Nursing Small Mammals
Michael Cannon BVSc, MACVSc, Grad Dip Ed

RAT FACT SHEET

Life span 2.5-3.5 years
Weight Male 265-500g; Female 225-325g
Sexual Maturity Females 6-10 weeks & Males at 8-12 weeks
Ovulation Oestrus every 4-5 days, oestrus lasts 14 hours
Gestation 3 weeks (20-23 days)
Litter Size 6-18 (average 10)
Birthweight 4-7g
Eyes open 12-15d (eat solids from day 14)
Weaning 21 days (40-50g)
Nursing Do not disturb mother in first few days
Dental Formula 2(1 I 1/1 C 0/0 P 0/0 M 3/3)
Temp 36-37.5C (Ideal temp range 21-24C, 45-55% Humidity)
HR 250-450
RR 70-150
Food 15-20g daily
GI Transit hours
Hard Faeces 9-15g/day
Water 10mls/10g daily/ 22-33ml/day
Urine 13-23ml/day

Blood collection
Blood Volume Approx 55-70ml/kg = 21-35ml
Safe sample volume 2.4-4ml
Collection sites Lateral tail vein, ventral tail artery, saphenous vein. Cardiac puncture & orbital venous plexus?

Urinalysis
Volume 13-23 ml/day

Haematology
PCV 0.54 – 0.85
RCC (x10⁶) 5.4 – 8.5
Haemoglobin 11.5 – 16.0 g/Dl
WCC ($\times 10^3$)  4 – 10.2
Fibroadenoma is most common s/c tumour (adenocarcinomas fewer than 10%)
(c.f. mice: adenocarcinomas, followed by fibrosarcomas)
MOUSE FACT SHEET

Life span: up to 3 years (average = 1.5-2.5 years)
Weight: Male 20-40g; female 25-63g
Sexual Maturity: Females 6-8 weeks & males at 6-8 weeks
Ovulation: Oestrus every 4-5 days, 9-20 hours duration (average 14 hours)
Gestation: 19-21 days
Litter Size: 6-12 (average 8)
Birthweight: 1-1.5g
Eyes open: 12-14 days (eat solids from day 12)
Weaning: 18-21 days (10-12g)
Dental Formula: 2(I 1/1 C 0/0 P 0/0 M 3/3)

Temp: 36.5-38.0 °C (ideal temp range 24-25°C, 45-55% humidity)
HR: 350-750
RR: 60-220

Food: 3-5g daily
Hard Faeces: 1-1.5g/day
Water: 5-8mls/day/adult
Urine: 1-2ml/day

Blood collection
Blood volume: approx 75-80ml/kg = 2-3.2ml.
Safe sample volume: 0.2-0.32ml
Collection sites: Lateral tail vein & Saphenous vein. Cardiac puncture & orbital venous plexus?

Haematology
PCV: 0.37 – 0.46
RCC (x10⁶): 7.9-10.1
Haemoglobin: 11.5 – 16.0 g/Dl
WCC (x10³): 5.0-13.7
GUINEA PIG FACT SHEET

Lifespan 5-9 years (Average 5-6 years)
Weight Males 900-1200g; females 700-900g
Sexual maturity Females 2-3 months; Males 3-4 months
Oestrous 15-17 days; non-seasonally polyoestrous
Ovulation Spontaneous
Gestation Average 68 days (59-72)
Postpartum oestrous 12-15 hours after littering
Litter Size 1-13 (usually 2-4)
Birth weight 70-100g
Weaning 21 days (180g)
Dental Formula 2(l 1/1 C 0/0 P 1/1 M 3/3)

Temp 36.5-39.5 °C
HR 240-310
RR 40-100

Blood Collection
Difficult in many cases
- Cephalic/lateral saphenous: 25G or smaller needle. Often difficult.
- Jugular: Similar to cat.
  - Often need to sedate or general anaesthesia.
  - Use anaesthesia, collect similar to ferrets

Lymphosarcoma most common tumour.
- Scruffy coat & peripheral lymphadenopathy
- WCC usually 25,000-500,000/uL

Dystocia: problem with pelvic symphysis fusion if not bred early ( < 7 months)
RABBIT FACT SHEET

Life span
6-15 years

Weight
Buck 2-5kg; Doe 2-6kg (varies with breed up to 10kg)

Sexual Maturity
4-10 months
puberty at 12 weeks, Recommend separate sexes at 10 weeks
2 uterine horns opening into vagina (2 cervices)

Ovulation
Induced, approx 10hrs after copulation, prolonged oestrus

Gestation
30-33 days

Pseudopregnancy
16-18 days

Litter Size
4-12 kits, Ave 5-8

Birth weight
30-100g

Weaning
4-6 weeks

Nursing
Once daily for few minutes

Dental Formula
2(1 2/1 C 0/0 P 3/2 M 3/3)

Temp
38.5-40C

HR
130-325

RR
30-60

Diet
Need high fibre (>20% for adults)

GI Transit
4-5 hours (caecotrophs)

GI Transit
8-9 hours (Hard Faeces)

Hard Faeces
5-18 g/kg

Water
50-150 ml/kg/day (50-100 probably more accurate)

Urine
20-250 ml/kg/24hrs, usually around 130

Blood collection
- Cephalic/Lateral Saphenous: 25G or smaller. Procedure similar to dog/cat.
- Marginal ear vein/Central ear artery: 25g needle or butterfly catheter, warm ear, clip, and alcohol swab. Allowing blood to drip from needle into syringe often better than syringe as does not collapse vein.
- Consider use of EMLA anaesthetic cream.
- Avoid collecting from central ear artery if possible.
- Jugular Vein: Similar to cats. May be difficult if a large dewlap present.

Urinalysis

Volume
20-350 ml/kg/day, average 130 ml/kg/day

SG
1.003 – 1.036

pH
8.2

Appearance
cloudy due to CaCo3, ammonium magnesium phosphate

Casts
none or rare

Leucocytes
occasional

Erythrocytes
occasional

Albumin
occasionally in young animals
Can carry Bordetella – Potentially pathogenic to Guinea Pigs

**FERRET FACT SHEET**

**Life span**
5-12 years (considered geriatric from 5-6 years age)

**Weight**
600g-2kg; males average 1kg, females 800g

**Sexual maturity**
4-8 months; females first spring after birth

Induced ovulators – similar to cat

**Gestation**
40-44 days (average 42)

**Litter size**
1-18 (average 8)

**Birth weight**
8-10g

**Kits eyes open**
21-37 days (average 30-35)

**Weaning**
6-8 weeks, 300g

**Temp**
38-40 °C

**HR**
180-250

**RR**
33-36

**Total blood volume**
5-7% bodyweight

**Urine**
26-28 ml/25hrs; pH 6.5-7.5;

**General**

Distemper Vaccination 10 & 14 weeks, then annually

**Food transit time**
>= 180 minutes.

**Diet**
high protein, high fat, low fibre, and low carbohydrate

**Sedation**

**Ketamine**
20-40 mg/kg IM

**Diazepam**
1-2 mg/kg IM

**Domitor (medetomidine)**
50ug/kg IM (0.25ml/5kg)

**Fluid Rx**
75-100ml/k/day maintenance.

**Blood Collection**

Cephalic/lateral saphenous: 25G or smaller.

Cranial vena cava. Anaesthesia, place at sternal notch, aim towards opposite kidney, mild positive pressure on syringe

Jugular
22-25G needle. Vein relatively more lateral & deep cf cat/dog.

Ventral tail artery
22-25G needle, 1-10ml syringe. Warm tail; dorsal recumbency. Insert 2-3cm from tail base until hit vertebrae. Apply suction whilst slowly withdrawing. Up to 6ml for adult.
Caring for Small Mammals

Rodents

The order *Rodentia* is divided into two major suborders:

- Hystricomorph (porcupine like rodents, includes Guinea Pigs)
- Sciurognathi (include rats and mice)

There are a rapidly increasing number of people in Australia who keep rats, mice and guinea pigs (also called cavy) as pets. As a veterinarian in companion animal practice, you need to be able to confidently and thoroughly examine and medicate these animals. An understanding of husbandry as well as common clinical techniques and diseases is important part of this process.

Examination of Rodents

You need a different approach when examining a rodent, compared to the more usual cat and dog, because of their unique anatomy and physiology. Many of the problems we see are a direct result of inappropriate husbandry and/or diet because of the fact that this is not well understood by owners or staff in pet shops and similar.

1. History

When examining one of the rodents, you need to uncover a more detailed history than you would for cats and dogs. Some experienced vets like to have the client arrive early to fill in a detailed history questionnaire prior to the consultation. I prefer to do this while speaking directly to the owner. When a client makes an appointment, our receptionist will recommend they bring in a fresh faecal sample for us to examine.

Obtaining a thorough history is the basis of a successful examination process.

History components you need to cover include:

- Age, breed, gender, any other cage mates or pets that mix with this one
- Date & place of acquisition
- A detailed list of diet components
- Details of the housing
  - Size
  - Supplemental Heat
  - Bedding/Substrate used
  - Cleaning regime
- How often cage cleaned?
- Diet – components? Treats?
- Previous medical problems.
- Tests performed previously
  - Faecal/Bloods/Other
• Outline of current problem:
  o how long?
  o Improving/same/worse?

• Medications
  o Formulation
  o Dose
  o Delivery

The advantage in obtaining a detailed history prior to the examination, is that it allows you to examine it prior to talking to your client and avoids you making mistakes such as incorrect breed or gender identification – that makes you look less competent. The advantage of collecting the information when speaking to a client is that you can explore any important areas you identify in more detail and with more immediacy. I also find that for many clients this is their first contact with a vet and for reasons I am unable to identify, they resent filling out all the information as they see it as a waste of their time – this can be overcome with well trained reception staff. In my practice, I found that asking clients to fill out a thorough history form led to resentment before I had had a chance to speak directly to the client and was a poor way to begin our relationship. You need to find the balance that works best for your practice.

2. Distant Examination

As soon as you enter the consultation room and meet the pet and the client, you should be discussing the history, but also take time to observe as much as you can before you reach over and restrain the pet.

The client is anxious for you to pick up their pet and examine it. You need to explain why you are spending time talking and observing.

When you have discussed the history, you should be developing a provisional differential diagnosis.

Now it is time for the patient to come out of its transport cage. I recommend you do not pick up the pet, but ask the owner to do so. This is less stressful for the animal and is also a good check of how the animal is used to being handled as well as the owner’s level of competence.

Ask the client to place the pet on the consultation table and quietly continue your observations. Answer the following questions:

• How has the pet responded to being handled?
• Is the pet alert and responsive to its surroundings?
• Note respiratory rate and depth
• Any signs of discomfort?
• Any obvious external lesions?

Once you have answered these questions, it is time to begin your physical examination. Only after quiet observation of the animal would I advise you to pick up the pet & begin your hands on clinical examination.
3. Physical Examination

This part is not greatly different to what you would perform on a dog or cat. The major complicating factor is that these animals are extremely prone to stress. Be quiet and move slowly but use first principles – examine each body system as you would routinely with a dog or cat. I do not routinely collect temperatures with a rectal thermometer as it creates too much stress.

RATS & MICE

Rats and mice belong to the suborder Sciurognathi of the order Rodentia. They share a common family – Muridae.

Rats and mice make very good pets for children. If they are raised from a young age with children, they easily adapt to being handled and the risk of them biting is minimal. Children enjoy watching them perform their natural behaviours during their daily active periods. Rodents raised in captivity do not display the nocturnal habits of wild rodents but can be active both day and night – especially mice.

Rats  (Rattus norvegidus or Brown Rat)

Normal data:

- Adult Weight:  Male 265-500g; Female 225-325g
- Average life span: 2.5—3.5 Years
- Rectal Temp 36-37.5C
- RR 70-150;
- HR 250-450
- Tidal Volume: 0.6-2 ml
- Blood Volume: 55-70 ml/Kg
- Blood Pressure: 84-134/60 (systolic/diastolic)
- Water consumption: 100-120 ml/Kg/day
- Food consumption: 100 g/Kg/day
- Urine production: 13-23 ml/day
- GIT Transit time 12-24 hr
- Dentition: 2(1/1 C0/0 P0/0 M3/3)

Reproductive data:

- Sexual Maturity: Male 6-10 weeks; Female 8-12 Weeks
- Oestrus cycle 4-5 days, oestrus for 14 hours, year round
- Gestation 20-23 Days
- Litter Size 6-18 (10 Average); 4-7g birth weight;
- Eyes open: 12-15 days, eat solids from day 14
- Wean from 21 days - 40-50g
Mice (Mus musculus)

Normal data:

- Adult Weight: Male 20-40g Female 25-63g
- Average Life Span: 1.5-2.5 Years
- Rectal Temp 36.5-38 °C
- RR 60-220
- HR 350-750
- Tidal Volume: 0.09-0.23 ml
- Blood Volume: 75-80 ml/Kg
- Water consumption: 150 ml/Kg/day
- Food consumption: 150 g/Kg/day
- Urine production: 0.5-2.5 ml/day
- GIT Transit time 8-14 hr
- Dentition: 2(1/1 C0/0 P0/0 M3/3)

Reproductive data:

- Sexual Maturity: Male 6-8 weeks; Female 6-8 Weeks
- Oestrus cycle 4-5 days, oestrus for 14 hours, year round
- Gestation 19-21 Days
- Litter Size 6-12 (8 Ave); 1-1.5g birth weight;
- Eyes Open: 12-14 days, eat solids from day 12
- Wean from 18-21 Days, 10-12g

Most pet rats belong to the species Rattus norvegicus. If raised with humans from an early age they socialise well and rarely bite or scratch. They make ideal pets for children as they are small but large enough to be handled easily. Many rats recognise their owners and can be trained to come for treats.

The key to a friendly rat is early socialisation with humans.

Rats are much more active at night than are mice. While adult male and female rats can cohabitate, it is not recommended to introduce adult males together as they can be quite aggressive.

Rats come in several colours and varieties including:

- Albino (white with red eyes, prone to poor vision),
- Agouti (common brown colour)
- Silver
- Rex
- Hooded (different head colour)
- Self (one solid colour).
**Diet**

Rodents are omnivorous herbivores so the most appropriate diets for pet rats and mice is a commercial rat or mouse pellet and as many different vegetables as they will eat (aim for vegetables to comprise 20-30% of diet). Most commercial rat pellets have a fat content of 4-5% and a protein level of 16%. Laboratory pellets should not be offered ad libitum but controlled to maintain good condition and avoid obesity.

Vegetables commonly offered: broccoli, cabbage, Brussels sprouts, endive, carrots, Bok Choy or other Asian greens, celery, parsley, berries, beans, peas. This can be supplemented with small amounts of fruit: apples, pears, banana, melons, citrus fruits, stone fruits, berries, tomato.

Some owners like to feed rats birdseed but this is not recommended other than in small amounts as a treat, because the fat content of seeds is too high for rodents - most common seeds range from 22-50% fat content.

The most common problem seen with diets is that the rats become obese as they over-eat fatty foods and under-exercise. Treats (cake, bread, chocolate, seed sticks) should be fed in very small volumes or preferably discourage clients from feeding any treats at all.

**Housing**


Many commercial prefabricated housing enclosures are available from pet shops. When recommending one to a client, emphasise that it must be easy to dismantle for thorough cleaning but also has good ventilation. Rats have an undeserved reputation for being dirty and smelly – in most cases the problem is that the client is not cleaning the enclosure frequently. The build up of ammonia from the rat’s urine can be overpowering and so cleaning should be done frequently enough so that this odour is minimised.

**Enclosure Specifications** (after Brown & Donnelly)

<table>
<thead>
<tr>
<th></th>
<th>Rats</th>
<th>Mice</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimum Floor Space</strong></td>
<td>152 cm²</td>
<td>38 cm²</td>
</tr>
<tr>
<td><strong>Minimum Cage Height</strong></td>
<td>38 cm</td>
<td>20 cm</td>
</tr>
<tr>
<td><strong>Enclosure Flooring</strong></td>
<td>Solid, avoid wire floors</td>
<td>Solid, avoid wire floors</td>
</tr>
<tr>
<td><strong>Temperature Range</strong></td>
<td>18-26 °C</td>
<td>18-26 °C</td>
</tr>
<tr>
<td><strong>Relative Humidity Range</strong></td>
<td>30-70%</td>
<td>30-70%</td>
</tr>
</tbody>
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Choose bedding carefully. It should be dust-free, absorbent and non-toxic. Provide a depth of 3-4 cm in most cases. Bedding should be changed daily. Commonly used bedding materials include:

- Wood shavings (avoid aromatic shavings or wood treated with copper arsenate etc.)
Handling and Restraint of Mice & Rats

How pet rodents are handled will determine how friendly they become. Be calm and gentle and they respond well. Always assess the rodent’s body language and progress slowly if the display and signs of being frightened or nervous. Avoid handling an animal that is asleep as they can be unpredictable when suddenly awoken.

Mice are gregarious animals and if kept in a group are more likely to be calm than those that are raised alone.

If you have been handling other animals (dogs, cats reptiles etc.) prior to handling the rat or mouse, thoroughly wash your hands to remove the threatening odours of predator animals.

The easiest way to restrain rats and mice is to progress quietly and with a calm manner. Allow them to smell your hands initially. Encourage them to walk onto your hands and then scoop them into your hands held in a cup shape. Use your hands to support their thorax and hindlegs. Take them a way from their cage to a neutral area as they are much easier to handle when not in their usual environment.

For nervous or territorial animals, ask the owner to remove the pet from the cage. A stranger attempting to remove some territorial animals can exacerbate aggressive tendencies.

Mice can also be handled by grasping the base of their tail. Rats are more easily damaged this way because of their larger weight, so this is not recommended for them. The correct method is to grasp the tail closer to the tail base, rather than near the tip - as degloving of the skin at the tail tip can easily occur.

For examination, mice can also be restrained by grasping the tail with your dominant hand and placing the mouse on a rough surface so it attempts to run away from you – extending it body and neck. This allows you to use the thumb and forefinger of your other hand to grasp the scruff of the neck, close to the base of the head. This should reduce the ability of the mouse to turn its head and bite you. Place the tail between the last two fingers of the hand holding the scruff and this comfortably restrains the mouse as well as providing you with your dominant hand free to perform an examination.

For examination, rats are restrained by placing your non-dominant hand over the dorsal aspect of the thoracic spine and ribs and using the thumb and forefinger to retrain around the head and neck. In some cases it is necessary to grasp the tail with your dominant hand and allow the rat to extend it body and head/neck, prior to restraining the rat as described above.

Rats are also gregarious but more prone to fights and disputes. Pets can be housed in groups of individually. In many case aggression is driven by disputes over feeding or drinking sites so multiple food and water sites should be provided.
Reproduction for Rats and Mice

Gender determination: With rats and mice it is easy to determine gender, even in neonatal animals, because of the significant difference in ano-gential distance – the distance between the anus and the opening of genital orifice. Males have the opening of the prepuce and the anus at approximately twice the distance compared to the females between the anus and vulva. Adult males have a prominent scrotum and testes. Only females possess nipples – in 2 rows on caudo-ventral abdomen.

Rodents need to be in compatible pairs or fighting will occur. Mice can be maintained in pairs or trios of 1 male and 1-2 females. If more males are present fighting is likely. Male Rats are more tolerant of each other and can be kept in mixed groups of both males and females.

MICE

Females are sexually mature at approximately 50 days old (8 weeks). The oestrous cycle occurs throughout the year. They are receptive to the male for 12 hours (usually at night) each 4-5 days until they are pregnant. Females come back into receptivity and fertile oestrus within 24 hours of delivering a litter of 10-12 babies (young and older females have smaller litters).

Gestation in mice lasts approximately 3 weeks, but can be up to ten days longer if the pregnant female is also nursing a litter.

Encourage owners to avoid handling members of a litter for 3-4 days after birth to avoid the mother abandoning the litter.

Weaning occurs around 3 weeks of age.

RATS

Females are sexually mature at approximately 65 days old (9 weeks). The biology of oestrus is similar to mice: The oestrous cycle occurs throughout the year. They are receptive to the male for 12 hours (usually at night) each 4-5 days until they are pregnant. Females come back into receptivity and fertile oestrus within 48 hours of delivering a litter of 6-12 babies (young and older females have smaller litters). Unlike mice, it is recommended that the male be removed from the enclosure prior to delivery of a litter as they may injure the pups, so they are usually not present to take advantage of the post-partum oestrus.

Gestation in rats is approximately 3 weeks. Similar to mice, the he female and her litter should not be disturbed for the first few days after birth, because a stressed female rat may injure or kill her pups.

Weaning occurs around 3 weeks of age. The female will returns to her normal oestrous cycle 2-5 days after the young are weaned.

Examination of Guinea Pigs

- Clinical examination of guinea pigs is difficult because they are so easily stressed and vocalise loudly – warn clients this will happen
- Monitor them closely on the examination table as they are prone to walking off the edge if not adequately restrained!
Examination of the mouth is impossible without sedation or anaesthesia. As with rats and mice, the literature contains many different anaesthetic regimes for rats & mice. The comments for rats and mice above hold true for guinea pigs.

I do not routinely fast prior to anaesthesia as rodents have difficulty vomiting so it is not an important risk factor as with cats and dogs. In many cases they have food removed 2-3 hours prior to anaesthesia so there is no food particles present in the oral cavity.

There is a large range of recommended premedication agents.
- I prefer Midazolam (1-2mg/kg IM).+ Butorphanol (1-2mg/kg SC).
- Another successful combination is Acepromazine (0.5-1mg/kg) + Buprenorphine (0.05-1mg/kg)

Induction with isoflurane via mask or in an induction chamber
- Consider pre-oxygenation for several minutes.
- Maintain on 1.5-3.5%.

Control heat loss.
- Use heat pads, bubble-wrap or heated air.
- Minimise clipping or overuse of skin disinfectants.

Monitor
- RR & HR.
- If possible, use a Doppler for heart rate & rhythm.

I prefer to avoid injectable anaesthetics. Many authors recommend their use.

Use careful surgical technique to minimise haemorrhage and blood loss.
- Handle tissues gently and carefully
- Use subcuticular skin sutures + tissue glue, so no protruding sutures they can chew and remove

Recovery
- Maintain use of heat pad or place in heated enclosure

Keep isolated from cage mates for 7-10 days to avoid any excessive exercise and wound breakdown.

Examination of Rabbits

Overview
Rabbits are a very common pet in Australia and overseas. There are approximately 70 different rabbit breeds recognised in UK and 42 different rabbit breeds in USA, available as pets or show animals.
Popular pet breeds:
- New Zealand white
- Angora,
- Dwarf breeds
  - Netherland Dwarf
  - Lop-ear (have pendulous ears rather than the usual erect ear)
  - Mini Rex.

In all states and territories of Australia, wild rabbits are legally considered vermin – in Queensland there are fines up to $5,000 for having a pet rabbit.

Rabbits belong to the Order *Lagomorpha*, family *Leporidae*. They close relatives of rodents but differ in that rabbits have a second pair of upper incisors – commonly referred to as ‘peg teeth’.

Male rabbits are called ‘bucks’, females are called ‘does’ and young are called ‘kits’.

Rabbits have been domesticated since the Roman Empire and are gentle, quiet animals that make excellent pets. Most rabbits respond well to human interaction and recognise and/or bond to individuals.

Rabbits are true herbivores and in the wild spend much of the day in burrows, emerging to forage at dawn and dusk. They like to explore, but also to chew, so it is important to guard against inquisitive nibbling when they are allowed to roam around the house—watch electrical cords, furniture and any wooden items!

It is important to provide a stimulating environment for rabbits, with items such as toys. These may be as simple as cardboard boxes or tubes, toilet roll or paper towel inserts, branches from fallen trees or wooden toys designed for parrots.

**Handling**

Care must be used when handling a rabbit, the hindlegs and spine should be supported when they are removed from their cage. Their hindlegs are so strong that if they suddenly kick out, explosively, with their hindlegs they can damage their spine.

Rabbits can be extremely gentle with owners and people they recognise but may kick, bite or scratch if frightened.

**Sexing**

- Older males easily animals sexed by detecting the well developed scrotal sacs & testes.
- Sexing can be a challenge in very immature animals
  - Vulval orifice is elliptical
  - Preputial orifice is circular & the anogenital distance is longer in males
  - Gently place a forefinger & thumb on either side of the orifice & press
    - Males you will extrude the circular tip of the penis
    - Females a ‘V’ shaped vulva is protruded
**Biology**

Weight: 900g—6kg (depending on breed)

Sexual Maturity: Male 4-7 months, Female 4-9 months (Dwarf breeds younger)

Puberty: approximately 12 weeks so separate sexes at 10 weeks of age!

Average life span: 6-8 years (Max 15)

Gestation period is 30-33 days

- does can mate soon after giving birth
- Litter size averages 5-8
  - NB. doe places the young in a nest and only returns to feed for several minutes (sometimes only 2-3) once or twice daily during which time the young can drink up to 20% of their bodyweight.
  - Clients often telephone the clinic to state the doe has ‘abandoned’ its young.
  - Eyes are open at 7 days
  - young emerge from the nest at around 18 days
  - commence eating vegetable matter at 3 weeks
  - weaned at 4-6 weeks.

- Rabbits are a social species
  - benefit from companionship
  - preferably kept as a bonded pair
  - Some pairs will bond for life & become inseparable
  - Desexing is strongly recommended
  - A single rabbit kept as a pet and is more likely to bond to its owner.

**Housing**

The traditional cramped box-like hutch with wire flooring is unsuitable for pet rabbits. It causes foot, spinal and behavioural problems.

The ideal hutch:

- Provides relief from extremes of temperature, wind and rain
- Is well ventilated yet minimises the risk of exposure to pathogens such as mosquitoes or fleas
- Provides a hide and/or sleeping area
- Has a run to allow free movement & exposure to natural light
- Does not have wire flooring
- Has sufficient hay or straw for bedding that is changed regularly
- Has a litter tray or corner for toileting
- Is easily cleaned and is cleaned regularly (ideally daily)
- Includes various furniture or toys for behavioural enrichment

It cannot be overemphasised that confining a rabbit to a hutch for long periods is bad!
**Exercise**

All pet rabbits MUST have daily exercise outside of the hutch.
- Recommend at least 4 hours free roam exercise daily
- Preferably outdoors with exposure to unfiltered light

**Exercise**
- Promotes a healthy GIT
- Prevents obesity & spinal concerns
- Promoting adequate skeletal strength and muscular tone
- Prevents behavioural problems
- Rabbits constantly in a cage exhibit many behavioural problems such as obsessive grooming, aggression, lethargy and chewing of cage bars.

**History & Clinical Examination of the Rabbit**

You need to modify your approach to examining a rabbit, or any other unusual or exotic pet because of their unique biology. The emphasis is on identifying poor husbandry and inappropriate diet as factors in many diseases as well as the poor general knowledge of clients regarding the health care of unusual or exotic pets.

**History**

A detailed history is crucial when dealing with rabbits. Some vets ask all owners to fill in a detailed history sheet before consultation. There are samples of these history forms on the UEP Yahoo website for free use/modification of members:

UnusualExoticPets@yahoogroups.com

It is also worthwhile asking owners at the time of booking to bring a faecal sample of their pet for examination.

Since a large percentage of problems in these pets are related to inadequate husbandry, this is the focus of much of the history.

Information you need to obtain from the owner includes:
- Age, breed, sex, any other cage mates
- Date & place of acquisition
- A detailed breakdown of diet
- Details of the housing – how big? Heating? Substrate? Cleaning?
- Previous medical problems. Routine screens (faecal, bloods) done?
- Outline of current problem: how long? Better/same/worse?
- Medications

If you are new to these animals, there is also a benefit in having your nurse collect the history prior to the consultation. You have an opportunity to examine the history before entering the consultation – this enables you to avoid making blunders like naming the wrong breed, sex or colouration of animal. You don’t need to be an expert on breeds etc. – get the client to inform you before the consultation!
**Distant Observation**

Spend some time reviewing the history with the owner once they enter the consultation room, you can also observe the rabbit and how it is responding etc in its transport cage. DO NOT pick up the patient yet! I prefer to ask the owner to remove the animal from the transport cage and place it on your exam table.

Take time to observe the animal:
- is it alert and aware of its surroundings?
- What is the respiration like?
- Does it seem in discomfort?
- Can you see any obvious external lesions?
- Rabbits, being a ‘prey’ species can often ‘freeze’ in a consultation, making detailed clinical examination difficult.
- Consider booking in rabbits & rodents together, to avoid a stressed rabbit sitting next to a cat or dog in the waiting room.

Only after quiet observation of the animal should you pick up the pet & begin your hands on clinical examination.

This allows you to pick up subtle abnormalities in the pet before handling stress occurs, but it also allows you to assess the skills of the client: does she seem confident handling the animal? Does it look like she handles this pet often?

**Hands on Clinical Examination**

- Perform a systematic examination of the rabbit as you would for a dog or cat.
- Stressed animals will be more difficult to examine.
- If you are uncertain regarding normal or abnormal features, Don’t panic - Go back to first principles – stop, think, be systematic!
- Do not routinely take rectal temperatures for most small mammals
  - Most rabbits are amenable to rectal temperature recording.
  - sitting the rabbit on its backside with the perineum uppermost, head resting in my lap.
  - Rabbits pave a wide rectal temperature range of rabbits: 38-5 – 40C.
  - Concern only if temperature is <38C or > 40.5C.
- Always support the hindquarters when carrying a rabbit.
  - Rabbits have a fragile skeleton (7-8% of body weight compared with 13% for cats).
  - tuck the rabbit into my body when carrying.
  - Place rabbit on a towel or other non slip surface on the examination table.
- Systematically examine all body systems as you would for the clinical examination of a dog or cat.
- Palpate the ventral mandibles for signs of bony lumps which are often present with dental disease.
- Mouth is difficult to examine without sedation or anaesthesia
Blood Collection

- Most veterinarians prefer jugular venipuncture.
- Alternative venipuncture sites
  - lateral (marginal or caudal auricular) ear vein
    - be careful not to catheterise the central ear artery which may then result in subsequent sloughing of the ear.
  - lateral saphenous vein
  - femoral vein. My preferred blood collection method is a ‘blind’ technique at the entrance to the thoracic cavity. The rabbit is anesthetised & a 25 gauge needle & 3ml syringe is used. The site of collection is at the sternal notch & the needle is angled at 30-45 degrees aiming to the contralateral femur. This will allow collection of blood from the jugular as it passes the thoracic cavity entrance. It is a very easy & repeatable technique to master.

Fluid therapy can be difficult in depressed or moribund rabbits.

Possible IV sites

- Marginal ear vein (caudal auricular vein)
- Using a 21-25 gauge butterfly catheter that is glued to the ear
- EMLA anaesthetic cream can aid with avoiding rabbit movement during placement.
- Intraosseous fluid therapy is an alternative
  - proximal humerus
  - tibial crest
  - proximal femur

Feeding

The most common cause of gastrointestinal disease in rabbits is poor diet. There are a large variety of rabbit foods available in pet shops and supermarkets, most, if not all of which are inappropriate for pet rabbits.

See notes in Common rabbit problems for more detail on feeding rabbits.

Examination of Ferrets

Ferrets are popular pets. They are extremely challenging because they are very inquisitive and intelligent. Most enjoy interacting with people – especially their owners.

Male ferrets are called hobs, females are called jills and the young are called kits.

Many people mistake ferrets as a member of the redent family. They are carnivores – *Mustela putorius furo*, from family *Mustelidae*. Their closest relatives are weasels, stoats, mink, otters, badgers, skunks etc. The domestic ferret is descended from the polecot and was originally raised to hunt rodents & rabbits. There is an endangered member of the ferret family - the black-footed ferret of North America. Ferrets have been used for hunting for over 2000 years, they are still used for hunting rabbits in Australia.

Colour variations:

- Normal wild type = sable or ‘Fitch’ (yellow with black guard hairs)
- Albino (white with red eyes)
• Cinnamon. (beige colour)
• Many other colours
  o Black eyed white (albino with black eyes)
  o Silver mitt (sable with white chest and feet)
  o Siamese (overall medium brown)
  o Panda (white head and neck, body any colour)

**Biology**

**Weight:** Male 1-2 kg; Female 0.5—1 kg

**Sexual Maturity:** 4-8 months

**Gestation:** 41-43 days

**Litter size:** usually 8-10 kits (can be 1-18)

**Eyes open:** 30-35 days

**Weaned:** 6-8 weeks (handle daily from 4 weeks to encourage tameness)

**Dentition:** Deciduous erupt weeks 3-4, Permanent 47-74 days.
  - **Deciduous:** 2 x (I4/3, C 1/1, PM 3/3, M 0/0)
  - **Permanent:** 2 x (I3/3, C 1/1, PM 3/3, M1/2)

**Average life span:** 5-8 years

**Husbandry**

The key to a healthy ferret is good husbandry.

**Enclosure:**

- Largest cage that will fit in the space available
- Provide several levels in cage cages, with connecting tunnels, ladders & other furniture.
  - PVC plumbing pipes make excellent tunnels and are easy to clean.
- Supervised play outside the cage is essential to avoid boredom and help with human socialisation.
- Chewing is a problem causing intestinal obstruction so a daily check to assess what has been chewed is recommended.
- Litter trays in every room that the ferret accesses.
- Litter tray substrate
  - Shredded paper products or recycled newspaper cat litter (e.g. Breeders Choice®).
  - Avoid wood shavings as they can contain resins or allergens that may cause respiratory irritation.

**Diet**

Ferrets have a very high metabolic rate and should have food and fresh water always available. Water bottles are less messy and therefore preferred to water dishes. Have at least 2 water supplies in case one becomes blocked or tipped over.
• Ferrets are true carnivores; their diet must consist mainly of meat and animal products.
• Unable to digest diets high in fibre or carbohydrates
• Commercial ferret diets, formulated to meet the specific nutritional needs of the ferret, are slowly becoming available in Australia.
• The best alternative to a ferret diet is a premium quality dry kitten food.
  o Hill’s Science Diet Kitten dry food.
  o IAMS Kitten or Advance Kitten DRY foods.
• Ferrets enjoy some fruits, vegetables, and other treats.
  o fed in moderation
  o excess consumption may result in diarrhoea and create finicky eaters.
• Offer a small raw meaty bone weekly to help prevent dental disease

Preventive Health Care
• Vaccination: Canine Distemper
  o Under 14 weeks require 2 vaccinations
  o Use 1/3 – 1/5 of a C3 vaccine.
  o For most vaccines, this is ‘off label’ use
  o Distemper is fatal in ferrets
  o Annual booster is recommended.
• Intestinal parasites are not a common problem in ferrets
  o Annual faecal examination for intestinal parasites
  o Repet annually or if any signs of illness.
• Quarantine all new ferrets
  o at least 4 weeks before being introduced to other ferrets
• Heartworm disease.
  o Clinical Signs:
    ▪ Heavy and laboured breathing
    ▪ Sudden death.
  o Monthly heartworm preventative:
    ▪ Selamectin (Revolution®)
    ▪ also covers flea infestations and some intestinal parasites
    ▪ good for sarcoptic mange
    ▪ Could also use Heartgard®
      ▪ Very palatable
  o Annual physical exam is recommended
    ▪ Consider twice yearly for ferrets over 3 years of age
    ▪ Four years age
      ▪ Radiographs and CBC/Biochem each 6-12 months
• Aim to detect early signs of diseases such as lymphoma, cardiomyopathy & splenomegaly which are relatively common in aged ferrets.

Summary preventative health points:
• High protein diet – top quality kitten dry food
• Distemper Vaccination
• Heartworm prevention
• Spay females

Clinical Examination Techniques
• Ferrets are very alert & inquisitive animals and need to be handled carefully
  o It is often best first to have the owner handle the ferret whilst you observe from a distance
• Most ferrets are used to being handled and rarely bite (although a testing ‘nip’ is not unusual).
• Use minimal restraint
• Scruffing high up near the base of the skull is used for firmer restraint. Clinical examination is similar to that of dogs & cats. Note the very caudal location of the heart. I do not routinely check rectal temperatures in apparently healthy ferrets. The recorded normal rectal temperature range for ferrets is wide: 37.5-40°C. Sexing ferrets is straightforward - the ano-genital distance is much larger in the male.
• Blood sampling can be difficult in conscious patients.
  o Some texts have the ferret restrained like a cat for jugular sampling – head arched back & held at the edge of the table by a nurse – this is usually not possible in my experience
  o I use general anaesthesia with Isoflurane to restrain a ferret for blood sampling
  o Collection sites:
    ▪ Vena Cava
    ▪ Cephalic Vein
    ▪ Saphenous veins
    ▪ Cardiac puncture is not recommended.
Medicating Birds, Reptiles and Small mammals

Michael Cannon
Cannon and Ball Veterinary Clinic
461 Crown Street
West Wollongong NSW 2500

Where can you locate information to treat these animals?

- Books
- Associations: AAV, AEMV, ARAV
- Conferences: USA (AAV, ARAV, ICE); Australia (AAVAC, UEP SIG)
- Internet: Birdmed, VIN, Exotic DVM, E-vet Exotic, UEP
- other vets

Why treat them?

- Clients expect us to be able to do this
- can become a significant part of your practice
- can be financially rewarding
- presents a challenge!

WHAT MAKES EXOTICS DIFFERENT FROM DOGS & CATS?

Anatomy & physiology affects

- dose rates used
- frequency of dosing
- route of administration
- effect of any given drug

Behaviour

- predator vs prey
- display of clinical signs
- ease of handling
- stress on patient
- risk to clinician
Anatomy & Physiology

- Respiratory system
- Digestive system
- Cardiovascular system
- Urinary system
- Body size
- Metabolic rate

Behaviour

- Predator vs Prey - the masking phenomenon
- Handling
- Effect of stress

Objectives in treating an exotic animal

- To get the right drug
- Into the animal
- At a therapeutic level
- With minimal side-effects
- Without hurting the animal
- Without getting hurt yourself

To select the right drug you need:

- a diagnosis
- knowledge of therapeutics and pharmacology
- a good reference book! E.g. *Exotic Animal Formulary*, by Carpenter *et al*

Making a diagnosis

Because of the differences discussed, it becomes important to make an accurate diagnosis as soon as possible.

This allows a specific treatment to be given in an appropriate dose and by an appropriate route, to achieve a clinical resolution in a timely manner.

The diagnostic pyramid

Before you use a medication, you should know:

- Indications
- Contra-indications
- Potential side-effects
- Potential interactions with other drugs being used concurrently
- If you are unsure, speak to the manufacturer
Routes of administration

- topical
- oral
- in-water
- parenteral
  - intra-muscular
  - subcutaneous
  - intravenous
  - Intra-osseous
  - Intracoelomic
- Intratracheal
  - nebulisation

In my veterinary hospital, I find the most useful forms of treatment are intramuscular and intravenous injections as well as gavage via a stainless steel crop needle. In some circumstances other methods of drug administration are required. You need to be clear in your mind as to the indications and limitations of all the various methods of medication for avian patients. As well, you need to teach all the staff these techniques so they can more easily assist you and remove the burden of you having to be the primary person caring for the birds.

Topical

Ointments and creams have a limited application in birds, other than for eyes or other areas that are not covered with feathers. Even when used on the non-feathered portions of the body they must be used sparingly as the oil base contained in most ointments is damaging to feathers. Creams should be used in preference to ointments as their water base is less damaging to the plumage than the oil base of ointments.

Hints and Tips

Warn clients and staff that it is not only their application of ointments or creams as medication that can cause problems, any ointment or similar product tends to be spread over the bird by its preening and this clumps the feather barbules, interfering with the bird’s ability to thermoregulate. Once the feathers are matted or clumped, the bird will lose heat quite rapidly due to disruption of their relatively large ratio of surface area to volume.

Oral

The oral route can be a very useful means of medicating birds.

I prefer to use a Stainless Steel gavage needle to deliver doses of oral medication. It is best to use as large bore a needle as can be safely passed down the oesophagus, as this allows the medication to be delivered more quickly and there is less chance of a large bore needle passing into the trachea. A useful gavage needle has a bleb of silver solder at the distal end, to provide a non-traumatic, blunted end. The most appropriate size for psittacines is a 14-16 gauge needle. For use in budgerigars I prefer a 4-inch needle increasing to a length of 6 inches in macaws. For finches I use a 3-inch 18-gauge needle.
These must be used carefully or there is a chance that the oesophagus or crop lining may be ruptured. The simplest method is to pass this tube down the oesophagus until it enters the crop and to deposit the medication in the crop near the thoracic inlet. If any resistance is felt you should stop and begin the procedure again. I only hold the syringe with two fingers and prefer to ‘feel’ my way down the oesophagus as gently as possible. Since the crop preferentially empties its fluid components from the cranial aspect, the medications are usually quickly passed further down the GIT. In my opinion, this is the preferred manner for delivering fluid therapy to all but the most severely affected birds.

When using a crop needle, it is important that the needle is not placed into the trachea. Always hold the bird so that you can feel the passage of the needle on a finger or thumb. As well the resistance to the needle passage is usually higher in the oesophagus as it is a potential space that the needle needs to push its way through. If you pass the crop needle into the trachea there is less resistance and the corrugations of the tracheal rings can be felt. As well the presence of the crop needle in the trachea will cause the bird to cease vocalising and it may display dyspnoea. Fluid overload in the crop may cause regurgitation and aspiration pneumonia.

Hints and Tips

The primary aim, when you are holding the bird, is to extend the neck and remove the normal, resting, sigmoid flexure of the cervical vertebrae. This is achieved by using your thumb and first 1-2 fingers to place upwards pressure under the mandible and at the same time using the heel of your thumb and last 2 fingers to place downwards pressure on the shoulders. Think of it as being similar to intubation in a mammal, but in this case we are entering the oesophagus.

Table 1  Recommended Volume of Fluid Administered into the Crop (e.g. hand feeding bid-tid)

<table>
<thead>
<tr>
<th>Species</th>
<th>Volume (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finch</td>
<td>0.2 - 0.5</td>
</tr>
<tr>
<td>Canary</td>
<td>0.2 - 0.5</td>
</tr>
<tr>
<td>Budgerigar</td>
<td>1.0 - 2.0</td>
</tr>
<tr>
<td>Cockatiel/Quarrion</td>
<td>3.0 - 6.0</td>
</tr>
<tr>
<td>Small Parrot (Conure)</td>
<td>4.0 - 12.0</td>
</tr>
<tr>
<td>Medium Parrot (Galah, Amazon)</td>
<td>15.0 - 35.0</td>
</tr>
<tr>
<td>Large Parrot (Cockatoo)</td>
<td>20.0 - 40.0</td>
</tr>
<tr>
<td>Macaw</td>
<td>35.0 - 60.0</td>
</tr>
</tbody>
</table>

In-Water Medication

This technique is commonly used where there are a large number of birds involved or it is difficult to medicate an individual bird. Dosage recommendations from manufacturers are based on the assumption that the bird will consume 50mL per kg body weight per day (this was developed for chickens so is not absolutely accurate in our cagebirds). In many situations the bird may over-consume the water (hot weather, feeding young,
courting) or when the bird is ill it may drink only small amounts of water. In both situations the effective dose will not be achieved. With some products (e.g. Dimetridazole) the bird may consume toxic levels with only small increments in water consumption. To avoid this, the daily volume of water consumed should be monitored and any dosage regimen adjusted according to total consumption over a 24-hour period.

**Hints and Tips**

To measure the 24 hour water consumption, advise your client to provide a measured volume of water and then subtract the volume remaining at the end of the 24 hour period. I realise this sounds extremely obvious but it is amazing how many clients find this confusing.

The concentration of many in-water medications will decay with exposure to light and heat. Place the water bowl containing medication in a coolest part of the bird’s enclosure. The most practical means to minimise this effect is to recommend that medications be provided fresh at least twice daily. Alternately the freshly made, medicated water should initially be provided in the cooler evening so there is less exposure to heat and light, and birds will still be drinking adequate concentrations of medicated water in the morning. Many medications provided in the morning have decayed to a level where the medication is ineffective by the middle of the day.

Medicated water should be placed in a bowl with an inert lining. Recommended bowls are stainless steel, glass or glazed ceramic. Plastic, earthenware and galvanised metal bowls should be avoided.

**Protocol for dosing by in-water medication**

1. Weigh or estimate the combined weight of birds in the aviary
2. Note and record the ambient temperature.
   - For 20-26°C use 10% body weight (10mL/100g).
   - For >30°C use 20% body weight (20mL/100g).
3. Withhold water for
   - 2 hours at ambient Temperature < 30 °C
   - 1.5 hours for ambient temperature > 30 °C.
4. Calculate the dose of medication for the combined weight of birds
5. Mix the calculated dose of medication in the calculated volume of water and offer to the birds until it is consumed, then provide normal drinking water.

**Example:**

1. 10 finches with an average estimated weight of 20g = 200g of birds in the aviary.
2. For 20-26°C use 10% body weight (10mL/100g) = 20mL water
3. For >30°C use 20% body weight (20mL/100g) = 40 mL water
4. Withhold for the appropriate time
5. For treatment with Moxidectin (100 μg/mL) dose = 0.2mL per 100g, so volume required = 0.4mL
6. Mix 0.4mL of Moxidectin in 20 or 40mL water (different temperature ranges) and offer to the birds.

You can draw up simple charts to assist staff and clients for commonly used medications. Below is a chart for Moxidectin (100μg/mL) at a dose of 0.2mL/100g body weight (developed by Dr Ross Perry)

<table>
<thead>
<tr>
<th>Combined weight of birds in an aviary or cage in grams</th>
<th>Dose of Moxidectin Concentrate (100μg/mL) in mL</th>
<th>Volume of medicated water consumed at temperature &lt; 26°C in mL</th>
<th>Volume of medicated water consumed at temperature &gt;30°C in mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>0.05</td>
<td>2.5</td>
<td>5.0</td>
</tr>
<tr>
<td>50</td>
<td>0.10</td>
<td>5.0</td>
<td>10.0</td>
</tr>
<tr>
<td>100</td>
<td>0.20</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>200</td>
<td>0.40</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>300</td>
<td>0.60</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>400</td>
<td>0.80</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>500</td>
<td>1.0</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>1000 (1.0 kg)</td>
<td>2.0</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>2000 (2.0 kg)</td>
<td>4.0</td>
<td>200</td>
<td>400</td>
</tr>
<tr>
<td>3000 (3.0 kg)</td>
<td>6.0</td>
<td>300</td>
<td>600</td>
</tr>
<tr>
<td>4000 (4.0 kg)</td>
<td>8.0</td>
<td>400</td>
<td>800</td>
</tr>
<tr>
<td>5000 (5.0 kg)</td>
<td>10.0</td>
<td>500</td>
<td>1000 (1.0 Litre)</td>
</tr>
<tr>
<td>10,000 (10.0 kg)</td>
<td>20.0</td>
<td>1000 (1.0 Litre)</td>
<td>2000 (2.0 Litre)</td>
</tr>
</tbody>
</table>

Examples
- 175  0.35  17.5  35.0
- 625  1.25  62.5  125.0
- 1350 2.70  135  270
- 18,125 36.25 1812 3624

**In-water medication must be palatable**
- add Flavouring until it tastes OK to you
- Some medications are flavoured by manufacturer:
- Metacam Drops – Honey flavour
- Clavulox drops – vanilla
- Nilstat Drops – Cherry flavour

**Flavouring you can add:**

- Glucodin
- Pina Colada
- Strawberry Daquiri
- Fruit Juice
- Raspberry Cordial
- Lime Cordial
- Fruit Cup Fruit Juice Cordial (Golden Circle®)

**Not all medications are soluble in water:** for Hepatopathy we use Ursofalk & Colgout

- Not soluble in water
- Are soluble in alcohol
- Brandy
- Vodka

**Parenteral**

Any bird that is severely ill requires the medication to act as quickly as possible and for it to be delivered in the least stressful manner possible. Injections are often the best means of satisfying these criteria. As well there is no chance that the bird can regurgitate the medication.

I most commonly use a tuberculin syringe and either 26, 27 or 30 gauge needles, depending upon the viscosity of the drug. If it is a very viscous drug, I will load the syringe with a large bore needle (19 or 21 gauge) and then place a new 26 or 30 gauge needle onto the hub for the injection procedure.

1. **Intramuscular**

The most commonly chosen site for intramuscular injections is the large pectoral muscle mass, or in larger birds, into the thigh muscles. I recommend using the smallest gauge needle the medication will flow through freely - usually 25-27 gauge needles, or 30 gauge in canaries and finches. There is a balance between the trauma from the needle and the stress of holding an animal for the long time required if the material is very viscous.

For repeated injections it is best to avoid injecting into the same site. To avoid this I follow a set pattern of injections by dividing the pectoral mass into four quadrants. Since many injections are given b.i.d. it is at least 48 hours before the same site is used again.

The first injection is given to the bird in the right upper quadrant.

Subsequent injections follow in the order of:
left lower quadrant, right lower quadrant, left upper quadrant.
Table 2  Recommended Injection Pattern for daily or weekly injections

<table>
<thead>
<tr>
<th>Injection Number</th>
<th>Position in Pectoral mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Upper right quadrant</td>
</tr>
<tr>
<td>2</td>
<td>Lower left quadrant</td>
</tr>
<tr>
<td>3</td>
<td>Lower right quadrant</td>
</tr>
<tr>
<td>4</td>
<td>Upper left quadrant</td>
</tr>
</tbody>
</table>

The following volumes are cited by Rosskopf (1989) as the maximum volume per site of injection:

Table 3  Maximum Volume for Intramuscular Injection at Each Site

<table>
<thead>
<tr>
<th>Species</th>
<th>Maximum Intramuscular Injection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cockatoo or Macaw (&gt; 500g)</td>
<td>0.5 mL</td>
</tr>
<tr>
<td>Medium Parrot (300-500g)</td>
<td>0.4 mL</td>
</tr>
<tr>
<td>Small Parrot (100-300g)</td>
<td>0.3 mL</td>
</tr>
<tr>
<td>Cockatiel</td>
<td>0.2 mL</td>
</tr>
<tr>
<td>Budgerigar</td>
<td>0.1 mL</td>
</tr>
<tr>
<td>Canary or Finch</td>
<td>0.1 mL</td>
</tr>
</tbody>
</table>

I prefer to use a small amount of alcohol on a cotton wool swab to prepare the skin. Beware soaking small birds with alcohol as it will cause significant chilling. If the swab is run down the keelbone in a caudal direction, this will facilitate the parting of the feathers, allowing better visualisation of the muscle mass. All intramuscular injections are injected as deeply into the pectoral muscle mass as possible.

In most cases it only requires one person to catch, restrain and give the intramuscular injection. The syringe is held at 90° to the pectoral muscle, between the thumb and middle finger so that the index finger depresses the plunger.

Hints and Tips

How to Calculate Volume of an injection:

Volume of injection (ml) = [Patient wt (Kg) X Dose (mg/Kg)] / Concentration (mg/ml)

e.g. to calculate the dose volume of 50mg/ml Baytril Injection for a 120g Quarrion @ 10mg/kg

Volume = (0.12 X 10) / 50 = 0.024 ml

You can use this formula in a spreadsheet to calculate prepared dose volumes for any of the common drugs you use in hospital and then it removes calculation error for staff. They only need to weigh a patient accurately and then the dose is available from the
table. Have the tables available in a folder or on a computer for reference.

2. Subcutaneous

Subcutaneous injections may be used. This form of injection is not as easy to perform as the intramuscular route and the drug is not as rapidly absorbed, so it is not often used. Recommended sites for subcutaneous injections are the ventral abdomen in the region of the groin or the dorsal caudal cervical region. Large volumes (5-10mL per kg) can be administered at each site without cardiac overload being a problem. Fluid leakage through the delivery hole, in the relatively inelastic skin, can be a problem, chilling the bird and reducing the volume of fluid available for absorption. In critically ill birds, the rate of absorption from the subcutaneous area may be impaired, making this an inappropriate method of delivery.

3. Intravenous

Intravenous injections are the preferred choice when there is a need for rapid onset of action of the drug. It is useful for critically ill birds and where blood or fluid loss has been acute and or severe.

The preferred sites for intravenous injections are the right jugular vein and either of the ulnar veins (medial aspect of the wing, just as the vein crosses the elbow joint) or in large birds the medial metatarsal veins. In many birds, I prefer to avoid the Ulnar vein as it is more difficult to control haemostasis and a large bruise may result from extravasation, particularly in a struggling patient. The ulnar vein is suited for patients over 300g or where the Jugular is difficult to locate (e.g. pigeons, ratites and some poultry). The medial metatarsal Vein is useful in large birds such as ducks and some seabirds (e.g. albatross, petrels) or birds with long legs (e.g. egrets, herons).

Injections into the Jugular vein should be performed slowly to avoid myocardial effects or retropulsion of the medication into the brain.

In medium to large birds, an intravenous catheter inserted into the jugular vein can be used for repeated delivery of medication, without the stress and damage of repeated venipunctures. A 20-27 gauge needle is recommended. Place a luer injection site cap into the catheter and attach a butterfly shaped tape to the catheter so you can suture it to the skin or attach to the adjacent skin/feathers with a very small bleb of tissue glue. The positioning of the catheter is important. If it is too low the bird can reach it, too high and the bird will extract it by the motion of turning its head.

Consider the shape of the bird and ease of access to the catheter for repeated use, when selecting which vein to catheterise. Parrots manage well with a catheter in either the ulnar vein or the jugular vein, but individual birds vary in their tolerance of the catheter. The catheter will allow slow infusion of fluids or repeated administration of medications without repeated punctures. Catheters usually need to be replaced each 2 days.

Birds can tolerate intravenous doses of fluids up to 10mL/kg via the intravenous route if it is given slowly - over approximately 5 minutes.
Table 4  Maximum Volume for Intravenous ‘Bolus’ Injection

<table>
<thead>
<tr>
<th>Species</th>
<th>Maximum Intravenous Injection Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cockatoo or Macaw  (&gt;500g)</td>
<td>15 - 25mL</td>
</tr>
<tr>
<td>Medium Parrot      (300-500g)</td>
<td>8 - 10mL</td>
</tr>
<tr>
<td>Small Parrot       (100-300g)</td>
<td>4 - 6mL</td>
</tr>
<tr>
<td>Cockatiel</td>
<td>2 - 3mL</td>
</tr>
<tr>
<td>Budgerigar</td>
<td>1 - 2mL</td>
</tr>
<tr>
<td>Canary or Finch</td>
<td>1mL</td>
</tr>
</tbody>
</table>

4. Intraosseous

Intraosseous injections are indicated where intravenous access is difficult (small patients, poor blood pressure) or if the perfusion will cover some time or be repeated frequently. The two useful sites for placement of the intraosseous catheter are: Proximal or Distal Ulna; Proximal Tibiotarsus.

The intraosseous infusion of hypertonic or alkaline solutions may be painful, and are best avoided.

The recommended rate of intraosseous infusion is 1mL/100g/hour.

This site can be easily accessed with a small amount of practice and provides an excellent portal to the circulatory system so that the absorption is the same as the intravenous route. The skin should be prepared aseptically prior to the catheter being introduced. I prefer to use an 18 to 22 gauge spinal tap needle in medium to large birds (over 300g), as the stilette interferes with bony material clogging the lumen of the needle. In small birds I use one 23 to 25 gauge needle to bore the hole in the bone and to remove the bony plug and then replace this with a second needle for infusion. The catheter should be long enough to penetrate to a third or half of the bone length.

The placement of the catheter can be painful and in many birds is best achieved under anaesthesia. In moribund birds and emergencies this is not indicated and in most cases not necessary.

Steps in placing a catheter in the Ulna
1. Identify the lateral notch in the distal ulna.
2. Pluck the feathers from the site and aseptically prepare the skin.
3. Choose the appropriate sized needle.
4. Flex the carpus.
5. Hold the needle parallel to the median plane and centred in the bone.
6. Support the ulna with your free hand, to stabilise it for the needle to enter.
7. Push the needle through the bone with a rotating motion.
8. Remove the stilette or replace the small bore needle.
9. Aspirate through the needle to check for patency and presence of marrow.
10. Flush with heparinised saline.
11. Fluid should flow easily into the medullary space.
12. Check the ulnar vein; it should blanch after fluids are injected into the catheter.
13. Tape, suture or use tissue glue to attach the catheter to the skin of the patient.

5. Intracoelomic
Some people have described intraperitoneal or intracoelomic injections. The air sacs surround the coelomic viscera and are intimately attached to the peritoneum. The ability to perform an injection into the intraperitoneal space is limited and usually results in the medication being injected into one of the air sacs, this may be irritant to the air sacs or if the volume is large enough may aspiration into the lungs.

6. Intratracheal
This route of medication of the respiratory system, may be used as an alternative route to nebulisation. It may be performed in a conscious bird that is gently restrained in a towel, while its beak is held open with a speculum or gauze bandage. Water-soluble medications at a rate up to 2mL/kg may be placed into the trachea, via the glottis. I prefer to use a small diameter crop needle (18-21ga). The medication is injected as quickly as possible to create turbulence so a spray or mist is created. Immediately the delivery is completed, you should release the bird, so it is able to cough and clear its trachea. Drugs administered in this manner include the water-soluble forms of: most antibiotics; clotrimazole and Amphotericin B. In most cases this is used as an adjunct to treatment for cases of Aspergillosis or other difficult respiratory infections.

Medication Tips & Hints
*To dispense medications that are only available in a tablet form, you can make up a suspension for the client to use at home.

Obtain some obstetrical lubricant i.e. one that only contains methylcellulose.
Mavlab produce a Suspending Medium that is intended as a diluent. Parnell’s make an Obstetrical Lubricant powder that contains only methylcellulose - take care as many others contain chlorhexidine which is contra-indicated. Make the methylcellulose up according to the manufacturer’s directions. If it is too viscous, you can dilute it more, as it is only being used as a vehicle to deliver the medication.

Use a pill crusher (available from your local chemist or veterinary wholesaler) to crush the tablet to a fine, even powder.

Dissolve the powder in a 2-3mL of water. If the tablet is not water-soluble, e.g. Ketoconazole (Nizoral), use 2-3mL of vinegar. Do a simple calculation based on the amount of drug in the tablet and the patient’s dose to calculate an appropriate dilution in the methylcellulose. Example: crush 2 x Vibravet 50mg tablets = 100mg. Add enough water to dissolve the powder, then make up to 20mL with
methylcellulose. Shake well to form the suspension. The final concentration is 5mg/mL.

*Do you find that commercial hand-rearing mixes are too viscous to pass through a crop needle?* Do you find yourself in a situation where you need to give a patient supplemental feeding but if you dilute the mix to flow easily through the crop needle, you are delivering mostly water? Try this! Mix your formula to the manufacturer’s recommendations, then add a pinch of pancreatic enzyme powder (e.g. Enzyplex). Mix it through and wait a few minutes. It becomes much less viscous and is easily administered, but is still high in nutritional value.

*Many injectable forms of medications are active orally*, especially antibiotics, and can be used to replace tablets for oral medications in birds. If you are uncertain, telephone the manufacturer and discuss it with their veterinary department.

*How do you dispense medications in appropriate doses that the client can understand?* I use products such as Clavulox drops. The manufacturer claims that one drop from the dropper supplied with this product contains 2.5mg Clavulox when it is diluted according to the directions. The product contains 62.5mg/mL of combined Amoxicillin & Clavulanic Acid, so this equates to 25 drops per mL. It is simple mathematics to calculate the bird’s dose and then translate this into $X$ drops bid. Also with other medications, you can calculate the number of drops required with the same Clavulox dropper by dividing the mg/mL by 25 to give the concentration per drop. If you use a different dropper you need to calculate the number of drops per mL and then adjust the dose.

*When manufacturers advise a dose rate for in-water medication, this dose rate is based on the assumption that each bird will drink 50mL/kg body weight daily. For many species, such as poultry or pigeons, this is an accurate estimation of daily water intake. But for other birds, especially some of the parrot species whose natural wild habitat is more like a desert, this is not an accurate estimation of daily water intake. You can adjust for this by measuring the actual water intake in an aviary you wish to treat and then, considering the bird’s weight, adjust the concentration of the water provided to fit in with the actual water intake.

\[
\text{Daily dose to add to water} = \frac{\text{Volume of drinking container}}{\text{Daily water consumption}} \times \text{Calculated dose for patients weight}
\]

*When a range of doses is given e.g 5-10 mg/kg*

- The smaller the animal the higher the actual dose.
- The more rapid the metabolic rate the higher the dose
Delivering Medication at a Therapeutic Level

Factors to consider:
- Absorption
- Distribution
- Metabolism
- Excretion

1. Absorption

Drugs can cross membrane barriers in one of five ways
- passive aqueous diffusion – large molecules can pass through aqueous pores. Skin has small pores; capillaries have large pores; capillaries in brain have no pores
- passive lipid diffusion – molecules go into solution in the lipids of the membrane; rate is driven by concentration and lipid solubility
- facilitated diffusion – transported at an accelerated rate by special carriers in the membrane, but at a rate determined by the concentration gradient
- pinocytosis – “cell drinking” - very large molecules are engulfed by the cell and expelled on the other side
- active transport – against a concentration gradient

Rate of absorption is therefore determined by:
- route of administration
- characteristics of the drug

2. Distribution

- drug molecules bind to plasma and tissue protein
- they diffuse into peripheral tissue through capillary filtration
- protein–bound drugs do not cross membranes, and they are not active
- lipophilic drugs diffuse faster in fat-containing tissues
- therefore distribution is determined by the drug’s
  1. Ionisation
  2. protein binding
  3. lipophilic characteristics

3. Metabolism

- most drugs are metabolised, and most are metabolised in the liver
- the rate of metabolism is proportional to the concentration of the drug
- some drugs need to be metabolised to become active
  e.g. anthelmintics (Fenbendazole, Thiabendazole)
some drugs are metabolised to toxic metabolites
e.g Cherry seeds contain cyanogenetic glycosides – cyanide released at digestion

4. Excretion
most drugs are excreted by the kidneys
some are excreted in the bile and therefore in the faeces
Doxycycline has an entero-hepatic circulation
  - Ca & Zn bind and reduce this
volatile anaesthetics are excreted from the lungs

Causing Minimal side-effects

Side-effects can occur  Aim to Deliver Medication Without hurting the animal
Any drug  Stress
Any animal  Capture myopathy
Any reaction  Immunosuppression
Any time….  - tetracyclines

Effect of the drug  
  - chemical irritant, eg Baytril injection, Doxycycline injection

DRUG USAGE GUIDE – WITHDRAWAL TIMES

<table>
<thead>
<tr>
<th>Drug Name</th>
<th>Days Withdrawal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxycillin</td>
<td>1</td>
</tr>
<tr>
<td>Ampicillin oral</td>
<td>1</td>
</tr>
<tr>
<td>Ampicillin injectable</td>
<td>15</td>
</tr>
<tr>
<td>Amprolium plus ethopabate</td>
<td>0</td>
</tr>
<tr>
<td>Apramycin sulphate</td>
<td>14</td>
</tr>
<tr>
<td>Azimetiphos</td>
<td>1</td>
</tr>
<tr>
<td>Bacitracin</td>
<td>0</td>
</tr>
<tr>
<td>Carbaryl</td>
<td>0</td>
</tr>
<tr>
<td>Chlortetracycline hydrochloride, water/feed</td>
<td>7</td>
</tr>
<tr>
<td>Dibutyl tin dilaurate + phenothiazme + piperazine HCI</td>
<td>7</td>
</tr>
<tr>
<td>Drug Name</td>
<td>Days Withdrawal</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Diclazuril</td>
<td>0</td>
</tr>
<tr>
<td>Dihydromestromycrn sulphate</td>
<td>30</td>
</tr>
<tr>
<td>Dimetridazole</td>
<td>5</td>
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<tr>
<td>Dinitro-ortho-toluamide</td>
<td>0</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>7</td>
</tr>
<tr>
<td>Fenchlorvos</td>
<td>14</td>
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<tr>
<td>Flavophospholipo</td>
<td>10</td>
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<tr>
<td>Furaltadone</td>
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<tr>
<td>Furazolidone</td>
<td>0</td>
</tr>
<tr>
<td>Gallimycin</td>
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<tr>
<td>Gentian Violet</td>
<td>0</td>
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<tr>
<td>Halofuginone</td>
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<tr>
<td>Halquinol</td>
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<tr>
<td>Hygromycin B</td>
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<tr>
<td>Lasolacid sodium</td>
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<tr>
<td>Levamisole</td>
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<tr>
<td>Lincomycin + spectinomycin:</td>
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<tr>
<td>Linco-Spectin Soluble Powder</td>
<td>10</td>
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<tr>
<td>Linco-Spectin 100 Soluble Powder</td>
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<tr>
<td>Linco-Spectin Sterile Solution</td>
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<tr>
<td>Linco-Spectin Antibiotic Premix</td>
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<tr>
<td>Maduromycin ammonium</td>
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<td>Malathion</td>
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<td>Monensin Sodium</td>
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<tr>
<td>Narasins</td>
<td>0</td>
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<tr>
<td>Neomycin sulphate sulphate, laying birds:</td>
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<tr>
<td>Neomix concentrate, Upjohn broilers</td>
<td>5</td>
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<tr>
<td>Neomix concentrate, Upjohn laying hens and turkeys</td>
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<tr>
<td>CCD Formula 8</td>
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</tr>
<tr>
<td>Nicarbazin</td>
<td>0</td>
</tr>
<tr>
<td>Drug Name</td>
<td>Days Withdrawal</td>
</tr>
<tr>
<td>------------------------------------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Novobiocin</td>
<td>4</td>
</tr>
<tr>
<td>3-nitro-hydroxy-phenylarsome acid</td>
<td>5</td>
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<tr>
<td>4-nitro-phenylarsome acid</td>
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<tr>
<td>Novobiocin</td>
<td>4</td>
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<tr>
<td>Oleandomycin</td>
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<tr>
<td>Oxytetracycline hydrochloride (Terramycin):</td>
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<tr>
<td>CCD Formula 3</td>
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<tr>
<td>Terramycin 200 Feed Supplement</td>
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<tr>
<td>Terramycin 100 Soluble Powder Concentrate</td>
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<tr>
<td>Terramycin 50 soluble powder</td>
<td>7</td>
</tr>
<tr>
<td>Terramycin LA</td>
<td>21</td>
</tr>
<tr>
<td>Penicillin, oral</td>
<td>1</td>
</tr>
<tr>
<td>Penicillin, injectable</td>
<td>5</td>
</tr>
<tr>
<td>Piperazine</td>
<td>0</td>
</tr>
<tr>
<td>Robenidine</td>
<td>5</td>
</tr>
<tr>
<td>Rotenone</td>
<td>1</td>
</tr>
<tr>
<td>Salinomycin</td>
<td>0</td>
</tr>
<tr>
<td>Sodium Salinomycin</td>
<td>0</td>
</tr>
<tr>
<td>Sodium sulphachloropyrazine monohydrate</td>
<td>7</td>
</tr>
<tr>
<td>Streptomycin, injectable</td>
<td>30</td>
</tr>
<tr>
<td>Sulphadiazine</td>
<td>10</td>
</tr>
<tr>
<td>Sulphadimidine sodium</td>
<td>10</td>
</tr>
<tr>
<td>Sulphaquinoxaline + diaveridine + vitamin K</td>
<td>7</td>
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<tr>
<td>Sulphaquinoxaline (MB) Embazin</td>
<td>0</td>
</tr>
<tr>
<td>Tiamulin hydrogen fumarate</td>
<td>5</td>
</tr>
<tr>
<td>Toltrazuril</td>
<td>0</td>
</tr>
<tr>
<td>Trimethoprim + sulphadiazine</td>
<td>10</td>
</tr>
<tr>
<td>Trimethoprim + sulphadoxine</td>
<td>10</td>
</tr>
<tr>
<td>Tylosin tartrate, chickens (oral)</td>
<td>2</td>
</tr>
<tr>
<td>Tylosin tartrate, chickens (injectable)</td>
<td>3</td>
</tr>
<tr>
<td>Drug Name</td>
<td>Days Withdrawal</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Tylosin tartrate, turkeys (oral, injectable)</td>
<td>5</td>
</tr>
<tr>
<td>Virginiamycin</td>
<td>0</td>
</tr>
</tbody>
</table>

**Some Useful Resources**

**Internet**
- www.vin.com  The Veterinary Information Network:
- www.aemv.org  Association of Exotic Mammal Veterinarians
- http://groups.yahoo.com/group/ExoticDVM
- http://groups.yahoo.com/group/UnusualExoticPets (AVA special interest group)
- www.davidvella.com.au

**Books**

**Journals/periodicals**
- Exotic DVM magazine. Published by the Zoological Education Network, PO Box 541749, Lake Worth, Florida 33454-1749, USA. www.exoticdvm.com.