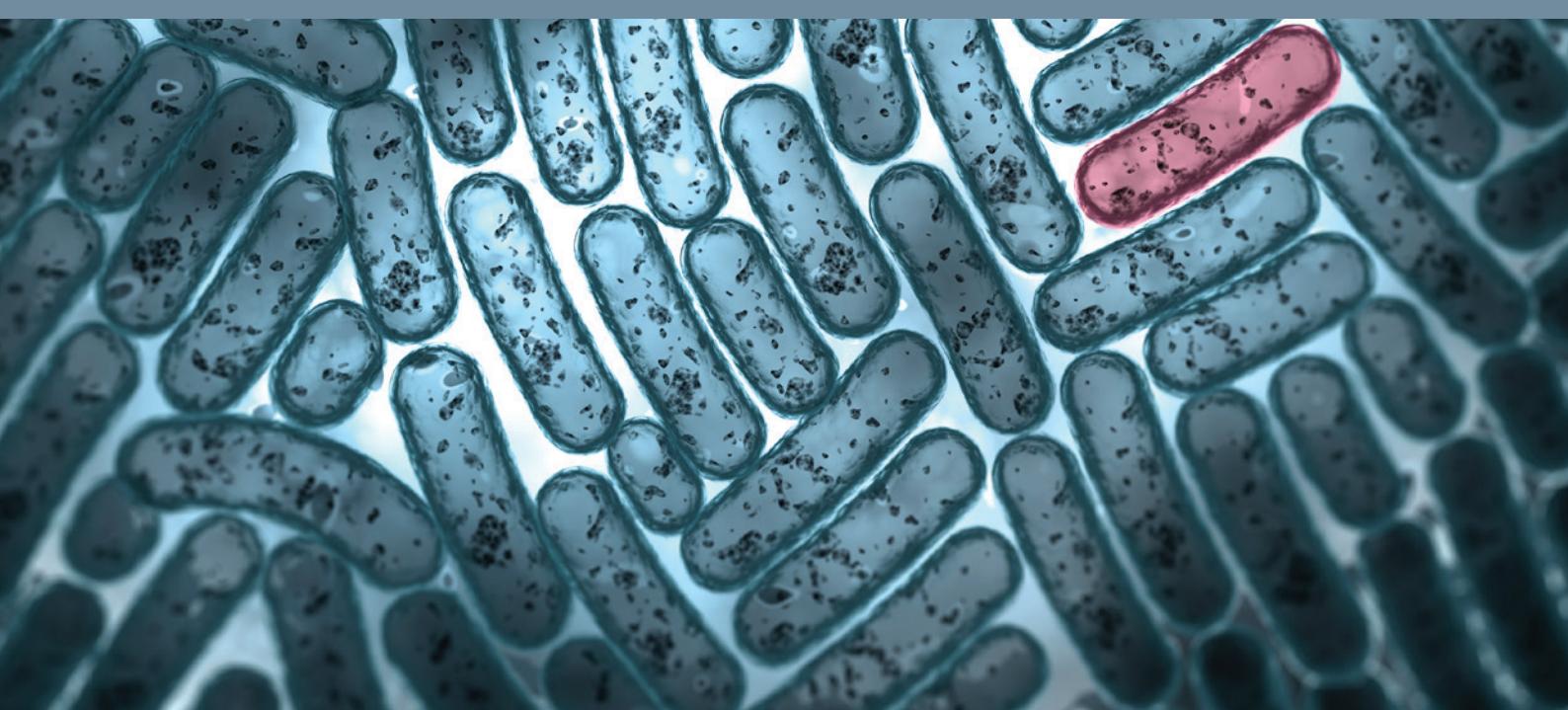




Australian Government
Department of Health
Department of Agriculture



RESPONDING TO THE THREAT OF antimicrobial resistance



Australia's First National Antimicrobial Resistance Strategy 2015–2019

June 2015

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National Antimicrobial Resistance Strategy 2015–2019

ISBN: 978-1-76007-191-2

Online ISBN: 978-1-76007-192-9

Publications approval number: 11074

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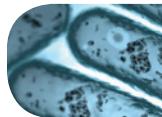
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Foreword

Antimicrobial medicines are a precious resource used every day all over the world to effectively treat infections in humans and animals. They have enabled advances in modern medicine that would not otherwise be possible, and contribute to our agricultural and food production industries.

Antimicrobial resistance is recognised as a significant global health priority that threatens to take modern medical and veterinary practice back into the pre-antibiotic era, when infection risk prevented procedures that are today considered routine, and simple infections caused significant harm. It is a shared concern of both developed and developing countries.

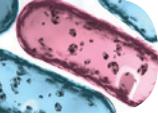
Globally, the increase in antibiotic resistance has been driven by the unrestrained use of antibiotics in human health, agriculture and animal husbandry. In Australia, the increasing number of antibiotic-resistant infections appearing in the community and acquired during international travel represent a looming public health issue.¹

As antimicrobial resistance has increased, so too have calls for national, regional and global efforts to slow its development. The World Health Organization has called on nations to do more and in May 2014, the World Health Assembly adopted a resolution to develop a Global Action Plan on antimicrobial resistance. The Australian Government has been an active participant in the development of the Global Action Plan, in addition to ensuring the development and implementation of its own national antimicrobial resistance strategy.

This first National Antimicrobial Resistance Strategy represents the collective, expert views of stakeholders from across the animal and human health, food and agriculture sectors on how best to combat antimicrobial resistance in Australia. The Strategy will also support global and regional efforts, recognising that no single country can manage the threat of antimicrobial resistance alone.

The Strategy calls on all stakeholders to support a collaborative effort to change those practices that have contributed to the development of resistance and implement new initiatives to reduce inappropriate antibiotic usage and resistance. It builds on the successful work already underway by integrating new and existing programmes and initiatives into a cohesive, national response.

Implementation of the priority areas identified here will take a staged approach over the life of the Strategy. It will involve many partners and require a high level of cross sectoral cooperation at the local, regional and national levels, as well as internationally. It is our hope that the broad range of professional bodies and institutions that have helped develop this Strategy will heed its call to action and actively look for opportunities to develop new, and strengthen existing, partnerships to support the achievement of the Strategy's objectives.



There are few single issues in Australia in recent times that have more powerfully linked the interests, concerns and efforts of the human and animal health, food and agricultural sectors than antimicrobial resistance.

We are confident this Strategy will help deliver an effective and sustainable response to antimicrobial resistance in Australia. We encourage all stakeholders to work together to minimise antimicrobial resistance and ensure the continued widespread availability of effective antimicrobials that support the delivery of world class human and animal health services and agricultural productivity.



The Hon Sussan Ley MP
Minister for Health



The Hon Barnaby Joyce MP
Minister for Agriculture

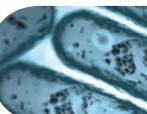
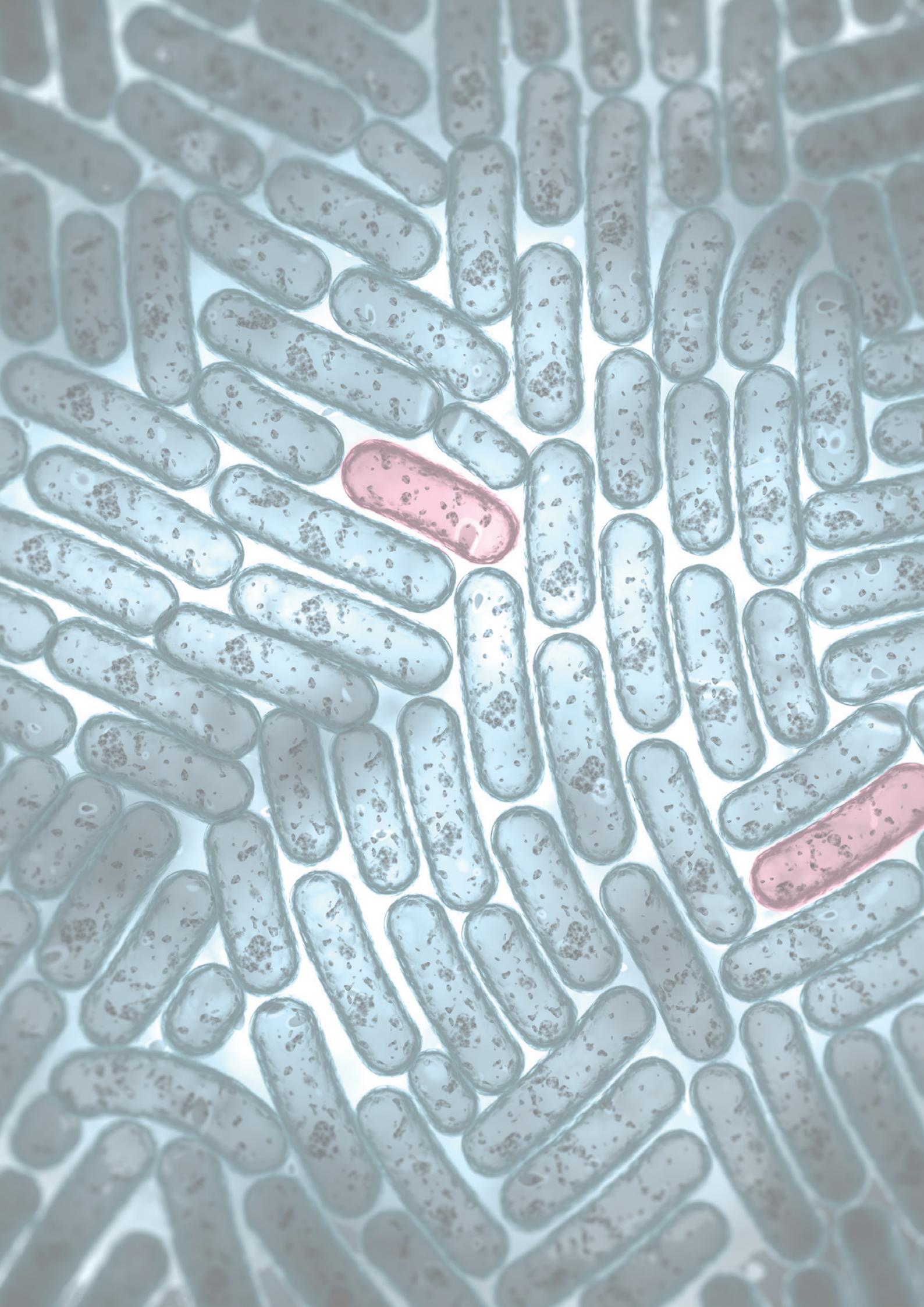
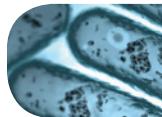


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Introduction

Since the 1940s, antimicrobial medicines such as antibiotics, antivirals and antimalarials have substantially reduced morbidity and mortality associated with infectious disease. The widespread availability of effective antimicrobials has enabled advancements in modern medical and veterinary practice that would have been unachievable without them. The development of resistance to antimicrobial medicines has, however, put these advances at risk.



“...this serious threat is no longer a prediction for the future; it is happening right now in every region of the world and has the potential to affect anyone, of any age, in any country.”

(WHO, 2014)



Global and national costs of resistance

In the United States, resistant infections are responsible for at least 23,000 deaths and more than two million illnesses each year, costing up to US\$35 billion in indirect societal costs. Across the European Union approximately 25,000 deaths per year are attributed to the development of resistance.

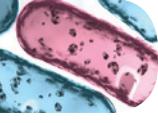
*While the impact of antimicrobial resistance in Australia has not yet been quantified, there are indications that the problem is increasing. For example, resistance in *Staphylococcus aureus* bacteraemia (SAB) isolates in Australia is a significant problem and is associated with high mortality. In 2013, the prevalence of methicillin resistant SAB was around 19 per cent*, which is significantly higher than reported in most European countries.*

The World Health Organization (WHO) has described antimicrobial resistance as one of the key global health issues facing our generation. The global nature of the problem means that no one country can act in isolation. Increasing international travel, medical tourism and global trade provide the opportunities for resistance to spread across all borders.

Antimicrobial resistance occurs when a microorganism, such as bacteria, becomes resistant to an antimicrobial medicine, such as an antibiotic, to which it was originally susceptible. The ability of bacteria to develop resistance was recognised almost as soon as antibiotics were discovered.² The evolution of resistant strains is a natural phenomenon that occurs when bacteria replicate themselves erroneously or when resistance traits are exchanged between them.

The global unrestrained use of antibiotics across human and animal health and in agriculture is largely responsible for accelerating the process and has been identified as the single most powerful contributor to the development of resistance.³

*Australian Group on Antimicrobial Resistance; Australian *Staphylococcus aureus* Sepsis Outcome Programme, Annual Report 2013.



Concerted efforts are needed to reduce the inappropriate use of antibiotics and achieve a reduction in resistance in clinical and veterinary practice and agriculture.

Poor hygiene and infection prevention and control practices and inappropriate food-handling exacerbate the problem by providing the conditions in which resistant bacteria can spread. Resistance to antibiotics, particularly last line antibiotics has now been documented in all regions of the world.⁴ Some bacteria are now so resistant that the infections they cause are virtually untreatable with any of the currently available antibiotics.

Until more recent times, the emergence of resistance was managed by replacing an antibiotic that had become ineffective with a new class of antibiotic that acted in a novel way and to which bacteria were susceptible. The problem of bacterial resistance today is that the development pipeline for new antibiotics has collapsed. The relatively low commercial return on the discovery and development of new antibiotics has resulted in most large and mid-sized pharmaceutical companies withdrawing from antibiotic research. Only two antibiotics that work in a novel way have been discovered and developed for use in humans in the last 50 years.⁵ The recent discovery of a new antibiotic, teixobactin, provides cause for optimism, however it will be several years before the drug is available for widespread use.⁶

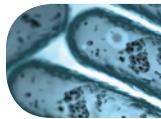
A One Health issue, requiring a One Health response

In human health, antibiotic resistant infections can have serious consequences for health systems, requiring more complex and expensive drug treatments, longer hospital stays, additional investigations and can cause increased morbidity and mortality. Globally, the death rate for hospital patients with serious resistant infections can be twice that of patients with infections caused by non-resistant strains.⁷

Estimates of the increased financial burden caused by resistant infections have largely focussed on the cost of longer hospital stays. However, the implications for modern medical practice could be far more important.

Our health system is now designed to treat more chronic conditions and antibiotics have become integrated in many aspects of such care. Antibiotics also provide protection against infectious complications of many modern medical practices, including surgery, neonatal care and cancer treatment. The costs of increasing resistance may ultimately not be limited to those associated with additional treatments for a primary infection: they may encompass the costs associated with the loss of modern health care.⁸

While the development of resistance is recognised as a significant human health issue, its implications reach far beyond. In animals, resistant infections can reduce animal health, welfare, biosecurity and production outcomes. Infections in animals can result in the spread of resistant bacteria and the transfer of genetic material responsible for resistance to



people who come into contact with them; and infections in animals for human consumption may pose a risk via foodborne transmission.⁹

Minimising the development of resistance in livestock and companion animals is an essential component of Australia's response. It will protect public health by preventing the emergence and spread of resistant organisms from animals to humans and vice versa; protect the health of our companion animals; and enhance the productivity, quality and reputation of our livestock industries, both domestically and internationally.

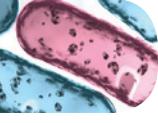
Australia's response to antimicrobial resistance recognises the need for actions in all sectors where antimicrobials are used. The Strategy had its impetus in the work of the former Antimicrobial Resistance Standing Committee (AMRSC), whose membership brought together representatives from the Australian Government and its agencies in human, animal and agricultural contexts, clinical experts and professional colleges. In July 2013, the Australian One Health Antimicrobial Resistance Colloquium was convened by the Antimicrobial Resistance Prevention and Containment Steering Group to bring together medical, veterinary and agricultural professionals and policy makers and begin collaborative discussions to inform a national one health strategy.

What is 'One Health'?

The One Health concept recognises that human, animal and ecosystem health are inextricably linked.

One Health is not a new concept, but it has become more important in recent years because many factors have changed the interactions among humans, animals, and the environment.

Achieving optimal health outcomes for people and animals requires the cooperation of the human health, veterinary health, and environmental health communities.



Australia's response—objectives for national action

This National Antimicrobial Resistance Strategy represents the first national, cross-sectoral response to the threat of antimicrobial resistance in Australia. It focuses predominantly on bacterial resistance and the rapid development of resistance to antibiotics as the area of greatest concern.

The challenge of antimicrobial resistance is complex and no single action will, in isolation provide an effective response. The Strategy sets out seven objectives that identify the broad areas where integrated and simultaneous action is required. Progress in each area is important to ensure a comprehensive response and support progress towards the Strategy's vision.

The Strategy's goal and objectives and the actions needed to achieve them have been informed by a review of national and international literature, expert advice and consultations with sector stakeholders. The Strategy aligns with the WHO's Global Action Plan on antimicrobial resistance, which is expected to be finalised in mid-2015.

The Strategy sets priorities for future actions and highlights some of the successful initiatives Australia already has in place to tackle antimicrobial resistance. The Australian Government is working with stakeholders to ensure that lessons from these successful strategies can be applied in all sectors where antimicrobials are used and where infectious disease represents a threat to human health, animal health and agricultural productivity.

Some actions will be concerned with adapting and extending existing successful initiatives and programmes in order to achieve a fully integrated One Health approach. Others will focus on identified gaps in Australia's response that require new areas of activity, the discovery of new knowledge and the formation of new partnerships. While individual actions will be important in their own right, many will be interrelated and specific actions in one area will contribute to the achievement of multiple objectives.

Vision

A society in which antimicrobials are recognised and managed as a valuable shared resource, maintaining their efficacy so that infections in humans and animals remain treatable and communities continue to benefit from the advances that antimicrobials enable.

Goal

Minimise the development and spread of antimicrobial resistance and ensure the continued availability of effective antimicrobials.

Objectives

1. Increase awareness and understanding of antimicrobial resistance, its implications, and actions to combat it through effective **communication, education and training**.
2. Implement effective **antimicrobial stewardship** practices across human health and animal care settings to ensure the appropriate and judicious prescribing, dispensing and administering of antimicrobials.
3. Develop nationally coordinated One Health **surveillance** of antimicrobial resistance and antimicrobial usage.
4. Improve **infection prevention and control** measures across human health and animal care settings to help prevent infections and the spread of antimicrobial resistance.
5. 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.
6. Strengthen **international partnerships** and collaboration on regional and global efforts to respond to antimicrobial resistance.
7. 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.



Implementation, Monitoring and Evaluation

Australia has a wide range of initiatives in place to address some aspects of antimicrobial resistance. Regulatory restrictions on the prescription and use of antibiotics; guidelines that support appropriate antibiotic prescribing; surveillance activities that collect and report data on antibiotic prescribing and usage; hand hygiene, infection prevention and control and antimicrobial stewardship programmes; strict requirements to manage bacterial levels along the food production and processing chain; education for prescribers on the judicious use of antibiotics; and research into new products and approaches that can minimise the emergence of resistance have all helped Australia avoid some of the more severe consequences of antimicrobial resistance being experienced by other countries.

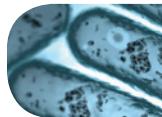
Despite these efforts, however, antimicrobial resistance is increasing and, in human health, Australia's rate of antibiotic consumption is amongst the highest in the OECD. Greater efforts are required by all stakeholders, both government and non-government, to ensure that antibiotics are used appropriately to minimise antimicrobial resistance.

The Strategy provides a framework to guide actions on antimicrobial resistance and use, and coordinate activities across stakeholder groups. Governments, regulators, health

care professionals, veterinary professionals, farmers, aquaculture producers, the pharmaceutical industry, pathology providers, standard-setting bodies, researchers, educators, professional organisations, animal owners and the community must work together under the Strategy to change those practices that are contributing to the inappropriate use of antibiotics and the increasing development of resistance in Australia. Effective governance arrangements will ensure a coordinated effort across sectors.

Implementation and evaluation of the Strategy will be supported by an Implementation Plan (the Plan) that provides the detail of specific actions, targets, timeframes and indicators. The Plan will be developed during 2015 in consultation with stakeholders. Implementation will take a staged approach over the period 2015–2019.

The Australian Antimicrobial Resistance Prevention and Containment Steering Group, which is led by the Secretaries of the Australian Government Departments of Health and Agriculture and includes the Chief Medical Officer and Chief Veterinary Officer, will oversee implementation and report publicly on progress.



Measuring success

Surveillance activities will monitor changes in antibiotic usage and resistance trends to ensure actions under the Strategy are having the desired effects. Initially, data collections will be focused on establishing baseline measurements against which future reduction targets can be set.

It will be important for Australia's response to know where antibiotics are being used and in what quantities. Benchmarking usage data by sector (for example, human health, animal health and food production); by setting (for example, hospitals, general practice, aged care facilities, companion animal veterinary practices, livestock and aquaculture production); and in the case of animal health by species, will allow us to monitor the performance of actions designed to reduce inappropriate antibiotic use in each sector.

Data on the prevalence of important drug resistant organisms will allow actions to be adjusted in response to new or emerging threats. Australia will also provide surveillance data to the WHO to inform its global antimicrobial resistance surveillance and to understand how we are performing compared to other countries.

Targets, indicators of progress and data sources for measuring the effectiveness of priority actions under the Strategy will be agreed with stakeholders in the development of the Plan.

Objective One

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

Antimicrobial resistance affects everyone, regardless of where they live, their health, economic circumstances, lifestyle or behaviour. It affects all sectors: human health, animal health, agriculture and food production. Everybody, in all sectors and disciplines, should be engaged in our national response.

Although work has been done in Australia to raise public awareness about antimicrobial resistance, further efforts are required. Research has found that while people increasingly recognise that antibiotic resistance poses a significant threat to public health, few understand how their own behaviours contribute to the development of resistance and the spread of resistant bacteria. The inappropriate use of antibiotics is a significant issue and community awareness and education initiatives are needed to modify patient expectations regarding antibiotic prescriptions.

Communicating effectively to raise the awareness and understanding of prescribers and dispensers across human health and animal health, farmers, animal owners and the general public about antimicrobial resistance is an important first step to creating an enabling environment for behaviour change. Effective communication can help improve understanding of the causes and effects of antimicrobial resistance, support more informed clinical decision making and judicious



Perspectives on antibiotic usage in Australia

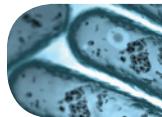
A May 2014 poll of Australian workers indicated that 65 per cent believed that taking antibiotics would help them recover from their cold or flu more quickly.

One in five people expect antibiotics for viral infections like a cold or flu.

Nearly 60 per cent of surveyed GPs would prescribe antibiotics to meet patient demands or expectations.

antibiotic prescribing and use, and assist in promoting behaviours that minimise the development and spread of resistant organisms.

Education is important for all prescribers and dispensers of antimicrobials to ensure they prescribe and dispense appropriately, consider alternatives to antibiotics for the treatment and control of bacterial diseases, and have appropriate supports to assist in communicating with patients, farmers and clients effectively. Education and awareness initiatives must also convey the importance of infection prevention and control practices in limiting the spread of resistant organisms.



Priority Areas for Action

1.1 Strengthen consumer awareness initiatives to improve understanding of antimicrobial resistance and the importance of using antibiotics appropriately

Given the seriousness of antimicrobial resistance and the need to improve consumer awareness, additional effort on this front is needed. It is important that strong and sustainable public awareness initiatives are instituted and supported across sectors. Efforts should be appropriately targeted and complementary to ensure maximum impact and best use of resources.

The introduction of antimicrobial resistance information and key messages for children through school curricula could assist in promoting greater awareness and understanding from a young age. Opportunities to work with the media to support accurate reporting about antimicrobial resistance should also be considered.

Consumers have different reasons for using medicines the way they do, based on social and cultural influences, experience, health beliefs, financial means and psychological aspects. Considering these differences will be key to developing effective consumer awareness initiatives. Making information about antibiotic usage in food production more readily accessible may also be an appropriate avenue to increase awareness and facilitate consumer choice.

Antibiotic Awareness Week (AAW)

Australia has been participating in AAW—a worldwide initiative to promote greater understanding of antibiotic resistance and the responsible use of antibiotics—since 2012.

AAW in Australia takes a One Health approach, with events coordinated across human and animal health.

In 2014 AAW was coordinated by the Australian Commission on Safety and Quality in Health Care, with support from the Australian Society for Antimicrobials, Australasian Society for Infectious Diseases, Australasian College for Infection Prevention and Control, the Society of Hospital Pharmacists, NPS MedicineWise, the Australian Veterinary Association, jurisdictions, and the Australian Government Departments of Health and Agriculture.

1.2 Increase support for human and animal health professionals in reinforcing key messages with patients and clients

Health and veterinary professionals have the opportunity to reinforce messages related to appropriate antibiotic use and effective infection prevention and control practices each time they prescribe, dispense or provide advice about antibiotics. There is a need to provide these professionals with resources to support informed decision making regarding treatment and to support efforts to educate their patients and clients.

The development of resources that support appropriate antibiotic prescribing in primary health care settings is a priority as general practitioners currently prescribe the greatest proportion of antibiotics in Australia¹⁰ and research has shown that patient expectations have a significant influence over a general



practitioner's decision to prescribe antibiotics.¹¹ Resources should support the communication efforts of all members of the practice team, including practice nurses, pharmacists and pharmacy staff.

1.3 Strengthen communication and education initiatives for health professionals and health care team members

Communication and education initiatives on antimicrobial resistance, antimicrobial stewardship and infection prevention and control need to be included through all stages of a health professional's formal training and be regularly reinforced by workplace-based education, including staff orientation and feedback mechanisms. This needs to include a strong inter-professional focus and reinforce the message that responding appropriately to antimicrobial resistance is a shared responsibility and all team members have an important role to play.

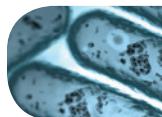
Reviewing the microbiology and antimicrobial prescribing and dispensing content of courses offered by universities, colleges and professional bodies would identify gaps and the need for new content. Options to promote national consistency of curricula content should be explored, as well as ways to ensure the competency of prescribers.

Existing educational resources on antimicrobial resistance, antimicrobial stewardship and infection prevention and control will be considered for broader application, including adaptation to suit the needs of other professional groups, as will the development of new continuing professional development activities and resources to target identified gaps.

1.4 Develop a stakeholder engagement and communication plan to support whole-of-society awareness of, and participation in implementing the Strategy

The significant amount of valuable information on the use of antibiotics and initiatives to minimise antimicrobial resistance available from various sources in Australia and internationally is not always easily accessible. In addition, there are sometimes mixed messages about the appropriate use of antibiotics, what constitutes inappropriate use, and how certain behaviours and practices can contribute to the development of resistance.

A stakeholder engagement and communication plan will be developed with the aim of increasing accessibility to reliable sources of information on antibiotics, antimicrobial resistance and the actions everybody can take to minimise the development and impacts of resistance. The plan will promote information for sectors, professionals and professional groups and the general public from a One Health perspective.



Objective Two

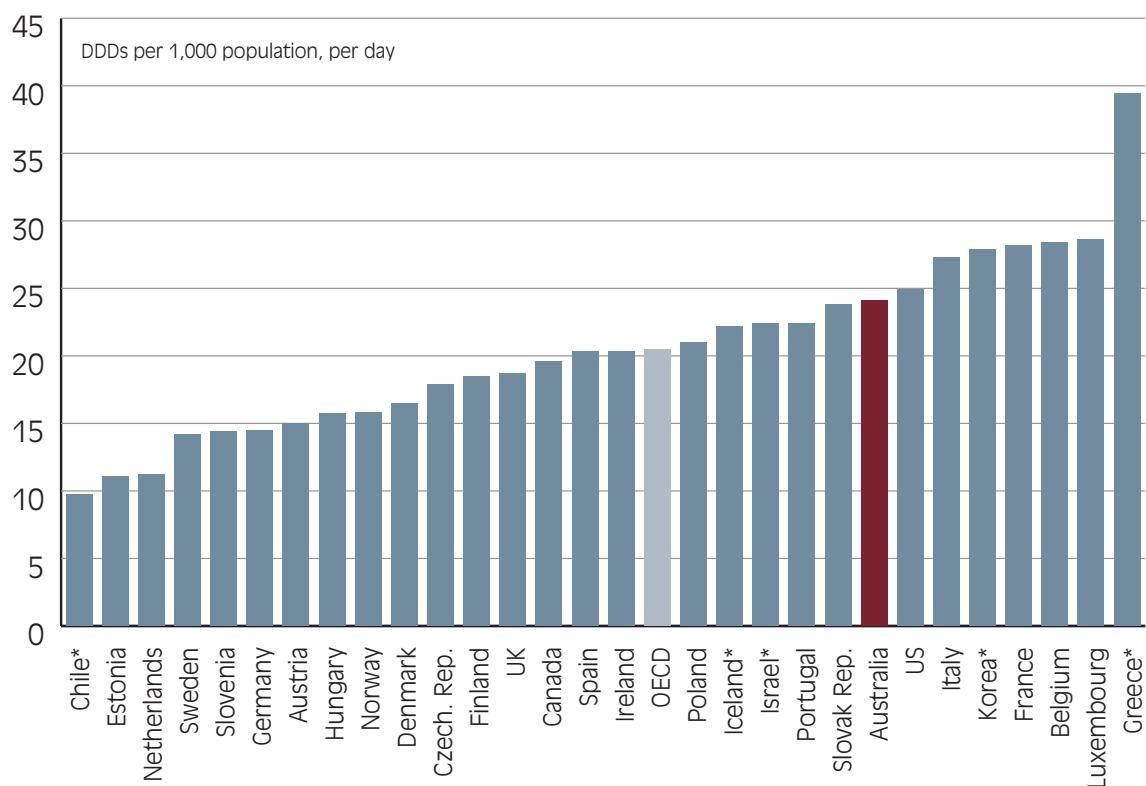
Implement effective antimicrobial stewardship practices across human health and animal care settings to ensure the appropriate and judicious prescribing, dispensing and administering of antimicrobials

The appropriate and judicious use of antimicrobials is essential to slowing the emergence of resistance. Antibiotic use contributes to the development of resistance by increasing the selection of resistant strains. Inappropriate and injudicious use exacerbates the problem.

In this context, the high rate of consumption of antibiotics in Australia is an area of immediate

concern. Australia's use of antibiotics in human health is high compared to other OECD countries and is well above the OECD average (see Figure 1). In 2013, the Pharmaceutical Benefits Scheme (PBS) and Repatriation Pharmaceutical Benefits Scheme (RPBS) supplied 29.2 million prescriptions for antibiotics to over 10 million unique patients (45 per cent of the Australian population).¹² While PBS and RPBS data provide a useful indicator, the true level

Figure 1: Overall volume of antibiotics prescribed, 2010 (or nearest year)



* Data refer to all sectors (not only primary care).

Source: *OECD Health Statistics 2013*, <http://dx.doi.org/10.1787/health-data-en>, *IMS for United States*
DDDS: Defined Daily Doses



of total antibiotic usage in humans in Australia is much higher as these figures do not capture hospital use or private prescriptions in the community.

Results from the 2013 *National Antimicrobial Prescribing Survey*¹³ provide a snapshot assessment of the appropriateness of antimicrobial prescribing practices in hospital settings. The survey found that:

- The clinical appropriateness of the top five most commonly prescribed antimicrobials ranged from 60–76 per cent.
- Overall, 30 per cent of prescriptions were deemed to be inappropriate. Inappropriate use was mainly related to unnecessary use of broad spectrum antimicrobials and incorrect duration of treatment.
- Surgical prophylaxis was the highest indication for antimicrobial use and was given for more than 24 hours in 41 per cent of cases. This is significantly higher than the recommended best practice target of less than five per cent.
- Only 71 per cent of antibiotic prescriptions had a reason documented in the medical notes, which falls below the best practice target of more than 95 per cent.

The widespread and inappropriate use of antibiotics has been reported in residential aged care facilities, with concerns about the susceptibility of older people, particularly those with advanced dementia or end-stage illness to the adverse consequences of inappropriate antibiotic usage.¹⁴

There is also an increasing body of evidence that points to antibiotic usage in agriculture as contributing to the emergence, persistence and spread of resistant bacteria, including in foodborne organisms.¹⁵ The annual mean total

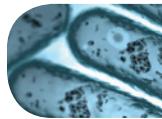
tonnage of antimicrobials sold in Australia for veterinary use over the period 2005 to 2010 was 587 tonnes.¹⁶ Ninety-eight per cent of the total (by weight) was for use in food-producing animals, with only two to three per cent for non-food animals. Applying the European population corrected sales usage (PCU) system shows Australia using around 15 mg/PCU per year* for food animals. In 2012, usage in European Union and European Economic Area countries ranged from around four to 397 mg/PCU¹⁷ (median 62 mg/PCU). Australia's comparatively low usage is to be expected, given Australia's predominant use of extensive grazing systems.

The proportion of antimicrobials used in food-producing animals for growth promotion is also low in Australia, accounting for around four per cent (23.5 tonnes) of total antimicrobial usage in 2010. Therapeutic or prophylactic antimicrobial use accounted for 43 per cent, with the remaining 51 per cent used for the control of coccidiosis in chickens.

The impact of antimicrobial usage in agriculture in Australia is not well understood. However, it is recognised that improved management of the use of antimicrobials in food animals, particularly reducing the use of those critically important for human medicine will be an important step towards ensuring the availability of appropriate antimicrobial therapy for the management of human illness.¹⁸

Antimicrobial stewardship (AMS) refers to coordinated actions designed to promote and increase the appropriate use of antimicrobials and is a key strategy to conserve the effectiveness of antibiotics. In health care settings, AMS programmes have been shown to improve the appropriateness of antibiotic

*Unpublished data.



use; reduce institutional rates of resistance, morbidity and mortality; reduce health care costs, including pharmacy costs; and reduce the adverse consequences of antibiotic use, including toxicity.¹⁹

AMS programmes do not currently exist for all settings in which antibiotics are used. Setting-specific, evidence-based guidelines and other resources and approaches are needed to encourage the development and implementation of AMS in primary health care settings, residential aged care facilities, kennels and catteries, veterinary practices, aquaculture and farms.

Stewardship programmes covering antibiotic use in animals and food production may have significant public health value in preventing the emergence of resistant strains and their spread to humans.

Priority Areas for Action

2.1 Ensure that tailored, evidence-based antibiotic prescribing guidelines are available for all sectors

The widespread availability and use of sector-specific, evidence-based prescribing guidelines is fundamental to improving the stewardship of antibiotics in Australia.

The *Importance Ratings and Summary of Antibacterial Uses in Humans in Australia*²⁰ (the Importance Ratings) rank antimicrobials according to their relative importance in human medicine and provide a reliable source of information for regulatory authorities in assessing the risk to human health of exposure of susceptible humans to either an antibiotic or antibiotic-resistant bacteria and to inform setting-specific prescribing guidelines. This important resource will be regularly reviewed and updated to ensure contemporary guidance.

The *Therapeutic Guidelines: Antibiotic*²¹ and the *Australian Medicines Handbook*²² provide guidance to prescribers to optimise selection, dosing, route of administration, duration and timing of initiation of antimicrobial treatment. Although these guidelines are generally widely available, particularly in hospitals, data suggest that the inappropriate use of antibiotics still occurs.²³

Access to, and use of these resources in all human health settings where antibiotics are prescribed should be standard practice. Any barriers to their accessibility and use must be explored and remedied.

Antibiotic prescribing guidelines for veterinary practices, livestock and aquaculture producers are needed to standardise and optimise the use of antibiotics, improve treatment outcomes and minimise resistance in these settings.



Antimicrobial Stewardship in Australian hospitals

Implementation of the National Safety and Quality Health Service (NSQHS) Standards commenced in 2013, and require every Australian hospital and day procedure service to implement infection prevention and AMS programmes.

With the introduction of these Standards, Australia leads the world in mandated requirements for infection prevention and control and AMS in hospitals and day procedure services. Over time, it is anticipated that the Standards will play a significant role in helping to improve the appropriateness of antimicrobial usage in Australian hospitals.

2.2 Ensure the availability of evidence-based, best-practice and nationally consistent approaches to AMS across human health and animal care settings

To support the implementation of AMS programmes in hospitals, the Australian Commission on Safety and Quality in Health Care established a National AMS Advisory Committee to provide strategic advice to ensure work undertaken in this area occurs in a nationally coordinated way; the National AMS Network to provide a forum for promoting a nationally consistent approach to AMS; and developed publications and resources, including *Antimicrobial Stewardship in Australian Hospitals*.²⁴ This publication is primarily for use in hospitals and describes the structure, governance and resources needed to establish an AMS programme, along with strategies that can influence antimicrobial prescribing and reduce inappropriate use.

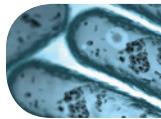
Approaches that support appropriate prescribing and supply of antibiotics outside of hospitals, however, are not well established. Best-practice, setting-specific approaches to AMS need to be developed so that it becomes standard practice in all settings where antibiotics are used. Primary Health Networks (PHNs) being established across Australia may be well placed to support implementation of AMS initiatives in general practice.

In November 2014, the Australian Veterinary Association released *Veterinary use of antibiotics critical to human health*²⁵ to guide how veterinarians should, in a broad and general sense, use antibiotics critical to human medicine. Detailed, species-specific guidelines are needed to further support antimicrobial stewardship in animal health settings.

2.3 Develop tailored, evidence-based resources to support the implementation of AMS programmes

While much has been done to ensure that effective AMS arrangements are standard practice in Australian hospitals there is a growing need for guidelines and resources, readily accessible at the point of care, to assist with the implementation of AMS in other settings. Research in Australia and overseas^{26,27} has investigated the reasons, both behavioural and structural, why practitioners may not prescribe in accordance with best practice guidelines. New resources, informed by these findings would aim to overcome the identified barriers.

There is high-level support for the principles of AMS used in human health care to be applied to animal health and agriculture, however structured AMS programmes for these settings are yet to be developed. Resources to support the implementation of AMS programmes in primary health care settings, residential aged care facilities, veterinary practices, kennels and catteries, the aquaculture industry and farms will help embed stewardship principles in all sectors where antibiotics are used.



2.4 Review existing accreditation and quality assurance programmes to ensure they appropriately support and encourage compliance with best practice AMS approaches

National Safety and Quality Health Service Standard 3 requires hospitals to develop and implement AMS programmes, ensure prescribers have access to current, endorsed antibiotic prescribing guidelines, monitor antibiotic usage and take action to improve the effectiveness of AMS programmes. The *Antimicrobial Stewardship Clinical Care Standard²⁸* aims to ensure that a patient with a bacterial infection receives optimal treatment with antibiotics, including the selection of the right antibiotic to treat their condition, the right dose, by the right route, at the right time and for the right duration based on accurate assessment and timely review. The Royal Australian College of General Practitioners (*RACGP Standards for General Practice*) and accreditation standards for aged care facilities encourage the implementation of AMS programmes in general practice and aged care settings.

These standards have maximum impact when they support adherence to best-practice and reduce barriers to implementation. Unlike hospital accreditation, general practice accreditation is voluntary in Australia and additional approaches for ensuring and monitoring compliance will need to be identified.

There are currently no accreditation or quality assurance programmes for veterinary practices in Australia that have specific requirements for AMS. The Australian Veterinary Association has a voluntary small animal veterinary hospital accreditation programme covering general practices and procedures. Livestock industries have accreditation and quality assurance programmes for ensuring product integrity (i.e. that animals sold which have been treated with an antibiotic are declared and have gone through a withholding period to ensure any possible residues are below prescribed maximum residue limits (MRLs)).

Identifying how these existing programmes and/or new programmes could best support and encourage compliance with best practice AMS principles in the animal sector needs to be explored.

2.5 Strengthen existing measures to better support appropriate and judicious use

The use of antibiotics could be optimised by making improvements to existing arrangements for the prescribing, dispensing and administering of antibiotics. For example, ensuring prescribing and dispensing software is better integrated with prescribing guidelines; enhancing decision support tools; dispensing only the quantity of antibiotics prescribed; better targeting incentives for practice improvement; showcasing examples of best practice implementation of AMS programmes; and reviewing existing regulations governing access to antibiotics to ensure they effectively support appropriate and judicious use. Opportunities to build monitoring, such as audit and feedback processes, into existing frameworks in each setting should also be explored.

Objective Three

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

Current gaps in surveillance coverage, jurisdictional differences in data collection, analysis and reporting, and the use of different diagnostic systems for undertaking susceptibility testing have resulted in a fragmented picture of antimicrobial resistance and usage in Australia. Nationally harmonised and coordinated surveillance is essential to understand the magnitude, distribution and impact of resistant organisms and antimicrobial usage, identify emerging resistance and trends, and determine associations between usage and resistance. Surveillance is needed at the local, jurisdictional and national levels, and globally. Such data will inform immediate actions as well as provide evidence to evaluate policies and set priorities.

Priority Areas for Action

3.1 Establish the foundations for national One Health surveillance

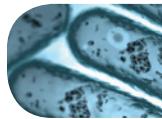
In the long term, surveillance of antimicrobial resistance and usage should be integrated across sectors under a One Health approach. Actions proposed in this first Strategy will be progressed with the aim of achieving this.

Development of agreed national objectives for surveillance will prioritise the key surveillance activities that need to be undertaken and inform system design and scope. The establishment of national surveillance programmes will be guided by the following objectives:

1. A nationally representative and coordinated programme for surveillance of antimicrobial usage in hospitals, the community, veterinary medicine and agricultural production.
2. Active and passive surveillance programmes to determine the prevalence of antimicrobial resistance in organisms causing serious health problems in health care and community acquired infections.
3. Targeted active surveillance programmes to determine the prevalence of antimicrobial resistance in indicator organisms in animal health and zoonotic organisms in food and the digestive tract of food animals.

The Australian Group on Antimicrobial Resistance (AGAR)

Australia has existing surveillance programmes in place to build upon in establishing a national system. AGAR is a collaboration of 34 public and private laboratories around Australia that collects, analyses and reports on trends in the levels of resistance in selected bacteria which cause important and life threatening infections in humans.



4. Surveillance systems that can examine associations between antibiotic consumption and antibiotic resistance.
5. A system of regular collection, collation, interpretation and reporting of national data to stakeholders.
6. Surveillance of pathogens from companion, performance and production animals where this informs on antibiotic use relevant to animal welfare and public health.

The establishment and implementation of national surveillance involves many complex issues and important phases, including undertaking evaluations of existing surveillance systems and data sources to identify gaps, and working with stakeholders to improve existing systems or to pilot new systems to address these gaps. Considering system attributes of data quality, representativeness, flexibility and acceptability is also important, as are resolving issues related to data ownership and access, the roles and responsibilities of participating stakeholders, system governance and data capture, integration and communication. Ensuring that Australia's national surveillance system provides useful information to data contributors and interested stakeholders will assist in engendering support and in overcoming some of the challenges associated with establishing these systems.

Some of the initial priority actions in progressing national surveillance include:

3.2 Agree the objectives of surveillance for each sector, ensuring they align with the overarching objectives for the national One Health surveillance system

It will be important to establish sector-specific objectives for surveillance that clearly define the scope of the system, identify and prioritise the end uses of the data, inform reporting cycles, and ensure that surveillance efforts are appropriately targeted.

3.3 Develop lists of priority organisms and associated antimicrobials for national reporting

Developing priority organism and associated antimicrobial lists for surveillance in each sector is necessary to ensure that surveillance is focussed and provides the information necessary to meet the objectives of the system. Lists for human health will, as a minimum, include the seven priority organisms identified by the WHO for its global antimicrobial resistance surveillance reports. Table 1 below lists the priority organisms for targeted surveillance in human health. This list will be updated in response to the changing incidence of resistant organisms.

For animal health, the World Organisation for Animal Health (OIE) Terrestrial Animal Health Code Article 6.7.3 suggests priority zoonotic organisms that should be monitored. Lists for animal health will account for the OIE suggested organisms, as relevant to the Australian context.

Table 1: Australia's list of priority organisms for human health

Rationale	Species
Impact in both hospitals and the community	<i>Enterobacteriaceae</i> (principally <i>Escherichia coli</i> and <i>Klebsiella species</i>) <i>Enterococcus</i> species <i>Mycobacterium tuberculosis</i> <i>Neisseria gonorrhoeae</i> <i>Neisseria meningitidis</i> <i>Salmonella</i> species <i>Shigella</i> species <i>Streptococcus pneumoniae</i> <i>Staphylococcus aureus</i>
Impact largely in hospitals	<i>Acinetobacter baumannii</i> complex <i>Enterobacter cloacae/aerogenes</i> <i>Pseudomonas aeruginosa</i>
Epidemiological and/or antimicrobial usage marker	<i>Campylobacter jejuni/coli</i>
Monitored through passive surveillance and elevated to targeted surveillance if threshold exceeded	<i>Clostridium difficile</i> <i>Haemophilus influenzae</i> type b <i>Streptococcus agalactiae</i> <i>Streptococcus pyogenes</i>

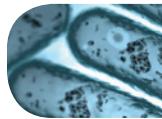
*WHO priority organisms for surveillance are in red.

3.4 Agree and implement a uniform standard for laboratory testing methods for antibacterial susceptibility

To enable data comparison, it is important to apply uniform testing and reporting standards across medical and veterinary diagnostic laboratories, ensuring methods are calibrated against the ISO reference standard where possible. At present, there is variation between the data sets held in surveillance systems, which may make data comparison at a national level difficult. Different susceptibility testing standards are used in Australian medical and veterinary diagnostic laboratories.

These standards are not always concordant on what is considered 'susceptible', 'intermediate' or 'resistant', meaning that resistance in a bacterium identified in one laboratory may be reported differently in another laboratory. This variability in standards is particularly pronounced in veterinary laboratories.

This work will be progressed in accordance with global standards in place or under development to support the international surveillance initiatives of the WHO, the Food and Agriculture Organization (FAO) and the OIE.



3.5 Improve human health surveillance

Current systems of data collection and collation vary between jurisdictions and there is limited coordination at a national level. A lack of consistency in reporting and analysis limits the comparability of data, making it difficult to ascertain a national picture of antimicrobial resistance and usage. Current surveillance initiatives predominantly occur in hospitals, with a lack of data from other health care settings and the community. The national communicable diseases/public health community is well established and surveillance is well coordinated in terms of disease epidemiology. Bridging the gap between hospital-based and community-based epidemiology may generate gains in improving passive surveillance incrementally.

The Australian Commission on Safety and Quality in Health Care (the Commission) is implementing national surveillance of resistance and antimicrobial usage in human health, based on agreed national surveillance objectives. This includes establishing passive and targeted surveillance systems across hospital, community and aged care settings and a national alert system to inform clinicians and policy-makers about emerging trends that could impact on public health. Surveillance of antimicrobial usage will also assess appropriateness of use.

Importantly, the Commission will establish a cycle of regular public reporting of surveillance findings to inform clinical and public health decision making, support increased consumer awareness, and help monitor and evaluate the effectiveness of actions under the Strategy. To facilitate timely improvements to surveillance data and ensure

maximum efficiency and effectiveness, this work will build on existing systems where appropriate. The national surveillance system will be established by June 2016.

3.6 Improve animal health and agriculture surveillance

Australia will increase its capacity to conduct surveillance of resistance in food-producing animals. Australia has recently produced a detailed report²⁹ on integrated surveillance options for meeting OIE standards and generating data that are internationally comparable. The findings of this report will inform a new Task Group, established by the Australian Government Department of Agriculture, to work with industry stakeholders to design and implement a 'proof of concept' model for surveillance in animals and agriculture.

3.7 Investigate requirements for surveillance in food

A significant knowledge gap exists in understanding the extent to which resistant bacteria are present in the food chain and the risks the presence of resistant bacteria, whether pathogens or indicator organisms pose in food. The 2007 study, *Pilot Surveillance Program of Antimicrobial Resistance in Bacteria of Animal Origin*³⁰ found antibiotic resistance was present in some indicator and pathogenic bacteria in food of animal origin in Australia, but overall the impact at a population level on human health was likely to be small. More surveillance data and research is required to better understand the pathways and extent of transmission of resistant organisms through foods of animal and non-animal origin and the risks this may pose to human health.

Objective Four

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

Infection prevention and control (IPC) practices, such as hand hygiene, the use of personal protective equipment, equipment disinfection, environmental cleaning and vaccination are recognised as an essential part of an effective response to antimicrobial resistance.

Infection prevention and control is critical in the control of all infectious organisms, but particularly so in limiting the spread of resistant organisms where there may be limited or no antimicrobial treatments available. Preventing infection and its spread reduces the need for antibiotics and the opportunity for organisms to develop resistance and share resistance genes.

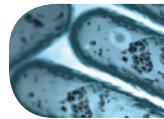
Resistant organisms can be transmitted between livestock animals and production workers, through the food chain, between companion animals and their owners and between humans in the community and health care facilities. Evidence-based IPC programmes are required across all sectors and settings, recognising that some settings pose a higher risk of infection than others. Over time, the availability of surveillance data, findings from research and the development of new technologies will inform new approaches and improvements in IPC.

National Hand Hygiene Initiative

The National Hand Hygiene Initiative was established in 2008 and is based on the WHO's 5 Moments for Hand Hygiene.

Since data were first collected in 2009, the national compliance rate for hand hygiene in hospitals has risen from 63.5 per cent to 81 per cent in 2014 [see www.hha.org.au/LatestNationalData.aspx]

Data for each hospital are publicly reported and this has become an accepted performance measurement for hospitals.



Priority Areas for Action

4.1 Ensure the availability of evidence-based, best-practice and nationally consistent standards for IPC across human health and animal care settings

The Australian *Guidelines for the Prevention and Control of Infection in Healthcare*³¹ were published in 2010 and established a nationally accepted approach to IPC for health care settings, including for the management of resistant organisms. These guidelines will be reviewed at appropriate intervals to identify gaps against the evidence base and any necessary revisions.

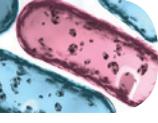
General, overarching IPC standards and guidelines for animals have not been developed in Australia. Specific IPC measures are accounted for through various programmes. An example includes guidelines for veterinary practice environmental cleaning as provided by veterinary surgeon registration boards. Another is Australia's Farm Biosecurity programme.³²

As there is a great diversity of animal care settings where antibiotics are used, identifying IPC gaps for each setting to account for resistance risks will be important into the future for preventing the spread of resistance.

4.2 Review existing accreditation and quality assurance programmes to ensure they appropriately support and encourage compliance with best practice IPC measures

NSQHS Standard 3 provides significant impetus for continued improvement in IPC systems and compliance rates in hospitals, including through auditing and reporting of data. To ensure these efforts are sustained and have maximum impact, hospital IPC programmes will continue to be refined as further experience of effective strategies is gained and shared. A formal review of the NSQHS Standards has commenced, involving broad stakeholder consultation, to identify any gaps and areas for improvement to better support the implementation of good IPC practices.

The RACGP *Standards for General Practice* and the accreditation standards for residential aged care facilities support the implementation of IPC measures in general practice and aged care facilities. However they are not as prescriptive as those for hospitals and do not specifically refer to the management of resistant infections. A recent study has raised concerns about the emergence of resistant organisms in aged care facilities and there is evidence that the prevalence of community acquired resistant bacteria is increasing.³³ A review of aged care and general practice accreditation standards will identify opportunities to further raise awareness of antimicrobial resistance and better support the implementation of, and compliance with best practice IPC measures in these settings. Not all general practices are accredited, so other mechanisms for supporting and monitoring compliance will need to be considered.



The Australian Veterinary Association small animal hospital accreditation and quality assurance programme supports general IPC measures in this setting. This programme is voluntary and most practices in Australia are not accredited. Animal industry accreditation and quality assurance programmes generally support food animal product integrity and food safety. The capabilities for these programmes to better support the implementation of IPC measures in the context of antimicrobial resistance needs to be considered.

4.3 Develop additional initiatives and resources to strengthen IPC in all human health care settings

Infection prevention and control initiatives have largely focused on hospital settings, as health care associated infections are the most common complication affecting patients in hospital.³⁴ However, there is increasing concern about community-acquired infections. Support is needed for all settings to ensure good IPC practices are in place. A critical component of the future research agenda will be to assess hospital based IPC programmes to determine where they may be adapted appropriately for community settings.

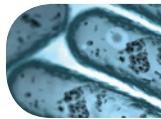
Resources that provide practical guidance to facilities on the design and implementation of an effective IPC programme are a priority, building on the suite of existing resources and targeting those settings most in need of this guidance. It will be important to evaluate new initiatives and resources to assess their effectiveness.

4.4 Further develop initiatives and resources to strengthen IPC in the livestock industry

Australia's quarantine and biosecurity laws underpin the Australian agricultural sector and protect animals from a variety of exotic pests and diseases. The introduction of food safety requirements throughout the supply chain over recent years, together with industry-led national quality assurance programmes for producers, ensure that meat from farms has been produced safely. Further species-specific supports are required to assist farmers, aquaculture producers and livestock workers to implement effective IPC measures, minimise disease introduction and spread and reduce the need for antibiotic treatments.

4.5 Further develop resources to strengthen IPC in veterinary practice

The Australian Veterinary Association produces guidelines for veterinary personnel that set a minimum standard for infection control in animal hospitals and in the field. Resources to further support IPC in veterinary practices, as well as in catteries and kennels will be reviewed and developed as required.



4.6 Encourage continued increases in vaccination rates to prevent infections

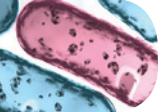
Vaccines offer potential to reduce antimicrobial resistance in humans and animals by preventing infection, assisting in the eradication of some diseases and eliminating the need for some antibiotics. In human health, seasonal influenza has been shown to be a significant driver of inappropriate antibiotic prescribing.³⁵ Efforts to improve immunisation coverage and, in particular, increase the uptake of the seasonal influenza vaccine among priority populations can help to reduce antibiotic usage.

Vaccines are an important part of IPC practices in all livestock production health programmes as well as in companion animal practice. There are currently more than 200 vaccines registered for use in Australia, providing protection against 86 diseases in animals. There is scope to improve the breadth of protection of many existing vaccines as well as develop vaccines against new and emerging diseases.

Vaccination for animal health

A new vaccine on the Australian market is used to treat a common cattle disease, infectious bovine kerato-conjunctivitis, primarily caused by the bacterium Moraxella bovis. This has reduced the need for tetracyclines and other antibiotics in its treatment. Vaccines have been and continue to be a highly important part of infection control practices in all livestock production health programmes as well as in companion animal practice.

Successes have also been reported in aquaculture. The Tasmanian aquaculture industry has achieved a major reduction in antibiotic use, particularly in the use of oxytetracycline, due to the availability of new vaccines for vibriosis and yersiniosis.



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 antimicrobial resistance

Limited systematic coordination of research effort has contributed to gaps in our understanding of how antimicrobial resistance develops and spreads and how best to prevent and contain it. A strong research and development agenda is needed to advance the discovery of new therapies and diagnostic technologies to better prevent infectious disease, treat resistant infections and support the development, refinement and implementation of evidence-based practices to limit the emergence and spread of antimicrobial resistance.

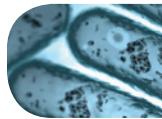
There is also a need to prioritise research and research translation activities to help ensure gaps in the evidence base are addressed and new evidence is rapidly adopted; and to encourage collaboration and information sharing, both nationally and internationally, to ensure the most efficient use of research and development resources.

Some critical gaps in our understanding of antimicrobial resistance are being examined through national research projects. The National Health and Medical Research Council (NHMRC) has provided over \$63 million in funding for research relating to antimicrobial resistance over the last 10 years. The NHMRC currently funds three Centres of Research Excellence (CREs) examining various aspects of antimicrobial resistance. CREs focus on accelerating knowledge translation into changes in practice and policy and it is anticipated that these centres will make significant contributions to future

research and research translation activities in Australia.

However, further research and development needs remain, for example:

- basic and molecular microbiological research is needed to advance the development of novel therapeutics, including antimicrobials, adjunct treatments, combination therapies and vaccines and support the redevelopment of existing antimicrobials;
- rapid and point-of-care diagnostic technologies are needed to reduce inappropriate and unnecessary antibiotic use. Existing systems are not in widespread use and there is a need to identify and minimise the barriers to their uptake;
- a better understanding of how resistance develops and can transfer between species and settings, including across different health care settings, between animals and their carers, in food processing and the environment is needed in order to better target intervention strategies;
- health services research is needed to identify and refine best-practice AMS and IPC approaches; and
- social research into key messaging to promote behaviour change is needed to support improved prescribing practice and the use of antimicrobials.



Priority Areas for Action

5.1 Identify current gaps and agree national research and development priorities

An agreed national list of research and development priorities could help guide the allocation of resources and focus attention on those areas where new discoveries, technological innovation and evidence of best practice are most needed. The first step in this process will be to map research and development needs against current research efforts to determine any gaps in the evidence base that are not currently being investigated and identify where the greatest impacts may be achieved. The process will take into account international, as well as national research agendas.

5.2 Coordinate national research activities and the sharing of information

Enhanced collaboration and information sharing between researchers, both across fields, for example, medical and public health research; and across sectors, for example, human and animal health, agriculture and food, will ensure an efficient use of resources and minimise duplication of effort.

5.3 Explore opportunities to increase support for research and development, including incentives for greater private sector investment

There is a need to look at how antimicrobial resistance-related research and development is funded, including how private investors and the pharmaceutical industry could be attracted back to the field. The discovery and development of new antimicrobials takes many years and their relatively low commercial return compared with other therapeutic drugs is a significant barrier to investment.

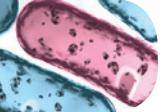
The discovery of new classes of antibiotics will not in itself provide a solution to emerging bacterial resistance. Research into other responses, including vaccines, therapeutic alternatives to antibiotics, better diagnostic technologies, improved IPC and AMS, and food production and animal welfare strategies is required. Opportunities to increase funding support for all national antimicrobial resistance research and development priorities will need to be explored.

For agriculture, industry specific research and development corporations (RDCs) exist to fund projects that provide industry with the innovation and productivity tools to compete

National Centre for Antimicrobial Stewardship (NCAS)

The NCAS is a new NHMRC-funded Centre of Research Excellence that will investigate the evidence gaps in what is known about the relationships between antibiotic use in humans and animals and antibiotic resistance.

The NCAS represents the first One Health collaboration where researchers, scientists and clinicians working on antimicrobial resistance within the human world and the animal world have formally come together to investigate the same key research questions as they apply to livestock, veterinary care, community settings and hospitals, general practice and aged care.



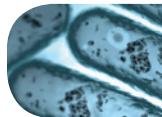
in global markets. These bodies are funded jointly between industry and government. Opportunities for cross-sectoral collaboration on antimicrobial resistance research, through the Council of Rural RDCs, and with human research and development bodies, needs to be explored to ensure a more strategic and efficient approach to research and development and the translation of findings into applications.

For companion animals, research and development is not provided for under government–industry arrangements as exist for agriculture. Noting their importance, there is a need to consider opportunities for this sector to ensure they are included in the broader research agenda and that they can benefit from new products and approaches to prevent, detect and contain antimicrobial resistance in this context.

5.4 Explore opportunities to support the translation of promising research findings into new products, policies and approaches

To benefit from research investment, research findings need to be applied to generate new products and approaches to prevent, detect and respond to resistant organisms. While organisations such as the NHMRC have a strong focus on the conversion of human medical research findings there is a need to ensure a broader One Health approach. Promising discoveries that have application both in and outside of human health settings need support to identify opportunities for commercial production.

Opportunities for streamlining regulatory requirements, for example fast-tracking new antimicrobials through clinical trials and registration, or simplifying the process for sponsors to add indications to existing antimicrobials to support re-purposing efforts could also be examined.



Objective Six

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

The increasing international movement of people, animals, foods and other products has the potential to facilitate the movement of resistant pathogens across borders faster and further than ever before.³⁶ Growth in medical tourism, involving the travel of people to another country for the purpose of obtaining medical treatment in that country, has accelerated the international spread of health care acquired infections that are frequently resistant to multiple drugs,³⁷ further highlighting the global nature of the problem.

Without international collaboration on antimicrobial resistance the efforts of individual countries will be of limited value. As such, Australia's Strategy will be most effective if it is aligned with international efforts. To support global efforts to reduce the spread of resistant organisms, Australia must continue to actively engage with other countries, particularly in the Asia-Pacific region, and multilateral organisations through strategic policy support, regulatory action and coordinated initiatives.

Regional assistance to combat antimicrobial resistance

Australia is providing funding to the Western Pacific Regional Office of the WHO to support low- and middle-income countries in the region to increase their capacity to combat antimicrobial resistance.

This includes assistance in the development and implementation of multi-sectoral national plans; and technical support to regulatory agencies to increase capacity to monitor the quality of antibiotics and increase enforcement actions to reduce over-the-counter sales of priority antibiotics.

Capacity building tools and training materials will also be developed to guide the establishment of antimicrobial stewardship programmes in hospital settings.

Priority Areas for Action

6.1 Active engagement with multilateral organisations and relevant forums to contribute to regional and global action on antimicrobial resistance

Australia strongly supports the WHO's leadership role in addressing the global human health impacts of antimicrobial resistance. The WHO is developing a *Global Action Plan on Antimicrobial Resistance* in consultation with the OIE, FAO and other relevant stakeholders. Australia will continue to actively participate in the development and implementation of the Global Action Plan.

6.2 Lead regional initiatives to increase capacity to respond to antimicrobial resistance

Australia is well placed to lead efforts to control emerging threats of resistance in the Asia-Pacific region.

Australia is supporting the Western Pacific Regional Office of the WHO to improve surveillance capacity in the region, including piloting new systems to monitor and report antimicrobial resistance and usage data in priority countries.

Aligned to Australia's development policy, work through the Australian aid programme on regional health security will also complement the objectives of this Strategy. Australia will support changes to the systems and policies that deliver better health in our region, including helping to improve health systems, supporting large-scale disease prevention and treatment, and supporting regional solutions to trans-boundary disease threats.

While the number of new cases is falling globally, tuberculosis (TB) remains a serious challenge in our region. Of the estimated 9 million people around the world who developed TB in 2013, more than half (56 per cent) were in Asia.³⁸ Australia will continue to support our neighbours to develop and fund flexible, responsive health systems that are better equipped to combat TB. Australia will also fund partnerships that bring new medicines, diagnostic tests and vaccines to market, with a focus on drug-resistant TB.

Partnering with countries in the region to strengthen regulatory capacity for medicines quality and safety is a priority. The quality of medicines is crucial for the treatment of patients and for the prevention and control of antimicrobial resistance.

The use of substandard antimicrobial medicines results in prolonged infections and the emergence of resistant microbes. Ensuring national regulatory systems have the capacity and capability to properly regulate health products, such as medicines, is essential in ensuring access to quality antimicrobial medicines.

Australia is a leader in our region in building regulatory systems capacity and will continue to support work in this area. This includes work to develop the Regional Alliance for National Regulatory Authorities for Vaccines in the Western Pacific Region, which aims to ensure that all vaccines, especially those used in national immunisation programmes, are of assured quality.

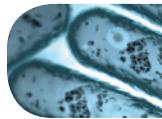
Australia will explore further opportunities to tackle antimicrobial resistance and advance regional health security with neighbouring countries and regional and global partners.

Tackling drug-resistant malaria in the Asia-Pacific

The Prime Ministers of Australia and Viet Nam co-chair the Asia Pacific Leaders' Malaria Alliance (APLMA), which, in November 2014, saw East Asia Summit leaders commit to eliminate malaria from the Asia-Pacific by 2030.

APLMA specifically aims to support efforts to eliminate resistance to the front line malaria drug, artemisinin.

APLMA aims to translate political commitment into action through research policy and programme coordination, regulatory collaboration, finance and governance.



6.3 Learn from international best practice

While Australia has considerable expertise in some areas relating to antimicrobial resistance there is much that can be learnt from international experience. Some countries are advanced in their implementation of specific activities to reduce antimicrobial usage and resistance.

There are opportunities to expand on international partnerships for action on antimicrobial resistance in animals and agriculture. Some countries are leading the way on testing and monitoring for resistance and reducing antibiotic use in animals and agriculture, and there is considerable scope to learn from these systems.

Collaboration with these countries and information sharing across international research networks would be of benefit to Australia and to international partners. Australia will seek to establish strategic partnerships and cooperative arrangements with countries that are achieving successes in reducing resistance and antibiotic usage.

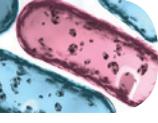
6.4 Participate in international surveillance initiatives

Australia's involvement in global surveillance initiatives will enable comparison with peer-group countries, facilitate greater international collaboration on antimicrobial resistance, support the detection of emerging resistance threats in other countries and inform appropriate responses. Australia will contribute data to inform global antimicrobial resistance surveillance reports developed by the WHO. Australia will also participate in a new OIE global initiative to collect quantitative data on the use of antimicrobial agents in animals to establish a global database.

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

Some countries are adopting a strategic and collaborative approach to investing in antimicrobial resistance-related research. For example, in 2013 the European Union (EU) Joint Programming Initiative on Antimicrobial Resistance, which involves 19 EU member states, developed a European Strategic Research Agenda for antimicrobial resistance; and the EU and United States of America have established a Trans-Atlantic Task Force to improve cooperation on combatting resistance.

The NHMRC liaises with international health research funding agencies, such as the US National Institutes of Health, the UK Medical Research Council and the Canadian Institutes of Health Research to ensure better coordination of international research efforts. These existing relationships may provide a foundation for further future engagement. Partnering with other countries and engaging in similar international collaborations could help inform the management of Australia's national research and development portfolios; inform national, regional and global research and development priorities; and make the most effective use of research resources and funding. Such partnerships can also progress the research and development agenda, from discovery level through to advanced development and manufacturing.



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 antimicrobial resistance

Achievement of the Strategy objectives requires a coordinated effort from a wide range of implementation partners. Stakeholders from across the Australian and state and territory governments, regulators, hospital administrators, standard-setting and accreditation bodies, the pharmaceutical industry, food animal producers and food manufacturers, agriculture, health and veterinary professionals, researchers, educators, professional bodies and consumers all have a role in ensuring actions under the Strategy are effectively implemented. Clear lines of responsibility and accountability at the national, jurisdictional and local levels will be needed to support progress. Furthermore, Australia will 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.

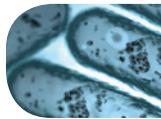
Engagement of the facilities and professional organisations whose staff and members are at the forefront of antibiotic prescribing, dispensing and use, or have responsibility for practices aimed at preventing or managing the conditions under which infections can arise and be transmitted, is crucial. These facilities and organisations are best placed to inform what will work in their sector; how to implement it effectively; how to best engage with members to increase awareness of antimicrobial resistance; and how to create the necessary impetus to drive change.

Priority Areas for Action

7.1 Identify, establish and maintain linkages between implementation partners across all sectors

Recognising the crucial importance of established jurisdictional frameworks, programmes and antimicrobial resistance initiatives through which actions under the Strategy will be implemented, the Australian Government will continue to work closely and collaboratively with state and territory governments to increase understanding and appreciation of the impacts of antimicrobial resistance, and commit to accelerate national and jurisdictional efforts to address this challenge. State and territory health and primary industry departments, medical and veterinary boards and professional colleges and societies are important partners in ensuring the Strategy is implemented effectively.

The Antimicrobial Resistance Prevention and Containment (AMRPC) Steering Group will be responsible for ensuring that clear governance and accountability arrangements are in place across all areas where new actions are being implemented and existing arrangements are continuing.



The Steering Group will monitor the implementation of actions under the Strategy, commencing with the development of a detailed Implementation Plan, and will report publicly on progress.

The Australian Government is establishing Primary Health Networks (PHNs) to increase the efficiency and effectiveness of medical services for patients, particularly those at risk of poor health outcomes, and improve coordination of care to ensure patients receive the right care in the right place at the right time.

PHNs will have an important role in supporting general practices to achieve the highest standards in safety and quality and improving health outcomes for their communities.

Administrators of public sector facilities will play a critical role in ensuring the governance and support structures necessary to implement actions in their facilities are available.

It will be equally crucial that non-government stakeholders and representative organisations best placed to implement specific actions provide the necessary leadership and commitment. The implementation of many actions will need to be supported by resources, awareness raising, education, and where necessary, behaviour change strategies. In particular, new areas of activity will need to be implemented and integrated with existing programmes such that the full suite of actions designed to minimise the development and spread of antimicrobial resistance and support the continued availability of effective antimicrobials become standard practice.

Relevant professional societies, industry associations and accreditation bodies will be called upon to ensure their members are encouraged and supported to maintain effective practices, or where necessary, change practices in support of the objectives of the Strategy. Similarly, managers of facilities that use or otherwise deal with antimicrobials will be asked to support the uptake of measures that lead to a reduction in antibiotic use and the incidence of infection.

National Governance Arrangements

The AMRPC Steering Group brings together the Secretaries of the Departments of Health and Agriculture and the Australian Government Chief Medical Officer and Chief Veterinary Officer to provide leadership on antimicrobial resistance and oversee the development and implementation of the national Strategy.

The Australian Strategic and Technical Advisory Group (ASTAG) on antimicrobial resistance provides expert advice to the Steering Group on current and emerging issues, research priorities and implementation approaches to support the Strategy.

Through its membership, ASTAG will help strengthen linkages between governments, industry, professional bodies and other key stakeholders to support a comprehensive and sustainable One Health response to antimicrobial resistance.

7.2 Work with stakeholders to develop an Implementation Plan for the Strategy

The Steering Group will bring together stakeholders from across relevant sectors to jointly develop an Implementation Plan that will detail the roles and responsibilities of implementation partners and timeframes for specific actions under the Strategy. Agreeing implementation roles, responsibilities and timeframes will reduce the risk of duplication of effort and identify and manage any gaps.

7.3 Establish baseline measures to inform monitoring and evaluation of the Strategy

The Implementation Plan will also detail targets and performance indicators for specific actions. A national report on current levels of antimicrobial resistance and usage in human health in Australia will be published in late 2015 to establish a baseline against which key actions under the Strategy can be measured. These baseline measures will also be established with reference to the WHO's Global Action Plan on antimicrobial resistance.

An assessment of the economic impacts of antimicrobial resistance in Australia will be undertaken to inform further policy development work and support the case for financial investment in actions to address antimicrobial resistance.

Effective use of regulatory measures

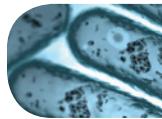
The WHO has identified fluoroquinolones as critically important antibiotics for human health.

Australia is the only country in the world that has regulatory measures in place to exclude the use of fluoroquinolones in food producing animals.

Australia has lower levels of resistance to fluoroquinolones, in contrast to most other countries, including in Europe and North America, where such measures were not taken.

7.4 Review regulation (legislated and other) relevant to antimicrobial resistance and antibiotic usage

Although clearly fundamental to an effective and sustainable Strategy, the effectiveness and appropriateness of regulation relevant to the emergence and response to antimicrobial resistance has not been systematically evaluated to identify areas where further action may be beneficial. Mapping the regulatory framework against the antibiotic supply chain and antimicrobial resistance trends in human and animal health would highlight existing regulations and identify any areas where governments and industry could work together more closely to limit the emergence of resistance.



Glossary

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

A medicine that, on application to living tissue or by systemic administration, will selectively kill or prevent or inhibit growth of susceptible organisms.

Antimicrobial resistance

A property of organisms, including bacteria, viruses, fungi and parasites that confers the capacity to grow or survive in the presence of antimicrobial levels that would normally suppress growth or kill susceptible organisms.

Community acquired infections

Infections acquired in the course of daily life in the community (including in the home and workplace).

'Critical' antibiotics (human use)

'Critical' antibiotics are those used to treat serious or life-threatening infections in humans for which there are very limited or no alternative antibiotics that can be used to treat the infections if antibiotic resistance develops. The antibiotics that are in this critical class change from time to time and are influenced by the availability of newer antibiotics and the resistance rate of bacteria causing serious human infections.

Food-producing animals

Animals reared for the production of meat or other food products (e.g. milk, eggs).

Growth promotion

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.

Health care associated/acquired infections (nosocomial infections)

Infections acquired as a result of medical intervention, e.g. in hospitals or in other clinical settings.

Incidence

The number of new cases of a diagnosis or event that occur over a specified period in a defined population. Incidence is usually expressed as a rate in relation to the population at risk (e.g. 10 new cases of MRSA per 100,000 people per year).

Maximum residue limit (MRL)

An MRL is defined as the maximum concentration of a residue resulting from the officially authorised safe use of an agricultural or veterinary chemical that is recommended to be legally permitted or recognised as acceptable in or on a food, agricultural commodity or animal feed. The concentration is expressed in milligrams per kilogram (mg/kg) of the commodity (or milligrams per litre (mg/L) in the case of a liquid).

Methicillin resistant *Staphylococcus aureus* (MRSA) (also called multiresistant *S. aureus*)

Strains of *Staphylococcus aureus* resistant to methicillin (and other β-lactams) and one or more other antibiotic classes.

Multiple drug resistance

Resistance to two or more antibiotics from different classes.

One Health

Describes a coordinated, collaborative, multidisciplinary and cross-sectoral approach to the development of health strategies 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.

Primary Health Networks (PHNs)

Thirty PHNs will be established from 1 July 2015 to increase the efficiency and effectiveness of medical services for patients, particularly those at risk of poor health outcomes; and improve coordination of care to ensure patients receive the right care in the right place at the right time. PHNs will work directly with general practitioners, other primary health care providers, secondary care providers and hospitals to ensure improved outcomes for patients.

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.

Selection (of resistant bacteria)

The process whereby exposure to an antibiotic kills or inhibits sensitive bacteria, allowing resistant bacteria to increase in number relative to the sensitive bacteria.

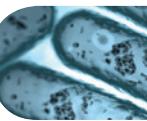
Surveillance

— Targeted

Targeted surveillance involves a prospective study of resistance directed at specific pathogens.

— Passive

Passive surveillance is the collection of routine analytical data from diagnostic laboratories.



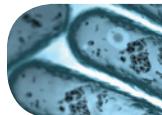
Acronyms and abbreviations

AAW	Antibiotic Awareness Week
AGAR	Australian Group on Antimicrobial Resistance
AMRPC	Antimicrobial Resistance Prevention and Containment Steering Group
AMRSC	Antimicrobial Resistance Standing Committee
AMS	Antimicrobial stewardship
APLMA	Asia Pacific Leaders' Malaria Alliance
ASTAG	Australian Strategic and Technical Advisory Group on antimicrobial resistance
CRE	Centre for research excellence
EEA	European Economic Area
EU	European Union
FAO	Food and Agriculture Organization
GP	General practitioner
IPC	Infection prevention and control
ISO	International Organization for Standardization
MRLs	Maximum residue limits
MRSA	Methicillin-resistant <i>Staphylococcus aureus</i>
NHMRC	National Health and Medical Research Council
NPS MedicineWise	National Prescribing Service MedicineWise
NSQHS Standards	National Safety and Quality Health Service Standards
OECD	Organisation for Economic Cooperation and Development
OIE	World Organisation for Animal Health
PBS	Pharmaceutical Benefits Scheme
PCU	population correction unit
PHN	Primary Health Network
RPBS	Repatriation Pharmaceutical Benefits Scheme
RACGP	Royal Australian College of General Practitioners
RDCs	Research and Development Corporations
SAB	<i>Staphylococcus aureus</i> bacteraemia
TB	Tuberculosis
UK	United Kingdom
USA	United States of America
WHO	World Health Organization

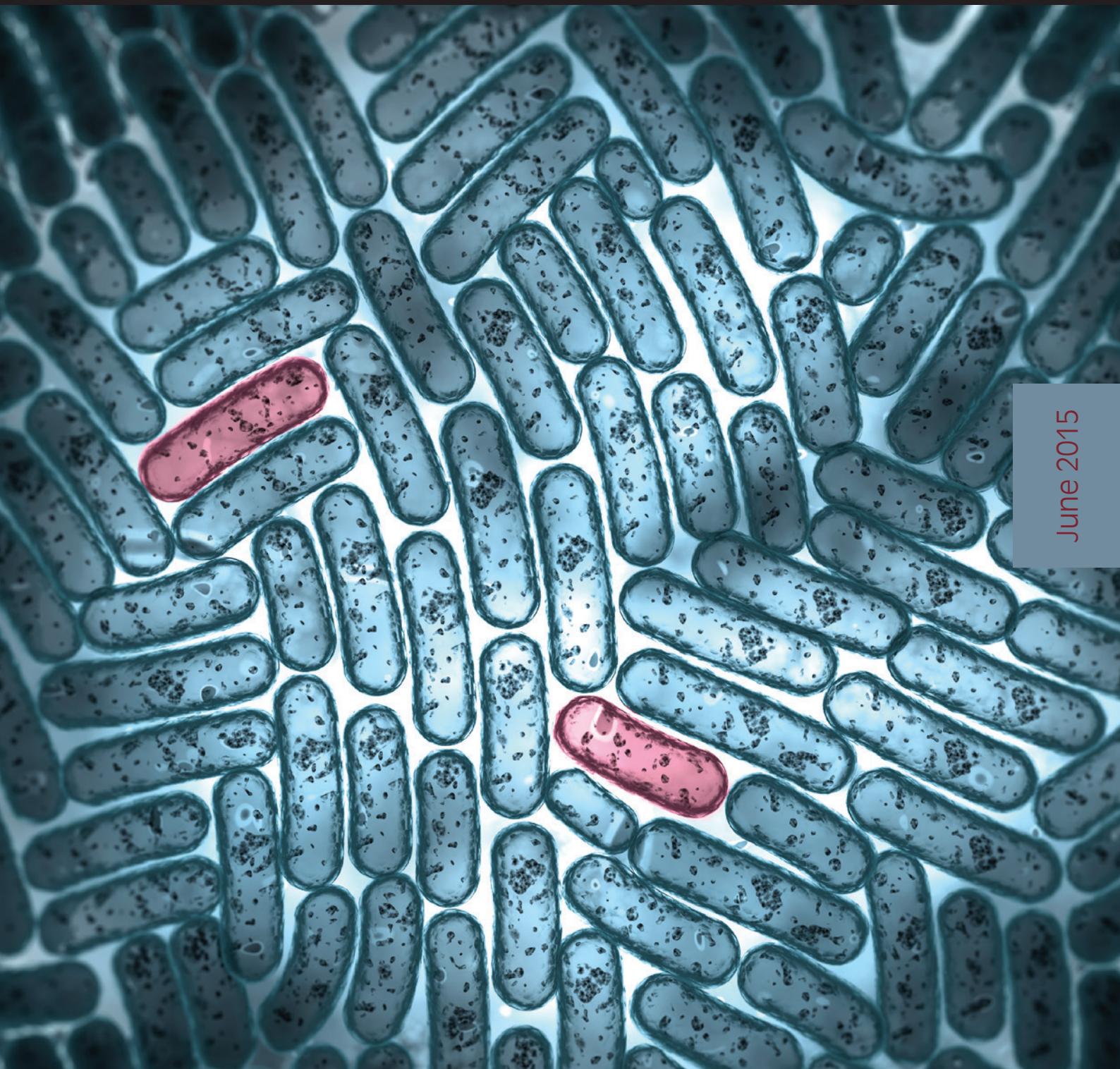


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