
AUSTRALIAN
VETERINARY
ANTIMICROBIAL
STEWARDSHIP
CONFERENCE
2023
SURFERS PARADISE, QUEENSLAND

WELCOME FROM THE CHAIR

I extend a warm welcome to the 2023 Australian Veterinary Antimicrobial Stewardship conference (AVAMS)! It is indeed an honour to preside over this year's event. It's wonderful to see everyone in person, especially considering that the last AVAMS conference adopted a hybrid format. Since our last gathering, there has been a remarkable surge in initiatives. As we convene for this year's conference, my hope is that all stakeholders can exchange fresh ideas, gain insights from one another, establish new connections, and collaborate towards enhancing veterinary antimicrobial stewardship efforts in Australia, with a unified One-Health approach.

Australia has traditionally taken a cautious approach to the use of antimicrobials in animals, influenced by our nation's clean and green reputation and the stance of the APVMA. For producers, the principles of antimicrobial stewardship have always been the guiding philosophy. With the escalating urgency of Antimicrobial Resistance (AMR), there is greater potential to acknowledge ongoing endeavours and pinpoint areas necessitating further advancement. All industries bear the responsibility of curbing the emergence of AMR while upholding rigorous standards of animal health and well-being.

I extend my gratitude to Dr. Kylie Hewson, who chaired the last two conferences and did an exceptional job, setting a commendable standard for future Chairs.

Enjoy the conference, and seize every chance to expand your professional network, deepen your knowledge, and hopefully depart with a clear comprehension of your role, as well as your organisation's, in mitigating AMR risks in Australia.

Raymond Chia
Chair, AVAMS 23 Organising Committee

ACKNOWLEDGEMENT

Organising Committee

Dr Raymond Chia
Australian Pork Limited

Dr Ian Jenson
FIRST Management Pty Ltd

Dr John Phelps
Agriculture Victoria

Dr Melanie Latter
Australian Veterinary Association

Verity Price
Australian Chicken Meat Federation

Dr Joseph McMeniman
Meat & Livestock Australia

Dr Kylie Hewson
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Dr Jo Coombe
Coombe Consulting

Dr Rachel Iglesias
Department of Agriculture, Fisheries and Forestry

Dr Jane Woolacott
Dairy Australia

Amanda Olthof
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Australian Pork Limited (APL)
Australian Pork Limited (APL) is a producer owned organisation promoting the Australian pork industry. APL is the service body for Australian pig producers, performing marketing activities to improve the demand for Australian pork, research and development to make the industry more competitive and providing industry representation ensuring government and regulators have all of the necessary information for successful policy outcomes. APL aims to enhance opportunities for the sustainable growth of the Australian pork industry by creating and fostering new innovations, technology and jobs in the agriculture sector.

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Animal Medicines Australia represents the leaders of the animal health industry. Our member companies innovate, manufacture, formulate, register and supply veterinary medicine products that prevent, control and cure disease across the companion animal, livestock and equine

sectors. In the livestock sector, member company products are improving productivity and promoting better environmental, health, safety and animal welfare outcomes. In the companion animal sector, veterinary medicines produced by member companies are facilitating longer, mutually beneficial partnerships between humans and animals.

SESSION SPONSOR

The Australian Veterinary Association
For more than 30 years the Australian Veterinary Association (AVA) has been involved in raising awareness and developing resources to fight the emergence of antimicrobial resistance (AMR).

We do this through the development of policies, factsheets and guidelines for the veterinary profession, as well as resources for the general public. We aim to increase awareness and understanding of antibiotic use and resistance in animals, and promote good antimicrobial stewardship across all animal use sectors.

Our policy on the use of antimicrobials in practice can be found here, and our numerous AMR resources can be found here.

The AVA is an active participant in the Australian Government's National AMR Strategy 2020 and Beyond and as a member of the Australian Strategic and Technical Advisory Group on AMR (ASTAG). We are proud to be active participants in the biennial Australian Veterinary Antimicrobial Stewardship (AVAMS) conference.

EXHIBITOR

Australian Eggs Limited
Australian Eggs is an industry owned not-for-profit company. It integrates marketing, research and development and industry services for the benefit of its stakeholders. It is mainly funded through statutory levies and Australian Government matching payments for the purposes of approved research and development. The company services Australian egg farmers, irrespective of their size, location or farming system. Australian Eggs' vision is to support egg farmers, to increase egg consumption and ensure industry sustainability.

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Agrifutures Australian Chicken Meat Program
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INVITED SPEAKERS

Mark Schipp

Mark Schipp was appointed Australian Chief Veterinary Officer in 2011. In 2012 he was elected to the OIE Council and in 2018 was elected President of the OIE General Assembly. Together with the Chief Medical Officer, Dr Schipp chairs the Australian Strategic and Technical Advisory Group on Antimicrobial Resistance. He is also a member of the Animal Health Committee.

Karin Thursky

Prof. Karin Thursky (MBBS, BSc, MD, FRACP, FAHMS, FAIDH) is an infectious diseases physician and health services researcher who has over 20 years' experience in the fields of antimicrobial stewardship and infections in the immunocompromised host. She has successfully implemented and scaled programs to improve the quality and safety of healthcare and has a national leadership role in antimicrobial stewardship and sepsis.

Professor Thursky leads the National Centre for Antimicrobial Stewardship which takes a One Health approach to AMS across all human and animal health sectors, and is the Director of the Guidance Group at the Royal Melbourne Hospital which develops, implements and scales information technology to support the judicious use of antimicrobials. She is also the Associate Director of Health Services Research and Implementation, and the implementation stream for the NHMRC National Centre for Infections in Cancer Sciences at Peter MacCallum Cancer Hospital

Krispin Hajkowicz

Krispin is the founding Director of the Queensland Statewide Antimicrobial Stewardship Program and former Director of the Infectious Diseases Unit at Royal Brisbane and Women's Hospital. He has led antimicrobial stewardship programs in hospitals for 15 years and has an extensive international publication track record. He is also an Associate Professor at the University of Queensland Centre for Clinical Research and a PhD Candidate in Professor Eddie Holmes' viral evolution laboratory at The University of Sydney where he researches the emergence of novel zoonotic pathogens of pandemic potential.

Catherine McLaughlin

Cat McLaughlin Chairs the Responsible Use of Medicines in Agriculture Alliance (RUMA) in the UK (www.ruma.org.uk). RUMA agriculture is a not-for-profit cross sectoral Alliance of 26 organisations representing supply chains from farm to fork. It provides leadership to the UK livestock industry encouraging innovative and proactive efforts to improve the responsible use of veterinary medicines while ensuring optimum animal health and welfare.

Stephen Page

Stephen is a consultant veterinary clinical pharmacologist and toxicologist and founder and sole director of Advanced Veterinary Therapeutics, a consulting company that provides advice on appropriate use of veterinary medicines to veterinarians, veterinary organisations (Australian Veterinary Association, World Veterinary Association, World Organisation for Animal Health), state and national government departments and statutory bodies (APVMA, Department of Agriculture, Department of Health, US Environmental Protection Agency), and global organisations (OIE, FAO, Chatham House).

INVITED SPEAKERS

Shabbir Simjee

Dr Simjee graduated from the University of Birmingham Medical School in England in 1992, he specialised in infectious diseases completing a MSc in 1994 and a PhD in 1998 also from the University of Birmingham Medical School. After a brief time in research, he went to work at the US FDA between 2000-2003 at the Centre for Veterinary Medicine specifically looking at gene transfer between animal and human pathogens. He returned to the UK in 2004 to take up a position at Elanco Animal Health as global technical and regulatory advisor on antibiotics.

Dewi Hughes

Dewi is responsible for delivering Government veterinary services and Menter a Busines' animal health initiatives in Wales. Dewi has co-developed and managed the Arwain DGC Programme (leading on the responsible use of antimicrobials in Wales). Working closely with Government, industry leaders, veterinary practitioners, academics, farmers and horse owners, he has coordinated an industry-led programme to reduce the need to use antibiotics.

Zoe Bartlett

Zoe Bartlett is a Senior Microbiologist with Food Standards Australia New Zealand. Zoe holds a Bachelor of Science majoring in Microbiology and has worked across private, academia and government sectors in the areas of microbiological risk assessment and food safety. Her work at FSANZ contributes to the microbiological evidence base underpinning national standards management, strategic science work, and coordination of surveillance of the national food supply. Zoe has contributed nationally and internationally to the development of antimicrobial resistance surveillance frameworks and initiatives. Her expertise spans a wide range of areas, including HACCP implementation, foodborne pathogen control, microbiological risk assessment, microbial ecology, bacterial antimicrobial resistance, food safety regulations and food safety management systems.

Nicholas Ashbolt

Dr Ashbolt joined the University of South Australia in September 2023 – where he leads risk assessment aspects within the Cooperative Research Centre for Solving Antimicrobial Resistance in Agribusiness, Foods and Environments. He has held various leading positions in academia (Dean, Faculty of Science and Engineering, Southern Cross University, Alberta Innovates Chair in Waterborne Disease Prevention in the School of Public Health at the University of Alberta, and Professor and Head of the School of Civil and Environmental Engineering, the University of New South Wales) and in industry (Senior Research Microbiologist within the National Exposure Research Laboratory, U.S. EPA and as Principal Scientist, Sydney Water Corp).

Luke Morison

Luke Morison is Business Manager - Dairy at Apiam Animal Health. Apiam is one of Australia's leading rural veterinary businesses and includes a team of over 300 highly experienced veterinarians working in the production and companion animal sectors.
Dr Morison is veterinary graduate from the University of Melbourne and has worked in mixed rural veterinary practice where he developed a strong interest in dairy production medicine. He also worked at Zoetis in the role of Veterinary Operations Manager before joining Apiam. In his current role Luke leads the ProDairy program, taking a proactive approach with dairy clients on delivering veterinary services and therapeutic requirements.

WELCOME FUNCTION

Monday 20th November 2023

6.00pm – 8.00pm

Norfolk Room Foyer, Crowne Plaza

Sponsored by:

LALLEMAND ANIMAL NUTRITION

POOLSIDE NETWORKING BBQ

Tuesday 21st November 2023

7.00pm – 10.00pm

Poolside, Crowne Plaza

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CONFERENCE

Gold Coast, QLD

20-22nd November 2023

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PROGRAM

Monday 20th November 2023

12:00pm	Registration and Lunch
	SURVEILLANCE OF USAGE AND RESISTANCE – WHERE SHOULD WE BE HEADING? Chair: **Jo Coombe**
1:00 - 1:20pm	**Erda Rame-Hau:** Critical appraisal of evidence: integrated surveillance of antimicrobial resistance at the human, animal and environment interfaces
1:20 - 1:40pm	**Samantha Ellis:** The increasing need for transparency around Antimicrobial Usage
1:40 - 2:00pm	**Ian Jenson:** Antibiotic Stewardship: Resistance surveillance in a One Health context
2:00 - 2:20pm	**Skye Badger:** Transforming AMR and AMU surveillance: Integrating data from people, animals, and the environment for better stewardship outcomes
2:20 - 2:40pm	**Zoe Bartlett:** Food Standards Australia New Zealand: National surveillance of antimicrobial resistant bacteria in retail food
2:40 - 3:00pm	**Jay Gomboso:** Tougher offshore regulations on the use of antimicrobials in food-animal production: What this means for Australian producers
3:00 - 3:20pm	Break
3:20 - 4:00pm	**Panel discussion and brainstorming session.**
	Session 1: CONFERENCE OPENING Chair: **Raymond Chia** Sponsored by: Animal Medicines Australia
4:30 - 5:00pm	**KEYNOTE:** **Mark Schipp:** Antimicrobial Stewardship in Animal Health
5:00 - 5:30pm	**KEYNOTE:** **Karin Thursky:** Antimicrobial Stewardship in Human Health
5:30 - 5:50pm	**Krispin Hajkowicz:** OneHealth Antimicrobial Stewardship in Australia – A Human Medicine Perspective
5.50 - 6.00pm	**Panel Questions**
6:00 - 8:00pm	**Networking Function in Trade Area** *Sponsored by Lallemand*

Tuesday 21st November 2023

8:00 - 8:30am	Registration and Arrival Tea and Coffee
	Session 2: AVAMS: THE BIG PICTURE Chair: **Ian Jenson** Sponsored by Australian Veterinary Association
8:30 - 8:40am	**Raymond Chia**: Welcome and introduction
8:40 - 9:10am	**KEYNOTE** **Catherine McLaughlin:** Responsible Use of Medicines in Agriculture Alliance (RUMA) in the UK
9:10 - 9:30am	**Nick Ashbolt:** Front-end Stewardship and back-end environment AMR associated with animal production
9:30 - 9:50am	**Kylie Hewson:** The Minimising Antimicrobial Resistance Mission - a coordinated One Health approach for addressing the risks of AMR in Australia
9:50 – 10:10am	**Jessica Hoopes:** Antimicrobial Stewardship in Remote Companion Animal Health Programs
10:10 – 10:15am	**Samantha Ellis:** Antimicrobial stewardship at the national level - responding to AMR using a One Health response
10:15 – 10:20am	**Kirsten Bailey:** Antimicrobial attitudes and knowledge in veterinarians and clients: a cross-sectional study
10:20 – 10:25am	**Anna Sri:** Using expert consensus to drive progress in antimicrobial stewardship

PROGRAM

Tuesday 21st November 2023

10:25 – 10:50am	Morning Tea
	Session 3: THE BIG PICTURE (cont) Chair: **Ian Jenson**
10:50 - 11:10am	**Peter Coombe**: Mitigating on-farm antimicrobial resistance risks for livestock industries; establishment of a testing framework
11:10 - 11:30am	**Chris Morrow:** Australian poultry industries antibiotic usage in comparison to rest of world. An undocumented success story
11:30 - 11:50am	**Katie Asplin:** Waste management options for unused veterinary medicines and packaging
11:50 - 12:10pm	**Michelle Power:** Antimicrobial resistance is widespread in Australian wildlife microbiomes
12:10 - 12:30pm	**Panel discussion**
12:30 – 1:30pm	Lunch
	Session 4: VETERINARY REPORTS Chair: **James Gilkerson** Sponsored by Australian Veterinary Association
1:30 - 1:45pm	**Jane Heller:** The AMR Vet Collective – moving from 'ours' to 'yours'
1:45 - 2:00pm	**Dharma Purushothaman:** Registration Requirements for Veterinary Antibiotics in Australia to combat Antimicrobial Resistance
2:00 - 2:15pm	**Laura Hardefeldt:** Preserving equine health: Riding high with an antimicrobial stewardship program
2:15 - 2:30pm	**Kirsten Bailey:** Automating assessment of antimicrobial appropriateness for veterinary antimicrobial stewardship: A data science approach
2:30 - 2:45pm	**Ri Scarborough:** Moving beyond fears: how Australian companion animal veterinarians can be supported to appropriately withhold antimicrobials
2:45 - 2:50pm	**Laura Hardefeldt:** A global evaluation of generic antimicrobial prescribing competencies for use in veterinary curricula
2:50 - 2:55pm	**Alice Aldora:** Exploring Antimicrobial Resistance in Australian Reptiles
2:55 - 3:00pm	**Rebbecca Wilcox:** ...Now the drugs don't work
3:00 - 3:30pm	Afternoon Tea
	Session 5: GLOBAL PROGRESS ON ANTIMICROBIAL STEWARDSHIP Chair: **John Phelps**
3:30 - 3:50pm	**Stephen Page:** World Organisation for Animal Health (WOAH) - Current activities on AMU, AMR and AMS
3:50 - 4:10pm	**Shabbir Simjee:** European Regulations on Prevention Use of Antimicrobials in the EU - Regulations 2019/4 and 2019/6
4:10 - 4:30pm	**Mona Kheng:** Challenges and opportunities in promoting the rational use of antimicrobials in the animal health sector in Papua New Guinea
4:30 - 4:50pm	**Mauricio Coppo:** Lessons from capacity building projects in low- and middle-income countries in South and Southeast Asia
4:50 - 5:00pm	**Glenn Browning:** Antimicrobial Consumption in Animal Health in Bhutan
5:00 - 5:05pm	**Pema Tshewang:** Survey of knowledge, attitudes and practices about AMR and AMU among poultry farmers in Bhutan
	Break
7:00 - 10:00pm	Casual Conference Dinner Poolside Sponsored by MLA

PROGRAM

Wednesday 22nd November 2023

8:30 - 9:00am	Registration
	Session 6: AMS in PRODUCTION ANIMALS Chair: **Amanda Olthof**
9:00 - 9:30am	**KEYNOTE** **Dewi Hughes:** A coordinated approach to tackling AMR in Wales
9:30 - 9:50am	**David Jordan:** Better antimicrobial stewardship in animals from enhanced surveillance for resistance
9:50 - 10:10am	**Ray Castle:** Improving antimicrobial stewardship via bulk tank milk surveillance
10:10 - 10:15am	**Sung Joon Yu:** Exploring phytogenic feed additives as an alternative to antibiotics: enhancing gut microbiota diversity and antimicrobial stewardship in nursery piglets.
10:15 - 10:20am	**Ri Scarborough:** Enablers of AMS for Australian production animal, equine and companion animal veterinarians
10:20 - 10:25am	**Lee Taylor:** Vetscan Mastigram+, a new tool to reduce antimicrobial use in Australian dairy herds
10:25 - 11:00pm	Morning Tea
	Session 7: AMR/AMS in ANIMALS Chair: **Joe McMeniman**
11:00 - 11:20am	**Sam Abraham:** Robotic Antimicrobial Susceptibility Platform (RASP): objective support antimicrobial
11:20 - 11:40am	**Raziallah Jafari Jozani:** Utilizing Porcine Cell Lines: A Promising Solution for MIC testing of *Mycoplasma hyopneumoniae*, a Fastidious Microorganism
11:40 - 12:00pm	**Amy Hii:** Evaluation of a decision support tool for treatment of sporadic urinary tract infections in companion animals
12:00 - 12:20pm	**Kirsten Bailey:** Between a rock and a hard place: using antimicrobials appropriately or following the label
12:20 - 12:25pm	**Anna Sri:** Prevalence of antimicrobial resistant bacteria in remote Northern Territory dogs
12:25 - 12:30pm	**Amin Kawarizadeh:** Prevalence and antimicrobial resistance patterns of *Klebsiella pneumoniae* reproductive isolates from mares during 2020-2022 breeding seasons
12:30 - 12:35pm	**Amy Hii:** Impact of free culture and sensitivity testing for urinary tract disease on antimicrobial prescribing in companion animal practice
12:35 - 1:20pm	Lunch
	Session 8: INDUSTRY REPORTS Chair: **Samantha Ellis**
1:20 - 1:35pm	**Tony Batterham:** Stewardship initiatives from the perspective of a feedlot consultant veterinarian
1:35 - 1:50pm	**Sam Abraham:** Surveillance for antimicrobial resistance in enteric commensals and pathogens in Australian meat chickens
1:50 - 2:05pm	**Luke Morison:** Antimicrobial stewardship in dairy herd health programs: A proactive approach with client data
2:05 - 2:20pm	**Sam Abraham:** AMR journey in the pig industry
2:25 - 2:40pm	**Mini Singh:** AMR in the eggs industry
2:40 - 3:00pm	**Panel Discussion –** Keep moving things forward Facilitator: **Jo Coombe**
3:00pm	**Wrap-up**

Thursday 23rd November 2023

	Post-conference meeting (Invite only)
9:00am - 2:00pm	AIAS Steering Committee forum meeting 2023

ABSTRACTS

Critical appraisal of evidence: integrated surveillance of antimicrobial resistance at the human, animal and environment interfaces

Erda E Rame Hau[1], Peter D Sly[2], Deirdre Mikkelsen[3], Erica Donner[4], Joanne Mollinger[5], Mark Schipp[6], Ricardo J Soares Magalhaes[2, 1]

1. Queensland Alliance for One Health Sciences, School of Veterinary Science, The University of Queensland, Gatton, QLD, Australia
2. Children Health Research Centre, The University of Queensland, St Lucia, QLD, Australia
3. 3School of Agriculture and Food Science, The University of Queensland, St Lucia, QLD, Australia
4. Future Industries Institute, University of South Australia, Adelaide, SA, Australia
5. Department of Agriculture and Fisheries, , Biosecurity Queensland, Brisbane, Queensland, Australia, Brisbane City, QLD, Australia
6. Office of the Australian Chief Veterinary Officer (OCVO), Australian Government Department of Agriculture, Fisheries and Forestry, Brisbane City, QLD, Australia

Background: Antimicrobial resistance (AMR) is a critical global health issue limiting therapeutic antimicrobial choices for infectious disease treatment in humans and animals. Efforts have been made to strengthen national and global antimicrobial resistance surveillance programs by integrating data collection across the human and animal sectors. More recently, One Health AMR surveillance protocols that also integrate environmental data collection are being developed.

Methods: We systematically searched literature databases including EMBASE, PubMed, Scopus, and Web of Science to review published studies reporting the implementation of integrated AMR surveillance approaches. Using the PRISMA framework, we identified a total of 96 articles from 36 countries published from 2000 to 2022 which met our inclusion criteria.

Results: Out of 96 studies, 47 (49%) articles integrated AMR analysis from human and animal (HA) populations, 24 (25%) considered human, animal, and environmental (HAE) samples together, 11 (12%) studies included animal and environment (AE) samples, and 12 (13%) integrated human and environmental (HE) surveillance. Most studies (97%) were cross-sectional in nature and were often (22, 28%) conducted in a small set of developed countries. Human isolate-based and animal isolate-based surveillance were the most common study designs (38, 52.78%), with the remainder applying human case-based and isolate-based for animal populations (32, 44.44%). The majority of studies focused on AMR surveillance of *Escherichia coli (E. coli* (44, 45.83%) followed by *Salmonella* spp. (20, 20.83%) and *Campylobacter* spp. (14, 14.48%). Finally, our results demonstrate that AMR studies on *E. coli* revealed lower correlation between human and animal AMR prevalence compared to *Salmonella* spp. and *Campylobacter* spp. studies. Different aspects of surveillance design were associated with the level of correlation of AMR prevalence between sectors.

Conclusions: Our study found that while global efforts for integrated AMR surveillance have increased in the past 10 years, significant variation exists between studies with regards to the epidemiological and laboratory aspects of the surveillance designs. Our findings indicate that to enable the generation of comparable epidemiological data across countries and sectors there is the need for a global protocol in surveillance design for integrated surveillance of antimicrobial resistance.

Key Antimicrobial Stewardship Message: Integrated design of antimicrobial resistance surveillance for better antimicrobial stewardship.

The increasing need for transparency around Antimicrobial Usage.

Samantha Ellis[1]
1. Department of Agriculture, Fisheries and Forestry, Canberra, ACT, Australia

Australia has one of the best international reputations for antimicrobial use practices and resistance levels. However, there is increasing demand for data transparency to support this reputation, from both national and international groups. Australia reports antimicrobial usage to the World Organisation for Animal Health (WOAH) through the ANIMUSE platform which makes global data collection and benchmarking easier and allows WOAH to report on antimicrobial usage in animals at an aggregated (regional) level.
Australia does not currently publish antimicrobial usage data, although some information is available covering the time period 2006-10 and the Australian Pesticides and Veterinary Medicines Authority (APVMA) publishes sales values annually. Recent publications and enquiries have demonstrated the need for publication of contemporary data by product weight to combat misinformation, support Australia's international policy positions and market access, highlight antimicrobial stewardship successes and identify any areas for improvements. This will require improvements to our current system and strong partnerships with the veterinary and livestock industries.
This presentation will describe the current system, outline some potential improvements, and discuss some of the ways proposed to upgrade this system and help demonstrate Australia's commitment to sustainable, safe international trade and global food security.

Key Antimicrobial Stewardship Message: Increased data collection and reporting to ensure that Australia can continue to provide assurances of our high quality, safe food, support export market access and retain use of antimicrobial medicines required to ensure high levels of health and welfare in our livestock.

Antibiotic Stewardship: Resistance surveillance in a One Health context

Ian Jenson[1]
1. FIRST Management, North Parramatta, NSW, Australia

A One Health perspective acknowledges that optimising the health of people, animals, and ecosystems requires management of closely linked and interdependent systems (.1) Many concerns are raised about the potential impacts of the use of antimicrobials in animals on human health. A One Health perspective demands that we also consider animal health and disease, resistance of bacterial pathogens in production, wild, and companion animals and how the environment may be affected by antibiotics as chemicals, genes and/or bacteria travel between one place and one species and another. Understanding these factors will assist our antibiotic stewardship efforts because it will help us to understand what we should measure, the significance of what we detect and the actions we take as a result.
It is therefore important to direct stewardship of antibiotics towards preserving antibiotics for treatment of animal disease as well as considering the potential impacts on human health, other animals, and the environment.
Prescribing guidelines for production animal species assist practitioners to make prudent use of antibiotics as part of a prevention and treatment strategy. Maintaining the health, productivity, and availability of animals to meet human nutritional needs is also part of the One Health paradigm.
When the presumed consumption of antibiotics in animals is ranked and compared with available resistance data, usually for indicator bacterial species rather than animal pathogens, it is noted that data are sometimes lacking for resistance, even of indicators species, to the antibiotics being used most in animal raising systems. Some data are available for AMR in animal pathogens, and this data gap may sometimes be significant, and should be addressed by a One Health surveillance system if required. Test methods and cut-offs for clinical efficacy need to be available for the antibiotics being used in animals. Rapid diagnostic systems to identify pathogens and their antibiotic resistance would further aid in good stewardship.
When examining available resistance data from commensal bacteria isolated from animals, it is evident that data for resistance to antibiotics not used in animals, but considered of high importance in human medicine, are frequently collected. While early detection of resistance of human pathogens to highly/critically important antimicrobials is important, a risk assessment should be conducted to determine the likelihood that resistance will arise from selective pressure in animal raising systems, consider the potential for antibiotics, genes or resistant organisms to transfer through the environment and other animals to humans, and thereby determine a pragmatic approach to surveillance. Given the current state of knowledge, this system needs to be flexible and adaptable.

Key Antimicrobial Stewardship Message: Surveillance systems for AMR in animals need to be relevant to animal treatment and risks of subsequent AMR infections in humans.

Acknowledgements: AgriFutures, Project PRO-016134, Mitigating on-farm antimicrobial resistance risks for livestock industries, Meat & Livestock Australia

[1]https://www.who.int/groups/one-health-high-level-expert-panel
Abraham, R. et al. 2022 Int. J. Food Microbiol. 371:109672
Alhamami, T. et al. 2021 Microorganisms 9:1322

Transforming AMR and AMU surveillance: Integrating data from people, animals, and the environment for better stewardship outcomes

Skye Badger[1], Melanie Bannister-Tyrrell[1, 2], Céline Faverjon[1], Adam Black[1], Ben Madlin[1], Angus Cameron[1]
1. AusVet, Fremantle, WA, Australia
2. Nossal Institute for Global Health, University of Melbourne, Melbourne, VIC, Australia

We rely on robust, high-quality data from humans, animals, and the environment to enable integrated surveillance of AMR and AMU nationally and globally. Yet few countries have successfully adopted a One Health approach to AMR and AMU surveillance or have electronic information systems integrating data across the human, animal, and environmental health domains (1). This gap in addressing AMR represents one of our greatest unmonitored health threats. The COVID-19 pandemic has underscored the critical role of data analytics in public health surveillance and accelerated technological advances in electronic information systems. This paves the way for broader national adoption of robust integrated information systems encompassing multisectoral AMR and AMU.

With the support of the Fleming Fund Country Grant projects in Indonesia and Nigeria, we have developed a secure, cloud-based electronic information system that integrates, manages, analyses, and reports national-level data from antimicrobial sensitivity testing and AMU and consumption data from humans, animals, and the environment. The system allows data integration from multiple laboratories, government departments, research studies, development projects and private sector partners. It supports AMR program monitoring, policy development, antimicrobial stewardship, and reporting to WHO and WOAH. The system reports important antimicrobial resistance patterns, monitors antimicrobial residues in animal products and the environment, monitors AMU in different sectors and levels, and reports antimicrobial prescriptions and purchases in real-time. While the system is designed to serve as a secondary data integration, analysis, and reporting tool, it can be adapted as a primary data collection tool—for example, collecting AMU data from individual farms, veterinary clinics, hospitals, and general practice clinics.

Electronic information systems are recognised for their role in developing and implementing antimicrobial stewardship programs in human health. Similarly, we anticipate that information systems like ours can advance antimicrobial stewardship initiatives in animal health by providing evidence-based information that informs policies and actions that safeguard antimicrobials for animals and people alike.

1. Oberin M, Badger S, Faverjon C, Cameron A, Bannister-Tyrrell M. Electronic information systems for One Health surveillance of antimicrobial resistance: a systematic scoping review. BMJ Glob Health. 2022 Jan;7(1):e007388

Food Standards Australia New Zealand: National surveillance of antimicrobial resistant bacteria in retail food

Zoe Bartlett[1]
1. Food Standards Australia & New Zealand, Majura, ACT, Australia

Food Standards Australia New Zealand (FSANZ) has been funded by the Australian Government Department of Health to look at antimicrobial resistant bacteria in the Australian food supply.
FSANZ, with the support of all jurisdictions, commenced sampling of selected retail foods in September 2022 and this was completed in August 2023. Food samples from three retail commodities - poultry, pork and beef – were purchased nationally by state and territory regulators. The next phase is the analysis of bacterial isolates for antimicrobial susceptibility and whole genome sequencing.
This presentation will describe the development and objectives of the national surveillance plan. FSANZ has taken advice from an Expert Scientific Advisory Group comprising experts from a variety of fields with extensive experience in antimicrobial resistance (AMR) and AMR surveillance to ensure the plan aligns with international standards.
FSANZ consulted extensively with jurisdictions, which participated in the surveillance through the Implementation Subcommittee for Food Regulation Surveillance, Evidence and Analysis Working Group.

Tougher offshore regulations on the use of antimicrobials in food-animal production: Impacts on Australia's pig producers

Jay Gomboso [1], Donkor Addai [1]
1. Department of Agriculture, Water and Environment, Canberra, ACT, Australia

There is growing international pressure to reduce the use of antimicrobials in food animal production. This is particularly the case in intensive production industries such as feedlots, piggeries, dairying and poultry farming, which generally use higher volumes of antimicrobials relative to free-range and extensive production systems.

Recent tightening of international regulations imposed on third countries (exporters) on the use of antimicrobials in their production processes are expected to have adverse impacts on both farm profitability and animal health. To determine the extent of these impacts, an epidemiological-economic model was used to simulate production and disease management in an intensive, large-scale commercial piggery.

The model estimated the likely impacts on a typical Australian 1000-sow farrow-to-finish piggery following: a ban on the use of antimicrobial growth promotants, a ban on the in-feed use of antimicrobials for disease prevention purposes, and a tightening of antimicrobials permitted for the treatment of Porcine Proliferative Enteropathy (ileitis) caused by a *Lawsonia intracellularis*.

The results provide valuable insights on the importance of using antimicrobials in food-animal production responsibly, and maintaining strict on- and off-farm biosecurity and stewardship practices if we are to minimise adverse farm profitability and animal health impacts brought about by changes in antimicrobial usage regulations in agriculture.

1. Gomboso, J & Addai, D 2023, Tougher offshore regulations on the use of antimicrobials in food-animal production: Impacts on Australia's pig producers, ABARES technical report, Canberra

Session 1: Conference Opening

Antimicrobial Stewardship in Animal Health

Mark Schipp [1]
1. Australian Government Department of Agriculture and Water Resources, Canberra, ACT, Australia

During my twelve years as Australian Chief Veterinary Officer there have been considerable changes in the global animal health and biosecurity landscape. The distribution of certain transboundary livestock diseases has increased, international supply chains and trade patterns have shifted and extreme weather events have impacted on livestock production and disease. Despite this, there has been increased recognition of the threat posed by antimicrobial resistance, and more coordinated and urgent global action to mitigate this threat. This action is also increasingly successful in engaging all of the One Health sectors and stakeholders. In this presentation I reflect on national and global progress on antimicrobial stewardship in the animal health sector, describe successes in One Health integration of actions to mitigate antimicrobial resistance and provide thoughts on priorities for the coming years.

Antimicrobial Stewardship in Human Health

Karin Thursky [1]
1. Director National Centre for Antimicrobial Stewardship, Department of Infectious Diseases, Melbourne Medical School, University of Melbourne

Antimicrobial stewardship (AMS) is an essential component of Australia's national AMR strategy as well as being included in accreditation frameworks for quality and safety in healthcare. Striving for optimal use of antimicrobials leads to improved patient outcomes and patient safety. However, across the human health sector there are various levels of maturity of AMS programs. The hospital sector has quite well-established programs that have been driven by detailed hospital accreditation standards that have been in place since 2013 (although challenges remain in remote rural and regional centres). In contrast, formal AMS programs are still emerging in the community setting, even though this is where the majority of prescribing occurs. The design, implementation, and resourcing of AMS programs in primary care and in aged care homes will require a considered health services research and implementation science approach. Antimicrobial use surveillance, with audit and feedback is a key activity to drive behaviour change although the optimal approach is unknown. The National Antimicrobial Prescribing Survey (NAPS) platform has been developed and implemented using the applied learning health systems framework and has become an important national asset for AMS programs in Australian hospitals and aged care homes. Understanding contextual factors, organisation readiness, barriers and facilitators is essential to drive the effective design and implementation of stewardship initiatives

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OneHealth Antimicrobial Stewardship in Australia – A Human Medicine Perspective

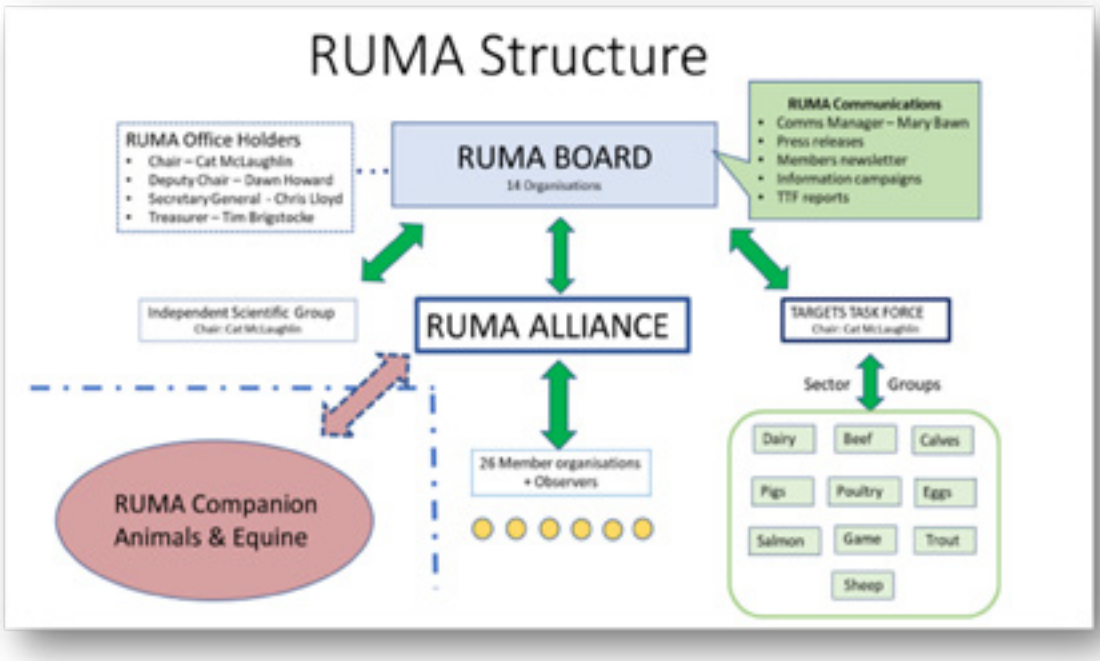
Krispin Hajkowicz [1]
1. Infectious Diseases, Royal Brisbane and Women's Hospital, Herston, QLD, Australia

Antimicrobial resistance is one of the key threats to human health in the 21st century. A nightmare scenario of people frequently dying from untreatable infections is the possible consequence unless broad and robust action is taken now. Although human antimicrobial stewardship (AMS) has been around for more than two decades, the acknowledgment of the contribution to animal and environmental antimicrobial use to human health outcomes has only been recognised recently. Significant progress in AMS in Australian health makes us a world leader. There is now a national mandatory standard, accreditation and a cultural shift by prescribers recognising the unintended consequences of excessive or inappropriate antimicrobial prescribing on the microbiome. Advances in health information management, clinical trials of antibiotic-sparing regimens, renewed focus on infection control and social research addressing the psychological and cultural aspects of antibiotic prescribing will shape mature AMS programs in the future. New technologies such as metagenomic host and environmental screening for human, animal and environmental surveillance promise to enable efficient responses embracing the concept of "One Health."

Responsible Use of Medicines in Agriculture Alliance (RUMA) in the UK

Cat McLaughlin [1]
1. RUMA, Stoneleigh, WARWICKSHIRE, United Kingdom

RUMA agriculture is a not-for-profit cross sectoral Alliance of 26 organisations representing supply chains from farm to fork across the UK. It provides leadership to the UK livestock industry encouraging innovative and proactive efforts to improve the responsible use of veterinary medicines while ensuring optimum animal health and welfare. RUMA uses evidence-based information to lead and promote the livestock industry's responsible use of medicines. The organisation has an ongoing focus on antimicrobial resistance (AMR) as well as supporting the message of responsible use beyond AMR and is committed to supporting a One Health strategy. This means that we also encourage preventative medicine use (vaccinations for instance) and animal husbandry protocols involving good hygiene, optimal feeding, excellent husbandry and genetics.
Our core principle fits around our strapline of 'As little as possible, as much as necessary'. This translates to the premise that even with high health and welfare standards in place, there will be times when animals get sick and we need to be able to treat them otherwise their welfare is compromised. If that treatment involves the use of antibiotics, then we use those antibiotics responsibly, which means that we use them in the right way, in the right dose, under veterinary prescription, and for animals that genuinely need them.
We do not use antibiotics routinely as preventative treatments, nor do we use them to promote growth. (The latter has in fact been banned across Europe and the UK for many years.) Those antibiotics classified as critically important for human health by the European Medicines Agency are only used as a last resort, and where veterinary diagnosis and testing dictates that there are no alternatives.
RUMA does not therefore advocate 'zero use' of antibiotics – this concept can in fact drive AB use 'underground' and compromise animal welfare.



RUMA was established in 1997 but in 2014/15, we refreshed our ways of working to respond to the global One Health agenda and the challenges being thrown up about antibiotics in agriculture and their contribution to antibiotic resistance in the human population.
We developed the RUMA Targets Task Force (TTF) – a group of leading farmers and vets from all the main food production sectors to help us develop targets for use across the UK's food production supply chains.
We also brought together a group of independent scientific experts from the fields of academia, veterinary and human medical science and invited government observers from the Veterinary Medicines Directorate and the Food Standards Agency to provide scientific advice and oversight to our activities.
All our work is published and freely accessible on our website, and we promote responsible use activities through our social media platforms on Twitter and LinkedIn, as well as through RUMA led campaigns and in collaboration with the industry wherever possible and appropriate.

We also welcomed the creation of the RUMA Companion Animals and Equines Alliance into the RUMA family two years ago. This group is currently looking at developing targets and responsible use strategies for companion animals and horses and they recently held an antibiotic amnesty, which was designed to help pet owners dispose of unused AB safely.
Under the co-ordinating and facilitating actions of RUMA Agriculture, via our sector specific Target Task Force, UK farming has achieved global recognition for its effective use of antibiotics in livestock, with a 55% reduction in use since 2014, alongside a large reduction in antibiotic resistance. The use in agriculture of the highest priority, critically important antibiotics for human health has also fallen by 83% since 2014. These results have been achieved through voluntary, cross sector collaborations and initiatives. (These figures will be updated in November 2023.)
Our ongoing work continues to support sector targets, against a backdrop of industry challenges. For some sectors, the focus is now on maintaining low use by promoting preventative animal health strategies

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Front-end Stewardship and back-end environment AMR associated with animal production

Nicholas Ashbolt[1]
1. Future Industries Institute, University of South Australia, Bundall, QLD, Australia

Environmental antimicrobial resistance (eAMR) is a complex and challenging problem, often referred to as a "wicked problem." Addressing it effectively requires adopting a One-Health perspective that considers the interconnectedness of human and animal health and the environment. While stewardship programs play a crucial role in mitigating AMR in both human and animal populations, they alone cannot provide a comprehensive solution to this multifaceted issue.

Proving the effectiveness of stewardship programs in controlling antimicrobial resistance goes beyond simple correlation analyses, such as establishing a linear relationship between reduced antimicrobial use (AMU) in animal production and reduced resistance in animals or humans within specific regions. The challenge arises from the presence of numerous non-linear factors that causally link AMU to AMR.

Within the context of the CRC SAAFE (Collaborative Research Centre for Solving Antimicrobial Resistance in Agribusinesses, Foods and Environments), our research focuses on mapping these intricate causal links and constructing a Bayesian Network model. This model will incorporate various management options aimed at assisting in the management of eAMR. While this conference audience focus is on the animal production sector, we recognize that factors such as the sources of animal drinking water, the use of cleaning agents, and manure management can have far-reaching impacts beyond the realm of animal and food production. All of these factors are important to capture, along with AMR in companion animals, waterfowl migration, international travel/trade and other factors that introduce or enhance gene/pathogen AMR problems back into animal production.

The Minimising Antimicrobial Resistance Mission – a coordinated One Health approach for addressing the risks of AMR in Australia

Kylie Hewson[1]
1. CSIRO, Herston, QLD, Australia

As one of the world's biggest health challenges, AMR urgently requires a coordinated One Health approach across the human health, animal health and environment sectors.

Co-designed by CSIRO, the Australian Department of Agriculture, Fisheries and Forestry, and the Department of Health and Aged Care, the Minimising Antimicrobial Resistance Mission is working to halt Australia's rising death rate and economic burden of antimicrobial resistance by 2030. The Mission will identify and prioritise the most effective technologies, processes and policies required to minimise AMR in and across the animal health, human health, and environment sectors, ensuring a 'One Health' R&D perspective.

Given the conservative regulations in Australia regarding the use of antibiotics in livestock and horticulture, coupled with high biosecurity standards and favourable animal and environmental health status, the levels of antimicrobial resistance are considered low compared to many countries. This distinct context requires a targeted and holistic approach to minimising AMR that is specifically tailored to Australia. This approach should focus on protecting the

efficacy and availability of current animal medicines, finding alternatives, and minimising the flow of antimicrobial residues into the environment. In addition to sustainable and accessible preventative measures and treatments, cost-effective, easy-to-use, accurate diagnostic tools and enhanced surveillance are needed. More sustainable funding for initiatives in the animal health and environment sectors is also essential.

The Mission's three focus areas seek solutions which:

- Prevent the emergence of AMR by reducing AMR selection pressure, by developing antimicrobial alternatives such as vaccines and immune stimulants.
- Manage existing AMR by identifying transmission pathways and assessing risk to inform action, such as through data standardisation, integration and analysis tools.
- Respond to AMR infections through improved diagnoses and treatments, such as developing technology to rapidly detect types of infection and AMR.

By connecting organisations addressing the challenge of AMR, the Minimising AMR Mission is working to find shared solutions through collaborations with common scope and outcomes and reduce duplication of effort.

Key Antimicrobial Stewardship Message: The Minimising Antimicrobial Resistance Mission is working to find shared solutions, tangible outcomes and reduce duplication of effort.

1. https://www.csiro.au/en/about/challenges-missions/Antimicrobial-resistance

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Antimicrobial Stewardship in Remote Companion Animal Health Programs

Jessica Hoopes[1], Bonny Cumming[1], Teresa M Wozniak[2], Lorraine Bell[2], Bindee Davis[1]
1. Animal Management in Rural and Remote Indigenous Communities (AMRRIC), Darwin, Larrakia Country, Northern Territory, Australia
2. Australian e-Health Research Centre CSIRO, Herston, Turrbal and Jagera Country, Queensland, Australia

Access to veterinary services, and appropriate usage of antibiotics is crucial for maintaining good animal health and in reducing the public health risks caused by antibiotic-resistant bacteria. Australia is currently ranked as the seventh highest country for antimicrobial usage in humans, compared to European countries, with particularly high rates of community use of antibiotics (ACSQH, 2021). Rural and remote settings in Australia have some of the highest rates of antimicrobial usage and antimicrobial resistance (AMR) (ACSQH, 2021; Wozniak et al. 2020). Despite high usage of antibiotics in humans, there is limited evidence of antibiotic usage and appropriateness in animals from remote communities. A lack of research in this area represents a critical knowledge gap.
Companion animals play an integral role in remote Aboriginal and Torres Strait Islander communities, but barriers to accessing veterinary services and a free-roaming lifestyle can lead to overpopulation and poor health status, with higher rates of infectious disease relative to dogs in urban environments (Constable et al. 2008). These factors may act as potential drivers for the emergence of AMR. While One Health focused community animal health and management programs have the potential to support preventative health care strategies to reduce the need for antimicrobial treatment, geographic isolation and limited resources pose unique challenges in implementing appropriate antimicrobial stewardship practices based on existing guidelines. To be effective, antimicrobial stewardship guidelines need to be responsive to the context of veterinarian service provision and consider the values and needs of veterinary service providers. This study characterises patterns of antibiotic use and prescribing practices in community companion animal health programs in rural and remote Aboriginal and Torres Strait Islander communities. This work will identify potential barriers and enablers to the effective implementation of antimicrobial stewardship practices and inform the development of context-specific antimicrobial treatment guidelines.

Key Antimicrobial Stewardship Message: The development of contextually appropriate therapeutic guidelines for practitioners working in remote companion animal health and management programs are critical to supporting stewardship programs and reducing the threat of AMR in animal and potential spill over to humans.

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Antimicrobial stewardship at the national level – responding to AMR using a One Health response.

Samantha Ellis[1]
1. Department of Agriculture, Fishery and Forestry, Canberra , ACT, Australia

Antimicrobial resistance is an issue that bridges the human, animal and environment spheres. The increased awareness of potential for maintenance and transmission of resistant organisms and/ or genetic elements among different species and via the environment makes a One Health approach essential for effective action.
The Department of Agriculture, Fisheries and Forestry contributes to a range of AMS activities to ensure that the low levels of AMR in Australian livestock are maintained and enhanced. This presentation will describe key achievements in AMS that have come from a One Health approach working closely with human health and environment counterparts and the livestock industries.

Key Antimicrobial Stewardship Message: National and international One Health initiatives continue to improve stewardship practices.

Antimicrobial attitudes and knowledge in veterinarians and clients: a cross-sectional study

Kirsten Bailey[1, 2], Glenn Browning[1, 2], James Gilkerson[1, 2], Laura Hardefeldt[1, 2], Ri Scarborough[1, 2]
1. National Centre for Antimicrobial Stewardship, Peter Doherty Institute for Infection and Immunity, Melbourne, Vic, Australia
2. Asia-Pacific Centre for Animal Health, Melbourne Veterinary School, Faculty of Science, The University of Melbourne, Parkville, Vic, Australia

Antimicrobial prescribing decisions involve a complex interplay of factors, including features of the clinical case, the veterinarian, the client and the drug itself. However, the relative importance of these factors to Australian veterinarians is unclear. Little is known about attitudes to and understanding of antimicrobial use in Australian veterinary clients, particularly farmers. This information is important for designing effective programs to improve antimicrobial use.

We conducted an online survey of veterinarians in Australia interrogating their antimicrobial prescribing decisions, knowledge of antimicrobial resistance (AMR) and stewardship (AMS) and related topics. We also surveyed veterinary clients who kept multiple animals of the same species, asking about their relationship with their vet, expectations of receiving antimicrobials and their understanding of AMR.

The veterinarian survey yielded 399 analysable responses. For all veterinarians, the decision to use antimicrobials in the absence of a clear indication was influenced by fear of the animal's condition deteriorating and diagnostic uncertainty; food animal veterinarians had the additional concern of disease spreading to other animals. Choice of antimicrobial was strongly influenced by the practicality of administering it (especially in production animals), the veterinarians' familiarity with the drug, prescribing guideline recommendations and concern about antibiotic resistance in animals and humans, whereas cost and profit margin were rarely considered. The client survey resulted in 495 analysable responses. Most clients viewed veterinarians as their most important source of animal health advice, however, the majority also felt their own knowledge was sufficient to determine whether antimicrobials were necessary, and more than half had specifically asked their veterinarian to give antimicrobials, highlighting significant potential for tension between veterinarian and client. Overall, a quarter of clients wanted to reduce their antimicrobial use from current levels, but there were marked differences between enterprises, with pig, (67%) cattle (46%) and sheep and goat (28%) farmers and those with large herd sizes more likely to agree. Clients with lower levels of education were more likely to believe that AMR described the animal (or human) body becoming tolerant to an antimicrobial.

Using expert consensus to drive progress in antimicrobial stewardship

Anna Sri[1, 2], Kirsten Bailey[1, 2], James Gilkerson[1, 2], Glenn Browning[1, 2], Laura Hardefeldt[1, 2]
1. Asia-Pacific Centre for Animal Health, Melbourne Veterinary School, Faculty of Science, University of Melbourne, Melbourne, Victoria
2. National Centre for Antimicrobial Stewardship, Peter Doherty Institute for Infection and Immunity, Melbourne, Victoria

High-importance antimicrobials are those that are “essential for the treatment or prevention of infections in humans where there are few or no treatment alternatives for infections” [1]. This study uses the Delphi method [2] to develop expert consensus across veterinary and human medical fields on the circumstances under which antimicrobials with high importance to human health can be used in animals.
Forty-four human and animal health experts including veterinarians, physicians, and microbiologists undertook three rounds of anonymous online surveys. Each round included results and additional information based on the previous round with the aim of achieving consensus on key questions.
Consensus was achieved on six items:

1. The country-specific rating system should take precedence over any other rating system
2. International prescribing guidelines should be adapted to account for the country-specific rating system.
3. Veterinarians should be able to create local practice-specific antimicrobial use protocols but should not create their own importance rating systems.
4. Use of high-importance antimicrobials is allowed after antimicrobial culture and sensitivity testing confirms resistance to low and medium importance rated antimicrobials
5. The use of high-importance antimicrobials in veterinary medicine should NOT be banned.
6. Any use of high-importance antimicrobials not registered for use in animals must be reported to a central authority.

Key Antimicrobial Stewardship Message: Achieving consensus on key issues means countries, particularly Australia, can use this evidence to implement policy changes and provide targeted education and other support for antimicrobial stewardship, with increased confidence.

Acknowledgements: We would like to thank the experts who took part in this survey including Dr Ray Castle, Dr Tim Nuttall, Dr Ross Cutler, Professor Darren Trott, Dr Jo Coombe, Dr David Singleton, Dr Tina Moeller Soerensen.
L.H. is funded by the Australian Research Council through the Discovery Early Career Research Award program. A.S. was a recipient of an Australian Postgraduate Award scholarship.

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Session 3 – The Big Picture

Mitigating on-farm antimicrobial resistance risks for livestock industries; establishment of a testing framework

Jo Coombe[1], **Peter Coombe**[1]
1. Coombe Consulting, Noosaville, QLD, Australia

This project which is co-funded by the Department of Agriculture Fisheries and Forestry, and all funding members of the Animal Industries' Antimcrobial Stewardship R, D & E Strategy (AIAS) has set out to establish a framework within which a livestock enterprise may test for the existence of antimicrobial resistance (AMR) and antimicrobial residues on site, and also examine the potential pathways that AMR organisms may enter and leave the site.
The identification of sample points is critical to the framework and will be discussed here.
Part of the framework is a pre-sample questionnaire in which an enterprise representative answers a number of questions to assist them and the testing team (if applicable) to select sites for testing. In the pilot phase of the project, it has been requested that sites be specifically selected with a bias towards a likelihood of the presence of organisms and potential antimicrobial residues (e.g. a hospital pen). Another aim of the project is to investigate potential transmission of AMR into and out of a farm, so testing sites that can be identified at a "boundary" of an enterprise are also considered valuable.
The questionnaire asks questions with reference to feed management, animal management (sick animals specifically), water management (fresh water and wastewater), animal bedding management, manure disposal/ management, other feral/working animals on the site, as well as other relevant questions.
With the answers to these questions, it is possible to map out potential testing sites with regards to these specific categories: Feed, water, bedding, manure, other faecal/cloacal samples, human traffic areas, products (limited to eggs and milk and only tested for AMR, not residues).
Note that not all enterprises will render all sample types when considered logically. For example, a house layer chicken enterprise does not have a separate bedding and manure management process, rather they are combined.
With a testing framework and relevant laboratories identified for testing we hope to enable enterprises to undertake a level of self-testing that will fit well within their own biosecurity plans.

Australian poultry industries antibiotic usage in comparison to rest of world. An undocumented success story

Chris J Morrow[1,2]

1. Bioproperties, Ringwood, Victoria, Australia
2. School of Veterinary Science, The University of Melbourne, Parkville, Australia

Most poultry in Australia receive no antibiotics for their whole life. Reductions are occurring in the use of ionophores as coccidiosis controls. Some sick flocks need treatments for Fowl Cholera or Spotty liver (mainly *Camplyobacter hepaticus)* in cage free flocks but interventions are sporadic and direct response to needing to treat clinically affected flocks (Morrow 2018). Australian poultry industries ended up in this position by funding the development of the live *Mycoplasma gallisepticum* (MG) vaccine ts-11 in the first half of the 1980s in the response to the emergence of tylosin resistance in MG infecting various meat breeding operations (a killed coryza vaccine was also developed). These initial successes prompted the funding of *M. synoviae* (MS) vaccine development. Massive advances in decreasing antibiotic dependence were the outcome by the new millennium (nearly 100% of meat breeders are now vaccinated) and this spilled over into the layer industries where nearly 80% are now vaccinated with both MG and MS vaccines. This was all before the AMR became an issue and consequently largely undocumented.
In contrast routine antibiosis especially during laying in layers and breeders and antibiotics to prevent "post vaccinal reactions" is still common in many countries and the target here is avian mycoplasma infections. This use of antibiotics is poorly documented in the literature although Kleven (2008) mentions the use of tetracyclines or tylosin in lay (a week a month) but is estimated to be 2.1 to 3.65 tonnes of active per Million layers per year and 6.7 tonnes of active for 400K PS and progeny per year (Morrow 2021). This mycoplasma control is the major use of antibiotics in poultry worldwide and live mycoplasma vaccines can replace it.
Acquired antimicrobial resistance in pathogenic Avian mycoplasmas is not a problem with direct consequences like transference of this resistance to human pathogens. Of more worry is the pressure for emergence of resistance in zoonotic infections in poultry and transfer by the human food chain (Mulchandani and others 2023). Salmonella

(especially *S. Enteriditis)* and *Campylobacter jejuni* and related organisms deserve our focus. Salmonella infections are subject to control measures and there are vaccines and may be considered controllable with current technologies. On the other hand, Campylobacter infections are ubiquitous in poultry and asymptomatic - indeed as far as the chicken is concerned, they seem to be a commensal. In humans this is different situation with macrolide treatment being considered an option whose effectiveness is needed to be maintained.

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Waste management options for unused veterinary medicines and packaging

Katie Asplin[1]

1. Animal Medicines Australia, Barton, ACT, Australia

Australia's attitudes about waste and resource management are shifting. Waste management and the development of responsible disposal solutions for product packaging continues to grow as a critical pillar of industry sustainability in Australia.

At the same time, the Australian government's commitment to waste management is growing, with significant aspirational and regulatory targets and requirements being introduced in recent years. While Australia's plastic packaging targets are currently voluntary, the Government have indicated they are likely to start implementing regulations to assist in meeting these targets. This presents a number of challenges and opportunities for the animal health sector.

The Australian Pesticides and Veterinary Medicines Authority (APVMA) is responsible for regulating statements regarding the disposal of both unused veterinary medicines and any empty packaging.

Current product stewardship programs including Agsafe's drumMUSTER and ChemClear programs, as well as the Return Unwanted Medicines Project (the RUM Project). There are opportunities for identifying and developing end-of-life stewardship options for product packaging types that are not eligible for these schemes – but the regulatory framework requires amendment to facilitate more responsible disposal options for veterinary medicine waste management.

Antimicrobial resistance is widespread in Australian wildlife microbiomes

Michelle Power[1]

1. Macquarie University, North Ryde, ACT, Australia

Increasing reports of antimicrobial resistant bacteria and genetic determinants of resistance in wildlife signifies the importance of antimicrobial stewardship when treating and rehabilitating wildlife. Our investigations of antimicrobial resistance (AMR) in diverse Australian wildlife have revealed widespread dissemination and integration of clinically important resistant enteric bacteria and diverse antibiotic resistance genes in the microbiomes of a wide array of terrestrial and aquatic wildlife species (flying fox, koala, Tasmanian devil, echidna, possum) and aquatic species (platypus, penguin, and pinnipeds).

AMR was found to range between 1% and 73% in free-ranging in >10 free-ranging wildlife species studied to date. That free-range species are carrying antibiotic resistance genes and resistant bacteria indicates acquisition of resistant bacteria or genetic mechanisms of resistance from environmental sources. Comparisons of AMR frequency in free-range animals to their counterparts under different scenarios (rehabilitation, captive breeding programs, permanent captivity) showed that wildlife in near proximity to people had a higher frequency of AMR carriage. Further, wildlife emergencies such as bushfires and heat stress events influence AMR dynamics with an increase in both frequency and the diversity of antibiotic resistance gene types observed.

The significance of AMR in wildlife is highlighted by the presence of 33 different antibiotic resistance genes, some to antibiotics of critical importance, in the gut microbiome of grey-headed flying foxes. While wildlife may rarely receive antibiotics, for some species where disease is a key threatening process, antibiotics may be important for conservation. For example, doxytetracycline and chloramphenical are used to treat koala chlamydiosis. Use of these

antibiotics us potentially complex given that we have detected tetracycline and chloramphenical resistance genes in koala microbiomes of both free-range individuals and koalas in rehabilitation.
Antimicrobial stewardship and One Health principles are required to ensure ongoing health of wildlife undergoing rehabilitation and the populations to which they are returned, and to reduce the risk of further emergence of AMR through wildlife reservoirs. Thus, it is imperative to ensure wildlife are included in antimicrobial stewardship training, education, and antibiotic use guidelines in the veterinary sector.

Session 4

The AMR Vet Collective – moving from 'ours' to 'yours'

Jane Heller[1], Kellie Thomas[1], Jacqueline Norris[2]
1. School of Agricultural, Environmental and Veterinary Sciences, Charles Sturt University, Wagga Wagga, NSW, Australia
2. Sydney School of Veterinary Science, University of Sydney, Sydney, NSW, Australia

The AMR Vet Collective (AMRVC; www.amrvetcollective.com) and associated Online Learning Program (VetAMS; www.vetams.org) were developed to create a strong collaborative online teaching environment for veterinarians (VetAMS; Norris et al, 2019) and provide a behaviour-informed pathway to access that environment and other key AMS resources (AMRVC). These assets were developed through collaboration between individuals from all veterinary schools in Australia and New Zealand, originally funded by the Commonwealth Department of Agriculture, Fisheries and Forestry.

Since its launch in February 2021, the AMRVC has received 9,800 users who have contributed to 32,000 views and 102,000 events, with the most frequently accessed pages those linking to antimicrobial prescribing guidelines and continuing education. Adjunct social media channels are also followed widely. Similarly, 1119 users have enrolled in the 9 module VetAMS course since it launched in September 2021 (with the addition of a poultry module in August, 2022). Feedback for these resources has been excellent (median feedback score of 9/10).
Following this initial success we now aim to ensure ongoing upkeep and development of VetAMS and the AMRVC to continue 1) updating teaching resources to reflect the changing AMR and AMS environment and 2) implementing behaviour-change methods in the form of social marketing to expand the target audience from those with pre-existing interest in AMS to those who are not yet interested, but represent key targets for these platforms.

We believe that to progress as outlined, a strong sense of shared ownership of this rich set of assets among all leaders in the AMS space (academia, industry and government) is required.

The AMRVC is a Not-for-Profit organisation that is steered by a board. Ongoing in-kind contribution by key individuals from at least two Universities, along with generous industry funding from three key industry areas has, to date, allowed its progression, but currently valuable resources (from these contributors) are spent trying to access ongoing support, rather than continuing the momentum that has been built.
We offer up the AMRVC, as a community-based Not-for-Profit, to all leaders in AMR and AMS to take shared responsibility and to contribute to ensuring its longevity, through a facilitated discussion around how this might best occur. As experts in AMS and not business, we seek guidance in ensuring the survival and clear future capacity of what we know are valued collaborative resources.

Key Antimicrobial Stewardship Message: The AMRVC and VetAMS are well received AMS resources that require a clear mandate and support for continuity.

Registration Requirements for Veterinary Antibiotics in Australia to combat Antimicrobial Resistance

Dharma Purushothaman[1], Donald Ray Sibanda[1]
1. Australian Pesticides and Veterinary Medicines Authority, Armidale, NSW, Australia

The Australian Pesticides and Veterinary Medicines Authority (APVMA) is the Australian Government regulator of agricultural and veterinary (agvet) chemical products, established in 1993 to centralise the registration of all agvet chemical products into the Australian marketplace. We regulate agricultural and veterinary chemicals to manage the risks of pests and diseases for the Australian community and to protect Australia's trade and the health and safety of people, animals and the environment. For an agvet chemical product to legally be manufactured, imported, supplied, sold or used in Australia, it must be registered by the APVMA – unless exempt by the Agvet Code.
Our registration process involves scientifically evaluating the safety and efficacy (effectiveness) of a product(1), including antibiotics, in order to protect Australia's trade and the health and safety of people, animals and the environment.

The APVMA evaluates all new applications for the registration of antibiotics for use in animals, major extensions of use, and any reviews of currently registered antibiotics, using an agreed set of data and information and a risk

assessment provided by applicants, as described in the regulatory guidelines(2). The main risk to be considered by applicants and assessed by the APVMA is the probability of diseases occurring in susceptible humans due to infection with antibiotic-resistant pathogens arising from proposed use of antibiotics in animals, and the consequences of such disease(3). The level of acceptable risk is that which, when weighed against proposed benefits of use in the target animal species, will not significantly compromise the therapeutic use of antibiotics in humans. For antibiotics to be used in non-food-producing animals, the risk assessment should address risks associated with the potential transfer of antimicrobial-resistant bacteria or their genetic material from non-food-producing animals, such as companion animals, to humans. The APVMA seeks advice from different organisations e.g., the National Health and Medical Research Council (NH&MRC), on the assessment of public health risks from the development of antibiotic resistance in human pathogens associated with the use of antibiotics in animals. However, the data, information and risk assessment are independently analysed by the APVMA to ensure that the active constituent and/or proposed product satisfy the statutory criteria.

This presentation will highlight the registration requirements for veterinary antibiotics in Australia to combat Antimicrobial Resistance (AMR) and provide guidance to industry as to how they can assist the regulator to contribute meaningfully to antimicrobial stewardship initiatives in Australia.

Key Antimicrobial Stewardship Message: This presentation will focus on AMR risk assessments for antibiotics registration in Australia.

1. Efficacy and target animal safety general guideline (Part 8), 2018 https://apvma.gov.au/node/401
2. Antibiotic resistance risk assessments, 2021. https://apvma.gov.au/node/1018
3. AMR and animal health in Australia, 2023. https://www.amr.gov.au/about-amr/amr-australia/animal-health

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Preserving equine health: Riding high with an antimicrobial stewardship program

Gaby van Galen[1], Kirsten E Bailey[2, 3], Denis Verwilghen[1], Chelsie Burden[1], Max Hannan[1], Stacey Sullivan[1], Josh D Slater[4], **Laura Y Hardefeldt[2, 3]**

1. Goulburn Valley Equine Hospital, Congupna, VIC, Australia
2. Asia-Pacific Centre for Animal Health, Melbourne Veterinary School, University of Melbourne, Parkville, VIC, Australia
3. National Centre for Antimicrobial Stewardship, Peter Doherty Institute for Infection and Immunity, Melbourne, VIC, Australia
4. Melbourne Veterinary School, University of Melbourne, Parkville, VIC, Australia

Antimicrobial resistance is a rapidly emerging threat in equine practice. Treatment failure, increased costs of therapy and pan-drug resistant organisms are being reported by equine veterinarians in Australia and may become more frequent if measures are not taken to reduce inappropriate antimicrobial use.
A co-design process was undertaken to implement an antimicrobial stewardship program (ASP) at Goulburn Valley Equine Hospital. The stewardship champions (SC) commenced in January 2022. Eight months later an initial workshop was held with an educational component and co-design of an ASP with all staff. Another three workshops allowed for protocol presentation and discussion. Antimicrobials sales and case numbers were retrieved from the practice management software.
All clinicians engaged with the ASP. In the 5 years before ASP, antimicrobial use (defined as daily dose per 100 cases) was 209 doses per 100 cases. In the SC period, antimicrobial use declined to 135 doses per 100 cases, and this was maintained during the ASP period (140 doses per 100 cases). High importance antimicrobial use declined in the ASP period (55 doses per 100 cases in 2021, 51 doses per 100 cases in SC period and 41 cases per 100 doses in the ASP period).

Key Antimicrobial Stewardship Message: This research demonstrates that co-design and simple interventions can have substantial impacts on antimicrobial use in equine practice.

Automating assessment of antimicrobial appropriateness for veterinary antimicrobial stewardship: A data science approach

Kirsten E Bailey[1, 2], Brian A Hur[3], Laura Y Hardefeldt[1, 2], James R Gilkerson[1, 2], Glenn F Browning[1, 2], Karin A Thursky[2]
1. Asia Pacific Centre for Animal Health, Melbourne Veterinary School, Faculty of Science, University of Melbourne , Parkville
2. National Centre for Antimicrobial Stewardship, Peter Doherty Institute for infection and Immunity, Melbourne
3. Biomedical Informatics and Medical Education, University of Washington, Seattle, Washington

Monitoring antimicrobial use is a foundational requirement for antimicrobial stewardship (AMS) programs. Globally, veterinary antimicrobial use monitoring has focused heavily on quantitative measurements with the goal of meeting reduction targets. However, antimicrobials are an essential tool for treating infections in animals, and therefore it is important that monitoring includes an assessment of the quality of use to enable AMS efforts to target areas of unnecessary, inappropriate, and suboptimal use.

The factors contributing to assessing the appropriateness of use include the indication for antimicrobial use, antimicrobial drug choice, dose rate, frequency of dosing, duration of dosing, and where available, compliance with prescribing guidelines. Building on previous research using natural language processing and machine learning, this project will automate the evaluation of clinical records for the reason for use (indication) and assessment of the appropriateness of antimicrobial use. Initially, algorithms for determining the appropriateness of antimicrobials used in the top 10 most common conditions in dogs and cats will be developed. A sample of records will be extracted, and veterinary clinicians will then evaluate these records and label the elements necessary to determine appropriateness. These developed labels will be used to train and test machine learning models to label the remainder of the data stored within VetCompass to evaluate the appropriateness of antimicrobial administration to companion animals in Australia at a population level. This methodology supports future scaling of antimicrobial use surveillance, including application to datasets from other animal sectors.

Key Antimicrobial Stewardship Message: This research uses novel data science methodologies to automate assessment of antimicrobial appropriateness to support Australian veterinary AMS efforts.

Acknowledgments: This research is part of the One Health project "Appropriate Antimicrobial Use: Scaling Surveillance Using Digital Health" funded by a Research Data Infrastructure MRFF grant (MRFFRD000113).

Moving beyond fears: how Australian companion animal veterinarians can be supported to appropriately withhold antimicrobials.

Ri Scarborough[1, 2], Anna Sri[1, 2], Glenn Browning[1, 2], Kirsten Bailey[1, 2], Laura Hardefeldt[1, 2]
1. National Centre for Antimicrobial Stewardship, Peter Doherty Institute for Infection and Immunity, Melbourne, Vic, Australia
2. Asia-Pacific Centre for Animal Health, Melbourne Veterinary School, Faculty of Science, The University of Melbourne, Parkville, Vic, Australia

Background: Veterinarians sometimes prescribe antimicrobials to pets, even when they suspect or are certain they will provide no benefit to the animal. To support appropriate withholding of antimicrobials, we must understand what drives these decisions.

Methods: In-depth, semi-structured interviews were conducted with 22 veterinarians who treated companion animals in Australia. All interviews included discussion of a cat fight abscess case, for which Australian guidelines recommend no systemic antimicrobials. Themes around the decision to withhold antimicrobials in the absence of a clear indication were analysed using the Theory of Planned Behaviour. (Ajzen, 1991)

Results: Fears of clinical deterioration and client dissatisfaction – and the many consequences of these potential outcomes - were the biggest barriers to appropriate withholding of antimicrobials. (Fig. 1) "The main things that you think of when someone leaves and you haven't given them antibiotics, you're like, is it going to get worse? Is the client going to ring up tomorrow and abuse me for not giving them the antibiotics?" - *Vet M, 28yo female, regional practice*

Figure 1: Veterinarians' fears when considering withholding antimicrobials in the absence of a clear indication, and contributory factors (grey boxes)

Veterinarians with strong communication skills, supportive workplace cultures, and sufficient time to undertake thorough consultations were empowered to withhold antimicrobials. The client's capability and willingness to monitor and nurse their animal(s) at home was also a critical factor in appropriate withholding decisions. Involving para-veterinary staff in antimicrobial stewardship efforts was another important enabler, as they could set client expectations of receiving antimicrobials or not, and assist clients with non-antimicrobial management, such as wound care.

Key Antimicrobial Stewardship Message: Actively involving para-veterinary staff in antimicrobial stewardship, cultivating a supportive veterinary workplace, training veterinarians in communication skills and improving clients' nursing capabilities are key modifiable factors that support appropriate antimicrobial withholding.

A global evaluation of generic antimicrobial prescribing competencies for use in veterinary curricula

Laura Y Hardefeldt[1,2], Glenn F Browning[1,2], Scott Weese[3], Kirsten E Bailey[1,2]
1. Asia-Pacific Centre for Animal Health, Melbourne Veterinary School, University of Melbourne, Parkville, VIC, Australia
2. National Centre for Antimicrobial Stewardship, Peter Doherty Institute for Infection and Immunity, Melbourne, VIC, Australia
3. Ontario Veterinary College, University of Guelph, Guelph, Canada

The European Society for Clinical Microbiology and Infectious Disease (ESCMID) developed consensus-based generic competencies in antimicrobial prescribing and stewardship. These may be useful in structuring, and evaluating, antimicrobial prescribing education to veterinary students but applicability has not been evaluated. We aimed to evaluate whether the ESCMID competencies are currently taught, and how relevant they are to veterinary prescribing, in veterinary schools globally. A multi-centre, cross-sectional survey was performed by administering an online questionnaire to academics teaching antimicrobial prescribing to veterinary students. Targeted recruitment was undertaken to ensure representation of diverse geographical locations. Responses (48) were received from veterinary schools in Europe (26), North America (7), Asia (6), Australia (3), Central and South America (3) and Africa (3). Of the 37 ESCMID prescribing competencies only 6 were considered only 'slightly' or 'not at all' relevant by more than 10% of respondents. Of the 37 competencies, 25 of the competencies were taught in more than 90% of schools and another 6 were taught by 80-89% of schools. Time spent teaching was 'too little' or 'far too little' for 5 competencies according to more than 50% of respondents. Additional competencies to address extra-label drug use, use of compounded antimicrobials, use of antimicrobials for metaphylaxis, prophylaxis and growth promotion and importance rating of antimicrobials were suggested. The ESCMID antimicrobial prescribing competencies had broad relevance and were widely covered in veterinary curriculum globally.

Key Antimicrobial Stewardship Message: The ESCMID antimicrobial prescribing competencies had broad relevance and were widely covered in veterinary curriculum globally.

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Exploring Antimicrobial Resistance in Australian Reptiles

Alice Aldora[1], Sasha Herbert[1], Kirsten Bailey[1], Marc Marenda[2], Rhys Bushell[2], Simon Firestone[1]
1. Melbourne Veterinary School, Faculty of Science, The University of Melbourne, Melbourne, Victoria, Australia
2. Asia Pacific Centre for Animal Health, Melbourne Veterinary School, Faculty of Science, The University of Melbourne, Melbourne, Victoria, Australia

According to the current global consensus, a widely implemented One Health approach is necessary to effectively tackle antimicrobial resistance (AMR) [1]. However, despite the recognition of AMR concerns in wildlife through collaborative efforts documented by several international organisations [2,3], practical implementation of AMR surveillance and control in wild animals lags behind that in human health and agriculture sectors [4–6].
Optimal administration of antimicrobials to wildlife is significantly hindered by the absence of comprehensive treatment guidelines specifically tailored to this group [7,8]. This lack of guidance stems from inadequate knowledge concerning species-specific pharmacology, attributable to their unique physiology and distinctive bacterial flora. Consequently, veterinarians frequently resort to extrapolating from other species, predominantly mammals, when prescribing antimicrobials. This approach often results in the utilization of broad-spectrum antibiotics, including those with high importance ratings.
This research aims to investigate the prevalence and probable drivers of resistant bacteria in snakes and lizards, starting with selecting target bacteria and developing an isolation and identification algorithm. A selective approach was employed to focus on specific bacterial taxa that address both animal health and public health concern, namely: 1. WHO AMR priority pathogens, 2. WHO vaccine availability, 3. zoonotic characteristics, 4. existence in reptiles as a reservoir, 5. detectability using oral and cloacal swabs, and 6. risks related to infection and resistance. Ten target bacteria were chosen for sensitivity testing, including *Enterobacteriaceae (Salmonella sp., E. coli, Klebsiella sp., Enterobacter sp., Citrobacter sp., Serratia sp., Edwardsiella sp.,* and *Proteus sp.), Enterococcus faecium,* and *Staphylococcus aureus*. The development of an algorithm for these selected bacteria proved challenging in reptiles, as they often lack common characteristics. Molecular methods such as sequencing are suggested for accurate species identification.

Key Antimicrobial Stewardship Message: Raising awareness of AMR concerns in wildlife, especially given the intricate nature of antimicrobial usage in reptiles and the absence of any established guidelines thus far.

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....Now The Drugs Don't Work

Rebbecca Wilcox[1]

1. University of Melbourne, ., VIC, Australia

Antimicrobial stewardship, in the laboratory animal industry, is the subject of just one peer-reviewed paper. We conducted the first surveys of their kind, in Australia, New Zealand, and North America, to characterise antimicrobial use in this underappreciated aspect of animal use and found that drugs of critical importance to human and animal health are routinely used, in large quantities, by 71-93% of institutions. Antimicrobials used routinely, include vancomycin, enrofloxacin, colistin, cefovecin, imipenem, etc. Antimicrobial use is unregulated, does not require prescription, is off-label and is 'baked' into laboratory rat and mouse research protocols, involving millions of animals per annum. Stewardship is poorly understood in this sector, as per survey data, with routine subtherapeutic dosing, use in inappropriate contexts, and with large scale environmental contamination. Herein lies an opportunity to address this source of antimicrobial misuse; educating the sector about stewardship, and introducing intra-institutional levers to ensure judicious use, both domestically and internationally.

Session 5 – Global Progress on antimicrobial stewardship

World Organisation for Animal Health (WOAH) - Current activities on AMU, AMR and AMS

Stephen Page[1]
1. Advanced Veterinary Therapeutics, Newton, NSW, Australia

Following an unexpected outbreak of Rinderpest in Belgium in 1920, it was in 1924 that WOAH, as the Office International des Epizooties, was created with 28 countries signing an international agreement. In January 2024 WOAH, now with 183 members (Australian admitted in 1925) will have been working to improve animal health for 100 years.
While transboundary disease (TBD) control was the initial and major focus of WOAH and antibiotics were still to be discovered in 1924, today, TBD control remains an important objective, but many other areas of animal health are critical elements of the strategic plan.
The AVAMS3 presentation will provide a brief summary of work related to antimicrobial use, resistance and stewardship including:

1. The WOAH List of Antimicrobial Agents of Veterinary Importance
2. Species antimicrobial lists - poultry, pigs, aquatic animals, cattle, dogs and cats
3. Terrestrial Animal Health Code, Chapter6.10, Responsible and prudent use of antimicrobial agents in veterinary medicine
4. Antimicrobial stewardship
5. AniMuse - a digital platform to gather data on antimicrobial use in animals
6. Anthelmintic guidelines
7. Falsified and substandard vet medicines

European Regulations on Prevention Use of Antimicrobials in the EU - Regulations 2019/4 and 2019/6

Shabbir Simjee[1], Gabriella Ippolito[2]
1. Elanco Animal Health, Basingstoke, HAMPSHIRE, United Kingdom
2. Elanco Animal Health, Greenfield, Indiana, USA

Antimicrobials remain a key tool for the treatment of infectious diseases in animals. There are three different circumstances for the therapeutic use of antibiotics in food producing animals: treatment, metaphylaxis/control and prophylaxis/prevention. In all cases where administration of an antibiotic is required, this should be prescribed following appropriate diagnosis by a veterinarian preferably with a good knowledge of the disease epidemiology on the farm. Animals with clinical signs of a bacterial infection that is impacting on their health and welfare in many cases need treatment with antibiotics. Metaphylaxis/control means the administration of a medicinal product to a group of animals after a diagnosis of clinical disease in part of the group has been established, with the aim of treating the clinically sick animals and controlling the spread of the disease to animals in close contact and at risk and which may already be subclinically infected. Prophylaxis/prevention means the administration of a medicinal product to an animal or group of animals before clinical signs of a disease, in order to prevent the occurrence of disease or infection i.e. in the absence of sub-clinical infection or detectable pathogens, there is a risk of disease outbreak.
Over the past several years significant progress on achieving better antibiotic stewardship in the veterinary sector has been achieved through regulatory legislations. The EU is now taking measures to phase out the routine use of antibiotics for disease prevention, reserving prophylactic use for exceptional circumstances. This article intends to add some clarifications regarding antibiotics for disease prevention that are embedded in two EU regulations which will came into force on 28th January 2022, Regulation (EU) 2019/4 on Medicated Feed and Regulation (EU) 2019/6 on Veterinary Medicinal Products.
In May 2020, the European Commission adopted the Farm to Fork Strategy, a tool to help shape the EU's path towards sustainable food systems. Its objective is the reduction by 50% of the overall EU sales of antibiotics for farmed animals and in aquaculture by 2030. The achievement of this objective will be supported by the implementation of the new Regulation (EU) 2019/4 and Regulation (EU) 2019/6.
Regulation 2019/6 legislates for the authorization, use and monitoring of veterinary medicinal products in the European Union. The legislation repeals Directive 2001/82/EC and is intended to:

- harmonise the internal EU market for veterinary medicinal products.
- reduce the administrative burden on companies and regulatory authorities.
- enhance availability of veterinary medicinal products.
- stimulate innovation of new and existing medicines.
- strengthen the EU response to fight antimicrobial resistance.

Specifically, regarding antibiotic resistance the new regulation mandates the following in relation to medically important antibiotics that are approved as veterinary medicines:

- Preventive use of antibiotics in single animal and small groups is allowed following veterinary assessment.
- Restricts the metaphylactic use of antibiotics
- Permits EU Member States to reserve specific antibiotics for humans only
- Oblige EU Member States to collect data on the sale and use of antibiotics
- Prohibits, for imported animals and products from outside the EU, antimicrobial veterinary products for promoting growth and places restrictions on antibiotics reserved for human use

Under article 105, which relates to veterinary prescriptions, prescriptions should only be issued following a proper clinical assessment. The justification for any prescription, especially for metaphylaxis or prophylaxis should be provided. The quantity of antibiotic prescribed for treatment should only be sufficient for the disease condition present at the time. If the prescription is for disease control or prevention, then the quantity prescribed should be limited to cover the 'at risk' period.
Of particular note is article 107, which has resulted in some confusion relating to metaphylaxis and prophylaxis. Article 107 explicitly specifies that antimicrobial medicinal products shall not be applied routinely nor used to compensate for poor hygiene, inadequate animal husbandry or lack of care or to compensate for poor farm management. With respect to metaphylaxis and prophylaxis Article 107 of regulation 2019/6 specifies the following:

1. Antimicrobial medicinal products shall not be used for prophylaxis other than in exceptional cases, for the administration to an individual animal or a restricted number of animals when the risk of an infection or of an infectious disease is very high and the consequences are likely to be severe.
2. Antimicrobial medicinal products shall be used for metaphylaxis only when the risk of spread of an infection or of an infectious disease in the group of animals is high and where no other appropriate alternatives are available.

Regulation 2019/4 relates to medicated feed, the scope of the medicated feed regulation is being extended to non-food producing animals and includes medicated feed for pets. To reduce the risk of antimicrobial resistance, rules on carry-over and preventive use of antibiotics are being proposed. The limits for carry-over of veterinary medicines into non-target feed will be set by delegated acts for specific active substances.
The legislation repeals Council Directive 90/167/EEC. Three points of particular interest relate to prescription, metaphylaxis and prophylaxis.
Regarding prescriptions of medicated feed, regulation 2019/4, under Article 16, requires:

1. The supply of medicated feed will be by presentation of a prescription only. The prescription will only be issued after a clinical assessment and only for diagnosed diseases.
2. Validity of prescriptions for medicated feed from the date of issue will be 6 months for non-food producing animals and three weeks for food-producing animals. However, if the medicated feed contains antibiotics, then the validity from date of issue will be limited to a maximum period of 5 days.
3. Duration of treatment and the amount of antibiotic containing feed that can be produced/supplied should be for a maximum of 2 weeks unless the summary of product characteristics (SPC) specifies differently
4. If it is not possible to confirm the presence of a diagnosed disease, a veterinary prescription for medicated feed containing an antiparasitic may be issued based on the knowledge of the parasitic infestation status in the animal or group of animals.

With regards to prescribing medicated feed containing medicinal antibiotics for prophylaxis, regulation 2019/4, under Article 17, require that:

1. Medicated feed containing antibiotic veterinary medicinal products shall not be used for prophylaxis.
2. Medicated feed containing antiparasitics may be used for prophylaxis on the basis of a prescription in accordance with Article 16 of 2019/4, as specified above.
3. Medicated feed containing immunological veterinary medicinal products can be used for prophylaxis on the basis of a prescription in accordance with Article 16 of 2019/4, as specified above.

With respect to metaphylaxis use of medicated feed, Regulation 2019/4 specifies that medicated feed containing antimicrobials for metaphylaxis should only be allowed when the risk of spread of an infection or of an infectious disease is high, in accordance with Regulation 2019/6 as assessed by a veterinarian.
In addition, it should be noted that Regulation 2019/4 Article 17 and Regulation 2019/6 Article 108 specify that the keeper of food-producing animals shall keep records of the medicinal products they use for a period of at least 5 years.
For clarity, it should be noted that anticoccidials (including ionophores) that are used in feed to kill and inhibit the coccidian parasites (these products are known as Coccidiostats in Europe) are registered as feed additives under regulation 1831/2003. Coccidiostats are approved as feed additives only for the species in which coccidias are ubiquitous in all production systems – whether free range or confined, small scale or large scale. The species for which they may be approved are chickens, turkeys, rabbits, guinea fowls, pheasants, quails, and partridges. As such they may be used as feed additives and therefore routinely in feed for these species without prescription.
For all other species in which coccidiosis and the associated risk of outbreaks are not always present, antiparasitic veterinary medicines are used to prevent, control or treat infections and this must be accompanied by a veterinary prescription.
In summary, regulation 2019/4 will not allow for medicinal antibiotics to be used in medicated feed for prophylactic use, however antiparasitics and immunologics can be used for disease prevention. Medicated feed containing medicinal antibiotics can still be used for disease treatment and control. Under regulation 2019/6 antibiotics can be used for disease prevention but should be limited to single or small groups of animals where the risk of disease is deemed to be high. It is hoped that this article helps to clarify any confusions around the metaphylactic and prophylactic use of medicinal antibiotics in the EU after 28th January 2022 both as a veterinary medicinal product and in medicated feed.
This talk will focus on the keys points of 219/4 and 2019/6 as well as its implications for third countries, i.e. countries exporting to the EU.

Key Antimicrobial Stewardship Message: EU bans prevention use of antibiotics' only in medicated feed and does not impact use of antimicrobials for prevention use in medicated feed.

Challenges and opportunities in promoting the rational use of antimicrobials in the animal health sector in Papua New Guinea

Daniel Kelly[1], **Mona Kheng[2]**, Paula Pupune[2], Victor Musyoki[2], Amrita Ronnachit[2], Ilagi Puana[1]
1. National Agriculture & Quarantine Inspection Authority, Port Moresby, Papua New Guinea
2. Burnet Institute, Melbourne, Victoria, Australia

In 2016, Papua New Guinea (PNG) conducted a country situation analysis to identify gaps in addressing antimicrobial resistance (AMR). Low engagement among stakeholders and inappropriate use of antimicrobials across all sectors were reported as major challenges. This created an opportunity for the health, agriculture, and environment sectors to jointly develop a National Action Plan (NAP) on AMR. A “One Health” approach was used to implement and advocate for improvement in the rational use of antimicrobial agents across all sectors, including animal health. Here, we highlight the challenges, underline the opportunities, and propose strategies to promote the rational use of antimicrobials in animal health in PNG.

An implementation review of strategic activities in the NAP on AMR to promote the rational use of antimicrobials in animal health was conducted by key stakeholders in 2021 and 2022. Challenges and opportunities were identified, and a SWOT (strengths, weaknesses, opportunities and threats) analysis was undertaken.

All strategic activities in the NAP on AMR to promote the rational use of antimicrobials in animal health were reviewed. Among the strategic activities reviewed, six key factors were identified as challenges associated with promoting the rational use of antimicrobials in animal health. These included rudimentary governance structures, limited diagnostic and surveillance laboratory capacity, a lack of human and financial resources to provide oversight of the rational use of antimicrobials at all levels, a lack of national antimicrobial policy and regulation, a lack of national veterinary treatment and IPC guidelines, and a lack of a robust surveillance system for AMR and antimicrobial use. Major opportunities identified were political commitment and collaborations with available local and international partners to promote technical and financial investment.

Rudimentary governance systems and low engagement and commitment among stakeholders are the key implementation challenges in promoting rational use of antimicrobials in animal health. Political commitment and

collaborations with local and international partners can facilitate implementation. We recommend strengthening government systems through political and partner collaborations, engagement, and commitment.

Lessons from capacity building projects in low- and middle-income countries in South and Southeast Asia

Mauricio JC Coppo[1], James R Gilkerson[1], Angeline S Ferdinand[2, 3], Benjamin P Howden[2], Glenn F Browning[1]
1. Asia-Pacific Centre for Animal Health, Melbourne Veterinary School, The University of Melbourne, Melbourne, Victoria, Australia
2. Microbiological Diagnostic Unit Public Health Laboratory, The Peter Doherty Institute for Infection and Immunity, Melbourne, Victoria, Australia
3. Melbourne School of Population and Global Health, The University of Melbourne, Melbourne, Victoria, Australia

The Asia-Pacific Centre for Animal Health, together with collaborators from the Peter Doherty Institute for Infection and Immunity, have been leading efforts in building capacity from a One Health perspective on antimicrobial resistance (AMR) and use (AMU) surveillance, and antimicrobial stewardship (AMS), in the animal health sectors of low- and middle-income countries (LMICs) in South Asia - Pakistan, Bhutan, Nepal; and Southeast Asia - Timor-Leste and Papua New Guinea, through the Fleming Fund programme.
Over the last three years, a substantial amount of work in close collaboration with animal health services of each country has resulted in a significant increase in the availability of AMR and AMU surveillance data, which are now being used to drive policy change, including the costing of national AMU in animal health, expansion of AMR surveillance targets in the animal production sectors, revision of national biosecurity standards and implementation of veterinary AMS programmes. Also, most countries are now in a position to be able to report AMU data of higher quality to the World Organisation for Animal Health sustainably.
Barriers for a One Health approach to prevent the emergence and spread of AMR have been identified in many of these countries. The expected limited access to resources (human, material and financial), as well as a lack of formal structures for collaboration and data sharing between organisations that participate in surveillance, and the gap in capacity that exists between human and animal health systems, are likely to impact on the achievement of National AMR Action Plan objectives. Continuing work with these countries will address those barriers to meeting the United Nations' Sustainable Development Goals (SDG) by 2030, particularly SDG17 (strengthening partnerships), SDG2 (secure access to food) and SDG3 (secure health), thus promoting conditions for decent work and economic growth (SDG8). Importantly, work with these governments is based on locally available workforce, and locally defined objectives and priorities within the context of their National AMR Action Plans, with the goal of promoting country ownership and long-term sustainability.

Key Antimicrobial Stewardship Message: Australia is in a privileged position to provide leadership and expertise (and resources) to help build capacity in LMICs across the region. Regional programmes also provide opportunities to strengthen networks and establish a community of practice with a common set of goals and harmonised criteria to establish AMS programmes in the Asia-Pacific region.

Antimicrobial Consumption in Animal Health in Bhutan

Ratna B Gurung[1], Karma P Zangmo[1], **Glenn F Browning**[2], James R Gilkerson[2], Angeline S Ferdinand[2], Mauricio J C Coppo[2]
1. Department of Livestock, Ministry of Agriculture and Forests, Thimphu, Bhutan
2. University of Melbourne, Parkville, VIC, Australia

Information about antimicrobial use in animal health is often limited and particularly so in low- and middle-income countries. Publication of data about use, and comparisons between countries, can help in the identification of policy initiatives to reduce unnecessary use and may drive implementation of better policy and practices. In this study we examined and analysed national data on antimicrobial consumption in Bhutan. The analysis found that antimicrobial consumption in animal health in Bhutan (3.83 mg per population correction unit) was comparable to that of the countries with the lowest rates of consumption in Europe and considerably lower than that in South Asian countries. However there was an increase in rates of use of fluoroquinolones and third generation cephalosporins between 2017 and 2021. Bhutan has high levels of governance of antimicrobial use in animal health, with high levels of compliance with regulation of use and high levels of adherence to national guidelines for treatment of livestock. These high levels of governance are likely to have resulted in the low rates of antimicrobial consumption.

Key Antimicrobial Stewardship Message: Antimicrobial consumption in animal health in Bhutan is lower than in most countries globally, reflecting strong governance of antimicrobial use and good levels of adherence to national treatment guidelines.

Survey of knowledge, attitudes and practices about AMR and AMU among poultry farmers in Bhutan

Pema Tshewang[2,1], Glenn F Browning[2], James R Gilkerson[2], Mauricio J.C Coppo[2], Karma Phuntsho[1], Kinley Penjor[3], Sherub Phuntsho[3], Chendu Dorji[4], Puspa M Sharma[5], Ugyen Namgyel[5]

1. National Veterinary Hospital, Department of Livestock, Thimphu, Bhutan
2. University of Melbourne, Parkville, VICTORIA, Australia
3. Bhutan Food and Drug Authority, Ministry of Health, Thimphu, Bhutan
4. Regional Veterinary Hospital and Epidemiology Center, Department of Livestock, Phuentsholing, Bhutan
5. National Center for Animal Health, Department of Livestock, Thimphu, Bhutan

Introduction: There have been numerous studies of the association between antimicrobial use in food animals and the occurrence of antimicrobial resistant bacteria in humans. In Bhutan, this is a source of considerable concern as Bhutan imports 90% of its meat and thus is highly susceptible to the risks posed by AMR bacteria in food. Even within the country, there is a shift from subsistence farming to commercial enterprises, especially in the poultry sector. Poultry meat and eggs are the most commonly consumed animal products in the country.

Rationale: Poultry farming is considered one of the hotspots for selection for AMR internationally because of the ways antimicrobials are used in this sector in some countries. High levels of use of antimicrobials, and projections for further increases in use in some countries, is concerning because there is evidence of imprudent use in such farming systems in many low- and middle-income countries. In order to develop strategies to combat AMR, it is essential to understand risk factors associated with the behaviours of end users. However, there are no studies of such factors in Bhutan. Therefore, we conducted a study to establish a baseline for future studies and to guide future policy interventions if they appear necessary.

Method: We conducted a structured questionnaire survey amongst poultry farmers in Bhutan with the objective of studying their knowledge, attitudes and practices (KAP) about AMR and AMU. The survey was distributed to the mobile phones using Epicollect5.

Result: A total of 715 poultry farmers across 10 districts participated in the survey. Most of the respondents were in their middle age (75%) and farm ownership was dominated by males (71%). Most farmers did not have any formal education (37.41%) and the majority of the farmers had less than five years of farming experience. The knowledge, attitudes and practices of the poultry farmers in Bhutan can be considered to be fair, based on the positive responses provided to the questionnaires in each category.
An adjusted logistic regression analysis showed that farmers' knowledge of AMR and AMU was significantly associated with their farming experience ($p = 0.040$), education level ($p = 0.000$), training attended ($p = 0.000$) and the frequency of visits by veterinarians to the farm ($p = 0.017$). However, there was no significant correlation with the farmer's gender ($p = 0.183$) or the farm size (0.841). None of these variables had any significant association with the farmers' attitudes but the education level of farmers ($p = 0.002$) and farm size ($p = 0.008$) had significant correlation with farmer's practices on AMR and AMU.

Conclusion: The overall KAP of AMR and AMU amongst the poultry farmers in Bhutan was found to be fair. However, KAP were affected differently by different socio-demographic variables. Therefore, targeted approaches should be designed to improve farmers' understanding of AMR to improve their attitudes and practices. While this is the first study of its kind in Bhutan, further studies are needed for comparison and to provide greater understanding.

Key Antimicrobial Stewardship Message: Focussed AMR and AMU education and training for end users can be crucial in mitigating AMR.

Acknowledgements:
- Fleming Fund, Department of Health and Social Care, United Kingdom for funding the study.
- University of Melbourne for the mentorship and resources.
- Livestock officials, Department of Livestock, Ministry of Agriculture and Livestock for conducting the survey.

Session 6 – AMS In Production Animals

A coordinated approach to tackling AMR in Wales

Dewi Hughes[1]
1. Menterabusness, Aberystwyth, CEREDIGION, United Kingdom

Wales may be a small country, but it's focused and integrated approach is already making a difference to the global challenges presented by AMR.
Progress is being achieved through an award-winning industry-led programme focusing on reducing the need to use antibiotics.
The Arwain DGC (Arwain Defnydd Gwrthfiotegau Cyfrifol - *or in English, Leading on Responsible Antibiotic Use)* Programme works with industry partners to deliver on coordinated and interdependent workstreams.
The programme works closely with government, industry leaders, veterinary practitioners, academics, farmers, and horse owners.
Arwain DGC supports farmers to trial new technology to help avoid the need to use antibiotics and shares good practice information encouraging mindset change.
Underpinned by collecting factual information on the usage of antibiotics on over 4,500 farms, the antimicrobial calculator provides a detailed usage breakdown and year-on-year benchmarking. This data is fundamental to identifying areas to drive further reduction in the need to use antibiotics. Additionally, environmental samples were collected and analysed from 54 farms across Wales over 12 months to determine AMR levels in the environment and transmission pathways.
The £5.5 million project (2021 – 2025) is funded by the Welsh Government as part of its five-year *AMR in Animals and the Environment Implementation Plan.*
Dewi Hughes, programme manager, will introduce the interdependent workstreams aiming to reduce AMR by responsible antibiotic use, setting standards, raising awareness of good practices, and embracing technology to avoid the need to use antibiotics.
The programme has seen significant progress, including establishing trained Veterinary Prescribing Champions in large animal vet practices (already at 90% participation, the aim is 100% by 2025), a veterinary-led code of good conduct and industry-agreed guidelines.
Key take home messages from Dewi will be how a national integrated programme has been established and delivered to reduce the risk of AMR in livestock and the environment.

Better antimicrobial stewardship in animals from enhanced surveillance for resistance

David Jordan[1], Alec Truswell[1], Zheng Zhou Lee[1], Rebecca Abraham[1], Sam Abraham[1]
1. Murdoch University, Murdoch, WA, Australia

Surveillance for antimicrobial resistance (AMR) in animals should be accurate, timely, affordable and serve the needs of antimicrobial stewardship (AMS). Existing AMR surveillance programs are typically the domain of national governments necessitated by the high cost per-isolate of manually performed sensitivity assays. In the case of resistance in commensal bacteria the numbers of isolates animals and herds appear incompatible with achieving some key objectives, such as the early detection of the emergence of resistance and defining the status of individual herds. Consequently, current versions of AMR surveillance have limited prospects for informing AMS, particularly as it relates to individual herds or flocks and changes through time.
The availability in Australia of high throughput robotics for antimicrobial sensitivity testing makes it possible to re-design surveillance to have far greater practical impact. To assist this process, a simulation model was constructed to show how enhanced study design improves the accuracy of surveillance for commensal *Escherichia coli.* The model mimics the process of applying a given surveillance protocol to a given biological scenario (describing prevalence and distribution of resistance) and uses authoritative metrics to compare and evaluate each protocol. Model assumptions were informed by extensive data on commensal *E. coli* isolates from multiple studies. The results show the fallibility of existing programs for early detection of resistance, for classifying herd status, and for detecting temporal changes in resistance. As an example, for detection of rare but important forms of resistance, Figure 1 compares standard surveillance (200 isolates in total) with high throughput surveillance (approx. 10k isolates per sample, 10 from each of 100 herds) in terms of the usefulness of negative test findings for specific herds.

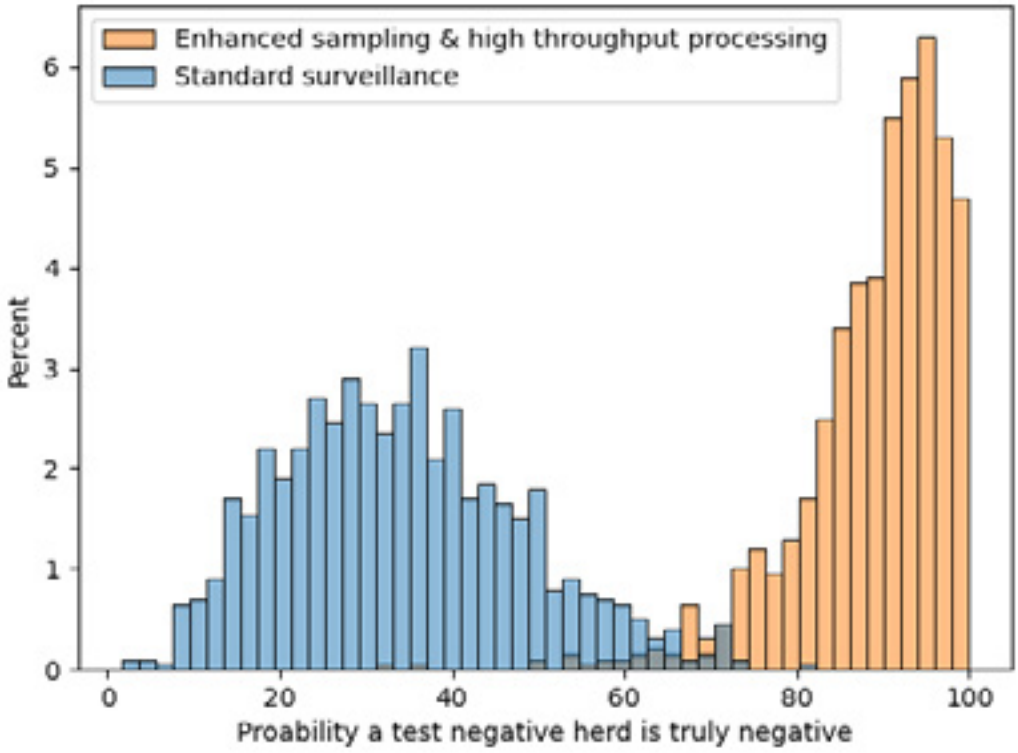

Figure 1. Negative predictive value at herd level for rare resistance by two forms of surveillance.

In conclusion, high throughput assessment of commensal bacteria for AMR is a unique opportunity to inform AMS. Data can be provided to individual animal enterprises with short turn-around and has a level of practical relevance missing in current surveillance strategies.

Key Antimicrobial Stewardship Message: Relevance of AMR surveillance data to AMS is enhanced when high throughput laboratory techniques are combined with enhanced study designs.

Improving antimicrobial stewardship via bulk tank milk surveillance

Scott McDougall[1], Ali Karkaba[1], Yvette MacPherson[1], **Ray Castle**[2]
1. Anexa, Morrinsville, WAIKATO, New Zealand
2. Elanco New Zealand, Auckland, New Zealand

An integral part of antimicrobial stewardship programs is surveillance for emergence of antimicrobial resistance. Antimicrobial use for control and treatment of intramammary infections is the largest indication for antimicrobial use in dairy cattle. Hence determination of the minimum inhibitory concentration (MIC) of isolates obtained from bulk tank milk offers a cost-effective and easy to implement surveillance system. Up to 20 isolates of *Staphylococcus aureus* and *Streptococcus uberis* are obtained from each bulk tank milk sample by use of selective media and isolates are pooled within species for broth microdilution testing against 10 antimicrobials. This Dairy Antibiogram (DAB) was established in 2017 in New Zealand and Australia.

Analysis of 4,518 *Staph aureus* DAB tests undertaken between August 2018 and April 2023 found a crude prevalence of isolates having an MIC greater than the epidemiological cut-off (ECOFF) for ampicillin and penicillin of 34.6% and 36.0%, respectively. The proportion of isolates with the MIC greater than ECOFF less than 1.5% for the remaining antimicrobials tested, which include amoxicillin/clavulanic acid (1.4%), cefazolin (1.0%), cefuroxime (0.3%), lincomycin (0.4%), neomycin (0.4%), cloxacillin (0.4%), oxytetracycline (0.6%), and Tylosin (0.2%).
Variations in proportion of isolates greater than ECOFF occurred across the regions of New Zealand, and with Australia, there was variability by calendar quarter across the year, and there has been a decline in the proportion of isolates greater than ECOFF over the last 6 years.

To find the possible source and molecular basis of resistance, *Staph aureus* isolates (n=150) with an MIC greater than

the ECOFF were submitted for whole gene sequencing. The genetic basis for the observed resistant phenotypes were confirmed for ampicillin/penicillin (i.e., presence of the blaZ), for methicillin resistant *Staphylococcus aureus (mecA)*, lincomycin *(lnu(A), vga(A))*, neomycin *(aadD1, aph3)*, oxytetracycline *(tet(K), tet(L))*, and Tylosin *(ermC)*. Presence of known antimicrobial resistance genes was associated with an elevated MIC in the majority of isolates. A mechanism for resistance was not identified by Resfinder for a small number of isolates (neomycin n=4; oxytetracycline n=5; penicillin n=4) and further bioinformatics is underway to identify the genetic basis of resistance. Six of the 7 MRSA isolates had one or more of the human immune evasion cluster genes and were located within clades of human MRSA isolates, suggesting a recent host switch from humans to bovines. Additionally, these MRSA isolates were multidrug resistant and had antimicrobial resistance genes for antimicrobials not used in bovine medicine (Fosfomycin *(fosD)*, fucidic acid *(fusB, fusC)*, mupirocin *(mupA)*, streptothricins *(sat4))*.

In conclusion, the Dairy Antibiogram offers a convenient and cost-effective strategy to undertake surveillance of multiple dairy farms across regions and time and provides veterinarians with a tool for providing feedback to their clients around emerging antimicrobial resistance patterns on their client's farms. Additionally source attribution of isolates and antimicrobial resistance genes may provide greater clarity about the source of antimicrobial resistance amongst bovine mastitis isolates.

Key Antimicrobial Stewardship Message: Determination of the MIC of the common bovine mastitis pathogens *Staph aureus* and *Strep uberis* offers a convenient way to undertake surveillance of multiple dairy herds across geographies and time hence enhancing our ability to detect emerging antimicrobial resistance quickly.

Exploring phytogenic feed additives as an alternative to antibiotics: enhancing gut microbiota diversity and antimicrobial stewardship in nursery piglets.

Sung Joon Yu[1], Andrew Morris[2], Thi Thu Hao Van[3], Yadav Bajagai[1], Dragana (Dana) Stanley[1]
1. Central Queensland University, KAWANA, QLD, Australia
2. Riverbend Pork Group, Toowoomba, QLD, Australia
3. School of Science, RMIT University, Bundoora, VIC, Australia

Introduction: Phytogenic feed additives (PFAs) are alternatives to antibiotics to help alleviate weaning-associated intestinal dysfunction and compromised growth. Their diverse biological functions, such as improving feed palatability, stimulating digestive enzyme secretion, and antioxidant, anti-inflammatory, and antimicrobial properties, have proven to improve feed intake and post-weaning piglet growth rates (Windisch et al., 2008). The weaning stage in pig management is a vital phase where piglets face several challenges that can negatively impact their health and growth. Reduced solid feed intake due to weaning can lead to weight loss and increased diarrhea and mortality risks. These issues also significantly affect the piglet's gastrointestinal tract (GIT), especially the intestines in charge of nutrient digestion and absorption. Changes in GIT structure and function can cause inflammation and affect nutrient utilization. The gut microbiota disturbances during weaning trigger gastrointestinal problems and pathogenic infections (Gresse et al., 2017). This study aimed to understand the effect of PFAs on microbial signatures, relative taxa abundance, and growth performance during this critical nursery period.

Material and methods: Two hundred piglets of 3-week age were randomly divided into control and treatment groups and given ad libitum access to water and a solid feed diet. The treatment group received a commercial PFA containing essential oils, mucilages, and flavonoids for five weeks. Parameters such as health, mortality, and body weight were monitored, and fecal and intestinal samples were collected for microbiota analysis with 16s rRNA gene sequencing. The microbiota sequencing data were analyzed using QIIME(2), R packages, and Primer e v7. Histomorphology analysis was conducted on ileum samples using H&E staining to measure villus height, crypt depth, and villus area.

Results: A significant improvement in the growth performance was observed in the pigs supplemented with PFA, with the treatment group displaying not only higher average weight gains but also a broader weight distribution in the higher percentile compared to the control group. Analysing the differences in the gut microbial populations the treatment group exhibited a more diverse gut microbiota, with a higher abundance of some specific microbial genera such as *Prevotella, Roseburia*, and *Faecalibacterium* (Figure 1), while reduction of unfavorable taxa such as *Clostridium sensu stricto (1)* and *Campylobacter* (Figure 1) was observed. Noticeable changes in the structural organization of the intestinal epithelium in the treatment group was observed in histomorphology analysis. The villus height, villus area, and villus/crypt ratios were significantly increased ($p < 0.0001$) in the treatment group.

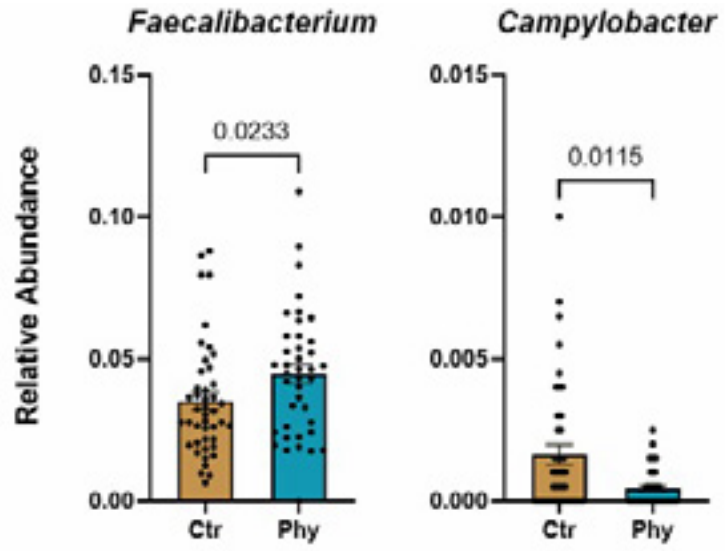

Figure 1. Bar chart showing relative abundance of differentially abundant genus from fecal samples.

Conclusions: This study showed that transition from milk to solid feed during weaning, combined with PFA supplementation, leads to significant alterations in the microbiota. Furthermore, PFA usage not only reduces the proportion of smaller pigs and improves growth performance but also enhances gut microbiota diversity, which is advantageous for animal health and immune function. To determine the practical applications of PFA in pig farming, additional investigation is necessary, considering factors such as pig behavior and various environmental conditions.

Key Antimicrobial Stewardship Message: The supplementation of phytogenic feed additives (PFAs) in piglets resulted in improved growth performance, enhanced gut microbiota diversity, and a reduction in unfavourable microbial taxa, suggesting the potential of PFAs as alternatives to antibiotics to mitigate weaning-associated intestinal dysfunction and compromised growth.

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2. Windisch, W., Schedle, K., Plitzner, C., & Kroismayr, A. (2008). Use of phytogenic products as feed additives for swine and poultry1. Journal of Animal Science, 86(suppl_14), E140-E148. https://doi.org/10.2527/jas.2007-0459

Enablers of AMS for Australian production animal, equine and companion animal veterinarians

Kirsten Bailey[1, 2], Glenn Browning[1, 2], James Gilkerson[1, 2], **Ri Scarborough[1, 2]**
1. National Centre for Antimicrobial Stewardship, Peter Doherty Institute for Infection and Immunity, Melbourne, Vic, Australia
2. Asia-Pacific Centre for Animal Health, Melbourne Veterinary School, Faculty of Science, The University of Melbourne, Parkville, Vic, Australia

Background: Understanding enablers of (and barriers to) antimicrobial stewardship for Australian veterinarians is a critical step in designing policies and interventions to support these prescribers. Very little qualitative research on this topic has been conducted with Australian veterinarians, particularly those working outside the companion animal sector.

Methods: In 2022, we conducted a survey of Australian veterinarians regarding their attitudes towards antimicrobial use. Interview volunteers were then selected from their survey responses, to represent a wide range of practice types, experiences and attitudes. Semi-structured, recorded, online interviews discussing antimicrobial use were conducted with these veterinarians by KB and RS, transcribed and thematically analysed according to the COM-B (capability, opportunity, motivation - behaviour) framework (Michie et al., 2011).

Results: Of the 14 interviewees, six were female, six were recent graduates, three were mid-career veterinarians and five were experienced veterinarians. Interviewees worked in mixed (3), poultry (2), pig (2), equine (2), companion

animal (2), dairy (1) and avian/exotic (1) practice.
Key enablers of antimicrobial stewardship identified by veterinarians included their concern about antimicrobial resistance, level of professional experience and self-confidence, communication skills, relationship of trust with the client, sufficient time for consulting and the existence of species-specific, up-to-date antimicrobial use guidelines. Higher client health literacy and client respect for the veterinarian's role were also felt to enable improved antimicrobial use. In production animal practice, clients' financial capacity and willingness to invest in infection prevention measures, including improved farm infrastructure and herd health consultations, were noted as key enablers of stewardship. Important barriers to stewardship were also identified.

Key Antimicrobial Stewardship Message: Investment in veterinarians' communication skills and client relationship building, production animal infrastructure, animal antimicrobial use guidelines and client health literacy could further improve antimicrobial use in animals in Australia.

Acknowledgements: These interviews formed part of a larger study commissioned and funded by the Australian Government, Department of Agriculture, Water and the Environment.

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Vetscan Mastigram+, a new tool to reduce antimicrobial use in Australian dairy herds

Lee F Taylor[1]
1. Livestock Veterinary Operations, Zoetis , Sydney, NSW, Australia

Treatment of clinical mastitis is a major contributor to overall antimicrobial use on Australian dairy farms. One means of reducing antimicrobial use on dairy farms is to selectively treat cows with clinical mastitis.[1] Cows with gram-positive infections are treated with antimicrobials while cows with no growth or gram-negative infections, which respond poorly to antimicrobial therapy, are treated with non-steroidal anti-inflammatory drugs where required. Zoetis have recently released Vetscan Mastigram+ as a rapid and accurate means of differentiating whether cows are suffering from gram-positive mastitis. The test utilises Rapid Immuno Migration technology, a test format that uses tagged colloidal gold particles as a colour signal to visualize the presence of gram-positive antigens in samples of mastitic milk. The test uses a dipstick method.

Test procedure: After aseptic collection, 1ml of the well-mixed mastitic milk sample is added to an enrichment vial containing enrichment broth and incubated at 37°C (+- 3C) for 7-7.5 hours in a standard incubator. Following incubation, a subsample of the enriched sample is transferred to a test tube. A test strip is inserted into the test tube from the top where it remains for 10 minutes. The sample is wicked vertically via capillary action through a deposit of dried colloidal gold within the test strip. The colloidal gold is conjugated with anti-gram-positive antibody, which form complexes specifically with gram-positive bacteria. The presence or absence of gram-positive bacteria in the test sample is visually determined by accumulation of colour on the test and control lines. To determine a negative result, it is important to wait 10 minutes. A positive result may be determined sooner than 10 minutes.

Test accuracy: Evaluations of the Vetscan Rapid Mastigram+ test demonstrated 99.1% diagnostic sensitivity and 100.0% diagnostic specificity when compared to direct culture and MALDI-TOF. The assay demonstrated 100.0% analytical specificity in detecting target gram-positive bacteria with an excellent limit of detection which ranged between 81 – 131 CFU/mL. Using a range of spiked samples, it achieved 100% inclusive analytical specificity and 100% exclusive analytical specificity. A field suitability study showed excellent accuracy across three different sites demonstrating test repeatability and reproducibility.

Key Antimicrobial Stewardship Message: Mastigram+ offers a rapid and accurate means of determining the presence of gram-positive bacteria in samples of mastitic milk, with a rapid turn-around time, enabling the practical application of selective therapy for mastitis on dairy farms.

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Robotic Antimicrobial Susceptibility Platform (RASP): objective support antimicrobial stewardship

Sam Abraham[1], Alec Truswell[1], Zheng Lee[1], Rebecca Abraham[1], David Jordan[1]
1. Murdoch University, Murdoch, WA, Australia

Antimicrobial resistance (AMR) is a global One-Health issue with implications for public and animal health. Here we describe two components of the Robotic Antimicrobial Susceptibility Platform (RASP) for characterising the occurrence of AMR to support antimicrobial stewardship. RASP revolutionises the scale and accuracy of AMR measurements while being affordable and logistically feasible. "RASP-MIC", applies to both pathogens and commensals, and combines mass spectrometry for organism identification with assay of minimal inhibitory concentration (MIC) and genomic interrogation of isolates. RASP-MIC conforms to international standards but can be implemented on a vast scale (thousands of isolates) for studying key factors in antimicrobial stewardship. "RASP-QUANT", is a modern agar dilution assay for commensal bacteria (e.g., *E. coli)* that quantifies the concentration of resistance in a sample and is extremely sensitive for detection of newly emerged resistance. Tandem use of the QUANT and MIC components of RASP is a powerful tool for addressing objectives that are hyper-relevant to antimicrobial stewardship (for example herd level attributes) which are neglected in most approaches to surveillance and research because they are not feasible. Practical gain from surveillance is augmented since reports can be automatically generated for dispatch to herd managers and veterinarians.

RASP components have been extensively validated in the laboratory and applied on a large-scale in real-world settings (1,2). In a national cross-sectional survey of 30 pig herds with a three-year longitudinal component for 10 herds, resistance to fluroquinolones and emergence of resistance to ceftiofur was found at concentrations unlikely to be detected by standard surveillance (Figure 1). In the future, automated reporting will allow herd managers to adjust stewardship measures based on data received from RASP within a week or so of sample submission.

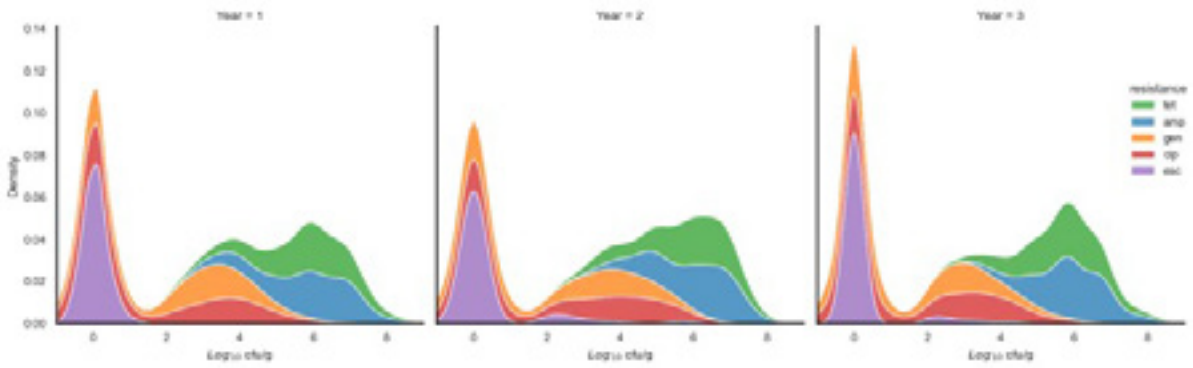

Figure 1. Temporal change in log concentration of resistance in commensal E. coli in ten pig herds across three years.

Key Antimicrobial Stewardship Message (one sentence) The RASP to AMR surveillance and research can fortify knowledge of key emerging AMR.

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Utilizing Porcine Cell Lines: A Promising Solution for MIC testing of *Mycoplasma hyopneumoniae*, a Fastidious Microorganism

Raziallah Jafari Jozani[1], Farhid Hemmatzadeh[1], Mauida Alkhallawi[1], Majed AL SAEGH[1], Darren Trott[1]
1. University of Adelaide, Roseworthy, SA, Australia

Antimicrobial profiling of fastidious microorganisms is a continuous challenge in antimicrobial stewardship. Due to the very slow growth of *Mycoplasma hyopneumoniae* very few studies have been done in MIC profiling of *M. hyopneumoniae*. It has long been recognized that mycoplasma species possess remarkable adaptability to eukaryotic cells, as they possess only the essential genes required to thrive in close association (extracellular and/or intracellular) with host cells1. Limited studies have been published in the determination of the Minimum Inhibitory Concentration (MIC) values for *M. hyopneumoniae* isolates2,3. Some studies have made progress by amplifying specific regions of the rRNA and/or tRNA genes and subsequently sequencing them. Unfortunately, comprehensive whole-genome sequencing has been overlooked in such investigations4. There are two primary challenges that hinder these studies. Firstly, the fastidious nature of *M. hyopneumoniae* and the labour-intensive techniques necessary for isolation and MIC profiling the bacteria are time-consuming and demand highly skilled laboratory personnel. Secondly, although antimicrobial resistance in *M. hyopneumoniae* is not yet a pressing concern, a growing number of studies in recent years have reported the emergence of resistant isolates to certain antimicrobials in various geographic regions5.

To address these challenges, we have established a eukaryotic cell system in parallel with traditional Friis broth to culture *M. hyopneumoniae*. Besides, a quantitative Real-Time PCR assay was developed based on the 16S rRNA gene to determine the growth curve of *M. hyopneumoniae* in infected porcine fibroblastic cell lines (PK15) and in Friis broth. The findings demonstrate that employing porcine cell lines can significantly reduce the time required for the isolation of *M. hyopneumoniae*.

	Inoculum day (day 0)	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
PK-15 (106 cells)	1×103	9×104	3×105	9×104	6×105	3×106	9×106	5×107
Friis broth (ml)	1×103	1×103	1×103	4×103	8×103	1×104	3×104	5×104

The comparison of *M. hyopneumoniae* copy number in traditional Friis broth and PK-15 cell line.
Key Antimicrobial Stewardship Message: *M. hyopneumoniae*, a microorganism notorious for its resistance to isolation, culturing, and preservation using conventional methods, necessitates a novel approach. This would allow for the generation of more MIC data, ultimately facilitating effective surveillance for antimicrobial stewardship.

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2. Vicca J, et al., Resistance mechanism against fluoroquinolones. Microb Drug Resist. 2007.
3. Le Carrou J et al., Persistence of Mycoplasma hyopneumoniae. Antimicrob Agents Chemother. 2006.
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Evaluation of a decision support tool for treatment of sporadic urinary tract infections in companion animals

Amy Hii[1, 2], James Gilkerson[1, 2], Ri Scarborough[1, 2], Anna Sri[1, 2], Magdoline Awad[3], Lynsey Etheridge[3], Laura Hardefeldt[1, 2]
1. Asia-Pacific Centre for Animal Health, Melbourne Veterinary School, Faculty of Science, University of Melbourne, Melbourne, VIC
2. National Centre for Antimicrobial Stewardship, Peter Doherty Institute for Infection and Immunity, Melbourne, VIC
3. Greencross Pet Wellness Company, North Ryde, NSW

Ten general practice veterinary clinics in Victoria were given access to free culture and sensitivity testing (C&S) for urine samples and provided with a decision support tool (a treatment guide poster for treating sporadic urinary tract infections) as part of an intervention study. At the end of the study, a survey was distributed to the veterinarians at the participating clinics and 23 responses were received. The aim of the survey was to determine the attitudes of veterinarians towards free C&S, investigate the effects of free C&S on antimicrobial prescribing behaviour, and to evaluate the decision support tool.

In the survey, most veterinarians (65%) stated that they followed the recommendations on the decision support tool at least half of the time they prescribed antibiotics. A majority of respondents (61%) felt that the tool changed the way they prescribed antibiotics and 74% prescribed empirical antibiotics based on the recommendations.

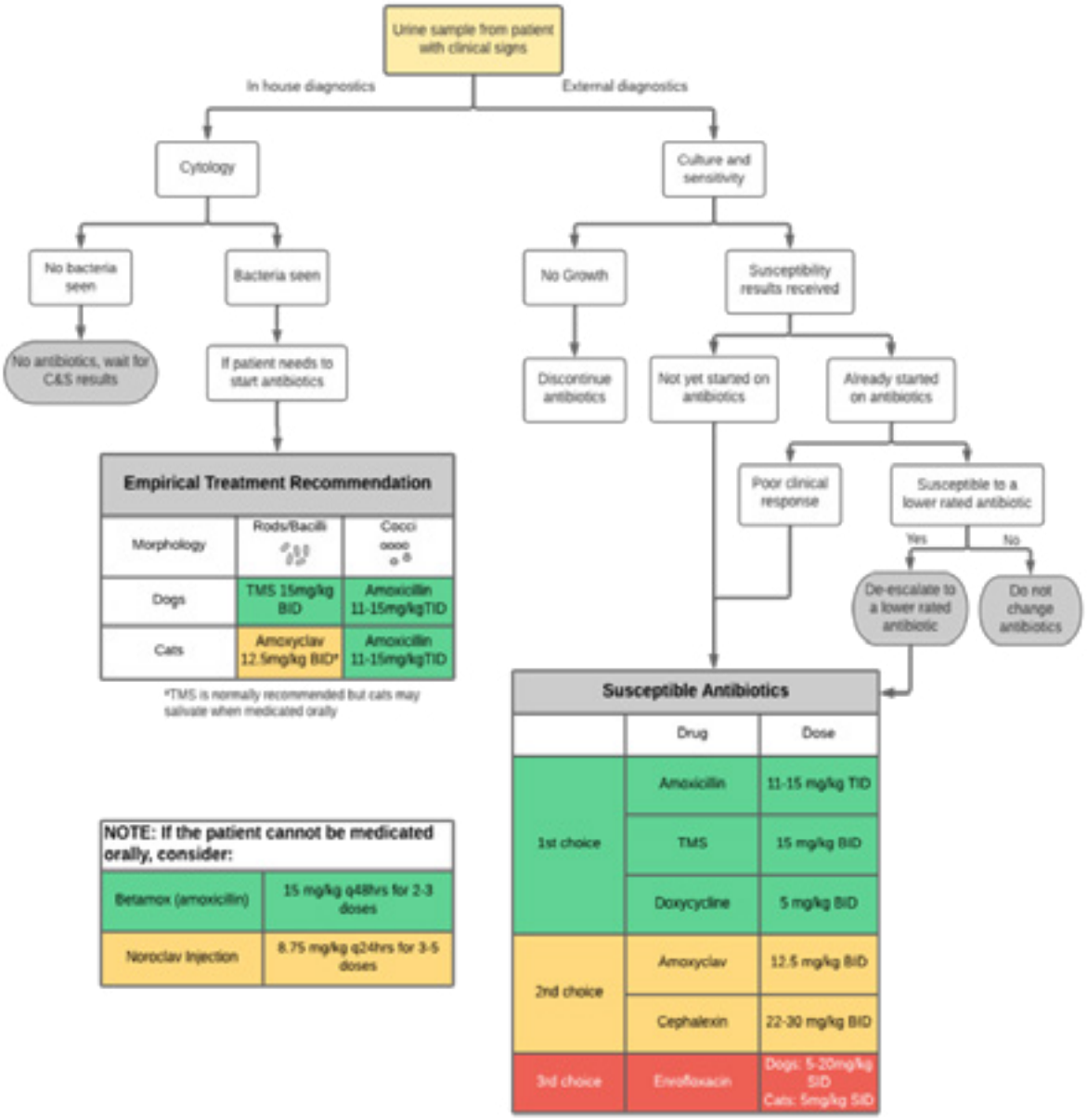

Figure: Treatment algorithm for sporadic urinary tract infections in dogs & cats

Key Antimicrobial Stewardship Message: The decision support tool could improve antimicrobial stewardship in veterinary practice and should be evaluated in a larger trial.

Acknowledgements: Greencross Pet Wellness Company, Idexx Laboratories

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2. Hardefeldt, L. Y., et al. (2018). Barriers to and enablers of implementing antimicrobial stewardship programs in veterinary practices. Journal of veterinary internal medicine, 32(3), 1092-1099.

Between a rock and a hard place: using antimicrobials appropriately or following the label

Kirsten Bailey[1,2], Glenn Browning[1,2], James Gilkerson[1,2], Laura Hardefeldt[1,2], Ri Scarborough[1,2]
1. National Centre for Antimicrobial Stewardship, Peter Doherty Institute for Infection and Immunity, Melbourne, Vic, Australia
2. Asia-Pacific Centre for Animal Health, Melbourne Veterinary School, Faculty of Science, The University of Melbourne, Parkville, Vic, Australia

Background: Antimicrobial residues in animal products can lead to serious consequences for the prescribing veterinarian. Following labelled doses and withholding periods provides the veterinarian with legal protection. However, there are production species for which no antimicrobials are registered, and some label regimens are outdated, as they fail to achieve the necessary minimum inhibitory concentrations. (Hardefeldt et al., 2018). Veterinarians must therefore often choose between using an evidence-based antimicrobial regimen or using a registered product at the labelled dose.

Methods: A survey of Australian veterinarians regarding antimicrobial use was conducted in 2022. Semi-structured interviews were then conducted with a carefully selected subgroup of survey respondents. Interview transcripts were thematically analysed.

Results: There were 399 analysable survey responses, representing a wide range of veterinary roles; 37% of those in clinical roles worked partially or entirely with food-producing animals and 63% with only non-food species. More than half the veterinarians surveyed wanted or needed to prescribe antimicrobials off label at least monthly, with the two most common reasons being lack of a registered product in that species or the label dose was out of date. In free-text responses and interviews, veterinarians were concerned about calculating appropriate withholding periods, particularly milk withholding periods in minor species such as goats and camels and how to implement use of prescribing guidelines that recommend off-label dose rates. Survey responses indicated that veterinarians' knowledge and understanding of the APVMA (Australian Pesticides and Veterinary Medicines Authority) process for off-label antimicrobial use were poor.

Key Antimicrobial Stewardship Message: There is an urgent need for collaboration between Government, livestock industry associations, veterinary industry bodies and animal medicine organisations to collate and fund studies to obtain the pharmacological and residue data to update product labels, and for legislatory change to ensure drug labels are regularly updated.

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Prevalence of antimicrobial resistant bacteria in remote Northern Territory dogs

Anna Sri[1,2], Kirsten Bailey[1,2], Amy Hii[1,2], Joan Malku Dhamarrandji[3], James Bayung Garrawitja[3], Joanne Allen[1], Rhys Bushell[1], Marc Marenda[1], James Gilkerson[1,2], Glenn Browning[1,2], Laura Hardefeldt[1,2]
1. Asia-Pacific Centre for Animal Health, Melbourne Veterinary School, Faculty of Science, University of Melbourne, Melbourne, Victoria
2. National Centre for Antimicrobial Stewardship, Peter Doherty Institute for Infection and Immunity, Melbourne, Victoria
3. Yalu Aboriginal Corporation, Galiwin'ku, Northern Territory

Antimicrobial stewardship measures are improved by a good understanding of the current levels of antimicrobial resistance. Antimicrobial susceptibility profiles were investigated in staphylococci isolated from dogs in a Northern Territory community. Canine faecal samples were also collected to check for the presence of extended spectrum ß-lactamase producing (ESBL) Gram-negative bacteria.
Samples were taken from the oral cavity, perineum or skin lesions of eighty-one dogs using plain swabs moistened with saline. Antimicrobial susceptibility testing was performed using Clinical & Laboratory Standards Institute broth microdilution on all isolated bacteria using Sensititre companion animal plates (Thermo Fischer Scientific) to identify drug-resistant isolates such as methicillin-resistant *Staphylococcus pseudintermedius* (MRSP) and methicillin-resistant *Staphylococcus aureus* (MRSA). Fifty-six percent of the 81 dogs sampled carried at least one species of staphylococci. No MRSA or MRSP was isolated and only one staphylococci isolate was multi-drug resistant. ESBL *E. coli* was isolated from one of six canine faecal samples. Further exploration is required to determine the significance of isolating ESBL *E. coli* from a dog who had not recently received antibiotics.

Key Antimicrobial Stewardship Message: Low levels of resistance are consistent with low levels of antibiotic use in this dog population. Research such as this provides a baseline for future antimicrobial stewardship activities.

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Prevalence and antimicrobial resistance patterns of *Klebsiella pneumoniae* reproductive isolates from mares during 2020-2022 breeding seasons

Amin Kawarizadeh[1], Keith Mitchell[2], Laura Hardefeldt[1, 3], Kirsten Bailey[1, 3], Marc Marenda[1], Catherine Chicken[2], Anna Blishen[2], Rhys Bushell[1], James Gilkerson[1, 3]

1. Asia-Pacific Centre for Animal Health, Melbourne Veterinary School, Faculty of Science, University of Melbourne, Melbourne, VIC
2. Scone Equine Hospital, Scone, NSW
3. National Centre for Antimicrobial Stewardship, Peter Doherty Institute for Infection and Immunity, Melbourne, VIC

Introduction: *Klebsiella pneumoniae* is a gram-negative, capsule-forming bacterium belonging to the *Enterobacteriaceae* family. This microorganism is among the bacteria associated with equine venereal disease, which impose an economic burden on the horse breeding industry. *K. pneumoniae* has been isolated in various pathological conditions affecting the equine reproductive system contributing to reproductive failure. Moreover, *K. pneumoniae* is one of the ESKAPE pathogens responsible for antibiotic-resistant infections. Today, the emergence of hypervirulent strains of *K. pneumoniae* and the increasing prevalence of multi-drug resistant isolates from samples of human and animal origin have made it difficult to treat *K. pneumoniae* infections. Although *K. pneumoniae* constitutes a relatively small proportion of bacteria isolated from the equine reproductive tract, their propensity to acquire and disseminate antibiotic-resistance genes highlights the importance of this research.

Methods: A total of 22191 equine reproductive samples were cultured between 2020 and 2022 (inclusive). Colony morphology, biochemical approaches (Microbact™ system (Oxoid) and negative motility tests were used to identify *K. pneumoniae* isolates. Antimicrobial susceptibility testing was performed using Vet Equine EQUIN1F Sensititre™ plates and the Sensititre™ ARIS™ 2X machine. The minimum inhibitory concentration (MIC) values for cefazolin, ceftiofur, ceftazidime, imipenem, tetracycline, doxycycline, amikacin, gentamicin, trimethoprim-sulfamethoxazole, chloramphenicol, and enrofloxacin were interpreted according to the CLSI guidelines.

Results: The prevalence of *K. pneumoniae* was 0.44% (range 0.31% to 0.52%). The prevalence of resistance to individual antimicrobials was 48% for cefazolin, 48% for ceftiofur, 36% for ceftazidime, 0% for imipenem, 52% for tetracycline, 38% for doxycycline, 0% for amikacin, 61% for gentamicin, 63% for trimethoprim-sulfamethoxazole, 15% for chloramphenicol and 46% for enrofloxacin. The prevalence of multi-drug resistance was 51%.

Key Antimicrobial Stewardship Message: The rate of multi-drug resistant *K. pneumoniae* in equine reproductive samples is alarming and warrants ongoing monitoring to inform antimicrobial stewardship efforts.

Impact of free culture and sensitivity testing for urinary tract disease on antimicrobial prescribing in companion animal practice

Amy Hii[1,2], James Gilkerson[1,2], Magdoline Awad[3], Lynsey Etheridge[3], Laura Hardefeldt[1,2]
1. Asia-Pacific Centre for Animal Health, Melbourne Veterinary School, Faculty of Science, University of Melbourne, Melbourne, VIC
2. National Centre for Antimicrobial Stewardship, Peter Doherty Institute for Infection and Immunity, Melbourne, VIC
3. Greencross Pet Wellness Company, North Ryde, NSW

Background: All patients with clinical signs of urinary tract disease should have culture and sensitivity testing (C&S) performed on their urine sample. Ideally, this is done before commencing antimicrobial therapy because there are other conditions which may present with similar clinical signs such as idiopathic cystitis in cats. The C&S is important to confirm the presence of infection and aid in antimicrobial selection to ensure the most appropriate drug is used. Veterinarians often cite the cost of C&S as a prohibitive factor and one of the reasons why they do not send all urine samples off to external laboratories for C&S.

Methods: From January 2022 to December 2022, 10 general practice veterinary clinics in Victoria were given access to free C&S for urine samples as part of an intervention study. The aim of this study was to determine if the cost of C&S is a barrier to antimicrobial stewardship in veterinary general practice and investigate if free C&S for urinary tract disease affected antimicrobial prescribing behaviour.

Results: A total of 480 urine C&S submissions were received in the 11 month study period. Around a third (35.5%) of these submissions were positive for bacterial growth and out of these, 62% involved *E. coli.* Of the positive samples, 21.8% were reported as mixed growth (more than 1 bacterial species isolated) and75% of these were from voided samples.
At the end of the intervention study, a survey was distributed to the veterinarians at the participating clinics. A total of 23 veterinarians completed this survey. Most respondents (80%) reported that they are submitting more urine samples for C&S compared to before the study and the remaining 20% said their number of submissions remained the same. Many of the veterinarians (74%) also said they delayed prescribing antibiotics while awaiting C&S results.

Key Antimicrobial Stewardship Message: There was an increase in urine C&S submissions when access to free C&S was available. Most veterinarians in the study self-reported positive changes to their antimicrobial prescribing behaviour as a result of the trial.

Acknowledgements: Greencross Pet Wellness Company, Idexx Laboratories

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Session 8: Industry Reports

Stewardship initiatives from the perspective of a feedlot consultant veterinarian

Tony Batterham[1]
1. Apiam Animal Health, Quirindi, NSW, Australia

Antimicrobial stewardship has gained significant importance in the Australian beef feedlot industry. It is a requirement for National Feedlot Accreditation Scheme membership to maintain an antimicrobial stewardship plan, overseen by a consulting veterinarian. The antimicrobial stewardship plan typically covers elements of regulatory compliance in the use of prescription antibiotics, adherence to veterinarian supplied treatment protocol(s), maintenance of treatment records, observance of WHP, and ongoing training of livestock staff in stewardship principles. More sophisticated plans include monitoring of usage, conducting microbiological surveillance of necropsies, monitoring health data for early indicators of reduced treatment response and utilising advanced diagnostics to discriminate between and/or confirm diagnoses. All stewardship plans emphasise the principles of refine, reduce, replace antimicrobial use.
Meat and Livestock Australia has (levy) funded multiple projects in the beef feedlot clinical setting, mostly concerning surveillance of antimicrobial resistance.
The main prevailing issues for the beef feedlot industry are the justification and application of metaphylaxis, the use of oral antimicrobials, the use of antimicrobials critical to human medicine and the emergence of multi-resistant bacteria via integrative and conjugative elements, noting that all of these variables occur at a very low prevalence from the vantage point of our practice's oversight.
In recent times, industry stakeholders have placed emphasis on usage recording and reporting with the aim of demonstrating decreased usage over time. Within industry, there is a long history of adoption of backgrounding and pre-vaccination husbandry to augment immunocompetence, vaccination at feedlot entry to boost immune response and also exploration of targeted autogenous vaccine strategies. On the diagnosis side, research and development has also pursued improved diagnostic methods such as remote sensing and use of ultrasonography at point of hospital presentation.

Surveillance for antimicrobial resistance in enteric commensals and pathogens in Australian meat chickens

Rebecca Abraham[1], Nikki Owiredu[1], Hui San Allison[1], David Jordan[1], Tony Pavic[2], Kylie Hewson[3], Zhou Lee[1], **Sam Abraham**[1]
1. Murdoch University, Murdoch, WA, Australia
2. Berling Laboratories, Sydney
3. Satavis, Beenleigh, Queensland

Antimicrobial resistance (AMR) is a serious threat to public health globally. The cornerstone of national and international efforts to address AMR is antimicrobial stewardship. The purpose of this study was to reassess the prevalence of resistance against specified antimicrobials amongst key indicator and foodborne pathogens isolated from caecal contents of Australian meat chickens at slaughter.
Caecal samples consisting of 5 caeca (n=190) were proportionally collected from 20 processing plants (October 2021 – May 2022) representing 90% of Australian meat chickens. *E. coli* and *Enterococci spp*. were isolated using selective agar on the Robotic Antimicrobial Susceptibility Platform (RASP) [1]. *Salmonella* and *Campylobacter spp.* were isolated using traditional methods [2]
A total of 2950 *E. coli* isolates were collected, 14 times more than in the 2016 study. The majority of isolates were susceptible to all tested antimicrobials (56.8%) with no resistance to third generation cephalosporins detected. Resistance to ciprofloxacin (1.2%) was detected. Only 2.92% of *E. coli* isolates were classified as multi-class resistance (MCR).
No resistance to vancomycin or linezolid was detected in enterococci isolates (n=171). Tetracycline resistance was the most prevalent *(E. faecalis* 87.5%, *E. faecium* 30.6%). Resistance to Erythromycin and quinupristin-dalfoprisitin decreased compared to the previous study [2,3], from 39% to 5.44% and 54.5% to 6.1% respectively.
Salmonella isolation was very low (n=9) with no resistance observed.
The majority of *Campylobacter* isolates (n=178) were susceptible to all antimicrobials tested *(C. jejuni* 68.7%; *C. coli* 88.9 %) with no MCR profiles or resistance to macrolides identified. Resistance to tetracycline (18.26% *C. jejuni;* 1.59% *C. coli)*, nalidixic acid (21.74% *C. jejuni;* 4.76% *C. coli)* or ciprofloxacin (24.35% *C. jejuni;* 3.17% *C. coli)* was detected.

Despite there being no use of fluoroquinolones in meat chicken industry in Australia, all the ciprofloxacin resistant isolates had mutations in the region known to confer resistance to quinolones.
The RASP processing of *E. coli* demonstrated the resolution achievable using high throughput robotics. Fluoroquinolone resistant isolates belonged to ST354, ST773 and ST752, globally disseminated multi-host strains. Considering the global prevalence of these fluoroquinolone resistant strains and the fact that fluoroquinolones are not used in the chicken meat industry it is likely the strains have been introduced through an external source. These results suggest the Australian chicken meat industry's efforts through its AMS program to reduce, refine and replace the use of antibiotics used in human medicine in the chicken industry are having a positive impact on the occurrence of AMR in chicken meat. The results also provide opportunities to continue improving antimicrobial stewardship efforts.

Key Antimicrobial Stewardship Message: AMS programs to reduce, refine and replace the use of antibiotics appears to be having a positive impact on the occurrence of AMR

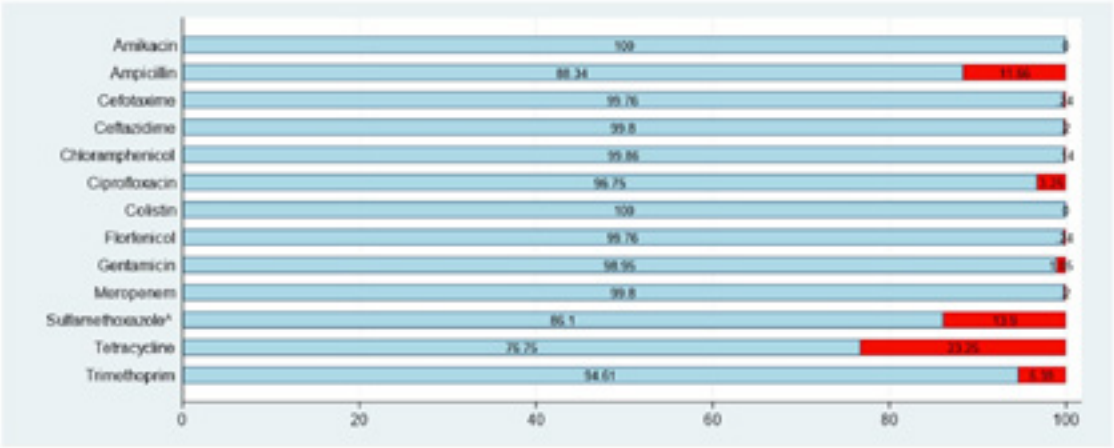

Figure 1. Antimicrobial resistance patterns for Escherichia coli (n=2950) based on microbiological (ECOFF) break points. Clinical break points are used when microbiological break point is unavailable. The proportion of susceptible is shown in blue and the proportion resistant in red. ^ Denotes no microbiological breakpoints available, therefore clinical breakpoints were used. # No data available due to lack of ECOFF and clinical breakpoints.

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Antimicrobial stewardship in dairy herd health programs: A proactive approach with client data

Luke Morison[1]
1. Apiam Animal Health, East Bendigo, VIC, Australia

ProDairy® is a proactive service delivery model implemented by dairy veterinarians within Apiam Animal Health Ltd. Over 400 farms currently participate in the program across the key dairy regions of Australia representing a base more than 200,000 milking cows. The ability to automate customised treatment protocols and the incorporation of required review visits has provided our team with new opportunities to direct the use of all antimicrobial products and drive change directly on farm.
Efforts to exert influence and provide education to producers regarding antimicrobial use within the industry have been greatly enhanced by the development and use of product purchasing reports. Farm visits including key

personnel are intentionally structured to review and direct the use of antimicrobials with reference to key areas of use, regional benchmarks and preventative measures.
The reporting model has gained substantial traction with our veterinary team and is experiencing a steady rise in adoption with producers.

Reporting Data:
The data schema used for products includes a wide array of attributes i.e. active ingredients, pharmaceutical therapeutic groups and classes, areas of use, biological systems, ASTAG ratings, routes of administration and withholding periods. Within product categories, assignment is available to species and subspecies level, further differentiating items for more comprehensive reporting.
Interpretation and presentation of the data has been refined over multiple iterations of reporting within the dairy segment. Key features have evolved which have proved to resonate strongly with both veterinarians and producers:

- Treatment courses described per 100 milking cows allowing ease of interpretation.
- Individual farm data benchmarked within dairy regions for increased local relevance.
- Rolling 12 month data ensuring currency of information.
- Comparison with previous years antimicrobial use to document change over time.
- Segmentation of antimicrobials to clearly differentiate categories of use.

Comments:
Our veterinarians face challenges with the accessibility, consistency, and accuracy of farm treatment records, especially when it comes to understanding disease incidence and making therapeutic decisions at a regional level. Benchmarking within our own database has proven to be a valuable tool to measure and direct antimicrobial use. The regional data plays a pivotal role in motivating protocol and usage pattern improvements.
Transaction records should be approached with caution to avoid overinterpretation, but overall, the data tends to intuitively reflect on-farm issues and areas of attention. Augmenting purchases with service provision and diagnostic records will further enhance insights and drive on-farm changes, especially regarding antimicrobial use.

AMR journey in the pig industry

Sam Abraham[1], David Jordan[1]
1. Murdoch University, Murdoch, WA, Australia

The use of antimicrobials and the development of antimicrobial resistance (AMR) in pig farming have garnered significant attention, both on a global scale and within Australia. While most medically relevant AMR issues are linked to the exclusive use of antimicrobials in human healthcare, there is growing concern about resistance in zoonotic foodborne pathogens like *Salmonella* and *Campylobacter sp,* as well as in livestock-associated bacteria such as *Escherichia coli* and *Enterococcus spp.* This heightened scrutiny is primarily due to the fact that many of the same classes of drugs used in human medicine are also employed in the treatment and control of bacterial diseases in livestock.
Until recently, Australia has benefited from its geographic isolation, a quarantine policy that has virtually excluded the entry of all food-animals for half a century, and an emphasis on extensive production systems in providing protection from emergence and propagation of critically important AMR in livestock. Additionally, there has been tight regulation of CIA use in food animals: key drugs either cannot be used [fluoroquinolone (FQ), carbapenems, polymyxins] or are subject to severe restriction compared to other countries [the extended spectrum cephalosporins (ESC) ceftiofur].
National AMR surveys in pigs have indicated very favourable antimicrobial resistance status. However, some limitations to these protections have recently become apparent, threatening the outstanding AMR status currently enjoyed by the Australian livestock sector. These vulnerabilities appear to be related to the inability to exclude exposure to geographically mobile hosts, including avian wildlife and in-contact humans, which allow transmission to livestock enterprises by introducing gut-borne contagion into production facilities. This include the detection of both ESC-resistant and FQ-resistant *E. coli* and community and livestock associated MRSA in pigs.
This presentation aims to review the AMR journey in the Australian Pig industry and discuss some of the key initiatives and novel approaches in combating antimicrobial resistance in Australian pigs.

AMR in the eggs industry

Mini Singh[1]
1. Australian Eggs, NSW, Australia

It is important that the egg industry participate in antimicrobial resistance stewardship practices to ensure that important antibiotics remain available to manage flock health and hen welfare, as well as meet our commitments to Australia's One Health strategy. In 2019 the egg industry commissioned its first survey of antimicrobial resistance and repeated this work within a 5-year timeframe. The findings of the survey reflect the low antimicrobial use and low disease status of Australian layer farms.
Australian Eggs developed the 'Antimicrobial Stewardship Framework (a guideline for veterinarians and the egg industry)', which was rolled out to key producer and veterinary stakeholders in early 2020. Since then, Australian Eggs has been involved in several initiatives within the AMR stewardship nationally. We are members and key participants in the steering committee of the AIAS. We have been represented at the National Monitoring and Evaluation Framework Development Project for the "National Antimicrobial Resistance Strategy - 2020 and beyond". Australian Eggs recently contributed to the 'AMS in Livestock' report. The AMR Vet Collective is another collaborative initiative we are involved with to provide training and educational materials to veterinarians. During 2022/2023 Australian Eggs undertook an antimicrobial usage survey project within the industry. We recently completed a project on alternatives to antibiotics that reviewed potential use of organic acids, nutraceuticals probiotics and prebiotics, enzymes, bacteriophages, and antimicrobial peptides. Within Australian egg industry's voluntary QA program, Egg Standards of Australia (ESA), medications used must be recorded and the principles of AMS are currently being formally incorporated to assist vets and farmers in recording all details regarding the use of antimicrobials, including a record of script and use directions from a veterinarian. As such, an excellent stewardship has been demonstrated by minimal use of antimicrobials and regular monitoring and recording in the Australian commercial layer industry

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Antimicrobial stewardship (AMS) is part of our duty of care for the world around us.

AMS is about ensuring the Quality Use of antimicrobials, including antibiotics. Good antimicrobial stewardship means using “as little as possible, as much as necessary” to ensure that high levels of health and welfare are present throughout the entire life of all humans and animals who might require antimicrobials to treat infection. Successful AMS requires recognition of its importance and a partnership approach with high level support. We need AMS to ensure we will always have effective antimicrobials, so that all humans and animals can live in a world where microbial infections can be managed successf