Papua New Guinea Veterinary Antimicrobial Prescribing Guidelines

For more information and further resources visit
https://science.unimelb.edu.au/avpg/resources

The Fleming Fund Regional Grants

UK International Development
Partnership | Progress | Prosperity

NATIONAL FISHERIES AUTHORITY
Papua New Guinea

APCAH
ASIA-PACIFIC CENTRE FOR ANIMAL HEALTH

THE UNIVERSITY OF MELBOURNE

Cattle | Poultry | Pigs | Aquaculture

Authors and contributors: Kamal R. Acharya, Tania Areori, Kirsten E. Bailey, Valerie Baru, Julius Bautista, Glenn F. Browning, James R. Gilkerson, Mauricio J. C. Coppo, Ian Russel Enriquez, Christopher Gorea, Anxieous T. Hwingwiri, Daniel Kelly, Nelson Kewa, David Kivia, Chaudhry Muhammad Mayo, Heni Nigani, Dorothy Pagru, Martin Paina, Paula Pupune, Ben Paul, Ilagi Puana, Estelo Quimbo, Anna E. Sri, David Thompson, Noel Vitales, Thompson Walambo, Laura Y. Hardefeldt.

These guidelines were made with the input of antimicrobial stewardship and microbiology experts, experienced government and private veterinary practitioners, animal health workers, industry and government representatives.

We hope these guidelines are helpful to you and we look forward to receiving any suggestions and feedback to enable their improvement.

Version 1, February 2026

Foreword by Managing Director

This Veterinary Antimicrobial Prescribing Guideline for Papua New Guinea is the first for the country and a milestone achieved.

Antimicrobial resistance (AMR) has become one of the most pressing health issues of our time. Over decades, after the first discovery of penicillin and other antimicrobials, thereafter inappropriate use of antimicrobials has led to development and spread of resistance. This negatively impacts the advances made in medicine, public health, veterinary care, agriculture and aquaculture production systems and food safety, affecting livelihoods globally.

The urgency in addressing the growing global threat of AMR was realised through the development of the first National Action Plan on AMR for Papua New Guinea (PNG). The plan adopted and domesticated the Global Action Plan on AMR that was ratified by World Health Assembly in 2015. Better implementation will require closer cooperation by adopting the 'One Health' approach as clearly outlined in the plan as a guiding principle for working together on AMR.

Access to effective antimicrobials and their appropriate and prudent use has a role in productive and sustainable agriculture, animal health and aquaculture. The guideline is intended to provide a guide for veterinarians, veterinary para-professionals, animal health officers and farm managers on prudent use of antimicrobials. Observing core Principles of Good Antimicrobial Practice is mandatory and encouraged as guided by these guidelines. This includes committing to antimicrobial stewardship, advocating for disease prevention systems, carefully selecting antimicrobials based on accurate diagnosis, optimizing drug choice, dose, and duration, and continuous learning to improve practices.

The PNG Biosecurity Policy 2022-2032 achieved an AMR milestone by recognising the issue and provide supporting statements. The Biosecurity Policy anticipates the challenges of safeguarding and protecting agriculture, biodiversity and public health. The legal framework supporting this undertaking is the new Biosecurity Act 2025 in co-operation with the National Medicines Policy 2014 and the Medicines and Cosmetics Act 1999. These provide the legal basis for the veterinary prescribing guideline as a subsidiary legislation on veterinary antimicrobial usage in country.

The guidelines are not substitutes for individual veterinary clinical judgment, especially concerning comorbidities, allergies, or patient-specific factors. The guidelines are developed based on the latest scientific literature, local antimicrobial usage and resistance data, and expert consensus from abroad and in country. These treatment guidelines are dynamic and are subject to periodic review and will be updated to reflect new evidence.

We humbly recognise The United Kingdom's Fleming Fund (FF) in supporting capacity building, laboratory infrastructure, and the development of national AMR response programs in PNG. The support provided through the FF Country Grant (FFCG), the Fleming Fund Fellowship (FFF) and AMR One Health for South-East Asia (AMROH-SEA) are acknowledged and appreciated. This Veterinary Antimicrobial Prescribing Guideline is the product of the Fleming Fund Fellowships and AMROH-SEA under the mentorship of the Asia-Pacific Centre for Animal Health (APCAH) through the University of Melbourne. The efforts of the multidisciplinary team involved in developing the guidelines is highly commended.

AMR affects us all (humans, animals, plants, planet). Preventing resistance together is the way forward.

Dr. Nime Kapo, BVSc (Syd.)
Managing Director
PNG Biosecurity Authority

Principles for Antimicrobial Use and How to Use these Guidelines

Antimicrobial resistance is a serious global problem. We can prevent and slow down antimicrobial resistance if we use antimicrobials appropriately.

This document was made to provide guidance for veterinarians, para-veterinarians, and other animal health workers when they are deciding whether a condition needs antimicrobial treatment. It provides recommendations for treatment and prevention of commonly seen conditions. By only using antimicrobials when they are needed, we preserve their efficacy for the future.

Firstly, prevention of disease through strategies such as vaccination and biosecurity are essential. This reduces the need for antimicrobials in the first place.

Information has also been provided to help estimate animal weights. It is important that when antimicrobials are used, they are given at the appropriate dose based on the animal's body weight. Giving the wrong dose can further increase the pressure for development of antimicrobial resistance.

It is best to store antimicrobials according to the manufacturers instructions however if the instructions state 'room temperature' it may be better to keep them refrigerated. Especially for open powders or open bottles of tablets or pills storing them in a fridge can prevent negative impacts of high humidity. If there appears to be discolouration of liquids or tablets or unexpected particulates in liquids, the antimicrobial should be disposed of appropriately.

Antimicrobial Side Effects

Serious side effects from antimicrobials are generally rare. However any antimicrobial use will disrupt the balance of normal healthy bacteria in an animal (its microbiome) and could lead to dysbiosis.

Injection site reactions: Swellings or firmness around the site of the antimicrobial injection. Sometimes these reactions can progress to abscesses especially if the injection was not given in a hygienic way. Most reactions will self resolve without treatment however monitor the injection site for discharging pus and if so treat as an abscess (refer to the 'Abscesses' section under 'Wounds and Lumps'). Very high doses or accidental intravenous injection of procaine- or benzathine-containing products may cause adverse nervous system or cardiovascular effects and death.

Allergic or anaphylactic reactions: These occur rarely and may include signs such as sudden respiratory distress, facial or throat swelling and skin reactions like wheals or hives. Treatment is usually with epinephrine/adrenaline +/- corticosteroids or antihistamines. Please consult a veterinarian if you suspect a reaction has occurred.

Gastrointestinal side effects: These may include vomiting and diarrhoea or loss of appetite. This will usually resolve after the antimicrobials are stopped. For oral antimicrobials, if the manufacturer's instructions state that they can be given with food, this may reduce nausea.

Photosensitivity: Some antimicrobials (usually tetracycline antimicrobials like oxytetracycline or chlortetracycline) may cause photosensitivity resulting in red, painful and peeling skin, especially in cattle. If this occurs, provide shade and pain relief.

Antimicrobial Contraindications

Oxytetracycline (Cattle, pigs, poultry): Do not use in pregnancy or young animals as it can cause impaired bone development and discoloration of the deciduous (baby) teeth. Use cautiously in animals with liver or kidney problems.

Chlortetracycline (Cattle, pigs): The same as oxytetracycline – do not use in pregnancy or young animals, use cautiously in animals with liver or kidney problems. High oral doses in ruminants can cause ruminoreticular stasis (the rumen movements stop or slow down).

Procaine and benzathine penicillin (Cattle, pigs): It is preferable to choose procaine penicillin whenever possible. Benzathine penicillin does not reach high enough concentrations to treat most bacteria except very susceptible staphylococci.

Trimethoprim/sulphadiazine (Cattle, pigs, poultry): Do not use in pregnant animals. Use cautiously in animals with liver or kidney problems.

When using antimicrobials in food-producing animals, always check product labels for indications, restrictions, and withdrawal times.

Do not use or use with caution if an animal has had a previous reaction to that same antimicrobial.

Priority Notifiable Diseases

THE DISEASES LISTED HERE ARE NOTIFIABLE IN PNG.

Many are viral diseases, which do not require antimicrobial treatment and are not currently present in PNG, therefore treatment information has not been included in these guidelines.

1. African Swine Fever – viral disease of pigs
2. Classical Swine Fever – viral disease of pigs
3. Foot and Mouth Disease – viral disease of pigs & cattle
4. Highly Pathogenic Avian Influenza – viral disease of poultry
5. Lumpy Skin disease – viral disease of cattle
6. Newcastle Disease – viral disease of poultry
7. Rabies – viral disease of dogs, cats, cattle
8. Very Virulent Infectious Bursal Disease – viral disease of poultry
9. White Spot Syndrome Virus – viral disease of shrimp
10. Yellow Head Virus – viral disease of shrimp

You are obligated under current legislation to report suspected cases of Notifiable Animal Diseases to the Chief Veterinary Officer at National Agriculture Quarantine & Inspection Authority (NAQIA)

It is recommended that you contact NAQIA through the following means:

Email: IPuana@naqia.gov.pg
Phone: +675 3136900
Tollfree: 1801332

Antimicrobial dose rates

ANTIMICROBIAL AGENT	RECOMMENDED DOSE	ROUTE	DOSING INTERVAL	WITHHOLDING PERIOD[1] (DAYS)
Procaine penicillin[1] Benzathine penicillin[2]	30,000 IU/kg (5 ml/100 kg) 40,000 IU/kg	IM IM	12 - 24 hours Every 48 hours	Not established[1, 2]
Amoxicillin	7 mg/kg (7 ml/100 kg)	SC or IM	24 hours	Milk: 2 Meat: 28
Oxytetracycline	10 mg/kg (5 ml/100 kg)	IV or IM	12 - 24 hours	Milk: 5 Meat: 14
Oxytetracycline long acting	20 mg/kg (20 ml/100 kg)	IM	72 hours	Milk: 7 Meat: 28
Trimethoprim/sulphadiazine	24 mg/kg (10 ml/100 kg)	IM	12 - 24 hours	Milk: 3 Meat: 28

Enrofloxacin or other fluoroquinolones

Colistin

The World Health Organisation classifies these medically important antimicrobials as highest priority, critically important antimicrobials. These antimicrobials may be used as last resort treatments for serious infections in humans. If bacteria develop resistance to these antimicrobials, the bacteria or the resistant genes can be transmitted via the food chain from animals to people. In many countries their use in food-producing animals is banned. If resistance develops, there are few remaining treatment options for serious diseases impacting people.

DO NOT USE ENROFLOXACIN, OTHER FLUOROQUINOLONES OR COLISTIN IN FOOD-PRODUCING ANIMALS.

1. Many of the recommendations in this guide represent off-label use of antimicrobials and the dose rates may extend the withholding periods required
2. It is preferable to choose procaine penicillin whenever possible. Long-acting penicillin (benzathine penicillin) is not recommended as therapeutic concentrations are not achieved and its slow absorption rate increases the risk of residues above acceptable limits. A 14 day WHP for procaine penicillin and 28 day WHP for benzathine penicillin has been suggested.

Chemical restraint – only with veterinary supervision

SEDATION	RECOMMENDED DOSE	ROUTE	WITHHOLDING PERIOD (DAYS)
Xylazine 100 mg/ml Used for standing sedation or darting + local anaesthetic for surgery	0.05 mg/kg (0.05 ml/100 kg) 0.1 mg/kg (0.1 ml/100 kg)	IV IM	Meat: 28*
Xylazine (100 mg/ml) and Ketamine (100 mg/ml) Given together for standing sedation or darting aggressive animals + local anaesthetic for surgery	0.04 mg/kg (0.04 ml/100 kg) 0.08 mg/kg (0.08 ml/100 kg)	IM	Milk: 7* Meat: 28*

PAIN RELIEF/ANAESTHESIA	RECOMMENDED DOSE	ROUTE	USED FOR	WITHHOLDING PERIOD (days)*
Lidocaine 2%	Up to 200ml Local infiltration	SC	Local anaesthesia	Milk: 6 Meat : 8
	4-6 ml Epidural	Epidural	Epidural anaesthesia	

*Always check product labels to confirm withholding periods.

Pain relief dose rates

ANALGESIA / ANTI-INFLAMMATORY	RECOMMENDED DOSE	ROUTE	USED FOR	WITHHOLDING PERIOD (DAYS)*
Tolfenamic acid	2 mg/kg (5 ml/100 kg)	IM	Pain, Inflammation	Milk: 3 Meat: 5
Meloxicam	0.5 mg/kg (2.5 ml/100 kg) One dose only	SC IV	Pain, Inflammation	Milk: 6 Meat : 8

*Always check product labels to confirm withholding periods.

WEIGHT ESTIMATION

$$\text{Weight in kg} = \frac{\text{Length(cm)} \times \text{girth(cm)} \times \text{girth(cm)}}{10830}$$

e.g. If Body Length is 150 cm and Heart Girth is 100 cm, weight in kg = 150 x 100 x 100/10830 = 138 kg

DRUG DOSE CALCULATION

$$\frac{\text{Bodyweight} \times \text{Dose rate}}{\text{Concentration}} = \text{Amount to give}$$

e.g. Oxytetracycline LA is 200 mg/ml concentration, and the dose is 20 mg/kg. For a 138 kg cow, the calculation would be:

$$\frac{138 \times 20}{200} = 13.8 \text{ ml, rounded to } 14 \text{ ml}$$

Peri-operative use

SURGICAL PROCEDURE	CONTAMINATION LEVEL	RECOMMENDATION	DURATION OF THERAPY	ADDITIONAL INFORMATION
Dehorning, castration	No contamination, performed efficiently in clean, dry conditions. Clean skin with antiseptic prior to procedure.	No antimicrobials required	Not applicable	Ivermectin or doromectin at the time of any procedures is recommended to prevent screwworm infestation. Provide pain relief with an NSAID such as meloxicam or tolfenamic acid and/or use local anaesthesia.
Field caesarean section or suturing a wound less than 12 hours old	Risk of some contamination due to open abdomen/wound and length of time open in field conditions. Use antiseptic to clean skin prior to procedure.	Oxytetracycline	24-48 hours To reach effective concentrations, the first dose of IM oxytetracycline needs to be 8 hours prior to surgery or 2 hours prior if using penicillin.	
Debridement, closure of infected wounds (For guidelines on treating abscess, refer to 'Wounds and Lumps' section)	Contaminated or infected wound e.g. faecal matter or dirt in the wound, signs of infection such as pus	Oxytetracycline or base on culture and susceptibility testing	Treat until infection is resolving or granulation tissue is present, usually within one week.	

Lameness

COMMON CONDITIONS AND CLINICAL EXAMINATION

Diagnosis of the cause of lameness can be made from clinical signs alone in many lameness cases. The foot must always be lifted for thorough examination. Restrain the animal using physical restraint (leg rope) +/- sedation.
Clean the hoof with scrubbing brush + water. Look for swelling and sole penetration. Ensure no foreign body is present in the interdigital space. Use hoof testers to localize pain.

Condition	Primary Location	Key Clinical Signs	Additional Characteristics
Hoof Abscess	Inside the hoof	- Severe lameness - Swelling above the affected claw - Heat in the affected area - Possible draining tract	- Often affects a single claw - May see pus discharge if abscess ruptures
White Line Disease	Junction between hoof wall and sole	- Moderate to severe lameness - Separation of the white line - Possible black marks along white line - Potential for secondary infection	- Often affects outer claw of hind feet - May lead to sole ulcers if untreated
Footrot	Between the claws	- Sudden onset of severe lameness - Swelling and redness between claws - Foul-smelling discharge - Symmetrical swelling above the hoof	- Often affects multiple animals in herd - Associated with wet, muddy conditions
Digital Dermatitis	Skin above the heel bulbs	- Variable lameness (mild to severe) - Circular, raw, red lesions - "Strawberry-like" appearance - Possible hair loss around lesion	- Highly contagious - Often affects multiple animals - May become chronic if untreated - Usually hind feet affected

Lameness

WHITE LINE DISEASE

The white line is a junction between the hoof wall and sole. Damage to this area, often caused by stress, can lead to separation and penetration by foreign material. Once the white line is separated, bacteria can enter and cause infection, leading to abscess formation.

CLINICAL SIGNS

Often lame, favouring the healthy claw to avoid putting weight on the affected one. Separation of the white line, bruising or black marks on the sole, and visible signs of pain (limping, favouring one leg)

RISK FACTORS

Wet, dirty, and rough ground conditions.
Overcrowding and improper yard design can increase the risk.
Cows with thin or worn soles are more susceptible.

TREATMENT

Provide pain relief - NSAIDs (e.g. tolfenamic acid, meloxicam).
Application of hoof block to alternate claw
Antibiotic treatment is not required.

HOOF ABSCESS

CLINICAL SIGNS

A painful condition characterized by the formation of pus-filled pockets in the hoof. Severe lameness with inflammation above the infected claw.

RISK FACTORS

Softening of the hoof in wet, muddy environments makes it more susceptible to injury and bacterial infection. Sharp pieces of metal, wood, stubble, or thorns can cause injuries and create entry points for bacteria and subsequent infection.
Concreted laneways and sharp gravel in yards can also cause abrasion and injury to the hooves.
Cracks and splits in the hoof can also provide entry points for bacteria.
In soft or wet terrain, hooves may not wear down adequately and can overgrow, predisposing animals to injuries and foot problems.

TREATMENT

Provide pain relief - NSAIDs (e.g. tolfenamic acid, meloxicam).
Application of hoof block to alternate claw
Antibiotic treatment is not required.

Lameness

DIGITAL DERMATITIS

Digital dermatitis is a bacterial disease primarily caused by spirochete bacteria of the genus *Treponema*. The gastrointestinal tract may act as a reservoir for DD-associated treponemes. Transmission likely occurs via faeces/slurry and direct skin-to-skin contact.

CLINICAL SIGNS

Painful ulcerative lesions typically on the skin adjacent to the heel bulbs. Causes lameness and changes in behaviour (increased lying time, decreased feeding time). Can lead to reduced milk yield and fertility in some cases. High recurrence rate even after treatment.

RISK FACTORS

Farm-level: Housing type (cubicles higher risk than straw yards), Poor hygiene/wet conditions, Larger herd sizes, Buying in replacement animals, Use of footbaths and hoof trimming practices

TREATMENT

Topical therapy with tetracycline is most effective. Bandaging maintains tetracycline contact with lesions. Treat for 3 days.
Zinc sulphate can also be used to treat affected stock. Walk cattle through 10-20% zinc sulphate foot baths (1kg of zinc sulphate salts to 9kg water).

FOOTROT

Foot rot in cattle is an infectious disease. The primary cause is bacterial infection, most commonly *Fusobacterium necrophorum*.

CLINICAL SIGNS

Lameness, swelling of the lower leg, foul odour, typically affecting the interdigital space. Cattle may stand with the foot raised and be reluctant to move. Animals may lose their appetite and weight due to pain and may have a low-grade fever. Lameness can reduce milk production.

RISK FACTORS

Wet environments can allow bacteria to enter the skin between the hooves. Bruises or cuts to the interdigital skin can create entry points for bacteria.

TREATMENT

Procaine penicillin is highly effective. Topical oxytetracyline can be used if procaine penicillin is not available but it is less effective.
Topical treatment with antibacterial, antiseptic and insecticidal e.g. Gusanex.
Treat until lesions have resolved, usually three days of procaine penicillin.

Wounds and lumps

WOUNDS

DIAGNOSTICS
Careful examination to determine what structures are damaged: skin, muscle, tendon, joint, chest or abdominal cavity penetration.

TREATMENT
Clip hair, clean and flush thewound with clean water or diluted iodine/betadine. Remove any gross contamination and dead tissue.

Provide pain relief with non-steroidal anti-inflammatories (e.g. tolfenamic acid, meloxicam)
Antimicrobials arenot indicated unless the wound is deep or involves joints or body cavities.

If using antimicrobials, oxytetracycline or procaine penicillin are a suitable choice.

ABSCESSES

CLINICAL SIGNS
Round tense swelling under the skin. Pain, heat and swelling in early stage, then cooler with a fibrous capsule.

DIAGNOSTICS
Clinical signs and needle aspiration of purulent (pus) material

TREATMENT
Surgically establish drainage (open abscess) and flush abscess cavity with clean water. Antibiotics not required as they do not penetrate the abscess wall.
Provide protection from flystrike.

Keep abscess area clean using iodine or chlohexidine solution (use for first 24-48 hours only as can be irritant to skin and delay healing) or use saline or clean water.

LUMPY JAW

CLINICAL SIGNS
Caused by *Actinomyces bovis*. Slow growing firm non-painful mass attached to jawbone initiated by injury to oral mucosa.

DIAGNOSTICS
Diagnosis can usually be made from clinical signs alone. Cytology and a gram stain of pus from deep inside the abscess (visualise gram positive pleomorphic rods) and bacterial culture can confirm diagnosis.

TREATMENT
Sodium iodide at 70 mg/kg, diluted in sterile water for injection by slow IV and long-acting oxytetracycline at 30 mg/kg IM weekly.

Prognosis good if treatment initiated early. If extensive bone involvement, resolution unlikely.

Neonatal

SEPTIC ARTHRITIS "JOINT ILL"

CLINICAL SIGNS
Joint swelling, lameness. Common bacteria include *E. coli* (especially young calves), *Salmonella* spp. and *Mycoplasma* spp. (outbreaks), *Trueperella pyogenes* (older calves) and streptococci.

DIAGNOSTICS
Diagnosis can be made from clinical signs. Aseptic collection of joint fluid for cytology and antimicrobial culture and susceptibility testing is beneficial.

TREATMENT

Amoxicillin or trimethoprim/sulphadiazine.
Oxytetracycline if *Mycoplasma* spp. suspected.
Flush joint and give anti-inflammatory medicine.

DURATION OF THERAPY
2 weeks

NEONATAL SEPTICAEMIA

CLINICAL SIGNS
Depression, loss of suckle, fever or hypothermia, red mucous membranes, dehydration, slow CRT, cold extremities.

DIAGNOSTICS
Diagnosis from clinical signs.
Consider bacterial cause (enteritis, naval ill) or failure of passive transfer (lack of colostrum).

TREATMENT
Oxytetracycline but care should be taken with hypovolaemic animals as renal toxicity can occur.
Trimethoprim/sulphadiazine is a suitable alternative.

DURATION OF THERAPY
5-7 days if uncomplicated, longer duration if umbilical infection or septic arthritis develop.

UMBILICAL INFECTION

DIAGNOSTICS
Diagnosis from clinical signs, palpation of umbilical stump.
Bacterial commonly involved include *Trueperella pyogenes*, *Escherichia coli*, *Proteus* spp. and *Enterococcus* spp.

TREATMENT
Systemic antimicrobial therapy may be adequate to resolve early cases:
Oxytetracycline or trimethoprim/sulphadiazine.
Surgical drainage of superficial abscessation.
Surgical removal of infected structures.

DURATION OF THERAPY
7-10 days depending on structures involved and extent of adhesions.

Respiratory

PNEUMONIA

CLINICAL SIGNS
Nasal discharge, fever, coughing, shallow rapid breathing, expiratory grunt, loss of condition, loss of appetite.
Most common pathogens are *Mannheimia haemolytica*, *Pasteurella multocida*, *Histophilus somni* and *Mycoplasma* spp, often in conjunction with viral pathogens.

DIAGNOSTICS
Culture and susceptibility testing of post-mortem specimens should be considered in outbreaks.

TREATMENT
Oxytetracycline long-acting most appropriate.
Amoxicillin can be used but is not effective against *Mycoplasma* spp.

DURATION OF THERAPY
Dependent on severity. 2-3 days may be adequate in mild cases.
5-7 days in more severe cases.

CALF DIPHTHERIA

CLINICAL SIGNS
Cough, open mouth breathing, noisy breathing, salivation/drooling, nasal discharge, foul smelling breath, painful swallowing, fever, loss of appetite, depression.

DIAGNOSTICS
Diagnosis usually based on clinical signs. Gentle pressure across larynx exacerbates noisy breathing, confirming the origin.
Consider underlying disease (persistently infected with BVDV) or foreign body.

TREATMENT
Procaine penicillin is preferred. Oxytetracycline is a suitable alternative. Severe cases may require tracheotomy.

DURATION OF THERAPY
5 days of daily procaine penicillin or 2 doses of long acting oxytetracycline (3 days apart) is generally sufficient.

Gastrointestinal

CALF DIARRHOEA

DIAGNOSTICS
Most cases are not caused by bacteria. *E. coli* (if the calf is less than 3 days of age) and *Salmonella* are possible bacterial causes.

TREATMENT
Antimicrobial therapy is not indicated for diarrhoea caused by
viruses or *Cryptosporidium*.

Systemic antimicrobials are indicated when:
•Documented bacterial cause.
•Sepsis.
•High-risk of sepsis (e.g. the calf is unable to stand and severely depressed).

Trimethoprim/sulphonamide or oxytetracycline are suitable choices.

DURATION OF THERAPY
5 days is generally considered adequate.

ENTERITIS IN ADULTS

DIAGNOSTICS
Faeces should be submitted for culture and susceptibility testing if salmonellosis is suspected.

TREATMENT
Antimicrobial therapy is not indicated for enteritis in cattle that are
systemically well.
Systemic antimicrobials are indicated when:
•Invasive salmonellosis is suspected.
•Signs of sepsis.

Trimethoprim/sulphadiazine or oxytetracycline are suitable choices. Consider vaccination in herds with salmonellosis problems.

DURATION OF THERAPY
5 days is generally considered adequate.

Gastrointestinal

CALF DIARRHOEA- FLUID THERAPY GUIDELINES

1) ESTIMATE DEHYDRATION

Clinical Signs	Dehydration %
Diarrhoea only, still drinking and active	5
Eyes slightly sunken, still drinking	7
Calf depressed, skin tent, not drinking	9
Calf cannot stand	12

2) CALCULATE FLUID NEEDED

Maintenance + Dehydration = Fluid requirement for 24 hours
Maintenance = 10% of Body weight (e.g. 30 kg calf = 3L)
Dehydration = Body weight x % dehydration / 100
(e.g. 7%, 30 kg calf = 30 x 7 /100 = 2.1L
Total requirement = 3 L + 2.1 L = 5.1L

3) FLUID TYPE

If drinking = Oral rehydration
Use Oralade or the following homemade recipe:

100 g sodium chloride
100 g sodium bicarbonate
Add 20g to 2 litres of water
(2 hours separation from milk feed)

If not drinking enough, consider stomach tubing.
If not drinking at all, the calf may require a veterinarian or suitably trained person to administer intravenous fluids.

4) MONITOR ONGOING FLUIDS AND HYDRATION STATUS

Give milk in the morning and the evening and give electrolyte solution in between. But always separate milk feeds and electrolyte feeds by 2 hours or more.

5) PAIN RELIEF

Tolfenamic acid or meloxicam can be used for calf diarrhoea once the animal is rehydrated.

Mastitis

GRAM NEGATIVE, SEVERE

CLINICAL SIGNS
Infection of the mammary gland is brief, most clinical signs are due to the endotoxin produced by the bacteria. Severe cases have signs of systemic illness – profoundly depressed, fever initially then low temperature, high heart rate, diarrhoea ± gangrenous mastitis.

DIAGNOSTICS
Diagnosis is generally made from clinical signs alone. Milk samples should be obtained for culture and susceptibility testing.

TREATMENT
Mild cases self resolve.

In severe cases initiate systemic antimicrobials immediately following sample collection as disease progresses rapidly and is often fatal. Intramammary therapy has poor penetration.
Use trimethoprim/sulfadiazine, amoxicillin or oxytetracycline.

Supportive therapy is strongly recommended (fluid therapy and non-steroidal anti-inflammatory drugs – tolfenamic acid or meloxicam).

DURATION OF THERAPY
5-7 days generally required.

GRAM POSITIVE

DIAGNOSTICS
Milk samples should be obtained for somatic cell count and for culture and susceptibility testing, especially in an outbreak.
Samples can be frozen, for later submission, if empirical treatment fails.
Training of farmers on aseptic milk collection techniques is critical.

TREATMENT
Intramammary antimicrobials are preferred as they exert less pressure on resistance development at a farm level. Antimicrobial selection should be guided by culture and susceptibility results.
Preparations containing cloxacillin or amoxicillin are generally effective against *Streptococcus* spp. (most frequently cultured organisms).
Staphylococcus aureus is associated with biofilm formation, which worsens the prognosis. Treatment during lactation may not be successful. Cows may need to be dried off.
If indicated, preferred systemic antimicrobials are penethamate hydrochloride and trimethoprim/sulphadiazine. Procaine penicillin can also be used.

DURATION OF THERAPY
Treat until clinical signs resolve and milk somatic cell count is normal. 2-3 days may be sufficient for mild cases.

Reproductive

RETAINED FOETAL MEMBRANES

CLINICAL SIGNS
Failure to pass foetal membranes within 24 hours of calving.

DIAGNOSTICS
Diagnosis from clinical signs.

TREATMENT
Systemic antimicrobial should only be used when systemic signs: fever, depression, inappetence.
Oxytetracycline IV or IM daily is preferred, procaine penicillin as a second choice.

Intrauterine antimicrobial therapy does not improve subsequent reproductive performance and may interfere with normal placental detachment.

DURATION OF THERAPY

3-5 days

METRITIS

CLINICAL SIGNS
Foul smelling watery-brown uterine discharge
within 21 days of calving.
Systemic signs: fever, depression, loss of appetite

DIAGNOSTICS
Diagnosis from clinical signs alone.

TREATMENT
Antimicrobial therapy is not indicated in cattle that are clinically well.
Systemic antimicrobials only used if systemic illness is present (see above)
Oxytetracycline is preferred.
Procaine penicillin as a second choice
Supportive therapy may be required (fluid therapy and non-steroidal anti-inflammatory drugs).

DURATION OF THERAPY
3 days is generally sufficient but longer may be necessary in severe cases.

ENDOMETRITIS

CLINICAL SIGNS
Purulent vaginal discharge more than 21
days after calving without systemic signs of disease.

DIAGNOSTICS
Diagnosis from clinical signs

TREATMENT
High self-cure rate.

Systemic antimicrobial therapy not recommended.

Prophylactic treatment with tetracycline
pessaries can be used when a calf has died in utero.

Reproductive

VAGINAL PROLAPSE

CLINICAL SIGNS
Pink mass the size of a grapefruit or basketball protruding from vulva, usually before calving. Initially mass appears moist and pink, over time becomes swollen then dry, purple/black and cold.

DIAGNOSTICS
Diagnosis from clinical signs.

TREATMENT
Systemic antimicrobial only indicated if prolapsed tissue compromised (dry, purple/black, cold) or when high degree of contamination of the prolapsed tissue.
Oxytetracycline daily for 3 days or single long-acting oxytetracycline injection.

DURATION OF THERAPY
3 days

UTERINE PROLAPSE

CLINICAL SIGNS
Large pink to red mass hanging to level of hocks and covered in raised circular areas (caruncles where placenta was attached).

DIAGNOSTICS
Diagnosis from clinical signs alone.

TREATMENT
Epidural to allow replacement.
Clean prolapse with plenty of clean water containing diluted betadine. Cover prolapse with lubricant gel and replace. Anti-inflammatory (NSAID) for pain and inflammation. Antimicrobial therapy if prolapsed tissue compromised (dry, purple/black, cold) or high degree of contamination (with soil and/or faeces) of the prolapsed tissue.
Oxytetracycline or trimethoprim/sulphonamide.
If prolapsed tissue is severely compromised or damaged- euthanise the cow.

DURATION OF THERAPY
3 days

Miscellaneous

LISTERIA

CLINICAL SIGNS
Head pressing, circling, blindness, one sided facial paralysis caused by *Listeria monocytogenes*.

DIAGNOSTICS
Diagnosis is generally made from clinical signs.

TREATMENT
Procaine penicillin IM or oxytetracycline IV or IM
Twice daily dosing is advised.

DURATION OF THERAPY
5-7 days is generally recommended.

PINKEYE

CLINICAL SIGNS
Ocular discharge, increased tears, redness, partially closed eye, conjunctivitis caused by *Moraxella bovis*.

DIAGNOSTICS
Diagnosis from clinical signs.

TREATMENT
Topical therapy with oxytetracycline is generally effective.
Use of topical eye treatment is preferred as the duration of action is longer.
Bulbar subconjunctival administration of penicillin (300mg) is useful in severe cases.
Avoid congregating cattle in dusty yards as will facilitate disease spread.
Use an eye mask or make an eye patch (commercial products are also available) to protect and cover the eye which promotes healing and prevents spread.

DURATION OF THERAPY
One application of oxytetracyline ointment may be sufficient.
Severe cases may need treatment every 48 hours (1-2 additional applications).

Miscellaneous

RINGWORM

CLINICAL SIGNS
Localised areas of loss of hair, particularly around the head and neck. The skin may be scaly or crusted and slightly raised. The lesions may or may not be itchy.

DIAGNOSTICS
Diagnosis is generally made from clinical signs.
Microscopic examination of skin scrapings can be used to confirm the diagnosis.

TREATMENT
It will generally resolve on its own once stress resolves e.g. improved nutrition.
For severe infections, application of miconazole ointment to the lesions or iodine scrub or enilconazole solution (prepared according to product directions).

DURATION OF THERAPY
Treat until the lesions have resolved

Image from David Beggs via The Australian Cattle Veterinarian Issue 68

Antimicrobial dose rates

ANTIBIOTIC AGENT	RECOMMENDED DOSE	ROUTE	INTER-DOSING INTERVAL	WITHHOLDING PERIOD (DAYS)
Amoxicillin	20 mg/kg	Drinking water***	24 hours	Eggs: Nil** Meat: 2
Chlortetracycline (CTC)	60 mg/kg	Drinking water***	24 hours	Eggs: Nil Meat: 3
Oxytetracycline	60-80 mg/kg	Drinking water***	24 hours	Eggs: DO NOT USE Meat: 5
Trimethoprim/ sulphonamide	30 mg/kg* <2wk old 15 mg/kg* >2wk old	Drinking water***	24 hours	Eggs: DO NOT USE Meat: 14

*Dose rate represents concentration of combined ingredients.

- 30 mg/kg = 25 mg/kg sulphonamide + 5 mg/kg trimethoprim
- 15 mg/kg = 12.5 mg/kg sulphonamide + 2.5 mg/kg trimethoprim
- 1 level small scoop Trimidine powder = 1.5 g combined ingredients = 1.25 g sulfadimidine + 0.25 g trimethoprim

**Only one amoxicillin trihydrate product registered with a Nil WHP for domestic eggs. However, it has a 14-day export egg WHP

*** Discard any unused water and prepare fresh every day.

Antimicrobial dose rates

ANTIBIOTIC AGENT	RECOMMENDED DOSE	ROUTE	INTER-DOSING INTERVAL	WITHHOLDING PERIOD (DAYS)
Amprolium 20%	250 mg/L for 5–7 days, then 150 mg/L for 5–7 days to treat an outbreak Amprolium 20% 13mg/ kg/day for 3-5 day	Drinking water***	24 hours	Meat: Nil Eggs: Nil
Toltrazuril/Baycox	3 L/1000 L 7mg/ kg/day	Drinking water***	48 hours	Eggs: DO NOT USE Meat: 14

Enrofloxacin or other fluoroquinolones	The World Health Organisation classifies these medically important antimicrobials as highest priority, critically important antimicrobials. These antimicrobials may be used as last resort treatments for serious infections in humans. If bacteria develop resistance to these antimicrobials, the bacteria or the resistant genes can be transmitted via the food chain from animals to people. In many countries their use in food-producing animals is banned. If resistance develops, there are few remaining treatment options for serious diseases impacting people.
Colistin	DO NOT USE ENROFLOXACIN, OTHER FLUOROQUINOLONES OR COLISTIN IN FOOD-PRODUCING ANIMALS.

*** Discard any unused water and prepare fresh every day.

Water requirements & medication

POULTRY TYPE	DAILY WATER REQUIREMENT
Non-laying hens	19 L/100 birds
Laying hens	19-28 L/100 birds
Broilers 4 weeks	7.6 L/100 birds
Broilers 8 weeks	15.5 L/100 birds
Broilers 12 weeks	21 L/100 birds

MEDICATION CALCULATION EXAMPLE

Dose rate: 20 mg/kg per bird for amoxicillin
Each bird: ~2 kg x 20 mg = 40 mg/bird

How many birds?
If 40 birds: 40 birds x 40 mg/bird = 1600 mg total

What is the concentration of the antibiotic per gram of the commercial product?
870 mg/g Amoxicillin
Calculate total g required: 1600/870 = 1.84 g of the commercial product. Add 1.84 g of amoxicillin to 24 hours of water (7.6-15.5 L) and provide to birds. Remove and replace with freshly made-up solution daily.

Gastrointestinal

COCCIDIOSIS

CLINICAL SIGNS AND PATHOLOGY
Diarrhoea, depression, lethargy, runting/stunting, mortality. Abnormal intestinal or caecal droppings. Lesions (like salt and pepper and/or haemorrhagic) of the intestinal mucosa upon post-mortem examination.

DIAGNOSTICS
Faecal flotation to identify coccidia in the faeces.
Lesion scoring based on post-mortem

TREATMENT
First choice: Amprolium: 5-7 days, followed by 5- 7 days at a reduced dose (see table describing antimicrobial dose rates).
Second choice: Toltrazuril: 2 consecutive days (cannot be used in birds that will be laying eggs within 8 weeks of treatment).

INTESTINAL WORMS

CLINICAL SIGNS AND PATHOLOGY
Diarrhoea, depression, lethargy, runting/stunting, mortality. Abnormal intestinal or caecal droppings. Observation of worms in faeces or during post/mortem examination.

DIAGNOSTICS
Faecal flotation to detect eggs or tapeworm segments in the faeces.

TREATMENT
Round worms (nematodes): Levamisole at 28 mg/kg

DURATION OF THERAPY
2 days is generally sufficient to treat the infection. When treating a severe infection, treatment must be repeated 17-21 days later.

Gastrointestinal

NECROTIC ENTERITIS

CLINICAL SIGNS
Diarrhoea, depression, lethargy, mortality. Necrotic lesions of the small intestine appearing ballooned, fragile or friable and containing a foul-smelling brown fluid.

DIAGNOSTICS
Frequently associated with coccidiosis. A direct smear of the intestinal mucosa to look for overgrowth of *Clostridium perfringens*, using a Gram stain to identify the organism which looks like Gram positive rods.

TREATMENT
1st choice: Amoxicillin
2nd choice: Chlortetracycline or oxytetracycline

DURATION OF THERAPY
3-5 days is generally sufficient to treat the infection.

SPOTTY LIVER DISEASE

CLINICAL SIGNS
Most commonly seen in layer and breeder birds. Non-specific clinical signs such as decreased egg production and increased mortality rates can be observed. Livers have multiple areas of focal necrosis. The causative agent is *Campylobacter hepaticum*.

DIAGNOSTICS
Culture and sensitivity of liver samples collected during post-mortem examination.

TREATMENT
1st choice: Chlortetracycline or oxytetracycline
2nd choice: Amoxicillin

DURATION OF THERAPY
5 days

PREVENTION
Decreasing flies, rodents, mites, litter beetles and wild birds, which all carry the bacteria. Improve cleaning of sheds and ensuring good terminal disinfection.

Respiratory

CONJUNCTIVITIS

CLINICAL SIGNS

Conjunctivitis, keratitis, photophobia, excess lacrimation. Most common bacterial causes of conjunctivitis are psittacosis (*Chlamydia psittaci*) and mycoplasmosis (*Mycoplasma gallisepticum*).

DIAGNOSTICS

Post-mortem findings. Viral infection (e.g.: influenza A, infectious bronchitis virus, infectious laryngotracheitis); fungal infection (e.g.: *Aspergillus* spp.); high levels of ammonia or nutritional (e.g.: vitamin A toxicity) causes should be ruled out prior to antimicrobial prescription.

TREATMENT

Try to delay treatment until a microbiological diagnosis and antimicrobial susceptibility can be established, but this can be affected by other concerns e.g. for bird welfare. If treatment is required before a diagnosis can be established, then the treatment of choice would be a tetracycline.
Chlortetracycline: effective against most bacterial pathogens.
Amoxicillin: DO NOT use if mycoplasmosis is suspected.
Oxytetracycline is NOT suitable for birds laying eggs for human consumption.

DURATION OF THERAPY

3-5 days

RHINITIS AND SINUSITIS

CLINICAL SIGNS

Sneezing and nasal discharge, facial swelling, periorbital swelling and excess lacrimation. Some respiratory disease may also cause birds to become systemically unwell or die suddenly.
Most common bacterial causes of rhinitis and sinusitis are Psittacosis (*Chlamydia psittaci*), Mycoplasmosis (*Mycoplasma gallisepticum*), infectious coryza (*Avibacterium paragallinarum*), fowl cholera (*Pasteurella multocida*),or infections with *Ornithobacterium rhinotracheale* and *Riemerella anatipestifer* (in ducks).

DIAGNOSTICS

Post-mortem findings. Viral infection (e.g.: influenza A, infectious bronchitis virus, infectious laryngotracheitis) should be ruled out prior to antimicrobial prescription.

TREATMENT

Chlortetracycline: effective against most bacterial pathogens.
Amoxicillin: DO NOT use if mycoplasmosis is suspected.
Oxytetracycline is NOT suitable for birds laying eggs for human consumption.

DURATION OF THERAPY

3-5 days

Respiratory

TRACHEITIS

CLINICAL SIGNS

Coughing, gasping.

Most common bacterial causes of tracheitis are mycoplasmosis (*Mycoplasma gallisepticum*), colibacillosis (*Escherichia coli*), *Bordetella avium*, *Ornithobacterium rhinotracheale* and fowl cholera (*Pasteurella multocida*).

DIAGNOSTICS

Post-mortem findings. Viral infection (e.g.: infectious laryngotracheitis, infectious bronchitis, avian influenza A, turkey rhinotracheitis and Newcastle disease); fungal infection (e.g.: Aspergillus spp.); high levels of ammonia or dust should be ruled out prior to antimicrobial prescription.

TREATMENT

Chlortetracycline: effective against most bacterial pathogens.
Amoxicillin: do NOT use if mycoplasmosis is suspected.
Oxytetracycline is NOT suitable for **birds laying eggs** for human consumption.

DURATION OF THERAPY

3-5 days

PNEUMONIA

CLINICAL SIGNS

Coughing, increased respiratory rate, open-mouthed breathing

Most common bacterial causes of pneumonia are colibacillosis (*Escherichia coli*), *Ornithobacterium rhinotracheale* and fowl cholera (*Pasteurella multocida*).

DIAGNOSTICS

Post-mortem findings. Viral infection (e.g.: influenza A, turkey rhinotracheitis) and fungal infection (e.g.: *Aspergillus* spp.) should be ruled out prior to antimicrobial prescription.

TREATMENT

Chlortetracycline: effective against most bacterial pathogens.
Amoxicillin if *E. coli* infection is suspected. DO NOT treat most cases of colibacillosis with antimicrobials, instead try to investigate and correct the root cause.
Oxytetracycline is NOT suitable for birds laying eggs for human consumption.

DURATION OF THERAPY

3-5 days

Respiratory

AIRSACCULITIS

CLINICAL SIGNS
Gasping, coughing.
Most common bacterial causes of airsacculitis are mycoplasmosis (*Mycoplasma gallisepticum/synoviae*), colibacillosis (*Escherichia coli*), fowl cholera (*Pasteurella multocida*), psittacosis (*Chlamydia psittaci*), or infections with *Bordetella avium*, *Ornithobacterium rhinotracheale* and *Riemerella anatipestifer* (in ducks).

DIAGNOSTICS
Post-mortem findings. Viral infection (e.g.: infectious bronchitis, avian influenza A, turkey rhinotracheitis and Newcastle disease) and fungal infection (e.g.: *Aspergillus* spp.) should be ruled out prior to antimicrobial prescription.

TREATMENT
Chlortetracycline: Effective against most bacterial pathogens.
Amoxicillin if *E. coli* infection is suspected. DO NOT treat most cases of colibacillosis with antimicrobials, instead try to investigate and correct the root cause.
Oxytetracycline is NOT suitable for birds laying eggs for human consumption.

DURATION OF THERAPY
3-5 days

Reproductive

EGG PRODUCTION DROPS

CLINICAL SIGNS
Egg production drops, internal laying (egg peritonitis), shell deformities, changes in albumen quality or yolk colour, pasty vent, infertility.

DIAGNOSTICS
Post-mortem findings. In all cases of egg production drops, husbandry, lighting, feed and water intake, nutrition and environmental stresses must be considered early in the investigation. Cases of reproductive disease can be caused by viral, bacterial or coccidial infections, as well as nutritional, environmental, management, toxic or traumatic causes.

TREATMENT
Most causes of reproductive disease are non-infectious. Bacterial causes of reproductive disease are uncommon. Antimicrobial treatment should only be used when a specific diagnosis has been made.
Chlortetracycline: Effective against most bacterial pathogens.
Amoxicillin if erysipelas or colibacillosis is suspected. DO NOT treat most cases of colibacillosis with antimicrobials, instead try to investigate and correct the root cause.
Oxytetracycline is NOT suitable for birds laying eggs for human consumption.

DURATION OF THERAPY
3-5 days

Musculoskeletal and neurological conditions

LAMENESS / RELUCTANCE TO MOVE

CLINICAL SIGNS AND PATHOLOGY

Lameness is usually chronic with a number of causes, including viral, bacterial, fungal infections, or metabolic and nutritional causes. Clinical signs and pathology vary depending on the cause and location of the lesions causing the disease.

DIAGNOSTICS

Post-mortem findings. Culture and antibiotic sensitivity when bacterial infection is suspected. Common bacterial infections: Mycoplasmosis (*Mycoplasma synoviae*), colibacillosis (*Escherichia coli*), fowl cholera (*Pasteurella multocida*), *Staphylococcus aureus* or enterococci, which may be accompanied by other clinical signs and pathological findings.

TREATMENT

Being a chronic disease, treatment with antimicrobials is NOT recommended, unless there is a clear indication of bacterial infection.
Chlortetracycline: effective against most bacterial pathogens.
Amoxicillin: if *E. coli* infection is suspected. DO NOT treat most cases of colibacillosis, instead investigate and correct the underlying cause.
Oxytetracycline is NOT suitable for birds laying eggs for human consumption.
Staphylococcus aureus or Enterococci infection: always follow culture and sensitivity results. If laboratory not available use amoxicillin.

DURATION OF THERAPY

3-5 days

NERVOUS SIGNS

CLINICAL SIGNS

Paresis or paralysis; leg misplacement; tremors; incoordination; blindness; head in abnormal positions (opisthotonous, torticollis); depression.

DIAGNOSTICS

Post-mortem findings. Very few cases of neurological disease are caused by bacterial infection; with viral or fungal infections, toxic, nutritional or management deficiencies being implicated in most cases. A thorough examination of the birds and clinical history will provide the bases for diagnosis.

TREATMENT

Bacterial causes of neurological disease in poultry are uncommon. Antimicrobial treatment is NOT recommended unless a specific diagnosis has been made.

Systemic disease

PERACUTE/ACUTE SEPTICAEMIA

CLINICAL SIGNS

Sudden increase in mortality with or without clinical signs or lesions found during post-mortem examination.
Most common bacterial causes of peracute/acute systemic disease are erysipelas (*Erysipelothrix rhusiopathiae*), fowl cholera (*Pasteurella multocida*), necrotic enteritis (*Clostridium perfringens*) and spotty liver disease (*Campylobacter hepaticum*).

DIAGNOSTICS

Post-mortem findings. Viral infection (e.g.: avian influenza A, Newcastle disease and duck plague), coccidial infection and problems associated with management (e.g.: heat stress, smothering), nutrition (e.g.: calcium tetany) should be ruled out prior to antimicrobial prescription.

TREATMENT

Chlortetracycline: effective against most bacterial pathogens.
Amoxicillin: if erysipelas or colibacillosis are suspected. DO NOT treat most cases of colibacillosis, instead try to investigate and correct the root cause.
Oxytetracycline is NOT suitable for birds laying eggs for human consumption.

DURATION OF THERAPY

3-5 days

SUB-ACUTE/CHRONIC SEPTICAEMIA

CLINICAL SIGNS

Increase in mortality and/or depression with chronic signs of septicaemia such as pericarditis, perihepatitis or focal liver necrosis.
Most common bacterial causes of sub-acute/chronic systemic disease are psittacosis (*Chlamydia psittaci*), erysipelas (*Erysipelothrix rhusiopathiae*), fowl cholera (*Pasteurella multocida*), spotty liver disease (*Campylobacter hepaticum*), colibacillosis (*Escherichia coli*), *Staphylococcus aureus*, *Riemerella anatiipestifer* (in ducks).

DIAGNOSTICS

Post-mortem findings. Culture and sensitivity of samples collected from lesions observed during post-mortem examination.

TREATMENT

Chlortetracycline: effective against most bacterial pathogens.
Amoxicillin: if erysipelas, or colibacillosis are suspected. If laboratory not available, use amoxicillin to treat S. aureus infections. DO NOT treat most cases of colibacillosis, instead try to investigate and correct the root cause.
Oxytetracycline is NOT suitable for birds laying eggs for human consumption.

DURATION OF THERAPY

3-5 days

Young chicks

HIGH MORTALITY 1-7 DAYS

CLINICAL SIGNS

High mortality. May also see yolk-sac infection, omphalitis, caseous material in the respiratory tract (aspergillosis), dehydration.

DIAGNOSTICS

Post-mortem findings and clinical history.

A thorough investigation of underlying causes is required to reach a diagnosis as most cases of mortality during this period are associated with poor management or environmental conditions.

Bacterial causes of young chick mortality are not uncommon.

TREATMENT

Antimicrobial treatment is NOT recommended. Consult the hatchery or supplier of the chicks or a veterinarian.

Control measures should focus on identifying underlying causes and improving management conditions such as hatchery hygiene, brooding conditions (under or over heating), and reducing environmental stressors (heat or cold stress, food and water availability and drinker management to prevent water deprivation, appropriate stocking density).

HIGH MORTALITY 7-14 DAYS

CLINICAL SIGNS

High mortality. Liver lesions and caseous material in the respiratory tract (aspergillosis).

DIAGNOSTICS

Post-mortem findings and clinical history.

Aspergillosis may cause gizzard erosions.

A thorough investigation of underlying causes is required to reach a diagnosis as most cases of mortality during this period are associated with poor brooding conditions.

TREATMENT

Antimicrobial treatment is NOT recommended. Consult a veterinarian.

Control measures should focus on identifying underlying causes and improving management conditions such as temperature regulation, feed and water availability, ventilation, litter management and stocking density.

Young chicks

DIARRHOEA/WET FLOORS

CLINICAL SIGNS

Diarrhoea, wet floors, runting-stunting syndrome. Lesions in the kidneys consistent with nephrosis (kidneys or ureters appear white).

DIAGNOSTICS

Post-mortem findings and clinical history.

A thorough investigation of underlying causes is required to reach a diagnosis as most cases of diarrhoea in young chicks are associated with poor management at the hatchery or poor brooding conditions.

TREATMENT

Antimicrobial treatment is NOT recommended.

Control measures should focus on identifying underlying causes and Improving hatchery hygiene, brooding conditions (under or over heating), temperature regulation, feed quality, ventilation, litter management, stocking density and drinker management.

SWOLLEN ABDOMEN

CLINICAL SIGNS

Swollen abdomen, yolk sac infection.

DIAGNOSTICS

Post-mortem findings and clinical history.

A thorough investigation of underlying causes is required to reach a diagnosis as most cases of yolk sac infection are associated with poor management at the hatchery or environmental conditions in the farm. Yolk sac infection is frequently caused by *Escherichia coli*, Staphylococcus aureus or enterococci.

TREATMENT

Antimicrobial treatment is NOT recommended.

Control measures should focus on identifying underlying causes and improving management conditions such as reducing faecal contamination of hatching eggs or early contamination at hatch, reducing stress and ensuring good litter management, good sanitation practices, temperature regulation, appropriate ventilation and air quality.

Young chicks

RESPIRATORY OR OCULAR SIGNS

CLINICAL SIGNS

Difficulty breathing, gasping, conjunctivitis, eyes closed.

DIAGNOSTICS

Post-mortem findings. Cheesy lesions in the respiratory tract are indicative of fungal infection (Aspergillosis). Viral causes of respiratory or ocular clinical signs include infectious bronchitis.

A thorough investigation of underlying causes is required to reach a diagnosis, as most cases of respiratory/ocular disease in young chicks are associated with poor management of brooding conditions, such as under of over heating, or elevated ammonia levels.

Heat stress can result in significant loss of chicks from 4 weeks onwards.

TREATMENT

Antimicrobial treatment is NOT recommended.

Control measures should focus on identifying underlying causes and improving management conditions such as reducing faecal contamination of hatching eggs or early contamination at hatch, reducing stress and ensuring good litter management, good sanitation practices, temperature regulation, appropriate ventilation and air quality.

Ensure appropriate housing and ventilation conditions especially once birds start feathering.

LAMENESS

CLINICAL SIGNS

Lameness or difficulty to move. Deformities of the legs.

DIAGNOSTICS

Post-mortem findings. Observation of the femoral heads for evidence of necrosis, which is indicative of bacterial infection (e.g.: *Staphylococcus aureus*, enterococci).

A thorough investigation of underlying causes is required to reach a diagnosis, as most cases of leg deformities in young chicks are associated with poor management at the hatchery or nutritional deficiencies (rickets or vitamin A deficiencies).

TREATMENT

Antimicrobial treatment is NOT recommended.

Control measures should focus on identifying underlying causes and improve management conditions at the hatchery or nutritional deficiencies.

Parasites

EYE WORM - Oxyspirura mansoni

CLINICAL SIGNS
The *Oxyspirura mansoni* worm is about 12–18 mm long. The parasite causes inflammation of the eye and surrounding structures, tearing, cloudy eyes, head scratching and decreased vision. Some birds may also have decreased appetite or weight loss.

DIAGNOSTICS
Visualisation of worms in the eye usually under the nictitating membrane (third eyelid).

TREATMENT
No antimicrobials needed. Flubendazole daily for 7 days. Careful manual removal of adult worms can be performed but will not stop the life cycle.

PREVENTION
The intermediate host is the cockroach. Improve pest management and keep poultry houses clean and dry. Cleaning out of enclosures and litter (every 1-2 weeks) can prevent the build up of parasites and other pests in the environment. Use of wire screen floors in overnight enclosures to reduce contact with worm eggs in the droppings can also be beneficial. Consider regular de-worming of household flocks.

Note: In rare cases this parasite can cause cutaneous larva migrans in humans. Always wear shoes when walking in areas where animals live.

INTESTINAL PARASITES

CLINICAL SIGNS
Mild infections of most worms do not cause clinical signs. Some infections may cause weight loss or diarrhoea. The most common intestinal parasites are *Ascaridia* spp. (round worms).

DIAGNOSTICS
Visualisation of worms in the faeces or during post-mortem examination. Faecal flotation may reveal parasite ova.

TREATMENT
Antibiotic treatment is NOT required. Treat with an appropriate anti-parasiticide such as levamisole or flubendazole.

PREVENTION
For local backyard poultry, regular cleaning out of enclosures and litter (every 1-2 weeks) can prevent the build up of parasites and other pests in the environment. Use of wire screen floors in overnight enclosures to reduce contact with worm eggs in the droppings can also be beneficial. Consider regular de-worming of household flocks.

Antimicrobial dose rates

ANTIMICROBIAL AGENT	RECOMMENDED DOSE	ROUTE	INTER-DOSING INTERVAL	WITHHOLDING PERIOD (DAYS)
Procaine penicillin Benzathine penicillin long-acting[1]	15,000 IU/kg (1 ml/10 kg) 13mg/kg	IM	24 hours Repeat after 3 days	Meat: 5 30 days WHP
Oxytetracycline	4 - 9 mg/kg (0.4 ml/10 kg)	IM	24 hours	Meat: 8-14
Oxytetracycline long acting	20 - 30 mg/kg* (1.5 ml/10 kg)	IM	Once	Meat: 28-42**

1. It is preferable to choose procaine penicillin whenever possible. Long-acting penicillin (benzathine penicillin) is not recommended as therapeutic concentrations are not achieved and its slow absorption rate increases the risk of residues above acceptable limits.

*Check product label – long-acting formulation dose rate 10 mg/kg
**Check the label for withholding period as variation between products.

Antimicrobial dose rates

ANTIMICROBIAL AGENT	RECOMMENDED DOSE	ROUTE	INTER-DOSING INTERVAL	WITHHOLDING PERIOD (DAYS)
Amoxicillin	7 mg/kg (0.5 ml/10 kg) 20 mg/kg	IM Oral in feed or water	24 hours	Meat: 14-28 Meat: 14
Tylosin	5 - 10 mg/kg (0.5 ml/10 kg)	IM	Daily, do not exceed 3 days	Meat: 3

Enrofloxacin or other fluoroquinolones

The World Health Organisation classifies these medically important antimicrobials as highest priority, critically important antimicrobials. These antimicrobials may be used as last resort treatments for serious infections in humans. If bacteria develop resistance to these antimicrobials, the bacteria or the resistant genes can be transmitted via the food chain from animals to people. In many countries their use in food-producing animals is banned. If resistance develops, there are few remaining treatment options for serious diseases impacting people.

Colistin

DO NOT USE ENROFLOXACIN, OTHER FLUOROQUINOLONES OR COLISTIN IN FOOD-PRODUCING ANIMALS.

Sedation and pain relief

SEDATION	RECOMMENDED DOSE	ROUTE	WITHHOLDING PERIOD (DAYS)
Azaperone (Stresnil)	1–2 mg/kg	IM	Meat: 6 hours
Xylazine	1-3 mg/kg	IM	Meat: 28 Off-label in pigs
Ketamine	5-10 mg/kg	IM	Meat: 28
ANALGESIA / ANTI-INFLAMMATORY	**RECOMMENDED DOSE**	**ROUTE**	**WITHHOLDING PERIOD (DAYS)**
Tolfenamic acid	1 mg/kg (1-2 ml/10 kg) daily for 3 days	IM	Meat: 28
Meloxicam	0.4 mg/kg (2 ml/100 kg) repeat once after 24 hrs	IM	Meat: 6
Dexamethasone	1 mg/kg (2.5 ml/10 kg)	IM	Meat: 2

Weight Estimation

$$\text{WEIGHT in kg} = \frac{\text{Length (cm)} \times \text{girth (cm)} \times \text{girth(cm)}}{14000}$$

e.g. If Body Length is 100 cm and Heart Girth is 127 cm, weight in kg = 100x 127 x 127 / 14000= 115 kg

DRUG CALCULATION

$$\frac{\text{Bodyweight} \times \text{Dose rate}}{\text{Concentration}} = \text{Amount to give}$$

Example: Oxytetracycline LA is 200 mg/ml concentration, and the dose is 20 mg/kg. For a 115 kg pig, the calculation would be:

$$\frac{115 \times 20}{200} = 11.5 \text{ ml, rounded to } 12\text{ml}$$

Surgical prophylaxis

SURGICAL PROCEDURES	CONTAMINATION LEVEL	RECOMMENDATION	DURATION OF THERAPY	ADDITIONAL INFORMATION
Castration Abscess without cellulitis	Clean, no mitigating factors such as unhygienic conditions or long procedure time.	NONE	Not applicable	Perform castration at a young age e.g. 5-21 days if possible to reduce the complexity of the procedure and the required recovery time. Ivermectin at the time of any procedures is recommended to prevent screwworm infestation. Provide pain relief with an NSAID e.g. meloxicam and local anaesthesia.
Suturing a wound less than 12 hours old Performing a caesarean	Clean with risk of contamination	Procaine penicillin	Stop within 24 hours	Ivermectin at the time of any procedures is recommended to prevent screwworm infestation. Provide pain relief with a NSAID and/or use local anaesthesia.
Debridement, closure of infected wounds	Contaminated or infected wound e.g. faecal matter or dirt in the wound, signs of infection such as pus	Procaine penicillin or based on antimicrobial culture and susceptibility testing	24-48 hours	

Lameness

ABRASIONS AND CUTS ON LIMBS AND FEET

Neonatal piglets - common organisms are streptococci and staphylococci (*E. coli* in a minority).

Skin abrasion over carpus/hock, erosion sole of foot, penetrating interdigital wounds. Shifting lameness, struggle to compete for nursing, weakness, leading to starvation, diarrhoea, septicaemia.

TREATMENT

1st choice: Procaine or benzathine penicillin
2nd choice: Oxytetracycline long-acting

PREVENTION

Floor surface – avoid abrasive floors and sharp pen walls (concrete/wire). Provide extra straw bedding.

ARTHRITIS

Common organisms are streptococci, staphylococci, *Haemophilus parasuis*. May occur following teeth clipping or umbilical infection.

TREATMENT

Oxytetracycline

PREVENTION

Umbilical hygiene, cease teeth clipping

MYCOPLASMA HYOSYNOVIAE

Lameness, swollen joints, reluctance to rise

TREATMENT
Oxytetracycline

PREVENTION
Improve air quality, space allowance, hygienic environment

POLYSEROSITIS (Mycoplasma hyorhinis)

3-10 weeks of age, polyserositis, sudden death

TREATMENT
Oxytetracycline

PREVENTION
Improve air quality, space allowance, hygienic environment

Skin lesions

ERYSIPELAS

CLINICAL SIGNS
Diamond shaped skin lesions, lameness (synovitis), inappetence, depression, fever and abortion caused by *Erysipelothrix rhusiopathiae*. Most commonly seen in growing, replacement breeding stock and mature sows.
Early signs resemble septicaemia or viraemia. Zoonotic

DIAGNOSTICS
Clinical signs, post mortem findings with widespread vascular lesions. Culture of lesions with susceptibility testing.

TREATMENT
Procaine penicillin is the drug of choice.

EXUDATIVE EPIDERMITIS

CLINICAL SIGNS
Caused by *Staphylococcus hyicus*, part of the pig's normal skin flora. Skin trauma (biting, abrasions) contributes to risk of disease. Initial reddening of the skin develops into reddish brown spots that exude serum and become crusty.
Rule out sarcoptic mange and zinc deficiency (parakeratosis).

DIAGNOSTICS
Clinical signs and bacterial culture of lesions.

TREATMENT
Topical antiseptics e.g. purple spray, combinex spray, iodine, chlorhexidine applied to entire body surface. Isolate affected pigs.

Improve environment – better ventilation, cleaner and drier pens, reduced stocking density. Improve management and ensure balanced nutrition including adequate protein

WOUNDS

DIAGNOSTICS
Careful examination to determine what structures are damaged: skin, muscle, tendon, joint, chest or abdominal cavity penetration.

TREATMENT
Clean and flush the wound with clean water or diluted betadine.
Remove any gross contamination and dead tissue.

Provide pain relief with corticosteroid (e.g. dexamethasone) or non-steroidal anti-inflammatories (e.g. tolfenamic acid).

Use oxytetracycline or procaine penicillin if the wound is over 6 hours old or unable to be thoroughly decontaminated.

Respiratory

PNEUMONIA

CLINICAL SIGNS

Coughing, open mouthed breathing, sudden death.

Common causative organisms: *Actinobacillus pleuropneumoniae*, *Pasteurella multocida* and *Mycoplasma hyopneumoniae*. *Mycoplasma hyopneumoniae* has an immunosuppressive effect and causes a dry cough. Secondary infection with *Pasteurella multicoda*, *Bordatella bronchiseptica*, streptococci and *Haemophilus parasuis* causes bronchopneumonia. Disease is exacerbated by porcine circovirus.

Actinobacillus pleuropneumoniae can occur concurrently with *M. hypopneumoniae* or be a serious primary pathogen resulting in sudden death.

Post-mortem findings include bleeding from the snout and fibrinous pleuropneumonia. Pleurisy in survivors leads to ill thrift.

DIAGNOSTICS

Check for fever

Post-mortem findings and culture and susceptibility testing for *P. multicida*.

Consider migrating ascarids and lung worms.

PREVENTION

Improve hygiene and air quality e.g. reduce dusty conditions and have adequate ventilation and space allowance. Ensure adequate nutrition especially protein

Separate sick animals from healthy animals. When purchasing or bringing in new animals, keep them separate from the main herd for an appropriate quarantine period.

TREATMENT

Procaine penicillin or amoxicillin IM once daily for 3-5 days If parasites are suspected, treat with antiparasiticides.

Gastrointestinal

DIARRHOEA & DYSENTERY

NEW-BORN PIGLETS

E. coli, *Salmonella* sp. and *Clostridium perfringens* are possible bacterial causes.
Rotavirus rarely causes fatal disease.

PRE-WEANING

Enterotoxigenic *E. coli* with severe diarrhoea, dehydration or sudden death.
Clostridium perfringens may be acute, bloody diarrhoea, sudden death, or chronic yellow diarrhoea.

POST-WEANING

E. coli most likely cause in first 7-14 days after weaning.
Salmonella spp infection more common than disease.
Lawsonia intracellularis infection 7-11 weeks of age, moderate diarrhoea, wasting, and failure to thrive.
Brachyspira pilosicoli and *Brachyspira hyodysenteriae* (Swine dysentery) from 7 weeks of age, mucus and blood in diarrhoea is indicative.

DIAGNOSTICS

Post mortem findings and culture and susceptibility testing of faeces

PREVENTION

Review hygiene of piglet and farrowing environment.
Ensure thorough cleaning and drying of pens, sunlight can be helpful to kill bacteria in the environment.

TREATMENT

Antimicrobial therapy is not indicated for diarrhoea caused by viruses.
Provide fluid therapy (electrolytes ± glucose) in drinking bowls or by stomach tube.
Systemic antimicrobials are indicated when:
- There is a known bacterial cause.
- Animals are septic or at high-risk of sepsis

E. coli: Trimethoprim/sulphadiazine, amoxicillin or oxytetracycline once daily for 3-5 days

Reproduction

METRITIS, MASTITIS AND AGALACTIA

CLINICAL SIGNS

Dystocia, vaginal prolapse, mastitis, urogenital problems, endometriosis, mummifications, abortion, stillbirths
Sows affected in first few days post farrowing.

May have mastitis (hot, firm glands) +/- urogenital infection (discharge from vulva). Infection is of bacterial origin: often *E. coli*, or it may involve streptococci or staphylococci.

Sows: Fever, loss of appetite, depression, reluctance to rise or reluctance to lie for piglets to feed. Vulval discharge with bad odour, one or more glands affected with mastitis.

Piglets may appear malnourished, hungry or lose weight. Causes can include Japanese encephalitis and brucellosis

DIAGNOSTICS

Diagnosis often made on clinical signs.

PREVENTION

Review hygiene of the farrowing environment, ensure prompt removal of faecal material. Ensure hygiene of the nursing area. It must be clean, disinfected and dry.
If intervention is needed for farrowing, the vulva should be washed with anti-septic and gloves used.
Fat sows may be predisposed to reproductive issues.
Ensure sows always have access to drinking water.

TREATMENT

Sows should receive an injection of an anti-inflammatory (NSAID) e.g. tolfenamic acid, meloxicam.
Oxytocin can be used if piglets are not suckling.
Oxytetracycline injection for 3-5 days or oxytetracycline long-acting.
Cases of mastitis later in lactation can be treated with procaine penicillin.
Warm compresses against the udder can be helpful.

Parasitic diseases

SCABIES

CLINICAL SIGNS

Intense itching, head-shaking, hyperkeratosis, white patches on the skin and ears, crusting lesions, small red papules

DIAGNOSTICS

Skin scraping from ear pinnae or body cytology

TREATMENT

A single injection of ivermectin is usually effective, treat all in-contact pigs. A second injection 14 days later may be required.
Keep external wounds clean with regular washing of the animals and maintain pens in a hygienic condition.
Any edible oil e.g. soybean or coconut, can also be rubbed into the skin to reduce irritation and suffocate mites

INTERNAL PARASITES

CLINICAL SIGNS

Ascariasis (*Ascaris suum*): respiratory signs including coughing and abdominal breathing, intestinal impaction, poor growth
Trichuris suis: Diarrhoea, poor growth, inappetence
Cysticercosis (*Taenia solium*): Clinical signs are not usually observed in pigs but can include neurological signs. Infection poses a zoonotic risk to humans.
Lungworm (*Metastrongylus* spp.): Reduced growth, coughing
Threadworm (*Strongyloides ransomi*): Usually only causes signs in piglets such as anemia, severe diarrhoea and dehydration.

POST-MORTEM FINDINGS

Larval migration of *Ascaris suum* can result in focal hepatitis (milk spots on the liver) and lesions in the lungs.
Exotic: Encysted larvae in meat is a significant indicator of infection of the herd with cysticercosis (*Taenia solium*)
Lungworm: Small grey nodules usually along the ventral edges of the caudal lung lobes. Adult worms may be visible in the bronchi.

DIAGNOSTICS

Faecal floatation may detect ascarid ova during the patent period for *Ascaris suum* and *Trichuris suis*.

TREATMENT

A single oral dose of 30 mg/kg of oxfendazole will treat cysticercosis and ascariasis.
Other treatment options for internal parasites include albendazole or flubendazole or ivermectin.
A vaccine is available against *Taenia solium* and there are significant synergistic benefits when it is used with oxfendazole for control and eradication of this disease.

Miscellaneous

SUDDEN DEATH

CLINICAL SIGNS
Enterotoxigenic and enterotoxaemic *E. coli*.
Diarrhoea, lack of appetite, swollen eyelids, ataxia, recumbency, death.

DIAGNOSTICS
Post-mortem findings: fluid filled bowel, oedema around stomach and colon.
Culture and susceptibility testing.

TREATMENT
No treatment available.

MENINGITIS

CLINICAL SIGNS
Streptococcus suis causes meningitis, as well as septicaemia, arthritis, pneumonia, and endocarditis (in pigs recovered from acute disesase).
Haemophilus parasuis causes meningitis and polyserositis.

African swine fever, classical swine fever and Japanese encephalitis can cause tremors and paralysis

DIAGNOSTICS
CSF can be collected for cytological evaluation.

TREATMENT
Procaine penicillin or Amoxicillin IM once daily for 3-5 days.

Fish Disease

WATER QUALITY

Focus on good quality water for your fish, most importantly, make sure your fish have plenty of dissolved oxygen in the water. At the first signs of unusual behaviour or lack of appetite in fish, check the water quality with a handheld meter.

Low oxygen levels are one of the biggest causes of problems in fish. Low dissolved oxygen levels can also make your fish more susceptible to disease and not grow well. If a very high number of your fish die suddenly e.g. 50% with minimal clinical signs in previous days – the cause is likely a water quality issue rather than infectious causes.

Dissolved oxygen levels in outside ponds can change during the day and are often lowest in the early morning and highest in the afternoon. Signs of low oxygenation in fish include gasping close to the surface of ponds, congregating near inlets or aerators and sometimes swimming slowly or abnormally.

Ensure adequate oxygenation by checking the stocking density is appropriate for the pond size and available oxygen. Check the power supply for aeration of tanks/ponds and ensure this is working. Aim for dissolved oxygen of at least 5 mg/L.

Other water quality parameters such as pH, salinity and organic load should also be closely monitored and kept in a range suitable for your species. Address changes in water quality early.

Sudden temperature changes can also stress or kill fish. Fish should be acclimatized as slowly as possible to changes in temperature. Warm water also holds less dissolved oxygen than cool water.

A major cause of skin problems in fish is poor water quality. Bacteria are often secondary. Fixing the water quality issues is the usually the best long-term way to fix the problem, not administering antimicrobials.

Aquaculture

Biosecurity and Stocking Density

Tips for Disease Prevention

BIOSECURITY

Bringing in live fish to your farm is one of the biggest risks for disease transmission.

Farms can spread diseases amongst one another. It is ideal for farmers in an area to work together to minimise risks and prevent disease outbreaks in their region.

Farms should have biosecurity plans that cover topics such as;

- Obtaining healthy animals from dependable providers e.g. focus on obtaining good quality, disease-free fingerlings from healthy broodstock
- A visitor policy e.g. limiting and recording movement of visitors to the farm
- Proper cleaning and disinfection of equipment especially if it is used in different ponds
- Prompt removal and appropriate disposal of dead or sick fish

STOCKING DENSITY AND GRADING

Don't have too many fish such that water quality decreases. Also, if possible, grade fish appropriately so that fish are living with other fish of the same size.

Make sure the equipment used to grade fish does not cause scratches and lesions. Knotted nets such as those used for fishing also damage the skin of fish. Try to use nets without knots.

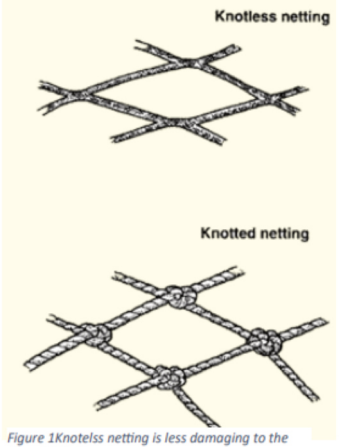


Figure 1Knotelss netting is less damaging to the skin of fish. Source: https://www.fao.org/fishery/static/FAO_Training/FAO_Training/General/x6709e/x6709e08.htm

Nutritional Diseases

NUTRITIONAL DEFICIENCIES

Always feed the best quality feed you can afford and that is the right feed for the fish you grow. Keep your feed stored in good, cool conditions.

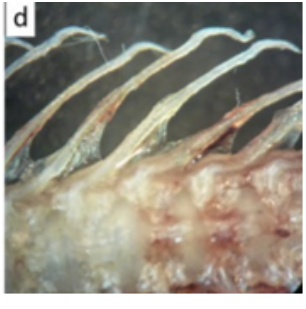
Heat will affect the quality of the feed. If your feed is maintained in poor conditions, over time, the amount of vitamins in the feed may decrease. Then when it is fed to your fish, it will not have the required amount of vitamins. Fish feed should be free from antimicrobials unless prior approval and prescription from NAQIA or NFA has been given.

Some diseases are caused by nutritional deficiencies – these cases DO NOT need antimicrobials.

VITAMIN C DEFICIENCY (BROKEN BACK DISEASE)
Fish need Vitamin C (ascorbic acid) in their feed. If it is insufficient they can develop skeletal deformities. Feed should be supplemented with a stabilized form of vitamin C – check feed packaging to ensure this is the case. This is very important at post-larval stages

RANCID UNSATURATED FATS AND LOW VITAMIN E
A lot of fish feeds have quite a high oil and fat content. If the fat spoils, it can cause emaciation and darkening of body color as well as petechia (red spots) at the base of the operculum. Occasionally fish will develop skeletal deformities. Make sure food is fresh or frozen so that unsaturated fats do not become rancid. Food should be supplemented with adequate vitamin E to protect against this.

PHOSPHOROUS DEFICIENCY
This causes anorexia, lethargy, reduced growth, and dark body colour. Observing bone deformities such as curling or bent rib ends or spine ends and overly flexible bones including jaw bones, allows for early detection of phosphorous deficiency. However, over supplementation of phosphorous must be avoided as excess phosphorous in the environment causes serious ecological pollution and damage.



A juvenile rainbow trout Oncorhynchus mykiss with bent neural spine ends. Neural spines of normal fish are straight.

Photo and caption from Aquaculture International (2025) 33:370 https://doi.org/10.1007/s10499-025-02051-3 by Shozo H. Sugiura

Bacterial diseases

DISEASE	CAUSATIVE AGENT	COMMONLY AFFECTED SPECIES	DIAGNOSIS AND CLINICAL SIGNS	TREATMENT AND MANAGEMENT
Bacterial Gill Disease (BGD)	*Flavobacterium branchiophilum*	Freshwater fish (trout, salmon)	Clinical signs include lethargy, loss of appetite, mortality, and excess mucus around gills. Filamentous bacteria may be visualised with microscopy on the gills as well as fusion of the lamellae. Confirm with laboratory AST.	Treatment is similar for both BGD and Columnaris disease. Treatment with a disinfectant such as potassium permanganate, chloramine-T, or hydrogen peroxide – best results are seen treating at first identification of disease. Remove any dead fish promptly. Physical abrasions on the skin and damage to the mucous layer facilitate infection so reduce stress, overcrowding and handling and improve water quality. Antimicrobial treatment uses oxytetracycline – ideally confirm diagnosis and susceptibility prior to use.
Columnaris Disease	*Flavobacterium columnare*	Warmwater species (tilapia, catfish)	Often grey or yellow lesions (can be necrotic) are seen around the gills, mouth and sides of body. Diagnosis via microscopy of wet mount preparations e.g. gills or surface lesion scrapings. Bacterial cells visible as 'haystacks' or columns. Confirm with laboratory AST.	

When investigating possible infectious causes of disease, always try to concurrently reduce other stressors such as overcrowding, reduced dissolved oxygen and injuries to the skin or mucous layer from handling or grading.

Bacterial diseases

DISEASE	CAUSATIVE AGENT	COMMONLY AFFECTED SPECIES	DIAGNOSIS AND CLINICAL SIGNS	TREATMENT AND MANAGEMENT
Aeromonas Septicemia	*Aeromonas hydrophila*, *A. sobria*, *A. caviae*, *A. salmonicida*	Freshwater fish including rainbow trout and other salmonids, occasionally impacts marine species	A highly contagious disease causing sudden death, lethargy, loss of appetite, haemorrhage and ulcers on the skin, mouth, fins, tail and in muscle, possible cloudy and bulging eyes. Fingerlings may die suddenly after darkening in colour. Post-mortem exam may show an enlarged spleen and necrosis (tissue death) in the liver. The stomach may contain mucus, blood and dead intestinal cells. Microscopy may show dead cells and bacterial colonies of gram-negative rods. Confirm with laboratory AST.	*Aeromonas septicemia*, vibriosis and edwardsiellosis may all present similarly with clinical signs affecting the whole fish and causing general signs of illness or death. Poor management and stress predispose to infection and outbreaks as do viral infections. Remove dead and sick fish promptly. Focus on improving water quality and reducing stress – avoid overcrowding, provide good nutrition, practice good biosecurity. Using antimicrobials, chemicals and vaccinations are not likely to be helpful if management is good. Only the atypical strain of *Aeromonas salmonicida* is present in PNG. The typical strain of *Aeromonas salmonicida* is not present in PNG. Please report to NFA and NAQIA if *Aeromonas* spp. is suspected.
Vibriosis	*Vibrio anguillarum*, *V. vulnificus*, *V. harveyi*	Marine species (tuna, seabass, grouper) and can occur in brackish water	Systemic infection is common resulting in lethargy, weight loss, skin lesions (small initially then becoming larger) across the body including at the vent and near the mouth, cloudy and bulging eyes and bulging fluid-filled abdomen. Microscopy of tissue samples from the kidney, spleen or blood samples may reveal curved, motile, gram-negative rods.	
Edwardsiellosis	*Edwardsiella tarda*, *E. ictaluri*	Tilapia, catfish, marine fish	Bulging eyes, bulging fluid-filled abdomen, skin lesions, pale and inflamed gill tissue, lesions or abscesses in the muscle that may also be filled with gas. Fish may also lie on their side at the bottom of ponds or float near the top due to infection of the swim bladder. On post-mortem and microscopic exam, abscess contents may show cells enlarged with gram-negative rod bacteria. Confirm with laboratory AST.	

Bacterial diseases

DISEASE	CAUSATIVE AGENT	COMMONLY AFFECTED SPECIES	DIAGNOSIS AND CLINICAL SIGNS	TREATMENT AND MANAGEMENT
Streptococcosis / Lactococcosis	*Streptococcus iniae*, *S. agalactiae*, *Lactococcus garvieae*	Tilapia, trout, marine fish	Sudden death, cloudy or bulging eyes, erratic swimming, and spinal deviation Gram-positive cocci	Vaccination, amoxicillin Remove dead fish promptly
Francisellosis	*Francisella noatunensis*	Tilapia, cod	Clinical signs similar to fungal or mycobacterial diseases – discoloration, abnormal behaviour, petechiae, skin ulcerations, and bulging eyes. Post mortem may show nodules in internal organs. Gram-negative, coccoid to short rods may be difficult to see with microscopy. Histopathology is most helpful for diagnosis.	Often no effective treatment; biosecurity focus
Pseudomonas Infection	*Pseudomonas fluorescens*	Various freshwater fish	Skin and fin lesions	Improve hygiene; oxytetracycline if sensitive
Mycobacteriosis	*Mycobacterium marinum*, *M. fortuitum*	Marine and ornamental fish	Signs can vary widely. Lethargy, low reproductive rates, scale loss, skin ulcers. Culture and susceptibility testing is very difficult and not usually used for diagnosis. Histopathology is likely to be most helpful. PCR testing may be available.	No effective treatment; cull infected fish. Improve water quality.
Enteric Redmouth Disease (ERM)	*Yersinia ruckeri*	Salmonids	Causes redness due to haemorrhage under the skin. Red mouth and tongue, redness over the skin and eye, swollen abdomen.	Vaccination, oxytetracycline in feed

Viral diseases

DISEASE	CAUSATIVE AGENT	COMMONLY AFFECTED SPECIES	CLINICAL SIGNS AND DIAGNOSIS	TREATMENT AND MANAGEMENT
Infectious Hematopoietic Necrosis (IHN)	IHN virus (Rhabdovirus)	Salmonids	Acute mortality, haemorrhage Young fish/fry: dark coloration, distended abdomen, bulging eyes, pale gills, mucoid opaque faecal casts. Histopathology or PCR for diagnosis IHN is not present in PNG. Please report to NFA and NAQIA if it is suspected.	No treatment; biosecurity and vaccination
Viral Hemorrhagic Septicemia (VHS)	VHS virus	Trout, marine fish	Lethargy, slow swimming, dark coloration, hemorrhage/redness at base of fins and around the eyes and mouth, bulging eyes, pale gills, swollen abdomen.	Biosecurity, disinfection
Infectious Pancreatic Necrosis (IPN)	IPN virus	Salmonids	High mortality Young fish/fry: darkened skin, rolling while swimming, bulging eyes, distended abdomen, hemorrhage, pale gills and viscera.	Biosecurity, disinfection, vaccination, improve water quality. Can be transmitted via water, blood feeding parasites and fish-eating birds.

Viral diseases

DISEASE	CAUSATIVE AGENT	COMMONLY AFFECTED SPECIES	CLINICAL SIGNS AND DIAGNOSIS	TREATMENT AND MANAGEMENT
Koi Herpesvirus (KHV)	Cyprinid herpesvirus-3	Koi, common carp	Lethargy, gasping at the surface, gill necrosis, mortality	No treatment, avoid use of contaminated water and the introduction of infected fish including latently infected fish.
Tilapia Lake Virus (TiLV)/Syncytial hepatitis of tilapia (SHT)	Orthomyxo-like virus	Tilapia	Redness/haemorrhage on skin, discolouration, protruding scales TiLV is not present in PNG. Please report to NFA and NAQIA if it is suspected.	No treatment; surveillance, disinfection, biosecurity
Infectious Spleen and Kidney Necrosis Virus (ISKNV)	Megalocytivirus	Marine and freshwater fish	Histopathology may show enlarged cells in the spleen, heart, gills and digestive tract	No treatment; quarantine and sanitation

Parasitic diseases

DISEASE	CAUSATIVE AGENT	COMMONLY AFFECTED SPECIES	DIAGNOSIS AND CLINICAL SIGNS	NOTES / CONTROL
Ichthyophthiriasis "Ich"	*Ichthyophthirius multifiliis* for freshwater species	Freshwater species	Small, white, raised bumps on the skin and fins. Fish may rub against objects. Increased mucous may be seen on the skin and gills. Microscopy of wet mounts of skin or gill biopsies, or by histopathology of affected tissues can be used for diagnosis.	UV treatment of incoming water. Remove infected or dead fish quickly to prevent contamination of water and further transmission. Treat freshwater fish with salt or formalin. Treat marine fish with formalin.
	Cryptocaryon irritans for marines species	Marine species		
Trichodiniasis	*Trichodina* spp.	Freshwater and marine	Thickening of the skin. Gill structure changes may be detected on a wet mount if serious damage is present, otherwise diagnosis requires histopathology.	Salt (for freshwater fish) or formalin baths
Ichthyobodosis	*Ichthyobodo necator*	Freshwater species	Lethargy, dark colouration, clamped fins, reddening at the base of the dorsal fin. Diagnosis via microscopic examination of wet mount of skin or gills (observe the edge of the gill epithelium) or histopathology.	Salt (for freshwater fish) or formalin treatment

Many external parasites of fish cause similar signs such as "flashing" or rubbing on objects in the environment, skin lesions, and bluish or whitish films on the body from increased mucous production.

Parasitic diseases

DISEASE	CAUSATIVE AGENT	COMMONLY AFFECTED SPECIES	CLINICAL SIGNS	NOTES / CONTROL MEASURES
Monogeneans	*Gyrodactylus* spp., *Dactylogyrus* spp.	Freshwater fish	Diagnosis via microscopic examination of wet mount of skin or gills (may observe characteristic jerking or caterpillar-like motion of the parasite and its worm-like appearance with an anchor) or histopathology. If any monogeneans are suspected, it is important to seek identification to the species level as some are exotic to PNG.	Formalin bath, hydrogen peroxide baths Improve water quality particularly organic pollution and ammonia levels. Reducing overcrowding can reduce transmission of some species.
Spironucleosis	*Spironucleus salmonis*	Salmonids	Abdominal distension, bulging eyes. Post-mortem examination may show enteritis.	Usually only impacts stressed or weak salmon

Fungal diseases

DISEASE	CAUSATIVE AGENT	COMMONLY AFFECTED SPECIES	CLINICAL SIGNS	NOTES / TREATMENT
Saprolegniasis	*Saprolegnia* spp.	Eggs and freshwater fish	Grey or white circular skin lesions. May look like cotton wool-like tufts on eggs or skin and gills, lethargy. Tentative diagnosis via skin scraping and miscroscopy. Confirm with fungal culture from tissue sample.	Fish are more susceptible if their skin has been damaged. Hydrogen peroxide, or salt baths can be used in the early stages of infection. Recovery from significant infection is unlikely.
Branchiomycosis "Gill Rot"	*Branchiomyces* spp.	Carp and freshwater fish	Mottled gills, sometimes nodules may form Diagnosis via microscopy of wet mounts and observation of characteristic fungal hyphae.	Manage water quality to reduce organic loading. No other direct treatment is available.

Aquaculture

Dose rates

Medication Dose Rates

DRUG	RECOMMENDED DOSE	ADDITIONAL NOTES	WITHHOLDING PERIOD (DAYS)
Formalin	There is no universal dose rate for these products. The dose will depend on which product is used, the type of pond system and factors such as water temperature.	Formalin can be useful for treating parasitic and fungal conditions in fish. Beware: This will decrease dissolved oxygen. Additional aeration may be required. Do not use when water is warmer than 27◦C	Nil
Hydrogen Peroxide		Test on a small number of fish before treating the whole group.	Nil
Potassium permanganate		Caution, low safety margin. Toxicity may occur and may kill fish.	7 days
Chloramine-T (sodium para-toluene-sulfonchloramide)		Caution, hazardous chemical. Causes severe skin burns and eye damage and may cause respiratory irritation, allergies or asthma symptoms if inhaled.	Nil

SOME OF THESE PRODUCTS IF USED INCORRECTLY WILL KILL YOUR FISH!

If you think you may need to use one of these products, it is very important to seek detailed advice from an experienced veterinarian or the relevant staff member at NFA or NAQIA.

Antimicrobial use in aquaculture

Generally, there should be no reason to use antimicrobials in farmed fish if you maintain good water quality, maintain biosecurity and provide effective nutrition. Occasionally, fish can become sick and it might be a bacteria that is causing the disease. In these circumstances, treatment with antimicrobials in the feed may be needed.

The use of antibiotics in fish will leave antibiotic residues in fish. You must allow sufficient time for the residues of antibiotics in the fish to deplete below detectable levels based on laboratory analysis before you can market your fish for human consumption.

It is not recommended to dose antimicrobials in water due to inaccurate dosing and issues with wastewater. When required, antimicrobial doses should be calculated accurately and coated over feed. To dose antimicrobials accurately in feed, knowledge of how many fish are in each pond and their average weight is required. The amount of active antimicrobial per weight of product must also be known. Some antimicrobials and other medications may also be dosed on a 'fish feed rate' that may be provided on the product label. Fish are expected to eat a certain amount, expressed as a percentage of fish body weight. When the gram of antimicrobial to be added per kilogram of feed is provided, it will result in achieving the target dose of medication (mg/kg fish biomass) for the individual fish.

If you think you may need to use an antimicrobial it is very important to seek detailed advice from an experienced veterinarian or the relevant staff member at NFA or NAQIA.

Antimicrobial Dose Rates

DRUG	RECOMMENDED DOSE[1]	WITHHOLDING PERIOD (DAYS)[1]
Florfenicol	10 days at 10 mg/kg of fish biomass	15 days for salmonids 12 days for tilapia
Amoxicillin	80 mg/kg fish biomass	10 days for salmonids and tilapia
Oxytetracycline	Oxytetracycline 75-100 mg/kg of fish biomass in feed once daily for 10 consecutive days	Conservative WHP of 180 days for salmonids In Australia the WHP if 1800 degree days. If the water temperature is 20 degrees, this means fish must be held for 90 days post treatment. 21 days for tilapia
Enrofloxacin or other fluoroquinolones	The World Health Organisation classifies some antimicrobials as highest priority, critically important antimicrobials. These antimicrobials may be used as last resort treatments for serious infections in humans. If bacteria develop resistance to these antimicrobials, the bacteria or the resistant genes can be transmitted via the food chain from animals to people. In many countries their use in food-producing animals is banned. If resistance develops, there are few remaining treatment options for serious diseases impacting people. **DO NOT USE ENROFLOXACIN, OTHER FLUOROQUINOLONES OR OTHER HIGH PRIORITY CRITICALLY IMPORTANT ANTIMICROBIALS IN FOOD-PRODUCING ANIMALS INCLUDING AQUACULTURE SPECIES.**	

1. There is no universal dose rate for these products. The dose will depend on which product is used, the fish species, the type of pond system and environmental factors such as water temperature. The antimicrobials described here have been used successfully in fish destined for human consumption. The dose rates and withholding periods are an absolute guide only.

References

Noga, Edward J. Fish disease: Diagnosis and treatment (2nd ed.) John Wiley & Sons, 2010.

Smith, S.A. (Ed.). (2019). Fish Diseases and Medicine (1st ed.). CRC Press. doi: 10.1201/9780429195259

Woo, P.T.K., Bruno, D.W. (Eds.). (2011) Fish Diseases and Disorders, Volume 3: Viral, Bacterial and Fungal Infections (2nd ed.).

Woo, P.T.K., Buchmann, K. (Eds.). Fish parasites : pathobiology and protection doi:10.1079/9781845938062.0000

Merck Veterinary Manual Therapeutic Considerations in Aquaculture https://www.msdvetmanual.com/exotic-and-laboratory-animals/aquaculture/therapeutic-considerations-in-aquaculture

Department of Agriculture, Water and the Environment 2020, Aquatic Animal Diseases Significant to Australia: Identification Field Guide, 5th Edition, Australian Government Department of Agriculture, Water and the Environment, Canberra. CC BY 4.0. Agriculture.gov.au/aadfieldguide

Vaccination Schedules - Cattle

VACCINE	DOSE	ROUTE	AGE AT FIRST DOSE	AGE AT SECOND DOSE	ANNUAL BOOSTER REQUIRED
B. abortus strain 19	1 ml	IM	3 - 6 months	No	No
Haemorrhagic septicaemia	2 ml	IM	6 months	No	No
Foot and mouth disease	2 ml	IM	3 - 6 months	Annual booster	Yes
Clostridial disease 5 in 1	2ml	IM or SC Refer to product label	6 months (if cow was vaccinated, earlier if calf from unvaccinated cow)	4-8 weeks later	Yes

Vaccination Schedules - Pigs

VACCINE	DOSE	ROUTE	AGE AT FIRST DOSE	AGE AT SECOND DOSE	ANNUAL BOOSTER REQUIRED
Classical swine fever	1 ml	IM	3 - 6 weeks	8 - 12 weeks	Yes

Vaccination Schedules - Poultry

VACCINE	DOSE	ROUTE	AGE AT FIRST DOSE	AGE AT SECOND DOSE
Newcastle disease	1 vial/100 birds (1 drop/bird)	Eye drop	1 - 4 days	12 - 18 weeks
Gumboro disease	0.1 - 0.2 ml	Oral drop	7 days	14 days (in water)
Avian influenza	0.2 - 0.5 ml	IM or SC	3 - 5 days	6-12 months
Infectious bronchitis virus	0.2 - 0.5 ml	Eye drop, SC or IM	1 - 4 days	3 weeks
Fowl pox	0.1 - 0.2 ml	Wing web	6 weeks	No

Anthelmintics – Cattle, Sheep, Goats and Pigs

TRADE NAME (active ingredient)	SPECIES	DOSE	ROUTE	WITHHOLDING PERIOD
Ivomec Antiparasitic Injection* (Ivermectin 10 mg/ml)	Cattle Pig	0.2mg/kg or 1ml/50 kg 1ml/33kg	SC	Meat: 49 days (cattle) 18 days (pigs)
Albendazole (100 mg/ml)	Cattle Sheep / Goats Pigs	5 ml/50 kg 1.5 ml/20 kg 1 ml/10 kg	PO	Meat: 12 days Milk: 4 days
Flukicide 12.5% (Albendazole 125 mg/ml)	Cattle / Sheep / Goats	2.8 ml/20 kg	PO	Meat : 14 days (cattle) 10 days (sheep)
Exifluke (Triclabendazole 100 mg/ml)	Cattle / Sheep / Goats	5 ml/50 kg	PO	Meat: 21 days
Panacur 100 Oral (Fenbendazole 100 mg/ml)	Cattle/Horses Sheep/Goats	0.75 ml/10 kg 1 ml/20 kg	PO	Meat: 10 days Milk: 96 hours (cattle) 35 days (sheep/goat)
Flubenol (Flubendazole 50 mg/g)	Pigs	5 mg / kg of body weight	In feed	Meat: 7 days

*Not for use in animals producing milk for human consumption

Anthelmintics – Poultry, Dogs and Cats

TRADE NAME (active ingredient)	SPECIES	DOSE	ROUTE	WITHHOLDING PERIOD
Aviverm (Levamisole 240 mg/ml)	Poultry	1 ml/9 kg liveweight	Drinking water	Meat: 7 days Eggs: 6 days
Levimasole powder	Poultry	8 g/10 L water 28mg/kg	Drinking water	Meat: 7 days Eggs: 0 days
Flubenol (Flubendazole)	Poultry	1.43 mg/kg daily (13 g of Flubenol is mixed into 21.5 kg of compound feed for chickens)	In feed	Meat: 7 days Eggs: 0 days

TRADE NAME (active ingredient)	SPECIES	DOSE	ROUTE
Albendazole	Dog and Cat	25 mg/kg (2 ml/10 kg)	PO
Pyremectin, Novamectin (Ivermectin)	Dog	0.2 - 0.4 mg/kg (0.2 ml/10 kg)	SC
Pyremectin, Novamectin (Ivermectin)	Cat	0.3 – 0.6 mg/kg (0.3 ml/10 kg)	SC

Normal Clinical Parameters

PARAMETER	CATTLE	SHEEP	PIG	POULTRY	HORSE	DOGS	CATS
Heart Rate (Beats Per Minute)	40-80 (Adult) 80-120 (Calf)	70-90	60-110 (Adult) 200-220 (Piglet)	200-400	28-40 (Adult) 60-100 (Foal)	70-120 (Adult) 90-140 (Puppy)	120 to 140 (Adult) 120-180 (Kitten)
Respiratory Rate (Breaths Per Minute)	15-30	20-30 (Adult) 30-45 (Lamb)	10-20 (Adult) 24-36 (Piglet)	15-30	8-16 (Adult) 20-80 (Foal)	10-30	16-40
Temperature (°C)	38-39 (Adult) 38.5-39.5 (Calf)	38.5-40 (Adult) 39-40 (Lamb)	38.5-39.5	40.5-42.0	37.0- 38.5	37.5-39.3	38.3-39.2
Pregnancy Length (Days)	279-291	150 (140-160)	115 (110-116)	21 (egg incubation)	320-380	57-68	63-65
Rumen Movements (Per Minute)	1-2	1-2					

Example Animal Prescription

ANIMAL PRESCRIPTION
This prescription is for ANIMAL USE ONLY

Veterinarian/Prescriber: Licence/registration Number: Prescriber's Contact details:

Patient Name/Identification Number:
Owner name:
Owner address:

Drug: Strength:
Quantity to be dispensed: Instructions:
Repeats:

Signature of prescriber: Date:
[Include an expiration date for the prescription or a note e.g. NOTE: This prescription must be first dispensed within 10 days of the date of writing.]

Glossary

Antimicrobial	Synthetic or naturally occurring substances that inactivate or kill microorganisms.
Antimicrobial resistance (AMR)	A property of microorganisms such as bacteria, viruses, and fungi that provides the ability to inactivate or escape the effects of antimicrobials or a mechanism that blocks the inhibitory or killing effects of antimicrobials.
Antimicrobial residue	Small amounts of an antimicrobial or its breakdown products left in animal tissues after they have been treated with or exposed to an antimicrobial.
Antimicrobial stewardship (AMS)	Activities that improve the appropriateness of antimicrobial use and aim to reduce the development of AMR in a clinical setting for example, audit and feedback, decision support tools, or point-of prescribing nudges. It also may include aspects of patient or client communication, disease prevention, biosecurity and animal husbandry.
Antimicrobial susceptibility testing (AST)	A laboratory procedure to identify which antimicrobial will be effective for inactivating or killing a bacteria or fungi i.e., determining to which antimicrobials the bacteria or fungi is susceptible.
Biosecurity	Activities, policies and rules that stop or minimise the introduction and spread of harmful organisms such as viruses, bacteria, fungi, animals, plants, parasites and insects into a location such as a country, region or farm.

Glossary

Dysbiosis	Disruption to the normal organisms such as bacteria that live on an animal such as in their gastrointestinal system or on their skin (their microbiome) .
Endemic disease	Disease or conditions regularly found in a certain area or amongst a particular population
Exotic disease	Diseases or conditions that are not usually found in a certain area or amongst a particular population.
Microbiome	The community of microorganisms that can usually be found living together in any given environment or on and within an animal.
Notifiable disease	Diseases that must be reported to government health or agricultural authorities to aid in their identification, management and prevention.
Photosensitivity	An increased sensitivity or reaction of the skin to ultraviolent light such as the sun, which may increase the risk of burns.
Zoonotic	Infectious diseases that can spread from animals to humans.

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

THE UNIVERSITY OF MELBOURNE

APCAH

ASIA-PACIFIC CENTRE FOR ANIMAL HEALTH