BVSC & AH STUDY BOOK 7 OF 7

Therapeutics by Species and Final Revision

Eight chapters that bring the series together: drug choice in dogs and cats, cattle and buffalo, small ruminants, horses, poultry, pigs and rabbits, exotics and wildlife, followed by a mixed practice bank with twenty field cases and a viva set, and a glossary with concept maps. Each chapter ends with a self-test.

8 chapters | **100** practice questions | **No** dose tables

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Start here

Pick a chapter from the list on the left (or the top bar on a phone). Chapters 1 to 6 apply the earlier books species by species. Chapter 7 is the practice bank: twenty Indian field cases, a viva question set and thirty mixed questions. Chapter 8 is the glossary and concept maps for last-minute revision. Each chapter has six parts: Learn, Concepts, Compare, Species, Quiz and Revise. Your quiz progress is saved on this device only.

CHAPTER 1 OF 8

Therapeutics in dogs and cats

How to reason from diagnosis to drug choice in common small animal conditions, what not to give to dogs and cats, and how to explain treatment to owners. The chapter links the pharmacology of Books 1 to 6 to everyday clinic decisions.

After this chapter you can

- Apply a stepwise reasoning method to choose a drug for a dog or cat
- Explain why antimicrobials are not the first answer to most acute vomiting and diarrhoea

- Choose between topical and systemic therapy for skin and ear disease using diagnostic findings
- List common drugs and household products that must not be given to dogs and cats and explain why
- Communicate drug use, side effects and follow-up clearly to an owner

From diagnosis to drug: a reasoning method

Good therapeutics begins before the prescription. Ask five questions in order. What is the diagnosis, or the most likely problem list? What is the aim of treatment: cure, control, comfort or prevention? Which drug classes can reach that target? Is this particular patient (species, age, breed, pregnancy, liver, kidney, other drugs) a reason to avoid any of them? And how will you and the owner know it is working?

Many treatment failures come from skipping the first question. Giving an antibiotic, a steroid and a vitamin injection together for 'fever' hides the diagnosis and makes the response impossible to interpret. Revise the principles of Book 1 (pharmacokinetics, adverse reactions) and Book 4 (applied pharmacology) alongside this chapter.

A useful habit is to prefer the narrowest, safest option that fits the aim, and to review the patient after a short interval rather than extend a course blindly.

Dogs and cats are not small people or small dogs

Species differences in drug handling decide many safe-or-harmful choices. **Cats** are deficient in some glucuronidation pathways, so drugs cleared mainly by glucuronide conjugation (paracetamol is the classic example) accumulate and damage red cells and liver. Cats also tolerate many NSAIDs poorly, because the drugs are cleared slowly. **Dogs** of some herding breeds carry the MDR1 (ABCB1) variant, which raises brain exposure to certain drugs such as ivermectin at higher doses (Book 1, Book 6).

Sighthounds recover slowly from some barbiturate anaesthetics because of low body fat and different metabolism (Book 5). Puppies, kittens and old animals have immature or reduced hepatic and renal clearance and less reliable hydration, so they need extra caution and clear monitoring.

A common confusion: 'safe in dogs' does not mean 'safe in cats'. Always check the species on the label and in the reference you use.

Gastrointestinal disease: vomiting and diarrhoea

Most acute vomiting and diarrhoea in dogs and cats is self-limiting or caused by diet, parasites or viruses. The therapeutic priorities are **hydration, electrolyte and acid-base correction, rest of the gut, then re-feeding**. Antibiotics do not treat viral or dietary causes and may worsen dysbiosis; they are reserved for patients with evidence of systemic spread, such as fever with a marked low white cell count, blood in the stool with sepsis signs, or a confirmed bacterial cause.

In parvoviral enteritis, treatment is supportive: fluids, anti-emetics, nutrition, pain control and often an antimicrobial because gut barrier damage allows bacteria to enter blood. The antimicrobial is aimed at that secondary risk, not at the virus. Vaccination and isolation are the real control (Book 2 and Book 4).

Choose anti-emetics by mechanism: central and peripheral agents act at different sites, and an anti-emetic must never be used if an obstruction or foreign body is possible, because it hides a surgical emergency. Be careful with antispasmodics and motility drugs in infectious diarrhoea.

Check for the common Indian causes first: heavy worm burden in puppies and kittens, dietary indiscretion, and tick-borne disease when fever and anaemia coexist.

Skin, ear and infectious disease

Skin disease is the commonest reason for antibiotic use in dogs. Before choosing a drug, find the cause: ectoparasites, allergy, fungal or bacterial infection. Cytology of skin or ear swabs separates bacteria, yeast and mites in minutes and guides the choice.

Where lesions are superficial and localised, **topical therapy** (antiseptic shampoos, topical agents) reduces systemic antibiotic exposure and resistance pressure. Systemic antibiotics are kept for deeper infection, and culture and sensitivity is advised for recurrent or non-responding cases. Treating pyoderma without treating the underlying allergy or parasite means relapse.

In otitis, identify the organism type and check the eardrum before using a topical, because some ear products can be ototoxic if the drum is ruptured (Book 6). Use corticosteroids carefully: they ease itch quickly, but they also suppress immunity, and a steroid given for 'allergy' on a patient with untreated demodicosis can make the disease explode.

For tick-borne disease such as ehrlichiosis or babesiosis, which are common in Indian dogs, diagnosis (smear, serology or PCR) should come first, then a drug active against the specific agent (Book 3). Doxycycline in cats can lodge in the oesophagus and cause stricture unless followed by food or water.

What not to give: safety and drug interactions

Make a short 'never' list that you can recall under pressure.

- **Paracetamol** in cats (and caution in dogs): methaemoglobinaemia and liver injury.
- **Human NSAIDs** (ibuprofen, naproxen, aspirin at human practice) in dogs and cats: gastric ulcers and kidney injury. Use only veterinary-licensed NSAIDs, and avoid them in dehydrated, hypotensive, or renal-compromised patients.
- **NSAID plus corticosteroid together**, or switching between two NSAIDs without the gap stated in the label: serious GI ulceration risk.
- **Permethrin and other pyrethroid products** for dogs applied to cats, or cats licking a treated dog: severe tremors and seizures (Book 6).
- **Xylitol**, chocolate, grapes and onion exposure: not drugs but common owner-introduced toxins.
- **Fluoroquinolones** in cats at high exposure: retinal damage. In growing large-breed puppies they may damage cartilage.
- **Aminoglycosides** in dehydrated or renal patients: nephrotoxicity.
- **Ivermectin-class drugs** in MDR1-affected breeds at doses used for other purposes.

Interaction thinking: loop diuretics plus NSAIDs affect the kidney, and sedatives plus opioids add respiratory depression. Always ask what the owner has already given at home, including Ayurvedic or human medicines from the pharmacy.

Talking to the owner

Drug success depends on the owner as much as on the drug. Explain in plain language: what the drug is for, how it is given, what to expect, what side effects need a phone call, and when to return. Link the instruction to something the owner can see, for example 'if the pet stops eating or vomits blood, stop the tablet and bring the dog in'.

Address the common client pressures honestly. Owners may ask for an antibiotic injection 'to be safe', request human tablets they have used, or stop the course when the pet looks better. Explain that the wrong or half course helps resistant bacteria, that some human drugs are dangerous for pets, and that some conditions (worms, tick fever, skin infection) need the full course or follow-up test.

Discuss cost openly, offer stepwise options, and record the plan. Remind owners that zoonotic risks (hookworm, ringworm, rabies) change how they handle the pet and its excreta. Do not guarantee outcomes. Document consent for off-label use and explain that unlicensed use is a professional decision to be made carefully. Check current Indian regulations for restricted drug classes before dispensing.

Concept cleared

Treat the diagnosis, not the symptom
A drug works only if it targets the cause or a real clinical aim. Antibiotics for viral diarrhoea or steroids for undiagnosed itch give false comfort and hide the true disease.

Species and breed set the safe list
Cats are weak in glucuronidation, some dogs carry MDR1 variants, and young or old animals clear drugs slowly. The same molecule can be safe in one patient and harmful in another.

Topical before systemic when the lesion is local
Local therapy gives high drug at the site with less body exposure and less selection of resistant bacteria. Systemic drugs are for deep or generalised disease.

Stewardship protects future patients

Culture, cytology, correct drug class and a complete course reduce resistance. Reserve higher-tier antimicrobials for cases where first-line drugs have failed or are unsuitable.

Memory aid: DRUG-PET check before prescribing

Diagnosis, Reason for treatment, Unwanted effects, Going home plan; Patient species, Existing drugs, Timing of review.

Compare and contrast

Dog versus cat: key pharmacological cautions

Issue	Dog	Cat
Paracetamol	Caution, liver and red cell injury at overdose	Avoid; very low tolerance
NSAIDs	Use licensed veterinary products with monitoring	Narrower safety; use only labelled products with care
Permethrin spot-ons	Generally tolerated as labelled	Severe neurotoxicity if exposed
Glucuronidation	Adequate	Deficient, drugs accumulate
Doxycycline tablets	Usually well tolerated	Risk of oesophageal stricture without fluid

Topical versus systemic therapy in skin disease

Feature	Topical	Systemic
Best for	Superficial, localised lesions	Deep or generalised infection
Resistance pressure	Lower	Higher
Owner compliance	Needs time and technique	Easy to dose but side effects more likely
Key need	Contact time and correct product	Culture and a full course

Species notes

Dogs

MDR1 variant breeds and sighthounds need special care. Skin and tick-borne disease dominate. Avoid human NSAIDs and chocolate or xylitol exposures.

Cats

Poor glucuronidation. Avoid paracetamol and permethrin. Tablets such as doxycycline should be followed by water or food. Cats hide illness, so earlier review is wise.

Puppies and kittens

Immature liver and kidney, easily dehydrated and hypoglycaemic. Check the label for age limits and worm control schedules.

Geriatric pets

Reduced renal and hepatic reserve. Check kidney function before NSAIDs and review earlier.

Pregnant or lactating animals

Some antimicrobials, antiparasitics and hormones are unsafe. Read the label and check the reference before use.

Clinical pearls

Self-test: 10 questions

1. Which drug is especially dangerous for cats because of deficient glucuronidation?

Cats cannot conjugate paracetamol efficiently, so toxic metabolites accumulate.

2. The main aim of antibiotics in parvoviral enteritis is to:

Antibiotics have no antiviral action; they cover bacteria entering through the damaged gut.

3. First-line therapy for most mild acute vomiting and diarrhoea is:

Most cases are self-limiting; rehydration and diet are the priorities.

4. Before giving an anti-emetic you must exclude:

Stopping vomiting can mask a surgical emergency.

5. Which combination is most likely to cause severe gastric ulceration?

Both reduce gastric mucosal protection and the effects add up.

6. A dog permethrin product applied to a cat is dangerous because:

Cats metabolise pyrethroids poorly and are highly susceptible.

7. Best first step in a dog with recurrent pyoderma is to:

Without treating allergy, parasites or endocrine disease, infection returns.

8. Doxycycline tablets in cats should be followed by:

This helps the tablet pass into the stomach and prevents oesophageal injury.

9. Which is a good reason for topical therapy in superficial skin infection?

Local delivery gives drug at the site and spares the rest of the body.

10. Which owner message improves safety most?

Clear warning signs help early detection of adverse effects.

Key points to revise

1. Ask five questions before every prescription: diagnosis, aim, drug options, patient factors and monitoring.
2. Hydration and electrolyte correction come before antimicrobials in most acute gastroenteritis.
3. Parvoviral enteritis antibiotics target secondary bacterial spread, not the virus.
4. Cytology and culture guide skin and ear therapy.
5. Topical therapy reduces systemic exposure where lesions are local.
6. Cats cannot handle paracetamol and many NSAIDs.
7. Human drugs should not be used in pets unless a veterinarian approves.
8. Good client communication improves compliance and safety.

Go deeper on this site

- Ch 2. Therapeutics in cattle and buffalo (in this book)
- Ch 3. Therapeutics in sheep, goats and camelids (in this book)
- Veterinary drugs list: classes, uses and cautions
- Veterinary Drug Index
- Veterinary Drug Concepts Clearly Explained

Sources

- Merck Veterinary Manual
- WSAVA Global Guidelines
- FDA Center for Veterinary Medicine

CHAPTER 2 OF 8

Therapeutics in cattle and buffalo

Drug-choice reasoning for common bovine problems: mastitis, fever, calf diarrhoea, metabolic disease and reproductive disorders. The chapter stresses withdrawal

periods for milk and meat, and how to explain them to dairy farmers.

After this chapter you can

- Explain why every treated dairy animal creates a milk and meat residue question
- Reason through mastitis therapy using type, cause and route of administration
- Distinguish causes of fever in cattle and buffalo before selecting a drug
- Describe supportive priorities in calf diarrhoea and key metabolic emergencies
- Communicate withdrawal and prudent-use advice to farmers

Food animals change the rules

In companion animals the patient is the only concern. In cattle and buffalo the **treated animal also produces food**. Every drug given to a lactating or slaughter-bound animal raises a second question: how long until milk and meat are safe for people? The answer is the **withdrawal period** (milk withdrawal and meat withdrawal are separate), printed on the product label.

Residues matter because they can cause allergy, disturb gut flora, interfere with dairy fermentation and drive antimicrobial resistance. The logic of the maximum residue limit (MRL) was covered in Books 1 and 4. Indian MRLs and permitted or banned substances change; check the current FSSAI and government notifications before advising a farmer.

Practical consequences are simple. Choose, where equal, the drug with the shorter withdrawal. Record the animal, drug, date and withdrawal end. Separate treated milk. Never use a drug listed as prohibited in food animals. Extra-label use should be a considered veterinary decision with an extended and defensible withdrawal, not a guess (Book 6 for toxic residues).

Mastitis

Mastitis is the commonest drug-use reason on dairy farms. Reason in steps. First, is it **clinical** (visible milk or udder change) or **subclinical** (raised somatic cell count,

positive screening test such as the California mastitis test)? Second, is the animal systemically ill? Third, which pathogen group is likely: Gram-positive (Staphylococcus aureus, Streptococcus), Gram-negative coliforms, or others such as Mycoplasma and yeasts?

Mild clinical cases usually need intramammary treatment, frequent stripping out of milk and good hygiene. Systemically ill cows, especially with coliform toxaemia, need **fluid therapy, NSAIDs for toxaemia and pain, and systemic antimicrobials** as clinically indicated. A drug must reach the milk compartment: some agents distribute poorly into milk because of their ionisation and protein binding (Book 1), so route matters.

Culture of milk from non-responding or recurrent cases guides drug choice. Chronic *S. aureus* infection often fails because bacteria hide inside cells and fibrous udder tissue, which is why cure rates are poor and prevention (milking hygiene, teat dipping, culling chronic cases) matters more. Antibiotic dry cow therapy is best used by risk or culture rather than automatically in every animal, subject to local advice.

Buffalo have narrower teat canals and long lactations, so treat any tight, painful udder promptly, and note that subclinical mastitis is silent and common.

Fever and tick-borne disease

Fever in cattle and buffalo is a sign, not a diagnosis. Common causes in India include tick-borne disease (theileriosis, babesiosis, anaplasmosis), bacterial pneumonia, metritis, mastitis, foot and mouth disease and haemorrhagic septicaemia. A systematic exam, blood smear and a look at lymph nodes, udder, uterus and lungs usually narrows the list.

Choose treatment by the diagnosis. Specific antiprotozoal drugs exist for theileriosis and babesiosis (Book 3), and early treatment greatly improves outcome. A broad antibiotic does not treat protozoa, and an NSAID for fever alone can hide the pattern. Viral diseases such as FMD need supportive care and secondary infection control, not antibiotics for the virus.

Antipyretics and NSAIDs reduce fever and pain but also reduce feed intake loss and so can be useful. Keep in mind hydration status and kidney perfusion before using them. Some NSAIDs have long withdrawal periods in food animals, and some drugs

are not permitted in livestock. For example, the diclofenac-vulture issue led to restrictions; check the current notification before using any NSAID.

Vaccination, tick control and quarantine are the long-term answer. Tell farmers that treating a fever without tick control invites repeat illness.

Calf diarrhoea and metabolic disease

Calf diarrhoea (scours) kills mainly through dehydration, acidosis and electrolyte loss, not through the germ itself. The first treatment is therefore **oral or intravenous fluids with electrolytes and an energy source**, and continuing milk feeding when possible. Antimicrobials are needed only when calves show systemic illness (fever, depression, signs of septicaemia) or invasive bacterial infection. Many scours are viral, protozoal (cryptosporidiosis) or nutritional, and antibiotics do not help these. Colostrum intake in the first hours of life is the best prevention.

Hypocalcaemia (milk fever) around calving is treated with slow intravenous calcium and careful heart monitoring because rapid infusion can cause arrhythmia. Relapse is common, so follow-up and correct feeding of dry cows are needed. Do not confuse it with other downer cow causes. **Ketosis** responds to glucose sources and attention to energy intake. Hypomagnesaemia produces tetany and needs magnesium given carefully. In all metabolic disease, treating the cause (feed and management) matters as much as the injection.

These conditions are mostly not antibiotic problems. An antibiotic in a milk fever cow adds only withdrawal burden unless a concurrent infection exists.

Reproductive problems

Retained placenta, metritis and endometritis are linked to difficult calving, hypocalcaemia and poor hygiene. Manual removal of a firmly attached placenta can cause injury and bleeding, so many clinicians prefer supportive measures and monitoring. Systemic antimicrobials are justified for metritis with fever and systemic signs. Intrauterine antibiotics in low-grade endometritis give mixed results and add withdrawal concerns.

Hormones need care. **Prostaglandin F2-alpha** analogues cause luteolysis and can terminate pregnancy, and they are hazardous to pregnant women and asthmatics handling them. **Oxytocin** has valid uses in obstetrics, but misuse to force milk let-

down is a recognised regulatory and welfare concern in India; check the current notification on its sale and use. Hormonal treatment of anoestrus or repeat breeding should follow a proper reproductive examination (Book 2 and Book 4), because in buffalo silent oestrus and poor heat detection are often the real problem and not a lack of hormone.

Always verify pregnancy status before using a drug that can affect gestation.

Prudent use and talking to farmers

Farmers often expect an injection every time. Explain the logic: right diagnosis, right drug, right duration, and time for the body to recover. Antimicrobial resistance moves between animals, farms and people, which is why international bodies such as the WHO promote a One Health approach.

Advise farmers to: complete the prescribed course; keep a treatment record; mark and separate treated animals; discard milk during the whole withdrawal period; avoid selling animals for slaughter before the meat withdrawal ends; and never use leftover or human drugs. Antimicrobials listed as restricted or banned for food animals must not be used; check the current regulatory list.

Encourage prevention: vaccination, deworming, tick control, clean milking, dry-cow management and good transition feeding. Use cost as a teaching point: preventing mastitis or milk fever costs less than treating and discarding milk. Where unsure of a withdrawal time, use the longest labelled value for the drug and consult current guidance rather than risk residues.

Concept cleared

Two withdrawal clocks
Milk and meat withdrawal periods are different and both start after the last dose. The longer applicable one governs what can be sold.

Drug must reach the site
In mastitis, ionisation, protein binding and route decide whether drug reaches milk. Intramammary and systemic therapy suit different situations.

Fluids first in scours

Calf deaths come from dehydration and acidosis, so replacement of fluid and electrolytes is the core treatment.

Prevent more than treat

Hygiene, colostrum, vaccines, tick control and balanced transition feeding reduce disease and drug use together.

Memory aid: TREAT-SAFE for food animals

Test and diagnose, Record the drug, Examine withdrawal, Avoid banned drugs, Tell the farmer; Separate milk, Allow full time, Follow up, Educate.

Compare and contrast

Clinical versus subclinical mastitis

Feature	Clinical	Subclinical
Signs	Visible milk or udder change	None; raised cell count or positive screening test
Detection	Farmer or vet examination	CMT, cell count, culture
Treatment focus	Intramammary, with systemic care if ill	Control by hygiene, dry-period therapy by risk, culling chronic cases
Milk	Discard for withdrawal	Also discard during any treatment withdrawal

Milk fever versus ketosis

Feature	Milk fever	Ketosis
Cause	Low blood calcium	Negative energy balance
Usual timing	Around calving	Early lactation
Treatment idea	Slow calcium with heart monitoring	Glucose source and better energy intake
Prevention	Dry cow mineral management	Good transition feeding

Species notes

Cattle

Most label data and withdrawal times exist for cattle. Check the product label and current Indian guidance. Crossbred dairy cows are prone to tick-borne disease and metabolic disease.

Buffalo

Silent heat, heat stress and narrow teat canals are common issues. Do not assume that cattle label times apply; check the label and use cautious extended times if data are missing.

Calves

Dehydration is the main danger. Immature rumen and liver mean some drugs act differently; check label limits.

Pregnant animals

Prostaglandins and some other drugs can cause abortion. Confirm pregnancy status first.

Lactating animals

Every drug needs a milk decision. Choose products with a clear milk withdrawal and keep records.

Clinical pearls

Self-test: 10 questions

1. A withdrawal period is the time that must pass:

It protects consumers by letting residues fall below safe levels.

2. In a calf with watery diarrhoea and dehydration, the first priority is:

Death is mainly from dehydration and acidosis.

3. Why is chronic Staphylococcus aureus mastitis hard to cure?

Poor drug access and intracellular survival reduce cure rates.

4. A cow with coliform mastitis and toxaemia needs:

Systemic illness needs supportive and systemic care.

5. Which statement about prostaglandin F2-alpha is correct?

It regresses the corpus luteum and hence can end pregnancy.

6. Milk fever treatment should use:

Rapid infusion can cause cardiac arrhythmia.

7. An antibiotic given for fever from theileriosis will:

Theileria is a protozoan; specific drugs are needed.

8. Which is best farmer advice?

Records and discard prevent residues and support traceability.

9. Why is accurate diagnosis important in buffalo reproductive problems?

Poor heat detection is often the real cause of apparent infertility.

10. Which approach supports prudent antimicrobial use on a farm?

Targeted therapy reduces resistance and residue risk.

Key points to revise

1. Treated food animals create residue risk for people.
2. Withdrawal periods must be followed for milk and meat separately.
3. Mastitis therapy depends on clinical state, pathogen and route.
4. Chronic Staphylococcus aureus mastitis cures poorly, so prevention and culling matter.
5. Fever in cattle has many causes; diagnose before choosing a drug.
6. Calf scours are treated first with fluids and electrolytes.
7. Milk fever needs slow intravenous calcium with heart monitoring.
8. Farmers need clear written instructions and records.

Go deeper on this site

- Ch 3. Therapeutics in sheep, goats and camelids (in this book)
- Ch 1. Therapeutics in dogs and cats (in this book)
- Veterinary drugs list: classes, uses and cautions
- Veterinary Drug Concepts
- Veterinary Drug Concepts Clearly Explained

Sources

- Merck Veterinary Manual
- FDA Center for Veterinary Medicine
- WHO antimicrobial resistance fact sheet

CHAPTER 3 OF 8

Therapeutics in sheep, goats and camelids

Small ruminants and camelids are often treated as small cattle, which causes errors. This chapter explains why dosing is constrained, how to control parasites without breeding resistant worms, and which species cautions matter in field practice.

After this chapter you can

- Explain why drugs licensed for cattle cannot be simply scaled down for sheep, goats and camelids
- Describe how anthelmintic resistance arises and how refugia, FAMACHA and targeted selective treatment slow it
- Choose drugs for common small ruminant conditions while respecting withdrawal and residue logic
- List species-specific cautions for goats, sheep and camelids
- Communicate treatment limits and withdrawal periods clearly to farmers

Why small ruminants are therapeutic orphans

Sheep and goats are numerous in India and are kept mostly by small and landless farmers, yet very few products are developed and licensed specifically for them. Most label information comes from cattle. This creates the central problem of this chapter: **extra-label use is common, but it is not safe by default**.

Three ideas explain the constraint. First, species differ in absorption, metabolism and elimination, so a cattle plan may under-treat or over-treat a goat. Second, animals that produce milk or meat for people need a defined **withdrawal period**, and for an extra-label use nobody has measured it. Third, the margin of safety of some drugs is narrow in small bodies, where measuring error is proportionally larger. Revise Book 1 on pharmacokinetics and Book 6 on toxicology alongside this chapter.

Dosing constraints: reasoning, not numbers

Goats are browsers and differ from sheep in how they handle many drugs. In general, goats are often described as clearing several anthelmintics and other drugs faster than sheep or cattle, so an effect that is adequate in one species can fail in another. This is a general teaching point, so always check product literature rather than copying a figure from another species.

Practical constraints you should apply every time:

- **Estimate weight honestly.** Under-dosing is the main driver of resistance, and over-dosing is the main driver of toxicity. Weigh or use a tape, and dose to the

heaviest animal in a small group, not the average, only when the drug has a wide margin.

- **Check the label for the species.** A drug approved in sheep may not be approved in goats, and milk-producing animals have extra limits.
- **Prefer the narrowest suitable route.** Injection sites matter in meat animals because residues persist at the site.
- **Consider the rumen.** Oral drugs meet rumen microbes; some are inactivated, and ruminal flow changes how quickly a drug reaches the abomasum and intestine.

Common confusion: students assume that a drug safe in cattle is safe in a kid or lamb. Young animals have immature metabolism and a much smaller body, so errors are magnified.

Parasite control and anthelmintic resistance

The barber pole worm, *Haemonchus contortus*, is the dominant killer of small ruminants in warm, humid regions. It sucks blood, so heavily infected animals become anaemic, develop bottle jaw and die. Anthelmintic resistance is widespread in small ruminants worldwide, and Indian veterinarians should assume it is present on any farm until shown otherwise by testing.

Resistance develops by selection. Every treatment kills susceptible worms and leaves resistant ones to breed. The worms that survive pass resistance genes on. Under-dosing, treating the whole flock repeatedly and moving treated animals straight to clean pasture all speed this up.

The modern strategy is to **keep susceptible worms alive**:

- **Refugia.** The worms not exposed to a drug, whether in untreated animals or on contaminated pasture, dilute resistant genes. Leaving some animals untreated is therefore a feature of good practice.
- **FAMACHA.** A colour chart for the conjunctiva, used to estimate anaemia from *Haemonchus*. Only animals that are anaemic are treated.
- **Targeted selective treatment (TST).** Treat the animals that show clinical signs, poor production or high faecal egg counts, using tools such as body condition and faecal egg count.

- **Test before trusting.** A faecal egg count reduction test shows whether a drug still works on that farm.
- **Quarantine and treat newcomers** with more than one drug class before mixing them with the flock, so that you do not import resistant worms.

FAMACHA is useful for Haemonchus only; it will not detect other causes of weight loss. Cross-refer to Book 3 for the anthelmintic classes and their mechanisms.

Antibiotics, anti-inflammatories and supportive care

Drug choice should follow diagnosis. Many small ruminant diseases that farmers call fever or pneumonia are parasitic, nutritional or viral, and antibiotics do nothing for them. Before giving an antibacterial, ask three questions: is there evidence of a bacterial cause, is the drug likely to reach the site, and what withdrawal applies in a milk or meat animal?

- **Pneumonia and enteric infection.** Choose by likely organism and by whether a milk or meat withdrawal is documented for that species.
- **Enterotoxaemia.** Prevention by vaccination is far more effective than treatment, because the toxins act within hours.
- **Coccidiosis in young stock.** Treat the group and fix hygiene and stocking density; drugs without management fail.
- **Pregnancy toxaemia and hypocalcaemia.** These are metabolic emergencies where correcting the metabolic problem, not giving antibiotics, is the treatment.
- **Anti-inflammatory drugs.** Use NSAIDs with caution in dehydrated or pregnant animals because of renal and gastric risk, and check the meat and milk status.

Remember the stewardship principle from Book 4: do not use critically important antibiotics as routine first-line drugs in food animals, and check the current notification of the relevant authority about restricted drugs.

Species cautions

These cautions are conceptual reminders. For details, always check the product label and a current reference.

- **Sheep and copper.** Sheep accumulate copper in the liver and are far more sensitive than cattle or goats. Avoid feed or mineral mixes meant for other species. See Book 6.

- **Goats.** Goats are often under-dosed because label doses come from sheep or cattle, and milk-producing goats require special withdrawal care. Do not assume that a sheep or cattle label covers a goat.
- **Ionophores.** Monensin and related feed additives can be toxic to small ruminants, and to horses and camelids, when dosing or mixing is wrong.
- **Camelids.** Camels and other camelids differ from true ruminants in their stomach compartments and in some drug handling, and many ruminant drugs have no camelid label. Seek camelid-specific guidance and be conservative.
- **Urea and non-protein nitrogen** poisoning is a risk in all ruminants fed unmixed supplements.

Common confusion: camelids are not ruminants in the strict sense and are not just small camels; do not extrapolate a cattle dose.

Withdrawal, residues and talking to the farmer

A **withdrawal period** is the minimum time between the last treatment and the sale of milk, meat or eggs, so that residues fall below the legal limit. The limit is called the maximum residue limit (MRL). Indian MRLs and withdrawal rules change, so check the current notification of the relevant authority. Extra-label use has no known withdrawal time, so the safe approach is to consult a source such as a poison and residue information service or the manufacturer, and to document the treatment.

Client communication carries most of the weight:

- Tell the owner in plain language not to sell milk or slaughter the animal until the withdrawal date, and write it down.
- Explain that treating every animal does not protect the flock, and may make worms resistant.
- Explain why you are not prescribing an antibiotic for a viral disease, and what to watch for.
- Record animal identity, drug, date and withdrawal for every treated animal.

A frequent exam error is forgetting that milk goes to children and to traditional dairy products. Residues in cheese and curd, and heat stability of residues, are real public health concerns, so withdrawal must be stated for the product the family actually consumes.

Concept cleared

Extra-label is not label-free
Using a drug outside its label means you carry responsibility for efficacy, safety and withdrawal. It needs a diagnosis, a reason, a source for the withdrawal advice and a record.

Refugia
Worms that escape drug exposure keep susceptible genes in the population. Leaving some animals untreated slows resistance.

Target the animal, not the flock
FAMACHA and targeted selective treatment treat only the animals that need it, using anaemia, condition or egg counts as guides.

Species differences in drug handling
Goats, sheep and camelids absorb, metabolise and eliminate drugs differently from cattle, so a cattle plan cannot be copied across.

Memory aid: Before you dose a small ruminant: SWAP
Species label, Weight estimate, Anthelmintic resistance status, Produce withdrawal (milk and meat). Check all four before you treat.

Compare and contrast

Sheep, goats and camelids at a glance

Feature	Sheep	Goats	Camelids
Main drug issue	Copper sensitivity	Under-dosing from borrowed labels	Few labelled products
Feeding style	Grazers	Browsers	Browsers and grazers with three-compartment stomach
Residue concern	Meat, wool-farm use	Milk and meat	Meat and milk in some regions
Reasoning rule	Check mineral mixes	Do not copy sheep labels	Seek camelid-specific advice

Whole-flock versus targeted treatment

Aspect	Whole-flock treatment	Targeted selective treatment
Drug use	High	Low
Selection for resistance	Strong	Weaker, refugia kept
Effort	Low	Needs FAMACHA or egg counts
Best when	Specific strategic periods advised locally	Routine management

Species notes

Sheep
Sensitive to copper; avoid mineral mixes made for other species. Weigh carefully before dosing.

Goats
Do not assume sheep or cattle labels fit goats; they are often under-dosed. Milk withdrawal needs particular care.

Camelids
Have a different stomach and handle some drugs differently from ruminants; there are few labelled

Young stock
Lambs, kids and crias have immature metabolism and small body size, so dosing errors are magnified.

products, so be conservative and seek specific guidance.

Pregnant and lactating animals
Check each drug for fetal safety and milk residues, and treat metabolic disease as an emergency.

Clinical pearls

Self-test: 10 questions

1. The main reason a cattle label cannot be applied to a goat is that

Species differ in drug handling, and extra-label use has no measured withdrawal.

2. Refugia means

Worms not exposed to drugs dilute resistant genes.

3. FAMACHA is used to

It grades the conjunctival colour so only anaemic animals are treated.

4. Which practice most speeds up anthelmintic resistance?

These practices select strongly for resistant worms.

5. Sheep are especially sensitive to

Sheep accumulate copper in the liver.

6. Targeted selective treatment treats

It keeps refugia and reduces selection.

7. A withdrawal period is

It lets residues fall below the MRL.

8. For a camelid with no labelled product you should

Camelids handle some drugs differently and few are labelled.

9. An owner asks for antibiotics for a viral disease. The best reply is to

Stewardship and client communication.

10. The best test to check whether an anthelmintic works on a farm is

It compares egg counts before and after treatment.

Key points to revise

1. Most small ruminant drug information is extrapolated from cattle, so extra-label use is common and risky.
2. Goats, sheep and camelids differ from cattle and from each other in drug handling.
3. Anthelmintic resistance is widespread in small ruminants and arises by selection.
4. Refugia, FAMACHA and targeted selective treatment slow resistance.
5. Test with a faecal egg count reduction test to see whether a drug still works.
6. Do not give antibiotics for parasitic, nutritional or viral problems.
7. Observe milk and meat withdrawal; check the current notification for Indian limits.
8. Counsel the owner and keep treatment records.

Go deeper on this site

- Ch 4. Therapeutics in horses and donkeys (in this book)
- Ch 2. Therapeutics in cattle and buffalo (in this book)
- Veterinary drugs list: classes, uses and cautions
- Veterinary Drug Index
- Veterinary Drug Concepts Clearly Explained

Sources

- Merck Veterinary Manual: Resistance to Anthelmintics in Animals
- Merck Veterinary Manual: Overview of Gastrointestinal Parasites of Ruminants
- Merck Veterinary Manual: Withholding Periods After Anthelmintic Treatment in Animals

CHAPTER 4 OF 8

Therapeutics in horses and donkeys

The horse is a hindgut fermenter with a fragile gut, high NSAID sensitivity of the colon and strict competition rules. This chapter explains colic analgesia, antibiotic choice and colitis, NSAID reasoning, and how doping and competition rules shape drug use.

After this chapter you can

- Explain why analgesia in colic must not hide the signs needed for diagnosis
- Compare the main colic analgesic groups and their cautions
- Explain why some antibiotics cause colitis in horses and how to choose safely
- Describe NSAID toxicity in horses and how to reduce risk
- Explain doping, withdrawal and competition rules and how to advise owners

The horse as a therapeutic problem

The horse is a hindgut fermenter. Its large colon and caecum contain a huge microbial population that depends on stable conditions. Many drug problems in horses come from disturbing this ecosystem, from the horse's sensitivity to pain

and shock, or from rules that govern competition. A horse also cannot vomit, so gastric distension is dangerous.

Donkeys and mules are often treated like small horses, which is a mistake. Donkeys metabolise some drugs faster and tolerate pain stoically, so signs of colic or laminitis can be subtle. Dose and interval should come from donkey-specific guidance. Revise Book 5 for sedatives and Book 2 for the digestive system.

Analgesia in colic

Colic is a sign, not a diagnosis. Most cases are mild and settle with analgesia, but a few need surgery, and pain is the signal that tells the clinician which is which. The central principle is that **analgesia relieves suffering but can mask the progress of disease**. Examine the horse first when it is safe to do so.

- **NSAIDs (flunixin).** The most commonly used drugs for abdominal pain. They also reduce endotoxin effects. Full doses may hide the signs of a surgical lesion, so many clinicians use a lower dose in cases that might need surgery.
- **Hyoscine butylbromide.** An antispasmodic for mild spasmodic colic. Because it blocks muscarinic receptors, it can raise heart rate, which complicates interpretation.
- **Alpha2-agonists (xylazine, detomidine).** Powerful analgesia and sedation. Xylazine acts quickly but briefly, while detomidine is more potent and longer lasting. They also slow gut motility and reduce cardiac output, so they are not a harmless default.
- **Opioids (butorphanol).** Often combined with an alpha2-agonist. Large amounts can cause excitement and instability.
- **Nasogastric tube.** Not a drug, but relieving gastric reflux is a treatment that prevents rupture.

A frequent mistake is using a strong analgesic repeatedly without re-examining. Rising need for analgesia is itself a reason to refer for surgery. Phenylephrine for nephrosplenic entrapment is used by specialists and is risky in old horses. Never give a laxative such as mineral oil, or any drug by stomach tube, to a horse with gastric reflux.

Antibiotics and colitis

Antibiotics kill bacteria that normally keep pathogens such as *Clostridium* in check. In the horse the result can be acute, severe, life-threatening diarrhoea, called antibiotic-associated colitis. Risk is higher with broad-spectrum agents, oral administration, those excreted in bile into the gut, hospitalisation and stress such as transport, surgery or fasting.

Decisions follow from this:

- **Do not give an antibacterial for an uncomplicated colic, viral respiratory disease or a non-infected wound.** The benefit is zero and the risk is real.
- **When infection is proven or likely**, choose the narrowest effective drug, confirm by culture where possible and stop as soon as you can.
- **Watch for a change in faeces** in any horse on antibiotics, and tell the owner to call at once if diarrhoea starts, because dehydration and endotoxaemia develop fast.
- **Avoid oral lincosamides and some other agents in adult horses.** Details differ between references, so check a current equine source.

Foals handle several antibiotics differently from adults, because their gut flora is still developing and their kidneys are immature. Cross-refer to Book 3 for classes and spectrum.

NSAIDs: benefit and harm

NSAIDs are the most used drugs in horses, for musculoskeletal pain, laminitis, colic and fever. They act by inhibiting cyclooxygenase, which also reduces protective prostaglandins in the gut mucosa and kidney. The horse's right dorsal colon and stomach are especially sensitive, and toxicity can lead to ulcers, protein-losing enteropathy and right dorsal colitis. Renal injury is more likely in dehydrated or hypotensive horses.

Key points:

- Toxicity depends on the drug, **dose and duration**. Giving more than recommended, or giving two NSAIDs together, adds risk without adding benefit.
- Some horses show toxicity at normal doses, so watch for dullness, poor appetite, oedema and low protein.

- Phenylbutazone is generally ranked as more ulcerogenic than flunixin, which is more than ketoprofen. Firocoxib, a COX-2 selective drug, appears safer, but selectivity does not remove all risk.
- Hydrate before and during NSAID use in sick horses.
- Do not give NSAIDs along with corticosteroids without good reason, because the gastric risk adds up.
- Phenylbutazone has important restrictions in horses that may enter the food chain, so check the current notification of the Indian authorities and the horse's passport or history.

Common confusion: flunixin is excellent for visceral pain, while phenylbutazone is often preferred for musculoskeletal pain, but this is a convention, not a rule.

Doping, competition rules and withdrawal

Racing and equestrian sport are governed by rules that treat some substances as forbidden. These rules aim at fair play and horse welfare, because a drug can hide pain and let a lame horse perform. Rules differ between bodies. For international competition, the FEI maintains lists of prohibited substances, including categories such as controlled medication. Indian racing and equestrian authorities have their own rules, so check the current rule book of the relevant body before treating a competition horse.

Concepts to apply:

- **Detection time versus withdrawal time.** A drug may be detectable long after its clinical effect has gone. A competition rule is about the test, not the effect.
- **Threshold substances.** Some compounds are naturally present, so rules set a concentration limit rather than banning them outright.
- **Contamination.** Feed or bedding contaminated by a prohibited plant or drug can cause a positive test; the owner remains responsible.
- **Therapeutic use.** A horse may need treatment for welfare; ask whether a therapeutic use exemption or a rest from competition applies.
- **Food chain status.** Horses are slaughtered for meat in some countries. Some drugs are banned for such horses, so treatment history needs to be recorded.

Never advise an owner to compete a horse within a short interval of treatment on the basis of a guess; recommend checking the rules and, where available, an

official testing laboratory or the authority.

Species cautions and client communication

- **Ionophore feed additives** such as monensin are highly toxic to horses, even in small amounts mixed into feed meant for other species. See Book 6.
- **Ivermectin-type drugs** are widely used in horses but resistance in cyathostomes is common; use faecal egg counts to select animals for deworming.
- **Donkeys** hide pain, may handle drugs differently, and are at risk of hyperlipaemia when they stop eating; do not starve a sick donkey.
- **Foals** are more sensitive to some antibiotics, and their NSAID tolerance differs.
- **Pregnant mares** need drug choices checked for fetal safety.

When talking to owners, explain why you are not giving an antibiotic for an uncomplicated colic, why a horse in pain should not be given repeated painkillers at home without calling the vet, and why a pain-relieved horse still needs observation. Many owners in India give home remedies and injections through unqualified helpers; ask politely about everything the horse has received before you examine it, because those drugs affect your findings and your drug choice.

Concept cleared

Analgesia versus diagnosis
Relieving pain in colic is a duty, but strong or repeated analgesia can hide a surgical lesion. Examine first and re-examine often.

The hindgut ecosystem
Antibiotics, stress and fasting can upset the colonic flora and cause severe colitis, so give antibiotics only for clear indications.

NSAID risk is dose and duration related
Toxicity follows excessive dose, long use, combinations and dehydration; use the lowest effective dose for the shortest time.

Detection is not the same as effect

Competition rules depend on tests, so a drug with no effect can still cause a positive result.

Memory aid: Colic checklist: EXAM

Examine before strong analgesia; eXclude surgical signs; Analgesia in the lowest effective amount; Monitor and re-examine.

Compare and contrast

Colic analgesics

Group	Main use	Main caution
NSAID (flunixin)	Visceral pain, endotoxaemia	Full dose may mask surgical signs; gut and kidney toxicity
Hyoscine butylbromide	Spasmodic colic	Raises heart rate; masks little else
Alpha2-agonists	Strong analgesia and sedation	Slow gut motility, lower cardiac output
Opioid (butorphanol)	Adjunct	Excitement if overdosed; weak alone

Common equine NSAIDs

Drug	Typical use	Relative gut risk
Phenylbutazone	Musculoskeletal pain	Highest of those compared
Flunixin	Colic, endotoxaemia	Intermediate
Ketoprofen	Pain, fever	Lower
Firocoxib (COX-2 selective)	Chronic osteoarthritis	Appears safer

Species notes

Horse

Donkey and mule

Hindgut fermenter; risk of colitis after antibiotics; NSAID-sensitive colon; cannot vomit.

Stoic and may handle drugs differently from horses; hyperlipaemia risk if not eating; use donkey-specific advice.

Foal
Developing gut flora and kidneys; many drugs are handled differently from adults.

Competition horse
Follow the rule book of the relevant authority and think about detection time.

Horse in the food chain
Some drugs are prohibited; keep treatment records and check the current notification.

Clinical pearls

Self-test: 10 questions

1. The main risk of full-dose NSAID in early colic is

Pain relief can hide deterioration.

2. Which drug acts as an antispasmodic in colic?

It blocks muscarinic receptors in gut smooth muscle.

3. A disadvantage of xylazine in colic is that it

Alpha2-agonists reduce motility and cardiac output.

4. Antibiotic-associated colitis in horses is caused by

Antibiotics disrupt the hindgut ecosystem.

5. Which NSAID appears safest for the gut in horses of those listed?

It is COX-2 selective.

6. NSAID toxicity in horses is increased by

Prostaglandin loss matters most in a poorly perfused gut and kidney.

7. Which is the best response to a horse with diarrhoea on antibiotics?

Dehydration and endotoxaemia progress fast.

8. Detection time in doping rules refers to

A drug can be detectable after its effect is gone.

9. Which feed additive is highly toxic to horses?

Ionophores affect the heart muscle of horses.

10. Donkeys differ from horses because they

Do not treat a donkey as a small horse.

Key points to revise

1. Colic is a sign; examine the horse before strong analgesia where safe.
2. Flunixin is the common NSAID for colic, but full doses may mask surgical signs.
3. Alpha2-agonists and opioids are often used together; each has cautions.
4. Antibiotics can cause colitis through disturbing colonic flora.

5. Avoid antibiotics for uncomplicated colic and viral disease.
6. NSAID toxicity depends on drug, dose, duration and hydration.
7. Competition rules depend on detection, not clinical effect; check the current rule book.
8. Donkeys differ from horses and hide pain.

Go deeper on this site

- Ch 5. Therapeutics in poultry, pigs and rabbits (in this book)
- Ch 3. Therapeutics in sheep, goats and camelids (in this book)
- Veterinary drugs list: classes, uses and cautions
- Veterinary Drug Index
- Veterinary Drug Concepts Clearly Explained

Sources

- Merck Veterinary Manual: Overview of Colic in Horses
- Merck Veterinary Manual: NSAID Toxicosis and Right Dorsal Colitis in Horses
- Merck Veterinary Manual: Resistance to Anthelmintics in Animals

CHAPTER 5 OF 8

Therapeutics in poultry, pigs and rabbits

How to think about drug choice when the patient is a flock, a pen of pigs or a rabbit. The chapter covers water and feed medication, why solubility and intake matter, withdrawal logic, and the species-specific toxicities that cause field losses.

After this chapter you can

- Explain why flock and herd medication is a group exercise and what limits it
- Describe how water solubility, stability and water intake affect medicated-water therapy
- Apply the logic of withdrawal periods and egg or meat residues to poultry and pigs
- Name the main species-specific drug hazards in poultry, pigs and rabbits

- Explain how to counsel a farmer or owner about responsible use and residues

Treating a group, not an individual

In a broiler shed or a pig unit the patient is the whole group. Treating one bird at a time is impractical, so the drug usually reaches the animals through **water or feed**. This changes how you think. The questions become: will every animal take in an effective amount, will the drug stay stable in the delivery system, and what happens to the product afterwards?

Individual injection is still used for valuable animals such as breeding boars, sows and pet rabbits, and for vaccines. For commercial poultry, mass medication is the norm.

Group treatment also carries a responsibility. Giving an antimicrobial to healthy in-contact animals is justified only by a clear diagnosis and a reasoned plan. It should not be a substitute for good housing, ventilation, biosecurity and vaccination. See Book 3 on antimicrobial stewardship.

Water medication and solubility

Water is the preferred route for fast flock treatment because sick birds and pigs often keep drinking after they stop eating. Several points decide success.

- **Solubility.** The product must dissolve completely and stay dissolved. Poorly soluble powders settle in tanks, block nipples and filters, and give uneven dosing. Some drugs are available as soluble salts or oral solutions specifically for this reason.
- **Stability.** Some drugs degrade in water, in sunlight, in hard or chlorinated water, or after many hours in a tank. Fresh medicated water must be prepared within the period given on the label.
- **Water intake.** Birds drink more in hot weather and less when ill or when water is too warm or foul. The same concentration therefore delivers different amounts on different days. Concentration is set from expected intake, so check actual consumption.
- **Competing water sources.** Open drinkers, leaks or rain reduce intake of medicated water.

- **Biofilm and lines.** Medicated water can leave residue in pipes. Cleaning and flushing matter for the next batch.

A common confusion is that a higher concentration is always safer for the flock. It is not. Overdosing wastes drug, raises toxicity risk, lengthens withdrawal and promotes resistance.

Feed medication and its limits

Medicated feed suits prevention and long courses, but sick animals eat less, so the sickest receive the least drug. Mixing errors and carry-over into the next feed batch are real hazards. Feed mixing must be even; ionophore coccidiostats and other narrow-margin drugs need very accurate mixing.

Pigs offer all three routes: injection for individuals, water through proportioners, and feed. A practical approach is to treat clinically affected pigs individually where possible and medicate the group only when the diagnosis supports it. Feed and water routes must also meet any rules about permitted medicated feeds. Check the current notification for what is allowed in India.

Withdrawal periods and residue logic

A **withdrawal period** is the time that must pass after the last dose before meat, eggs or milk may enter the food chain. It is set so that tissue residue falls below the maximum residue limit (MRL). It depends on the drug, formulation, route, and the tissue measured. The same drug can need different periods for meat and eggs.

Key reasoning rules:

- Use the label withdrawal for the product and species in front of you. If a drug is used off label, the usual approach is a conservative, documented withdrawal, and the authority's guidance should be consulted.
- Layers are a special problem. Many drugs have no accepted egg withdrawal, and so should not be given to hens producing eggs for human consumption. Treat this as a starting assumption and read the label.
- Kidney, liver and injection-site tissue hold residues longest. Slaughter before the withdrawal ends is a violation even if the animal looks healthy.
- Records are part of the treatment: product, batch, date, group, and expiry of withdrawal.

Residues matter for consumers because of allergy risk, effects on gut flora and resistance selection. Hedged note: MRLs and banned substances in India are set by national authorities and change; check the current FSSAI and Government of India notifications. Some antimicrobials have been restricted or banned for food animals in recent years, so confirm before prescribing.

Species-specific hazards in poultry, pigs and rabbits

Poultry. Ionophore coccidiostats (monensin, salinomycin, narasin and similar) are safe in chickens at label levels but toxic to horses, dogs and some other species, and turkeys are more sensitive than chickens. Feed intended for chickens must never reach horses. Ionophores also interact dangerously with tiamulin, and a few other drugs, causing toxicity in poultry and pigs, so avoid combining them without clear label approval. Heavy-handed sulfonamide use in birds can cause kidney and haematological injury, linking to Book 6.

Pigs. Pigs are sensitive to salt poisoning when water is restricted, and this can be mistaken for an infectious neurological disease. They can be affected by certain feed-borne toxins and by overdose of some injectables. Ivermectin-type drugs are generally safe in pigs at label use. Always match the product to the species on the label, as some pour-on or in-feed products are not intended for pigs.

Rabbits. Rabbits are hindgut fermenters whose caecal flora is delicate. Some antibiotics, particularly lincosamides, many penicillins taken by mouth, and macrolides, can cause a fatal overgrowth of harmful bacteria and enterotoxaemia. Rabbits also reingest caecotrophs, so oral drugs may be recycled. Anorexia is itself an emergency because it leads to gut stasis. Analgesia and nutritional support are part of treatment, and drugs that slow gut movement need thought. Some individual rabbits have enzymes that break down atropine, making response unreliable.

These cautions relate to Book 2 on the gastrointestinal system and Book 6 on toxicology.

Choosing the drug and talking to the client

Reasoning sequence for a flock or herd outbreak:

1. Establish the likely diagnosis from history, necropsy and, if possible, culture or sensitivity (Book 3).

2. Ask whether the problem is infectious, nutritional, toxic or management related. Not every outbreak needs an antimicrobial.
3. Choose a drug with proven activity, an acceptable route for the group, and a withdrawal that fits the production stage (broiler near slaughter, layer, breeder).
4. Use the narrowest effective spectrum and the shortest sensible course.
5. Check for interactions and species-specific toxicity.
6. Record, set a review date and plan prevention.

With farmers, explain in plain terms why a withdrawal must be followed: the meat or egg may look normal but still carry residue. Explain that stopping early, or doubling the dose, creates resistance and loss of the drug for future outbreaks. With rabbit owners, stress that loss of appetite or droppings is urgent, and that medicines licensed for other animals may be harmful. Where the farm sells to export or integrator markets, buyers may have stricter rules than the law.

Cross-references: Book 3 for antimicrobial choice, Book 4 for applied pharmacology and Book 6 for toxicities.

Concept cleared

Group dosing depends on intake
The dose delivered is concentration multiplied by how much the animals actually drink or eat. Heat, illness and poor palatability change intake, so a fixed concentration gives a variable dose.

Solubility and stability are therapeutic properties
A drug that settles out, clogs lines or degrades in the tank cannot treat the flock, however good its spectrum.

Withdrawal is about tissue residue
Withdrawal time protects the consumer by allowing residues to fall under the MRL. It is product, route and tissue specific and is a legal as well as a scientific matter.

Hindgut fermenters are antibiotic-sensitive

In rabbits, upsetting caecal flora can be lethal. Safety is judged by the effect on gut bacteria, not only by the target infection.

Memory aid: SWIM before you medicate a flock

Solubility, Water intake, Interactions, Meat or egg withdrawal. Check all four before mixing the first batch.

Compare and contrast

Routes for group treatment

Route	Strength	Main limitation
Drinking water	Fast start, sick animals keep drinking	Depends on intake, solubility, stability and clean lines
Medicated feed	Convenient for long courses and prevention	Sick animals eat less, mixing errors, carry-over
Individual injection	Precise for each animal	Labour, stress and injection-site residue, impractical for large flocks

Species-specific cautions

Species	Drug or group	Concern
Poultry, pigs	Ionophores with tiamulin	Serious interaction and toxicity
Horses, dogs	Ionophore-contaminated feed	Cardiac and muscle toxicity
Rabbits	Lincosamides, oral penicillins, macrolides	Enterotoxaemia and death
Layer hens	Many antimicrobials	No accepted egg withdrawal, avoid

Species notes

Broiler chickens

Layer hens

Short life cycle means withdrawal often decides whether a drug can be used at all. Ionophore feed is routine for coccidiosis control.

Eggs are a food product, so most drugs should be avoided during lay. Read the label before any use.

Turkeys

More sensitive than chickens to some ionophores. Use only products labelled for turkeys.

Pigs

Group treatment by water or feed is common, but individual treatment of sick pigs is preferred when practical. Watch for salt poisoning after water restriction.

Rabbits

Fragile caecal flora and reingestion of caecotrophs. Antibiotic choice must be made for gut safety and appetite must be supported.

Clinical pearls

Self-test: 10 questions

1. Why is water often preferred for emergency flock medication?

Appetite falls first in sick birds, while drinking usually continues, though intake must still be checked.

2. Which factor can make a fixed drug concentration in water deliver a different dose?

Dose delivered equals concentration times intake, and intake changes with heat and illness.

3. Poor solubility of a water-mixed drug mainly causes

Undissolved drug does not reach birds evenly and can block nipples.

4. A withdrawal period is set so that

It is a consumer-protection measure based on tissue residue depletion.

5. Which statement about laying hens is the safest starting rule?

Egg residues are a separate issue, and many products are not permitted in lay.

6. Ionophore-containing chicken feed is dangerous if eaten by

Horses, and also dogs, are highly susceptible to ionophore toxicity.

7. Which combination is a recognised hazard in poultry and pigs?

This interaction can cause severe toxicity.

8. Why can oral lincosamides be dangerous in rabbits?

Rabbits are hindgut fermenters and are sensitive to antibiotic-induced dysbiosis.

9. Which sign in a rabbit should be treated as urgent?

Anorexia and reduced faeces suggest gut stasis, which can become fatal.

10. For Indian MRLs and banned antimicrobials in food animals, the best advice is to

Rules are revised, so confirm the latest notification before prescribing.

Key points to revise

1. Flock and herd therapy mostly uses water or feed.
2. Intake changes with weather and disease, so dose varies.
3. Poor solubility or stability leads to treatment failure.
4. Overdosing increases toxicity, residues and resistance.
5. Withdrawal periods protect the consumer and depend on product, route and tissue.
6. Many drugs are unsuitable for laying hens.
7. Rabbits can die from antibiotic-induced dysbiosis.
8. Check current Indian notifications for banned drugs and MRLs.

Go deeper on this site

- Ch 6. Therapeutics in exotics and wildlife (in this book)
- Ch 4. Therapeutics in horses and donkeys (in this book)
- Veterinary drugs list: classes, uses and cautions
- Veterinary Drug Concepts
- Veterinary Drug Concepts Clearly Explained

Sources

- WHO - Antimicrobial resistance fact sheet
- FAO - Antimicrobial resistance
- WSAVA - Global guidelines

CHAPTER 6 OF 8

Therapeutics in exotics and wildlife

Principles for treating birds, reptiles, small mammals and zoo or wild animals when few drugs are licensed. The chapter focuses on physiology that changes drug behaviour, the reasoning behind cautions, safety of handlers and legal responsibilities.

After this chapter you can

- Explain why few drugs are licensed for exotic and wild species and what that means for prescribing
- Describe how body temperature, metabolism and anatomy alter drug behaviour in reptiles and birds
- Identify antibiotic and drug hazards in small mammals
- Outline the main principles of drug use in zoo and free-ranging wildlife, including handler safety
- Counsel owners and authorities on legal, welfare and public-health aspects

Why exotics are different

Exotic pets and wildlife include hundreds of species, and the diversity is the central problem. Most drugs are tested in a few domestic species. For a parrot, a tortoise or a leopard there is usually little or no approved product, so the clinician must reason from **physiology and published experience**.

Using a drug in a species for which it is not labelled is often called extra-label or off-label use. It must be justified, based on the best available evidence, recorded, and explained to the owner. It must also remember that doses do not scale in a simple linear way with body weight, because metabolic rate does not. Exact dosing information should come from reliable species-specific references, not from memory or from extrapolation. This book gives no numeric doses.

Always begin with husbandry. In exotics, most disease is linked to wrong temperature, diet, light, humidity or crowding, and correcting these is part of therapy. Drugs rarely work in an animal kept in the wrong environment.

Birds

Birds have features that matter to a pharmacologist.

- **High metabolic rate and small size.** Small birds can deteriorate fast, and fasting should be kept short because glucose reserves are small. Stress from handling can itself be dangerous, so plan procedures before restraint.
- **Air sac respiratory system.** Inhalational anaesthetics are taken up and cleared quickly, which gives rapid control but also rapid change. Respiration must be watched closely. Book 5 covers the principles.

- **Renal portal system.** Blood from the lower body partly passes through the kidney before reaching the general circulation. Concern about injecting into the legs for drugs cleared by the kidney has been a classical teaching point. Its practical importance is debated, so use current species references.
- **Uric acid excretion.** Birds are uricotelic, and kidney damage can lead to visceral gout. Nephrotoxic drugs and dehydration are therefore dangerous.
- **NSAID sensitivity in some species.** The best known example is diclofenac, which caused kidney failure and a collapse in vulture populations in South Asia after vultures fed on treated carcasses. India restricted the veterinary use of diclofenac to protect vultures. Check the current notification. This links directly to Book 6 and shows that a drug given to livestock can harm wildlife through the food chain.

For pet birds, delivery is a practical issue. Injections, crop feeding, drinking water medication and food mixing each have limits. Medicated water is unreliable because intake varies and many drugs degrade or taste bitter.

Reptiles

Reptiles are **ectotherms**. Their body temperature depends on the environment, and this controls metabolism, immune response and drug handling. A reptile kept too cold absorbs, distributes and clears drugs slowly and its immune system works poorly. Treatment is usually given while the animal is kept within its preferred optimal temperature range.

Other points:

- Slow metabolism means long intervals between doses for many drugs and long recovery times from anaesthetics.
- A renal portal system exists in reptiles too, and the same discussion about injection sites applies.
- Some drug classes are dangerous in particular groups. Ivermectin is the classic example, being toxic to chelonians (tortoises and turtles). Never extend a product used in other species to a reptile without checking species-specific guidance.
- Many reptile diseases such as shell disease, respiratory disease and metabolic bone disease are due to husbandry or nutrition, so drug choice alone will fail.

- Reptiles can carry Salmonella without signs, which is a public-health issue (see the section on legal and public-health aspects).

Hibernation or brumation also changes metabolism, and treating a cold, inactive reptile needs careful judgement.

Small mammals

Rabbits were covered in the previous chapter. Other small mammals share the same principle: **the gut flora is the weak point**.

- **Guinea pigs, hamsters, gerbils and chinchillas.** Many antibiotics can cause fatal dysbiosis and enterotoxaemia, particularly some penicillins, lincosamides and macrolides when given by mouth. Always check a small-mammal reference before choosing any antimicrobial. Guinea pigs also need vitamin C in the diet, and deficiency affects healing and immunity.
- **Rodents.** Small body size makes volume, injection site and stress limiting. Anorexia is serious, and supportive feeding and warmth are part of the plan.
- **Ferrets.** Carnivores with a short gut and fast transit, they are more tolerant of antibiotics than herbivorous rodents but still need species-specific advice on many drugs.

Small mammals often hide illness, so by the time they are brought in they are dehydrated and hypothermic. Fluids, warmth and feeding come before many drugs.

Zoo animals and wildlife

Treating large or dangerous animals raises problems that are not about drug effect alone.

- **Remote delivery.** Darting and chemical restraint are common, and the animal is often only partly weighed or estimated. The drug choice must have a wide safety margin and, where possible, a reversal agent. Planning of the team, location and recovery site matters as much as the drug.
- **Handler safety.** Some potent opioids used to immobilise large animals can kill a human after accidental exposure. The antagonist and emergency plan must be at hand, and staff must be trained. This is a major clinical meaning of Book 5.
- **Capture stress and capture myopathy.** Exertion, heat and fear can cause muscle damage, acidosis and death some time after a technically successful

procedure. Minimising chase time and stress is part of pharmacology.

- **Species differences in response.** The same drug can have very different effects in a bear, an antelope and a primate. Use species-specific references and experienced colleagues.
- **Residue and food chain.** Drugs used in free-ranging or captive animals that may be eaten, or be eaten by scavengers, can cause harm, as the diclofenac story showed.

Anaesthetic risks such as regurgitation, bloat in ruminants and hyperthermia need monitoring and the right position during recovery.

Legal, public-health and client aspects

Exotics and wildlife are subject to law. In India the Wildlife Protection Act and related rules control possession of many species, and treatment or release may need permission from the forest authorities. Confirm the current legal position before accepting a wild animal for treatment, and involve the authorities.

Many exotic animals carry zoonotic agents, such as Salmonella in reptiles or Chlamydia in birds. WHO describes zoonoses as diseases that spread between animals and humans, and protective hygiene should be taught to owners.

Antimicrobial use in exotics still contributes to resistance, so culture and sensitivity should be used where possible (Book 3).

When talking to owners, be honest: tell them that many treatments are not licensed for the species, that the evidence is limited, that husbandry changes are part of treatment, and that some prognoses are guarded. Ask for informed consent, discuss costs and welfare, and agree on endpoints. Never prescribe a household remedy or a dog or cat product for an exotic pet without checking species safety, since many errors in exotics come from simple extrapolation.

Concept cleared

Physiology drives drug choice

When no label exists, reasoning from temperature, metabolism, anatomy, diet and gut type is the safest guide. Doses must come from species-specific references.

Husbandry is therapy

Wrong temperature, diet or light causes most exotic disease. Drugs given without correcting these often fail.

Gut flora is the weak point in small herbivores

Rabbits, guinea pigs, hamsters and chinchillas can die from antibiotic-induced dysbiosis, so oral antibiotic choice needs special checking.

Drug effects reach beyond the patient

Veterinary diclofenac harmed vultures through carcasses, and potent immobilising opioids can endanger handlers. Consider the environment and the people.

Memory aid: TEMP-GUT-LAW

Temperature, Environment, Metabolism, Physiology; then Gut flora; then Legal permissions and Animal welfare. A quick checklist before treating any exotic or wild patient.

Compare and contrast

Exotic groups and their pharmacological key point

Group	Key feature	Practical consequence
Birds	Air sacs, high metabolism, uric acid	Rapid anaesthetic changes, kidney caution, short fasting
Reptiles	Ectotherms, slow metabolism	Treat at preferred temperature, long dosing intervals
Small herbivorous mammals	Delicate gut flora	Avoid risky oral antibiotics, support appetite
Zoo and wild animals	Remote delivery, large size	Wide safety margin, reversal agent, handler safety

Cautions recap by species

Species	Drug or situation	Concern
Vultures and some raptors	Diclofenac residues	Kidney failure and population collapse
Chelonians	Ivermectin	Toxicity
Guinea pigs and hamsters	Oral lincosamides, some penicillins	Fatal enterotoxaemia
Large wild animals	Potent opioids	Human exposure risk, capture myopathy

Species notes

Pet birds

Fast metabolism and air sacs. Short fasting, careful respiratory monitoring and kidney caution. Medicated water is unreliable.

Reptiles

Keep in preferred temperature during treatment. Be cautious with ivermectin in tortoises and turtles. Remember Salmonella risk.

Guinea pigs, hamsters, chinchillas

Sensitive to antibiotic-induced gut disturbance. Provide warmth, fluids and feeding. Guinea pigs need dietary vitamin C.

Ferrets

Carnivores with fast gut transit and more antibiotic tolerance than herbivorous rodents, but species references are still needed.

Zoo and wild animals

Plan darting, safety margin, reversal agents and recovery. Protect handlers. Watch for capture myopathy and check legal permissions.

Clinical pearls

Self-test: 10 questions

1. What is the best guide when no licensed product exists for an exotic species?

Metabolism differs between species, so evidence and physiology must guide choice.

2. Why must a reptile be kept in its preferred temperature range during therapy?

Reptiles are ectotherms, so temperature affects drug handling and immune response.

3. Which drug is classically hazardous in chelonians?

Ivermectin toxicity in tortoises and turtles is a well-known caution.

4. Why is prolonged fasting avoided in small birds?

Small birds can become hypoglycaemic quickly.

5. The vulture decline in South Asia was linked to

Vultures eating carcasses of treated livestock developed kidney failure.

6. Which problem is a special risk with antibiotics in guinea pigs and hamsters?

These species are sensitive to antibiotic-induced dysbiosis and enterotoxaemia.

7. What does the renal portal system raise a concern about?

Blood from the hind body may pass through the kidney first, so site choice has been questioned.

8. What is the main danger of potent opioids used for large wild animals?

Handlers can be seriously harmed, so antagonist and training are essential.

9. Capture myopathy is best prevented by

Exertion and stress cause muscle injury and metabolic problems.

10. Before treating a wild animal in India you should

Possession and release of many wild species are legally controlled, so confirm current rules.

Key points to revise

1. Few drugs are licensed for exotic and wild species.
2. Off-label use needs justification, records and owner consent.
3. Dose scaling is not linear with body weight.
4. Birds have air sacs and a high metabolic rate.
5. Reptiles depend on environmental temperature.
6. Small herbivorous mammals are sensitive to oral antibiotics.
7. Zoo anaesthesia needs a reversal plan and handler safety.
8. Wildlife treatment may need legal permission; check current rules.

Go deeper on this site

- Ch 7. Practice MCQ bank, case scenarios and viva questions (in this book)
- Ch 5. Therapeutics in poultry, pigs and rabbits (in this book)
- Veterinary drugs list: classes, uses and cautions
- Veterinary Drug Index
- Veterinary Drug Concepts Clearly Explained

Sources

- WHO - Zoonoses fact sheet
- WHO - Antimicrobial resistance fact sheet
- WSAVA - Global guidelines

CHAPTER 7 OF 8

Practice MCQ bank, case scenarios and viva questions

A revision chapter with twenty Indian field case scenarios worked as reasoning exercises, a viva question set with model answer outlines, exam strategy, and thirty mixed MCQs drawn from Books 1 to 6. Use it to test whether you can apply drugs, not only name them.

> **After this chapter you can**
>
> - Apply drug-choice reasoning to common Indian field presentations in dogs, cats, ruminants, horses, poultry and rabbits
> - Recognise species-specific cautions and the toxicities that follow from them
> - Apply milk, meat and egg withdrawal logic to treatment decisions
> - Answer viva questions in a short, structured way
> - Use a repeatable method to eliminate wrong options in MCQs

How to use this bank

Read the situation, cover the answer and decide *before* reading on. For every case ask four things: what is the likely problem, which drug class fits and why, what must I avoid in this species, and what do I tell the owner. Doses are deliberately absent;

the aim is reasoning. Where a case points to an earlier book, revise that chapter afterwards. Attempt the 30 MCQs in one sitting, then mark the topics you missed.

Field cases 1 to 7

Case 1. A herding-breed dog develops ataxia, salivation and stupor after ivermectin was given for mange. *Think:* why this breed? *Answer:* A MDR1 (ABCB1) mutation leaves P-glycoprotein deficient at the blood-brain barrier, so ivermectin enters the brain. Stop the drug, give supportive care, and consider genotyping; choose another acaricide for the patient.

Case 2. A cat is brought with tremors after the owner applied a dog tick product containing permethrin. *Answer:* Cats are very sensitive to pyrethroids. Wash off the product, control tremors and keep the cat warm. Counsel the owner never to use dog products on cats.

Case 3. A cat given a human paracetamol tablet becomes dull, with brown mucous membranes. *Answer:* Cats have poor glucuronidation, so toxic metabolites cause methaemoglobinaemia and red cell damage. Early decontamination, oxygen and specific antidotal therapy are needed; this is an emergency (Book 6).

Case 4. A buffalo with acute clinical mastitis is treated with an antibiotic and the farmer wants to sell milk the same evening. *Answer:* No. Milk must be discarded for the labelled withdrawal period, which is longer than the treatment course. Explain residues, resistance and consumer risk; check the product label and current notifications.

Case 5. A cow salivates, has diarrhoea and muscle twitching after a pesticide spray around the cattle shed. *Answer:* Organophosphate or carbamate poisoning from cholinesterase inhibition. Decontaminate the skin, give atropine for muscarinic signs, and an oxime only for organophosphates; avoid oximes in carbamate cases as a general rule (Books 1 and 6).

Case 6. A high-yielding cow, down soon after calving, is cold with a dry muzzle. *Answer:* Think hypocalcaemia. Give calcium slowly by vein while listening to the heart, because rapid infusion risks arrhythmia and cardiac arrest. Plan prevention in the dry period.

Case 7. A calf is bloated on lush green fodder, and froth is seen. *Answer:* Frothy bloat traps gas in stable foam. An antifoaming agent lowers surface tension; a stomach tube may not release gas. Pass a trocar if life-threatening, then correct the diet.

Field cases 8 to 14

Case 8. A goat flock with anaemia and bottle jaw has failed repeated deworming. *Answer:* Haemonchus with probable anthelmintic resistance. Confirm with faecal egg counts, treat selectively using anaemia scoring, rotate classes sensibly and avoid underdosing, which selects resistant worms (Book 3).

Case 9. A horse with colic improves dramatically after an NSAID and the owner wants to move it. *Answer:* Analgesia can mask a surgical lesion. Reassess pulse, gut sounds and pain; NSAIDs risk gastric and renal injury, and competition rules on medication also apply.

Case 10. A horse develops severe diarrhoea after an oral lincosamide. *Answer:* Antibiotic-associated colitis from hindgut dysbiosis and Clostridial overgrowth. Avoid lincosamides in horses and manage fluids and shock.

Case 11. A pet rabbit becomes anorexic with bloat after oral broad-spectrum antibiotic therapy. *Answer:* Gut flora disruption in a hindgut fermenter. Choose antibiotics known to be safer in rabbits, avoid lincosamides and some penicillins by mouth, and support feeding.

Case 12. A layer farm treats a respiratory outbreak through drinking water. *Answer:* Check water solubility, uniform intake and egg withdrawal. Layers producing eggs for people need drugs with no egg restriction. Several antimicrobials are restricted in Indian poultry; check the current notification.

Case 13. A horse eating feed made for poultry collapses. *Answer:* Ionophore (monensin) toxicity, which damages heart and skeletal muscle in horses. Stop the feed, give supportive treatment and prevent cross-contamination at the feed mill.

Case 14. A dog bitten by a snake has drooping eyelids and breathing weakness. *Answer:* Likely neurotoxic envenomation. Species-appropriate antivenom is central; supportive ventilation matters. Check current protocols; anticholinesterase adjuncts are used in some cases.

Field cases 15 to 20

Case 15. A dog ate rat bait three days ago and is now bleeding. *Answer:* Anticoagulant rodenticide toxicity; factors II, VII, IX and X are depleted, signs delayed. Vitamin K1 is the antidote and must continue for the long action of second-generation compounds.

Case 16. A cat given an enrofloxacin-containing tablet becomes blind. *Answer:* Fluoroquinolones can cause retinal toxicity in cats, especially with high exposure. Counsel on dose accuracy and choose alternatives when possible.

Case 17. A dog on prednisolone for allergy is also given an NSAID by a neighbour, and passes black stools. *Answer:* Combined corticosteroid and NSAID raises the risk of gastric ulceration. Stop both, protect the mucosa and allow washout before any switch (Book 2).

Case 18. An epileptic dog on phenobarbital has raised liver enzymes after months. *Answer:* Phenobarbital induces enzymes and can be hepatotoxic. Check serum levels and bile acids, and do not stop abruptly because that provokes seizures.

Case 19. A pregnant cow near term was given dexamethasone and aborted. *Answer:* Glucocorticoids can induce parturition in late pregnancy in cattle, so avoid them in pregnant animals unless intended. Prostaglandin F2-alpha is also contraindicated (Book 2).

Case 20. A calf with watery diarrhoea is dull and weak, and the owner demands antibiotics. *Answer:* The main killer is dehydration and acidosis, so give fluids and electrolytes first. Antibiotics are not routine; use them only with systemic illness. Discuss stewardship.

Viva question set

Answer in three parts: define, explain the mechanism, give the clinical point.

1. **Why do collies react badly to ivermectin?** MDR1 mutation, defective P-glycoprotein, drug enters CNS, neurotoxicity, test and avoid.
2. **What is withdrawal period?** Time after the last dose before milk, meat or eggs is safe, so residues fall below the MRL. Check current Indian notifications.
3. **Why is atropine alone not enough in organophosphate poisoning?** It blocks muscarinic effects only; nicotinic effects need oximes (organophosphates) and

supportive care.

4. **Why avoid aminoglycosides in dehydrated animals?** Nephrotoxicity and ototoxicity; renal accumulation worsens with poor perfusion.
5. **Why are cats sensitive to some drugs?** Reduced glucuronidation; examples are paracetamol and some NSAIDs.
6. **Name one rational use of an antifoaming agent.** Frothy bloat in ruminants.
7. **Difference between bacteriostatic and bactericidal?** Inhibit versus kill; in immunocompromised or severe infection, bactericidal is preferred.
8. **Why not use antibiotics routinely for viral diarrhoea?** They do not act on viruses and drive resistance.

Exam strategy

Read the stem twice and predict the answer before looking at options. Eliminate absolutes such as always and never unless the pharmacology demands it. In species-specific questions, ask what is different about this animal: ruminant rumen, equine hindgut, feline glucuronidation, canine MDR1, avian egg. In theory papers use a short definition, a mechanism, one example and one clinical point. In the viva be calm and honest; if you do not know, reason aloud from the drug class, as examiners value reasoning more than recall. Keep a one-page list of antidotes and species cautions for the last night.

Concept cleared

Species decides the drug
Metabolic, digestive and genetic differences between species can turn a safe drug into a toxic one.

Withdrawal logic
Residues in milk, meat and eggs must fall below the MRL before human use; the period is label-specific, check current notifications.

Treat the cause and the complication

Fluids and supportive care often matter more than the headline drug, as in calf diarrhoea and OP poisoning.

Stewardship

Use antimicrobials only when indicated, with the right class and duration, to reduce resistance.

Memory aid: SPEED for case answers

Species, Problem, Evidence, Estimate the drug class, Discuss with the owner (including withdrawal).

Compare and contrast

Antidotes recap across Book 6

Poison	Antidote or key treatment	Key reason
Organophosphate	Atropine plus oxime, decontamination	Muscarinic block and enzyme reactivation
Anticoagulant rodenticide	Vitamin K1	Restores clotting factor synthesis
Paracetamol in cats	Early decontamination and specific antidotal therapy	Methaemoglobin and red cell damage
Snake neurotoxic bite	Antivenom and ventilatory support	Neutralise venom and protect breathing

Species cautions recap

Species	Caution	Reason
Dog (herding breeds)	Ivermectin sensitivity	MDR1 mutation
Cat	Permethrin, paracetamol	Poor detoxification
Horse	Lincosamides, ionophores	Hindgut dysbiosis, cardiotoxicity
Rabbit	Oral broad-spectrum antibiotics	Hindgut flora disruption

Species notes

Dogs

MDR1 breeds react to ivermectin and some other P-glycoprotein substrates; avoid NSAID plus corticosteroid together.

Cats

Poor glucuronidation: avoid paracetamol and permethrin; be careful with fluoroquinolones.

Ruminants

Rumen flora affect oral antibiotics; milk and meat withdrawal apply.

Horses

Avoid lincosamides; monensin is toxic; competition medication rules apply.

Rabbits and poultry

Rabbits are prone to dysbiosis; layers need egg withdrawal and water-medication planning.

Clinical pearls

Self-test: 30 questions

1. Ivermectin neurotoxicity in some collies is due to a mutation in which gene?

MDR1 deficiency removes P-glycoprotein from the blood-brain barrier.

2. Which receptor family acts fastest?

Ion channels open within milliseconds.

3. Cats are sensitive to paracetamol mainly because of poor

Limited glucuronidation leads to toxic metabolites and methaemoglobinaemia.

4. Atropine in organophosphate poisoning mainly reverses

Atropine is a muscarinic antagonist.

5. An oxime acts by

Oximes reactivate phosphorylated cholinesterase if given early.

6. The antidote for anticoagulant rodenticides is

Vitamin K1 restores synthesis of clotting factors.

7. Which is nephrotoxic and ototoxic?

Aminoglycosides accumulate in renal tubular and inner ear cells.

8. A drug that inhibits bacterial cell wall synthesis is

Beta-lactams block peptidoglycan cross-linking.

9. Which is the main reason for a milk withdrawal period?

Residues must be below the MRL before milk is used by people.

10. Frothy bloat is managed with

They break stable foam so gas can escape.

11. Lincosamides in horses carry the risk of

Hindgut flora disruption allows Clostridial overgrowth.

12. Monensin toxicity in horses mainly affects

Ionophores cause myocardial and muscle necrosis.

13. Cats given permethrin dog products show

Pyrethroids cause neurotoxic signs in cats.

14. Which combination raises GI ulcer risk in dogs?

Both reduce protective prostaglandin effects and mucosal defences.

15. Phenobarbital can increase liver enzymes because it

Enzyme induction, and sometimes hepatotoxicity, occur on long-term use.

16. Rapid IV calcium in milk fever may cause

Calcium affects cardiac conduction and contractility.

17. The main priority in calf diarrhoea is

Dehydration and acidosis cause death.

18. Selective deworming with anaemia scoring aims to

Leaving some worms unexposed (refugia) slows resistant populations.

19. Bactericidal therapy is preferred in

Killing the organism matters when host defences are poor.

20. Corticosteroids in late pregnancy in cattle may

Glucocorticoids trigger the parturition cascade.

21. Drug dose in obese animals is best calculated by

Hydrophilic drugs distribute mainly in lean tissue.

22. First-pass effect refers to

Portal blood passes through the liver before reaching the circulation.

23. Which route avoids first-pass metabolism?

IV drug enters the systemic circulation directly.

24. Ruminants given oral antibiotics risk

Antibiotics kill rumen microbes needed for digestion.

25. A drug that blocks beta-1 receptors would

Beta-1 blockade reduces cardiac stimulation.

26. Heinz bodies and methaemoglobin are associated with

Oxidants denature haemoglobin.

27. The main purpose of antimicrobial stewardship is

Prudent use preserves drug effectiveness.

28. Neurotoxic snake bite is managed chiefly with

Antivenom neutralises venom and respiratory support prevents death.

29. Which sign suggests organophosphate toxicity?

Excess acetylcholine causes muscarinic signs.

30. Enrofloxacin carries a retinal risk in

Retinal degeneration is reported in cats, particularly with high exposure.

Key points to revise

1. Case reasoning combines species, pathology and pharmacology.
2. MDR1 mutation explains ivermectin neurotoxicity in some dogs.
3. Cats are sensitive to permethrin and paracetamol.
4. Withdrawal periods protect consumers from residues.

5. Atropine does not treat nicotinic signs of OP poisoning.
6. Antibiotic-associated colitis is a serious risk in horses and rabbits.
7. Corticosteroids can induce abortion in late pregnancy in cattle.
8. Structured viva answers earn more marks than lists.

Go deeper on this site

- Ch 8. Glossary and exam-day concept maps (in this book)
- Ch 6. Therapeutics in exotics and wildlife (in this book)
- Veterinary drugs list: classes, uses and cautions
- Veterinary Drug Index
- Veterinary Drug Concepts Clearly Explained

Sources

- Cornell University College of Veterinary Medicine: Drug sensitivity (MDR1)
- University of Minnesota Libraries: Pharmacology, G protein-coupled receptors
- FDA Center for Veterinary Medicine: Antimicrobial resistance

CHAPTER 8 OF 8

Glossary and exam-day concept maps

A plain-language glossary of about 80 key terms from Books 1 to 6, linked to the earlier chapters, with one-page concept maps for each part. Use it for fast revision before the exam.

> **After this chapter you can**
>
> - Recognise and define about 80 core pharmacology terms
> - Link terms to the chapters where they are explained
> - Use concept maps to connect mechanism, clinical use and cautions
> - Distinguish commonly confused term pairs
> - Plan last-minute revision using ADME-R and species cautions

How to use this glossary

This chapter is for the last week before the exam. Read the glossary once for recognition, then cover the definition and test yourself. Each entry gives a short plain meaning; for mechanism, doses in the field and cautions, go back to the chapter on that topic in Books 1 to 6.

The concept maps at the end show how the ideas connect. In a viva, examiners reward links: for example, why a lipid-soluble drug has a large volume of distribution, and why that matters for withdrawal. Draw each map from memory, then compare it with the printed one.

Glossary: pharmacokinetics and pharmacodynamics (Book 1)

Bioavailability: fraction of a dose that reaches the systemic circulation unchanged; low after poor absorption or heavy first-pass loss.

First-pass effect: removal of oral drug by gut wall and liver before it reaches the general circulation.

Volume of distribution: an apparent space that links the amount of drug in the body to its plasma concentration; large for lipid-soluble drugs.

Clearance: the volume of plasma cleared of drug per unit time; it sets the maintenance requirement.

Half-life: time for the plasma concentration to fall by half; guides dosing interval and time to steady state.

Steady state: the balance reached when input equals elimination, usually after several half-lives.

Loading dose: an initial larger exposure to reach effective levels quickly, used when half-life is long.

Protein binding: reversible attachment to plasma proteins; only the free drug is active, filtered or metabolised.

Biotransformation: enzymatic conversion of a drug to metabolites, mainly in the liver (phase I and phase II).

Glucuronidation: a phase II conjugation step that is deficient in cats, so some drugs linger and become toxic.

Enterohepatic recycling: biliary excretion followed by gut reabsorption, which prolongs drug action.

Ion trapping: accumulation of a weak acid or base on the side of a membrane where it is ionised.

P-glycoprotein: an efflux pump (MDR1/ABCB1) that limits entry of drugs into brain and gut; defective in some collie-type dogs.

Therapeutic index: the margin between a toxic and an effective dose; narrow means little room for error.

Agonist: a drug that binds a receptor and produces a response.

Antagonist: a drug that binds a receptor but produces no response and blocks the agonist.

Partial agonist: gives a submaximal response even at full occupancy.

Potency and efficacy: potency is how much drug is needed; efficacy is the maximum effect possible.

Tolerance and tachyphylaxis: reduced response on repeated use, slowly or rapidly.

Second messenger: an intracellular signal such as cAMP, IP3 or calcium that relays receptor activation.

Glossary: autonomic, CNS and inflammation (Book 2)

Cholinergic: acting through acetylcholine, as with muscarinic and nicotinic receptors.

Anticholinergic: blocks muscarinic receptors, causing dry mucosa, tachycardia and reduced gut motility.

Adrenergic: acting through noradrenaline or adrenaline on alpha and beta receptors.

Alpha-2 agonist: sedative-analgesic that also slows the heart and raises early blood pressure; reversed by specific antagonists.

Neuromuscular blocker: stops transmission at the motor end plate; the animal is paralysed but not anaesthetised.

Anticonvulsant: a drug that raises seizure threshold or limits seizure spread.

Sedative: calms an animal while it can still be roused.

Analeptic: a stimulant of respiration or the CNS, now little used.

Euthanasia: a death that is painless and humane, with unconsciousness first.

Histamine: autacoid in allergy and gastric acid secretion, acting on H1 and H2 receptors.

Eicosanoid: lipid mediator such as prostaglandin or leukotriene made from arachidonic acid.

Cyclooxygenase: enzyme making prostaglandins; blocked by NSAIDs.

NSAID: non-steroidal anti-inflammatory drug that is analgesic, antipyretic and anti-inflammatory; watch kidney, gut and platelet effects.

Antipyretic: a drug that lowers fever by acting on the hypothalamic set point.

Glucocorticoid: adrenal steroid or analogue with anti-inflammatory and immunosuppressive action.

HPA suppression: shutdown of the pituitary-adrenal axis after prolonged steroid use; stop gradually.

Disease-modifying drug: one that slows the structural course of a disease such as osteoarthritis.

Autacoid: a local hormone acting near where it is released.

Pharmacological antagonism: blockade at the same receptor; contrast with physiological antagonism through opposite effects.

Adverse drug reaction: any harmful, unintended response at normal doses.

Glossary: cardiovascular, renal, respiratory, digestive and endocrine (Book 2)

Inotrope: a drug that changes the force of cardiac contraction.

Chronotrope: a drug that changes heart rate.

Antiarrhythmic: a drug that restores or controls rhythm; may itself be proarrhythmic.

Vasodilator: widens vessels, lowering preload, afterload or both.

Preload and afterload: filling load before and resistance after contraction.

Diuretic: increases urine output by reducing tubular sodium and water reabsorption.

Loop diuretic: acts on the thick ascending limb; strong and fast, can cause potassium loss.

Azotaemia: raised urea and creatinine; check before choosing renally cleared drugs.

Anticoagulant: blocks clotting factors or thrombin.

Haematinic: supplies iron, copper, B12 or folate to build red cells.

Bronchodilator: relaxes airway smooth muscle.

Mucolytic and expectorant: drugs that thin or help clear airway secretions.

Antiemetic: drug that controls vomiting through the chemoreceptor trigger zone or vomiting centre.

Prokinetic: drug that improves coordinated gut propulsion.

Proton pump inhibitor: strongly reduces gastric acid by blocking the H+/K+ ATPase.

Rumen microflora: the microbe community that digests feed; harmed by sudden diet or antibiotic change.

Negative feedback: a hormone limiting its own release, central to endocrine drug action.

Hyperadrenocorticism: excess cortisol, treated by blocking synthesis rather than adding steroid.

Anabolic steroid: a synthetic androgen that builds tissue; banned as a growth promoter in food animals under many rules, check the current notification.

Oxytocic: a drug that causes uterine contraction; used only when the birth canal is clear.

Glossary: chemotherapy, anaesthesia and toxicology (Books 3, 5 and 6)

Bactericidal and bacteriostatic: killing versus inhibiting bacteria; the label matters less than host defences.

MIC: minimum inhibitory concentration, the lowest level that stops visible growth.

Time-dependent killing: effect depends on time above MIC, as with beta-lactams.

Concentration-dependent killing: effect depends on peak level relative to MIC, as with aminoglycosides and fluoroquinolones.

Antimicrobial resistance: loss of bacterial susceptibility, driven by selection pressure from use.

Stewardship: using antimicrobials only when needed, choosing narrow agents and correct duration.

Withdrawal period: the interval after last treatment before milk, meat or eggs are safe for food.

MRL: maximum residue limit, the legal ceiling of a residue in food; check the current notification for Indian values.

Intramammary therapy: drug put directly into the udder; milk withdrawal applies.

Anthelmintic: drug against parasitic worms; resistance is a major problem in small ruminants.

Ectoparasiticide: drug against ticks, mites, lice and flies.

Antiprotozoal: drug against protozoa such as Babesia, Trypanosoma and coccidia.

Cytotoxic: drug that kills dividing cells; bone marrow and gut are common targets.

Premedication: drugs given before anaesthesia to calm, reduce drug need and add analgesia.

Balanced anaesthesia: combining several agents in small amounts to reduce side effects of each.

MAC: minimum alveolar concentration; a measure of inhaled agent potency.

Local anaesthetic: blocks sodium channels in nerves; intravenous error can cause toxicity.

Antidote: an agent that counters a poison, by blocking, binding or reversing it.

LD50: dose expected to kill half of test animals; an index of acute toxicity, not a safe dose.

Decontamination: removing poison from skin, gut or eyes before it is absorbed.

One-page concept maps by part

Map 1. General pharmacology (Book 1)

- Drug enters the body
  - Route and formulation decide absorption
  - Bioavailability, first-pass loss
- Drug moves
  - Protein binding and volume of distribution
  - P-glycoprotein and barriers
- Drug acts
  - Receptor, agonist or antagonist, second messenger
  - Potency, efficacy, therapeutic index
- Drug leaves
  - Biotransformation and clearance
  - Half-life sets interval and withdrawal
  - Species and age change every step

Map 2. Systemic pharmacology (Book 2)

- Nervous system
  - Cholinergic versus anticholinergic; adrenergic and alpha-2 agents
  - Anticonvulsants and sedatives
- Inflammation
  - Arachidonic acid, cyclooxygenase, NSAIDs
  - Glucocorticoids and HPA suppression
- Organ systems
  - Heart: inotropes, antiarrhythmics, vasodilators
  - Kidney: diuretics, renal caution

    - Gut: acid, vomiting, motility, rumen
- Endocrine
    - Feedback loops guide drug choice
    - Sex hormones and growth promoters are regulated

Map 3. Chemotherapy (Book 3)

- Diagnose, then choose
    - Likely bug, site, culture and MIC
- Pattern of killing
    - Time-dependent versus concentration-dependent
- Consequences
    - Resistance, stewardship
    - Residues, withdrawal, MRL
- Parasites, fungi, viruses, cancer follow the same rule: selective toxicity

Map 4. Applied, anaesthesia and toxicology (Books 4 to 6)

- Applied
    - Fluids, acid-base, vitamins, feed additives
- Anaesthesia
    - Assess patient, premedicate, induce, maintain, monitor, recover
- Toxicology
    - Stop exposure, decontaminate, antidote, support
    - Record and report for medico-legal cases

Map 5. Species therapeutics (Book 7)

- Species cautions
    - Cats: glucuronidation; dogs: MDR1; ruminants: rumen; horses: colitis
- Food animals: withdrawal first, then drug choice

Concept cleared

Think in loops

Absorption, distribution, metabolism and excretion decide how much drug is at the receptor, and the receptor decides the effect. Most exam questions test one link in this chain.

Species changes the rule

Many drug rules are really species rules. Cat glucuronidation, canine MDR1 and the ruminant rumen are the standard examples.

Food animals add a second question

After asking whether a drug works, ask whether milk, meat or eggs will be safe. Withdrawal follows elimination.

Antidote logic

Match the antidote to the mechanism, not the poison name: block, bind, reverse or support.

Memory aid: ADME-R

Absorption, Distribution, Metabolism, Excretion, Receptor: say it in order when explaining any drug in a viva.

Compare and contrast

Terms students confuse

Pair	Difference
Potency vs efficacy	Amount needed vs maximum effect
Tolerance vs tachyphylaxis	Slow vs rapid loss of response
Bactericidal vs bacteriostatic	Kills vs inhibits growth
MIC vs MRL	Bacterial inhibitory level vs legal residue ceiling
LD50 vs therapeutic index	Acute lethality marker vs safety margin

Where each part sits

Book	Core idea
1 General	Handling and action of drugs
2 Systemic	Organ-system drugs
3 Chemotherapy	Selective toxicity, resistance, residues
4 Applied	Fluids, nutrition, additives
5 Anaesthesia	Safe loss of consciousness and pain
6 Toxicology	Poisons and antidotes

Species notes

Cats
Weak glucuronidation, so extra caution with many analgesics and phenolics.

Dogs
MDR1 mutation in some herding breeds raises risk with certain drugs.

Ruminants
Oral antibiotics can upset the rumen; withdrawal times apply to milk and meat.

Horses
Colitis risk with some antibiotics; competition rules restrict many drugs.

Poultry and pigs
Flock water medication and egg or meat withdrawal need planning.

Clinical pearls

Self-test: 10 questions

1. Fraction of a dose reaching the systemic circulation is called:

Bioavailability is the fraction reaching the systemic circulation.

2. Which pair describes a reduced response on repeated use, rapid in onset?

Tachyphylaxis is rapid; tolerance develops more slowly.

3. Cats are especially sensitive to some drugs because of weak:

Cats have limited glucuronyl transferase activity.

4. P-glycoprotein deficiency in some dogs is linked to which gene?

MDR1 (ABCB1) encodes P-glycoprotein.

5. NSAIDs act mainly by blocking:

They block prostaglandin synthesis via COX.

6. The lowest antibiotic concentration that stops visible bacterial growth is the:

MIC is the minimum inhibitory concentration.

7. A legal ceiling for a drug residue in food is the:

MRL is the maximum residue limit.

8. MAC measures:

MAC is minimum alveolar concentration.

9. A loop diuretic acts mainly on the:

Loop diuretics act on the thick ascending limb.

10. Withdrawal period is the time:

It protects consumers from residues.

Key points to revise

1. A glossary is for recognition; maps are for linking.
2. Bioavailability, clearance and half-life drive dosing.
3. Agonist and antagonist differ in intrinsic activity.
4. NSAIDs block cyclooxygenase.
5. Resistance grows with selection pressure; stewardship slows it.
6. Withdrawal periods protect consumers; check current Indian notifications.
7. MIC is a laboratory measure of susceptibility.
8. Antidotes act by block, bind, reverse or support.

Go deeper on this site

- Ch 7. Practice MCQ bank, case scenarios and viva questions (in this book)
- Ch 6. Therapeutics in exotics and wildlife (in this book)
- Veterinary drugs list: classes, uses and cautions
- Veterinary Drug Index
- Veterinary Drug Concepts Clearly Explained

Sources

- MSD Veterinary Manual: Overview of Pharmacology
- MSD Veterinary Manual: Overview of Veterinary Toxicology
- US FDA: Antimicrobial Resistance (animal and veterinary)

How to use Book 7: a short discussion

The first six books built a complete picture of veterinary pharmacology, toxicology, chemotherapy and anaesthesia, topic by topic. Book 7 turns that picture upside down. Instead of starting with a drug and asking what it does, it starts with a species and asks which drugs help, which are risky and which should simply be avoided. That is how the knowledge is used in practice and how clinical examinations often test it.

Species chapters

The first six chapters cover dogs and cats, cattle and buffalo, sheep, goats and camelids, horses and donkeys, poultry, pigs and rabbits, and finally exotics and wildlife. Each one lists common conditions, explains the reasoning behind drug choice, names the cautions that are specific to the species and points back to the relevant chapters in the earlier books. In food animals the chapters give special attention to withdrawal periods and residues, and in companion animals they stress client communication and the safety of human medicines in the home.

Why species matter so much

The same drug can be a routine treatment in one species and a poison in another. Cats cannot handle some painkillers, horses react badly to certain feed additives, rabbits can develop a fatal gut disorder after the wrong antibiotic, and ruminants alter drugs in the rumen. The Species sections throughout the series gather these facts, and this book groups them by animal so that they can be revised together.

The practice bank

Chapter 7 is a revision tool. It contains twenty field cases drawn from Indian practice, each with a short situation, guiding questions and a reasoning outline, together with a set of viva questions and thirty mixed multiple-choice questions covering all the books. Work through the cases before reading the reasoning, and speak the viva answers aloud, because explaining an idea in your own words is the best test of whether you understand it.

Glossary and concept maps

Chapter 8 provides plain-language definitions of about eighty terms and text concept maps that show how ideas link within each part of the series. Use it on the last day before an examination, and use the search box above the chapter list to find a term quickly.

Reasoning through a case

When you read a case in this book, follow the same four steps every time. First identify the species, age and physiological state of the animal, including pregnancy, lactation and any food-chain status. Second, decide what the problem is and whether a drug is needed at all, because rest, fluids, nursing and management often matter more. Third, choose a drug by mechanism and by the cautions for that species, and think about what it will do to the gut, kidney, liver and nervous system. Fourth, plan the follow-up: what to monitor, what to tell the owner, when to review, and how long any milk, meat or eggs must be withheld. This habit is more useful in an examination and in practice than any list of drug names.

A final reminder

As throughout the series, the book does not contain dose tables and does not replace a product label, a current formulary or the judgement of a registered veterinarian. Indian regulatory points are marked for checking against the current notification, because rules on drugs, residues and controlled substances change. Treat the series as a framework for understanding, keep revising with the self-tests, and return to the earlier books whenever a species chapter points you there.

Good luck with your studies, and if a chapter helped you, share the site with classmates so that more students can learn the same material.