



Australian Government
Department of Health



Australian Government
**Department of Agriculture
and Water Resources**

Australia's First National Antimicrobial Resistance Strategy 2015-2019

Progress Report

November 2017

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Foreword

Over the past several decades, people have survived injuries, operations, diseases and child birth, thanks to antimicrobial drugs. Now these tried and true drugs are failing us. Antimicrobial resistance (AMR) has the potential to not only impact our health, but to derail our social and economic development by placing a greater burden on patients, health care providers and the health system.

The past few years have seen a significant increase in the profile of AMR, both here in Australia and internationally. Commitments have been made at numerous international fora and across all levels of government to tackle this growing human health concern. It is important that we take advantage of this momentum to continue current activities and garner further action in priority areas.

In June 2015, the Australian Government released its first National AMR Strategy to guide the response to the threat posed by AMR. The Strategy's Implementation Plan, which was released in November 2016, highlighted the significant effort and financial contribution undertaken by a wide range of organisations across sectors to tackle the issue of AMR.

Through the development of the Strategy and the Implementation Plan, the value of information sharing and collaboration has become abundantly clear. To facilitate this, we are developing a One Health AMR website, which will act as a central repository for information and resources for professionals and consumers. The website will include an activity and research directory, which will enable more timely collaboration between stakeholders on, and tracking of, projects. This will ensure that we keep sight of the breadth of AMR-related activities being undertaken in Australia and where further efforts need to be focussed.

Significant progress has been made over the last few years. However, there is still a long way to go. We must continue to identify and fill gaps, test and refine existing systems, and frequently review what works to ensure that optimal arrangements are in place to ensure antimicrobials are preserved for future treatments. This Progress Report not only highlights the progress that has been made in Australia in the past two years, but also recognises challenges and gaps that need to be addressed.

We would like to thank all stakeholders for their continued engagement and support in implementing activities under the National AMR Strategy and for their ongoing contribution in limiting and containing the spread of AMR.



Professor Brendan Murphy
Australian Government Chief Medical Officer



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Introduction

Antimicrobial resistance is a global health priority and a One Health issue requiring coordinated action in all sectors where antimicrobials are used, including human and animal health, agriculture and food production.

In June 2015, the Australian Government released its first *National Antimicrobial Resistance Strategy 2015–2019* (the Strategy) with the goal of minimising the development and spread of AMR and ensuring the continued availability of effective antimicrobials. The Strategy aligns with the World Health Organization’s Global Action Plan on AMR and provides the framework for Australia’s national response.

The Strategy supports a One Health approach with seven common objectives across the human and animal health, agriculture, and food sectors:

1. increase awareness and understanding of AMR
2. implement effective antimicrobial stewardship
3. develop integrated national surveillance
4. improve infection prevention and control practices
5. develop a national AMR research agenda
6. strengthen international partnerships
7. establish clear governance arrangements

The Implementation Plan (the Plan) to support the Strategy was released in November 2016. The Plan outlines specific focus areas for action, and includes a stocktake of activities being undertaken by stakeholders that contribute to the achievement of the objectives. All activities contained within the Plan will have the opportunity to be published on the newly developed national One Health AMR website, which will provide a platform for collaboration and information sharing.

This first Progress Report highlights some of the activities undertaken in Australia in the first two years of the Strategy (2015-2017), as well as challenges and areas for continued or future action. This report does not attempt to capture the full range of AMR-related initiatives and activities currently underway in Australia. Australia’s new One Health AMR website houses a ‘research and activities directory’ which provides a mechanism for sharing information and improving collaboration on AMR-related initiatives. Through the website, organisations can provide status updates on current projects, and information on new projects as they commence.

More information about the research and activities directory (including how to upload your activity/research) can be found on the [Australian Government's AMR website](#).

Current Trends

Antibiotic resistance

Antimicrobial resistance continues to be a significant issue for health care in Australia and globally. In order to understand the impact of activities under the National AMR Strategy data on AMR and antibiotic usage needs to be reviewed on a regular basis.

The second *Australian report on antimicrobial use and resistance in human health* (AURA 2017) provides data and analysis from the Antimicrobial Use and Resistance in Australia (AURA) surveillance system, primarily from 2015.

Key issues from AURA 2017 include:

- vancomycin-resistant enterococci (VRE) have emerged as a major healthcare problem in Australia;
- the proportion of vancomycin-resistant *Enterococcus faecium* isolates in Australia has increased rapidly from 2005 and is now higher than that of any European country;
- community-acquired methicillin-resistant *Staphylococcus aureus* (CA-MRSA) is now a more common cause of bloodstream infection than healthcare-associated MRSA, with the latter on the decline;
- infections caused by strains of MRSA that start in the community are likely to fail treatment with the usual antibiotics used by community practitioners, resulting in hospitalisation for treatment with antimicrobials given directly into the blood. The treatment of MRSA with vancomycin and related agents has the potential to increase other multidrug-resistant pathogens such as VRE;
- a challenge for health care is that no country has, so far, found effective interventions to control the spread of CA-MRSA. Effort in this area is a priority;
- *Escherichia coli* resistance to fluoroquinolones is steadily rising, albeit from a low base, and despite restricted access to fluoroquinolones in the community and hospitals;
- resistance to ceftriaxone in *Neisseria gonorrhoeae* (which causes gonorrhoea) is an emerging concern globally. In Australia, failure of ceftriaxone treatment has been seen, but is still relatively uncommon; and
- carbapenemase-producing Enterobacteriaceae were the most frequently recorded (48 %) critical antimicrobial resistance in 2015.

A proof-of-concept model for AMR surveillance in food animals has been developed through an expert task group. This work initially commenced with the pig industry and a second project is progressing with the chicken meat industry.

A workshop to raise awareness of AMR and to determine specifications for a pilot surveillance project in the Tasmanian salmon industry occurred in October 2016. In April 2017, a further project was undertaken to determine AMR surveillance in *Salmonella* isolates taken from Australian chicken eggs. Further discussions with other intensive animal industries to consider and/or undertake surveillance activities are anticipated. Results from these current projects will start to be available in the near future and expand knowledge on baseline data.

Antibiotic use

A high rate of antibiotic use is acknowledged as a key driver of increasing rates of antibiotic resistance. The use of antibiotics can be life-saving, but unnecessary use has side-effects for the individual patient and implications for the community. Minimising inappropriate use supports patient safety and health outcomes, and reduces the emergence of resistance. Examples of inappropriate use include prescribing antibiotics when not indicated (e.g. for a viral infection), prescribing the wrong type of antibiotic, and prescribing for the incorrect duration.

AURA 2017 presented the following key findings relating to antibiotic use and the appropriateness of antibiotic prescribing in human health:

- more than 30 million antimicrobial prescriptions were dispensed through the Pharmaceutical Benefits Scheme (PBS) or Repatriation PBS in 2015. There has been little change in this number since 2008;
- prescribing of antibiotics to treat presumptively viral respiratory tract infections is common – more than 60% of patients with these conditions may be prescribed an antibiotic when antibiotics are usually not recommended for these conditions;
- a survey of aged care homes in 2015 showed that the prevalence of aged care residents with signs and symptoms of infection was 4.5%, while the prevalence of residents prescribed one or more antimicrobials was 11.3%;
- Australia's rate of antibacterial use in hospitals peaked in 2010, and has steadily decreased between 2010 and 2015;
- there has been a reduction in fluoroquinolone usage rates in line with strategies to restrict use in most Australian hospitals;
- in hospitals, 23.3% of antibiotic prescribing did not comply with guidelines. Of surgical prophylaxis prescriptions, 27.4% were continued for longer than 24 hours (less than 5% is considered best practice);
- almost 40% of cefalexin prescriptions in survey hospitals were inappropriate, with most inappropriate use for surgical prophylaxis, urinary tract infections and pneumonia;
- the most common reasons that hospital prescriptions were deemed to be inappropriate were:
 - an antimicrobial was not needed
 - the antimicrobial chosen was incorrect (spectrum too broad)
 - the duration of treatment or the dose was incorrect.

Australia has one of the most conservative approaches to the use of antimicrobials in livestock production in the world. The Australian Pesticides and Veterinary Medicines Authority (APVMA) evaluates and registers antimicrobials for animal use in Australia. The evaluation process involves conducting a risk assessment, including for antibiotic resistance. Nearly all antimicrobials used in animals are Schedule 4 medicines meaning that they are prescription only medicines. Veterinary surgeons boards (established under state/territory legislation) control the practice of veterinary science and the capacity of veterinarians to use, prescribe, and supply antimicrobials.

Australia has been participating in the World Organisation for Animal Health (OIE) data collection on antimicrobial usage in animals since the commencement of this process in 2015.

Australia is currently exploring, in collaboration with key stakeholders, the best approach to improve data collection for international reporting obligations on veterinary antimicrobials and to support antimicrobial usage for animals in Australia.

The Australian Government Department of Agriculture and Water Resources has also funded an antimicrobial stewardship project with Veterinary Schools of Australia and New Zealand to develop an education module for veterinarians in practice to improve stewardship of antimicrobials in this setting. Every veterinary school's curriculum emphasises best prescribing practices in relation to the minimisation of AMR, but this may be 'unlearned' following graduation.

This activity has been complemented by other grassroots antimicrobial stewardship initiatives such as the Intensive Animal Antimicrobial Stewardship working group, which has developed an antimicrobial stewardship framework to use as a basis for antimicrobial stewardship activities in the pig, chicken meat and chicken egg sectors.

Progress against the Objectives of the National AMR Strategy 2015-19

Objective 1: Increase awareness and understanding of AMR, its implications and actions to combat it, through effective communication, education and training.

Introduction

Communicating effectively to raise the awareness and understanding of prescribers, dispensers, and other key professional groups across human health and animal health, farmers and the general public about AMR is an important first step to creating an enabling environment for behaviour change. Effective communication, education and training will improve understanding of the causes and effects of AMR, support more informed clinical decision-making and judicious antibiotic prescribing and use, and assist in influencing behaviours that minimise the spread of resistant organisms.

What have we achieved?

One Health

- The Australian Government, through the departments of Health and Agriculture and Water Resources, has developed a One Health AMR website. The [Australian Government's AMR website](http://www.amr.gov.au) (www.amr.gov.au) contains resources and information about AMR relating to human and animal health, agriculture and the general public. The website includes a feedback/enquiries option where stakeholders can ask questions or provide details of projects or initiatives.
- Continued participation in the annual Antibiotic Awareness Week (AAW) has increased the profile of AMR and the importance of appropriate prescribing and use of antibiotics in human hospitals, veterinary clinics, on-farm, and in the community. AAW is led by the Australian Commission on Safety and Quality in Health Care and is supported by the Australian Government Department of Health, the Department of Agriculture and Water Resources, states and territories, NPS MedicineWise, the Australian Veterinary Association, and other organisations committed to reducing AMR.
- The National Centre for Antimicrobial Stewardship has developed antimicrobial prescribing guidelines for companion animal, bovine and equine veterinary practices, as well as guidelines and educational material for the establishment of antimicrobial stewardship programs at veterinary practices.
- The University of Sydney has conducted an online survey of more than 500 medical practitioners, 400 veterinarians, and 350 dentists around Australia on their knowledge of and perceptions towards antibiotic resistance and the barriers to appropriate prescribing of antibiotics and the achievement of effective management of antibiotic resistance. Insights into effective strategies are offered to increase AMR awareness and improve prescribing practices through a One Health approach.

- The University of Sydney has also completed a project on convening two Citizens' Juries to deliberate on the feasibility and fairness of introducing different mechanisms to change consumer and prescriber behaviour. This paper has been published¹.
- Wildlife Health Australia (WHA) has developed a new fact sheet on AMR and wildlife, which is available on the [WHA website](#).
- Macquarie University received an *Inspiring Australia Citizen Science* grant for 'Scoop a poop: citizen scientists tackle AMR in the wild', which involves partnering with high schools to educate students on issues of AMR. Participants in NSW will collect brushtail possum scats from their backyards using a specially designed kit.

Human Health

- The release of the first and second AURA surveillance reports (2016 and 2017) has raised the profile of AMR through the dissemination of data on AMR and antibiotic use on a recurring basis. [AURA 2017](#) is available through the [Australian Commission on Safety and Quality in Health Care website](#).
- In June 2017, the Australian Government Chief Medical Officer sent letters to general practitioners (GPs) in the top 30% of prescribers, compared to others in their local area, based on the most common antibiotics in general practice. The letter provided comparison with GPs in the same region and sought the GP's assistance in reducing unnecessary antibiotic prescribing.
- The National Centre for Antimicrobial Stewardship conducts AMR education and training activities, including education seminars and workshops for various specialist groups on antimicrobial stewardship strategies; an annual forum during AAW; and disseminates research, clinical perspectives and advice on antimicrobial stewardship strategies.
- Queensland University of Technology undertook an investigation to establish the dominant factors influencing decision-making on antibiotic use from the perspectives of general practitioners, community pharmacists and consumers.
- NPS MedicineWise has been delivering on a five year *Reducing Antibiotic Resistance Program (2012-2017)*. Activities targeted to health care professionals include online education modules, e-audits, feedback to clinicians benchmarking their prescribing against best practice and other prescribers, and provision of 'Antibiotic Resistance Resource' kits. Activities specifically developed for consumers include mass media and social media campaigns, a video competition used in later campaigns, 'Antibiotic Resistance Fighter' packs for community pharmacies and an education kit for schools nationwide. The NPS MedicineWise program is integrated with Antibiotic Awareness Week.

¹ Degeling C, Johnson J, Iredell J, Nguyen KA, Norris JM, Turnidge JD, Dawson A, Carter S, Gilbert GL. (2017) Assessing the public acceptability of proposed policy interventions to reduce the misuse of antibiotics in Australia: A report on two community juries. *Health Expectations* DOI: 10.1111/hex.12589; 30 June 2017.

Animal Health and Agriculture

- In August 2017, the Australian Chief Veterinary Officer wrote to Australian registered veterinarians. The letter provided a reminder of prudent and responsible use of antimicrobials in veterinary practice, to limit and minimise the spread of AMR.
- Primary Industries and Regions South Australia has increased communication of AMR issues to state government staff via conferences and newsletters, and to pig and poultry (chicken meat and eggs) peak bodies.
- The Australian Veterinary Association (AVA) National Conference has featured an opening plenary on AMR by the Australian Chief Veterinary Officer and/or AMR stewardship and surveillance topics in the programme since 2016. The AVA also annually participates in Antibiotic Awareness Week about responsible antibiotic usage.
- The Veterinary Practitioners Board of New South Wales released information about the National AMR Strategy to the profession in their publication 'Boardtalk' in December 2015 and assisted with the dissemination of a survey from the University of Sydney on the attitudes to antibiotic use and resistance in October 2016.
- The Victorian Department of Economic Development, Jobs, Transport and Resources (DEDJTR) prepared and promoted multiple resources on the risks associated with AMR for veterinarians, veterinary staff and students, farmers and other stakeholders at 28 events as of September 2017. Educational resources include new AMR web pages, *Principles of Appropriate Use of Antimicrobials* and *The 5R's and Framework of AMR Stewardship* posters, *Busting myths about AMR* factsheet, and *Key messages on AMR* magnets. These resources can be found on the [Victorian DEDJTR AMR website](#).
- The University of Melbourne Veterinary School will disseminate educational materials on AMR to second-, third- and fourth-year veterinary students in 2017.
- Western Australia's [Department of Primary Industries and Regional Development](#) has completed an AMR webpage with information for veterinarians and livestock owners, and disseminated AMR information through electronic newsletters and communication with producers during field days.

What are our challenges?

- Australian prescribing rates in human health remain high by international standards, some of which is probably driven by patient expectations. Our challenge is to maintain the momentum in raising awareness of AMR among consumers and health professionals and translate it into concrete actions which will help to reduce prescribing rates.
- Ensuring that communication initiatives are informed by the factors that influence the way a consumer uses a medicine is challenging. These include social and cultural conventions, health beliefs, previous experiences, financial considerations and psychological aspects.
- Educating prescribers while they are students and after graduation is important to reinforce important messages. This can be challenging in often crowded curricula.

- Greater collaboration across professional colleges and peak groups would assist in promoting the key AMR messages, both to professionals and consumers, and support increased uptake of AMR-related training, tools and other initiatives.

Where to next?

- Capitalise on the opportunities presented by the establishment of the One Health AMR website to better reach target audiences. Explore further channels and links for communicating key AMR messages to support regular, consistent and effective information flows.
- Improve engagement with the nursing profession and explore the need for tailored resources and tools that might better support their role in areas such as antimicrobial stewardship, infection prevention and control, and patient education.
- Consider options for improving the education of human and animal health professionals during their career on antimicrobial resistance. For example, analysis of course content offered by universities, colleges and professional bodies to identify gaps and the need for new and/or revised content on AMR.
- Identify further opportunities to improve the education and training provided to prescribers in relation to appropriate antibiotic prescribing, such as the delivery of Continuing Professional Development programmes.
- Consider options for a national AMR education and awareness campaign to increase awareness of AMR and the importance of appropriate antibiotic use.

Objective 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.

Introduction

Antimicrobial stewardship (AMS) refers to coordinated actions designed to promote and increase the appropriate use of antimicrobials. Optimal AMS programs are supported by guidelines, protocols and regulatory frameworks that cover antimicrobial prescription, supply and use, and incorporate monitoring to measure effectiveness and guide improvements.

What have we achieved?

Human Health

- There are a range of activities in place to support improved use of antimicrobials in hospitals, including:
 - mandatory compliance with National Safety and Quality Health Service Standards (NSQHS) *Standard 3: Preventing and Controlling Healthcare Associated Infections*, which includes developing, implementing and regularly reviewing the effectiveness of the AMS system. This has contributed to an increased focus on the implementation of local, state and territory and national AMS programs as well as infection prevention and control practice in hospitals;
 - a suite of tailored resources developed by the Australian Commission on Safety and Quality in Health Care (the Commission) assist with the implementation of Standard 3. This includes the *Antimicrobial Stewardship in Australian Hospitals (2011)* handbook, a new edition of which is due for release in the first half 2018; and
 - participation by hospitals in the National Antimicrobial Prescribing Survey (NAPS) and the National Antimicrobial Use Surveillance Program (NAUSP), which are activities that demonstrate compliance with NSQHS Standard 3. The number of hospitals that contribute to NAUSP is increasing, and around one third of eligible public hospitals now participate in NAPS.
- There are a range of activities in place to support improved use of antimicrobials in community settings, including:
 - the development of a range of patient decision aids, available on the Commission's [website](#), to support GPs to engage in shared decision making with patients on treatment options for sore throat, middle ear complaints and acute bronchitis.
 - the NPS MedicineWise MedicineInsight program, which provides information on patterns of systemic antimicrobial use and the appropriateness of prescribing for specific conditions among primary care providers. The MedicineInsight program currently has over 600 participating general practices;

- NPS MedicineWise e-audits of general practice prescribing, which assist GPs to review their current prescribing practices and compare them to therapeutic guidelines. NPS MedicineWise provides continuing professional development for GPs, pharmacists and nurses on aspects of antimicrobial use; and
- following a successful pilot in 2015, the Aged Care National Antimicrobial Prescribing Survey (acNAPS), which is a survey of aged care home prescribing, was undertaken in 2016, with 251 aged care homes participating. There will also be a pilot general practice survey (gpNAPS) in 2017.

Animal Health and Agriculture

- The Australian Veterinary Association (AVA) and Animal Medicines Australia are jointly funding the development of best practice antibiotic prescribing guidelines for production animals (beef cattle, feedlot cattle, dairy cattle, sheep and poultry) and horses.
- The AVA is coordinating a trial of an AMS program with companion animal practices in Canberra. The project looks at prescribing activity over a 12 month period, comparing prescribing behaviour before and after the participants receive training in AMS. The results should be ready for collation and publication in late 2017 or early 2018.
- The Australian Chicken Meat Federation and Rural Industries Research and Development Corporation are collaborating on a range of initiatives, including an AMS framework, a review of AMS implementation and external verification of programs within each of the major chicken meat companies, and development of evidence-based resources to support the implementation of a chicken meat stewardship framework that can be easily tailored for other poultry meat industries e.g. turkey.
- The Australian Chicken Meat Federation, Meat & Livestock Australia, Australian Pork Limited, and Australian Eggs Limited have formed the Intensive Animal Antimicrobial Stewardship working group, which is actively discussing AMS efforts in each industry. An agreed stewardship framework has been developed for all parties to use as a basis for AMS activities. Each member of the working group is producing a report on AMS activities (past, present and future) for their industry that will contribute to a compendium on AMS in Australian intensive livestock industries. The report is due at the end of 2017.
- Meat & Livestock Australia are developing an AMS program that documents arrangements on feedlots to reduce antibiotic usage and ensure antibiotics are judiciously managed to minimise the risk of AMR. A technical manual is being prepared. It is expected that communication and extension activities will commence during 2018.

- The University of Sydney is researching the relationships between the use of diagnostic microbiology and antimicrobial prescribing/use in veterinary practices as part of a survey on stakeholder perspectives about AMR. The survey has determined attitudes to antimicrobial prescribing by veterinarians to companion and production animals. The University is also surveying how dairy farmers make decisions about using antibiotics when treating commonly occurring bacterial diseases in cattle on their farm.
- Australian Eggs Limited are developing and promoting an antimicrobial stewardship framework. Stakeholder consultation started at the end of December 2016 and is due to be completed in December 2018.
- Australian Eggs Limited has updated the egg industry's quality assurance program, *Egg Standards of Australia* supporting compliance with best practice antimicrobial stewardship approaches.
- Veterinary Schools of Australia and New Zealand commenced a project funded by the Australian Government Department of Agriculture and Water Resources on 'Antimicrobial stewardship in veterinary practice – development of training package and delivery strategy'. The outcome will be an online training package in AMS targeted at recent (2-3 year) veterinary graduates, as well as a delivery plan that identifies ways to maximise course uptake. The project is due for completion in June 2018.

What are our challenges?

- In community healthcare settings the rates of antibiotic use have not shown improvement. Australia's antimicrobial prescribing rate in community health care is the eighth highest among member countries of the Organisation for Economic Co-operation and Development, and is more than double that of countries that prescribe the lowest rates of antimicrobials. Effective and sustainable approaches to improve prescribing in this setting are needed.
- In hospitals there are areas of antibiotic use that need further attention, for example improving the appropriateness of antibiotic prescribing in surgical prophylaxis.
- Aged care homes have been found to have high rates of inappropriate use of antibiotics. Innovative approaches to address the barriers to best practice prescribing in this setting are needed.
- Increasing the availability of evidence-based and best practice prescribing guidelines for the use of antibiotics in animal health in Australia is important to complement other AMS initiatives.

Where to next?

- Continued investigation to identify how to best support the implementation of AMS programs and best-practice antibiotic usage policies via accreditation arrangements and practice standards for general practices, aged care homes, veterinarians and pharmacists.

- Continued effort to increase access to programs that provide prescribers and facilities with analysis of antibiotic prescribing data. These programs assist in identification of variation from recommended guidelines, and inform areas for quality improvement.
- Review of the supply of antibiotics through the Pharmaceutical Benefits Scheme, particularly for those commonly prescribed in the community, to assist in identifying opportunities to better support appropriate prescribing and dispensing.
- Update the *Importance Ratings and Summary of Antibacterial Uses in Humans in Australia* (2015) (the Importance Ratings), which provide information, particularly to regulators and prescribers, on the importance of antibacterial agents in the treatment of particular infections and the seriousness of the consequences should resistance emerge or be amplified.
- Applying data from research relating to antimicrobial consumption, inappropriate use, and interventions to change prescribing behaviour to inform the development and implementation of AMS initiatives. There are a number of groups making headway in this area. Two such groups are:
 - the Centre for Research Excellence in Minimising Antibiotic Resistance for Acute Respiratory Infections (CREMARA), which investigates the effect of strategies such as shared decision making and delayed prescribing on improving antibiotic prescribing for acute respiratory infections in primary care; and
 - the National Centre for Antimicrobial Stewardship, which will contribute to the development of stewardship interventions across sectors, including: general practice; regional and remote hospital settings; nursing; surgery in tertiary hospitals; aged-care settings; veterinary settings for companion animals and livestock.
- The AMR Targeted Call for Research under the Medical Research Future Fund is aimed at stimulating research on novel and innovative methodologies, such as genomics, to determine AMR profiles and transmission within and to/from aged care homes. Data arising from this research will be used to inform the development, implementation and enhancement of AMS initiatives in this setting.

Objective 3: Develop nationally coordinated One Health surveillance of AMR and antimicrobial usage.

Introduction

Nationally harmonised and coordinated surveillance of AMR and antimicrobial usage 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 data provide evidence to evaluate policies, set priorities and identify where immediate action is required and where resources need to be targeted. The long term goal is to establish an integrated One Health surveillance system.

What have we achieved?

One Health

- The Australian Government Department of Health is funding a literature review to determine the extent to which AMR is present in food, the extent to which food is a route of transmission of AMR, and to identify gaps to inform decision making about the extent of surveillance required and future work.
- Food Standards Australia New Zealand (FSANZ) has recently initiated a project on AMR in the food supply chain, which aims to clarify the role of FSANZ in assessing AMR in a multiagency One Health regulatory environment, and establish a framework to assess the risks of AMR in the food supply for Australian consumers.
- Macquarie University is investigating the ecology of drug resistant pathogenic *E. coli*, *Salmonella* and carbapenem-resistant Enterobacteriaceae isolated from flying foxes and possums undergoing care and rehabilitation, and will determine the significance of reverse zoonoses to AMR ecology (AMR gene carriage and antimicrobial susceptibility patterns). The research is due for completion in 2020.
- The University of Queensland has completed projects on investigating AMR in *E. coli*, *Salmonella* and *Campylobacter* in backyard chickens and the health risk posed to humans.
- The University of Sydney has undertaken a research project into multi-drug resistant pathogenic *E. coli* and methicillin resistant *Staphylococcus* species isolated from animal infections to determine their significance to animal and public health. The surveillance component has been completed.

Human Health

- The Australian Commission on Safety and Quality in Health Care (the Commission) has established a national system for AMR and antimicrobial usage surveillance in human health (the 'AURA' surveillance system), which collects and reports data from partner programs across acute and community healthcare settings, and provides integrated reporting on priority organisms and antimicrobial use at a national level. Priority organisms are those considered to have the greatest potential for harm, are of high public health importance, or are common pathogens where the impact of resistance is substantial in hospital and community settings.

- To date, two AURA surveillance reports have been released, titled *AURA 2016* and *AURA 2017*, as well as more detailed reports for component programs, such as the National Antimicrobial Usage Surveillance Program (NAUSP), the National Antimicrobial Prescribing Survey (NAPS), the Australian Group on Antimicrobial Resistance (AGAR) and the National Alert System for Critical Antimicrobial Resistances (CARAlert).

Four core surveillance programs provide the foundations of AURA: AGAR; NAUSP; NAPS; and the Australian Passive AMR Surveillance system (using the OrgTrx IT platform). Funding provided through AURA has contributed to the enhancement and/or expansion of these programs. The Commission has also established CARAlert, which collects data on nationally agreed priority organisms that are resistant to last-line antimicrobial agents, known as critical antimicrobial resistances (CARs). The system aims to provide more timely advice to state and territory health authorities on the occurrence of CARs in their hospitals and communities, to provide a national picture of these CARs and to complement existing processes for confirming and acting on CARs.

- The National Centre for Antimicrobial Stewardship coordinates the hospital NAPS, aged care NAPS, and surgical NAPS surveys. These surveys enable facilities to audit local antibiotic prescribing patterns to identify inappropriate prescribing (e.g. spectrum too broad, incorrect duration, non-compliant with prescribing guidelines) and identify where improvements can be made. A pilot is also underway for implementing NAPS in general practice (gpNAPS).
- To guide the development of the surveillance system, several key projects have been completed over the last two years, including the development of a surveillance plan for human health in 2015; the establishment of a Communicable Diseases Network Australia (CDNA) working group in 2016 to make recommendation on the public health response to multi-drug resistant organisms; and an independent review of the human health surveillance system in 2017.

Animal Health and Agriculture

- The Australian Government Department of Agriculture and Water Resources has completed a review of the [antimicrobial screen applied to imported finfish](#). The screen will now include two quinolones in addition to the current screen for malachite green and fluoroquinolones. This will take effect during August 2017.
- Meat & Livestock Australia is measuring and assessing antibiotic use in the meat and livestock industry through on-going monitoring and analysis of antibiotic treatment data from a representative sample of feedlots to improve judicious use. This project will continue until 2020.
- The Australian Pesticides and Veterinary Medicines Authority is working with industry to improve the usage data collection process, such as enhancing the electronic portal for data submission. The data collection for the 2015-16 financial year has been completed.

- The Australian Government Department of Agriculture and Water Resources has funded a number of proof-of-concept AMR surveillance projects in pigs, chicken meat, chicken eggs and salmon industries. These projects are being undertaken in conjunction with Australian Pork Limited, Australian Chicken Meat Federation, The University of Adelaide with Australian Eggs Limited, and the Tasmanian Salmonid Growers Association. Results of these projects will start to be available after late 2017.
- Australian Pork Limited, Rural Industries Research and Development Corporation, Australian Chicken Meat Federation, University of Adelaide, Murdoch University, and NSW Department of Primary Industries will be jointly undertaking a project on high throughput technology for defining AMR status of pork and chicken meat enterprises. The proposed research aims to utilise robotics that work extremely quickly, precisely and cost-effectively, to provide efficient, accurate and cost effective methods to determine bacterial AMR present on farm.
- The Australian Chicken Meat Federation and Rural Industries Research and Development Corporation are surveying current laboratory capacity across the chicken meat industry and developing an agreed methodology for isolation and AMR testing. This is due for completion at the end of 2018.
- Western Australia's Department of Primary Industries and Regional Development have commenced an investigation of AMR in *E. coli* and *Enterococcus* species isolates from Western Australian cattle. The study is expected to be completed by June 2018.
- Meat & Livestock Australia are commencing a survey of AMR of pathogens (*Salmonella*) and commensals (*E. coli*, *Enterococcus* species) in sheep faeces at the time of slaughter. Specimen collection will begin in the second half of 2017 and a report is expected in mid-2019.
- The University of Queensland and the Poultry Cooperative Research Centre are investigating AMR, virulence and the risk associated with avian pathogenic *E. coli* in commercial broiler chickens in Southeast Queensland. The study is due for completion in late 2017.

The University of Queensland is studying prevalence, risk factors and phylogeography of methicillin-resistant *Staphylococcus* species in dogs, cats and horses in the greater Brisbane area. This is due for completion in 2018.

What are our challenges?

- Establishing a national, integrated, funded, sustainable and ongoing One Health surveillance system that also caters for the notification of AMR isolates in companion animals and the environment is a complex undertaking requiring a staged, prioritised approach.
- The current lack of quantitative data on antibiotic usage per animal species and sector.
- Ongoing rather than ad hoc surveillance of AMR and antimicrobial usage in animal health, including companion animals is required. This is essential to establish a One Health surveillance system in the future.

- The current variation in jurisdictional and national datasets within surveillance systems is problematic. To enable data comparison, diagnostic laboratories need to apply uniform antibacterial susceptibility testing methods and reporting standards.
- Fit for purpose IT infrastructure to deliver real-time access to data across all sectors (human health, food and animal health) would enable appropriate interventions and responses.
- Privacy considerations prevent the collection of patient-identifying information, which limits the detail of what can be collected. Some data are potentially relevant to analysis (such as post-codes) and help identify cross-border regional case clusters of resistant organisms.

Where to next?

- The evolution of AMR and antimicrobial usage surveillance will be informed by the recommendations of recent reviews and reports. This includes exploring options to ensure surveillance systems inform action at a local level, and that appropriate response capacity and coordination is in place.
- Progress the establishment of nationally consistent antibacterial susceptibility testing methods and reporting standards. This will involve addressing the barriers for implementing consistent methods and promoting the benefits of a national approach.
- In relation to international surveillance, we need to work to ensure that Australian surveillance systems have capacity to contribute to the global body of surveillance data, via the WHO Global AMR Surveillance System (GLASS) and the World Organisation for Animal Health (OIE) global database on the use of antimicrobial agents in animals (under development).

Objective 4: Improve infection prevention and control measures across human health and animal care settings to help prevent infections and the spread of resistance.

Introduction

Preventing and controlling infection is recognised as an essential part of an effective response to AMR, particularly where there may be limited or no alternative antimicrobial treatments available. Effective infection prevention and control (IPC) measures such as hand hygiene, the use of personal protective equipment, equipment disinfection and environmental cleaning are essential. Improvement and expansion of implemented, evidence-based IPC measures across all sectors should be informed by surveillance data, and be appropriate to the risk of transmission.

What have we achieved?

Human Health

- The national hand hygiene benchmark, under the National Hand Hygiene Initiative, was increased to 75% in 2016, followed by an increase to 80% in 2017. All jurisdictions have shown strong leadership in implementing hospital hand hygiene guidelines, and compliance is consistently improving. In June 2017, based on data collected nationally from a total of 937 organisations from both the public and private sectors, the average compliance rate was 84.3%.
- The *Australian Guidelines for the Prevention and Control of Infection in Healthcare* were developed in 2010 to provide a coordinated approach to the prevention and management of healthcare-associated infections in Australia. The National Health and Medical Research Council, in collaboration with the Australian Commission on Safety and Quality in Health Care (the Commission) are reviewing the Guidelines to ensure it reflects the best available evidence and is current and relevant for the Australian context. The update is expected to be completed in late 2018.
- The second edition of the National Safety and Quality Health Service (NSQHS) Standards, which includes *Standard 3: Preventing and Controlling Healthcare-Associated Infections*, will be released in November 2017, with assessments against the Standards to commence from January 2019. The Commission has released a range of resources to support health service organisations to implement and prepare for assessment against the revised Standards.
- The Commission worked in partnership with the Australasian Society for Infectious Diseases, Australasian College for Infection Prevention and Control, Public Health Laboratory Network and Australian Society of Antimicrobials to develop recommendations for the management and testing of patients with carbapenem-resistant Enterobacteriaceae (CRE). The *Recommendations for the control of carbapenemase-producing Enterobacteriaceae – A guide for acute care health facilities* was released in May 2017.

- The Queensland University of Technology has completed the intervention phase of a randomised controlled trial of a novel cleaning bundle intervention to improve cleaning performance and reduce the risk of infection in Australian hospitals. The analysis of data will occur in late 2017 and will inform hospital cleaning policies.
- The Microbiological Diagnostic Unit Public Health Laboratory at the University of Melbourne has undertaken a number of activities to guide IPC in human health care facilities, including defining prevalence and characteristics of multi-drug resistant organisms and the role of genomics in identifying and preventing transmission, and enhancing capacity for outbreak detection and source tracking.

Animal Health and Agriculture

- The Australian Veterinary Association (AVA) has recently updated the *infection, prevention and control principles and procedures* in the *AVA Guidelines for veterinary personal biosecurity*. This provides the latest information about infection control, how to deal with high risk situations, and is relevant to veterinary practices of all types.
- The Australian Cattle Veterinarians (a special interest group of the AVA) launched *BIOCHECK[®] Biosecurity plan*. This plan ensures that farms consider major biosecurity risks and have appropriate risk management strategies in place to prevent disease.
- Meat & Livestock Australia is involved in a project to research and develop evidence-based IPC measures for adoption into industry standards for managing infectious cattle diseases, including bovine respiratory disease, on feedlots. A technical manual is being prepared and communication and extension activities are expected during 2018.
- Meat & Livestock Australia is involved in a project assessing the efficacy of different vaccination regimens prior to cattle entering the feedlot so that evidence-based practices can be introduced to support the control of bovine respiratory disease. The research will be completed in September 2017 and communication materials developed subsequently.
- The University of Sydney, along with the Centre for Veterinary Education and the Australian and New Zealand College of Veterinary Scientists are developing eLearning resources to support education on infection prevention and control in veterinary practice. They delivered presentations in July 2017 and developed a podcast.
- The University of Sydney is undertaking a study entitled *Unravelling the Secret Lives of Animal Staphylococcal Superbugs: informing infection control in veterinary practice*. This is due for completion in January 2018.
- Australian Eggs Limited and Scolexia are assessing the efficacy of feed additive products (prebiotics, probiotics and organic acids) in the control of Spotty Liver Disease caused by *Campylobacter* species. This project is due for completion in 2018.
- Australian Eggs Limited and Charles Sturt University are investigating the drivers of biosecurity engagement and approaches for improving engagement among egg producers in Australia. This is due for completion in 2019.

What are our challenges?

- Data collected through AURA show that the prevalence of community-acquired resistant bacteria is increasing. However, we have limited understanding how transmission occurs.
- There is limited data available on IPC in community settings (e.g. for general practices and aged care homes) in terms of compliance, and standards are not as prescriptive as those for hospitals and do not specifically refer to the management of resistant organisms.
- Ensuring that surveillance is available, timely and identifies potential outbreaks is a challenge. This is important to trigger the prompt implementation of IPC measures, in addition to standard IPC, appropriate for the increased risk of transmission.
- As the transmission of infection is very common in early childhood education and care settings, it is important to educate staff at these settings on contemporary IPC practices.
- We haven't yet made good progress in applying existing initiatives (such as hand hygiene) used in human healthcare settings to animal healthcare and agriculture, and vice versa, to enhance current IPC approaches.
- Vaccines are key in the prevention of infection. However, for food-producing animals there is a lack of vaccine availability to prevent diseases. Australia's animal population is small and the revenue generated from potential vaccine sales would also be small. This limits access to new vaccines.

Where to next?

- Continue to improve and review surveillance data to enable the implementation of targeted and effective IPC measures, where needed.
- Identify and implement innovative ways to maximise best practice IPC, including through increased research, in primary health care and aged care homes that are appropriate for the level of risk in these settings and consistent with the *Australian Guidelines for the Prevention and Control of Infection in Healthcare*.
- Strengthen coordination and information sharing between the human and animal health sectors in terms of surveillance, prevention and management.
- Keep finding and using measures to prevent infection, including vaccines.

Objective 5: Agree a national research agenda and promote investment in the discovery and development of new products and approaches to prevent, detect and contain AMR.

Introduction

The promotion and prioritisation of investment into research and development, both domestically and internationally, will generate new products and approaches to prevent and respond to AMR. Amongst other things, this includes basic molecular and genetic research leading to new therapeutic agents; rapid and point-of-care diagnostic technologies and vaccines; best-practice antimicrobial stewardship, infection prevention and control approaches; and clinical trials. Research into key messaging and the promotion of behaviour change is also needed to reduce antibiotic over- and mis-use and to ensure existing treatments remain effective for as long as possible.

What have we achieved?

One Health

- Macquarie University and the University of Sydney have undertaken research in marine vertebrates to correlate mobile genetic elements and resistance gene carriage in isolates from humans to those from marine wildlife. The research is expected to be complete by 2020.
- Murdoch University (AMR and Infectious Diseases laboratory) is undertaking a *Cross sectional study on the carriage of critically important antimicrobial resistant E. coli from urban seagull populations in Australia*. This cross-sectional study will specifically detect the carriage of *E. coli* resistance to fluoroquinolones, third-generation cephalosporins and carbapenems. Outcomes of the study are expected to be completed by early 2018.

Human Health

- Investment in AMR research and development in Australia remains strong, with over \$90 million in active National Health and Medical Research Council (NHMRC) grants as at April 2017. Research categories include: the development and biology of AMR (\$28 million across 38 grants); the spread and surveillance of AMR (\$1 million across 3 grants); antimicrobial stewardship (\$13.1 million across 15 grants); health services research (\$31.7 million across 25 grants); the development of rapid and/or point of care diagnostics (\$2.1 million across four grants); and the development of new antimicrobials and/or novel therapies (\$16 million across 20 grants).
- The *Australian Medical Research and Innovation Priorities 2016-2018* identified AMR as a research priority for the Medical Research Future Fund (MRFF) for the years 2016-2017 and 2017-2018. The 2016-2017 MRFF allocation for AMR research was \$5.9 million. An AMR Targeted Call for Research aims to stimulate research on novel and innovative methodologies, such as genomics, to determine AMR profiles and transmission within and to/from aged care homes.

- The NHMRC’s Centres of Research Excellence (CRE) scheme is providing support for teams of researchers to pursue collaborative research and develop capacity in different aspects of the AMR response. Examples include:
 - the Centre of Research Excellence in Reducing Healthcare Associated Infection (RHAi) is focused on generating new knowledge about strategies to reduce healthcare associated infections and providing data on the cost-effectiveness of infection control programs. The RHAi have developed a model to estimate country-level health and economic impacts of five key drug-resistant infections in Australia (Queensland University of Technology);
 - the National Centre for Antimicrobial Stewardship (NCAS) is investigating the evidence gaps in what is known about the relationships between antibiotic use in humans and animals and antibiotic resistance. The NCAS, at the University of Melbourne, has established AMR research collaborations with the University of Queensland, the Queensland University of Technology, Bond University, the Australian Commission on Safety and Quality in Health Care, the Royal Australian College of General Practitioners and the Australian Government Department of Health with the aim of linking content experts with implementation experts;
 - the Centre for REdefining antibiotic use to reDUce ResistanCE and Prolong the Lives of Antibiotics (REDUCE), is focused on research to prolong the clinical utility of antimicrobials and on finding new ways to treat conditions when current antibiotics stop working (University of Queensland);
 - the Centre of Research Excellence in Minimising Antibiotic Resistance for Acute Respiratory Infections (CREMARA) undertakes research into the potentially reversible factors that give rise to antibiotic resistance from antibiotic prescribing for acute respiratory infections (Bond University); and
 - the Centre of Research Excellence in Protecting the Public from Emerging Infectious Diseases (CREID) researches emerging and re-emerging infectious diseases to protect Australia and our region from emerging infectious disease threats.
- The Institute for Molecular Biosciences at the University of Queensland is undertaking research to discover new compounds with antimicrobial properties. Through the Community for Open Antimicrobial Drug Discovery, the Institute is testing over 200,000 compounds, received from over 200 academic groups in 40 countries, for novel antimicrobial properties.
- International research collaboratives and Product Development Partnerships (PDPs) have been established that support global research and development in new antimicrobial treatments and technologies, such as rapid, point-of-care diagnostics. Australia is active in consultations to establish the aims and objectives of these initiatives, and is looking for opportunities to become involved in internationally coordinated research programs.

Australia is investing \$30 million over three years (2015-2017) to support research and development on tuberculosis (TB), including drug-resistant strains, and malaria in our region via three PDPs: Global Alliance for TB Drug Development (TB Alliance); Foundation for Innovative New Diagnostics (FIND); and Medicines for Malaria Venture (MMV).

We remain open to contributing to new research initiatives, such as the UK Government's Global AMR Innovation Fund (GAMRIF), and the Global Antibiotic Research and Development Partnership (GARD-P), which is a joint venture of the WHO and Drugs for Neglected Diseases Initiative, as opportunities arise.

Some of Australia's leading research institutes, including The Institute for Molecular Bioscience at The University of Queensland are actively engaged with these and other research collaboratives, including GARD-P, Pew Trust, Wellcome Trust, the Combating Antibiotic Resistant Bacteria Accelerator (CARB-X), and Medicines for Malaria Venture, to help forge closer links between Australian and international AMR research.

The Microbiological Diagnostic Unit Public Health Laboratory at the Doherty Institute, University of Melbourne, is working to strengthen international genomics based comparisons of AMR bacteria.

Animal Health and Agriculture

- Macquarie University is investigating transmission of mobile genetic elements and resistance gene carriage/construct diversity in urban wildlife. Research is expected to be completed in 2020.
- Murdoch University (AMR and Infectious Diseases laboratory) and New South Wales Department of Primary Industries, using funds from the Australian Government Department of Agriculture and Water Resources, are studying *Risk management of critical antimicrobial resistant bacteria in food producing animals*. A semi-automated enumeration assay is being developed to study standard (e.g. as used in surveillance) and enhanced tests (e.g. selective recovery) for the detection of the occurrence of critically-important AMR bacteria in animal faeces and food products. The project is due for completion in April 2019.
- The University of Sydney is undertaking a study entitled *Phenotypic expression of biocide tolerance in clinical veterinary Staphylococcus isolates: are our disinfectants working?* Funding has been received from the Australian Companion Animal Health Foundation and the study is due for completion in November 2017.

What are our challenges?

- Significant progress has been made in increasing the level of information sharing and collaboration between Australia's research institutes. However, Australia lacks a national AMR research agenda that identifies agreed research and development priorities to which institutes lend their expertise and work collaboratively to fill knowledge gaps.

- Research and development needs mapped against current effort would provide guidance on gaps and where the greatest impacts of new research and development investment could be achieved.
- A national mechanism for improved collaboration and information and data sharing is needed to promote efficient use of resources and minimise duplication of effort within and between all sectors (One Health), including the Australian Government, state and territory governments, non-government organisations, professional bodies and research organisations.

Where to next?

- Australia will continue to encourage research institutes, centres of research excellence and national research funding bodies such as the NHMRC, MRFF and Australian Research Council to work collaboratively to establish agreed national AMR research priorities.
- The One Health AMR website will house a research and activity directory, which will allow stakeholders to submit information about projects or initiatives they are undertaking to support Australia's response to AMR.
- The financial and strategic need for increased international collaboration and coordination of research and development effort has emerged over the past two years with the establishment of global research collaboratives such as the *Global AMR Research and Development Hub*, the *Global Antibiotic Research and Development Partnership*, and the *Global AMR Innovation Fund*. Australia will seek to engage in these initiatives to maximise efficiency and minimise duplication of global AMR research.

Objective 6: Strengthen international partnerships and collaboration on regional and global efforts to respond to AMR.

Introduction

Antimicrobial resistance is a global issue that requires a global response. AMR potentially affects everyone, regardless of where they live, their health or economic circumstances. The increasing international movement of people, animals, food and other products increases the potential for AMR to spread rapidly across the world. Without international collaboration the efforts of individual countries to combat AMR will be of limited value. Australia is aligning its efforts, wherever possible, to provide support to our neighbours, our region and globally.

What have we achieved?

One Health

- Australia is an active participant in the international response to AMR including through the United Nations General Assembly, G20, World Health Organization (WHO), World Organisation for Animal Health (OIE), Food and Agriculture Organization of the United Nations (FAO), Organisation for Economic Co-operation and Development (OECD) and the Global Health Security Agenda (GHSA).
- Australia's National AMR Strategy is closely aligned with the WHO Global Action Plan (GAP) on AMR, which was endorsed as the global framework for tackling AMR by the World Health Assembly in May 2015 and the United Nations General Assembly in September 2016. As such, we are able to effectively contribute to global and regional initiatives consistent with the GAP.
- Australia is involved in the development of the antimicrobial stewardship and development framework, which is a key element of the GAP. This will establish a global framework for stewarding the use of antimicrobials, including the preservation of both older antimicrobials and those developed through new global research and development partnerships, while ensuring appropriate access.
- Australia also contributed to the development of the tripartite (WHO, OIE, FAO) *Monitoring and Evaluation of the Global Action Plan on AMR* through the online consultation process.
- Australia co-chaired the Codex physical working group (PWG) on AMR, which was held from 29 November to 1 December 2016 in London.
 - The PWG developed two project documents for approval of new work by the Codex Alimentarius Commission and the Terms of Reference for scientific advice from the FAO and WHO. The 40th Session of the Codex Alimentarius Commission (July 2017) approved the new work and agreed to establish electronic working groups to start development. Australia will participate in the development of the guidelines through the electronic working groups and will attend the session of the Codex Task Force on AMR, which is scheduled to be held from 27 November to 1 December 2017 in the Republic of Korea.

- The Australian Government Department of Agriculture and Water Resources has completed: two annual OIE antimicrobial usage questionnaires for Australia since 2015; another OIE questionnaire for Australia to support the OIE General Session May 2017 Technical item 1 (Global action to alleviate the threat of AMR: progress and opportunities for future activities under the One health initiative); and, a WHO questionnaire on AMR in Australia.

Human Health

- Australia is working with the WHO Western Pacific Regional Office on regional AMR initiatives, including through information sharing and the provision of expertise and best-practice resources to promote the development and implementation of AMR National Action Plans in countries in our region.
- For example, the National Centre for Antimicrobial Stewardship (NCAS) has been working with the WHO on an antimicrobial stewardship (AMS) training framework for low- and middle-income countries in the Asia-Pacific region. In 2016, NCAS undertook country-specific AMS gap analyses for Laos, Vietnam, Mongolia and the Philippines. NCAS has undertaken AMS educational activities in Vietnam and Malaysia, as well as information exchanges with the WHO Western Pacific Regional Office, focusing on surveillance of antimicrobial use, diagnostics, research in AMS, and AMS implementation.

Animal Health and Agriculture

- The University of Queensland commenced a study identifying current antimicrobial usage and AMR in commensal *E. coli* on integrated chicken-fish farms in Myanmar and development of research capacity in AMR diagnosis at the University of Veterinary Science, Myanmar. The study is due for completion in 2017.
- The University of Queensland is conducting research with the International Livestock Research Institute. This research aims to inform effective antimicrobial stewardship policy and action through an understanding of how antibiotics are used in the livelihood strategies of smallholder farmers and their animal health networks in Vietnam.

What are our challenges?

- Australia has limited resources to directly invest in the development and implementation of AMR National Action Plans in countries in our region. Despite this, our in-kind contributions of best-practice resources and expertise are highly valued. For example, countries in the Western Pacific continue to look to Australia to provide leadership and best-practice approaches to combat AMR.
- There are many international groups showing significant interest in the issue of AMR, and many initiatives progressing in parallel. The challenge is to ensure duplication of effort is minimised and that appropriate links are made to maximise effort. The work of the United Nations Interagency Coordination Group on AMR will be critical to assisting efforts to coordinate the wide range of work being conducted.
- Australian surveillance systems need capacity to contribute to the WHO and OIE global surveillance systems.

- The OIE's request for antimicrobial use data in animals will be ongoing. Australia is refining its processes and creating a better system to meet these international reporting obligations to support global AMR mitigation. A national system in animal health will also be needed to collate and analyse antimicrobial usage and antimicrobial resistance surveillance data.

Where to next?

- Between 24 November and 1 December 2017, Australia will be undertaking a self-assessment and external evaluation of its implementation of the core capacities established under the *International Health Regulations 2005* (IHRs) and the Joint External Evaluation (JEE) process. AMR is one of a suite of 19 capacities being assessed. The external evaluation will allow Australia to identify the most urgent needs within its health security system, including for its AMR response.
- Our participation in the external assessment will also contribute to Australia's international engagement effort: countries both within and outside our region will be encouraged to undertake an external assessment, following Australia's lead, and contribute transparently to the regional and global picture of preparedness to prevent the emergence and spread of AMR.
- Australia is also working towards being able to contribute AMR surveillance and antimicrobial usage monitoring data to regional and global data collections as part of a WHO data collection and reporting initiative that will allow countries to benchmark their surveillance and monitoring data against leading countries.
- A priority area for action under the National AMR Strategy is for Australia to participate in international surveillance activities. We are presently considering the feasibility of contributing AMR surveillance data to the WHO Global AMR Surveillance System (GLASS), and antimicrobial consumption data to the WHO Western Pacific regional data collection.
- More broadly, Australia will continue its active engagement with the tripartite WHO, OIE and FAO, including in the development of a Monitoring and Evaluation Framework for the GAP, as well as other multi-lateral forums convened by the United Nations General Assembly Interagency Coordination Group, the OECD, G20, and others to progress global and regional action.

Objective 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 AMR.

Introduction

Implementation of the Strategy requires a multidisciplinary approach and involves a wide range of partners. It brings together stakeholders from across the Australian and state and territory governments, regulators, standard-setting and accreditation bodies, the pharmaceutical industry, food animal producers, agriculture, health and veterinary professionals, researchers, educators, professional bodies and consumers. Strong leadership and good governance is required to ensure a high level of stakeholder cooperation and coordination, and to facilitate the establishment of the key partnerships necessary to implement the Strategy.

Effective governance involves establishing processes and arrangements for making, communicating and implementing decisions, and outlining the structures that ensure collaboration, accountability, transparency, responsiveness and inclusiveness. Clear lines of responsibility and accountability at the national, jurisdictional and local levels are crucial to support progress.

What have we achieved?

One Health

- In November 2016, the Australian Government released the Implementation Plan to support the Strategy. Extensive consultation was undertaken with Australian Government agencies, state and territory governments, and a wide range of organisations from across the human and animal health, food, agriculture, and research sectors to inform the development of the Implementation Plan. This consultation process included a National AMR Stakeholder Forum held in November 2015. Approximately 170 representatives from across the AMR community attended this Forum.
- The AMR Prevention and Containment (AMRPC) Steering Group, previously headed by the Secretaries of the departments of Health and Agriculture and Water Resources, with the Australian Chief Medical Officer (CMO) and Chief Veterinary Officer (CVO) has convened to provide leadership on AMR and oversee the development and implementation of the Strategy.
- The Australian Strategic and Technical Advisory Group on AMR (ASTAG) has met twice-yearly since its establishment in November 2014 to provide expert advice to the Steering Group on current and emerging issues, research priorities and implementation approaches to support the Strategy. ASTAG working groups have been established to assist in driving key pieces of work under the Strategy.

- An internal review of ASTAG was undertaken in May 2017 to identify any areas where ASTAG involvement could be strengthened or more appropriately focussed to meet future needs, and evaluate ASTAG's membership to ensure that the required expertise was available to effectively support the implementation phase of the Strategy.

What are our challenges?

- Challenges include implementing governance arrangements that are not cumbersome, but harness the breadth and depth of required expertise across sectors, as well as create linkages with key groups and organisations. As priorities change, governance arrangements need revision to ensure effectiveness in driving change and supporting the implementation of priority AMR activities.
- We need to better understand where the current regulatory arrangements might be improved. The effectiveness and appropriateness of regulation relevant to the emergence and response to AMR has not been systematically evaluated. There is a need to map the current regulatory framework against the antibiotic supply chain and AMR trends in human and animal health to identify areas where regulation could be applied or streamlined to support efforts to reduce AMR.

Where to next?

- The AMRPC Steering Group will continue to oversee and drive specific actions under the Strategy, with the highly valued input of ASTAG. From October 2017, the Steering Group will be jointly chaired by the Australian Chief Medical Officer and Chief Veterinary Officer with regular consultation with the Secretaries of Health and Agriculture and Water Resources. This arrangement is designed to support the more intensive nature of the Strategy's implementation phase.
- ASTAG working groups will be established to drive specific action in areas of highest priority, including surveillance and regulation. Ad hoc working groups will also be established to action other specific projects as required.
- A review will be undertaken of the current regulation (legislated and other) in Australia across the human and animal health, agriculture and food sectors, relevant to AMR and the antibiotic supply chain. The aim of the review is to identify gaps, overlaps, inconsistencies, and inefficiencies in the current regulatory arrangements.

Next Steps

As our surveillance systems develop and mature, the data we receive will help better identify areas of concern and where actions need to be focussed, and guide the development of future targets and indicators. Based on surveillance data to date, including AURA 2017, our efforts over the next couple of years will include a strong focus on driving behavioural changes in both health professionals and consumers, and implementing measures to reduce inappropriate prescribing in the community. We also need to continue to build levels of awareness of AMR and the importance of appropriate antibiotic use across groups, including consumers, prescribing professionals, farmers and pet owners.

A prerequisite for the successful implementation of activities, particularly in a federated country, is implementing appropriate governance arrangements to oversee and guide activities, and ensure accountability and progress. Improving and refining AMR governance will be a priority in the short term, including investigating options to better inform and support responses to both human and animal AMR and antibiotic usage surveillance data.

Our intention is to take a One Health approach that, over time, will support the integration of systems, and allow combined reporting of data and more coordinated interventions. Achieving an integrated One Health surveillance system may be progressed through surveillance of similar target organisms of public health importance using standardised laboratory methodology and standardised data systems. Adequate resourcing to establish these systems will be necessary.

The development of the next AMR Strategy will also take place within the next two years. This will provide an opportunity to reflect on what is working well, what changes need to be made and what further action is required. The next Strategy will be informed by key projects including, an economic impact assessment, which will be undertaken to determine the human health and economic burden of AMR in Australia. This will provide further rationale for the benefit and cost-effectiveness of actions to reduce AMR, and, along with the broader evidence base, will assist in ensuring that activities under the next Strategy are informed by the best available knowledge and evidence.

Summary of key achievements

Summary of key achievements against the objectives of the National AMR Strategy 2015-2019
<p><i>Awareness and understanding</i></p> <ul style="list-style-type: none">• Development of a national One Health AMR website will provide a central repository for trusted information on AMR and antimicrobial use targeted at human and animal health professionals, the agriculture sector, animal owners and the general public.• Continued participation in Antibiotic Awareness Week has increased the profile of AMR and the importance of appropriate prescribing and use of antibiotics in hospitals, vet clinics, on-farm and in the community.• The Australian Chief Medical and Veterinary Officers have written to their professional communities about prudent and responsible use of antimicrobials in practice. The overall aim is to limit and minimise the spread of AMR.
<p><i>Antimicrobial Stewardship</i></p> <ul style="list-style-type: none">• Antimicrobial use in Australian hospitals has declined since the peak usage rate in 2010. Rates of inappropriate use have also declined from 2014 to 2015.• Expansion of the National Antimicrobial Utilisation Surveillance Program and the Hospital National Antimicrobial Prescribing Survey (NAPS) has provided opportunities for more hospitals to benchmark their use of antimicrobials and improve the appropriateness of prescribing.• NAPS has provided insights into antimicrobial prescribing practices across a range of settings to inform both local quality improvement (clinician/practice level) and provide evidence for regional/national programs and responses.• Mandatory compliance with National Safety and Quality Health Service Standard 3: <i>Preventing and Controlling Healthcare Associated Infections</i> has increased focus on antimicrobial stewardship and infection prevention and control in hospitals.• The Australian Chicken Meat Federation, Meat & Livestock Australia, Australian Pork Limited, and Australian Eggs Limited have formed an Intensive Animal Antimicrobial Stewardship working group. The working group has developed an antimicrobial stewardship framework that all parties have agreed to use as a basis for stewardship activities.• The Australian Veterinary Association is currently coordinating a pilot trial of an antimicrobial stewardship program with companion animal practices in Canberra. The project looks at prescribing activity over a 12 month period, comparing prescribing behaviour before and after the participants receive training in stewardship.
<p><i>Surveillance</i></p> <ul style="list-style-type: none">• Establishment of the National Antimicrobial Usage and Resistance in Australia surveillance system and expansion of key surveillance programs in human health has improved our understanding of the extent of the problem in Australia and informs prevention and containment strategies.• Establishment of proof-of-concept AMR surveillance projects in key intensive animal industries. The outcomes will help inform approaches with AMR for participating industries and policy makers.

Infection Prevention and Control

- The national hand hygiene benchmark was increased to 80% in 2017 and compliance is consistently improving.
- The *Australian Guidelines for the Prevention and Control of Infection in Healthcare*, which are currently being updated, provide a national, best-practice source of information that can be adapted to specific settings.
- Additional guidance has been developed for controlling the spread of carbapenem-resistant Enterobacteriaceae, an organism of particular concern.
- In 2017, the Australian Veterinary Association (AVA) published updated *AVA Guidelines for veterinary personal biosecurity*.
- The Australian Cattle Veterinarians (special interest group of the AVA) launched the *BIOCHECK® Biosecurity plan*.
- The University of Sydney is undertaking a range of projects related to resistant *Staphylococcus* species in companion animals.

Research

- The *Australian Medical Research and Innovation Priorities 2016-2018* identified AMR as a research priority for the Medical Research Future Fund for 2016-17 to 2017-18. The 2016-2017 allocation for AMR research is \$5.9 million.
- Investment in AMR research and development in Australia remains strong, with over \$90 million in active National Health and Medical Research Council grants as at April 2017.
- The NHMRC's Centres of Research Excellence scheme continues to support teams of researchers to pursue collaborative research and develop capacity in different aspects of the AMR response.
- Macquarie University is conducting key research into mobile genetic elements and resistance gene carriage/construct diversity in urban wildlife and marine vertebrates.

International Engagement

- Australia is actively contributing to global AMR initiatives, including those being led by the United Nations General Assembly, the G20, the Organisation for Economic Cooperation and Development, the Global Health Security Agenda and through the tripartite partnership of the World Health Organization, World Organisation for Animal Health, and Food and Agriculture Organization of the United Nations.
- Australia continues to actively support the implementation of the WHO *Global Action Plan (GAP) on AMR*. Australia regularly contributes to the establishment of GAP initiatives, such as the monitoring and evaluation framework, and the global development and stewardship framework.
- Australia is also contributing to the Codex physical working group on AMR and its two AMR projects being undertaken by working groups.
- Australia is contributing regionally to animal health. For example, the School of Veterinary Science at The University of Queensland has partnered with research institutes to support the advancement of antimicrobial stewardship practices in livestock-producing communities in Vietnam and the identification of antimicrobial usage and AMR in integrated chicken-fish farms in Myanmar.
- In late 2017, Australia will be undertaking a self-assessment and external evaluation of its implementation of the core capacities established under the *International Health*

Regulations 2005 (IHRs) through the Joint External Evaluation (JEE) process. AMR is one of a suite of 19 capacities being assessed. The external evaluation will allow Australia to identify the most urgent needs within its health security system, including for its AMR response.

Governance

- The Antimicrobial Resistance Prevention and Containment Steering Group (the Steering Group), previously headed by the Secretaries of the departments of Health and Agriculture and Water Resources, with the Australian Chief Medical Officer (CMO) and Chief Veterinary Officer (CVO) has convened to provide leadership on AMR and oversee the development and implementation of the Strategy.
- The Australian Strategic and Technical Advisory Group on AMR (ASTAG), consisting of representatives from across the animal and human health, food and agriculture sectors, the Australian Government and state and territory governments, has been instrumental in providing expert advice to inform the implementation of the Strategy and in establishing important links with key organisations and groups to support a collaborative One Health approach to Australia's response.
- The Australian Government released the Strategy Implementation Plan in November 2016. The Implementation Plan supports the National AMR Strategy, and guides and enables collaboration of stakeholders on the immediate focus areas for activity in Australia to limit antimicrobial resistance.
- The Department of Agriculture and Water Resources is working with senior state and territory officials on a number of potential reforms to agricultural and veterinary chemicals control-of-use regulations, such as nationally-harmonised minimum training, licensing and record keeping requirements, as well as veterinary prescribing and compounding rights. The Australian Government will continue to encourage national coordination of these matters.