. These have shown good results about the current prevalence of resistance against specified antimicrobials in one or more indicator organisms. Progressed an antimicrobial resistance survey in conjunction with the Tasmanian salmon industry, as well as funding activities towards antimicrobial resistance surveys in the Australian barramundi and chicken egg industries. 	Public Sector
<p>State and territory governments</p> <p>Agriculture Victoria</p> <ul style="list-style-type: none"> Involved in a cross-agency research project with the Environment Protection Authority Victoria, the Victorian Department of Health and Human Services, the University of South Australia, Water Research Australia and various water authorities, which will further our understanding of antimicrobial resistance in agriculture and the environment by investigating baseline levels of antimicrobial resistant bacteria and genes in agricultural environments. Surveyed Australian veterinarians about what influences the uptake of bacterial culture and sensitivity testing by veterinary clinic clients. <p>Department of Agriculture and Fisheries (Queensland)</p> <ul style="list-style-type: none"> Commenced as technical lead, the study design phase of an antimicrobial resistance surveillance pilot study for the Australian barramundi industry funded by the Department of Agriculture, Water and the Environment. Contributed to national laboratory-based surveillance research projects/pilot programs in conjunction with industry and university. Continued to retain isolates from veterinary diagnostic submissions (livestock and aquatic) for future antimicrobial resistance studies. Continued working with industry to enhance passive surveillance of antimicrobial resistance in the livestock and aquatic industries by attending and/or presenting at various industry meetings to promote laboratory testing. Continued working actively to standardise susceptibility testing at both state and federal level to allow for surveillance reporting in veterinary livestock pathogens. Connected with Queensland Health to ensure veterinary reporting can align with existing human health surveillance. <p>Department of Primary Industries and Regions (South Australia)</p> <ul style="list-style-type: none"> Biosecurity SA met at least quarterly with SA Health and the Department of Environment and Water, as part of a One Health working group, with antimicrobial resistance a standing agenda item. Participated in national working groups on laboratory standards and microbiology, with a focus on antimicrobial resistance and susceptibility testing. <p>Department of Primary Industries and Regional Development (Western Australia)</p> <ul style="list-style-type: none"> Contributed to national laboratory-based surveillance research projects/pilot programs. Continued to retain and test isolates for antimicrobial resistance from cattle faeces submitted as part of disease surveillance. Testing of antimicrobial resistance in isolates has been used in two Masters projects with the University of Western Australia. Retained isolates from diagnostic livestock submissions for future antimicrobial resistance studies. 	Public Sector

Objective Three Achievements: One Health surveillance

Organisation Type

<ul style="list-style-type: none"> Completed work and submitted draft final report to the Australian Government Department of Agriculture, Water and the Environment in collaboration with the Department of Primary Industries, Water and Environment (Tasmania), and the Tasmanian Salmon Growers Association, 'Pilot project for antimicrobial resistance surveillance of <i>Yersinia ruckeri</i> and <i>Tenacibaculum maritimum</i> from Tasmanian Atlantic Salmon'. Assisted the Department of Agriculture and Fisheries, Queensland, with the approach and methods for antimicrobial resistance surveillance in bacteria from barramundi. 	
<p>Animal Health Committee</p> <ul style="list-style-type: none"> Formed a technical working group focused on the national standardisation of antimicrobial susceptibility testing in Australian animal health laboratories under the auspices of the Animal Health Committee's Sub-Committee on Animal Health Laboratory Standards. 	<p>Public Sector Private Sector and Industry</p>
<p>Animal Health Australia (AHA)</p> <ul style="list-style-type: none"> Partnered with Animal Medicines Australia (AMA) to develop an industry level antimicrobial monitoring program and will continue to collaborate with them into the future (as needed) as that monitoring program is implemented to validate AMA antibiotic sales data through AHA's livestock industry and private veterinary networks as well as extension capability. Actively participated in the AMR Surveillance Task Group. 	<p>Public Sector Private Sector and Industry</p>
<p>Australian Chicken Meat Federation</p> <ul style="list-style-type: none"> Published a report on the presence of antimicrobial resistance in enteric commensal bacteria from meat chickens at slaughter. 	<p>Private Sector and Industry</p>
<p>Australian Eggs Limited</p> <ul style="list-style-type: none"> Published a report on antimicrobial resistance in <i>Salmonella</i> isolates from environments in Australian commercial egg farms. Planned a survey on antimicrobial resistance on <i>Escherichia coli</i> and <i>Enterococcus</i>. 	<p>Private Sector and Industry</p>
<p>Australian Pork Limited</p> <ul style="list-style-type: none"> Published an antimicrobial resistance surveillance study assessing antimicrobial resistance in commensal bacteria from pigs at slaughter. 	<p>Private Sector and Industry</p>
<p>Meat and Livestock Australia</p> <ul style="list-style-type: none"> Published antimicrobial resistance survey (three microorganisms) in bovines using a well-designed survey, standardised methods and reporting against standard breakpoints. Continued conducting a second survey in cattle, due to be completed in 2020. Completed an antimicrobial resistance survey in sheep. 	<p>Private Sector and Industry</p>
<p>Scolexia</p> <ul style="list-style-type: none"> Contributed to a survey of <i>Salmonella</i> resistance in layer birds, and audit of pathogenic <i>Escherichia coli</i> isolates from laying chickens. 	<p>Private Sector and Industry</p>
<p>National Centre for Antimicrobial Stewardship (NCAS) - Animal stream</p> <ul style="list-style-type: none"> Continued development of antimicrobial usage surveillance, both quantitative and qualitative, in the companion veterinary sector, including through use of novel techniques such as machine learning. 	<p>Research Community</p>
<p>Wildlife Health Australia</p> <ul style="list-style-type: none"> Commenced capture of information on antimicrobial resistance in the National Wildlife Health Information System (eWHIS). 	<p>Public Sector Private Sector and Industry Society</p>

Objective Three Achievements: One Health surveillance

Organisation Type

Zoetis Australia Pty Ltd

- Contributed financially and as Partner Investigator to an ARC Linkage funded study 'Superbugs and veterinary drugs: are multidrug-resistant zoonotic pathogens residing in Australian animals?', which includes livestock and companion animals.

Private Sector and Industry

Objective Four: Infection Prevention and Control Measures

Improve infection prevention and control measures across human health and animal care settings to help prevent infections and the spread of resistance

Objective Four Achievements: Infection prevention and control measures	Organisation Type
Human Health	
<p>Australian Government</p> <p>Australian Commission on Safety and Quality in Health Care</p> <ul style="list-style-type: none"> • Continued to improve hand hygiene practice through the National Hand Hygiene Initiative across a range of clinical groups and health service organisation settings so there is sustained health care worker and health service organisation support for, and understanding of, the role of hand hygiene in the prevention of health care associated infections. • Released the second edition of NSQHS Standards, including Preventing and Controlling Healthcare-Associated Infection Standard. Published a suite of implementation support resources on the Commission website, so all health service organisations meet the requirements of the Standards. The Commission approves accrediting agencies to assess health service organisations to the updated Standards. Accreditation began in January 2019. • Worked on delivering guidelines to improve infection prevention and control, for example, updated the Implementation Guide for Surveillance of Central Line Associated Bloodstream Infection to help prevent such infections through correct insertion and line maintenance techniques, and undertaking a public consultation on the draft Peripheral Venous Access Clinical Care Standard. • Published <i>Recommendations for the control of carbapenemase-producing Enterobacteriaceae (CPE) – A guide for acute care health facilities</i> and complementary resources (2017). • Published technical reports on the annual prevalence of <i>Clostridioides difficile</i> and the strategies to improve the prevention and management of this disease in Australia. • Included a review of the impact of 2017 antibiotic shortages on annual <i>Clostridioides difficile</i> infection in <i>2017 Clostridium difficile Data Snapshot Report</i>. • Published a suite of ten online learning modules that provide education on the key principles of infection prevention and control. • Published a Hospital Acquired Complication Information kit, which includes resources to prevent the occurrence of healthcare-associated infections. <p>National Health and Medical Research Council</p> <ul style="list-style-type: none"> • Released revised <i>Australian Guidelines for the Prevention and Control of Infection in Healthcare</i> in May 2019 in collaboration with the Australian Commission on Safety and Quality in Health Care. 	Public Sector
<p>NPS MedicineWise</p> <ul style="list-style-type: none"> • Undertook consumer campaigns such as on principles of infection control, hygiene and hand washing in different settings such as workplaces, public transport, childcare centres and schools. • Implemented the Primary Health Network (PHN) Immunisation Support Program (ISP) in partnership with the National Centre for Immunisation Research and Surveillance. (Funded by the Australian Government.) 	Professionals
<p>State and territory governments</p> <ul style="list-style-type: none"> • Delivered infection prevention and control initiatives in line with national standards, and supported by governance frameworks within healthcare facilities and/or jurisdiction-wide committees. For example: <ul style="list-style-type: none"> – Delivered health services in line with the National Safety and Quality Health Service Standards including the Preventing and Controlling Healthcare Associated Infection Standard; 	Public Sector

Objective Four Achievements: Infection prevention and control measures

Organisation Type

<ul style="list-style-type: none"> – Delivered hand hygiene programs consistent with the National Hand Hygiene Initiative. • Implemented jurisdiction-wide policies, protocols, guidelines and projects for infection prevention and control in health services and other settings such as aged care facilities. For example: <ul style="list-style-type: none"> – Australian Capital Territory, through ACT Health, requires MRO screening for patients transferred from another health care facility or patients known to have been an inpatient in an overseas hospital in the past 12 months; – New South Wales, through Health Protection NSW – has administered a safety alert regarding isolation and testing measures of any international transfer patients (September 2018); – New South Wales, through NSW Clinical Excellence Commission, has regularly reviewed and updated the NSW Health Infection Prevention and Control Policy and the NSW Health Infection Prevention and Control Practice Handbook; – Tasmania has developed a ‘Bare Below The Elbows’ audit tool to be trialed to assist local implementation of adherence to the Bare Below The Elbows component of the statewide hand hygiene protocol; – Victoria has introduced infection prevention guidelines for the prevention and spread of carbapenemase-producing Enterobacteriaceae and <i>Candida auris</i> within health services and aged care facilities; – Victoria has implemented the ‘soapy heroes’ program in state primary schools in 2018, an interactive program to educate school aged children on hand hygiene and improve hand hygiene in schools. 	
Animal Health / Agriculture	
<p>Australian Chicken Meat Federation</p> <ul style="list-style-type: none"> • Updated the <i>National Biosecurity Manual for Chicken Growers</i>, which is the industry’s biosecurity reference guide. • Produced accompanying biosecurity manuals with more detail for additional high-risk points (for bacterial contamination) in the supply chain. • Continued investment in biosecurity and disease prevention. 	Private Sector and Industry
<p>Australian Eggs Limited</p> <ul style="list-style-type: none"> • Continued to use vaccines and develop new vaccines for preventative healthcare in layer chickens, to reduce the need for antimicrobial treatment. • Made ongoing investments in biosecurity and flock health. 	Private Sector and Industry
<p>Australian Pork Limited</p> <ul style="list-style-type: none"> • Continued to educate producers and the wider pork industry about biosecurity, disease prevention and management through numerous industry-targeted publications. • Updated its Australian Pork Industry Quality Assurance biosecurity video. 	Private Sector and Industry
<p>Australian Veterinary Association</p> <ul style="list-style-type: none"> • Developed guidelines with latest information about biosecurity and infection prevention and control for veterinarians. 	Professionals
<p>Meat and Livestock Australia</p> <ul style="list-style-type: none"> • Continued investigating the use of a vaccine against infectious bovine keratoconjunctivitis to reduce the need for tetracyclines and other antibiotics in its treatment. 	Research Community
<p>Scolexia</p> <ul style="list-style-type: none"> • Promoted implementation of a higher degree of biosecurity within the layer industry. 	Private Sector and Industry

<p>State and territory governments</p> <p>Agriculture Victoria</p> <ul style="list-style-type: none"> Produced and distributed educational resources for veterinarians and biosecurity professionals that highlight the role of proactive animal health management, including biosecurity, hygiene and vaccination programs, in reducing the spread of AMR. <p>Department of Agriculture and Fisheries (Queensland)</p> <ul style="list-style-type: none"> Promoted on-farm biosecurity planning, infection control/hygiene practices in the livestock industries. <p>Department of Industry, Tourism and Trade (Northern Territory)</p> <ul style="list-style-type: none"> Promoted on-farm biosecurity and application of diagnostics in endemic disease control practices in livestock. <p>Department of Primary Industries and Regions (South Australia)</p> <ul style="list-style-type: none"> Promoted on-farm biosecurity and management of infectious endemic diseases in sheep and cattle through the One Biosecurity program. State diagnostic laboratory collaboration with a state research centre (Australian Centre for Antimicrobial Resistance Ecology) on identification of resistant bacterial isolates from animals. <p>Department of Primary Industries and Regional Development (Western Australia)</p> <ul style="list-style-type: none"> Promoted on-farm biosecurity and endemic disease management practices in livestock. 	Public Sector
<p>University of Sydney</p> <ul style="list-style-type: none"> Undertook studies to inform infection prevention and control in veterinary practice and with the Centre for Veterinary Education and the Australian and New Zealand College of Veterinary Scientists, developing eLearning resources on this issue. 	Research Community
<p>Wildlife Health Australia</p> <ul style="list-style-type: none"> Produced National Wildlife Biosecurity Guidelines (these include antimicrobial resistance and the use of antibiotics), which are circulated and made available to those who work with wildlife in Australia. 	Public Sector Private Sector and Industry Society
<p>Zoetis Australia Pty Ltd</p> <ul style="list-style-type: none"> Funded the Australasian Infectious Disease Advisory Panel to develop <i>Practical Infection Control Guidelines for Infection Protection and Control in Australian veterinary hospitals</i>, which is available free to all veterinarians on the Australian Veterinarian Association website. 	Private Sector and Industry

Objective Five: Research

Agree a national research agenda and promote investment in the discovery and development of new products and approaches to prevent, detect and contain antimicrobial resistance

Objective Five Achievements: Research	Organisation Type
One Health	
<p>Australian Government Department of Health</p> <ul style="list-style-type: none"> Funded Griffith University to assess health and economic burden of antimicrobial resistance in Australia. <p>Australian Medical Research Advisory Board</p> <ul style="list-style-type: none"> Released biennial <i>Australian Medical Research and Innovation Priorities</i>, which identified One Health – antimicrobial resistance as a Medical Research Future Fund priority for 2018–2020. The Priorities affirm that funding from the MRFF is complementary to the work of the National Health and Medical Research Council, Australia's premier health and medical research funding body. 	Public Sector
<p>Monash University</p> <ul style="list-style-type: none"> Undertook antimicrobial resistance research: <ul style="list-style-type: none"> (Project lead: Dr Victor Cadarso) Engineering micro- and nano-surfaces with enhanced antimicrobial properties to prevent microbial adhesion and biofouling. (Project lead: A/Prof. Max Cryle) Utilising a novel chemo-enzymatic formation route to overcome growing bacterial resistance against vancomycin-type antibiotics. (Project lead: A/Prof. Max Cryle) Developing a new approach to tackling antibiotic resistance that exploits alternate mechanisms to overcome bacterial infections through augmentation of host immune responses and removal of bacterial evasion mechanisms. 	Research Community
<p>University of South Australia (Project lead: A/Prof. Erica Donner)</p> <ul style="list-style-type: none"> Prepared to launch AMR WaterNet – a web-based collaborative platform that will serve as a go-to point for antimicrobial resistance knowledge transfer for the Australian water sector with support from Water Research Australia and Melbourne Water. 	Research Community
<p>University of Adelaide</p> <ul style="list-style-type: none"> Continued investigating alternative regulatory and funding models for antimicrobial drugs focused on the Australian market within the global context. 	Research Community
<p>The University of Queensland (Program lead: Prof. Matt Cooper)</p> <ul style="list-style-type: none"> Continued to lead a not-for-profit initiative that screens compounds for antimicrobial activity for academic research groups for free so researchers worldwide find new, diverse compounds to combat drug-resistant infections. 	Research Community
Human Health	
<p>Australian Government Department of Health</p> <ul style="list-style-type: none"> Established, through the Medical Research Future Fund, the Tackling Antimicrobial Resistance initiative with a targeted call for research worth \$5.9 million, resulting in four projects focused on the use of metagenomics to understand carriage and transmission of antimicrobial resistance and antimicrobial use in the elderly and in residential aged care settings. Committed, through the Medical Research Future Fund, a further \$23 million over the next ten years for the Global Health – Tackling AMR and Drug Resistant Tuberculosis initiative. The first grant opportunity under this initiative is expected to open later in 2019 and will provide \$8 million to support research into the diagnosis, treatment and prevention of drug resistant tuberculosis and reducing the spread of antimicrobial resistance. 	Public Sector Research Community

Objective Five Achievements: Research

Organisation Type

Objective Five Achievements: Research	Organisation Type
<p>National Health and Medical Research Council</p> <ul style="list-style-type: none"> • Provided funding for 100 grants relevant to antimicrobial resistance research and development during 2017–2019, totalling approximately \$82 million. 	
<p>The Kirby Institute (Project lead: Prof. Rebecca Guy)</p> <ul style="list-style-type: none"> • A partnership between industry, researchers and end users to develop new technology to tackle antimicrobial resistance and ensure investments in this area are most efficiently spent. The Hub will focus on sexually transmitted microorganisms – a critical area of concern in Australia and an exemplar of the wider problem of antimicrobial resistance. It will bring together 21 different organisations, including five Australian universities, five industry partners and 11 other organisations. (Funded by the Australian Government ARC.) 	Research Community
<p>Menzies School of Health Research</p> <ul style="list-style-type: none"> • Continued using multi-state modelling with Queensland University of Technology to generate unbiased estimates of the health and economic burden hospital-associated infections in Queensland. This work is now expanded to NT. 	Research Community
<p>Monash University</p> <ul style="list-style-type: none"> • Undertook antimicrobial resistance research: <ul style="list-style-type: none"> – (Project lead: Prof. Trevor Lithgow) Conducted research through the Centre to Impact AMR focusing on infections that target patients in hospital settings, intensive care units, immunosuppressed people undergoing cancer therapies, stem cell therapies, organ transplants, as well as babies and the elderly. – (Project lead: Dr Thomas Naderer) Investigated how to control infections caused by <i>Neisseria gonorrhoeae</i>, which is now resistant to all available antibiotics, by developing new options that activate immune system. – (Project lead: Prof. Jian Li) Worked on discovering and developing new generation polymyxins against gram-negative superbugs. 	Research Community
<p>National Centre for Antimicrobial Stewardship</p> <ul style="list-style-type: none"> • Conducted various antimicrobial stewardship research activities, including on antimicrobial prescribing and stewardship across human and animal health; surgical antimicrobial prophylaxis prescribing; and antifungal use and stewardship in immunocompromised patients. 	Research Community
<p>NPS MedicineWise</p> <ul style="list-style-type: none"> • Continued to manage MedicineInsight, the general practice data program available for researchers to investigate antimicrobial resistance and antimicrobial stewardship in primary care. (Funded by the Australian Government Department of Health.) 	Private Sector and Industry
<p>The Peter Doherty Institute for Infection and Immunity</p> <ul style="list-style-type: none"> • Researched antimicrobial use with Menzies School of Health Research in remote Aboriginal communities to improve understanding of antimicrobial stewardship approaches needed. • Researched the health economic burden of antimicrobial resistance with Menzies School of Health Research in the Northern Territory to promote investment in the development of approaches to prevent, detect and contain antimicrobial resistance in this region. • Developed tools and approaches to integrate pathogen genomics into antimicrobial resistance control. (Funded by the Australian Government National Health and Medical Research Council.) • Improved understanding of ways to reduce STI transmission through genomics. (Funded by the Australian Government National Health and Medical Research Council.) 	Research Community

<p>State and territory governments</p> <ul style="list-style-type: none"> • Through public health laboratories, Investigated Whole Genome Sequencing. For example: <ul style="list-style-type: none"> – Victoria worked on developing whole genome sequencing capability and capacity, which has been a pivotal step in researching the development and spread of antimicrobial resistance, particularly in outbreak situations; – New South Wales, through NSW Health Protection, routinely performed whole genome sequencing, with capacity to use for emerging pathogens or antimicrobial resistance. A research pathway is trialling routine whole genome sequencing in HIV and gonorrhoea, including use in resistance profiles. 	Public Sector
<p>University of Technology Sydney (Project leads: A/Prof. Marizio Labbate and Prof. Marilyn Cruickshank)</p> <ul style="list-style-type: none"> • Published widely on honey as a potent antimicrobial, effective against a range of multi-drug resistant bacteria and biofilms, as well as yeasts and fungi causing wounds and skin infections. • Led a human trial investigating the use of honey as a prebiotic food to remediate the gut microbiome and combat gut-related infections and disease. • Undertook strong community engagement and education around antimicrobial resistance, and the appropriate medicinal uses of honey. This has led to partnering with both the agricultural and medicinal honey industry and attracted significant interest in the development of commercial products. • Researched biofilms in partnership with industry. This led to a redesign of the shape of their medical implants (without biocides) to reduce the incidence of infection by 50%. 	Research Community
<p>University of Wollongong (Project leads: Prof. Antoine van Oijen and Prof. Mitchell Byrne)</p> <ul style="list-style-type: none"> • Established Wollongong Antimicrobial Resistance Research Alliance (WARRA) to tackle antimicrobial resistance by developing and testing interventions to stop, or at the very least slow down, rates of resistance. The Illawarra Shoalhaven region's stable and diverse population base provides an excellent test bed for research to characterise antimicrobial resistance and provide evidence to drive policy and practice. 	Research Community
Animal Health / Agriculture	
<p>Australian Chicken Meat Federation</p> <ul style="list-style-type: none"> • Contributed extensively to the development of an <i>Animal Industry Antimicrobial Stewardship Research, Development and Extension Strategy</i>, which will bring together key animal industry stakeholders to identify and collaboratively address cross-sectoral antimicrobial stewardship priorities. 	Private Sector and Industry
<p>Australian Eggs Limited, Australian Pork Limited, Meat and Livestock Australia</p> <ul style="list-style-type: none"> • Contributed to development of the <i>Animal Industry Antimicrobial Stewardship Research, Development and Extension Strategy</i>, which will identify cross-sectoral antimicrobial stewardship priorities. 	Private Sector and Industry
<p>Australian Pork Limited</p> <ul style="list-style-type: none"> • Continued investing into biosecurity and disease prevention research such as projects to standardise testing and reporting of antimicrobial resistance, and research into streamlining the approvals process for vaccine registration. • Continued leading a collaborative project to define antimicrobial resistance status in pork and chicken using high throughput technology with other partners (AgriFutures Australia, Murdoch University, the University of Adelaide, Tecan Australia, ThermoFisher Scientific, Illumina and New South Wales Department of Primary Industries). 	Private Sector and Industry
<p>Meat and Livestock Australia</p> <ul style="list-style-type: none"> • Maintained investment of over \$3.5m on research contracts during the period 2015–2020 in the areas of antimicrobial resistance surveillance, antimicrobial usage measurement, antimicrobial stewardship implementation, vaccines and prescribing guidelines. 	Private Sector and Industry

Objective Five Achievements: Research	Organisation Type
<p>Murdoch University</p> <ul style="list-style-type: none"> Continued undertaking a project about risk management of critical antimicrobial resistant bacteria in food producing animals, which aims to optimise a microbiological enumeration assay and quantify its detection of critical antimicrobial resistance bacteria. 	Research Community
<p>Scolexia</p> <ul style="list-style-type: none"> Sustained research on the use of organic acids, short and medium chain fatty acids, vaccines, probiotics and prebiotics, essential oils and phytobiotic compounds in feed to help with gut microbiota stability, pathogen reduction and disease control. 	Private Sector and Industry
<p>State and territory governments</p> <p>Agriculture Victoria</p> <ul style="list-style-type: none"> Collaborated with the University of Melbourne and the University of South Australia on antimicrobial resistance research. Collaborated, through a co-funded project with Dairy Australia and the Milk Road, with AMR researchers from the University of Bristol in the United Kingdom. <p>Department of Primary Industries (New South Wales)</p> <ul style="list-style-type: none"> Partnered with multiple institutions in Australia and overseas on research aimed at reducing the threat of antimicrobial resistance to animals and humans. <p>Department of Industry, Tourism and Trade (Northern Territory)</p> <ul style="list-style-type: none"> Collaborated with the crocodilian industry locally and internationally to research alternate approaches to disease management and reduce antimicrobial use. <p>Western Australia</p> <ul style="list-style-type: none"> Collaborated with Murdoch University on antimicrobial resistance research. 	Public Sector
<p>Wildlife Health Australia:</p> <ul style="list-style-type: none"> Provided information and advocacy in support of research work on antimicrobial resistance in wildlife. 	Public Sector Private Sector and Industry Society

Objective Six: International Partnership and Collaboration

Strengthen international partnerships and collaboration on regional and global efforts to respond to antimicrobial resistance

Objective Six Achievements: International Partnership and Collaboration	Organisation Type
One Health	
<p>Australian Government Department of Health and Department of Agriculture, Water and the Environment</p> <ul style="list-style-type: none"> In late 2017, Australia underwent a WHO Joint External Evaluation (JEE), which aimed to evaluate existing gaps in health systems and preparedness. Australia's participation in the external evaluation required collaboration between the Australian Government and partners across the public and private and human and animal health sectors. Used the recommendations from the JEE to produce Australia's <i>National Action Plan for Health Security 2019–2023</i>, and provided expertise and experience to JEEs in other countries within the immediate region. <p>Commonwealth Scientific and Industrial Research Organisation (led by Dr Paul De Barro)</p> <ul style="list-style-type: none"> Supporting Fijian health and agricultural authorities implement the <i>National Antimicrobial Resistance (AMR) Action Plan</i>. A scoping study to identify and support specific needs of the Fijian government to strengthen and advance leadership, governance and operations on mitigating antimicrobial resistance through a One Health approach under Fiji's National AMR Action Plan. (Co-funded by the Australian Government Indo-Pacific Centre for Health Security.) 	Public Sector
Human Health	
<p>Australian Government Department of Health</p> <ul style="list-style-type: none"> Enrolled in the World Health Organization's Global Antimicrobial Resistance Surveillance System (GLASS) and, in 2018–2019, provided funding to the World Health Organization Collaborating Centre for Sexually Transmitted Diseases to contribute Australian Gonococcal Surveillance Programme data. <p>Australian Commission on Safety and Quality in Health Care</p> <ul style="list-style-type: none"> Engaged with northern European antimicrobial resistance and antimicrobial use surveillance programs and agencies involving promulgation of AURA reports, which include international comparisons where possible. <p>National Health and Medical Research Council</p> <ul style="list-style-type: none"> Continued membership of global organisations such as the Global Research Collaboration for Infectious Disease Preparedness and the Heads of International (Biomedical) Research Organisations. Committed up to \$3 million commencing in 2019 for research into infectious diseases, antimicrobial and multi-drug resistance and cancer as part of the e-ASIA Joint Research Program. 	Public Sector
<p>Burnet Institute (Project Lead: Leanne Robinson)</p> <ul style="list-style-type: none"> Led <i>Stronger Surveillance and Systems Support for Rapid Identification and Containment of Resurgent or Resistant Vector Borne Pathogens in Papua New Guinea (STRIVE)</i>. This project is evaluating and implementing real-time surveillance for malaria and other vector-borne illnesses to provide early warning of drug-resistance and insecticide resistant vectors. The project will also strengthen PNG's outbreak response capability by providing decision support tools to frontline healthcare workers and policymakers. (Funded by the Australian Government Indo-Pacific Centre for Health Security.) 	Research Community
<p>Global Antibiotic Research and Development Partnership (GARDP)</p> <ul style="list-style-type: none"> Launched <i>REVIVE</i>, an online space that has hosted five webinars for researchers worldwide on different aspects of antimicrobial drug development. 	Private Sector and Industry

Objective Six Achievements: International Partnership and Collaboration

Organisation Type

<p>Menzies School of Health Research (Project leads: Dr Josh Francis and Prof. Richard Price)</p> <ul style="list-style-type: none"> • Led <i>Surveillance Training, Research Opportunities and National Guidelines for Communicable Disease Control in Timor Leste</i> (STRONG-TL) where local and international experts are working together to deliver high quality disease surveillance and have developed and implemented National Guidelines and strengthened operational research. (Funded by the Australian Government Indo-Pacific Centre for Health Security.) • Will be working with regional partners to improve antimicrobial resistance and antimicrobial use surveillance in human and animal health in Timor-Leste. • Led <i>Stronger Health Systems for multi-drug resistant Tuberculosis and Malaria</i> (STRATUM), developing and implementing cost-effective interventions for the cure of multi-drug resistant malaria and new approaches to multi-drug resistant strains of tuberculosis. (Funded by the Australian Government Indo-Pacific Centre for Health Security.) 	<p>Research Community</p>
<p>Monash University (Project lead: Prof. Trevor Lithgow)</p> <ul style="list-style-type: none"> • Engaged with partners in Wenzhou, China to analyse recent rise in antimicrobial resistance in their hospitals. • Opened the Monash BDI-WMU Alliance in Clinical and Experimental Biomedicine at Wenzhou Medical University, China to access patient data and collect antimicrobial resistance superbugs isolated from patients over past 15 years. • Entered partnership through the Centre to Impact Antimicrobial Resistance with Center for Innovative Phage Applications and Therapeutics, California. 	<p>Research Community</p>
<p>National Centre for Antimicrobial Stewardship</p> <ul style="list-style-type: none"> • Delivered in-country assessments (such as gap analysis), workshops and One Health educational training in the Asia-Pacific to train clinicians and support antimicrobial stewardship in the region. • Undertook mentorship roles to train international fellows in antimicrobial resistance and antimicrobial prescribing surveillance and antimicrobial stewardship across human and animal health as part of programs such as the Fleming Fund and through direct collaborations. • Scaled NAPS internationally, to Canada, Malaysia, Fiji and New Zealand, with further implementation being undertaken in Bhutan and Nepal. • Collaborated with international organisations to conduct joint education, training and research activities, such as working with WHO to create an antimicrobial stewardship training framework for low- and middle-income countries in Asia-Pacific region. 	<p>Research Community</p>
<p>NPS MedicineWise</p> <ul style="list-style-type: none"> • Involved in the Protecting Indonesia from Threat of Antibiotic Resistance study. • Hosted delegation from the V-RESIST research group. • Shared learnings and findings of the Choosing Wisely initiative among international community. 	<p>Private Sector and Industry</p>
<p>The Peter Doherty Institute for Infection and Immunity</p> <ul style="list-style-type: none"> • Engaged by WHO on a range of workshops and consultative projects on a regular basis. • Undertook training and ongoing support for national laboratories in regional countries to increase laboratory capacity to detect and characterise strains and respond to antimicrobial resistance, including serving as the WHO Regional Reference Laboratory for Invasive Vaccine-Preventable Diseases. • Hosted a Fleming Fund Fellowship program that provides capacity building, training and mentoring to professionals working in antimicrobial resistance in low and middle income countries. 	<p>Research Community</p>
<p>The Kirby Institute (Project lead: A/Prof. Virginia Wiseman)</p> <ul style="list-style-type: none"> • Established a strong, trusted and effective clinical research network across the Asia-Pacific region to evaluate prevalence and incidence of antimicrobial 	<p>Research Community</p>

Objective Six Achievements: International Partnership and Collaboration

Organisation Type

<p>resistance among priority populations, including sex workers, men who have sex with men, transgender men and women.</p> <ul style="list-style-type: none"> Led Protecting Indonesia from the Threat of Antibiotic Resistance (PINTAR) – a project involving collaborators from Indonesia, Australia and the United Kingdom that seeks to improve the antibiotic-dispensing practices of private drug sellers, a major supplier of antibiotics in Indonesia. The team is investigating the current scale, operations and motivations of these drug sellers as well as community attitudes towards them. This formative research will inform the design and evaluation of an intervention to improve the use of antibiotics by community pharmacies and drug sellers. (Funded by the Australian Government Indo-Pacific Centre for Health Security.) 	
<p>State and territory governments</p> <ul style="list-style-type: none"> Engaged actively with international organisations to learn from international best practice and share own successes. For example: <ul style="list-style-type: none"> New South Wales, through Health Protection NSW, consulted with international bodies such as National Health Service, UK and Health Protection Scotland about surveillance and management of carbapenemase-producing Enterobacteriaceae in acute and non-acute care settings. Western Australia, through PathWest Laboratory Medicine WA, is working with EUCAST, Public Health England, DSTL Porton Down, Norwegian Public Health Institute and various academic centres around the Indian Ocean Rim. Victoria, through Victoria Department of Health and Human Services, has established strong relationships with a number of international groups as part of work on antimicrobial resistance. This includes delegations to India, which have resulted in several ongoing collaborations, both between government and non-government agencies and research institutions. Also hosted international leaders in the antimicrobial resistance field (UK and Israel) to contribute to Victoria practice. 	Public Sector
<p>University of Sydney (Project lead: A/Prof. Gregory Fox)</p> <ul style="list-style-type: none"> Led V-RESIST – evaluating an intervention in Vietnam aimed at reducing inappropriate use of antibiotics and helping to understand and target the drivers of drug resistance. (Funded by the Australian Government Indo-Pacific Centre for Health Security.) 	Research Community
Animal Health / Agriculture	
<p>Animal Medicines Australia</p> <ul style="list-style-type: none"> Became a signatory to the <i>Animal Sector Commitments and Actions on Antibiotic Use</i>, a global agreement to support responsible use of antibiotics. 	Professionals
<p>Australian Government</p> <p>Food Standards Australia New Zealand and Department of Agriculture, Water and the Environment</p> <ul style="list-style-type: none"> Provided Australian input towards the Ad hoc Codex Intergovernmental Task Force on Antimicrobial Resistance in 2017–2019 for the revision of the <i>Code of Practice to Minimise and Contain Foodborne Antimicrobial Resistance</i> and the development of <i>Guidelines on Integrated Monitoring and Surveillance of Foodborne Antimicrobial Resistance</i>. <p>Department of Agriculture, Water and the Environment</p> <ul style="list-style-type: none"> Participated actively on antimicrobial resistance initiatives associated with the World Organisation for Animal Health (OIE), the Food and Agriculture Organization of the United Nations (FAO), the Organisation for Economic Co-operation and Development (OECD), the Asia-Pacific Economic Cooperation’s (APEC) Food Safety Cooperation Forum and other forums. 	Public Sector
<p>Australian Chicken Meat Federation</p> <ul style="list-style-type: none"> Continued working with chicken industries of other countries to develop <i>Best Practice Guidance on Use of Antibiotics in Poultry Production</i>. 	Private Sector and Industry

Objective Six Achievements: International Partnership and Collaboration

Organisation Type

<p>Australian Pork Limited:</p> <ul style="list-style-type: none"> Maintained sponsorship of the Australasian Pig Science Association, which draws delegates in pig science from Australia, New Zealand and Asia. The 2019 Conference had dedicated sessions on pig health and nutrition, with much of the research being presented aiming to reduce routine antimicrobial use through improved diagnostics, vaccines, and nutritional strategies. 	<p>Private Sector and Industry</p>
<p>State and territory governments</p> <p>Department of Primary Industries (New South Wales)</p> <ul style="list-style-type: none"> Collaborated with the Department of Foreign Affairs and Trade, and the governments of Singapore and the United States of America to deliver one week of intensive training on management of antimicrobial resistance to government officials from ASEAN countries. <p>Agriculture Victoria</p> <ul style="list-style-type: none"> Partnered with the Antibiotic Guardian initiative (developed by Public Health England) and funded the creation of an Australian-specific pledge page for use by all sectors. 	<p>Public Sector</p>
<p>Wildlife Health Australia:</p> <ul style="list-style-type: none"> Provided updates on wildlife and antimicrobial resistance for the OIE Working Group on Wildlife and Regional Wildlife Focal Points. 	<p>Public Sector; Private Sector and Industry; Society</p>

Objective Seven: Clear Governance

Establish and support clear governance arrangements at the local, jurisdictional, national and international levels to ensure leadership, engagement and accountability for actions to combat antimicrobial resistance

Objective Seven Achievements: Clinical Governance	Organisation Type
One Health	
<p>Australian Government</p> <p>Department of Health and Department of Agriculture, Water and the Environment</p> <ul style="list-style-type: none"> • Tabled in Parliament the official Australian Government response to the Inquiry by the Senate Standing Committee on Finance and Public Administration into the progress on the implementation of the recommendations of the Joint Expert Technical Advisory Committee on Antibiotic Resistance. 	Public Sector
Human Health	
<p>Australian Government</p> <p>Department of Health</p> <ul style="list-style-type: none"> • Established the General Practitioner Antimicrobial Stewardship (antimicrobial stewardship) Expert Group to provide advice to ASTAG and the Department of Health on issues related to antibiotic use, antimicrobial stewardship and antimicrobial resistance in general practice. Membership includes the Royal Australian College of General Practitioners (RACGP), the Australian College of Rural and Remote Medicine (ACRRM), Primary Health Networks (PHN) and the National Centre for Antimicrobial Stewardship (NCAS) in addition to the Department of Health. 	Public Sector
<p>Council of Australian Governments Health Council:</p> <ul style="list-style-type: none"> • Agreed on 12 October 2018 to make antimicrobial resistance a Tier One priority issue of national significance that requires cooperation of all jurisdictions for 2019–2020. 	Public Sector
<p>State and territory governments:</p> <ul style="list-style-type: none"> • Worked towards establishing governance structures to ensure a coordinated and integrated approach to antimicrobial resistance across jurisdictions. Local governance arrangements include hospital antimicrobial stewardship committees, statewide infection prevention and control advisory committees and MRO networks or units. • Developed jurisdictional strategies and policies regarding antimicrobial resistance, biosecurity and healthcare associated infections. For example: <ul style="list-style-type: none"> – Queensland is developing a jurisdictional antimicrobial resistance strategy (not published as at 6 September 2019). 	Public Sector
Animal Health / Agriculture	
<p>Australian Government</p> <p>Department of Agriculture, Water and the Environment</p> <ul style="list-style-type: none"> • Developed the Australian Animal Sector National Antimicrobial Resistance Plan 2018 with the animal health sector. • Continued working with stakeholders on drafting an action plan for the animal health sector to support the 2020 Strategy. 	Public Sector
<p>Ridley Corporation</p> <ul style="list-style-type: none"> • Provided membership, contribution to and in-kind support of the then Department of Agriculture's Focus and Writing Groups. 	Private Sector and Industry
<p>State and territory governments</p> <p>Australian Capital Territory (ACT)</p> <ul style="list-style-type: none"> • The Committee for Infectious Threat Preparedness and Management was established in September 2019, led by the Health Directorate, ACT Government. 	Public Sector

The Chief Health Officer and Chief Veterinary Officer are members of the Committee. Specific mention of AMR is made in one of its Terms of Reference. This being to “Provide advice in the development and oversight of a strategic framework for the prevention and control of resistant organisms of public health significance in the ACT, including plans for surveillance, prevention and response measures”.

New South Wales (NSW)

- Finalised a biosecurity policy on *Antimicrobial stewardship and resistance*.
- Reviewed legislation under the *Stock Medicines Act 1989*, the *Veterinary Practitioners Act 2003*, and, in collaboration with NSW Health, through review of the *Poisons and Therapeutic Goods Act 1966*.
- Provided membership of the Harmonised Agvet Chemical Control of Use Task Group developing national harmonisation of minimum veterinary prescribing and compounding regulatory requirements for veterinary practitioners – Treatment of Livestock.

Victoria

- Led by the Department of Health and Human Services and in collaboration with Agriculture Victoria and the Environment Protection Agency Victoria, Victoria is drafting the *Victorian Antimicrobial Resistance Strategy*, with a view to finalisation in 2020. This state strategy will be aligned with the next national AMR strategy and the *Australian Animal Sector National Antimicrobial Resistance Plan 2018*. It will incorporate the expertise of an Agriculture Victoria chaired animal sector stakeholder Technical Advisory Group.

Queensland

- Appointed a Principal Scientist with specialist expertise to develop and implement approaches to address antimicrobial resistance and to provide specialist advice the Chief Veterinary Officer and Chief Biosecurity Officer on AMR matters.
- Led by Queensland Health, Queensland has developed a jurisdictional antimicrobial resistance strategy in close collaboration with Department of Agriculture and Fisheries (due for release early 2020).
- Met with Queensland Health biannually to discuss interagency issues with AMR as a standing agenda item.
- Chaired the National Antimicrobial Resistance Testing Technical Working Group to develop antimicrobial resistance surveillance guidelines for state laboratories.

Western Australia (WA)

- Held an antimicrobial resistance/antimicrobial stewardship workshop in early 2019, and ongoing development of an antimicrobial resistance policy.
- Maintained ongoing development of an antimicrobial resistance/antimicrobial stewardship policy.
- Undertook biannual meetings between the Department of Primary Industries and Regional Development and the Department of Health (WA) with antimicrobial resistance as a standing agenda item.
- Provided representation on the National Antimicrobial Resistance Testing Technical Working Group to develop antimicrobial resistance surveillance guidelines for state laboratories.

GLOSSARY

TERM	DEFINITION
Antibiotic resistance	A property of bacteria that confers the capacity to grow in the presence of antibiotic levels that would normally suppress growth or kill susceptible bacteria.
Antimicrobial	An active agent, such as a medicine, that on application to living tissue or through systemic use kills, prevents or inhibits the growth of microorganisms. Antimicrobials include antibiotics, antifungals, antivirals, anthelmintics and antiseptics.
Antimicrobial resistance (AMR)	The ability of microorganisms – including bacteria, viruses, fungi and parasites – to develop a capability to grow or survive in the presence of antimicrobials, and to pass this trait on via their genes to other microorganisms.
Community acquired infections	Infections acquired in the course of daily life in the community (including in the home and workplace)
Food-producing animals	Land and water-based animals reared for the production of meat or other food products (e.g. milk, eggs).
Growth promotant	The use of substances (growth promotants) that increase the rate of weight gain and/or the efficiency of feed utilisation in animals by other than purely nutritional means. The term does not apply to the use of antibiotics for the purpose of inhibiting specific pathogens even when an incidental growth response may be thus obtained
Methicillin resistant <i>Staphylococcus aureus</i> (MRSA) (also called multidrug-resistant <i>S. aureus</i>)	Strains of <i>Staphylococcus aureus</i> resistant to methicillin (and other β -lactams) and one or more other antibiotic classes.
Multi-drug resistance organisms	Refers to microorganisms with acquired non-susceptibility to at least one agent in at least three antimicrobial classes.
One Health	The principle of applying a collaborative and coordinated effort across multiple sectors – working locally, nationally and globally – to attain optimal health for people, animals and the environment.
Prevalence	The number of events of interest in a given population at a given point in time, usually expressed as a prevalence rate i.e. as a proportion of the defined population size at that time. It includes all the events of interest, both new and long-standing cases.
Prophylaxis	The use of treatment e.g. the administration of an antibiotic, in advance of an actual infection or disease condition because such a condition is expected to occur if treatment is withheld.
'Superbugs'	'Superbugs' are bacteria that have adapted to become resistant to multiple antibiotics.
Surveillance – Targeted	Targeted surveillance involves a prospective study of resistance directed at specific pathogens.
Surveillance – Passive	Passive surveillance is the collection of routine analytical data from diagnostic laboratories.

ABBREVIATIONS

ACRONYM	TERM
AMR	Antimicrobial resistance
AMRPC	Antimicrobial Resistance Prevention and Containment Steering Group
AMS	Antimicrobial stewardship
APVMA	Australian Pesticides and Veterinary Medicines Authority
ASTAG	Australian Strategic and Technical Advisory Group on Antimicrobial Resistance
AURA	Antimicrobial Use and Resistance in Australia Surveillance System
COAG	Council of Australian Governments
CAR	Critical antimicrobial resistance
CPE	Carbapenemase-producing Enterobacteriaceae
FAO	Food and Agriculture Organization of the United Nations
GAP	Global Action Plan on Antimicrobial Resistance
IPC	Infection prevention and control
NAPS	National Antimicrobial Prescribing Survey
NSQHS Standards	National Safety and Quality Health Service Standards
OECD	Organisation for Economic Co-operation and Development
OIE	World Organisation for Animal Health
PAA	Priority area for action
PBS	Pharmaceutical Benefits Scheme
PDPs	Product Development Partnerships
PHNs	Primary Health Networks
PPPs	Public-Private Partnerships
RPBS	Repatriation Pharmaceutical Benefits Scheme
STI	Sexually transmitted infection
UN	United Nations
UTI	Urinary Tract Infections
WHO	World Health Organization

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