Types of treatments and treating animals

Animal physiology

- Normal physiological values
- Reasons for abnormal physiological values
- Other factors to observe

Medical treatments

- Factors affecting treatment
- Route of administration
- Local and systemic effects of medication
- Ways of giving medication
- Forms of medications and treatments
- Topical medication
- Ocular medications
- Aural medications
- Rectal route of drug administration
- Intra-uterine route of drug administration

Treating small animals: Rats, mice, rabbits and guinea pigs

- Types of treatments
- Routine health procedures for rabbits and guinea pigs
- Handling and treating rabbits
- Handling and treating guinea pigs
- Handling and treating rats and mice
- Weighing small animals

Treating birds

- Preventative health measures
- Treatment for disease
- Ways of medicating birds
- Choosing a treatment method
Obtaining professional assistance 34

Treating reptiles and amphibians 36
  Initial details to find out 36
  Examining reptiles and amphibians 36
  Handling reptiles and amphibians 38
  Quarantine policy 40

Treating horses 42
  Types of treatments 42
  Steps for oral administration 43
  Ocular treatments for horses 45

Treating fish 47
  Treating an individual fish 47
  Treating the entire tank 47
  Hygiene and husbandry procedures 48
  Types of treatment 48
  Ways of giving medication 49
Animal physiology

When examining a hospitalised patient in a vet clinic, factors such as their temperature, pulse rate and respiration rate—the physiological values—need to be assessed. Understanding what should be normal physiological values for particular types of hospitalised animals will also tell you what is not normal—in other words, abnormal.

Normal physiological values

Normal physiological values vary from species to species and between individual animals. It is important to be able to recognise the normal values for each species and reasons why they may be abnormal. The role of a vet nurse includes recording and reporting these observations promptly.

The table below shows normal physiological values for a range of animals you are likely to encounter in a vet clinic.

<table>
<thead>
<tr>
<th>Species</th>
<th>Rectal temperature</th>
<th>Pulse rate (beats per min)</th>
<th>Respiration rate (breaths per min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dog</td>
<td>38.3–39.2 °C</td>
<td>60–180</td>
<td>10–30</td>
</tr>
<tr>
<td>Cat</td>
<td>38.0–38.5 °C</td>
<td>110–180</td>
<td>20–30</td>
</tr>
<tr>
<td>Cow</td>
<td>38.0–39.0 °C</td>
<td>60–70</td>
<td>30</td>
</tr>
<tr>
<td>Horse</td>
<td>37.5–38.5 °C</td>
<td>23–70</td>
<td>12</td>
</tr>
<tr>
<td>Sheep</td>
<td>39.0–40.0 °C</td>
<td>60–120</td>
<td>19</td>
</tr>
<tr>
<td>Rabbit</td>
<td>38.8 – 39.8 °C</td>
<td>123 – 304</td>
<td>30</td>
</tr>
</tbody>
</table>

Reasons for abnormal physiological values

Some of the possible reasons for abnormal physiological values include:

- stress—fear of an unfamiliar environment, smells and sounds
- heat—will increase temperature and heart rate
- bitches on heat will agitate other male dogs
• unable to urinate/defecate—house trained dogs locked in a cage
• exercise
• sleep
• excitement.

If the above reasons for abnormal findings have been eliminated, then the possibility of disease may need to be considered.

Pathological causes of abnormal physiological values

Table 2 lists some of the possible pathological causes of abnormal physiological values.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Possible Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raised pulse rate</td>
<td>• fever (pyrexia)</td>
</tr>
<tr>
<td></td>
<td>• hypoxia</td>
</tr>
<tr>
<td></td>
<td>• pain</td>
</tr>
<tr>
<td>Lowered pulse rate</td>
<td>• unconsciousness</td>
</tr>
<tr>
<td></td>
<td>• anaesthesia</td>
</tr>
<tr>
<td></td>
<td>• debilitating disease</td>
</tr>
<tr>
<td>Weak pulse rate</td>
<td>• shock</td>
</tr>
<tr>
<td></td>
<td>• diminished cardiac output</td>
</tr>
<tr>
<td></td>
<td>• strong jerky pulse rate</td>
</tr>
<tr>
<td></td>
<td>• valvular insufficiency</td>
</tr>
<tr>
<td></td>
<td>• congenital heart defects</td>
</tr>
<tr>
<td>Abnormal respiration</td>
<td>• tachypnoea—increased respiration rate</td>
</tr>
<tr>
<td></td>
<td>• pain</td>
</tr>
<tr>
<td></td>
<td>• poison</td>
</tr>
<tr>
<td>Decreased respiration rate</td>
<td>• poisons</td>
</tr>
<tr>
<td></td>
<td>• metabolic alkalosis</td>
</tr>
<tr>
<td>Difficult breathing</td>
<td>• obstructions</td>
</tr>
<tr>
<td></td>
<td>• bronchitis</td>
</tr>
<tr>
<td></td>
<td>• emphysema</td>
</tr>
<tr>
<td></td>
<td>• pleural adhesions</td>
</tr>
<tr>
<td></td>
<td>• pneumonia</td>
</tr>
<tr>
<td></td>
<td>• pneumothorax</td>
</tr>
<tr>
<td></td>
<td>• hydrothorax</td>
</tr>
<tr>
<td></td>
<td>• pyothorax</td>
</tr>
<tr>
<td>Low temperature (hypothermia)</td>
<td>• inadequate thermo regulation—neonates</td>
</tr>
<tr>
<td></td>
<td>• anaesthetised patients</td>
</tr>
</tbody>
</table>
Other factors to observe

In addition to physiological factors, the animal should be observed overall for:

- Normal state: Is it normal for that breed? Is it normal for the individual animal?
- Behaviour: Is it Bright, Alert and Responsive (BAR)? Is it eating and drinking normally?
- Disposition: is it placid, aggressive or nervous?
- Body condition: This will vary depending on the age of the animal, whether it is in a reproductive state, type of nutrition it is used to, stage of disease process.
- Coat condition
- Mobility, gait, posture: Do they walk and hold themselves normally?
- Conformation: Are there any defects that could cause problems?
- Elimination patterns: How often is it urinating/defecating? Are the amounts normal? Is there any pain, blood or diarrhoea?
- Discharge from any orifice: What is the amount, colour and consistency?
- Obvious findings: Are there any wounds, haemorrhage etc?
Medical treatments

The type and route of administration of a treatment to any animal is determined by many factors. The most common of these factors are discussed below.

Factors affecting treatment

The following are factors that will affect the treatment and medication an animal takes:

- the size of the animal—eg a large dog compared to a mouse
- temperament of the animal
- the age of the animal—eg neonatal, young, adult or elderly
- current health status and previous history—eg injuries old or new
- type of medication and quantity being administered—eg an injection, oral liquid or tablet
- animal’s past experience with treatments
- other treatments or medication the animal is undertaking.

Route of administration

The route of administration can vary between treatments. Factors that may determine this may include:

- How quickly the treatment needs to work: If an animal is extremely ill and treatment needs to be fast and aggressive, then the quickest route of absorption is needed. This is usually intravenous.
- Cost of treatment: Some treatments are cheaper in tablet form than in an injection, as you do not have the added costs of the equipment needed to give the injection.
- Ability of the animal to absorb the treatment: If, for example, the animal’s digestive system is compromised, then oral treatments may be avoided. Injectable is always less irritant to the gut, so this may be the solution.
Reactions to the route of administration

Possible reactions to the route of administration may be:

- gastrointestinal irritation and diarrhoea—this can be caused by oral anti-inflammatory treatments
- sloughing of the vein—this can be caused by some drugs that are given by the intravenous route if given incorrectly. Therefore, these drugs are given by the vet only. When they are to be administered by others, the vet will supply them in a different form.

Local and systemic effects of medication

When a medication is administered to an animal it contains specific drugs that are intended to treat the problem. The route of administration of a particular drug affects the parts of the body that can be reached by the medication.

There are two main effects of drugs:

- Local effect: This is when the drug affects only the small part of the body immediately surrounding the area where the drug was administered, eg local anaesthetic, creams applied directly to the skin.
- Systemic effect: This is when the drug affects the body as a whole and includes oral, parenteral and rectal routes.

Ways of giving medication

There are several different ways that we can administer specific or combination drugs to animals. Sometimes the way a medication is prepared and administered depends on the drugs 'target' within the animal's body. For example:

- oral
- parenteral
- topical
- rectal
- intra-uterine
- intramammary.
Forms of medications and treatments

Some medications are available in only one form, for example some are only available in tablet form. Some medications are available in a variety of forms for example injectable, oral liquids, granules or tablets. The drug combination stays the same, but the dose rate strength usually varies.

The types of medication and treatments you may be assisting with include:

- injectable
- tablets and capsules
- oral liquids
- pastes and gels
- topical preparations
- dressings
- powders and granules
- rinses and sprays
- preparations that are added to drinking water—eg worming preparations for birds
- preparations that are added to food.

Oral administration

Administering an oral treatment involves the administration of medications via the animal’s mouth. ‘By mouth’ is often expressed as PO or Per OS on an animal’s treatment sheet at a veterinary hospital.

The treatment is meant to be swallowed and generally ends up in the animal’s stomach. From here, the medication may be absorbed, enter the bloodstream to act systemically or act locally in the gastrointestinal tract.

Advantages

Advantages of oral administration include:

- it is usually least painful for the animal
- if done correctly, it does not cause much, if any, stress to the animal
- it is usually easily administered by the animal carer or owner
- the skin is not penetrated, therefore there is less risk of introducing infection.
Disadvantages

Disadvantages of oral administration include:

- choking and aspiration pneumonia—aspiration of medication (caused especially by liquids)
- variable rate of absorption from the animal’s gut—depending on individual patient, health of the animal, contents of gut. For example, if the animal has no food in its gut then absorption may be poor
- vomiting, irritation of gut by the medication—eg aspirin
- patient intolerance of the administration
- difficulty of ensuring correct dosage where, for example, the animal struggles and spits some out.

Features of oral medication

Examples of different forms of medications that can be administered orally include:

- tablets
- compressed drug in a carrier, such as chalk or sugar.

Tablets

Tablets are the most common form of medication. They are often coated in order to:

- protect the drug inside from moisture
- disguise unpleasant tastes
- protect from gastric juices, to slow down the breakdown of the drug for a slower release
- avoid irritation
- give the tablet a recognisable colour.

Tablets are usually scored into halves or quarters so that is easier to break into smaller parts for more accurate dosing.

Capsules

Capsules are usually bullet-shaped and are a gelatin container with powder, granules or liquid inside. The gelatin dissolves in stomach. They are easier to swallow (smooth) than tablets and do not need a 'carrier'.
Granules and powders

Granules and powders are solid preparations that come in a form designed to be dissolved in water or mixed with feed.

Liquid preparations

Liquid preparations include:
- syrups
  - drugs contained in a concentrated sugar solution
  - good for young animals/small doses
- solutions
  - drug in liquid form or dissolved in water
- suspensions
  - insoluble particles float in liquid
  - need to be mixed up each time
- emulsion
  - two immiscible liquids—liquids that do not mix—in together, for example a water based liquid and an oil based.

Liquid preparations can be administered:
- directly into the mouth
- by crop needle (used in birds)
- by a stomach tube.

The photo below shows liquid preparation being given directly into the mouth of a bird via a syringe. Care must be taken to avoid aspiration of fluids.

Stomach tubes are used for:
• drugs which burn the mouth
• very young animals, to reduce the risk of aspiration
• large volumes of fluid.

_Pastes and gels_

Pastes and gels are a semi-solid form of preparation, usually in a water soluble base. Pastes and gels:
• can be administered via syringe
• are easy for the owner to use
• are suitable for use with rodents—eg rabbits, guinea pigs
• are suitable for horse or cat worming pastes.

_Administration of medicines by injection_

The administration of medicines by injection—known as, parenteral route—depends on the type of drug injected, the condition and temperament of the patient, the volume of the drug and the speed of action.

The routes used for parenteral drugs are:
• intradermal
• subcutaneous
• intramuscular
• intravenous.

_Intradermal_

Intradermal (i/d) means into the skin layers.
• It needs a very fine needle.
• It causes a blister like appearance—called a bleb—if performed correctly as in, for example, tuberculin testing or allergy testing.

_Subcutaneous_

Subcutaneous (s/c) means under the skin, so that it is deposited between the skin layers and the superficial muscles.
• It is the most common site for many preparations, eg vaccines.
• The loose skin over the shoulder blade area is a good injection site.
• It is less painful than intramuscular injections.
• It can only be done using non-irritant drugs.
• It has a slower absorption rate. The absorption is even slower if the animal is dehydrated.
• It is suitable for smaller volumes in the one site.

The illustration below shows the area where the drug from a subcutaneous injection is meant to be deposited.

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**Intramuscular**

Intramuscular (i/m) means injecting deep into the body of a muscle. It is most commonly used for injection of parenteral antibiotics, for example penicillin.

• Intramuscular method is less likely to cause a tissue reaction.
• Insert the needle at right angles to the skin. In smaller animals, when using shorter needles the injection may be given more parallel to the skin.
• Larger volumes may be injected in the one site than with other routes.
• It has a faster absorption than s/c.
• Extreme care should be taken when administering intramuscular injections to avoid depositing them into a blood vessel.

The illustration below shows the area where the drugs are meant to be deposited when giving an intramuscular injection.
The illustration below shows the points where the needle within the muscle can be relocated.

With an intramuscular injection, before injecting the syringe contents, the syringe must be drawn back to make sure that the needle is not in a blood vessel. When being pulled back and blood enters the syringe, this means that the needle is in a blood vessel. In this case the needle should be redirected under the skin until when drawing back on the syringe, no more blood enters it. This can be done without removing the needle from the muscle, by pulling it part of the way out and then redirecting it back into the muscle.
**Intravenous**

Intravenous (i/v) means into the vein directly.

- The drug starts to act immediately because it does not need to be absorbed from a tissue into the blood.
- It gives high circulating blood levels very quickly—eg crystalline penicillin, antivenene.
- Intravenous injection can give irritant solutions into the vein which cannot be given by i/m or s/c.
- Irritant drugs should be given via an intravenous catheter.

The illustration below shows the area where the drugs are meant to be deposited when giving an intravenous injection.

[Image of intravenous injection site]

Intravenous injections should only be performed by veterinarians or veterinary nurses or animal carers under the supervision of a veterinarian. This is because:

- They are meant to be deposited into a vein which means that it could easily be deposited into an artery. This may have adverse effects on the animal.
- If an irritant solution does escape the vein and enters the perivascular tissues, it can cause necrosis (death) of the tissues and the area may 'slough'. This may result in the death of the animal.

**Intraperitoneal**

Intraperitoneal (i/p) means into the peritoneal cavity. This form of injection is almost painless.
• Intraperitoneal injections usually given through the abdominal muscles, just to one side of the muscle nearest the umbilical area.

• It is commonly used with rodents and birds and for the euthanasia of young difficult patients.

**Intracardiac**

Intracardiac (i/c) means an injection through the chest wall into the heart.

• This is used in emergencies—eg during cardiac resuscitation (adrenaline)

• Intracardiac injection is used for euthanasia, by depositing the drug used for euthanasia directly into the heart.

**Intrapleural**

Intrapleural means injection into the pleural space in the thoracic cavity, through the chest wall. It is not commonly used.

**Intra-articular**

Intra-articular (i/a) is an injection into the joint space, through the skin.

• It needs full surgical preparation where the drug is drawn up in a sterile manner—to avoid introducing any infections. New unused bottle and gloves are used.

• It is most commonly used in equine procedures.

**Epidural**

Epidural is an injection into the dural space surrounding the spinal cord, usually in the lumbar site.

• A full sterile surgical preparation is needed.

• The animal needs to be positioned on its sternum, with back legs drawn forwards.

• It is usually used before an orthopaedic procedure on the spine or hindquarters for pain relief, eg morphine, local anaesthetic for a dog.

• It is also used for obstetrical procedures in large animals to stop straining during parturition and to give pain relief.

**Subconjunctival**

Subconjunctival is an injection into the conjunctiva of the eye and is used to treat specific ocular conditions.

• A fine needle is used.
• It needs very good restraint.

**Restraint for jugular blood samples**

If a dog or cat requires a jugular injection for blood samples, the animal should be restrained with the head gently held back to allow easy access to the neck, as can be seen in the photo below.

The animal can be laid on its side with the head held up for easy access to the jugular. Alternatively, it can be held on its back with the head and neck extended downwards.

**Parenteral drugs**

Parenteral drugs are administered through intravenous or intramuscular injection—eg crystalline solutions, solutions and suspensions.

**Crystalline solutions**

Crystalline solutions are a dry, water soluble powder—eg crystalline penicillin. It:

- is prepared for injection by being mixed with water
- must be used immediately—it cannot be stored for a long period
- is often administered intravenously.

**Solutions**

Solutions remain stable and are not necessarily water-based—eg some antibiotics, some analgesics (pain killers) and sedatives.

- They do not separate out on storage and remain their normal one colour.
- They can usually be administered intravenously or intramuscularly.
Suspensions

Suspensions are a liquid with 'floating' particles which settle on standing, eg injectable procaine penicillin. They:

- must be shaken before use to remix the contents
- are not for intravenous or intraperitoneal administration
- are for intramuscular or subcutaneous administration only.

Topical medication

Topical medications are those that are administered to the external surfaces of the body—for example, skin, eyes or ears. It also includes application to exposed mucous membranes, for example the gums, nasal mucosa, prepuce and penis, vulva and vagina.

The drugs are designed to:

- work only on the area to which it is applied—eg ringworm ointment or
- be absorbed systemically into the body—eg spot on flea treatments for dogs.

Examples of topical treatments

Examples of topical treatments include:

- Creams—a semi-solid water soluble emulsion which penetrates the skin surface.
  - many come in tubes or plastic squeeze bottles
  - generally wash off with water
- Ointments—are semi-solid, oil based preparations, usually with a base of wax or jelly.
  - not water soluble
  - many come in tubes, jars, etc
  - are designed to treat skin problems, therefore they do not usually get absorbed by the skin
- Suspensions are liquid preparations which are particles suspended in the liquid.
  - will separate out on standing, so need to be shaken, before use
  - rinses/washes solutions
  - liquids which are often diluted and poured on an animal
- may have a residual action when dry
- aerosols are liquids that are released under pressure. They are sprayed on as particles of liquid suspended in air
- Powders are finely particulate solid preparations which are sprinkled on. They:
  - can be irritant to open wounds
  - may help to dry weeping wounds.

Ocular medications

Ocular means medication to go directly into the animal’s eye. Ocular medications may be in the form of drops or ointment. In some animals they can be difficult to administer, especially if the eye is sore. Here is an example of a lavage line that has been inserted into a horse's eye to allow easy, pain and stress free treatment.

![Image of a horse's eye with a lavage line inserted](image_url)

Large and difficult animals like horses may need to have a sub-palpebral lavage line inserted if they need frequent medication. This is a fine irrigation tube that has been stitched into the eye—generally inserted under a short term anaesthetic—and then attached to the horses halter. The end has a giving port which allows you to insert a needle and deposit the medication through a syringe and it runs into the eye. This is painless and stress free for the horse.

Aural medications

Aural refers to the ear of the animal. Aural medications are usually in the form of liquid drops, ointment or suspension. The ear must be gently cleaned of wax and discharge before administration of medication. The photo below shows the types of equipment needed to cleanse the ear of an animal—cleansing solution, cotton buds and swabs.
Note: Care must be taken when cleaning the ears, especially when using cotton buds. This photo shows a dog’s ear that has been cleansed; note the clean pink colour.

Rectal route of drug administration

The rectal route is via the anus into the rectum. Drugs administered this way can be used with vomiting patients for systemic drug absorption. The drugs may have a local effect only. Important: It is possible to rupture the rectum which leads to death for the horse. It should only ever be performed by a veterinarian, with much care needed to do the procedure.

Examples of rectal treatments include:

- Enemas—commercial solutions in a syringe, tube or pack designed to stimulate defecation
  - soapy water often used with a funnel and some soft lubricated tubing
  - other substances like mineral oils may be given this way to lubricate, for example paraffin
- Suppositories—are bullet shaped, semi solid and glycerine based.
  - melts at body temperature
  - can contain antibiotics, laxatives, soothing agents
  - may be absorbed systemically
• Fluid replacement—are occasionally used in horses for electrolyte and water replacement.

Intra-uterine route of drug administration

The intra-uterine route is usually used for a local effect in the uterus on the uterine endometrium, which is the lining of the uterus.

Examples of intra-uterine treatments include:

• Solutions: Are administered via the vagina and cervix using a pipette (inflexible tube) or a foley catheter (has a balloon to stop backflow of fluids while they are being administered).
  - This is done to the female during oestrus (heat period) when the cervix is relaxed.
  - Some of the fluids will remain in the uterus, while others will be siphoned out again
  - Examples of treatments used to treat the uterus this way include antibiotic mixtures, saline or saline based solutions or plasma.

• Pessaries: Are large tablets which usually have an antibiotic incorporated in them.
  - They may also have a foaming agent.
  - They are administered by hand when the cervix is open and then deposited into the uterus.
  - These are often used on large animals post parturition (after giving birth).

• Intramammary preparations: Are solutions or suspensions that go to the mammary gland via the teat canal.
  - These come in syringes for easy administration, often one syringe per teat.
  - Usually, these are used to treat larger animals for conditions such as mastitis.
  - Intramammary preparations are usually an antibiotic, may contain corticosteroids too.
  - Those used for cattle often contain a dye (blue) so that the milk will not be used for human consumption.
  - Different types: for lactating animals (feeding young) and for when the animal is dried off (ceased lactation).
Treating small animals: Rats, mice, rabbits and guinea pigs

Owners and carers of rats, mice, rabbits and guinea pigs generally administer their treatments. The veterinarian administers certain treatments only when required, for example those required for surgical procedures, the more invasive medical procedures and, in some cases, routine vaccines.

Types of treatments

Types of treatments for rats, mice, rabbits and guinea pigs include:

- Oral treatments: Includes tablets, capsules, gels and liquids. We can also include here those treatments that can be or should be added to the food.

- Topical treatments: Includes spot on or back liner treatments like external parasite preparation, powders, creams, ointments etc. Care should be taken when applying topical treatments as these animals will consume the treatment whilst grooming. If they are to be used they should be placed high up on the back of the neck, or an Elizabethan collar used.

- Ocular treatments: Includes liquid drops, ointments/gels, powders etc.

- Aural treatments: Includes liquid drops, ointments, suspensions and solutions.

- Injectable treatments: Mainly subcutaneous, intramuscular or intravenous. Subcutaneous and intramuscular may be able to be administered by very experienced people, but intravenous is usually veterinary only, or under veterinary supervision.
Routine health procedures for rabbits and guinea pigs

The following are examples of routine health procedures for rabbits and guinea pigs.

- **Trimming nails:** It is important to trim toenails regularly to prevent them from catching and causing injury to the animal.
  - Rabbits and guinea pigs in captivity don’t have the opportunity to wear their nails down.
  - These need to be checked regularly and trimmed if necessary.
  - This will help prevent injury to animals and handlers.

- **Teeth:** These are continually growing. If they are not worn evenly they may overgrow and misalign. This will make eating difficult and the animal may starve to death. Teeth may need to be trimmed and more hard feed added to the diet.

- **Coat condition:** Needs to be checked for parasites and disease. Long haired animals need grooming to prevent matting and can be prone to fly strike in the warmer months so vigilance is necessary.
• Vaccinations: All rabbits over the age of ten weeks should be vaccinated against Calici virus followed by an annual booster.

Handling and treating rabbits

To give treatment to rabbits, they require handling and restraint.

Handling rabbits

Always keep in mind that rabbits have a very lightweight skeleton. It makes up around eight percent of the body weight, in comparison to cats, which is about thirteen percent of total body weight. Incorrect handling can easily result in fractures to the spine and hind legs.

It is always best to spend some time observing a rabbit in its cage or pen before attempting to handle it. Note its attitude and whether it is breathing effortlessly, as even minimal restraint can cause respiratory arrest in a rabbit with some sort of respiratory stress. If the rabbit is aggressive, additional help and materials may be needed for treatment.

Steps for lifting a rabbit

Never attempt to pick up a rabbit by the ears as this is very painful and the animal will struggle violently, inflicting injury to you and itself. Instead, you should:

1. Grasp the fur over the shoulders.
2. Raise the animal a small distance.
3. Place your other hand under the hind legs and hold onto them firmly.
4. Bring the rabbit close to your body, allowing the animal to hide its head in the crook of your arm. Do not let go of the legs or you may be seriously scratched.

When holding or restraining a rabbit for examination and treatment, it is important to make it feel secure and to prevent it from struggling or injuring itself.
Probably the best way to restrain a rabbit is to wrap it in a towel, leaving the head exposed. Another way is to have an assistant restrain the rabbit, tucking the head under their arm, leaving the mouth exposed.

**Administering oral treatment to rabbits**

Start by restraining the rabbit as described above and then:

1. Gently introduce the syringe containing the fluid type treatment into the rabbit’s mouth behind the incisor teeth.
2. Direct the end of the syringe back into the back part of the rabbit’s mouth.
3. The head should be level, not tilted back as this may cause aspiration.
4. Administer the treatment slowly, only about 3 mls at a time, allowing the rabbit to swallow each dose before introducing any more.

**Handling and treating guinea pigs**

Guinea pigs require specific handling and treating techniques.
Steps for lifting a guinea pig

Guinea pigs have very fine bones and a large body mass, this makes it easy to break or dislocate their limbs if they aren't handled carefully. To lift a guinea pig:

1. Place your hand around the shoulders of the guinea pig.
2. Lift the front of the guinea pig off the ground.
3. Place your other hand under the guinea pig's bottom and support its weight.

Restraining guinea pigs

To administer treatments to guinea pigs, make sure you hold them firmly, preferably with another person holding whilst you administer treatment. It needs to be done similarly to the rabbit, being gentle but quick as we do not want to stress them. Generally, only small volumes of liquids (under 5 mls) can be given orally to guinea pigs.

To restrain a guinea pig, use both hands. Place one hand around the shoulders and the other must support the hindquarters. When handling pregnant females be careful not to allow them to struggle. These little animals rarely bite, but will squeal quite a lot.

Handling and treating rats and mice

Stress to the animal and the possibility of injury to both the handler and the animal can be avoided or reduced with good handling and restraining techniques. Some tips are:

- It is important to be gentle but firm and confident in your actions.
- Mice are particularly quick to move and should be in an enclosed area so that if they escape, they can be recaptured easily.
- Place the cage on the floor before handling to avoid injury to animals that may jump from a bench top.
Steps for handling a mouse

1. Before you begin, make sure you have the following items:
   a. a rat or mouse bag
   b. a small towel
   c. a rat and mouse restrainer.

2. Using the forefingers, grasp the base of the tail firmly.

3. Lift the mouse and place onto a solid surface.

4. Mice can turn around and climb up their own tail and bite the handler. So it is best to grasp the loose skin at the back of the neck and shoulders.

   A small handtowel may be thrown over them and they may be picked up in this if they are very timid.

5. Mice may be held in the corner of a small clear plastic bag with the corner cut out to allow them to breathe. This will allow a good view of them and give the opportunity to give injections through the bag, without causing undue stress to the animal.

   Mice accustomed to being handled can be picked up in the palm of the hand as can be seen in this photo.

Steps for handling a rat

Pet rats are usually sociable and don't resent handling. They can be picked up by grasping them around the neck and shoulders.

1. Place your forefinger under the jaw and your thumb under the forearm on the other side.

2. Hold the tail and hind limbs with the opposite hand to give additional support.

   Active rats may need to be caught initially by grasping the base of the tail to hold them still while you pick them up.
A small handtowel may be thrown over them and they may be picked up in this if they are very timid.

3. Rats may be held in the corner of a clear plastic bag with the corner cut out to allow them to breathe. This will allow a good view of them and give the opportunity to give injections through the bag, without causing undue stress to the animal.

**Handling tips**

The skin around the tail area is very fine and can be easily abraded—this could result in amputation of the tail. However, gentle handling that also supports the animal will help to avoid injury to the tail.

When picking mice up, it is advised to grasp the tail gently but firmly to lift the hind limbs off the ground and allow the forelimbs to grasp a solid object.

**Administering oral treatment to mice**

Start by restraining them using the above steps. Restrain them around the head and neck area so that you can have access to their mouth and then:

1. Gently introduce the syringe containing the fluid type treatment into the mouth behind the incisor teeth.

2. Direct the end of the syringe back into the back part of the mouth.

3. The head should be level, not tilted back as this may cause aspiration.
4. Administer the treatment slowly, less than a millilitre at a time, allowing them to swallow each dose before introducing any more.

**Weighing small animals**

Regular weighing of the animals will assist you to assess their health status. Noticeable weight loss or gain is indicative of a range of health problems and a veterinary check would be recommended.

**Steps for weighing an individual animal accurately**

You will need a container such as a small cardboard box (suitable for mice or rats) or a small bucket (suitable for a rabbit) and a set of sensitive digital scales.

Then:
1. Place the container onto the scales.
2. Note the weight of the container.
3. Place the animal in the container.
4. Note the total weight of the animal and the box.
5. Subtract the original weight of the box from the total. This should give you the correct weight of the individual animal.
Quiet, well handled animals may be placed directly onto the scales. Care must be taken to ensure that they do not fall off or escape.
Treating birds

Birds that require medication, need this as:

- a preventative health measure
- treatment for disease.

Preventative health measures

Probiotics, for example, are used as a preventative health measure. These help to re-establish normal gut flora in birds that have undergone antibiotic treatment—while antibiotics kill bacteria that cause disease, they also kill the useful bacteria in the gut. Other treatments used as preventative health measures for birds include:

- anthelmintics (wormers)
- coccidiostats in poultry flocks
- vaccines in aviary, farmed and companion birds
- antiprotozoal drugs in racing pigeon lofts, squab farms or budgie aviaries where trichomoniasis is a problem.

Treatment for disease

Treatments for disease are usually given when the preventative methods have failed, have not been carried out, or there has been a breakdown in management and husbandry.

Drugs should not be used as the answer to disease problems, but as an adjunct to gaining control of a problem until the husbandry procedures that led to the problem are addressed and rectified.

In the majority of cases in captive bird husbandry, it is the management problems that have led to the disease problem(s) and the resultant need for medication. If the management problems are not addressed then very often medication will only have a temporary effect, or will not work at all.
Ways of medicating birds

There are a number of methods that can be used to medicate birds:

• Crop tube/needle:
  - allows accurate dosing but is very stressful as it requires capture and restraint
  - needs skill to do
  - good for gastro-intestinal tract disease but many drugs for systemic illness are unreliably absorbed from the gut

• In food
  - used for prophylactic medications—eg worming
  - need to assess how much a bird eats per day to work out dosing

• In drinking water:
  - not recommended for systemic illness as antibiotics are poorly absorbed from the gut
  - intake tends to be erratic, especially if drug tastes bad
  - need to remove greens as these contain water
  - if it rains, birds will drink rain off the cage wire
  - usually used for medicating large groups of birds especially for worming

• Oral dosing:
  - works well for liquid preparations but pills and capsules are virtually impossible to force feed a bird. Liquids are best given by crop needle which reduces the likelihood of the bird regurgitating the medication
  - using a syringe to deliver liquid medication is an easy method but the dosing can be a little inaccurate as the birds often splutter and sneeze

• Injection—parenterally:
  - only reliable way to medicate and is usually by intramuscular injection into the pectoral or quadriceps muscles
  - intravenous drugs can be administered via the brachial (wing) or jugular veins but care is needed as these veins are thin walled and fragile and susceptible to developing large haematomas
  - is usually a procedure performed by veterinarians

• Nebulisation:
- this means dissolving drugs in water and turning it into a vapour, which is then inhaled by the birds
- is a method of getting drugs directly into the air sacs and lungs
- you need special equipment and drugs to do this, therefore it tends to be a vet only procedure

• Topically:
  - eye and ear drops can be used to treat some conditions in the nasal passages and eyes.

Choosing a treatment method

When choosing which method to use, the following should be taken into consideration:

• Condition of the bird:
  - the more seriously ill the bird, the more likely it will need individual treatment, but this often requires handling and restraint which can kill the bird from stress

• Disease involved:
  - gastrointestinal worms respond best to oral drugs; problems with the airways respond best to nebulisation
  - characteristics of the drug to be administered
  - if it tastes bad the birds will probably not eat or drink it. Some drugs do not mix with water; if it is expensive you will not want to oversupply the drug, eg in the water

• Number of birds to be treated:
  - if you have a whole aviary of 25 birds to be treated, it is unrealistic to expect to treat them individually—except where the birds are extremely valuable and this is the best way to treat them
  - behavioural characteristics and accessibility of the birds
  - some wild birds will not cope with the stress of handling and some birds are too dangerous to handle—eg cassowaries and emus

• Owner compliance:
  - some owners are inexperienced or unsure of how to effectively medicate birds.
Consider pros and cons of the treatment method

When choosing a treatment method, consider also the advantages and disadvantages—as can be seen in the summary table below.

<table>
<thead>
<tr>
<th>Method: Adding treatment to the drinking water</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Advantages</td>
<td>Disadvantages</td>
</tr>
<tr>
<td>• easy to do</td>
<td>• not recommended for systemic illness as many antibiotics are poorly absorbed from the gut</td>
</tr>
<tr>
<td>• birds will self-medicate</td>
<td>• intake tends to be erratic, especially if drug tastes bad</td>
</tr>
<tr>
<td>• good for medicating large groups of birds, especially for worming</td>
<td>• the dosing is inaccurate and if the weather is hot and the birds drink a lot of water the intake of some drugs can reach toxic levels</td>
</tr>
<tr>
<td></td>
<td>• sick birds may not drink enough</td>
</tr>
<tr>
<td></td>
<td>• need to remove greens and fruits as these contain water and the birds will survive on these without drinking for a number of days</td>
</tr>
<tr>
<td></td>
<td>• if it rains, birds will drink rain off the cage wire</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Method: Adding treatment to the food</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Advantages</td>
<td>Disadvantages</td>
</tr>
<tr>
<td>• easy to administer</td>
<td>• bad tasting drugs will cause a reduction in food intake</td>
</tr>
<tr>
<td>• food consumption is usually more consistent than water consumption</td>
<td>• some drugs need special types of food to mix with which may need a change in diet for the bird—eg putting a powder based medication on dry seed does not tend to work well</td>
</tr>
<tr>
<td>• birds will self-medicate several times a day</td>
<td>• no good for anorexic birds</td>
</tr>
<tr>
<td></td>
<td>• not accurate, especially with more than one bird in aviary</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Method: Oral dosing</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Advantages</td>
<td>Disadvantages</td>
</tr>
<tr>
<td>• allows accurate dosing</td>
<td>• very stressful as it requires capture and restraint</td>
</tr>
<tr>
<td>• good for gastro-intestinal tract disease and worms</td>
<td>• needs skill to do</td>
</tr>
<tr>
<td></td>
<td>• many drugs for systemic illness are unreliably absorbed from the gut</td>
</tr>
</tbody>
</table>
**Method: Injection (parenterally)**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• may be easier than crop needling for many owners</td>
<td>• usually a veterinarian only procedure</td>
</tr>
<tr>
<td>• reliable method—an exact dose can be given</td>
<td>• some injections are painful</td>
</tr>
<tr>
<td>• absorption is rapid which is good for acute illness</td>
<td>• thin birds have no muscle mass to inject into</td>
</tr>
<tr>
<td></td>
<td>• the dose volume must be kept to an absolute minimum to avoid pain</td>
</tr>
<tr>
<td></td>
<td>• injections in ostrich's may damage the hide (a valuable leather).</td>
</tr>
<tr>
<td></td>
<td>• bird veins are fragile and liable to leak after injection. Some diseases, particularly liver disease, will cause large hematomas to form under the skin</td>
</tr>
</tbody>
</table>

**Method: Nebulising**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• a useful additional way of treating birds with respiratory problems</td>
<td>• needs special paediatric equipment and drugs to do this therefore tends to be a vet only procedure</td>
</tr>
<tr>
<td>• not very stressful as there is little handling of the birds</td>
<td>• time consuming and expensive</td>
</tr>
</tbody>
</table>

**Method: Topically**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• useful to treat some conditions in the nasal passages and eyes</td>
<td>• creams and ointments can cause clogging of the feathers, which can lead to loss of insulation and self-mutilation of the area</td>
</tr>
</tbody>
</table>

**Obtaining professional assistance**

It is imperative to have the cause of the problem correctly identified and the correct drug, dose and route of medication worked out before starting a course of treatment or preventative medication regime.

**Note:** Be cautious of advice from many unqualified people telling you what should be done and how to save money. Their advice about the diagnosis, what drugs to use and how much to take are usually incorrect! Obtain professional assistance—such as a veterinarian who specialises in avian
medicine, or an aviculturalist who is highly experienced in raising and breeding captive birds.

With the increasing number of people interested in bird keeping and willing to spend money on their animals, the number of veterinarians with avian knowledge has increased substantially. In most major clinics you will now find vets with a keen interest in birds.

When should you seek professional assistance?

- when the birds are not responding to treatment
- when the condition is spreading rapidly through the aviaries and is not responding to treatment
- conditions that have to be treated with medications that are only legally available from veterinarians
- injuries and fractures that require more help than basic first aid, especially with valuable birds.

Most of the drugs used to treat illness are prescription only drugs and can only be legally obtained from a veterinarian. It is also illegal for non-veterinarians to diagnose and treat disease in a professional context.
Treating reptiles and amphibians

It is very important to spend time observing reptiles and amphibians, then examining them before carrying out any treatment. Treatment of reptiles should be carried out by skilled professionals, or for those learning under their supervision.

Initial details to find out

Before examining the animal, find out the following:

- What is the origin of the animal?
- Was it caught in the wild or bred in captivity?
- How long has the animal been owned?

Disease problems can be quite distinct between those animals recently collected from the wild and those animals born and kept long-term in captivity.

Examining reptiles and amphibians

When examining reptiles and amphibians, you should look at the animal’s:

- Movement and behaviour:
  - Observe the animal unrestrained, preferably in its normal environment—eg on the ground, in trees, swimming—to see if it moves normally.
  - Observe the animal’s current attitude and behaviour.
  - Snakes hate being on a slippery surface. If used to being handled, the snake can be supported at two points on its body and allowed to continually move through the hands while being examined.

- Faeces:
  - In relation to feeding, how often does it normally defecate?
  - What is the colour and consistency of the faeces?
- Has a faecal specimen previously been examined for evidence of parasitism? Direct smears, sediments, and flotation specimens are routinely used for examining faecal specimens.

- **Food and water:**
  - What is the quantity offered and how much is consumed? What is the source of the food?
  - How is the food stored? Reptiles include frugivorous, insectivores, omnivores, herbivores, and carnivores. Even though the carnivorous reptiles are usually the easiest to maintain, they commonly suffer from diet related diseases because of being fed a meat-only diet. Snakes being fed live rodents can suffer from traumatic bite wounds from the prey turning on the predator.
  - How is water offered and, if there is a water bowl, how large is it and how often is it changed and disinfected? Some reptiles take in water as dew droplets on foliage, whereas some obtain much of their water from their food. Still, many reptiles actively drink water and will consume it directly from a water bowl. The water bowl should not be so excessively high as to challenge the reptile to get a drink. Water bowls should be cleaned and replenished daily.

### Examine the animal’s immediate environment

Look for any problems in the animal’s immediate environment—such as cage design, construction materials, substrate, water—as these factors can cause disease.

Check for example:

- **Wooden cages:** Often the wood is coated with water-impermeable materials, such as polyurethane which give off toxic fumes and should be aired for a few days before use.
- **Heat sources:** Such as bulbs, should not be placed in the cage itself.
If there is a chance of direct contact, they will often result in thermal skin burns.

- Substrates, such as sand, gravel, wood shavings, newspaper, etc. If too fine it can stick to food and be ingested. Bedding that remains wet will cause skin problems, e.g., kitty litter. Wood shavings can contain poisonous resins and should be avoided. Disinfectants such as Lysol and phenolic compounds, are potentially toxic. Diluted (2 ppm) sodium hypochlorite is an ideal disinfectant.

- Check the water: Aquatic animals swim in the water in which they defecate so check this for hygiene. Dirty water is a sure sign that there will be health problems!

- Humidity: An ideal humidity range for many species is 50 to 60 per cent. However, desert species—many Australian species—need to be maintained under much drier conditions (10 per cent) or they will develop skin problems, and tropical rain fairest species may have to be misted daily.

- With photoperiod, a natural light to dark cycle is ideal. The light should also contain UV rays and many reptiles exist indoors with no direct sunlight. These will develop bone problems.

- Check for the possibility of exposure to potential toxic agents like pesticides and herbicides—e.g., fly spray used inside.

**Observe the other animals in the collection**

If there are cage mates or other animals in the collection and household, observe whether there have been any previous disease problems with other animals in the collection.

Many infectious disease problems in captive animals originate from the introduction of a carrier. Ideally, except for breeding time, many species should be housed individually.

There are always exceptions, such as those species that form colonies in the wild and are generally gregarious. Such species adapt better to captivity if maintained in a large group. It is up to the owner to know the full range of social behaviour for the species in their care so they can be housed correctly.

**Handling reptiles and amphibians**

To treat reptiles and amphibians often requires some form of handling. There are other times when handling may be required. It is a good idea to spend time with a very experienced person handling and treating these animals and learn how to do it ‘hands on’.
As well as handling a reptile and/or an amphibian for examining or treatment purposes, you may need to handle it to:

- capture a specimen—eg a wild specimen for research purposes
- provide prophylactic treatments—eg internal and external parasites
- identify it—eg counting scales on snakes
- collect venom from snakes for antivenene production
- move it from a point of danger to a place of safety—eg moving a tortoise or lizard off the road
- move it from one enclosure to another.

During the course of your studies, you may also need to handle the animals for educational purposes.

**Basic rules for handling**

All reptiles should only be handled as much as is necessary. No matter how tame and socialised they are, it must be remembered that reptiles are still wild animals that will react instinctively.

Reptiles get to know their handlers and they recognise them by sight, scent and the sound of the voice and may even approach that person when it looks like they are going to be picked up. They also remember people who made them uncomfortable or insecure, and may respond to those individuals by getting a bit aggressive and/or drawing away from them.

The more confident you are in picking up and handling a reptile, the more comfortable and relaxed they will be.

Here are some basic guidelines:

- Stroke reptiles in the direction of their scales from head to tail. This is to avoid injury to the scales and underlying skin as the scales may be lifted if stroked the wrong way.
• You must support their body weight so that they feel comfortable and secure.

• Decide where to put the tail so that it is comfortable for both of you.

• For safety reasons, ask someone to help you—two or more people are needed to hold a large python or goanna.

• Familiarise yourself with using the various forms of capture and restraint equipment for the more dangerous and/or poisonous reptiles.

• Small specimens are delicate so coax them into a small container rather than handle them. Always have a firm, confident manner.

• With the more lively species, you can switch the heat source off and their activity will decrease as they cool down.

• For aquatic species, catch them in a net and moisten your hands or wear gloves before handling to prevent damaging their sensitive skins.

Avoid excessive handling

You will find that it is a rare reptile or amphibian that actually enjoys being handled. They are not really 'pets' in the same sense as a dog or cat—which enjoy close physical contact with their owners—and do not enjoy being stroked or patted. In fact, excessive handling of amphibians can actually damage their fragile skins and many chemicals on our hands can be harmful.

However, reptiles kept in captivity do need some competent contact with their handlers to allow them to become used to handling. This will help prevent the panic responses where they may injure themselves in their attempts to escape, or their handlers if they bite.

Quarantine policy

The average reptile/amphibian owner will often introduce new animals immediately into a well-established collection. This is a poor quarantine policy and a recipe for eventual disaster!

Ideally, newly acquired animals should be kept in a separate building or at the least in a separate room that is away from the main collection, for a period of at least 60 days. During this period of time, the animals should be observed for behavioural or anatomic abnormalities. Faeces should be checked for evidence of parasitism, and cultures should be taken of the faeces and mouth to check for bacteria.
Quarantine does not completely eliminate the spread of disease from new animals to long-term captives, but it will reduce the chance of introducing a devastating disease into a well-established collection.
Treating horses

There are many types of treatments that do not require a veterinarian to administer. These types of medications can be administered by horse owners and carers, but the person administering them does need to be very experienced with horses. The reason being is that horses can easily hurt you, which can occur accidentally or deliberately.

Whenever administering treatments to a horse, make sure that you stand out of kicking or striking range and having an assistant is always a good idea.

Types of treatments

The types of treatments for horses include:

- oral treatments—such as paste, gels and liquids and also, those treatments that can be or should be added to the food
- topical treatments—including treatments like external parasite preparation, powders, creams, ointments, sprays, suspensions
- ocular treatments—including liquid drops, ointments/gels, powders.

Other types of treatments are generally difficult to administer, or carry risks to the horse when given. Examples of these are:

- Aural (ear) treatments—are not common with horses and are very difficult to do. Fortunately ears problems do not occur with horses like they do with dogs and cats. If they do require treatment it would have to be performed by a veterinarian and most probably with the horse sedated or anaesthetised.

- Injectable treatments—eg subcutaneous, intramuscular, intravenous. These should only be administered by experienced people, especially intravenous treatments which should be done by veterinarians or under veterinary supervision in most cases.

- Intra-uterine treatments—are specific treatments targeting the uterus of the mare. They are mainly performed by veterinarians or very experienced horse people and carry many risks. For example, risks to the mare, she may easily have her reproductive tract damage if the procedure is not carried out carefully. Alternatively, there is a risk of injury or death to the operator if the mare is not restrained properly, either in a horse crush or by using leg restraints.
Nasogastric tubes (stomach tubes) carry many risks, aspiration pneumonia, so is better left to a veterinary professional.

Steps for oral administration

The following are steps for the oral administration of a paste, gel or small amount of liquid to horses.

Preparation

1. Bring the horse into an enclosed area. Make sure you have a quick and easy escape route in case things go wrong and you need to leave in a hurry.

2. Make sure you have the treatment drawn up into the syringe ready to go and have any other equipment that you need ready to go.

3. Make sure the horse is fitted with a good halter and lead and, when possible, have an assistant hold the horse for you. This way, you can concentrate on administering the treatment.
Giving the treatment

4. Always use a strong quality syringe to administer the treatment; horses have very strong jaws.

5. Check that the horse has an empty mouth as you do not want them spitting out their medication.

6. Standing on the left side of the horse, in front of the shoulder and facing the horse, place your free hand over the nose area of the horse.

7. If you are using a handler to hold the horse, they should be on the same side of the horse as you—this is much safer if the horse plays up. Horses move away from pain or fear, so the horse will move away from you and the handler. If you are both on the same side of the horse, then you greatly reduce your chances of being hurt.

8. Use the thumb of your hand over the horse's nose to open the corner of the mouth, then slide the syringe into the mouth through the bars (the gap in the side of the mouth where the bit sits) and up over the back of the tongue as far as you can go.

9. Once the horse has lifted its head, administer the treatment over the back of the tongue.

Finishing

10. Remove the syringe from the mouth.

11. Hold the horse head up until it swallows.

Note: Take care when administering oral liquids to horses; you do not want the liquids to end up in the airways. Always administer them in small amounts and not too quickly.

Make sure that the syringe does not make its way between the horse's teeth, as they will very quickly and easily crush it with their powerful jaw.
Administering oral paste should be done quickly, but gently.

Ocular treatments for horses

Ocular treatment is very effective for treating a horse’s eye, providing the horse is cooperative.

The following are steps for administering ocular medication.
1. Restrain the horse in a safe place and make sure it is in an area where it cannot hit its head should it throw its head about.
2. Make sure you have everything that you need ready to go.
3. Standing to the side of the horse, place your hand and fingers around the eye area.
4. Open and hold the eye open with the fingers, if the horse will allow you to!!!

5. Quickly treat the eye.

6. When applying substances to the eye, ensure that the tip of the applicator does not touch the eye.

7. With difficult patients, a small amount of ointment can be placed on the finger and applied to the conjunctiva (not with drops).

8. Allow the animal to blink to disperse the medication.

9. Horses may need to have a sub-palpebral lavage line inserted if they need frequent medication.

A palpebral lavage line makes treating the eye easy and pain/stress free.
Treat fish

Fish are quite difficult to treat so, for this reason, it is better to use preventative measures, such as good housekeeping, to limit the incidence of disease.

A decision needs to be made about whether the individual fish are to be treated or whether the entire environment, the aquarium itself, is to be treated.

Treat an individual fish

Where possible, the treatment should be limited to the individual fish for the following reasons:

- Many of the medications that are commonly employed will damage, or kill, members of some species. This means that it may be inevitable that members of non-target species may be lost or otherwise affected—rendered infertile, lifespan shortened—if the whole tank is treated.
- Some medications affect aquatic plants and may kill them.
- The use of many medications will affect the biological filter. Remember the concept of supporting both populations: the fish and the bacteria in the filter. This is one of the ways that the concept is important. If the bacteria within the biological filter are killed or significantly reduced in number then the filter will become less efficient and will lead to further compromise of the tank environment.

Treat the entire tank

Any infection or, more commonly, infestation that affects or involves the whole tank requires that the aquarium be treated as a whole.

White spot is a prime example of this. The parasite involved—Ichthyophthirius multifiliis—has as a free-living stage to its life cycle and it is this stage that is susceptible to treatment. This means that the whole of the aquarium must be subjected to treatment.
Remember: With fish, prevention is always better than cure.

Hygiene and husbandry procedures

There are a few simple hygiene and husbandry procedures that should be followed, regardless of the treatment methods to be employed.

- Any dead or seriously affected fish should be isolated or destroyed, especially any with discharging lesions.
- All organic debris should be removed from the aquarium floor.
- Hospital tanks should be used, if available, for individual fish.
- If antibiotics or any other potentially dangerous drugs have been used, activated charcoal should be employed in the filtration system to remove residues after the recommended time interval of exposure has elapsed (chemical filtration).

Types of treatment

When using medication, care must be taken that adverse reactions don’t occur. Some of the more common treatment regimes include the following products:

- methylene blue—can kill plants and will occasionally adversely affect biological filters
- malachite green—toxic for all tetras and can sterilise live-bearers
- copper and zinc—toxic for corydoras and some other catfish
- formalin—toxic to all fish.

Other forms of treatment include:

- A wide range of antibiotics, the main ones being:
  - oxytetracycline
  - doxycycline
  - metronidazole
  - neomycin
  - gentamycin
  - nitrofurazone
  - chloramphenicol
  - enrofloxacin
- Various drugs used in proprietary preparations, including the non-antibiotics listed above.
There are other drugs with dubious therapeutic value, including various 'secret ingredients' in some water conditioners. Nalidixic acid is an example of a drug that is used for specific conditions but where there is little data to support its use.

- Adding salt to the water is quite effective for treating some skin conditions. This may be done by salting the entire tank and then replenishing it with aged fresh water when the treatment time has elapsed or it may be done by netting individual fish and placing them in a salt water 'bath' for a set period of time.
- Increasing the temperature of the water for a short period. This can kill some parasites, but it may also kill some fish.
- Some filters are claimed to be able to filter out protozoan parasites, e.g. diatomaceous earth filters can supposedly filter down to one micrometre.

Ways of minimising danger from using antibiotics

Any time antibiotics are used in an aquarium it should be assumed that the biological filter will also be affected. This can create a dangerous situation and steps should be taken to minimise the possibility of this occurring.

- The biological filter can be disconnected and run on a separate tank whilst the treatment is administered to the affected tank. This means that a separate filter will have to be run on the affected tank to circulate water. It also means that the biological filter may remain a source of re-infection or re-infestation when it is reconnected to the affected tank. Having the capacity to provide a spare filter and tank obviously increases the expense of the procedure as a whole.
- The biological filter can be disconnected and just left stagnant. This will only work if the treatment is being applied for very short periods. If the filter is left stagnant for more than four hours then the bacterial population will start to alter its constitution and could present problems when reconnected to the original tank.
- Leave the biological filter attached and closely observe the water parameters in the period following treatment. It is unlikely that a single dose of antibiotic will totally destroy the filter, although it is possible.
- Leave the biological filter attached and make extensive use of probiotic formulations after treatment has ceased. Probiotics contain 'good' bacteria and are commonly used to seed newly set up tanks and filters.

Ways of giving medication

Medications can be delivered by:
• in feed medication
• parenteral injection
• in water medication.

In feed medication

In feed medication is a way of dispersing the antibiotic amongst flake or granular foods. Tiny amounts are fed often, making sure fish eat all that is offered. This is very inefficient, as many antibiotics have poor palatability and it is impossible to know what dose each fish is receiving; some fish may selectively avoid the antibiotic. It is also possible to soak foods in antibiotic solutions but the same disadvantages apply.

A dose can be injected into favoured food items, such as earthworms and prawns. This method is only practical with small numbers of individually recognisable, large fish.

Antibiotics can be incorporated into custom made feeds. This is only practicable in commercial fish farms.

In water medication

In water medication is the most common method of supplying antibiotics to domestic fish but it is also probably the method most fraught with problems, as has been noted above.

Parenteral injection

Parenteral injection is only practical for larger, valuable fish. The injections may be performed as:

• intramuscular—on either side of the dorsal fin or
• intraperitoneal—just cranial to the vent.

The stress of having to net and restrain the fish must be weighed up against the possible benefit of the injection.