



**NZVA**  
New Zealand Veterinary Association

# Guide to prudent use of antimicrobial agents in

# Red meat production





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# Foreword

Good anti-microbial usage and judicious authorisation practices by veterinarians, and appropriate anti-microbial usage at farm level are essential tools to ensure that both the needs of the food industry and the expectations of consumers are met.

In many cases, antimicrobial agents are life-saving medicines both within human and veterinary medicine. One of the largest threats against public and animal health is, however, the increase in antimicrobial resistance. Antimicrobial -resistant bacteria can be transferred between animals and humans and thus, in the case of the veterinary use of antimicrobials, the benefits must be weighed-up against the possible effects on public health.

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Resistance development can be counteracted by the responsible use of antimicrobials, good hygiene and active disease control. Active advice to animal owners on, for example, hygiene and vaccination also plays an important part.

In July 2015 the New Zealand Veterinary Association produced an aspirational statement, "By the year 2030 New Zealand Inc. will not need antibiotics for the maintenance of animal health and wellness." This is an aspirational statement that means the veterinary profession is taking leadership on the issue of antimicrobial stewardship.

Clearly antimicrobial therapy will still be relevant and animal welfare is an overriding influence in choosing to authorise an antimicrobial. However, by taking this position the profession is removing itself from dependency on, and possible misuse of, antimicrobials in the effort to ensure that these drugs remain valuable weapons in the therapeutic armoury, not only of veterinarians themselves, but also the human medical profession.

The objective of this document has been to produce a guide that can be used when deciding upon a course of treatment it is written for current New Zealand conditions and practices.

Antimicrobial treatment is normally only indicated if both of the criteria described below are fulfilled:

- There is a bacterial infection (or when there is sufficient cause to suspect that an actual bacterial infection is present)
- If the infection, in all likelihood, will not resolve without the support of antimicrobial therapy.

If there are equivalent methods of treatment by which antimicrobial agents are not used, these should be the chosen courses of therapy. It is of fundamental importance that antimicrobial agents should only be used when absolutely necessary and that the occurrence of infections should be counteracted, whenever possible, by means of preventative measures.

Prophylactic antimicrobial treatment can, in a few specific situations, be justified. For example, when a specific surgical procedure presents a high risk for bacterial infection, or specific situations be motivated in connection with specific surgical procedures, where the risk for bacterial infection is high or where an infection can drastically worsen the prognosis. The prophylactic use of antimicrobial agents should never be implemented to compensate for poor hygiene.

When possible, the actual infectious agent should be demonstrated by means of laboratory examination. This is especially important in cases of therapy failure, relapse and on other occasions when antimicrobial resistance may be suspected. Samples should always be taken from infections that arise postoperatively.

The risk of antimicrobial resistance should always be taken into consideration when choosing an antimicrobial agent. This means that the antimicrobial agent and the route of administration should be chosen so that the animal's normal flora is affected as little as possible (so-called narrow-spectrum antimicrobials). With this in mind, local treatment when correctly implemented can, in fact, be preferable provided that its effect is thought to be sufficient. Any effect on the normal flora can also be minimised if the course of treatment is kept as short as possible and is then discontinued if the indication is no longer thought to be applicable.

These guidelines have been adapted from the International Dairy Federation Guide to Prudent Use of Antimicrobial Agents in Dairy Production 2013, ISBN 978-92-9098-041-4 the Purata Farm Antibiotic Stewardship Plan and the 2015 RUMA (Responsible Use of Medicines in Agriculture) Guidelines.

The aim is to provide a framework to support the responsible use of antimicrobial agents on dairy farms. The IDF guidelines stress the importance and need for a whole supply chain approach to ensure food safety therefore apply not only to farmers and veterinarians but also milk processing companies, pharmaceutical companies and regulators.



On the other hand the NZVA guidelines are to assist New Zealand veterinarians with their own practice principles and to assist the practices in providing advice and education for their clients. Therefore only the sectors pertaining to farmers and veterinarians have been adapted from the IDF Guidelines.

As antibiotic usage and resistance profiles may differ between regions such guidelines are naturally broad, encompassing principles, and individual practices are encouraged to develop their own authorisation habits based upon these principles.

The term “antimicrobial agent” is used rather than “antibiotic” in this Guide. The term antimicrobial agent is as defined by the World Organisation for Animal Health (OIE) and means a naturally occurring, semi-synthetic or synthetic substance that exhibits antimicrobial activity (kills or inhibits growth of microorganisms) at concentrations attainable in vivo.

Anthelmintics and substances classed as disinfectants or antiseptics are excluded from this definition. Antimicrobial agents are inclusive of anti-bacterials, anti-virals, anti-fungals and anti-protozoals.

The guiding objective is that meat should be produced from healthy animals under generally accepted agricultural conditions, with minimal and controlled use of antimicrobial agents.

- The correct dosage and duration of medication
- The correct circumstances of use
- The correct procedures for observing withdrawal periods.

All of which is to ensure the accuracy of medication of animals at the anticipated site of infection.

## Acknowledgments

These guidelines have been formulated by the Antimicrobial Working Group appointed by NZVA.

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## Core Principles

1. All farmers and their veterinarians must be totally committed to producing safe food.
2. Farms should be managed to reduce the risk of disease challenge and, therefore, the need to use antibiotics and other medicines.
3. Farmers and their veterinarians should draw up, implement and regularly review an appropriate herd health plan that outlines routine preventive treatments (e.g. biosecurity, vaccination programmes etc.) and disease control policy.
4. Antibiotics should only be authorised by a veterinarian when there is evidence of a susceptible bacterial infection, treatment is necessary to maintain animal health and welfare and no other treatment such as drainage or antiseptics is likely to be effective. Treatment should be restricted to individual animals where possible.
5. Choice of antibiotic should be based on knowledge of common pathogens and local laboratory data.
6. Antibiotics and dose regimes should be chosen to minimise the development of clinically significant resistance in people or animals.
7. An appropriate withholding time must be applied before the milk consumption or slaughter of treated animals.
8. Accurate information recording the identity of the treated cattle, the nature of the condition being treated, drugs used and withholding period must be kept.

# Antimicrobial classification

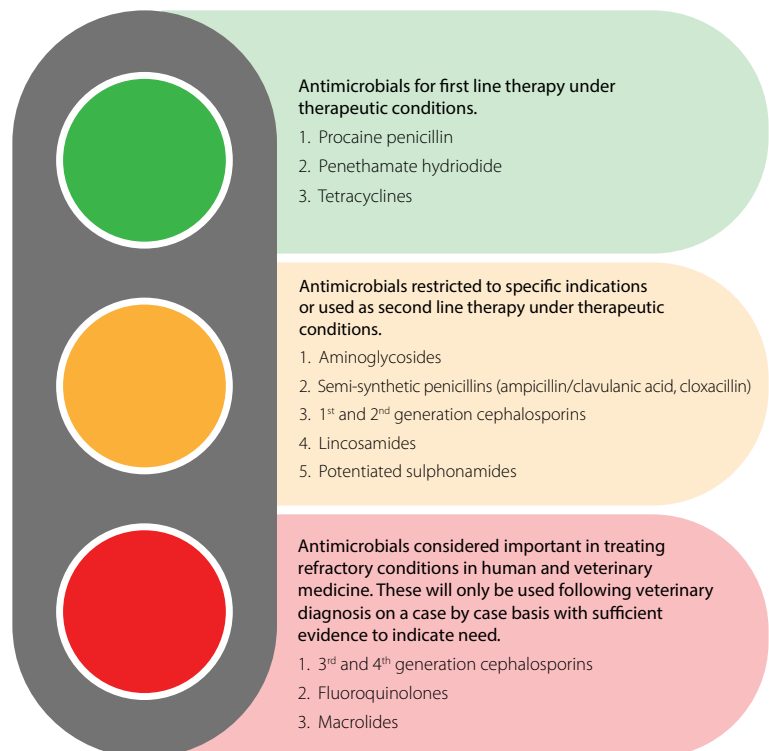
General guidelines classifying antimicrobials according to a three tier (traffic light) system is an example of a type of system that might be employed.

This classification is based on but differs from the WHO classification, being less restrictive and intended to suit practical guidelines for veterinary practice in New Zealand conditions.

Consideration should always be given to PK/PD properties to ensure enough of the appropriate antibiotic is available at the biophase.

Culture and susceptibility should be utilised, when clinically relevant, to aid in the selection of antimicrobials.

Narrow-spectrum antimicrobials should be used in preference to broad-spectrum antimicrobials whenever appropriate.



## The 5 R's

The 5 R's refer to an acronym popularised in Europe for responsible antimicrobial stewardship and refer to reduction, refinement and replacement (where possible) of antimicrobials and also responsibility (taking ownership of the issue) and review (constantly monitoring progress).

### Reduction

Reduction is achieved by:

1. Preventative measures:
  - a. Husbandry
  - b. Vaccination
  - c. Monitoring
  - d. Training
2. Elimination of use of antimicrobials where they are of limited or no use, (for example, in uncomplicated viral infection or in a lame cow where trimming only is needed) this requires.
  - a. Accurate diagnosis
  - b. Training
  - c. Treatment guidelines detailing when not to use antimicrobials
3. Use of topical/local antimicrobials in preference to systemic delivery.

### Refinement

Continuously evaluate authorising practices and therapeutic plans, based on:

- a. Response to treatment with reference to the desired treatment outcomes
- b. Repeat cases
- c. Clinical studies
- d. In-house and local resistance data
- e. Industry use guidelines

### Replacement

Selection pressure can be reduced with adoption of an alternative, non-antimicrobial, approach. For example:

1. Use of internal teat sealants without an accompanying antimicrobial
2. Use of prostaglandin F2 alpha treatment in CL+ cows with evidence of endometritis

The decision to use an alternative must be evidence based on, and take into consideration, the health and welfare outcomes for the animal. Replacement will only be instigated where there is peer reviewed evidence that this will be equally or more effective than antimicrobial treatment.

## Responsibility

Without engagement, understanding and personal responsibility of people at all levels involved in the authorisation, treatment and management of stock stewardship plans cannot hope to achieve the desired outcomes.

Engagement will be achieved through:

1. Positioning of a program and clear description of the 'Why' to all involved:
  - a. What's in it for me?
  - b. What's in it for the animals?
  - c. What's in it for the business?
  - d. What's in it for the industry and community?
2. Ensuring understanding of the core principles not just the operational procedures
3. Encouragement of 'upward leadership' – empowerment of team members to contribute to success of the plan, bring new ideas and innovation and refine the processes.

## Review

A stewardship plan is a 'living document' and will be subject to periodic (at least annually) review to ensure objectives are met.

1. Animal health and welfare outcomes remain top priority and monitored to ensure they are achieved.
2. Protocols should be reviewed for compliance and relevance by the practice on a yearly basis.
3. There should be awareness of any susceptibility data available to ensure appropriate selection of antimicrobials, maximise efficacy and monitor resistance in target pathogens.
4. Investigation of strategies that can be employed to improve stewardship of antimicrobials within a veterinary practice should occur on an on-going basis.

# Guidelines section one: Beef

Condition	Treatment	Alternative	Notes
Respiratory system			
Calves			
Calf diphtheria/Necrotic stomatitis	<b>Procaine penicillin</b> im 25 mg/kg SID	<b>Trimethoprim + sulphamethoxazole</b> im 16–20 mg/kg SID	Poor prognosis in laryngeal infection due to poor blood supply to affected tissue and scarring of the larynx
Enzootic pneumonia of calves	<b>Amoxicillin</b> im 7–15 mg/kg SID	<b>Oxytetracycline</b> im 4–20 mg/kg SID <b>Trimethoprim + sulphamethoxazole</b> po 24–35 mg/kg SID <b>Trimethoprim + sulphamethoxazole</b> im 16–20 mg/kg SID	Oxytetracycline is indicated as second choice because of possible tissue irritation in case of long term use
Young stock			
Pathogen unknown	<b>Amoxicillin</b> im 7–15 mg/kg SID	<b>Trimethoprim + sulphamethoxazole</b> po 24–35 mg/kg SID <b>Trimethoprim + sulphamethoxazole</b> im 16–20 mg/kg SID <b>Oxytetracycline</b> im 4–20 mg/kg SID <b>Tulathromycin</b> Sc 2.5 mg/kg SID	If the animals are not yet eating fibre then the preference is to give oral antibiotics especially for formulations that can cause tissue irritation. Oxytetracycline is indicated as second choice because of possible tissue irritation in case of long term use. Do not use Tulathromycin in female dairy cattle 20 months of age or older.
Pasteurella multocida, Pasteurella haemolytica, Salmonella dublin	<b>Amoxicillin</b> im 7–15 mg/kg SID	<b>Oxytetracycline</b> im 4–20 mg/kg SID <b>Ceftiofur hydrochloride</b> im/sc 2.2 mg/kg SID <b>Tylosin</b> im 10 mg/kg SID	
Histophilus somni	<b>Oxytetracycline</b> im 4–20 mg/kg SID	<b>Doxycycline</b> po 10 mg/kg SID <b>Ceftiofur hydrochloride</b> im/sc 2.2 mg/kg SID	
Adult			
Pathogen unknown	<b>Trimethoprim + sulphamethoxazole</b> im 16–20 mg/kg SID	<b>Oxytetracycline</b> im 4–20 mg/kg SID <b>Marbofloxacin</b> sc/iv/im 10 mg/kg once <b>Enrofloxacin</b> sc 5 mg/kg SID <b>Ceftiofur hydrochloride</b> im/sc 2.2 mg/kg SID <b>Tylosin</b> im 10 mg/kg SID	Oxytetracycline is indicated as second choice because of possible tissue irritation in case of long term use
Pasteurella multocida, Pasteurella haemolytica, Salmonella dublin	<b>Amoxicillin</b> im 7–15 mg/kg SID <b>Trimethoprim + sulphamethoxazole</b> im 16–20 mg/kg SID	<b>Oxytetracycline</b> im 4–20 mg/kg SID <b>Marbofloxacin</b> sc/iv/im 10 mg/kg Once <b>Enrofloxacin</b> sc 5 mg/kg SID <b>Ceftiofur hydrochloride</b> im/sc 2.2 mg/kg SID	
Aspiration pneumonia Mixed infection often with obligate anaerobes	<b>Procaine penicillin</b> im 25 mg/kg SID	<b>Oxytetracycline</b> im 4–20 mg/kg SID	Prognosis poor – consider euthanasia
Alimentary system			
Woody Tongue/ Actinobacillosis	<b>Streptomycin</b> im 15–25 mg/kg SID	<b>Oxytetracycline</b> im 4–20 mg/kg SID	Consider treatment with iodide e.g. sodium iodide at 1g/12kg live weight in 10% solution, repeat 10–14days

Lumpy Jaw/Actinomycosis	<b>Streptomycin</b> im 15–25 mg/kg SID	<b>Oxytetracycline</b> im 4–20 mg/kg SID	<ol style="list-style-type: none"> <li>Poor prognosis, long treatment course required. Only likely to halt progression and not resolve the lesion.</li> <li>Consider treatment with iodide e.g. sodium iodide at 1g/12kg live weight in 10% solution IV, repeat 10–14days. Avoid peri-vascular administration.</li> <li>Surgical debridement and packing the wound with iodine may also be of use.</li> </ol>
Necrotic stomatitis /Calf diphtheria	<b>Procaine penicillin</b> im 25 mg/kg SID	<b>Trimethoprim + sulphamethoxazole</b> Im 16 mg/kg SID	Poor prognosis in laryngeal infection due to poor blood supply to affected tissue and scarring of the larynx.
Rumenitis – Pre ruminant calves	<b>Sulphamonomethoxazole</b> po 200 mg/kg start; 70–100 mg/kg maintenance SID/BID <b>Trimethoprim + sulphamethoxazole</b> po 24–35 mg/kg SID <b>Trimethoprim + sulphamethoxazole</b> im 16–20 mg/kg SID	<b>Amoxicillin/clavulanic acid</b> Im 8.75 mg/kg SID	<p>Immediately initiate symptomatic treatment to maintain hydration with electrolytes and water</p> <p>Consider NSAIDs.</p> <p>Check that the diet (nature and amount) is correct.</p> <p>Orally administered drugs are preferable when treating pre-ruminant calves except for Salmonella for which parenteral treatment is preferred.</p> <p>Every effort should be made to establish the identity of the pathogen before antibiotic treatment is implemented.</p>
Salmonellosis Calf	<b>Trimethoprim + sulphamethoxazole</b> im 16–20 mg/kg SID		
Colibacillosis (Escherichia coli)	<b>Trimethoprim + sulphamethoxazole</b> po 24–35 mg/kg SID <b>Trimethoprim + sulphamethoxazole</b> im 16–20 mg/kg SID		
Enterotoxaemia (Clostridium perfringens)	<b>Procaine penicillin</b> im 25 mg/kg SID		
Adult (Ruminant) enteritis Pathogen unknown	<b>Trimethoprim + sulphamethoxazole</b> Im 16 mg/kg SID <b>Oxytetracycline</b> im 4–20 mg/kg SID	<b>Marbofloxacin</b> sc/iv/im 2 mg/kg SID <b>Enrofloxacin</b> sc 5 mg/kg SID	<p>Immediately initiate symptomatic treatment to maintain hydration with electrolytes and water.</p> <p>Consider NSAIDs.</p> <p>Check that the diet (nature and amount) is correct.</p> <p><u>Antimicrobials may not be required at all.</u></p>
Adult (Ruminant) enteritis Salmonella	<b>Trimethoprim + sulphamethoxazole</b> Im 16 mg/kg SID	<b>Marbofloxacin</b> sc/iv/im 2 mg/kg SID <b>Enrofloxacin</b> sc 5 mg/kg SID	
Yersiniosis	<b>Oxytetracycline</b> im 4–20 mg/kg SID	<b>Trimethoprim + sulphamethoxazole</b> im 16–20 mg/kg SID	
Peritonitis Mixed infection including anaerobes	<b>Procaine penicillin</b> im 25 mg/kg SID	<b>Amoxicillin</b> im 7–15 mg/kg SID	
<b>Renal system</b>			
Pyelonephritis Pathogen unknown	<b>Procaine penicillin</b> im 25 mg/kg SID <b>Trimethoprim + sulphamethoxazole</b> im 16–20 mg/kg SID	<b>Amoxicillin</b> im 7–15 mg/kg SID	
Contagious bovine pyelonephritis (Corynebacterium renale)	<b>Procaine penicillin</b> im 25 mg/kg SID <b>Amoxicillin</b> im 7–15 mg/kg SID	<b>Amoxicillin/clavulanic acid</b> Im 8.75 mg/kg SID	
Leptospirosis (Leptospira interrogans ser. hardjo, pomona, tarassovi, interrogans)	<b>Streptomycin</b> im 15–25 mg/kg SID <b>Amoxicillin</b> im 7–15 mg/kg SID	<b>Procaine penicillin</b> im 25 mg/kg SID	
Cystitis Pathogen unknown	<b>Trimethoprim + sulphamethoxazole</b> im 16–20 mg/kg SID	<b>Amoxicillin</b> im 7–15 mg/kg SID	
<b>Reproductive tract</b>			
Retained foetal membranes Mixed infection including anaerobes	<b>Procaine penicillin</b> im 25 mg/kg SID	<b>Amoxicillin</b> im 7–15 mg/kg SID	Antibiotics are only required if the cow is systemically ill.



Acute metritis (affected systemically)	Procaine penicillin im 25 mg/kg SID Amoxicillin im 7–15 mg/kg SID	Ceftiofur hydrochloride im/sc 2.2 mg/kg SID	
Endometritis (not affected systemically)	Cephapirin <sup>®</sup> iu 500 mg Once		Cephapirin cannot be used within 14 days after calving.
Mixed infection including anaerobes			Cows with luteal tissue may respond to prostaglandin injection.
Vaginitis/Peri-vaginal reactions	Procaine penicillin im 25 mg/k once g SID	Oxytetracycline im 4–20 mg/kg SID	
Mixed infection including anaerobes	Amoxicillin im 7–15 mg/kg SID		
Vibriosis	Streptomycin im 15–25 mg/kg SID	Oxytetracycline im 4–20 mg/kg SID Procaine penicillin im 25 mg/kg SID	Therapy has a poor prognosis in older bulls. Consider culling.
Trichomoniasis	No treatment available		
<b>Cardiovascular system</b>			
Endocarditis and Pericarditis	Procaine penicillin im 25 mg/kg SID Amoxicillin im 7–15 mg/kg SID		
Navel ill (omphalophlebitis)	Procaine penicillin im 25 mg/kg SID	Amoxicillin/clavulanic acid im 8.75 mg/kg SID	Extended therapy often required, surgical resection may be necessary to assist healing and antibiotic penetration.
<b>Central nervous system</b>			
Spinal cord abscess	Procaine penicillin im 25 mg/kg SID		Prognosis poor – consider euthanasia
Listeriosis	Procaine penicillin im 25 mg/kg SID Trimethoprim + sulpha im 16–20 mg/kg SID	Oxytetracycline 4–20 mg/kg SID	If cow is recumbent, consider euthanasia
Tetanus	Procaine penicillin im 25 mg/kg SID		1. Also administer tetanus antitoxin 2. If a wound is detectable then debridement and flushing the wound should be undertaken
Meningo-encephalitis/Encephalitis			
Pathogen unknown	Procaine penicillin im 25 mg/kg SID Trimethoprim + sulpha im 16–20 mg/kg SID	Ceftiofur hydrochloride im/sc 2.2 mg/kg SID Marbofloxacin sc/iv/im 2 mg/kg SID Enrofloxacin sc 5 mg/kg SID	
B-haemolytic streptococci	Procaine penicillin im 25 mg/kg SID Amoxicillin im 7–15 mg/kg SID	Ceftiofur hydrochloride im/sc 2.2 mg/kg SID	
Histophilus somni	Procaine penicillin im 25 mg/kg SID Amoxicillin im 7–15 mg/kg SID	Ceftiofur hydrochloride im/sc 2.2 mg/kg SID Marbofloxacin sc/iv/im 2 mg/kg SID Enrofloxacin sc 5 mg/kg SID	
<b>Musculoskeletal disease</b>			
Footrot	Procaine penicillin im 25 mg/kg SID		
Toe abscess	No antibiotics indicated		Effect good drainage and apply hoof block to take weight off the affected digit
Joint ill-Arthritis-Osteomyelitis-Peri-arthritis	Procaine penicillin im 25 mg/kg SID Amoxicillin/clavulanic acid im 8.75 mg/kg SID	Oxytetracycline im 4–20 mg/kg SID	
Blackleg	Procaine penicillin im 25 mg/kg SID		

Cellulitis	Procaine penicillin im 25 mg/kg SID Amoxicillin im 7–15 mg/kg SID	Trimethoprim + sulpha im 16–20 mg/kg SID	If lesion is around the head use a penicillin based product
<b>Mastitis</b>			
Gangrenous Mastitis	Oxytetracycline im 4–20 mg/kg SID	Tylosin im 10 mg/kg SID	Treat within 24 hours and administer anti-inflammatory. Prognosis guarded. Euthanase advanced cases.
Staphylococcal Mastitis	Penethamate hydriodide* im 5g SID	Tylosin im 10 mg/kg SID	*For Staphylococcal isolates that are known to be sensitive to penicillin.
<b>Skin conditions</b>			
Dermatophilus	Procaine penicillin im 25 mg/kg SID		Topical treatment with iodine or chlorhexidine compounds in mild cases
Ringworm Trichophyton spp			Topical treatment with iodine or chlorhexidine compounds in mild cases
<b>Eyes</b>			
Pink Eye Moraxella bovis	Topical Oxytetracycline powder for mild cases	Oxytetracycline im 4–20 mg/kg SID for severe cases	Normally self-limiting disease but can be debilitating and permanent eye damage can result.
<b>Surgery</b>			
	Procaine penicillin im 25 mg/kg SID	Amoxicillin im 7–15 mg/kg SID	Possibly indicated with surgeries of the gastrointestinal tract, umbilical hernias, teat surgery, hoof surgery and caesarian section. Preferably give pre-operatively.

## Guidelines section one: Sheep

Condition	Treatment	Alternative	Notes
<b>Respiratory</b>			
Acute viral pneumonia	NR	NR	
CNPP	NR	NR	Prevention best
Laryngeal Chondritis	Tetracycline LA @ 20mg/kg x 3 doses 3 days apart		Early treatment required. Give anti-inflammatories also. Prognosis guarded.
<b>Enteric</b>			
Salmonella typhimurium	Tetracycline LA @ 20mg/kg	Trimethoprim Sulphur @40 mg Trimethoprim, 200 mg Sulphadiazine/kg Daily for 3 days	Consider only early clinical cases for antibiotic therapy. Provide fluid support. Vaccinate and spread sheep out and reduce stress to slow epidemic.
Campylobacter spp.	Tetracycline LA @ 20mg/kg	Trimethoprim Sulphur @40 mg Trimethoprim, 200 mg Sulphadiazine/kg Daily for 3 days	Consider only early clinical cases for antibiotic therapy. Provide fluid support. Spread sheep out and reduce stress to slow epidemic.
Yersinia pseudotuberculosis	Tetracycline LA @ 20mg/kg	Trimethoprim Sulphur @40 mg Trimethoprim, 200 mg Sulphadiazine/kg Daily for 3 days	Consider only early clinical cases for antibiotic therapy. Provide fluid support. Spread sheep out and reduce stress to slow epidemic.
Listeria monocytogenes	Procaine penicillin @35000 units/kg	Trimethoprim Sulphur @40 mg Trimethoprim, 200 mg Sulphadiazine/kg Daily for 3 days	Consider only early clinical cases for antibiotic therapy. Provide fluid support. Spread sheep out and reduce stress to slow epidemic.
<b>Abortion</b>			
Campylobacter spp	Tetracycline LA @ 20mg/kg	NR	Treat only aborted ewes that are sick with endometritis. Spread unaffected ewes out. Remove aborted material and ewes. Hygiene. Vaccination.

Salmonella Brandenburg	Tetracycline LA @ 20mg/kg	NR	Treat only aborted ewes that are sick with endometritis. Spread unaffected ewes out. Remove aborted material and ewes. Hygiene. Vaccination.
Toxoplasmosis gondii	NR	NR	Aborted ewes will have strong natural immunity. Vaccination of young replacements.
Listeria spp	Procaine penicillin @35000 units/kg	NR	Treat only aborted ewes that are sick with endometritis. Spread unaffected ewes out. Remove aborted material and ewes. Hygiene.
<b>Mastitis</b>			
Gangrenous Mastitis	Tetracycline LA @ 20mg/kg. Consider off-label intramammary treatment also.	Tylosin 10 mg/kg SID 3 days	Treat within 24 hours and administer anti-inflammatory. Prognosis guarded. Euthanase advanced cases.
General Mastitis	Tetracycline LA @ 20mg/kg. Consider off-label intramammary treatment also.	Tylosin 10 mg/kg SID 3 days	
<b>Feet infections</b>			
Scald/OID	Footbath in 10% zinc sulphate, 5% formalin %. Topical tetracycline spray.	Parental antibiotics considered for cases unresponsive to footbathing. Procaine penicillin @35000 units/kg, Tetracycline @10 mg/kg	Usually self-limiting once under foot conditions become dry.
Footrot	Tetracycline LA @ 20mg/kg. Procaine penicillin @75000 units/kg	Erythromycin 12 mg/kg Tulathromycin 2.5 mg/kg Tilmicosin 5 mg/kg.	Use only as part of a footrot management plan. Keep feet dry for 24 hours post antibiotic treatment.
Foot abscess	Tetracycline LA @ 20mg/kg x 2 doses, 2 to 3 days apart	Penicillin LA @150 mg of Procaine penicillin G and 150 mg Benzathine penicillin per 10 kg. Give 2 doses, 2 days apart	Treat early for best results.
<b>Eyes, skin and CNS</b>			
Dermatophilus	Dip 1% zinc sulphate or 1% potassium aluminium	Streptomycin 75mg/kg	Provide a dry and hygienic environment.
Pinkeye	Topical tetracycline or pinkeye powder for mild cases	Tetracycline LA @ 20 mg/kg for severe cases	Normally self-limiting disease but can be debilitating and permanent eye damage can result.
Pseudomonas aeruginosa dermatitis	NR	NR	Debride and lavage ulcers
Listeria monocytogenes	NR	NR	Antibiotics will not reverse brain damage.
Chlamydia pecorum	Tetracycline LA 20 mg/kg	NR	Very rare. Early treatment essential.
Scabby Mouth (Contagious Ecthyma)	NR	Tetracycline LA @ 20 mg/kg for severe cases.	Normally self-limiting disease but can be debilitating. Antibiotics to control secondary infection.
<b>Urogenital</b>			
Balano-posthitis	NR	NR	Clip wool from prepuce. Irrigate prepuce. Lower urine pH. Hay feed for 2 days.
Endometritis/Toxaemia following rotten lambing	Procaine penicillin daily 5 days @35000 units/kg	NR	Treat early. Prognosis guarded. Consider euthanasia.
<b>Surgery</b>			
Vasectomies, Laparoscopic AI, Open castrations, Vaginal/Uterine prolapse, C-section, etc.	Procaine penicillin @35000 units/kg	Tetracycline LA @ 20 mg/kg	Operate under aseptic conditions to reduce surgical infections.
<b>Miscellaneous</b>			
Septic arthritis	NR	NR	Euthanase
Leptospirosis	Streptomycin 20mg/kg		Early antibiotic treatment of clinical cases recommended. Vaccination recommended.
Watery Mouth (E. coli)	Tetracycline @ 10 mg/kg		Must be given early in disease course.
Post dipping lameness	Procaine penicillin @35000 units/kg		Self-limiting disease.

# Guidelines section one: Deer

## Important disclaimer

There is little published data on effective antibiotic dose rates in deer. Cattle and sheep dose rates are commonly used in deer with minimal side effects but are commonly increased over labelled recommendations to achieve persistency. (Wilson, PR. Observations of a long acting formulation of oxytetracycline in red deer (*Cervus elaphus*). New Zealand Veterinary Journal 31: 75–77, 1983, Haigh JC. Pharmacokinetics of long-acting oxytetracycline in fallow deer (*Dama dama*) Journal of Veterinary Pharmacology and Therapeutics. 20: 243–245, 1997)

Note that doses given below are cattle and sheep dose rates. Since there are few antimicrobials registered for use in deer, and the above recommendation to increase dose rates above cattle and sheep dose rates, practitioners need to be acutely aware of the risk of residues and be extremely conservative with withholding times.

Condition	Treatment	Alternative	Notes
<b>Respiratory system</b>			
<i>Pasteurella pneumonia</i>	Amoxicillin im 7–15 mg/kg SID Trimethoprim + sulpha im 16–20 mg/kg SID	Oxytetracycline im 4–20 mg/kg SID Marbofloxacin sc/iv/im 10 mg/kg once Enrofloxacin sc 5 mg/kg SID Ceftiofur hydrochloride im/sc 2.2 mg/kg SID Tylosin im 10 mg/kg SID	<i>Pasteurella multocida</i> or <i>P. haemolytica</i> been isolated from a very few cases of severe fibrinous bronchopneumonia in housed weaner deer. NZ deer are not housed.
<b>Enteric</b>			
<i>Yersinia pseudotuberculosis</i>	Tetracycline LA @ 20mg/kg	Trimethoprim Sulphur @40 mg Trimethoprim, 200 mg Sulphadiazine/kg Daily for 3 days	One of the most common causes of death in young deer. The majority of cases occur in young deer in their first autumn or winter, often associated with the stress of recent weaning.
<i>Yersinia pseudotuberculosis</i> Metaphylaxis	Oxytetracycline powder Neomycin suspension		It is not uncommon to utilise metaphylaxis in face of a <i>Yersinia</i> outbreak.
<i>Salmonella typhimurium</i>	Tetracycline LA @ 20mg/kg	Trimethoprim Sulphur @40 mg Trimethoprim, 200 mg Sulphadiazine/kg Daily for 3 days	<i>Salmonella typhimurium</i> and <i>S. hindmarsh</i> have been isolated from deer dying of other causes. These organisms do not appear to cause primary disease in deer in New Zealand.
<b>Feet infections</b>			
Footrot	Tetracycline LA @ 20 mg/kg	Procaine penicillin @75000 units/kg. Erythromycin 12 mg/kg.	Use only as part of a footrot management plan. Keep feet dry for 24 hours post antibiotic treatment.
Foot abscess	Tetracycline LA @ 20 mg/kg x 2 doses 2 to 3 days apart	Penicillin LA @150 mg of Procaine penicillin G and 150 mg Benzathine penicillin per 10 kg. Give 2 doses 2 days apart.	Treat early for best results.
Necrobacillosi	Tetracycline LA @ 20mg/kg Procaine penicillin is effective but due to its short half-life it requires frequent administration and it does not penetrate abscesses particularly well, making it an impractical choice.	Trimethoprim Sulphur @40 mg Trimethoprim, 200 mg Sulphadiazine /kg Daily for 3 days	This organism, <i>Fusobacterium necrophorum</i> , is part of the normal intestinal flora of many species. Therapeutic antimicrobial use should be based on culture and sensitivity but resistance appears to be less of a problem than inadequate drug penetration in infected tissues.

Eyes, skin and CNS		
Parapoxvirus	Not responsive to antibiotics. However secondary bacterial infection is common.	Similar to the virus causing scabby mouth in sheep.
Keratitis	Subconjunctival <b>penicillin</b>	A disease similar to pinkeye in cattle has been diagnosed and is responsive to penicillin. No causative organism has been established but Moraxella bovis does not seem implicated.
Miscellaneous		
Malignant catarrhal fever	Not responsive to antibiotics	Stags are more susceptible than hinds, and winter is the worst time for infection. Prevention is the best approach, and this is done by separating sheep from deer, feeding deer well and minimising their stress.
Leptospirosis	<b>Streptomycin</b> 20mg/kg	Early antibiotic treatment of clinical cases recommended. Vaccination recommended. Metaphylaxis in face of outbreak it not uncommon.





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