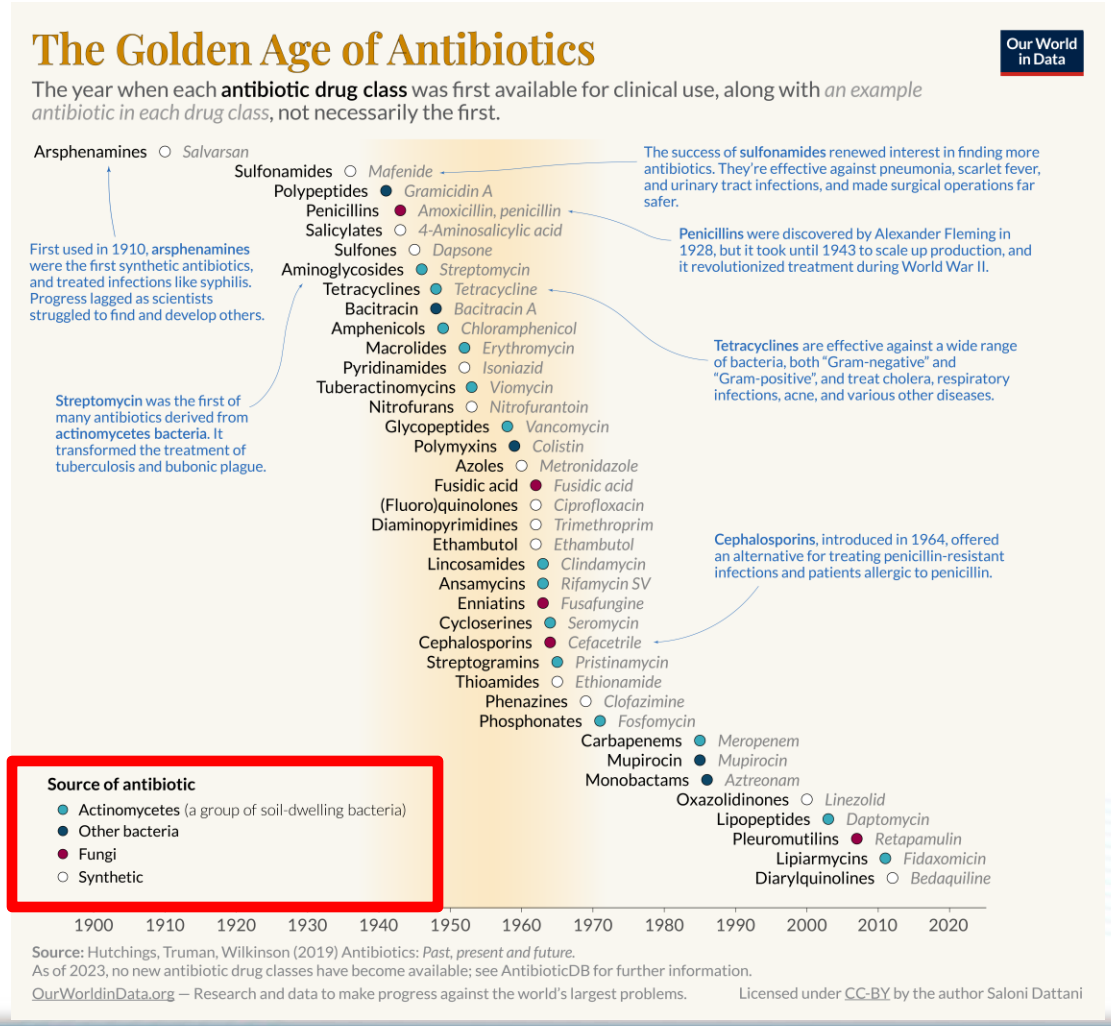
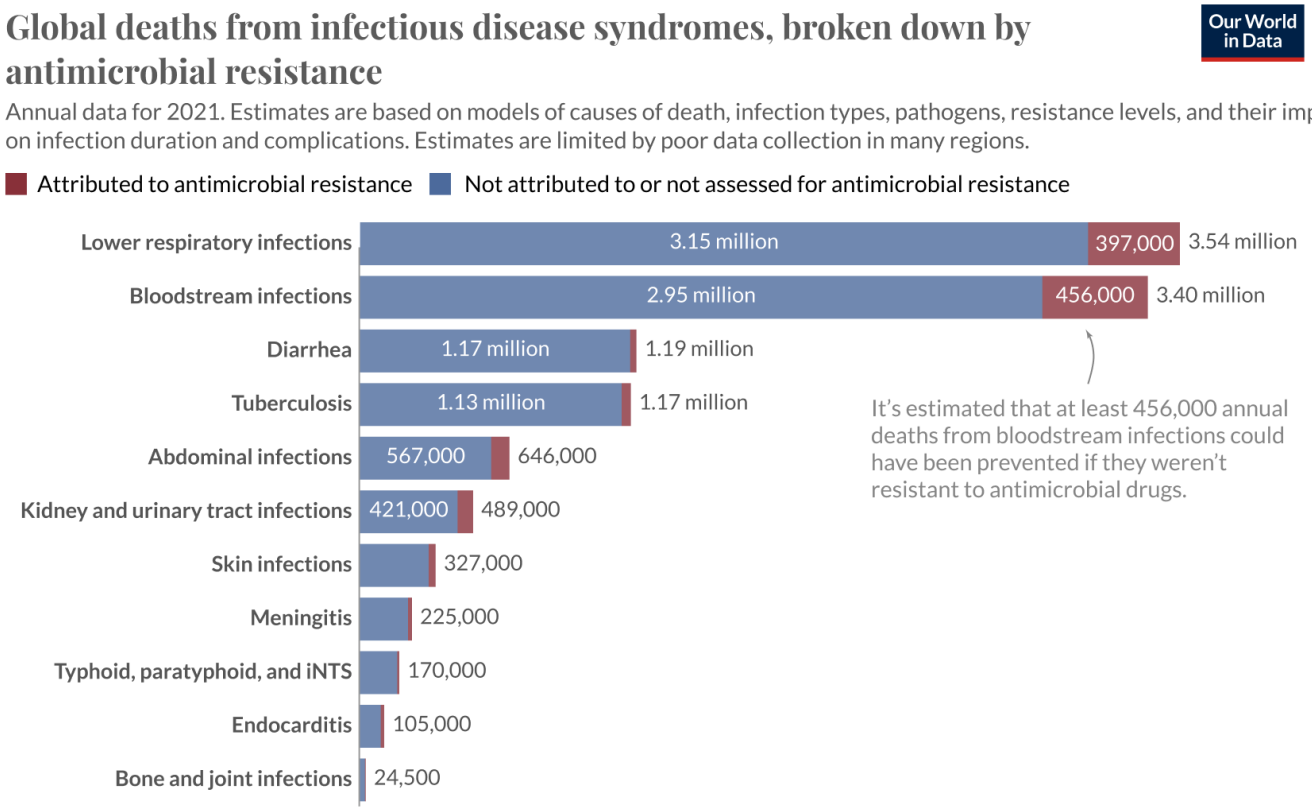
AMR capacity building projects in Asia and the Pacific: lessons from the Fleming Fund and beyond.

James Gilkerson.
Melbourne Veterinary School

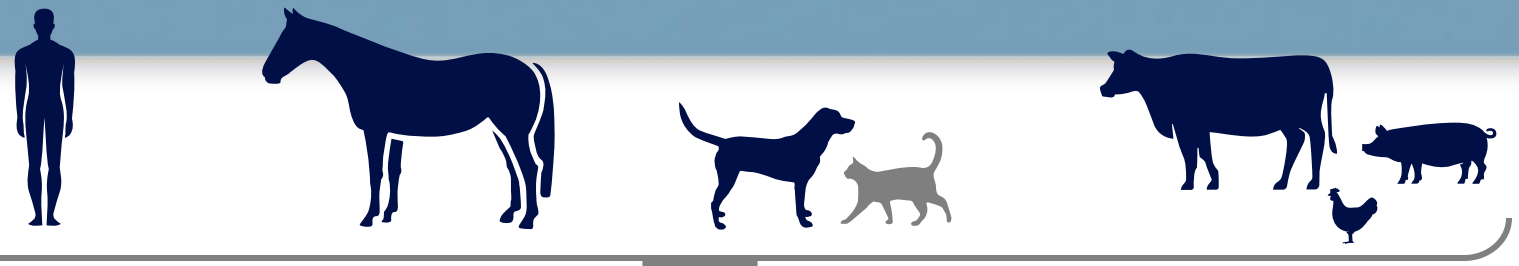
AMR is a global threat to human health





https://ourworldindata.org/antibiotics?utm_source=OWID+Newsletter&utm_campaign=d8328d8deb-RSS_EMAIL_CAMPAIGN&utm_medium=email&utm_term=0_2e166c1fc1-d8328d8deb-532657629

All antimicrobial use exerts selection pressure



All animal species

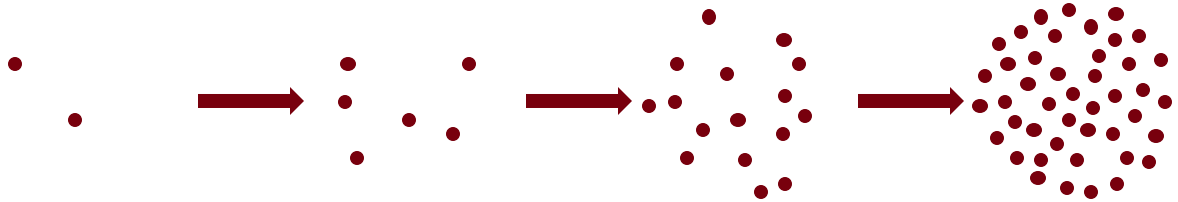
ANTIMICROBIAL USE

Appropriate & unnecessary use

MICROBIOME

Susceptible bacteria

Resistant bacteria



INCREASING ANTIMICROBIAL RESISTANCE

All exposed bacteria: target pathogen + commensals

Unnecessary use selects for resistance without benefit

APPROPRIATE ANTIMICROBIAL USE

Selection pressure on all exposed bacteria
+
Potential harms

Clinical benefit

UNNECESSARY ANTIMICROBIAL USE

Selection pressure on all exposed bacteria
+
Potential harms

No clinical benefit

Examples of unnecessary use

Self-resolving infections
Abscesses

Longer than needed
Surgical prophylaxis >24hrs

Just in case
Viral respiratory disease

AMR is a global **One Health** threat



We need a <u>One Health</u> approach

Inter-Sectoral Collaboration

Shared Methodology

Inter-disciplinary Research

Data Sharing


Human
Health

AMR is a global **One Health** threat

We need a truly One Health approach

- What are the important animal species?
- What diseases are important?
- How are these diseases treated?
- How appropriate is the treatment?
- How successful is the treatment?

We can't share data that doesn't exist!

Not a level playing field

AMR is a global **One Health** threat

We need a truly One Health approach

- What are the important animal species?
- What diseases are important?
- How are these diseases treated?
- How appropriate is the treatment?
- How successful is the treatment?

Animal population data

Animal health data

- Disease surveillance data
  - Sample collection
  - Sample submission
  - Laboratory capacity
  - Cost
- Treatment data
  - Government vets
  - Private vets
  - Paravets
  - Farmers / Owners
- **Cost – who pays?**

Are we looking at the right problem?



Antimicrobial Stewardship

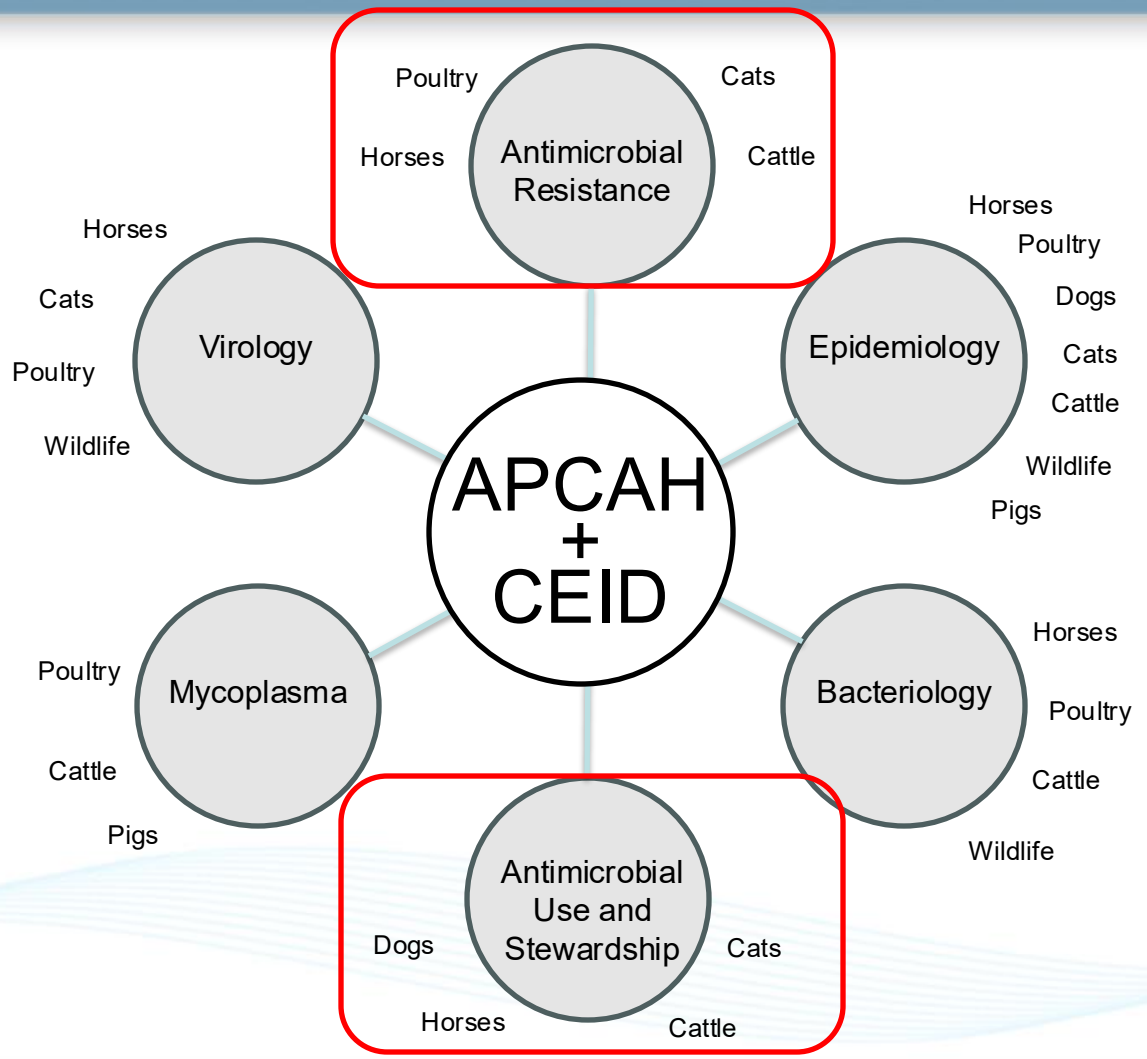


Appropriate antimicrobial use

Asia Pacific Centre for Animal Health
Centre for Equine Infectious Disease



39 Staff
72 Students
81 Publications (2025-26)





How often are antimicrobials used?

RESEARCH ARTICLE

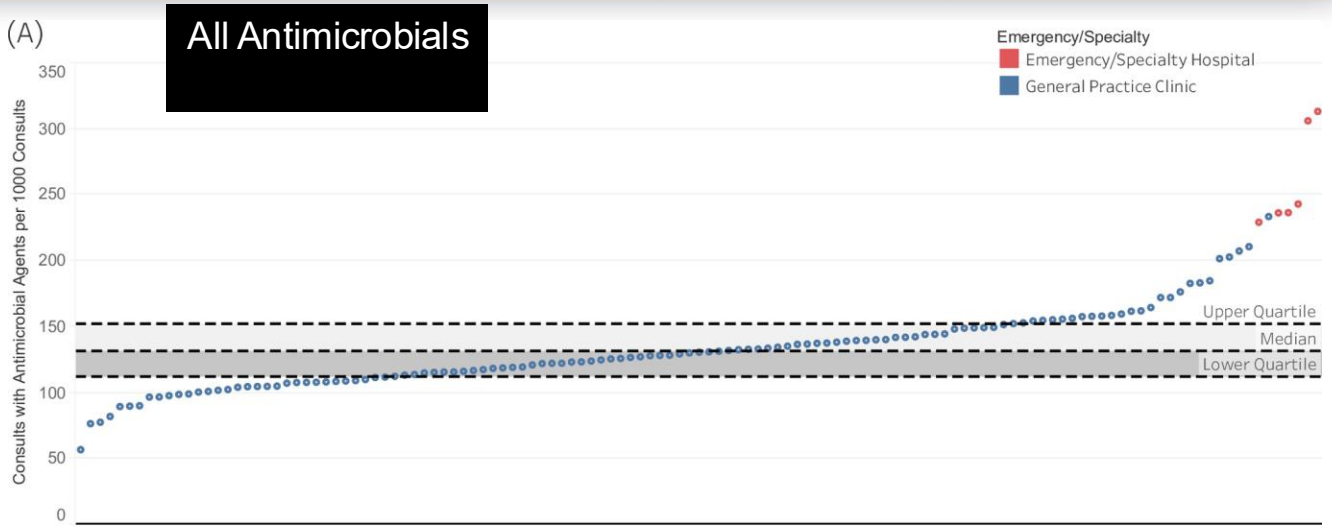
Describing the antimicrobial usage patterns of companion animal veterinary practices; free text analysis of more than 4.4 million consultation records

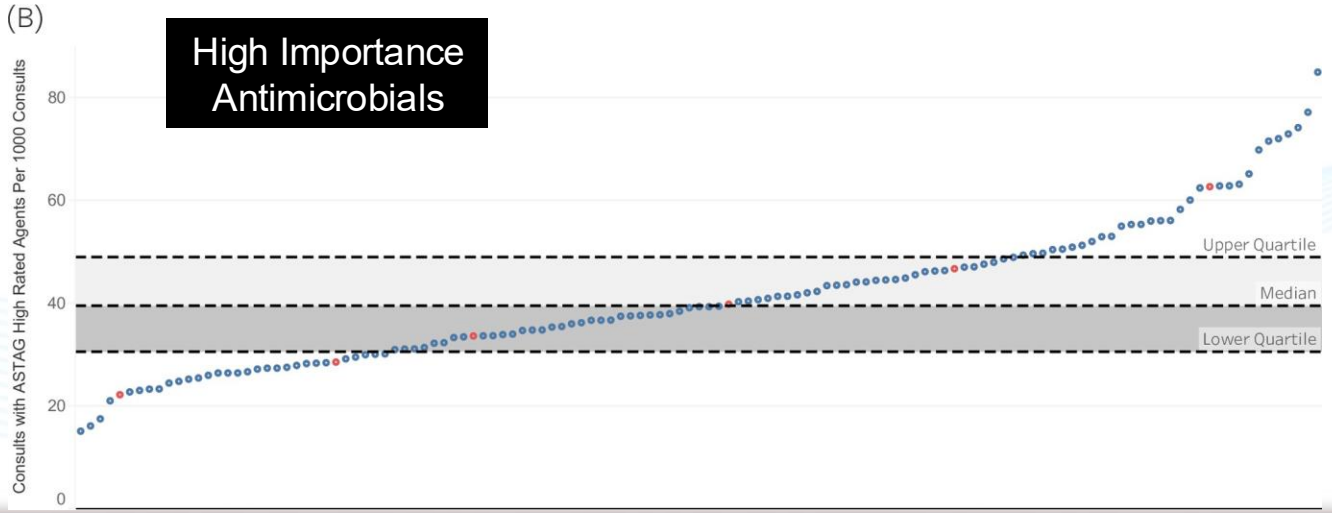
Brian A. Hur[1,2]*, Laura Y. Hardefeldt[1], Karin M. Verspoor[2,3], Timothy Baldwin[2], James R. Gilkerson[1]

1 Asia-Pacific Centre for Animal Health, Melbourne Veterinary School, University of Melbourne, Parkville, Victoria, Australia, **2** School of Computing and Information Systems, University of Melbourne, Parkville, Victoria, Australia, **3** Centre for the Digital Transformation of Health, University of Melbourne, Parkville, Victoria, Australia

* b.hur@unimelb.edu.au

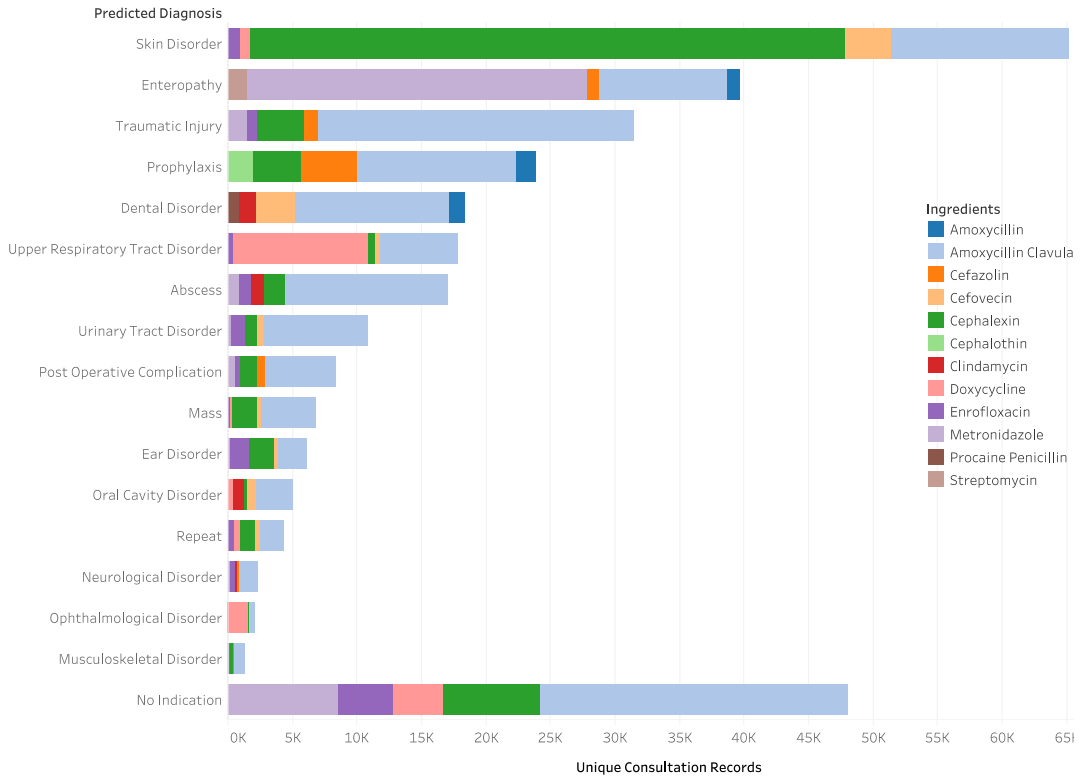




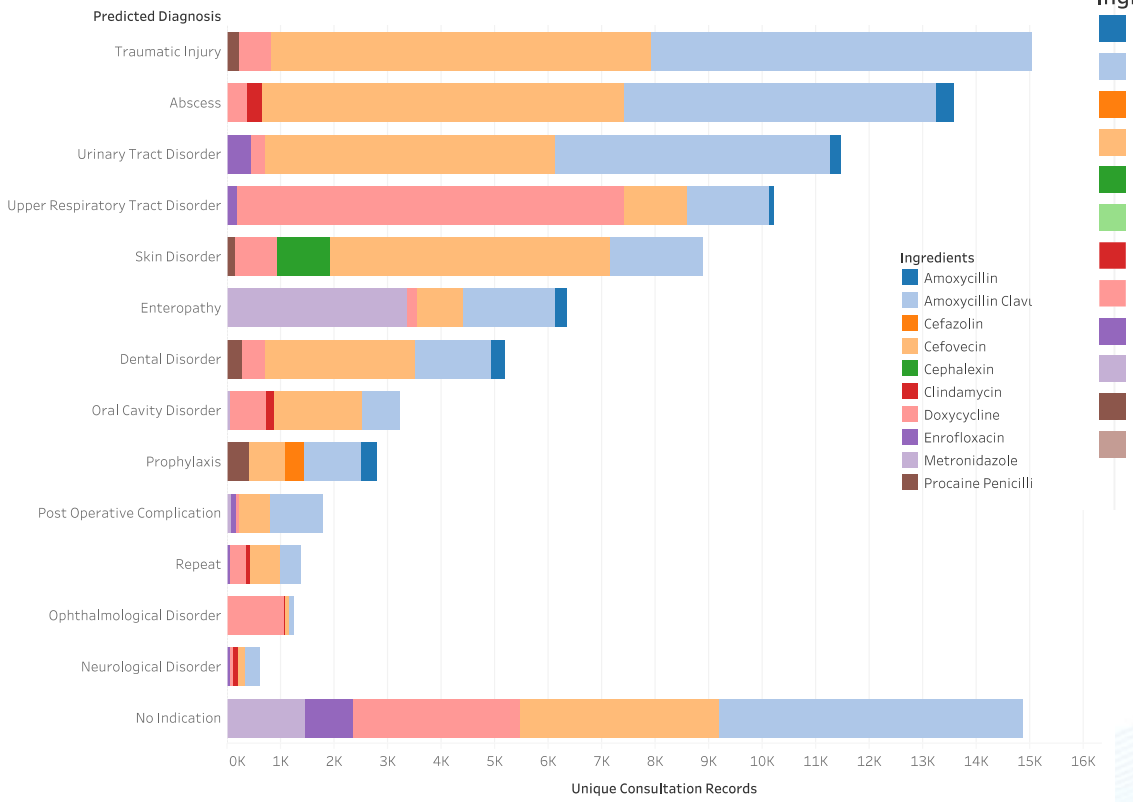


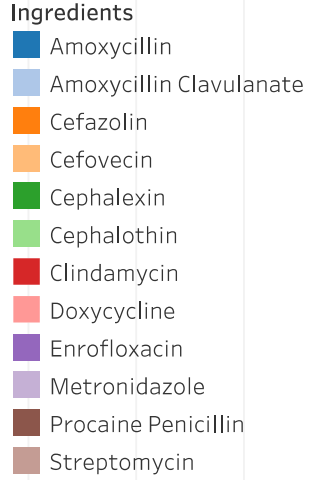
Which antimicrobial?

(a) Antimicrobials Given by Diagnosis in Dogs



(b) Antimicrobials Given by Diagnosis in Cats





Amoxicillin-clavulanate, Cefovecin, Cephalexin, Metronidazole

Laboratory diagnosis (Barriers?)

- Collaboration between Greencross and Idexx
- 10 GP clinics voluntarily enrolled



- Clinics receive:
- **Free urine culture and sensitivity** (C&S) tests
- Peer support from Dr Amy Hii
- Treatment guide poster

IDEXX

Greencross Vets

AMS: can we improve quality of AMU?

JAC Antimicrob Resist
https://doi.org/10.1093/jacamr/dlac015

JAC-Antimicrobial Resistance

Antimicrobial stewardship in companion animal practice: an implementation trial in 135 general practice veterinary clinics

L. Y. Hardefeldt[1,2]*, B. Hur[1,3], S. Richards[1,2], R. Scarborough[1,2], G. F. Browning[1,2], H. Billman-Jacobe[1,2], J. R. Gilkerson[1,2], J. Ierardo[4], M. Awad[4], R. Chay[4] and K. E. Bailey[1,2]

Received: 9 May 2023 | Revised: 22 June 2023 | Accepted: 30 June 2023
DOI: 10.1002/vetr.3268

Vet Record

ORIGINAL RESEARCH

Cross-sectional evaluation of a large-scale antimicrobial stewardship trial in Australian companion animal practices

Suzanna Richards[1,2] | Kirsten E. Bailey[1,2] | Ri Scarborough[1,2] | James R. Gilkerson[1,2] | Glenn F. Browning[1,2] | Brian Hur[1,2,3] | Jessica Ierardo[4] | Magdoline Awad[4] | Rachel Chay[4] | Laura Y. Hardefeldt[1,2]

Planning
July 2018

Implementation
October 2018 – July 2019

Post-implementation
August 2019 – October 2020



8

AMS: can we improve quality of AMU?

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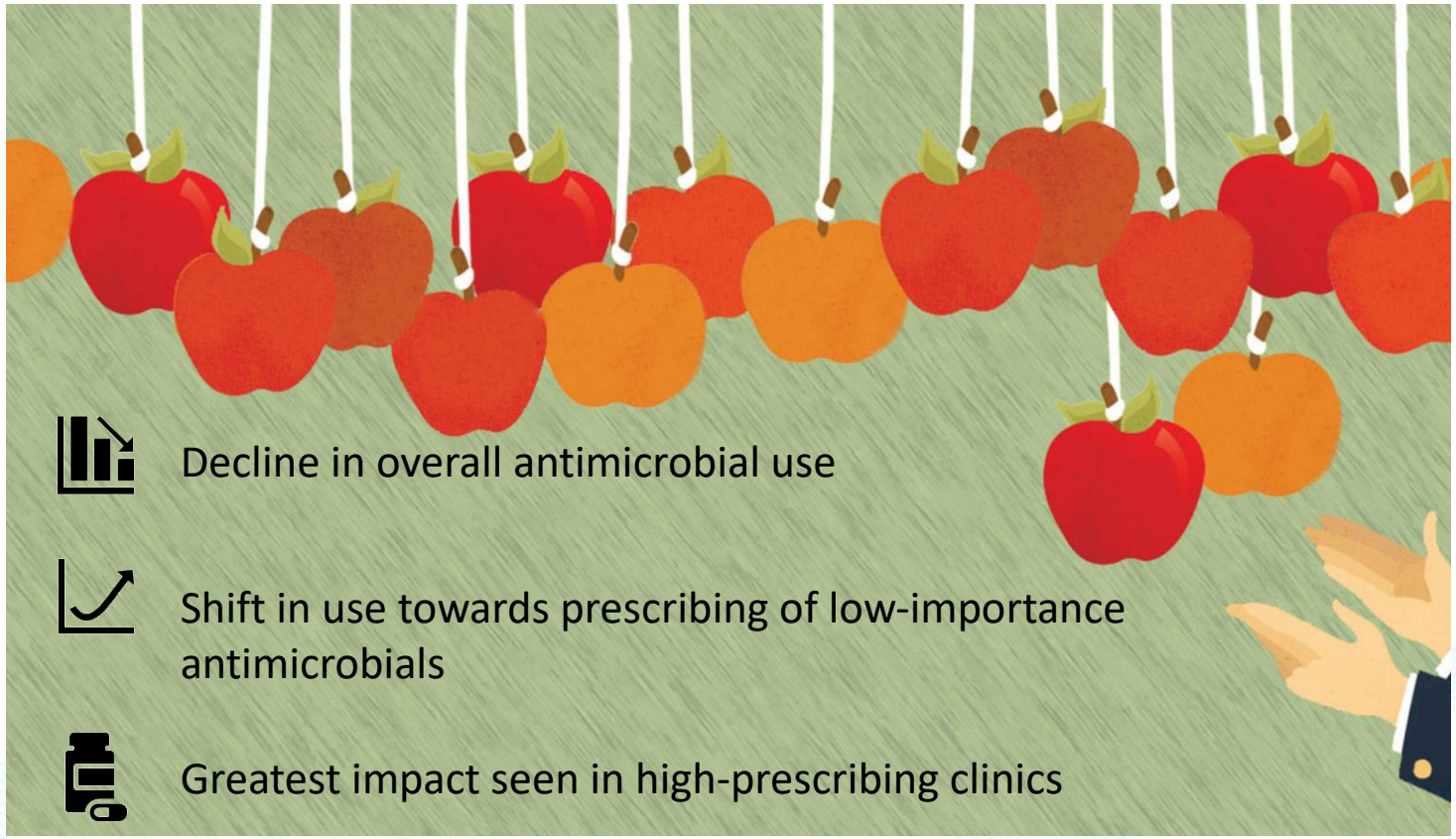


- Decline in overall antimicrobial use
- Shift in use towards prescribing of low-importance antimicrobials
- Greatest impact seen in high-prescribing clinics

Projects in Asia and the Pacific



Projects in Asia and the Pacific



Greater engagement in the combat against resistance







Fleming Fund Fellowships

20 Animal Health Fellows
Bhutan (5)
Nepal (5)
Timor-Leste (4)
Pakistan (1)
Papua New Guinea (3)









Fleming Fund Fellows (Animal Health, Lab, Policy)

Fleming Fund Fellowships

20 Animal Health Fellows

Bhutan (5)
Nepal (5)
Timor-Leste (4)
Pakistan (1)
Papua New Guinea (3)



Order Article Reprints

Open Access Article

Antimicrobial Consumption in the Livestock Sector in Bhutan: Volumes, Values, Rates, and Trends for the Period 2017–2021

by Ratna B. Gurung [1], Karma P. Zangmo [1], James R. Gilkerson [2,†], Glenn F. Browning [2,*,†], Angeline S. Ferdinand [3,†] and Mauricio J. C. Coppo [2,4,†]

[1] National Centre for Animal Health, Serbithang, Department of Livestock, Ministry of Agriculture and Forests, Thimphu 11001, Bhutan
[2] Asia-Pacific Centre for Animal Health, Melbourne Veterinary School, Faculty of Science, University of Melbourne, Parkville, VIC 3010, Australia
[3] Centre for Health Policy, Melbourne School of Population and Global Health, University of Melbourne, 207 Bouverie St., Carlton, VIC 3053, Australia
[4] Escuela de Medicina Veterinaria, Facultad de Ciencias de la Vida, Universidad Andrés Bello, Concepción 4300866, Chile
* Author to whom correspondence should be addressed.
† These authors contributed equally to this work.

Antibiotics **2023**, *12*(2), 411; **https://doi.org/10.3390/antibiotics12020411**

Received: 23 January 2023 / Revised: 14 February 2023 / Accepted: 15 February 2023 / Published: 18 February 2023

(This article belongs to the Special Issue **Antibiotics Use in Farms**)

Regional training workshops



Two workshops: 95 delegates and trainers from 7 countries
(Laboratory capacity, bioinformatics, animal health – cattle, fish, poultry, pigs, epidemiology, policy development)

AMR One Health regional grant – Southeast Asia



4 themes per country

- One Health
- Animal Health
- Practitioner (& Paravet) Engagement
- Environment

Laboratory capacity Necropsy training AMR surveillance AMS strategies AMU / guidelines

APCAH | ASIA-PACIFIC CENTRE FOR ANIMAL HEALTH

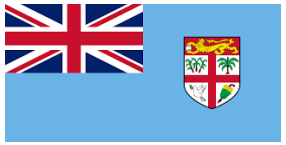
UKaid from the British people

The Fleming Fund Regional Grants

Pacific Islands training

Funded by the Australian Government Department of Foreign Affairs and Trade (DFAT) Centre for Health Security, COMBAT-AMR supports

training, mentorship, and capacity building of clinicians, pharmacists, scientists, veterinarians and policy makers to improve **prevention and surveillance** to address the threat of AMR.



FIJI



PAPUA NEW GUINEA



SOLOMON ISLANDS



SAMOA









Paravet training: Solomons (top) and Samoa (bottom)

Engagement (Guidelines)

- Species based advice
- Antimicrobials
  - Drug
  - Dose
  - Route
  - Inter-dosing interval
  - With-hold period
- Chemical restraint
- Pain relief
- Weight estimation
- Clinical syndromes



Engagement (Guidelines)

- Species based advice
- Antimicrobials
  - Drug
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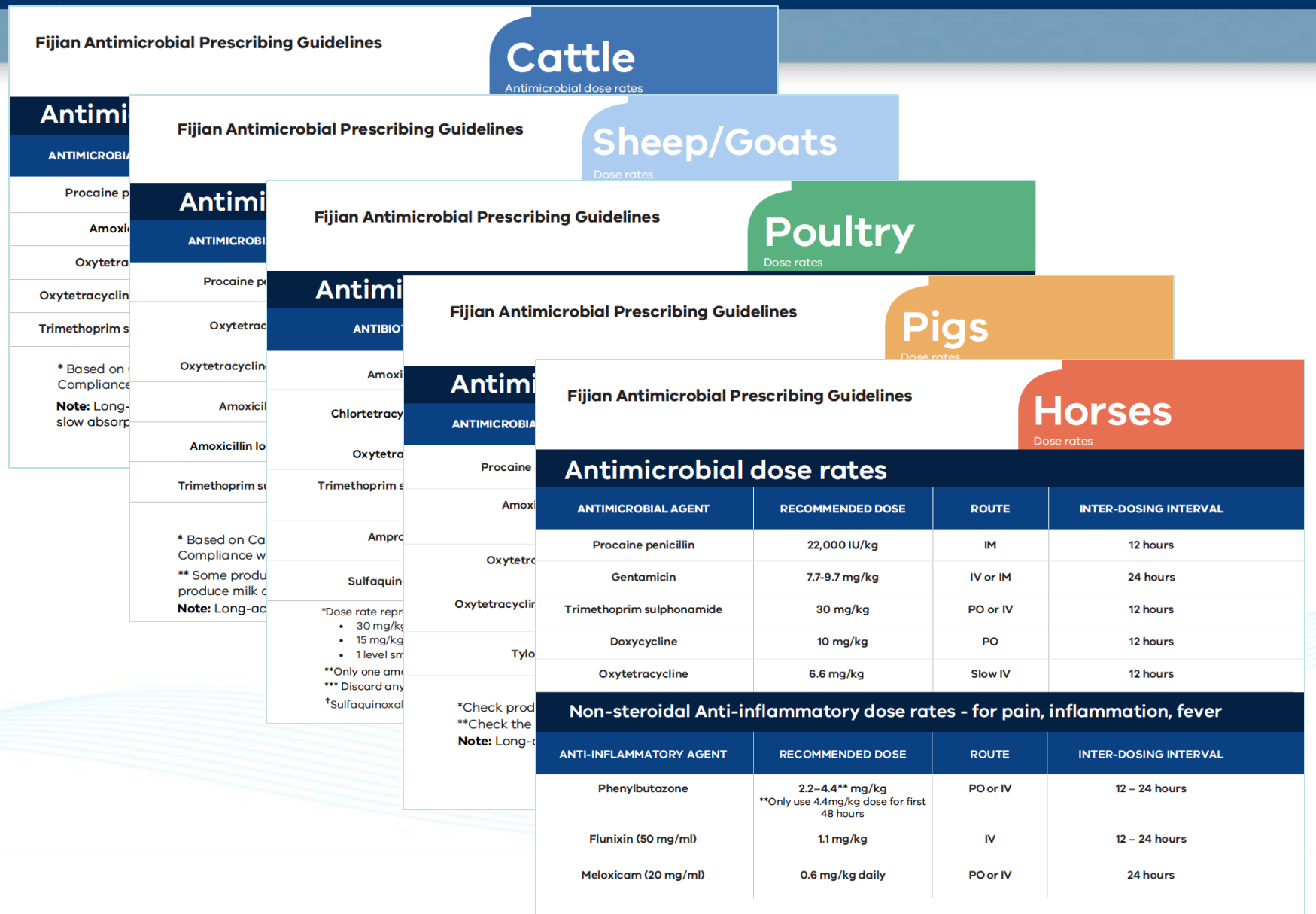

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Fijian Antimicrobial Prescribing Guidelines

Cattle
Antimicrobial dose rates

Antimicrobial dose rates

ANTIMICROBIAL AGENT	RECOMMENDED DOSE	ROUTE	INTER-DOSING INTERVAL	WITHHOLDING PERIOD (days)
Procaine penicillin*	22,000 IU/kg	IM	12 - 24 hours	Milk: 4 Meat: 10*
Amoxicillin	7 mg/kg	SC or IM	24 hours	Milk: 2 Meat: 28
Oxytetracycline	10 mg/kg	IV or IM	12 - 24 hours	Milk: 5 Meat: 14
Oxytetracycline long acting	20 mg/kg	IM	72 hours	Milk: 7 Meat: 28
Trimethoprim sulphonamide	24 mg/kg	IM	12 - 24 hours	Milk: 3 Meat: 28

* Based on Canadian label for Procaine Penicillin, represents off-label use of Australian/NZ products. Compliance with the legal requirements of your jurisdiction is your responsibility.

Note: Long-acting penicillin is not recommended as therapeutic concentrations are not achieved and slow absorption rate increases risk of violative residues.

Low critically important antimicrobials (generally)

Engagement (Guidelines)

- Species based advice
- Antimicrobials
  - Drug
  - Dose
  - Route
  - Inter-dosing interval
  - With-hold period
- Chemical restraint
- Pain relief
- Weight estimation
- Clinical syndromes

Fijian Antimicrobial Prescribing Guidelines

Cattle
Chemical Restraint

Chemical restraint dose rates (Veterinary Supervision only)

SEDATION	RECOMMENDED DOSE	ROUTE	USED FOR	WITHHOLDING PERIOD (days)
Xylazine 100mg/ml - single agent	0.05mg/kg (0.05ml/100kg) 0.1mg/kg (0.1ml/100kg)	IV IM	Standing Sedation or darting + Local Anesthetic for surgery	Meat: 28*
Standing 'K-Stun' (One syringe) – Xylazine (100mg/ml) Ketamine (100mg/ml) Butorphanol** (10mg/ml)	0.04mg/kg (0.04ml/100kg) 0.08mg/kg (0.08ml/100kg) 0.01mg/kg (0.1ml/100kg)	IM	Standing Sedation or darting Aggressive animals + Local anaesthetic for surgery	Milk: 7* Meat: 28*
Xylazine (100mg/ml) + Butorphanol**	0.05mg/kg (0.05ml/100kg) 0.05mg/kg (0.5ml/100kg)	IM	Standing seda short proce	

*Some products not registered for use in cattle – check the label for withholding perio
**No butorphanol products registered for cattle, a withholding period recommended
days

Fijian Antimicrobial Prescribing Guidelines

Cattle
Pain Relief/Analgesia

Pain relief dose rates

ANALGESIA / ANTI-INFLAMMATORY	RECOMMENDED DOSE	ROUTE	USED FOR	WITHHOLDING PERIOD (days)
Lignocaine 2% (e.g. Lopaine)	Up to 200 ml Local infiltration 4-6 mls Epidural	SC Epidural	Local Anaesthetic Epidural	Milk: 6 Meat : 8
Meloxicam	0.5 mg/kg (2.5 ml/100 kg) One dose only	SC, IV	Pain, Inflammation	Milk: 6 Meat: 8
Flunixin (Not Breeding Bulls)	2.2 mg/kg (4.4 ml/100 kg)	IV	Fever, Pain, Inflammation	Milk: 36 hours Meat: 4
Ketoprofen	3 mg/kg (3 mls/100 kg) Daily, up to 3 days	IM	Pain, Inflammation	Milk: 0 Meat: 4

Engagement (Guidelines)

- Species based advice
- Antimicrobials
  - Drug
  - Dose
  - Route
  - Inter-dosing interval
  - With-hold period
- Chemical restraint
- Pain relief
- Weight estimation
- Clinical syndromes



In-person workshop (Fiji & Samoa)

Lectures

- Antimicrobial resistance & One Health
- Classification and pharmacology of antimicrobials
- Sample collection technique, packaging and transport
- Appropriate data collection for sample submission

Hands on workshops

- Basic microbiology techniques (Gram staining, culture techniques, microscopy)
- Interpretation of laboratory results
- Chicken post-mortem and sample collection



Cattle workshop (Fiji)

Lectures

- Cattle nutrition
- Calf rearing
- Physical examination and anatomy
- Reproduction, pregnancy detection, dystocia management
- Mastitis management and treatment
- Lameness diagnosis and management



Practical sessions

- Physical examination of the cow
- Sample collection – urine, blood, milk
- Administering injections
- Lameness

Australian Aid

COMBAT AMR
A program supported by the Australian Government and implemented by the Doherty Institute

APCAH
ASIA-PACIFIC CENTRE FOR ANIMAL HEALTH

Melbourne training (Samoa)

Wide range of topics in microbiology, epidemiology & parasitology

- Bacterial identification and isolation
- Performing and interpretation of antimicrobial susceptibility tests
- Study design, appropriate data collection, data management and analysis
- Develop SOPs, risk assessments and implementation of controls for diagnostic testing

Scientific writing, reading scientific articles and giving presentations

Open discussion on upcoming projects and potential future collaborations



Engagement: Resource Development



EVA & UNIVERISITY OF MELBOURNE

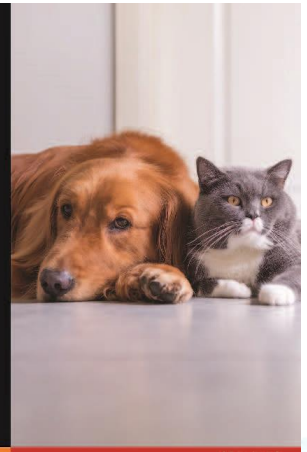
POCKET GUIDE FOR ANTIMICROBIAL USE IN HORSES

For more information and further resources visit
www.fvas.unimelb.edu.au/vetantibiotics

Version One

UNIVERSITY OF MELBOURNE

GUIDE FOR ANTIMICROBIAL USE IN DOGS AND CATS

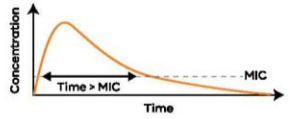
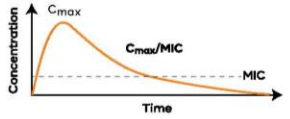


For more information and further resources visit
www.fvas.unimelb.edu.au/vetantibiotics

Version 1

https://science.unimelb.edu.au/avpg/resources

Antibiotic Pharmacokinetics & Pharmacodynamics

Bacteriostatic	Bactericidal
"ECSTaTiC for bacteriostatic"	"Very Proficient For Complete Cell Murder"
Erythromycin (macrolides) Clindamycin Sulphonamides Trimethoprim Tetracyclines Chloramphenicol	Vancomycin Penicillin Fluoroquinolones Cephalosporins Carbapenems Metronidazole
Time-Dependent	**Concentration Dependent**
• Optimise killing by maximising **time above MIC.** • **More frequent administration** or extended infusion increases efficacy by extending T>MIC. • Goal **exceed MIC by 1-5 times for 50-80% of dosage interval.** • E.g. penicillin, ceftiofur, TMS, tetracyclines chloramphenicol.	• Optimise killing by maximising **peak concentration.** • **Higher doses** at less frequent intervals increases efficacy by maximising Cmax:MIC ratio. • Goal **Cmax:MIC >8.** • E.g. aminoglycosides, fluoroquinolones, metronidazole.
	
Intrinsic resistance	**Acquired resistance**
All members of a bacterial genus or species have properties that make them naturally resistant to certain antimicrobials.	Previously susceptible bacteria acquire new genes or a mutation occurs conferring resistance.

Spectrum of Activity Against Common Bacteria

Refer to local antibiogram for susceptibility rates (if available).

Bug \ Drug	Procaine Penicillin	Ampicillin	Doxycycline	Oxytetracycline	Trimethoprim sulpho	Chloramphenicol*	Gentamicin	Metronidazole	Cefiofur	Clarithromycin or Azithromycin + rifampin	Enrofloxacin	Amikacin
Beta-haemolytic streptococci	✓	+	±	±	±	+	IR		+		+	IR
Staphylococcus aureus ¥	±		±	±	±	+	±				+	±
Enterococcus faecalis ¥	+	✓	±	±	IR	±	IR		IR		±	IR
Enterococcus faecium ¥			±	±	IR	±	IR		IR		±	IR
Rhodococcus equi										✓		
Escherichia coli ¥	IR	±	±	±	±	±	✓		+		+	+
Klebsiella spp. ¥	IR	IR	±	±	±		✓		±		±	+
Enterobacter spp. ¥	IR	IR	±	±	±	±	±		±		+	+
Pseudomonas aeruginosa ¥	IR	IR	IR	IR	IR	IR	✓		IR		±	+
Actinobacillus equuli	±	±	✓	✓	✓	±	✓		+		+	+
Pasteurella spp.	✓	+	+	+	±	±	✓		+		+	+
Lawsonia intracellularis			✓	✓								
Bacteroides spp.	IR	IR	±	±		+	IR	+				IR
Clostridium spp.	✓	+	±	±			IR	+	±			IR

MRSP dermatology fact sheet

Methicillin-resistant *Staphylococcus pseudintermedius* (MRSP)

KEY FACTS

- *Staphylococcus pseudintermedius* (SP) are normal skin/mucosal flora found on dogs and cats.
- Methicillin resistance = resistance to all β-lactam antimicrobials (including β-lactamase inhibitor combinations).
- Emerging opportunistic pathogen in Australia – 12% clinical SP infections MRSP, 8% healthy urban dogs MRSP carriers.
- MRSP vs Methicillin-susceptible SP
  + No more pathogenic
  + No difference in clinical disease.
- Many MRSP carry other resistance genes, sometimes extensive drug resistance.

β-lactams

- ✗ Penicillin
- ✗ Amoxycillin
- ✗ Cephalosporins*
- ✗ Carbapenems
- ✗ Amoxy/clav

*Except a few anti-MRSA cephalosporins

BIOSECURITY

PERSONAL
Routinely wash hands before & after each patient.
Use liquid soap or alcohol-based hand sanitiser.
Wear gloves when handling patients.

PATIENT
Isolate MRSP patients.
Consider in-contact pets carriers.
Pets may carry MRSP after clinical resolution.

HOSPITAL
Clean gross contamination/biofilm with detergent first then disinfect.
Routine cleaning and disinfection all that is required.
MRSP readily inactivated by commonly used disinfectants.

TREATMENT OPTIONS
Critical to identify & address underlying cause.
Try topical‡
MRSP is not resistant to antiseptics (eg. chlorhexidine, bleach).
If needed, systemic therapy based on C&S.
No dominant susceptibility pattern, often MDR.

ZOONOTIC RISK
Dogs are the natural SP host. Infection in people is rare, but possible.
Minimise contact between infected **dogs, other animals and people.** Exposed bedding and surfaces will also be contaminated.
Avoid contact with skin, nose, mouth, perineum and faeces of infected dogs.
Warn owners of zoonotic potential, particularly those with breaches in their skin barrier or poor skin integrity (ie **wounds, elderly** people).
Wash or alcohol-sanitise hands after handling infected dog.

For more information and further resources visit
agriculture.vic.gov.au/amr
www.fvas.unimelb.edu.au/vetantibiotics

S4 medicated feed order

A medicated feed order is a form for a veterinarian to authorise a feed mill to supply S4 medicated feed to a farm.

All details must be entered to be compliant with legislation and good veterinary practice.



- Must be on letterheaded paper.
- You must retain a copy (for 3 years) and supply a copy to the client.
  The original documents must go to the feed mill.
- This whole section must be filled out.
  Type is beef/dairy or layers/broilers or weaners/growers etc.
- Maximum treatment duration is 3 months.
- Feed orders are only valid for 3 months, you cannot write a script for a longer period.

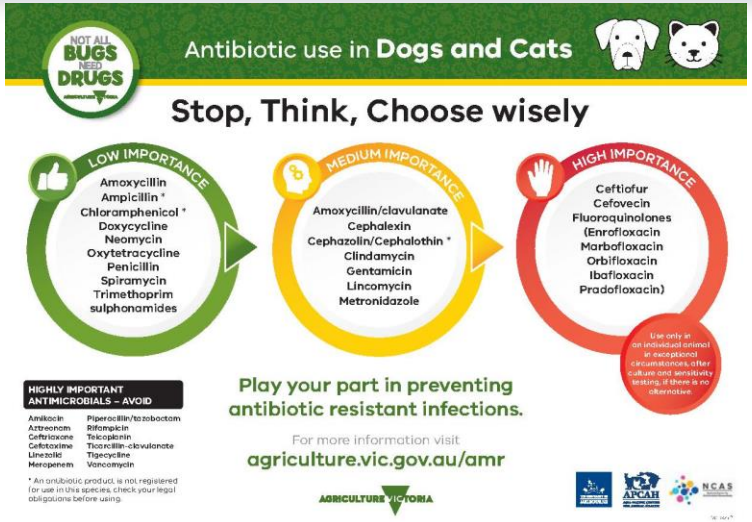
The WHP must be specified, regardless of whether you are using the labelled or an off-label dose.

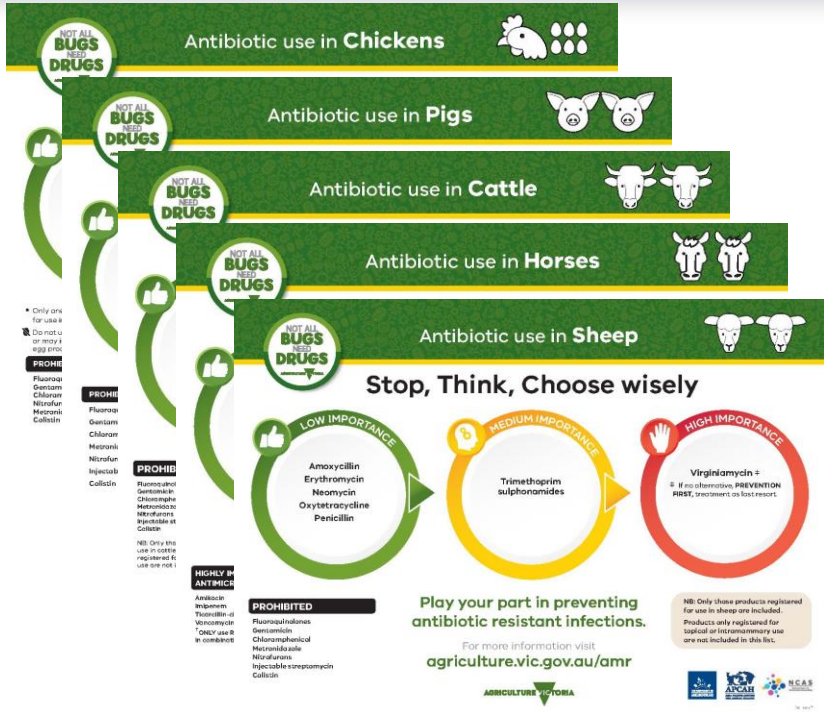
Off-label authorisation requirements:
- Must not be contrary to the specific label constraints
- Must be approved for at least one major food producing species
- Client must be informed that use is off-label
- Veterinarian must consider and assign an appropriate WHP, for which they are legally responsible if that proves to be inadequate.

For more information and further resources visit
agriculture.vic.gov.au/amr
www.fvas.unimelb.edu.au/vetantibiotics

Engagement: Resource Development

https://vetantibiotics.science.unimelb.edu.au/









UVet

THE UNIVERSITY OF MELBOURNE

Veterinary Microbiology Laboratory

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Case Number: CM2019-0300
Owner: Smith
Name: Bobby
Identifier: 332762
Species: Equine
Submitter: Jo Blogs
Specimen information: Nasal swab

Date of Report: 06/03/2019
Date Submitted: 01/03/2019
Number of Specimens: 1
Test requested: C&S

Results

Microbiology – Preliminary Report Final Report

Identification: Mixed, Org 2 *Escherichia coli*

Antimicrobial Testing Results

First line – First line therapy

Penicillin	.	Neomycin	.
Ampicillin/Amoxycillin	S	Erythromycin	.
Tetracycline (Doxy/Oxy)	R	Azithromycin*	
Sulfafurazole	R	Clarithromycin*	
Trimethoprim	R	Florfenicol*	
Chloramphenicol	.		
Metronidazole*			

Second line - Only use if compelling reason not to use low importance rating antimicrobials

Amoxycillin+Clavulanate	.	Gentamicin	S
Cephalexin	.	Clindamycin	.
Cephazolin		Apramcycin*	
Cloxacillin*			

Third line - Only use after culture with susceptibility testing results indicating no lesser alternative

Ceftiofur	S	Enrofloxacin/Moxifloxacin	S
Cefovecin/Cefotaxime	.	Marbofloxacin	
Ceftazidime	.	Pradofloxacin	
Amikacin	S	Ciprofloxacin	.
Tobramycin	.	Polymyxin B	.
Bacitracin	.	Rifampicin	.
Ticarcillin + Clavulanate*		Spectinomycin	.
Piperacillin+Tazobactam*		Nitrofurantoin*	.

Reserve – Antibiotics of last resort

Vancomycin*	.		
Imipenem*	.	Linezolid*	

Report prepared by: R Bushell

* Please contact laboratory. Not tested routinely.
Many of the antimicrobial susceptibility testing results reported will require off-label use. Compliance with the legal requirements of your jurisdiction is your responsibility.

For more information please refer to www.fvas.unimelb.edu.au/vetantibiotics

Summary



- All antimicrobial use drives antimicrobial resistance
- **Appropriate** use is KEY to SLOW development of AMR
  - Appropriate drug (based on **microbiological diagnosis** and susceptibility testing)
  - Appropriate dose (based on weight)
  - Appropriate duration (shorter is better)
- **Necropsy and laboratory diagnosis** is essential
- **Antimicrobial use data** is essential to monitoring and evaluation of any stewardship programme
- Stewardship is a programme of **actions**

Collaborators and colleagues (One Health)


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NCAS
National Centre for Antimicrobial Stewardship

zoetis

Elanco

Consortium partners and team

Australian Aid

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Doherty Institute · theAlfred · APCAH · Burnet · Massey University · PRIDA

Greencross Vets

The Royal Melbourne Hospital

GUIDANCE GROUP

BioGrid
Connecting health information

RMIT UNIVERSITY

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VetCompass Australia

NCIC
National Centre for Infections in Cancer

Veterinary Microbiology
Melbourne Veterinary School
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Australian Government
Australian Research Council

