EXOTIC COMPANION MEDICINE HANDBOOK

FOR VETERINARIANS

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EXOTIC COMPANION MEDICINE HANDBOOK

FOR VETERINARIANS

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FOR VETERINARIANS

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Preface

Dear Reader:

"The Exotic Companion Medicine Handbook" began as a way for me to organize all my quick reference notes, diagnostic and clinical pathology charts, formularies, lists, and other clinical notes that I found I needed close at hand during practice. The very nature of avian and exotic animal practice requires drawing from many reference sources. Diverse continuing education courses and the switching of mental gears between office calls requires far more knowledge than one is prepared for in traditional small animal practice.

Long ago I stopped memorizing life history numbers, dosages and the other bits of reference information needed infrequently. Instead, I memorized where I had to look for quick reference. Those "cheat sheets" had expanded into three, large loose-leaf notebooks, and it was clearly time to put the information into a much more concise and usable form.

With the encouragement, support, and enthusiasm of Linda Harrison and Greg Harrison, the idea of creating a concise, pocket reference source became a reality. This publication contains the information needed quickly by anyone working with companion birds, rabbits, rodents, ferrets, hedgehogs, reptiles, amphibians, invertebrates and other species frequently or even occasionally encountered by veterinarians. We put it in notebook form so the clinician could customize and rearrange pages to fit his/her personal information needs. We kept the size of the book small enough to be carried in a laboratory coat pocket. This book was designed for veterinarians, veterinary technicians and students. Much of this information may be of use to others in other fields who work with animals. We hope you find the "handbook" very useful and welcome your comments on this project.

I would like to thank and acknowledge those in addition to the folks at Zoological Education Network who have contributed to the form and content of this project: W.B. “Skip” Nelson, Carrie Reid, Melanie Longfellow, Stephanie Knutson, Christine Cannon, the members of the Association of Northwest Avian and Exotic Veterinarians, Storm Hudelson, Cheryl Greenacre, Michael Delaney, Gail Hoofnagle, Michael Garner, Susan Brown, Carolyn Cray, Robbie McFerret Delaney, and all the avian/exotic practitioners who share their experiences through journals, conferences and organizations so the rest of us can better the lives of non-traditional companion animals.

Sincerely,

Cathy A. Johnson-Delaney, DVM

How to use

This quick reference guidebook is for you to personalize and develop in ways that best suit your individual role in animal care.

The *Exotic Companion Medicine Handbook for Veterinarians* consists of two 13-ring pocket-sized binders and 23 color-coded tabs with the following titles:

SMALL MAMMALS
Ferrets
Rabbits
Small Rodents (rats, mice, gerbils, hamsters)
Guinea Pigs
Special Rodents (chinchillas, prairie dogs, degus, duprasi)
Hedgehogs
Marsupials (sugar gliders, possums, wallabies)
Exotic Carnivores (skunks)

BIRDS
Psittacines
Passerines & Softbills
Pigeons
Poultry & Waterfowl
Raptors
Ratites

REPTILES
Snakes
Turtles & Tortoises
Lizards

AMPHIBIANS

INVERTEBRATES
Tarantulas

APPENDIX

Where To Find It

The chapters with general headings of Small Mammals, Birds, Reptiles, Amphibians and Invertebrates cover topics that apply to all members of the Class. Information on a specific Order is presented within its separate chapter. Each chapter begins with a contents page so the abbreviated topics can be located more quickly. In cases where several segments are included in a

chapter (eg, Rats, Mice, Gerbils, Hamsters in SMALL RODENTS), an individual contents page is provided for each segment. The material within each tabbed section is numbered consecutively for that section alone.

We have attempted to cover the following topics in each chapter with as much as is known to date:

Common Species, Behavior, Diet, Housing, Preventive Care, Restraint, Sexing, Physiologic Quick Facts, Reproductive Quick Facts, Breeding & Raising Young, First Visit /Annual Examination, Blood Collection, Injection Sites, Hematologic and Biochemistry Reference Ranges, Radiography, Common Clinical Conditions, Zoonotic Potential, Rule Out Chart Based on Clinical Signs and Formulary. Rule Out Charts are laid out alphabetically according to the dominant clinical sign. Each formulary is alphabetical according to generic name of the product.

Illustrations

All radiographic anatomy illustrations are from Rübel, Isenbügel and Wolvekamp: *Atlas of Diagnostic Radiology of Exotic Pets*, 1991, and used with permission of Schlütersche, Hannover, Germany. Other selected restraint and sex determination illustrations are reprinted courtesy of Iowa State University Press and Williams and Wilkins.

Disclaimer

Although every effort has been made to ensure the accuracy of the contents, particularly drug doses, it is the responsibility of the clinician to critically evaluate the contents, to stay informed of pharmacokinetic information and to observe recommendations provided by manufacturers.

A Living Resource

During the production of this handbook, we have maintained contact with newly published material. However, because of the enthusiasm of pet owners for exotic species and the need for veterinary medicine to accept responsibility for their care, information on exotic companion species is constantly being modified and updated. This handbook, therefore, must become a living resource that is also continually being revised and updated by the user. It is only then that its true value can be realized. We sincerely seek your comments and input on how future editions may serve you even better.

Small mammals

The Small Mammals section includes individual chapters for Ferrets, Rabbits, Small Rodents (rats, mice, gerbils, hamsters), Guinea Pigs, Special Rodents (chinchillas, prairie dogs, degus, duprasi), Hedgehogs, Marsupials (sugar gliders, brushtail possums, ringtail possums, short-tailed possums, Tammar wallaby, Bennett's wallaby) and Exotic Carnivores (skunks). The topics listed below in this introductory chapter apply generally to all animals in this section.

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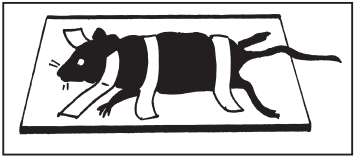
In all chapters, printed hematologic and biochemistry reference values represent ranges derived from the literature. Individual practitioners should strive to establish their own "normals" with their own laboratory.

Although every effort has been made to ensure the accuracy of the information presented herein (particularly drug doses), the clinician is responsible for the use of any therapeutic recommendations. Most drugs used in exotic companion species are considered extra-label and few pharmacokinetic studies have been conducted; therefore, the clinician must critically evaluate the information provided.

SMALL MAMMALS

Radiographic Positioning in Small Mammals

- Routine whole body study, dorsoventral view: The sedated or anesthetized patient is placed on the x-ray cassette in sternal recumbency. The DV examination is preferred to the VD examination since it may be difficult to eliminate patient rotation in the VD projection.



Masking tape is used to immobilize the patient, with moderate extension of the head, neck and legs.

- Routine whole body study, lateral view: The sedated patient is placed on the cassette in lateral recumbency. Masking tape is used to immobilize the legs in a comfortably extended position and the neck is also taped. The dependent legs should be positioned cranial to the contralateral limbs.

Intraosseous Catheter Placement in Small Mammals

- Suitable for use in ferrets, rabbits, mice, rats, hamsters, gerbils, guinea pigs, chinchillas, hedgehogs.
- Sedate the patient (preferably with isoflurane) only if necessary. Most critically ill animals will not need to be sedated.
- Clip the hair over the head of the femur/hip area. After surgical prep, a drape should be used, along with gloves & good sterile technique.
- Block the skin over the head of the femur with Lidocaine.
- If the head of the femur cannot be easily palpated (ie, there is considerable fat/muscle tissue or tough skin in the case of a severely dehydrated animal), a small stab incision will need to be made to facilitate insertion of the needle into the bone. Otherwise the needle may be bent or dulled during penetration of the skin, or will be difficult to place without considerable tissue trauma. An 18, 20 or 22 ga short (3/4 - 1”) spinal needle is preferred to prevent bone plugs. However, regular syringe needles of the appropriate gauge may be used. Stylets can be made for regular syringe needles from used stylets or smaller gauge needles.
- Insert the needle. Once it is in the marrow cavity, there should

be no resistance. If you do meet resistance, you are hitting the cortical bone. Withdraw the needle and redirect it. Attach a sterile 3 ml syringe and aspirate. A small amount of marrow should be visible in the hub.

- A small piece of tape should be placed over the hub of the needle (wings) and sutured in place on the hip.
- Attach IV fluids. Delivery should be set at approximately 50-60 drops per minute.
- Fluid choice: 1/2 strength LRS/2.5% Dex combination (isotonic formulation) is preferred. Small mammals have a high metabolic rate. Dex5%W is first choice for the severely anorectic patient.
- Fluid volume requirements: 20-25 ml/kg daily plus amount needed to correct dehydration. Monitor closely. If the patient is in shock: 25-40 ml/kg/ 24 hours, but reassess frequently.
- Fluids should be warmed to body temperature and delivered warm (can use Safe & Warm fluid administration system or keep fluids warm in a spare incubator). If microwave is used, be sure fluid is mixed well for even temperature. Hot water bath works well for individual syringes and to run non-insulated line through.
- If fluids are not to be continuous, a catheter male adapter plug may be inserted into the end of the needle, and the site padded with gauze and wrapped with Vetwrap to protect the hub.
- Sterile technique should be used whenever access to the catheter plug is used.
- Intraosseous catheters may be left in place for up to 72 hours in the critically ill patient. Frequently they must be pulled within 24 hours if the animal becomes active (and bends the needle).

Small Exotic Mammal References

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Sources of Ferret Information

Ferret Central -- http://www.optics.rochester.edu:8080/users/pgreene/central..html

Ferret FAQ Global Index -- http://www.optics.rochester.edu:8080/users/pgreene/faq/index.html

Ferret Pathology -- http://vetpath.afip.mil/ferretpath.html

American Ferret Association
PO Box 3986
Frederich, MD 21701-3986

International Ferret Association
PO Box 522
Roanoke, VA 24003-0522
703-342-7430

Domestic Ferret Association of Canada
47 Oakcrest Ave.
Toronto, Ont, CANADA M4C 1B4

Greater Chicago Ferret Association
PO Box 7093
Westchester, IL 60154-7093
312-357-8682

Ferret Franciers Club
711 Chantauque Court
Pittsburgh, PA 15214

FURO (Ferret Unity + Registration Organization, Inc)
PO Box 18193
Greensboro, NC 27419

California Domestic Ferret Association
PO Box 1868
Healdsburg, CA 95448
707-431-2277

Central Illinois Friends of Ferrets
PO Box 564
Urbana, IL 61801

Selected Rodent Organizations

National Fancy Rat Society
c/o Hon Sec Greg Baker
4 Salisbury Road, Ealing
London W13 9TX, ENGLAND

NFRS Membership Coord.
c/o Elaine Johnston
4 Mayfair Court, Barn Hall Avenue
Colchester CO2 8TH, ENGLAND

National Mouse Club and Rare Varieties Support Group (mice)
c/o Hon. Secretary Dave Bumford
15 Rossall Drive
Fulwood, Preston, Lancs
ENGLAND PR2 3SL
(tel) 0772 715444

SRS - Swedish Rat Society
c/o Potku Holmstedt
Kullstigen 10, 3tr
S-142 30 Trangsund, SWEDEN
(tel) 46-(0)8-7716718
or see homepage:
http://www.mdh.se/@ltd92fsk/srs_main.html

Finish Rat Society
Eva-Lotte Mattsson
Ronnvagen 11
04130 Sibbo, FINLAND
(tel) 90 231 867

American Fancy Rat and Mouse Assoc
AFRMA Secretary
9230 64th Street
Riverside, CA 92509

Rat, Mouse & Hamster Fanciers
c/o John Langdell
1756 14th Ave.
San Francisco, CA 94122
415-564-6374

Mouse and Rat Breeders Assoc
c/o Sharon Brown
127 Stockbridge Ln.
Ojai, CA 93023
805-646-0663

The American Rat, Mouse and Hamster Society
c/o Sandy Ramey
9370 Adlai Road
Lakeside, CA 92040

Northeast Rat & Mouse International
c/o Diana Potter, Pres.
20 Oak Lane
Sterling, VA 20165
703-430-4063

Rat Fan Club
857 Lindo Lane
Chico, CA 95926
916-899-0605
debbie_ducommun@macgate.csuchico.edu

The British Hamster Association
P.O. Box 825, Sheffield
S17 3RU, ENGLAND

Sources of Hedgehog Information

Storer P: Everything You Wanted to Know About Hedgehogs but You Didn't Know Who to Ask 3rd ed. Country Storer Enterprises P.O. Box 160, Columbus, TX 78934 USA, 409-732-9417

Stocher L: The Complete Hedgehog, Trafalgar Square, United Kingdom, Chatto & Windus, 1994. 128 pp, illus, ISBN 0-7011-3272-8.

Hedgehog FAQ - Internet: macnamara@pci.on.ca (Brian MacNamara)

Hedgehog News ($35/four issues)
North American Hedgehog Association
601 Tijeras NW Suite 201
Albuquerque NM 87102
505-843-6351

Professional Wildlife Rehabilitation Organizations

National Wildlife
Rehabilitators Association
14 North 7th Avenue
St. Cloud, MN 56303

International Wildlife
Rehabilitation Council
4437 Central Place, B-4
Suisun, CA 94585

Pocket Pet Regulations

The United States Department of Agriculture is now regulating retail dealers who sell small exotic animals or "pocket pets." Retail stores that sell small exotic animals as pets will be licensed as class "B" dealers and must pass a pre-licensing inspection. Follow-up inspections of these facilities will be conducted on a complaint-driven basis with a minimum of one inspection every three years.

The Animal Welfare Act requires that regulated individuals and businesses provide animals with care and treatment according to the standards established by APHIS. Animals protected by the law must be provided with adequate housing, handling, sanitation, food, water, transportation, veterinary care and shelter. The law covers animals that are sold as pets at the wholesale level and small exotic pets sold at the retail level, transported in commerce, used for biomedical research, or used for exhibition purposes.

Infectious Diseases of Small Mammals

Sendai virus	
System:	Respiratory
Transmission:	Aerosol, contact
Diagnosis:	ELISA
Significance:	Very high
Hosts:	Mouse, rat, hamster, guinea pig
Pneumonia virus of mice	
System:	Respiratory
Transmission:	Aerosol, contact
Diagnosis:	ELISA
Significance:	Low
Hosts:	Mouse, rat, hamster, guinea pig, rabbit
Mouse encephalomyelitis virus	
System:	Systemic, nervous
Transmission:	Oral
Diagnosis:	ELISA
Significance:	Low
Hosts:	Mouse, rat

Reovirus - 3	
System:	Respiratory, gastrointestinal
Transmission:	Aerosol, oral, fomites
Diagnosis:	ELISA
Significance:	Low
Hosts:	Mouse, rat, hamster, guinea pig

Mycoplasma pulmonis	
System:	Respiratory, reproductive
Transmission:	Aerosol, vertical
Diagnosis:	ELISA
Significance:	Very high
Hosts:	Mouse, rat, rabbit, hamster, guinea pig

Lymphocytic choriomeningitis virus	
System:	Systemic
Transmission:	Contact, vertical
Diagnosis:	ELISA, IFA
Significance:	High (zoonoses)
Hosts:	Mouse, rat, hamster guinea pig, rabbit

Mouse adenovirus	
System:	Systemic, gastrointestinal
Transmission:	Oral
Diagnosis:	ELISA
Significance:	Low
Hosts:	Mouse, rat

Hantaan virus*	
System:	Systemic, urinary
Transmission:	Aerosol
Diagnosis:	ELISA
Significance:	High (zoonoses)
Hosts:	Wild rodents

Encephalitozoon cuniculi	
System:	Nervous, urinary
Transmission:	Oral, vertical (RB)
Diagnosis:	ELISA, IFA
Significance:	Low
Hosts:	Mouse, rat, hamster guinea pig, rabbit

Rat coronavirus (SDAV)	
System:	Respiratory, systemic
Transmission:	Contact, aerosol
Diagnosis:	ELISA
Significance:	High
Hosts:	Mouse, rat

Kilham rat virus	
System:	Systemic
Transmission:	Aerosol, oral, fomites
Diagnosis:	ELISA
Significance:	High
Hosts:	Rat, hamster

CAR bacillus	
System:	Respiratory
Transmission:	Unknown
Diagnosis:	ELISA, IFA, pathology
Significance:	Unknown
Hosts:	Mouse, rat, hamster guinea pig, rabbit

Corynebacterium kutscheri	
System:	Systemic, respiratory
Transmission:	Oral, aerosol
Diagnosis:	Pathology, culture
Significance:	Moderate or unknown
Hosts:	Mouse, rat, guinea pig

Streptococcus pneumoniae	
System:	Respiratory
Transmission:	Aerosol
Diagnosis:	Pathology, culture
Significance:	Low (zoonoses)
Hosts:	Rat, guinea pig, mouse

Salmonella enteritides	
System:	Gastrointestinal, systemic
Transmission:	Oral
Diagnosis:	Pathology, culture
Significance:	Moderate or unknown (zoonoses)
Hosts:	Mouse, rat

* *For guidelines in working with rodents potentially infected with hantavirus, contact Dr. Mills at CDC 404-639-1075.*

Ferrets

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of ferrets and is not intended to replace comprehensive reference material.

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FERRETS Order - **Carnivora** Family - **Mustelidae**

Species *Mustela putorius furo* or *Mustela furo*

Common Variations

- The ferret is a domestic animal descended from the European polecat (originally domesticated for pest control and hunting). It has been used for hunting rodents and rabbits, and has been raised for fur.
- Color variations include, but are not limited to:
  Sable, "fitch" = clearly defined mask and dark eyes
  Pastel, cream = light-colored mask, dark eyes
  Siamese = brown guard hairs
  Cinnamon = reddish guard hairs
  Albino, white (no mask or patterning, red eyes)
  Silver mitt (white, silver fur, black eyes, usually white feet)
  Gnome, brown or pastel (four white paws and throat patch)
- Cross-breeding produces many other colors.

Ferret-free Zones

- Ferret-free Zones (FFZ) are states or localities where ferrets are banned or illegal (subject to change). Complete listings are kept on the internet at "Ferret Central."
- Several states have special rabies quarantine laws governing ferrets in case of a human bite.
- Some states/municipalities (eg, Georgia, Illinois, Washington, DC, New York state, San Antonio, etc) require registration, permits, licenses or certificates of neutering.
- Most ferrets sold as companion animals are descented (demusked) and neutered at a young age.

Behavior

- Ferrets are good-natured, playful, non-aggressive, non-territorial, and require a fair amount of attention.
- They are very active and curious animals that enjoy the company of humans and other animals.
- They maintain their playfulness throughout their lives.
- Ferrets are not exclusively diurnal or nocturnal: they are usually most active in the early morning and evening but their natural schedule can be changed to coincide with their owners.
- They are best suited to run around free in the home, where they can be taught to use a litter box like a cat. It is advisable to have a litter box in every room or area where the ferret

spends a great deal of time. Place litter boxes in corners.

- Ferrets are extremely inquisitive, agile and get into everything; they attack household plants, steal socks, push things down from shelves.
- Ferrets should be caged when unattended. This prevents incalculable damage to your home, and prevents the dangers of injury, toxicity and escape of the ferret.
- Ferrets steal items they treasure and drag things back into nooks and corners — most ferrets have stashes in several locations around a home.
- Ferrets like to get into tight spaces - if they can get their head in, the body will follow. They like sacks, tunnels, pillow cases, drawers, clothing, ducts, boxes, cupboards and cabinets.
- Both genders become less stressed if they are neutered.
- Ferrets learn quickly and can be trained to come to particular cues such as bells, squeaks, or clickers.
- Ferrets tend to bite and latch onto toys; early discipline and training will eliminate nipping and biting when they are older (licking not acceptable; "ferret kisses" not recommended).
- Ferrets easily adapt to a harness and lead.
- They travel well, and love to go places. A standard dog or cat carrier, equipped with a small litter box, is adequate for a ferret.
- Ferrets are quiet. The only vocalizations they make are chuckles and giggles during play. Occasionally ferrets will whine or cry when they want something, or if they are in pain or ill.

Diet

- Ferrets are true carnivores; they cannot handle fiber >4%.
- Commercial diets specifically formulated for ferrets are recommended; eg, Totally Ferret (Performance Foods, Inc), Forti Diet (Kaytee Products, Inc.), Marshall Ferret Diet (Marshall Pet Products, Inc.), Purina/Mazuri Ferret Chow (Mazuri Zoo Feeding Resource Line), (PMI Feeds, Inc.).
- To convert ferrets from dry cat foods to ferret food: pulverize both the cat food and the ferret food so that pieces are too small to differentiate from each other, eg, 1/16 of an inch. Gradually mix in the ferret food: start with 90% cat, 10% ferret food; over 2-3 weeks change proportions to reach 100% ferret food.
- Avoid added salt in the diet.
- Food intake (dry matter) is approximately 20-40 g/day/adult.
- Gut transit time is a maximum of 3 hours.
- Fresh water must always be available.

- Although many ferrets enjoy sweets, dairy products, raisins, fruits and vegetables, ingestion should be limited. Many will produce diarrhea and ferrets cannot digest the fiber in many fruits and vegetables.

Preventive Care

Vaccination protocol:

- Canine distemper - Fervac-D™ (United Vaccine)
  6 weeks of age SC
  10 weeks of age SC
  14 weeks of age SC
  Annual booster
- An anaphylactic-like reaction to repeated (booster) doses of Fervac-D™ has been reported. As a precaution, have the ferret stay in your clinic 20-30 minutes post booster. The reaction may be manifested by dyspnea, hypersalivation, tremor or seizure, urination/defecation, pyrexia. Treatment includes parenteral dyphenhydramine, predisone or dexamethasone, supplemental oxygen, and other supportive care as needed. It is still recommended that the ferret receive an annual distemper booster, even if it has had a reaction. Pre-administration of an intramuscular dose of diphenhydramine has worked successfully in preventing a repeat reaction.
- Rabies - Imrab® (Rhone Merieux)
  #1 @ 3 months SC
  Annual booster
- Heartworm preventive
- Grooming: bathe, cut nails, clean ears.
- Dental prophylaxis. Frequent brushing of teeth; routine scaling and cleaning.
- Provide a safe environment, as ferrets want to investigate everything.
- Eliminate toys of rubber, plastics that can be ingested.
- Keep litter boxes clean and dry.

Housing

- Cage dimensions (L x W x H): Breeding = 75 x 45 x 15 cm; Growing = 55 x 50 x 40 cm; Experimental = varies
- Environmental temperature: 15-25°C
- Humidity: 45-55%
- Lighting: 12-16 hr/day

- Nest material: shavings (hard wood, pine, avoid cedar) or composite recycled pelleted
- Sleeping preference: with a towel, blanket or sweater; in hammock or box. Like to burrow into soft cloth or garments.

Restraint

Manual restraint of ferret.

Ferrets - Quick Facts

Physiologic	
Life span:	5-8 yr (avg. for pets)
Adult male body weight:	0.8-3.0 kg
Adult female body weight:	0.7-1.0 kg
Body temperature:	37.8-40°C (100-104.1°F)
Respiratory rate:	33-36 breaths/min
Heart rate:	225 bpm
Blood volume:	60-80 ml/kg

Reproductive	
Age at pairing (male):	8-12 months
Age at pairing (female):	8-12 months
Type of estrous cycle:	Polyestrous
Duration of estrous:	Prolonged
Mechanism of ovulation:	Induced
Time of ovulation:	30 hr
Breeding season:	All year
Time of implantation:	Day 13
Length of gestation:	42 days
Litter size:	10 (7-14)
Weight at birth:	8.5 g
Weaning age:	6 weeks
Weaning weight:	0.2-0.4 kg
Rebreeding:	Immediate
Begin solid food:	14-21 days

First Visit/ Annual Examination

- Physical examination: weight, otoscopic and dental exams
- Fecal flotation (first visit and first year - then only as history or exposure dictates)
- If abnormalities noted: CBC/chemistries, urinalysis, radiographs, fecal culture, direct smear; additional diagnostics
- Booster vaccinations for canine distemper and rabies (if due)
- Optional: transponder scanning/microchip implantation

Geriatric Examination (3+ years)

- Annual (and pre-anesthetic) physical examination: heart and lung sounds, temperature, weight and general condition
- General blood panel CBC/chemistries, urinalysis; specialized serum or urine chemistries if clinical history, PE warrant

(Under isoflurane anesthesia:)

- Deep abdominal palpation for “lumps,” enlarged organs
- Ultrasonography if abnormalities found
- Deep ear examination and cleaning if necessary
- Dental examination - scale tartar from teeth if needed
- Radiographs (chest and abdomen)
- Cardiography/echocardiography, electrocardiogram
- Optional: fecal concentration test, stool culture

Blood Collection Sites

- Cranial vena cava
- Jugular
- Ventral tail vein
- Saphenous vein
- Cephalic vein

HEMATOLOGIC AND BIOCHEMISTRY REFERENCE VALUES OF FERRETS*

Analyte	Method	Male	Female
Erythrocytes	Electrical resistance	9.65-9.69 x 10^6/mm^3	9.3-9.34 x 10^6/mm^3
Hematocrit	Calculated	49.4-49.8%	48.4-48.8%
Hemoglobin	Coulter Hemoterge II	16.7-16.8 g/dl	16.2-16.3 g/dl
MCV	Electrical resistance	51.4 μ^3	52.1-52.2 μ^3
Fibrinogen	Optics	171-189 mg/dl	171-184 mg/dl
Lymphocytes	Wrights Giemsa	46-48%	45%
Neutrophils (segmented)	Wrights Giemsa	47-48%	49-50%
Neutrophils (band)	Wrights Giemsa	0-0.16%	0-0.11%
Eosinophils	Wrights Giemsa	3-3.5%	3-3.3%
Monocytes	Wrights Giemsa	1-1.19%	1-1.12%
Basophils	Wrights Giemsa	0-0.49%	0-0.34%
MCH	Calculated	17.3 pg	17.5 pg
MCHC	Calculated	33.7-33.8%	33.4-33.5%
Leukocyte count	Electric resistance	8.9-9.2 x 10^3/mm^3	7.0-7.6 x 10^3/mm^3
Platelet count	Unopette (manual)	735-766 x 10^3/mm^3	730-764 x 10^3/mm^3
Uric acid	Uricase	1.2-1.3 mg/dl	1.7-1.8 mg/dl
Cholesterol	Esterase/oxidase	158-162 mg/dl	182-183 mg/dl

HEMATOLOGIC AND BIOCHEMISTRY REFERENCE VALUES OF FERRETS*

Analyte	Method	Male	Female
Total protein	Biuret	6.0 g/dl	5.9 g/dl
Albumin	Bromcresol Green	3.5 g/dl	3.4 g/dl
Globulin	Calculated	2.4-2.6 g/dl	2.4-2.5 g/dl
AG ratio	Calculated	1.42-1.46	1.39-1.42
Bilirubin (total)	DPD	0.2 mg/dl	0.2 mg/dl
Alkaline phosphatase	Modified Bowers/McComb	31-37 IU/L	34-40 IU/L
Lactate dehydrogenase	Modified Wacher	432-595 IU/L	492-621 IU/L
Aspartate transaminase	Modified Henry	76-92 IU/L	84-97 IU/L
Alanine transaminase	Modified Henry	139-205 IU/L	138-210 IU/L
Glucose	Hexokinase	109-110 mg/dl	117-118 mg/dl
Urea nitrogen	Urease	19-21 mg/dl	21-27 mg/dl
Creatinine	Jaffe	0.48-0.50 mg/dl	0.40-0.44 mg/dl
Calcium	CPC	9.5 mg/dl	9.6 mg/dl
Phosphorus	Molybdate	7.0 mg/dl	6.4-6.5 mg/dl

** Marshall Farms Ferrets Hematology Data and Clinical Chemistry Data*

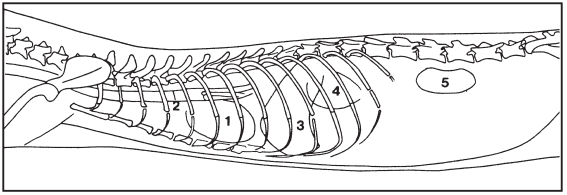
Additional Serum Chemistry Values**	
Sodium:	148 mmol/l
Potassium:	5.9 mmol/l
Chloride:	116 mmol/l
Inorg. Phos:	5.9 mg/dl

*** Ferret Blood Comparisons from Marshall Farms*

Hematology Reference Ranges***	
WBC:	3.3-15.9 x10^3
PCV:	30-55%
Heterophils:	Seg: 9.0-54% Band: 0-1%
Lymphocytes:	34-85%
Monocytes:	0-8%
Eosinophils:	0-10%
Basophils:	0-3%
RBC:	3.6-10.0 x10^6

**** University of Miami Avian Diagnostic Lab (ranges determined from plasma 12-24 hrs old on Kodak Ektachem and Dupont Analyst benchtop machines).*

Radiographic Appearance



In the elongated thorax, the heart (1), trachea (2) and lungs may be clearly defined. The liver (3) may be demarcated by a food-filled stomach (4) and by the diaphragm. The left kidney (5) is present at the level of the third and fourth lumbar vertebrae. The right kidney is visible at the level of the first and third lumbar vertebrae and can only be defined on the ventrodorsal radiograph. *Rübel, 1991.*

Special Notes and Resources for Ferrets

- **LSA Research:** Dr. Susan Erdman, Division of Comp Med, MIT Bldg 45, 37 Vassar Street, Cambridge, MA 02139; 617-253-1722
- **Ferret urolith analysis (stones or urethral plugs):** Dr. Carl Osborne, Minnesota Urolith Center, Dept of Small Animal Clinical Science, College of Vet Med, University of Minnesota, St. Paul, MN 55108; 612-625-4221 (No charge - get request form to submit.)

- **For diagnosis of adrenal gland tumors (adrenocortical disease, hyperadrenalcorticism, adrenal disease):***

  Serum estradiol:

  < 20 pg/ml = normal

  > 20 pg/ml = suspect functional adrenal tumor

  ACTH test:

  Limited value, as cortisol may not be the major hormone being secreted; +/or problems with administering & interpreting the test; speculation that ferrets do not maintain ACTH receptor sites with functional adrenal gland tumors.

  Urinary cortisol:creatinine ratios

  Normal ferrets = 0.04×10^{-6} to 1.66×10^{-6} (median value of 0.22×10^{-6})

  Adrenal gland tumors/hyperadrenocorticism

  = 0.5×10^{-6} to 60.13×10^{-6} (median value 5.98×10^{-6})**

* *Wagner & Dorn, 1994*

** *Gould, et al, 1995*

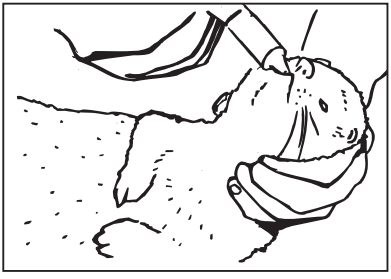
Common Emergencies and Clinical Conditions

- Gastrointestinal (may present depressed, acute abdomen, weak, dehydrated, diarrhea, vomiting)
  - Foreign body
  - Proliferative bowel disease
  - Campylobacter/Helicobacter
  - Gastric dilation secondary to foreign body, gorging
- Neoplasia
- Seizures/neurologic signs
  - Insulinoma, Trauma, Toxicities, Canine distemper virus
- Heat stress
- Cyanotic mucous membranes
  - Respiratory compromise (pneumonia or LSA mass - chest)
  - Cardiomyopathy
  - Diaphragmatic hernia
  - Trauma, Electric shock
  - Toxicities/allergic reaction
- Trauma: history of fall, drop, being squeezed, crushed
  - Fractures, luxations
  - Wounds including crush/compression
- Respiratory distress - dyspnea
  - Influenza vs canine distemper virus
  - Pneumonia
  - Mechanical (abdominal pressure, neoplastic masses, diaphragmatic hernia, etc)

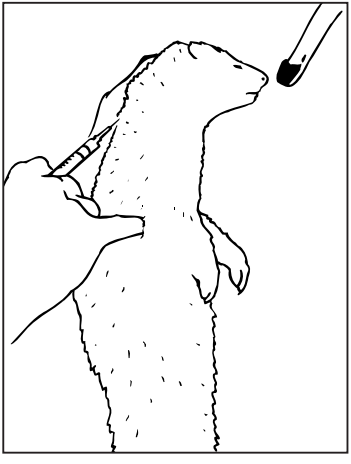
Zoonotic Potential

- *Giardia*
- *Listeria*
- *Microsporum canis* - Dermatomycosis
- *Salmonella*
- *Campylobacter*
- Tuberculosis - *Mycobacterium avium, M. bovis, M. tuberculinum*
- Influenza virus A
- Fleas = *Ctenocephalides*
- Sarcoptes mites: *Sarcoptes scabei*
- Ear mites: Otodectes
- Rabies
- *Dirofilaria immitis* (heartworms)
- *Cryptosporidia*

Therapy



Delivering oral medications to ferrets.



The ferret can be distracted with Nutrical on a tongue depressor while a SC injection is being given.

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Abdominal enlargement, Mass	Pregnant, Full/blocked bladder secondary to urolithiasis, Idiopathic splenomegaly, Adrenal mass, Lymphosarcoma, GI foreign body, Metastasis of other neoplasia, Splenomegaly secondary to anesthesia, Tuberculosis (avian, bovine, human), Histoplasma, Polycystic kidneys	Physical exam, History, CBC/chemistries, Radiographs, Ultrasonography, Abdominal tap & cytology, Fine needle aspirate of mass, Biopsy, Exploratory laparotomy, C&S, Acid-fast stains, Diagnostics for adrenal disease	Dependent on diagnosis
Abdominal enlargement, Fluid	Ascites - cardiomyopathy, peritonitis, neoplasia	Physical exam, History, Abdominal tap & cytology, Radiographs, Cardiac evaluation, CBC/chems	
Abortion	Salmonella, Septicemia, Trauma, Underlying metabolic disease	Necropsy of aborted material, C&S, CBC/chemistries, History	Appropriate antibiotics if bacterial, Supportive care
Alopecia	Dermatomycosis (*Microsporum canis*)	Fungal culture, KOH prep, Wood's light	Griseofulvin topical, Discuss zoonotic potential with owner
	Ectoparasites (*Sarcoptes scabei*), Ctenocephalides (flea allergic derm.)	Visual examination, Skin scraping	Ivermectin, Topical flea powders (feline), Environmental control

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Alopecia (symmetrical indicative of endocrinopathy: rat tail, comedones, swollen vulva)	Hyperadrenocorticism (adrenal disease: hyperplasia, adenoma, carcinoma), Hyperestrogenism (adrenal disease; ovarian remnant in spayed female; intact female)	Physical exam, History, CBC/chemistries, Serum estradiol, Urinary cortisol: creatinine ratio, Ultrasonography, Radiography, Laparotomy, ACTH for evaluating adrenal function may not be useful	Adrenal disease: surgical excision, lysodren (mitotane), chemotherapy, Prognosis guarded (frequently other neoplasias), Hyperestrogenism: remove ovarian remnant, Intact female: may use HCG to cycle out for surgery prep, Blood transfusions and supportive care to treat concurrent anemia, Ovariohysterectomy
Alopecia	Mast cell tumor	Biopsy, Histopath	Surgical excision, Antihistamines
	Seasonal variation (tail only)	-	Time, May be adrenal related
Anorexia (without significant weight loss, acute) May see as part of many other disease conditions, Frequently is the sole presenting symptom, If greater than 24 hours, may see some degree of depression, dehydration, tarry stool, hind quarters paresis, seizures, generalized weakness	GI foreign body, Trichobezoar, Gastroenteritis, Proliferative bowel disease ("eosinophilic gastroenteritis, " *Desulfovibrio*), *Campylobacter /Helicobacter*, Gastric ulcers, Cardiomyopathy, Upper respiratory disease, Pneumonia, Neoplasia, Dental disease, Renal disease, Liver disease, Peracute anorexia: gastric dilatation due to foreign body, *Clostridium*, Gorging (juveniles)	Physical exam, History, CBC/chemistries, Radiographs (contrast studies), Ultrasonography/ echocardiography, Dental exam, Urinalysis, Microbiology, Laparotomy, Enterotomy/gastrotomy if foreign body, Endoscopy and biopsy, Histopathology	Supportive care including additional nutrition (Nutrical, A/D or P/D foods (Hills), Correct underlying condition
Conjunctivitis	Trauma, Foreign body	Ophthalmic exam & stain	Rx as per other mammals

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Conjunctivitis	Canine distemper	Serology, Rule out everything else	No Rx
	Influenza	History, Human exposures	Symptomatic, Antibiotics for secondary infections, Antihistamines, Cough suppressants
Constipation	GI foreign body	Physical exam, Radiographs, History	Supportive fluids, Removal of foreign body
	Dehydration (may follow diarrhea)	CBC, Serum protein, Physical exam	Fluids, Treat underlying cause of GI upset
Cyanotic mucous membranes	Respiratory compromise, Pneumonia, Cardiomyopathy, Dyspnea, Heartworms	Auscultation, Physical, Radiographs, Thoracentesis or tracheal wash, Cytology + analysis (sp. gravity), Gram's stain, C&S, Heartworm tests, Cardiac evaluation	Oxygen, Supportive care until diagnosis
Dental disease (gingivitis, periodontitis, fractured teeth, plaque, caries)	Underlying systemic disease contributions	Oral exam, Oral radiographs	Appropriate dental measures (as in other carnivores)
Diarrhea	Rotavirus	Serology (3-4 week-old kits), Fecal flotation & smear, Radiographs +/- contrast helpful, CBC/chemistries to assess overall condition	Fluids, Supportive

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Diarrhea	Proliferative bowel disease (*Helicobacter mustelae, Desulfovibrio, Campylobacter*)	Fecal float/smear, Radiographs +/- contrast, CBC/chemistries to assess overall condition, Endoscopy, Biopsy, Histopath	Amoxicillin, Metronidazole, Pepto Bismol combo, Chloramphenicol, Enrofloxacin
	GI foreign body	Radiographs +/- contrast, History, Fecal exam, CBC/chemistries to assess overall condition	May need laparotomy/gastro/enterotomy, Supportive care
	Salmonella	Fecal/rectal C&S	Fluids, Supportive care, Appropriate antibiotics, Zoonotic potential
	Aleutian disease	Serology	Supportive care
	Eosinophilic gastroenteritis, Food allergy	GI biopsy definitive	Prednisone, Antibiotics, Ivermectin (unknown why but seems to help)
	GI parasitism (Coccidia, Giardia, *Toxascaris leonina, Toxocara cati, Ancylostoma* sp., *Dipylidium caninum)*	Fecal	Sulfas (coccidia), Metronidazole (giardia), Piperazine, Ivermectin, Praziquantel, Flea control if tapeworms, Sanitation
Dyspnea	Acute: anaphylaxis or allergic reaction	Vaccination reaction (at booster), Insect/arachnid bite or sting	Corticosteroids, Antihistamines, Oxygen support, Epinephrine, Supportive, Analgesic may be needed for painful sting

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Dyspnea	Electric shock (pleural edema, oropharyngeal acute edema /inflammation)	Physical examination, History (chewing on cord), Oral lesions (+/-)	Corticosteroids, Diuretics, Fluids, Antibiotics if oral lesions or severe pulmonary edema
	Heat stress (may be panting, open mouth breathing)	Otic or rectal temperature elevation, Ambient temperature, History	Lower core body temperature: fluids, cool cloth/pack to neck, shoulders, tepid water bath
	Hyperadrenalcorticism, Megaesophagus, Abdominal enlargement due to ascites, masses or organomegaly	Radiographs, barium swallow for megaesophagus/abdominal differentiation, CBC/chemistries, Endocrine assays, Abdominocentesis and fluid cytology, analysis, Ultrasonography	Hyperadrenalcorticism: adrenalectomy, medical therapy, Megaesophagus: small, elevated meals, metoclopramide or cisapride, Correct underlying etiologies for ascites, masses, organomegaly
	Pleural edema due to cardiomyopathy, trauma, heartworms	Radiographs, Cardiac evaluation, Occult heartworm tests, CBC/chemistries, Thoracentesis and fluid cytology, analysis	Oxygen, Supportive for trauma, Analgesics, Cardiomyopathy: diuretics, inotropics, vasodilators, Heartworm therapy (prognosis guarded)
	Pleural effusion due to a space occupying mass in thorax, Lymphosarcoma	Radiographs, CBC/chemistries, Thoracentesis and fluid cytology, analysis, Bone marrow biopsy	Chemotherapy for lymphosarcoma, Supportive, Symptomatic

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Dyspnea	Pneumonia, Etiologies: human influenza virus, *Bordetella bronchiseptica*, blastomycosis, histoplasmosis, coccidioidomycosis, *Klebsiella, E. coli, Pseudomonas, Proteus*, etc.	History, Radiographs, Tracheal wash, C&S, Cytology	Influenza: symptomatic antihistamines, cough suppressants, antibiotics for 2° infection, Bacterial: antibiotics, Fungal: systemic antifungals, All: supportive care
	Trauma: diaphragmatic hernia, Fractures: ribs, cranium, nasal, jaws, dental, Direct chest trauma crush, compression, hematoma	History, Physical exam, Radiographs, CBC/chemistries, Thoracentesis if fluid present	Supportive, Analgesics, Repair hernia/orthopedics as in dog/cat
Fever (elevated core temperature)	Heat stress, Septicemia/systemic disease including pyelonephritis, Pain/inflammation	Otic/rectal temperature, Ambient temperature, Physical exam, CBC/chemistries, Urinalysis	Appropriate therapies to etiology, Heat stress: fluids, cool ambient temperature, baths, If pain /inflammation: analgesics, NSAIDS, find underlying pathology, Septicemia/systemic disease: antimicrobials
Hematuria (stranguria, dysuria)	Urolithiasis, Cystitis, Urethral obstruction, Pyelonephritis	Urinalysis (cystocentesis), Catheterization if obstructed and retrograde flush, Radiography including contrast	Fluids, Antibiotics, Catheterization if obstructed (as in feline), Urinary acidifiers as needed, Analgesics, Anti-inflammatories, Surgery to remove large calculi, Feline urinary diets may be helpful acutely

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Hypersalivation (see also Neurologic, Vomiting)	Dental/oral irritation (fractured tooth, foreign body wedged in arch, reaction to bitter/toxic plant or substance)	History, Physical/oral exam, Stomach tube/content analysis	Correct dental condition, Remove foreign body, Follow appropriate antidote/remedies as in dog/cat if toxic plant, toxin involved
	Gastritis, Ulcer (*Helicobacter mustelae*), Gastroenteritis (parasitic, bacterial), Eosinophilic gastro-enteritis, Pancreatitis (pain/ nausea associated), GI foreign body	Fecal flotation, smear, Radiographs, Biopsy, CBC/chemistries to assess overall condition, Physical exam and abdominal palpation	Antimicrobials, Antiparasitics if indicated, Cimetidine, sucralfate, GI protectants/NSAIDS, etc., Gastrotomy/enterotomy for foreign body removal if necessary
	Heat stress	Otic/rectal temperature, Ambient temperature	Lower core body temperature: fluids, cool cloth/pack to neck, shoulders, tepid water bath
	Insulinoma (beta cell tumor)	Blood glucose (<60 mg/dL), CBC/ chems, Insulin: glucose ratio (may/ may not be normal), Radiography, Ultrasonography, Laparotomy	Supportive, Surgical excision, Diazoxide, Prednisone, Frequent meals
	Misc conditions: Electric shock, Rabies (very rare)	Electric shock: see above, Rabies: postmortem, histopathology and immunoassay	Electric shock: see above, Rabies: none, Zoonotic potential, Notify public health authorities

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Icteric mucous membranes (jaundice)	Liver disease including hepatitis (bacterial), Cirrhosis/fatty degeneration, Sequelae to diabetes mellitus or pancreatitis, Cholecystitis, Toxicity	Physical exam, Dietary history (ingestion oils, fats, sugars), CBC/chemistries, Radiographs, Ultrasonography, Biopsy	Supportive, Antimicrobials if bacterial, Dietary: feline liver/GI diets may help, B-complex vitamins, fluids, Diabetes: insulin/diet therapy, GI soothants/protectants PRN, May need analgesics, Toxins: Appropriate antidotes as per dog/cat
Mastitis	Neoplasia, Bacteria infection (hemolytic *E. coli*), Trauma from nursing	Physical exam, C&S exudate, Biopsy if indicated	Remove kits, Fluids, Antibiotics, Surgical resection, Analgesics, Supportive care
Neurologic signs (seizures, convulsions, ataxia) See also Hypersalivation, Weakness, Paralysis	Seizures (any of the below): Prior to diagnosis, treat the seizure	At least try to get a blood sample for glucose level before giving dextrose/glucose, Hyperglycemia (diabetes) is rare in the ferret, but it has been documented	First aid: Isotonic dextrose (IV, IO, SC), Oral glucose, Diazepam or phenobarb (IV) to stop seizure
	Acute seizure or convulsion: Anaphylaxis or allergic reaction	Vaccination reaction (at booster), Insect/arachnid bite or sting	Corticosteroids, Antihistamines, Oxygen support, Epinephrine, Supportive, Analgesic may be needed for painful sting, Usually will not need diazepam
	Azotemia (renal disease, failure)	CBC/chemistries, BUN elevated, Urinalysis, Radiographs, Ultrasonography, Biopsy	Fluid therapy to lower BUN, Supportive care, Feline kidney diets may be of some use

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Neurologic signs	Botulism	History of eating rancid mink diet	Supportive, O_2, Respiratory support
	Canine distemper	Vaccination history, Physical exam, Conjunctival scraping, Serology	None, Supportive care only, Prognosis grave
	Electric shock	Physical examination, History (chewing on cord), Oral lesions (+/-)	Corticosteroids, Diuretics, Fluids, Antibiotics if oral lesions or severe pulmonary edema
	Hyperglycemia (diabetes mellitus)	Blood glucose (> 200-300? mg/dL), CBC/chemistries, as in feline	Insulin therapy, Follow feline guidelines, Regulate feeding
	Infectious encephalitis (bacterial, fungal especially cryptococcus)	Physical exam, CBC/chemistries, CSF tap: C&S, cytology, analysis	Appropriate antimicrobials, Analgesics, Supportive care
	Insulinoma (beta cell tumor)	Blood glucose (<60 mg/dL), CBC /chems, Insulin:glucose ratio, Radiography, Ultrasonography, Laparotomy	Supportive, Surgical excision, Diazoxide, Prednisone, Frequent meals
	Lead toxicity	Physical, History, CBC/chemistries, Blood lead, Radiographs	Calcium EDTA and supportive care, Lead removal as in other species
	Listeriosis	Serology, C&S	Tetracycline, Treat as in dogs/cats
	Rabies	Postmortem, Histopathology, Immunoassay	None, Zoonotic potential, Notify public health authorities

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Neurologic signs	Toxicities (plant, chemicals, pesticides, materials around home)	History, Exposure to toxins, Pass materials in feces/stomach contents, CBC/chemistries, Physical exam, Urinalysis	Appropriate antidotes per toxin, Follow guidelines for dogs/cats, Supportive care
	Trauma	History, Physical exam, Radiographs, CBC/chemistries	Anti-shock therapy, Analgesics, Corticosteroids, Antimicrobials, Surgical as appropriate
Organomegaly	Spleen: idiopathic hypersplenism, splenomegaly due to anesthesia, Lymphosarcoma	Physical exam, Radiographs, Ultrasonography, Biopsy	Dependent on etiology
	Adrenal enlargement: hyperplasia, adenoma, adenosarcoma	Physical exam, Endocrine assays: serum, urine, Ultrasonography, Biopsy/histopathology	See treatment for hyperadrenal-corticism
	Lymph nodes: lymphadenopathy due to systemic infection, lymphosarcoma, tuberculosis	Physical exam, CBC/chemistries, Fine needle aspirate: cytology, C&S, Grams or acid fast stain, biop-sy, histopathology	Systemic infection: appropriate antimicrobials, Lymphosarcoma: see LSA therapy, Tuberculosis: zoonotic potential, treatments not proven efficacious
	Abdominal: gastric or enteric (neoplasia or foreign body)	Physical exam, History, Radiographs plus contrast, Exploratory laparotomy	If foreign body, passage or surgical removal, Neoplasia: excision or chemo depending on etiology

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Organomegaly	Bladder: urinary obstruction, lithiasis, neoplasia, Renal: cysts, hydronephrosis, neoplasia	Physical exam, Cystocentesis, Urinalysis; radiographs, contrast cystogram/excretory urogram, Exploratory laparotomy	Urolithiasis: see under Hematuria, Renal: if unilateral remove affected kidney, Appropriate surgical intervention, resection, stone removal
	Cardiomegaly, Dilatative or hypertrophic cardiomyopathy, Rule out heartworms	Physical exam, Radiographs, Electrocardiogram, Echocardiography, Occult heartworm tests, CBC/chemistries, Cardiac biopsy	Appropriate cardiac therapies per type of cardiomyopathy, if heartworms present
Pale mucous membranes	Anemia due to hyperestrinism (unspayed female, ovarian remnant in spayed female, advanced hyperadrenalcorticism), Neoplasia including lymphosarcoma (involving bone marrow or red cell depletion/consumption by spleen)	Physical exam, CBC (esp PCV, reticulocyte count), History, Ultrasonography, Endocrine assays, Bone marrow cytology, Exploratory laparotomy, Biopsy	Supportive, Blood transfusion to stabilize, May use HCG to cycle female out of estrus prior to surgery, Surgical excision ovarian tissue, Adrenalectomy, Splenectomy, Appropriate chemotherapy per neoplasia
	Hypothermia	Otic/rectal temperature, History	Warmth, Warmed fluid therapy
	Trauma, Shock	History, Physical exam	Fluid therapy, Corticosteroids, Supportive (as in dog/cat)
	Cardiac compromise, failure (poor perfusion), Cardiomyopathy	History, Physical exam, Cardiac evaluation, CBC/chemistries to assess degree of other organ compromise	Appropriate cardiac therapies per type of cardiomyopathy, Supportive care, Feline cardiac diets may be useful

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Paresis/paralysis (see also Weakness, Neurologic)	Any debilitating systemic illness including Aleutian disease, neoplasia, renal disease	General diagnostic workup, Serology for AD	Supportive, Corrective per disorder
	Anorexia, Starvation	Physical exam, Diet history, CBC/chemistries, Assess if underlying disease condition, Malabsorption, Gastroenteric condition, Metabolic or neoplastic condition that is preventing utilization of food	Parenteral feeding, Correct underlying condition(s), Feline A/D (Hills) diet, Nutrical, Other nutritional supplements, Feed good quality ferret diet
	Botulism	History of eating rancid mink diet	Supportive including oxygen, Respiratory support
	Myelitis, Encephalomyelitis: bacterial, fungal	Physical, CBC/chemistries, Radiographs, CSF tap, cytology, C&S	Supportive, Appropriate antimicrobials
	Post exercise: Insulinoma (hypoglycemia), Cardiomyopathy	History, Physical, CBC/chem. esp. blood glucose, Cardiac evaluation	As appropriate per insulinoma or cardiomyopathy
	Rabies	Postmortem, Histopathology, Immunoassay	None, Zoonotic potential, Notify public health authorities
	Tuberculosis	Radiographs, CSF tap, C&S, Acid/fast stain, Cytology	Zoonotic potential, Treatments not proven efficacious

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Paresis/paralysis	Trauma (spinal injury, abdominal/limb trauma - consider crush/compression injury from dog bite, fall)	Physical exam, History, Radiographs, CBC/chemistries	Treat appropriately for shock, pain, respiratory/circulatory compromise, Abdominal organ compression/ rupture may not appear for a few hours after injury), Orthopedic repair
Pruritus	Bacterial dermatitis (esp Staph)	C&S	Appropriate antibiotics, Topicals, Medicated bath for soothing
	Ectoparasites (fleas, ear mites, sarcoptes mites)	Physical exam, Skin scraping	Ivermectin, Topical flea products (cats), Environmental control, Zoonotic potential
	Hyperadrenalcorticism	CBC/chemistries, Urinary cortisol:creatinine ratio, Serum endocrine panel incl. estradiol, Ultrasonography	Surgical excision (adrenal mass), If cannot completely excise, lysodren/chemotherapy indicated
	Mast cell tumor	Biopsy, Histopath	Excision, Antihistamines
Respiratory signs (coughing, dyspnea, conjunctivitis, upper respiratory disease, sneezing)	Cardiomyopathy, Pneumonia, Influenza, Canine distemper, Irritants, Neoplasia, Heat stress, Corneal injury/ulcer, Mechanical pressure from abdomen, diaphragmatic hernia, Space-occupying masses, Tooth abscess	History, Physical, Radiographs, Thoracentesis, Tracheal wash, C&S exudates, Cytology, Cardiac evaluation, Occult heartworm tests, Ophthalmic exam, Sinus/lacrimal flush, Oral/dental exam	Appropriate for etiology

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Respiratory signs (rhinitis, sinusitis)	Infectious, Foreign bodies, Particulates or irritants	History (exposures to chemicals, dusts), Radiographs, Sinus flush, C&S/cytology exudates, flush fluid	If possible, remove foreign bodies or materials, Antimicrobials, Antihistamines, Decongestants, Decrease exposures to chemicals, irritants
Seizures (see also Neurologic signs)	Epilepsy, Insulinoma, Acute toxicity, Extreme pain, Renal failure, Heart failure, Neoplasia, Starvation, Heat stroke, Trauma, Canine distemper virus	Physical examination, History, CBC/chemistries, Radiographs, Cardiac evaluation, Other diagnostics per etiology	Stabilize (before diagnosis): Fluids (isotonic Dex 5% to start, then LRS, glucose PO, SC, IO, IV), Diazepam or phenobarb IV to stop seizure, Appropriate therapy per diagnosis
Stranguria, Dysuria (see also Hematuria)	Urolithiasis, Cystitis, Urethral obstruction	Physical exam, Urinalysis	Approp. antibiotics, acidifiers if nec., Catheterize male (under anesthesia) if obstruction, Fluids, Analgesics, Feline urinary diets, Cystotomy to remove large uroliths
Swollen vulva	Estrus, Hyperadrenalcorticism (in spayed female), Ovarian remnant in spayed female	History, CBC (assess degree of anemia)/chemistries, Urinary cortisol: creatinine ratio, Serum estradiol, Ultrasonography, Exploratory laparotomy	Surgical excision (adrenal mass), Consider chemotherapy (Lysodren) if inoperable, Complete ovariohysterectomy (may use HCG to cycle out for surgery prep)
Vomiting, Regurgitation (see also Neurologic signs, Seizures, Hypersalivation, Trauma)	Pain (esp head pain)	Physical exam, Full workup	Analgesics PRN, Correct underlying etiology

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Vomiting	Nausea, GI foreign body including trichobezoar, Gastric ulcers (*Helicobacter mustelae*), Gastritis, Eosinophilic gastroenteritis, Heat stress, Ingestion of toxic material, Liver/pancreatic disease, Megaesophagus	History, CBC/chemistries, Radiographs & contrast, C&S rectal, stool, stomach juice, Biopsy	Appropriate antibiotics, GI protectants, Pepto Bismol, Sucralfate, Cimetidine, Appropriate antidotes if toxicity, Other medications, Diet therapy per etiology, Foreign body removal may require surgery
	Neoplasia (insulinoma)	Blood glucose, Insulin/glucose ratios, Ultrasound, Laparotomy	Prednisone, Fluids (dextrose), Diazoxide, Surgery, Supportive, Prognosis: guarded (survivals 4-24 mo. post-op, possible recurrence)
	Azotemia, Renal disease	CBC/chemistries, Urinalysis	GI soothants and protectants like sucralfate & Pepto Bismol (symptomatic), Fluids, Supportive, Feline kidney diets may be helpful
	Carsickness, Motion sickness	History	Diphenhydramine prior to car ride
	Rabies	Postmortem, Histopathology, Immunoassay	None, Zoonotic potential, Notify public health authorities
Weakness (see also Neurologic, other etiologies)	Hypoglycemia due to: insulinoma (beta cell tumor), Sepsis, Starvation, Severe GI disease preventing absorption or nutrient loss through diarrhea, hypermotility, parasitism	History, Physical exam, CBC/chemistries, Radiographs (contrast study), Microbiology, Endocrine assay, Ultrasonography, Exploratory laparotomy	Per etiology, Insulinoma: Supportive, Surgical excision, Diazoxide, Prednisone, Frequent meals, Appropriate antimicrobials/ antiparasitics, GI protectants and therapies

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Weakness	Adrenal, associated endocrinopathy	History, Physical exam, Serum estradiol, Urinary cortisol: creatinine, Ultrasonography, Exploratory laparotomy, Biopsy, CBC/chemistries	Surgical excision, Chemotherapy (Lysodren), Supportive care
	Hypothyroidism, May also have other endocrinopathies	Physical, CBC/chemistries, T_3/T_4, Investigate adrenal/beta cell abnormalities	Thyroxin, Therapy appropriate for other endocrinopathies if also present
	Anemia due to: Lymphosarcoma, Blood loss, Hyperestrinism (intact female, ovarian remnant, advanced hyperadrenalcorticism)	Physical exam, History, CBC/chemistries, Bone marrow biopsy, Endocrine assays, Exploratory laparotomy	Appropriate per etiology, Supportive care including blood transfusion(s), Surgery, Chemotherapy
	Cardiomyopathy (dilatative, hypertrophic, heartworms)	Physical exam, History, Cardiac evaluation, Occult heartworm tests, CBC/chemistries to assess condition	Appropriate per type of cardiomyopathy, Feline heart diets may be helpful, Heartworm disease: prognosis guarded
Weight loss (may/may not be anorectic, progressive, sub-acute or chronic condition)	Aleutian disease (chronic wasting disease)	Serology, CBC/chemistries with serum electrophoresis	None, Supportive care
	Chronic GI foreign body	Radiographs, contrast study	Surgical removal, Supportive care
	Dental disease	Oral exam, Radiographs	Endodontics, Prophylactic, Appropriate extraction, Antibiotics PRN

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Weight loss	Gastroenteritis or gastric ulcers (may also see diarrhea, tarry stools, intermittent vomiting or retching)	History, CBC/chemistries, Radiographs (contrast), C&S rectal /gastric secretions, Endoscopy, Fecal flotation, smear, May illicit pain when palpating stomach if ulcers present, Severe inflammation	Appropriate antibiotics, Sucralfate, Bismuth subsalicylate, Cimetidine
	Proliferative bowel disease (eosinophilic enteritis/colitis, *Desulfovibrio, Campylobacter*, idiopathic), May also see diarrhea, tarry stools, intermittent anorexia	Fecal smear, flotation, Radiographs +/- contrast, CBC/chemistries, Endoscopy, Biopsy, Histopathology	Enrofloxacin, Amoxicillin, Metronidazole, Bismuth subsalicylate, Chloramphenicol, Supportive care
	Intestinal parasites (may also see diarrhea, intermittent anorexia)	Fecal flotation/direct smear, Specialized tests for protozoa	Anthelmintics, Antiprotozoals
	Megaesophagus (may also see vomiting, regurgitation)	Barium swallow and radiography, Endoscopy, Fluoroscopy	Cisapride or metoclopramide, Small meals (elevated), Supportive
	Mycotic disease (eg, Blastomycoses)	History, geography, CBC/chems, Radiography, Fungal cultures, Cytology	Systemic antifungals
	Neoplasia (any)	Physical, Radiographs, CBC/chems, Specific endocrine assays, Ultrasonography, Laparotomy, Biopsy, Histopathology	Supportive per type of neoplasia

RULE OUT CHART FOR FERRETS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Weight loss	Lymphosarcoma (may note marked lethargy, splenomegaly, lymphadenopathy, tumors in various tissues)	History, Physical exam, Radiographs, CBC, Cytology (bone marrow, effusions, lymph node), Histopathology	Chemotherapy, some excisional, Prognosis guarded to poor although some respond well to chemotherapy, May be retroviral or parvoviral involvement
	Mycobacterium infection, Tuberculosis (*M. avium*, *M. bovis*, *M. tuberculosis*)	Acid-fast stains, Cytology, Histopathology, Radiographs	Zoonotic potential, Treatment may not be advisable as efficacy unproven
	Pyelonephritis, Renal disease (may also see fever, leukocytosis, depression, lethargy, polyuria, polydipsia), Acute phase may also see anorexia, dysuria/hematuria (if ascending from cystitis), Abdominal discomfort and restlessness, Chronic renal disease with azotemia, May also see retching, dehydration	Physical exam, CBC/chemistries, Urinalysis (cystocentesis), Urine C&S, Excretory urogram, Radiography may be helpful	Antibiotics, Fluids, Analgesics, Unknown if feline kidney diets useful
	Cardiomyopathy (may also see progressive exercise intolerance, lethargy, dyspnea, ascites)	Physical exam (femoral pulse deficit, poor perfusion limbs, mucous membranes), ECG, Echocardiography, Radiography (cardiomegaly +/- effusions, pulmonary edema, ascites, hepatosplenomegaly)	Appropriate cardiac medications depending on type of cardiomyopathy, Supportive care, Feline heart disease diets may help, Diuretics if pulmonary edema +/- ascites

FORMULARY FOR FERRETS

Drug	Route	Dosage	Comments
Acepromazine (injectable)	IM, SC	0.1-0.25 mg/kg	Preanesthetic, light sedation
	IM, SC	0.2-0.5 mg/kg	Sedative dosage
Amikacin (Amiglyde® 50 mg/ml)	IM, SC	10 mg/kg q12h	-
Aminophylline	PO, IM, IV	4.0 mg/kg	Bronchodilation****
Amoxicillin (Amoxidrops,® Robaxin®)	PO	25-35 mg/kg q12h	For *Helicobacter/Campylobacter:* 10 mg/kg q8h combined w/metronidazole PO and Pepto Bismol
Amoxicillin (50 mg/ml)	PO	10-25 mg/kg q12h	Broad spectrum
Amphotericin B	IV	0.4 mg/kg daily, weekly pending BUN til total dose up to 25 mg reached	-
	IV	0.25 -1 mg/kg q24-48h til total dose of 0.7-25 mg/kg is delivered	For blastomycosis
	IV	0.15 mg/kg 3x week for 2-4 months	For cryptococcosis
Ampicillin (Polyflex®)	SC	10-30 mg/kg q12h	-
Aspirin	PO	10-20 mg/kg q24h	Short-term analgesia; give with food
Atenolol (Tenormin® 25 mg tablets)	PO	6.25 mg q24h (1/4 of a 25 mg tablet)	Beta adrenergic blocker for hypertrophic cardio-myopathy
Atropine	IM, SC	0.05 mg/kg	Control of salivary, respiratory secretions, bradycardia; administered as part of preanesthetic regimen

FORMULARY FOR FERRETS

Drug	Route	Dosage	Comments
Atropine	IM, SC	5-10 mg/kg	Organophosphate toxicity
Azimycin (Dexabiotic®)	IM	0.05 ml/lb BW q8-12h	Penicillin/dexamethasone combination
B-complex vitamins (injectable)	SC, IM	0.2-0.3 ml q24h PRN	-
Bismuth salicylate	PO	1 ml/kg q8h (Pepto Bismol® 0.25 mg/kg q4-6h)	See metronidazole/amoxi for *Helicobacter* therapy
Buprenorphine (Buprenex®)	SC, IV	0.01-0.5 mg/kg q8-12h	Analgesic
Butorphanol (Torbutrol®, Torbugesic®)	SC	0.05-0.1 mg/kg q8-12h	Analgesic
Cefadroxil (Cefa-drops)	PO	15-20 mg/kg q12h	Broad spectrum****
Cephaloridine	IM or SC	10-15 mg/kg q24h 5-7 days	Broad spectrum
Cephalexin (Keflex® pediatric suspension)	PO	10-15 mg/lb q12h for 10 days	Broad spectrum for respiratory, urinary
Chloramphenicol palmitate	PO	50 mg/kg q12h 14-21 days	For proliferative bowel disease (*Desulfovibrio* sp. ICLO); advise owner of chloramphenicol toxicities
Chloramphenicol succinate	IM, IV	30-50 mg/kg q12h	Proliferative bowel disease
Chlorampheniramine (Chlor-Trimeton®)	PO	1-2 mg/kg up to q8h	Available as syrup OTC
Cimetidine	PO	5-10 mg/kg q6-8h	Gastric ulcer treatment

FORMULARY FOR FERRETS

Drug	Route	Dosage	Comments
Ciprofloxacin (500 mg tab)	PO	10-15 mg/kg q12h	Mix one 500 mg tablet in 10 ml H_2O 5 mg/0.10 ml
Ciprofloxacin HCL 0.3% (ophthalmic - Ciloxin®)	Topical	2-3 drops q12h	Antibacterial ophthalmic*****
Cisapride (Propulsid®)	PO	Start @ 0.5 mg/kg q24h, increase to 1 mg/kg if needed	Useful post-op ileus, megaesophagus*****
Clavamox® (Augmentin® - amoxicillin 25 mg/ml plus clavulanate potassium 6.25 mg/ml)	PO	12.5 mg/kg q12h x 10-14 days	Store in refrigerator; okay to give with food or mixed with food; good broad spectrum
Clindamycin	PO	10 mg/kg q12h	For osteomyelitis, dental disease
Cloxacillin	PO, IV, IM	10 mg/kg q6h	-
Dexamethasone (injectable 2 mg/ml)	IM, IV	2-4 mg/kg once	For shock
	IM, SC	0.5-1mg/kg	For continued use
Dexamethasone (Azium® 0.25 mg tab)	PO	0.5 mg/kg q24h	-
Diazepam	IM	1-2 mg/kg	Seizures, appetite stimulant @ 1 mg or less
Diethylcarbamazine	-	2.75-5.5 mg/kg	Heartworm treatment

FORMULARY FOR FERRETS

Drug	Route	Dosage	Comments
Digoxin (0.05 mg/ml)	PO	Tailor dosage as with cats. Loading at a higher dosage may only be for the first 1-2 days (0.01 mg/kg of 12-48 hrs); Maintenance: 0.005 mg/kg q12h or 0.01 mg/kg q24h	Dilative cardiomyopathy
Diltiazem (Cardizem® 30 mg tablet)	PO	3.75-7.5 mg q12h (1/8 - 1/4 of tablet)	Calcium charcoal blocker: hypertrophic cardiomyopathy
Diphenhydramine (Benadryl®)	PO, IM, IV	0.5-2 mg/kg q12h or q8h PRN	Available as syrup OTC. Can use prevaccine in cases where there has been a previous reaction
Doxapram	IV	5-11 mg/kg	Respiratory stimulant
Enalapril maleate (Enacard®)	PO	0.5 mg/kg q48h	ACE inhibitor for dilated cardiomyopathy; do not use in presence of renal disease*****
Enrofloxacin	PO, SC, IM	5-10 mg/kg q12h	Broad spectrum, IM only for short time period
Enteral feeding formulas	PO	200-300 kcal/kg/day	Supportive care for anorectic ferret
Epoetin alpha (Epogen®)	IM	50-150 IU/kg 3x weekly/weekly maintenance	Stimulate RBC production****
Erythromycin	PO	10-15 mg/kg q6h	-
Famotidine (Pepcid®)	IV, PO	0.25-0.5 mg/kg q24h	Decrease gastric secretions, ulcer therapy**
Ferric dextran	IM	10 mg/avg ferret as needed	Iron deficiency
Fluids (isotonic: half-strength LRS + 2.5% dextrose; LRS; 0.9% saline)	IV, SC	60 ml/kg/day or as needed to correct dehydration	Supportive care

FORMULARY FOR FERRETS

Drug	Route	Dosage	Comments
Flunixin (Banamine® 50 mg/ml)	IM	0.03 mg/kg as needed q8h	Analgesic, anti-inflammatory
	SC, PO	0.3 mg/kg q24h	Longterm use, 5 days on, 3 days off or continuously once q48h-72h; oral: put injectable in palatable syrup****
Flurbiprofen sodium (Occufen®)	Ophth., topical	1-2 drops q12-24h	Ophthalmic inflammation. This is a NSAID*****
Furosemide (Lasix®)	PO, SC, IM	0.1 ml/ferret q12h**; can use 1-4 mg/kg IM, then 1 mg/kg q12-24h PRN	-
Gentamycin	IM or SC	5 mg/kg q24h 5 days	-
GnRH (Cystorelin®)	IM, SC	20 mcg; may need to repeat in 2 weeks	Prep for ovariohysterectomy
Griseofulvin tabs	PO	25 mg/kg q12h	Frequency, use can follow cat protocol
Halothane	-	Mask, endotracheal tube to effect	Anesthetic
HCG	IM, SC	100 IU; may need to repeat in 2 weeks	Prep for ovariohysterectomy
Hydrocortisone Na succinate	IV	25-40 mg/kg	-
Insulin NPH	-	0.5-1 IU/kg or to effect	May work out to be 1 IU per ferret
Isoflurane	-	Mask, endotracheal tube to effect	Preferred anesthesia!
Ivermectin (Ivomec®)	SC	0.2-0.5 mg/kg; second injection 10-14 days	Antinematodal
	Topical	1 mg/kg divided in two and massaged into each ear. Repeat in 2 weeks	For ear mites, Bathe animal thoroughly 24 hrs after treatment and wash bedding

FORMULARY FOR FERRETS

Drug	Route	Dosage	Comments
Ivermectin (Ivomec®)	IM, SC	0.2-0.5 mg/kg	Sarcoptes mites; wash bedding; bathe daily for 3-4 days
	SC, PO	0.05-0.1 mg/kg monthly	Dirofilaria prevention
Ivermectin (68 mcg tabs)	PO	1 68 mcg tab/ferret/month (0.06 mg/kg)	Dirofilaria prevention
Kaolin/pectin (Kaopectate®)	PO	1-2 ml/kg q2-6h PRN	-
Ketamine	IM	10-20 mg/kg	Sedative dosage
	IM	35-40 mg/kg	Surgical anesthesia dosage
Ketamine + acepromazine	IM	Ketamine 20-40 mg/kg + acepromazine 0.2-0.35 mg/kg	Anesthetic dosage
Ketamine + diazepam	IM	Ketamine 25-35 mg/kg + diazepam 2-3 mg/kg	Anesthetic dosage
Ketamine + xylazine	IM	-	Not recommended as anesthetic regimen
Ketoconazole (Nizoral® 200 mg tabs)	PO	10-50 mg/kg divided q8h or 50 mg/ferret q24h	-
Lactulose syrup (15 mg/10 cc)	PO	0.10-0.5 cc/kg q8-12h	Absorption blood ammonia; may cause soft stools
Levamisole (oral)	PO	5 mg/lb daily for 30 days	Dirofilariasis (usually not successful)
Megestrol acetate (Ovaban®)	-	Do not use in ferrets: predisposes animal to pyometra	Do not use in ferrets
Methoxyflurane	-	Mask, endotracheal tube to effect	Anesthesia

FORMULARY FOR FERRETS

Drug	Route	Dosage	Comments
Metronidazole	PO	15-20 mg/kg q24h x 2 weeks	Protozoal (giardia) infections
	PO	20 mg/kg q8h 10 days	For *Helicobacter/Campylobacter* combine with amoxicillin PO and Pepto Bismol)
Milbemycin oxime	-	1.15-2.30 mg/kg	Heartworm treatment
Nandrolone decanoate	IM	1-5 mg/kg q 1 week	-
Neomycin	PO	10-20 mg/kg q6h	-
Nitroglycerine ointment 2%	Topical	1/16 - 1/8 inch q12-24h	Vasodilator, cardiomyopathy
Oxytocin	SC, IM	0.2-3.0 units/kg	-
Penicillin G (procaine)	IM	44,000 IU/kg q24h or 22,000 IU/kg q12h	-
Penicillin G (potassium)	IV, IM, SC	20,000 IU/kg q4h (as in cat)	-
Penicillin (oral suspension)	PO	40,000 IU/kg q8h	-
Pentobarbital	IP	30 mg/kg	-
PEP-E (injectable amino acids)	SC or IM	0.2 ml/ferret PRN	Nutritive supplement
Phenobarbital elixir (20 mg/5 ml = 4 mg/ml)	PO	1-2 mg/kg q12h	For seizures; therapeutic dosage for maintenance may vary, Can follow cat guidelines
Piperazine	PO	45-65 mg/kg up to 250 mg; repeat dose in 2 wks	As for cats/kittens
Praziquantel (Droncit® 23 mg tab)	PO	<4 lb: 1/2 tab or 5-10 mg/kg once	Cat dosage; repeat in 2 weeks

FORMULARY FOR FERRETS

Drug	Route	Dosage	Comments
Praziquantel (injectable 56.8 mg/ml)	SC	<5 lb: 0.2 ml or 5-10 mg/kg once	Repeat dose in 2 weeks
Prednisone (oral)	PO	0.5-2 mg/kg q24h	-
	PO	Schedule like cat for LSA: 2 mg/kg q24h, 1.25-2.5 mg/kg q24h, gradually decrease to q48hr (eosinophilic gastroenteritis)	-
Prednisone acetate (inj)	IM, SC	2 mg/kg start, q24h	Reduce dosage as with cat for subsequent doses
Prochlorperazine	IM	0.06 mg/lb BW q3-4h deep	-
Propranolol (Inderal®)	PO, SC	2.5 mg/ferret q12h	Vasodilator - hypertrophic cardiomyopathy
Prostglandin (Lutalyse®)	IM	0.1 ml PRN	Use with antibiotics in metritis to help expel necrotic debris****
Pyrantel pamoate (Nemex®)	PO	4.4 mg/kg; repeat dose usually 2 weeks	Parasiticide
Stanzolol (Winstrol V® inj 50 mg/ml; tablets)	IM, SC, PO	0.5 mg/kg q12h or 10-25 mg/kg IM weekly	Caution if liver disease
Sucralfate (Carafate®)	PO	25 mg/kg q6-8h; (1/8 of 1 g tablet PO q6-8h)	Despite other protocols listing this with Cimetidine or other antacids it should NOT be used simultaneously with alkalinizers as it requires an acid environment to be active
Sulfadimethoxine (Albon® 12.5%)	PO	25-50 mg/kg q24h	-

FORMULARY FOR FERRETS

Drug	Route	Dosage	Comments
Sulfadimethoxine (inj)	IM, SC	25 mg/kg q24h	-
Sulfasoxazole (Gantrisin®)	PO	50 mg/kg q8h	-
Tetracycline (oral or susp.)	PO	25 mg/kg q12h or 17 mg/kg q8h	-
Theophylline elixir	PO	4.25 mg/kg q8-12h	-
Thyroxin (Levothyroxine)	PO	0.2-0.4 mg/kg q12h adjust as necessary, taper to q24h	-
Trimethoprim sulfa (Bactrim® + sulfamethoxazole; Tribrissen® + sulfadiazine)	PO	30 mg of combined drug/kg q12h	Maintain hydration, Good for respiratory and urinary infections
Trimethoprim sulfa (Ditrim® 240 mg/ml)	IM, SC	30 mg/kg q12h	Maintain hydration
Xylazine (Rompun®)	IM, SC	1.0 mg/kg	Not recommended, can cause severe hypotension

** Johnson-Delaney, 1994, ** Brown, 1995, *** Carpenter, 1994, **** Jenkins, 1995, ***** Rosenthal, 1995*

ANTINEOPLASTIC REGIMENS

Drug	Route	Dosage	Comments
Brewer's yeast containing chromium	PO	1/8-1/4 tsp q12h in food	Insulinoma adjunctive therapy
Cyclophosphamide (Cytoxin®)	PO	1/4 25 mg tablet/ferret once every 3 wks for 3 doses	Lymphosarcoma; do not give on same day as vincristine
Diazoxide	IM, SC start	10 mg/kg q12h to start, may increase to 40 mg/kg as needed	Insulinoma; usually don't start unless prednisone doesn't work; insulin blocking, hypertensive
Lysodren (Mitotane® 500 mg tab; see comments)	PO	50 mg/kg (roughly 50 mg/ferret) q24h 7 days, then every third day up to 8 wks, then increase or decrease in frequency depending on the case	Adrenal neoplasia; need to be repacked by pharmacist into small gelatin capsules 50 mg/cap; saliva must not touch the drug!
Melphalan (Alkeran®; see comments)		0.10 mg capsule/ferret q24h for 2 wks, then one 0.50 mg capsule/ferret for 2 wks, finally wean off using 0.50 mg capsule/ferret every 2 days for 2 doses, then every 3 days for 2 doses, then every 5 days for 2 doses.	Lymphosarcoma; have pharmacist pack into small capsules of 0.10 mg and 0.50 mg; Discontinue therapy if CBC shows changes (WBC drops below 2000 or thrombocytopenia or anemia occurs)
Prednisone (oral)	PO	0.5-1 ml/kg	Insulinoma; schedule like cat
	PO	2 mg/kg q24h	Lymphosarcoma therapy
Prednisone acetate (inj)	IM, SC start	2 mg/kg q24h; reduce dosage as with cat for subsequent doses	Insulinoma
Vincristine	IV	0.05 mg for ferrets <1 kg; 0.10 mg for ferrets >1 kg BW	Lymphosarcoma

CHEMOTHERAPY PROTOCOL FOR LYMPHOSARCOMA	
Drug	**Dose**
Week 1	
Vincristine	0.07 mg/kg IV
Asparaginase	400 IU/kg IP
Prednisone	1 mg/kg PO q24h
Week 2	
Cyclophosphamide	10 mg/kg SC
Prednisone	1 mg/kg PO q24h
Week 3	
Doxorubicin	1 mg/kg IV
Prednisone	1 mg/kg PO q24h
Week 4-6	
as weeks 1-3 above but without asparaginase	
Week 7	
Prednisone	1 mg/kg PO q24h
Week 8	
Vincristine	0.07 mg/kg IV
Prednisone	1 mg/kg PO q24h
Week 9	
Prednisone	1 mg/kg PO q24h
Week 10	
Cyclophosphamide	10 mg/kg SC
Prednisone	1 mg/kg PO q24h
Week 11	
Prednisone	1 mg/kg PO q24h
Week 12	
Vincristine	0.07 mg/kg IV
Predisone	1 mg/kg PO q24h
Week 13	
Prednisone	1 mg/kg PO q24h
Week 14	
Methotrexate	0.5 mg/kg IV
Prednisone	1 mg/kg PO q24h
Continue in sequence biweekly; prednisone given throughout	

Injection Sites

Intravenous:	cephalic, saphenous, or jugular vein
Intramuscular:	thigh
Subcutaneous:	intrascapular, flank

NEW ANESTHETIC PROTOCOLS FOR FERRETS

Drug	Route	Dosage	Comments
Glycopyrrolate (Robinul-V®)	IM	0.01 mg/kg	Anticholinergic; use prior to anesthesia (esp. ketamine or Telazol)
Medetomidine (Dormitor®)	IM, SC	60-80 μg/kg; 100 μg/kg* SC = light to moderate sedation	Sedative, analgesic; reverse with atipamezole
Atipamezole (Antisedan®)	IM, SC, IP, IV*	1 mg/kg	To reverse action of medetomidine
Ketamine + medetomidine	IM	10 mg/kg ketamine + 60 μg/kg medetomidine	Good for chemical restraint on a healthy ferret
Ketamine + medetomidine	IM	8 mg/kg ketamine + 100 μg/kg* medtomidine	Surgical anesthesia
Midazolam	IM	1 mg/kg	Benzadiazepine
Tiletamine/zolazepam (Telazol®)	IM	12-22 mg/kg	Immobilization; poor analgesia, long recovery; use glycopyrrolate or atropine as they salivate with this.
Xylazine	IM, SC	1 mg/kg	Not recommended in ferrets

**Flecknell P: Lab Animal, Feb:21-25, 1997.*

FLEA PRODUCTS FOR FERRETS*

Product	Use	Comments
Imidaclopride (Advantage®)	2-3 drops of feline product (for cats under 9 lbs) monthly, on skin, back of head (part the hair)	Be aware that frequent bathing probably decreases efficacy, just as in dogs and cats; Administration may need to be more frequent, but safe frequency has not been determined in ferrets.
Fipronil (Top Spot®/Frontline®)	2 drops monthly, on skin, back of head (part the hair)	Author has been using this for ferrets and rabbits based on the European experience for the past years; seems to be working well. Treat all dogs and cats in the home.
Lufenuron (Program®)	Feline preparation; dose based on ferret's weight	Oral
Pyrethrin-based flea spray and powders	Follow recommendation for kittens.	Do not spray or powder ferret directly. Put in on a brush or washcloth and work through the fur. Take a damp cloth afterward and wipe off excess.
Flea shampoos (Mycodex® carbaryl or pyrethrin only, NOT LINDANE)	For immediate killing of fleas.	Rinse and rinse and rinse.
Flea powder (VetKem®)	Work through fur from brush.	Ferrets, guinea pigs, rabbits, chinchillas, wildlife, birds.
Flea/tick pump spray (VetKem®)	Follow recommendation for kittens.	Apply to baby brush and brush the ferret, then towel off to remove excess.
Ferret shampoo (regular, not flea control)	Use 24 hours after ivermectin earmite treatment.	Follow with environmental cleaning/ectoparasite control.

** None of the systemic flea products are approved for use on ferrets, but they have been used following recommendations for cats (with dosages reduced due to body weight of ferret). The owner needs to control fleas on the other pets, and in the environment.*

Rabbits

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of rabbits and is not intended to replace comprehensive reference material.

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RABBITS

Species *Oryctolagus cuniculus*

Common Breeds and Variations

- Rabbits are not rodents; they are lagomorphs.
- Many breeds, varieties, colors and coat combinations are currently popular as pets.
- Common pet breeds: Angora = English, French, German; Lop-eared = English, French, Holland, Mini; Dwarf = Florida White, Netherlands Dwarf, Polish
- Lop-eared rabbits have ears that may touch the floor when the rabbit is standing up; mini-lop refers to the length of the ear, not the size of the rabbit.
- Other pet breeds: Blanc de Hotot, Dutch, Chinchilla, Rhinlanders, Silver Martin, New Zealand White, Flemish Giant
- Laboratory breeds: Dutch, New Zealand White, French Lop
- Meat breeds: Giants = Checkered, Flemish; New Zealand; Californian; Himalayan
- Wool/pelt breeds: Rex, Angora

Behavior

- Rabbits make nice, quiet and gentle pets; most have docile dispositions.
- A panic scream or occasional warning growl is usually the extent of vocal sounds.
- Foot thumping is used as a signal of warning.
- Cecotrophy (coprophagy of cecotrophs) is necessary, usually taken in dawn hours.
- The morning cecotroph is small, soft, covered with mucus and swallowed whole, which serves to aid the rabbit in digestion of plant material.
- Rabbits put out large quantities of the normally dry, fairly round fecal pellets daily.
- Many pet rabbits may be harness, leash, and litter box-trained.
- Suggested litter box filler for rabbits: pelleted paper or other organic products such as Cellu-Dri, Yesterday's News (both recycled paper); Mountain Cat Kitty Litter or Harvest Litter (pelleted grass products); or similar types are preferable.
- Litter products should be non-toxic and digestible if eaten.
- Do not use corncob, walnut shell, shavings or clay litters.
- Males (and some females) may spray urine when upset or stressed.

Diet

- Rabbits are herbivores and feed continuously (are "nibblers").

Recommended daily diet includes:

- Unlimited mixed grass hay or timothy hay. Alfalfa hay is not recommended for most adult house rabbits as it is too high in calcium content and calories, but can be offered free choice to young rabbits.
- No more than 1/8 cup of high fiber maintenance-type (alfalfa-based) rabbit pellets (18% or higher fiber) per 5 lb. adult (non-breeding) house rabbit.
- Minimum of 1 cup vegetables for each 4 lb. body weight. Select 3 different types dark green or dark yellow vegetables daily: for example, alfalfa sprouts, basil, beet greens, broccoli leaves, brussels sprouts, carrot and carrot tops, cilantro, collard greens, endive, green peppers, parsley, romaine lettuce, kale, outer cabbage leaves, raspberry leaves, wheat grass, pea pods (not the peas), squash, raddichio, dandelion leaves.
- Small amount of fruit (up to 3 types) totaling only 1-2 level Tbs. per 5 lb. body weight (none if dieting): stay with high fiber fruits: apple, peach, plum, pear, melon, raspberry, papaya, blueberry, blackberry, strawberry, pineapple. Avoid sugary fruits: bananas, grapes.

Housing

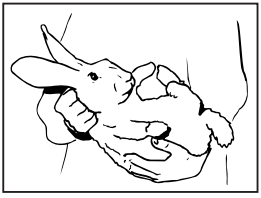
- Enclosure should be strong enough to prevent the rabbit from chewing its way out.
- Partial solid flooring is recommended.
- Rabbits raised on dirty floors or 100% wire flooring may develop severe foot ulcers that require treatment.
- Enclosure should provide shelter from prevailing wind, rain or snow, and provide shade from direct or full sun.
- It should be constructed to keep rabbit protected from dampness, extreme temperature fluctuations and other animals (wild and domestic).
- With outdoor rabbits, accumulated feces should be composted away from rabbit housing and not allowed to build up under the enclosure (flies, other animals are attracted to this waste material).
- Rabbits as pets must have rabbit-proofed home (remove electrical cords from reach, etc.).

Preventive Care

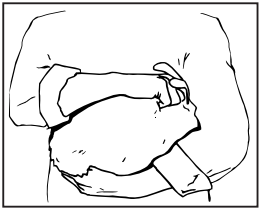
- Sanitation is very important: even with drop-through style enclosure flooring, feces and urine deposits should not be allowed to accumulate.
- Fur should be brushed and combed 1-2 times a week; long-haired varieties need daily care.
- Nail trims as necessary.
- Following grooming, a small dose cat laxative or pineapple juice can be given for hairball prevention, esp. if rabbit lives indoors.
- In some areas, need 1-2 times a week treatment with a "safe for rabbits" flea/insect control product.
- Weigh rabbit at least monthly.
- Check teeth frequently.

Restraint and Handling

- Improper handling may result in a struggling bunny and a scratched human. The rabbit can also injure itself — dislocated or fractured spine.
- Rabbits should not be lifted or restrained by their ears.
- Cat carriers provide adequate space and ventilation for long travel.
- A rabbit is easily "hypnotized" by cradling it on its back in your arms or across your lap, tipping the head backwards until it's "out." If the hind feet seem to be vibrating, touching them will stop it. Useful to check perineum, feet, cheeks.

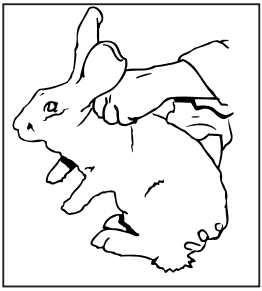


For short distance carries (restraint for nail trims, etc), the "bundling" position works well. The neck skin "scruff" is grasped in one hand, with the rear quarters supported with the other. The back of the rabbit rests against the handler's tummy area.



To carry a rabbit, the animal's head should be tucked into the handler's arm, and the handler's forearms used to provide support both along the back and beneath the rabbit.

Adapted from photographs in Beynon PG, Cooper JE (eds): *BSAVA Manual of Exotic Pets*. Cheltenham, BSAVA, 1991.



Method of restraint for intraperitoneal injection.

Sexing

In male rabbits, the penis overlies the anus; it can be protruded by gentle pressure on either side of genital opening. Inguinal pouches lie laterally to the urogenital opening in both sexes and may be filled with a strong-smelling, dark-colored glandular secretion.

The rabbit's back and hindquarters are supported on the handler's thigh to allow examination of the external genitalia. The testicles are retractable into the abdomen.

Adapted from photographs in Beynon PG, Cooper JE (eds): *BSAVA Manual of Exotic Pets*. Cheltenham, BSAVA, 1991.

External genitalia of male rabbit.
S = scrotal sac
P = tip of penis.

External genitalia of female rabbit.
U = urogenital orifice
A = anus.

Rabbit - Quick Facts

Physiologic	
Life span:	5-8 years or more
Adult male body weight:	2-5 kg - depends on breed
Adult female body weight:	2-6 kg - depends on breed
Body surface area in cm^2 =	9.5 $(\text{wt in grams})^{2/3}$
Rectal temperature:	38.5-40°C, 99.1-102.9°F
Diploid number:	44
Food consumption:	5 g/100 g/day
Water consumption:	5-10 ml/100 g/day or more
GI transit time:	4-5 hr
Respiratory rate:	30-60/min
Tidal volume:	4-6 ml/kg
Oxygen use:	0.47-0.85 ml/g/hr
Heart rate:	130-325/min
Blood volume:	57-65 ml/kg
Blood pressure:	90-130/60-90 mm Hg
Dentition:	two small, tube-shaped incisors behind the large upper incisors; all open-rooted; incisors grow 10-12 cm/yr
Dental formula:	2-0-3-3 / 1-0-2-3
Reproductive	
Male: buck, Female: doe	
Breeding onset (male):	6-10 mo*
Breeding onset (female):	4-9 mo*
Cycle length:	induced ovulator
Gestation period:	29-35 days
Parturition:	kindling
Postpartum estrus:	none
Litter size:	4-10
Babies:	kittens or bunnies
Birth weight:	30-80 g
Weaning age:	4-6 weeks
Breeding duration:	1-3 years
Breeding duration (commercial):	7-11 litters
Young production:	2-4/mo
Milk composition:	12.2% fat, 10.4% protein, 1.8% lactose

**Dwarf breeds mature earlier than giant/large breeds.*

Breeding and Raising Young

- Use cardboard box or wooden crate for housing, large enough for female to easily stand.
- Shouldn't be too large, because doe may step on bunnies if she spends too much time in the box.
- Cut a high doorway in the side (6" off the floor) so doe can

hop in, but bunnies won't fall out. When the bunnies' eyes are open, cut doorway lower so bunnies can climb in and out.

- Nest is usually lined by female with plucked hair. If she hasn't, use flannel, terry cloth or facial tissues. Replace if it becomes soiled.
- Provide warmth for bunnies - heating pad set on low over one side of the box (make sure doe can't get at the cord). Only needed if nest is not made of rabbit hair. Indoor clients' homes are warm enough with a fur nest.
- Rabbits feed young only once (rarely twice) daily.
- Mother rabbits stay with the young only briefly while feeding.
- Advise care-giver to check once daily to determine if babies are being fed.
- Don't disturb much until bunnies' eyes are open (10 days). If in doubt, weigh bunnies once daily, same time each day. Does don't reject handled bunnies.
- Bunnies are being fed if skin is not wrinkled, if they're warm, and bunched together.
- Even if the doe doesn't appear to be feeding the bunnies the first couple of days, tell care-giver not to remove. Doe may be slow in initiating lactation (first feeding often 24 hours after birth) and may be able to feed in a few days (up to 4 days after birth).
- Supplemental feedings must be given if the bunnies have not been fed during first 2 days.
- If some bunnies appear wrinkled, may give supplemental feedings once or twice a day.
- Stimulate bunnies to urinate/defecate after each feeding. Use cotton ball dipped in warm water or your finger to gently wipe bunny bottoms.
- When eyes are open, introduce to pellets, leafy greens, hay.
- At weaning add cecotroph or fecal gruel from the mother.

Composition of Milk for Orphan Rabbits

Milk type	% solids	Kcal/ml	Fat	Protein	Carbohydrate	Ash
		----------as % of solids----------				
Rabbit	31.2	2.06	49	32	6	6
Hare	32.2	2.01	46	31	5	-
KMR Sub.*	33	1.78	26	43	22	-
Esbilac*	33	1.78	43	34	15	-
Multi-Milk*	NA	NA	30	55	NA	-

**Pet-Ag*

Suggestion: Add egg yolk or Multi-milk to KMR or Esbilac to increase fat and protein ; also add acidophilus.

Formula Requirements by Age for Total Daily Replacement*

Age	KMR	Acidophilus**
Newborn	5 ml	0.5 ml
1 wk old	12-15 ml	1 ml
2 wk old	25-27 ml	1 ml
3 wk old	30 ml	2 ml
Until weaned	30+ ml	2 ml

** Do not feed in one feeding; Divide into 2 feedings by bottle, or several feedings (less preferable) by syringe.*
*** Commercial liquid acidophilus for baby rabbit replacement formulas: feed in at least two feedings a day. Amounts may vary somewhat with breed size.*

First Visit/ Annual Examination

- Physical exam including oral/dental
- Fecal flotation/smear
- Transponder scanning (if microchip ID)
- In addition:
  - CBC/chemistries (esp. serum calcium if alfalfa-based diet)
  - Urinalysis (especially if alfalfa-based diet)
  - Pasteurella, encephalitozoon serology
  - Syphilis testing (Treponema) if breeder, symptoms
  - Radiographs
  - Rectal/stool culture, salmonella screen

Blood Collection

Pluck hair, do not shave.
Lateral saphenous: 25-27 gauge needle.
Jugular (problem in rabbits with large dewlaps): 22-25 gauge needle, restraint as in a dog or cat.
Cephalic vein

Injection Sites

Intramuscular
quadriceps, 23 gauge needle, 0.25-1.0 ml
Subcutaneous
overlying neck and thorax, 21-23 gauge needle, large volumes
Intraperitoneal
restrain on back by scruff; introduce short 2.5 cm needle at right angles to body wall just off midline at a point equidistant between xiphisternum and pubis
Intravenous
cephalic, lateral saphenous or marginal ear vein, jugular
Note: Veins of rabbits are small and fragile. Jugular catheterization is best done under sedation using a small gauge catheter. Collar to prevent rabbit from chewing the catheter.

Oral Medicating

- Wrap rabbit in towel with its head exposed.
- The nozzle of a syringe is introduced into the corner of the mouth and small (0.25-0.5 ml) boluses of fluid are administered, allowing time for swallowing.
- If the rabbit refuses to swallow then a stomach tube can be passed (3.0 mm outside diameter (8.0 Fr) soft catheter).
- A speculum is usually necessary as rabbits will rapidly chew through most tubes; drill a hole through the sides of plastic case provided with disposable syringe.
- Alternatively, a commercial speculum can be used.

Oral Fluid Therapy (weight % dry powder)

Glucose (dextrose)	61.6	Citric acid	9.1
NaCl	15.0	Kaolin	2.1
KCl	2.0	Sodium bicarbonate	12.0
C vitamin (ascorbic acid)	6.9		

Dissolve 25 g in 1 L water. Prepare fresh daily. Change bottle or bowl q12-24h. Give post-op or when decreased water intake.

Hematologic and Biochemistry Reference Ranges*	
Erythrocytes:	4-7 x 10^6/mm^3
Hematocrit:	36-48%
Hemoglobin:	10.0-15.5 mg/dl
Leukocytes:	9-11 x 10^3/mm^3
Neutrophils:	20-75%
Lymphocytes:	30-85%
Eosinophils:	0-4%
Monocytes:	1-4%
Basophils:	2-7%
Platelets:	250-270 x 10^3/mm^3
Serum protein:	5.4-7.5 g/dl
Albumin:	2.7-4.6 g/dl
Globulin:	1.5-2.8 g/dl
Serum glucose:	75-150 mg/dl
Blood urea nitrogen:	17.0-23.5 mg/dl
Creatinine:	0.8-1.8 mg/dl
Total bilirubin:	0.25-0.74 mg/dl
Serum lipids:	280-350 mg/dl
Phospholipids:	75-113 mg/dl
Triglycerides:	124-156 mg/dl
Cholesterol:	35-53 mg/dl
Serum calcium:	5.6-12.5 mg/dl
Serum phosphate:	4.0-6.2 mg/dl

**Printed values represent ranges derived from the literature. Individual practitioners should strive to establish their own "normals" with their own lab.*

Selected Biochemistry Values Separated by Sex*

Test	Males (mean)	Females (mean)
Sodium	139	141
Potassium	4.5	4.5
Calcium	13.9	14.3
Phosphorus	3.9	3.4
Total protein	5.5	5.8
A/G Ratio	2.35	1.74
Osmolality	282	284
Chloride	10^6	10^9
CO_2	20.7	20.7
Anion gap	12.0	11.1
Bilirubin	.36	.50
GGT	4.0	5.6
Alkaline phos.	54.5	42.5
ALT (SGPT)	38.2	37.1
AST (SGOT)	21.3	17.3
Cholesterol	28.5	25.8

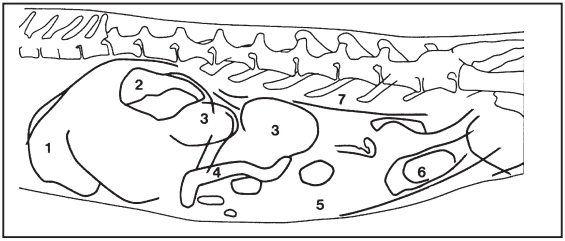
* *Harkness, 1989; Jenkins, 1993*

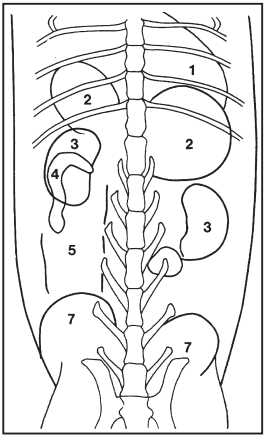
Urinalysis	
Urine volume/24hr	20-350 mL/kg (average 130 mL/kg)
Specific gravity	1.003-1.036
Average pH	8
Color	Pale to dark yellow; orange; rust (dietary pigment may relate)
Appearance	Mildly radiopaque with sand
Protein	Negative to trace
Ketones	Negative
Glucose	Negative to trace
Casts	None
WBC	Rare
RBC	Rare
Epithelial cells, bacteria	None to rare
Crystals	Common: triple phosphate, calcium carbonate monohydrate, and anhydrous calcium carbonate
Differentiate polyuria from dysuria	

Radiographic Technique

	Thorax	Abdomen
Size:	8 cm	8 cm
Film Type:	Cronex 6 with par speed intensifying screens	
MA:	300	100
kVp:	60	58
Exposure time (sec):	1/120 (.008)	1/30 (.034)
Focal film distance (inches):	40	40

Normal Radiographic Appearances





In lateral and VD radiographs of an adult malt rabbit, several abdominal structures can be recognized:
1. liver,
2. stomach filled with food and gas,
3. kidneys,
4. small bowel loops,
5. cecum,
6. urinary bladder and
7. intra-abdominal fat deposits.

Rübel, 1991

Skull Radiograph

In the normal radiographic appearance of the skull, the angular processes of the mandibles are large, but paper-thin and appear almost radiolucent. A ventrodorsal open-mouth projection is required. For comparison of the two sides, exact symmetrical positioning is essential. In the normal skull radiograph, the third upper molar is very small and hardly visible. The first two incisors of the upper jaw grow in a half circle towards the hard palate of the oral cavity. The lower incisors prevent this by rubbing constantly on the upper pair. Therefore, incisors of upper and lower jaw must be in good alignment with each other. All upper premolars and molars grow parallel to each other. In the lower jaw, the last two molars grow at a slight angle towards the other teeth.

Special Notes and Resources for Rabbits

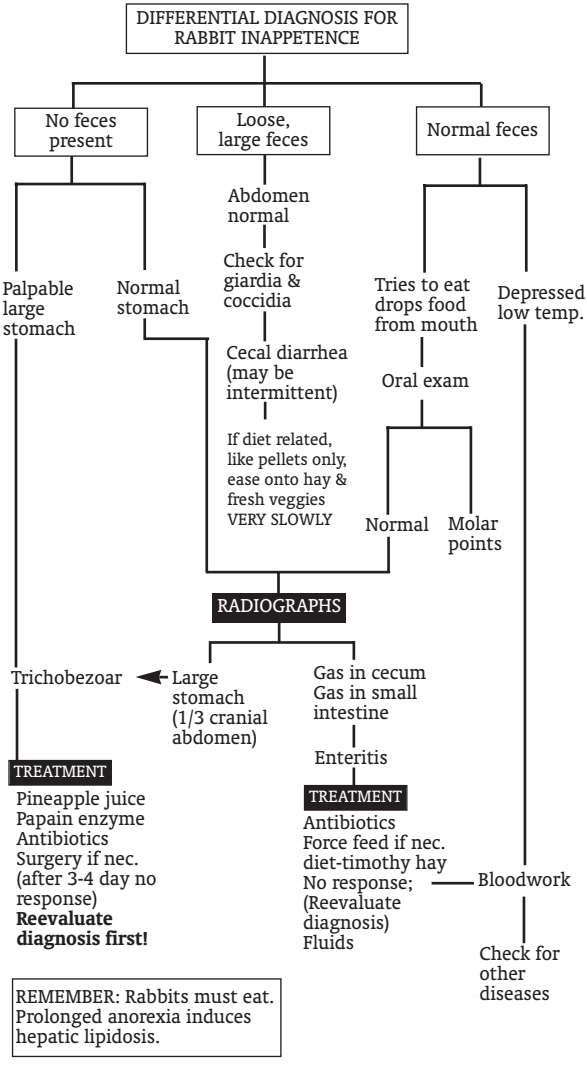
- Pasteurella detection: serum samples. Dr. Barbara Deeb, Dept of Comparative Medicine, Box 357190, School of Medicine, University of Washington, Seattle, WA, 98195-7190 USA; Tel 206-685-3202 or Fax 206-685-3006.

Rabbit Viruses

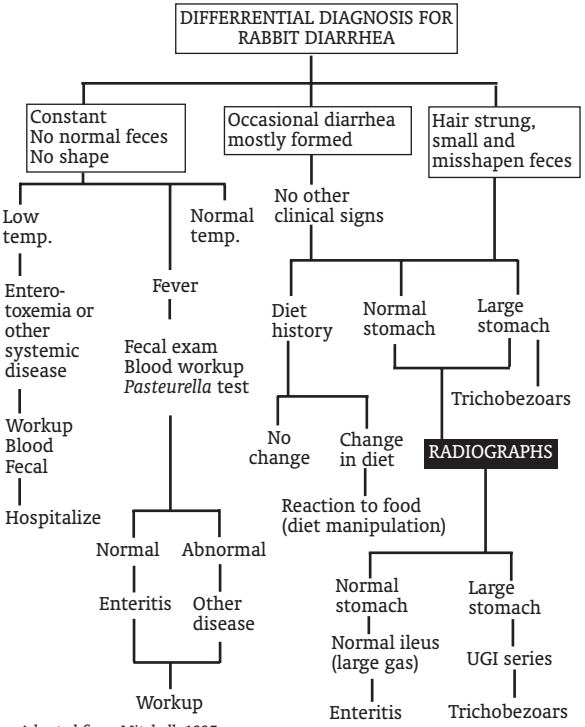
Virus	Clinical Signs
Myxomavirus (pox):	Facial edema, conjunctivitis, tumors, skin lesions
Papillomavirus:	Skin papillomas
Oral papillomavirus:	Papillomas in mouth, under tongue
Rotavirus:	Diarrhea
Coronavirus (systemic):	Pleural effusion, cardiomyopathy
Coronavirus (enteric):	Diarrhea
Calicivirus:	Hemorrhages, liver necrosis

Common Emergencies and Clinical Conditions

- Gastrointestinal
  - Anorexia >24-28 hours
  - Diarrhea or lack of stool
- Trauma
  - Fractures (limb or back)
  - Wounds (self-inflicted, environment, or from another animal)
  - Ophthalmic (underlying pathology may be *Pasteurella*)
  - Sore hocks (husbandry problem with 2° bacterial infection)
- Geriatric conditions
  - Neoplasia
  - Cardiac (arteriosclerosis, cardiomyopathy, atherosclerosis)
- Neurologic signs (seizures/convulsions/torticollis)
  - Encephalitis
  - Encephalitozoonosis
  - Otitis interna, torticollis (*Pasteurella* sp. *Staphylococcus* spp.)
  - Intoxications (lead)
  - Metabolic disorders
- Respiratory
  - Dyspnea
  - Pneumonia
- Integumentary
  - Severe pruritus - fleas
  - Myiasis - cuterebra (usually outdoor rabbits)
- Heat Stress/Stroke
- Fever
- Dystocia, mastitis



Adapted from Mitchell, 1995



Adapted from Mitchell, 1995

Some Causes of GI Disease in Rabbits

Hairball impactions, foreign material, too little roughage in diet! Cecal stasis: (*Clostridium* spp.), "enterotoxemia" with other bacterial involvement? Severe coccidial infection with secondary bacterial overgrowths. Teeth overgrowth/malocclusion (often secondary to *Pasteurella* infection). Physical impairment to eating.

Zoonotic Potential

- Campylobacter
- *Psoroptes* sp.
- Dermatomycosis
- *Multiceps serialis*
- Tularemia
- *Taenia taeniaeformis*
- *Cheyletiella* sp.
- Salmonella
- Pasteurella
- Bacteria infections from rabbit bites or scratches
- *Sarcoptes* sp.

ASSESSING THE GASTROINTESTINAL STATUS OF THE SICK RABBIT*

Parameter	Level 1 Outpatient	Level 2 Watch Closely	Level 3 Hospitalize
Appetite	Normal; eating greens & treats	Refusing greens	Refusing treats
Activity & attitude (Note: teeth grinding may occur at any level)	Normal, frisky; hiding	Depressed; not moving much	Limp, dull, head down; unresponsive
Stool	Normal, soft-formed, very small & dry	Scant; small, misshapen; no stool x 24 hr.	Liquid diarrhea; mucoid diarrhea, no stool in x days
Palpation	Normal; fluidy, non-painful; may palpate material in gut, stomach	Focally painful; gassy	Gastric tympany; cecal tympany; mass effect; generalized tenderness
Cardiovascular	Mucous membrane pink; ears warm	Mucous membrane usually still pink; usually ears still warm	Pale mucous membrane; ears cool, poor circulation
Gut sounds	Normal or hyperactive	Decreased or none	No gut sounds
Urine	Volume & color normal; may have brown tinge	May be decreased volume; increased odor; may have brown tinge	Decreased volume, increased odor, acidic, clear urine
Body temperature	101°-104°F	Below 101°F or above 104°F	Below 100°F or above 105°F
Treatment	Diet corrections - hay, pineapple juice, laxatives, If trichobezoar involvement, fluids PRN SC	Fluids and supportive care including high fiber force feeding Analgesics, Metoclopramide/ cisapride if no obstruction, Enrofloxacin	IV fluids, SC to follow analgesics, esp. flunixin, Dexamethasone if shocky, Enrofloxacin, Metoclo-pramide/cisapride if no obstruction, Force feeding including Nutrical, Prozyme, *Lactobacillus acidophilus*

** adapted from C. Harvey, 1992*

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Abdominal enlargement (acute/subacute)	Intestinal disorders, Enteropathies, Obstruction, Foreign bodies, Trauma, Peritonitis	History, Physical exam, Radiographs (scout, contrast), CBC/chemistries, Abdominal tap & fluid analysis, Ultrasonography	Supportive care, Correct underlying etiology
	Coccidiosis (hepatic) (*Eimeria stiedae*)	History, Physical exam, Radiographs, CBC/chemistries, Abdominal tap and fluid analysis, Ultrasonography, Biopsy	No Rx, Supportive care, May try sulfas, Sanitation
	Pyometra, Metritis, Uterine adenocarcinoma	History, Signalment, Physical exam, Radiographs, CBC/chemistries, Abdominal tap and fluid analysis, Ultrasonography, Reproductive history	Celiotomy, Hysterectomy, Antibiotics (if pyometra), Therapy pre and post op
Abdominal enlargement (subacute/chronic)	Neoplasia	History, Signalment, Physical exam, Radiographs, CBC/chemistries, Abdominal tap and fluid analysis, Ultrasonography, Biopsy	Celiotomy, tumor excision
	Obesity	History, Palpation	Diet correction, Exercise
	Ascites, Cardiomyopathy, Heart failure	Physical exam, ECG, Echocardiography, Radiography	Medicate as in other mammals

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Alopecia	Hair pulling, Nest building, Hair chewing, Idiopathic overgrooming	Observation, History, Skin scraping (R/O other causes)	Behavior, husbandry changes, Less aggressive grooming by human
	Rubbing/scratching, Pruritic response (see Dermatitis), Flea Allergy Dermatitis with secondary bacterial infection, Fur mites (*Cheyletiella* sp.)	Observation, History, Skin scraping, Fleas, flea dirt	Correct habitat, Topical anti-flea/antiparasiticide shampoo, spray, dust, Environmental control, Corticosteroids for symptomatic treatment if pruritis/inflammation, Antibiotics if bacterial infection
	Genetic hairlessness, Hypotrichoses	Genetic history, Biopsy	No treatment
	Dermatophytosis	Skin scraping, Cytology, Fungal culture, Biopsy	Systemic and/or topical antifungal, Sanitation
	Seasonal molt	History, R/O other causes	No treatment
Anorexia	Malocclusion, tooth root abscess	Physical/oral exam, Dental/head radiographs, Abdominal palpation, Pasteurella serology	If abscess, antibiotics, surgical tooth extraction; drainage, Correction of tooth spurs, trimming as necessary
	Trichobezoars	History, Signalment, Fecal evaluation, Radiographs +/- contrast, Abdominal palpation, Analgesics	Fluids, Pineapple juice, Cat laxative, Metoclopramide or Cisapride, Force feed fiber, Severe cases (if medical therapy doesn't work): gastrotomy and removal
	Cecal stasis, Gastroenteropathy	See under Diarrhea	

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Anorexia	Pneumonia, Respiratory disease, Sinusitis	Physical exam, Thoracic/skull radiographs, Pasteurella serology, CBC/chem, C&S nasal discharge, conjunctiva, Rule out secondary gastrointestinal problems, Abdominal palpation, Fecal exam, Radiographs	Supportive care, Antibiotics
	Coccidiosis (hepatic or intestinal)	History, Signalment, Physical exam, Radiographs, CBC/chemistries, Abdominal tap, Fluid analysis, Ultrasonography, Fecal exam, Possible liver biopsy	Supportive care, Sulfas for intestinal, Hepatic form may not be treatable
	Pain	Physical exam, History, Other disease present	Analgesics, Correct underlying etiology
	Unpalatable feed, Abrupt feed change	History, Rule out other causes, Physical examination	Gradual changes of feed, Correct husbandry, Vitamin B injection (sometimes stimulates appetite)
	Stress/heat stress	History, Rule out other causes, Physical examination	Correct husbandry, Temperature control, Fluids if rectal temperature is elevated
	Insufficient water	History, Review husbandry, Physical, CBC/chems to check electrolytes	Correct husbandry, Fluids as necessary for dehydration

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Constipation	Trichobezoars	History, Signalment, Fecal evaluation, Radiographs +/- contrast, Abdominal palpation	Fluids, Pineapple juice, Cat laxative, Metoclopramide or Cisapride, Force feed fiber, Analgesics, Severe cases: gastrotomy and removal
	Enteropathy	History, Signalment, Physical exam, Fecal exam, Gross direct smear, CBC/chemistries, Abdominal palpation, Radiographs +/- contrast	Supportive care (fluids, oral administration of feces from a healthy rabbit), Force feed high fiber +/- antibiotics, Metoclopramide or Cisapride, Analgesics, Laxatives
	Anorexia	See Anorexia	Supportive, Fluids, Correct underlying etiology
	Dehydration/insufficient water	History, Signalment, Fecal evaluation, Radiographs +/- contrast, Abdominal palpation, CBC/chemistries to evaluate electrolytes	Correct husbandry, Fluid therapy, Supportive care
Cutaneous or subcutaneous swellings	Bacterial abscesses	C&S, Gram's stain, Pasteurella serology	Antibiotics, Surgical draining
Cutaneous or subcutaneous swellings (mammary glands)	Lactation, Mastitis, Mammary neoplasia	C&S, Gram's stain, Cytology of fluid, Biopsy	No Rx (lactation), Antibiotics, Warm pack, Draining, Surgical excision, Remove bunnies

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Cutaneous or subcutaneous swellings	Cuterebriasis	Physical exam	Topical insecticides, Excision
	Multiceps serialis (Coenurus) cysts	Aspiration of cyst, Cytology, Biopsy, Observation, Palpation	Excision, Prevent by eliminating ingestion of carnivore feces
	Neoplasia (Shope fibromatosis - poxvirus, Papilloma, Lymphosarcoma, Mammary adenocarcinoma, Epidermal carcinoma)	Biopsy, Radiographs (rule out metastasis)	Surgical excision, Supportive care as needed
	Hematoma	Aspiration, Physical examination	Warm, moist pack, Analgesics
Dermatitis	Ectoparasitism (Ear mites: *Psoroptes cuniculi*, Fur mite = *Cheyletiella parasitovorax*, Mange mite = *Sarcoptes* sp., *Notoedres* sp., Lice = Pediculosis, *Haemodipsus ventricosus*, Fleas = *Ctenocephalides felis, C. canis, Cediopsylla* sp., *Odontopsyllus* sp. *Hoplopsyllus* sp.	Skin scraping, Biopsy, Swab, Microscopic examination, Visualization	Ivermectin, External parasiticides, powders, sprays, baths (safe for young cats), Environmental control, Corticosteroids if severe pruritus or FAD
	Pododermatitis (ulcerative dermatitis)	C&S, Biopsy	Antibiotics, Padded bandages, Solid, soft flooring, Sanitation, Non-steroidal anti-inflammatories, Analgesics
	Bite wounds (ulcerative dermatitis)	C&S, Biopsy, History	Antibiotics, Nonsteroidal anti-inflammatories, Analgesics

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Dermatitis	Moist dermatitis (ulcerative dermatitis)	C&S, Biopsy, Review husbandry	Antibiotics, Paper substrate, Sanitation, Use water bottle
	Bacterial dermatitis (*Pasteurella multocida, Treponema cuniculi, Staphylococcus aureus, Pseudomonas aeruginosa, Corynebacterium* spp.) may be secondary to *Cheyletiella* sp.	C&S, Biopsy, Gram's stain/smear, Pasteurella serology, Skin scraping if parasites suspected	Antibiotics as indicated by C&S, Sanitation, Use newspaper/paper substrates
	Fusobacterium necrophorum ("Necrobacillosis")	Microscopic exam	No treatment known; Supportive care (progressive necrotic lesions)
	Dermatophytosis (*Trichophyton mentagrophytes*)	Fungal culture, Microscopic exam	Antifungals, systemic +/- topical, Sanitation
	Myxomatosis ("rabbit pox")	Rule out bacterial infection, Biopsy	May be progressive, fatal, No treatment except supportive care, Sanitation, Symptomatic, Vector control, Avoid contact with wild rabbits
Diarrhea (+ nonspecific enteropathies)	History of inappropriate antibiotic administration (oral penicillins, erythromycin, clindamycin, lincomycin)	History, Signalment, Physical exam, Fecal exam: gross, direct smear and flotation, Rectal temperature, CBC/chemistries	Discontinue medications, Supportive care (fluids, oral administration of feces from a healthy rabbit to recolonize gut, force feed high fiber)
Diarrhea	Mucoid enteropathy	History, Signalment, Physical, Fecal exam: gross, direct smear/flotation, Rectal temperature, CBC/chemistries	Supportive care, Metoclopramide or cisapride, Force feed high fiber

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Diarrhea	Tyzzer's disease, *Clostridium piliformis* (acute hemorrhagic typhlocolitis)	History, Signalment, Physical exam, Fecal exam: gross, direct smear and flotation, Rectal temperature, CBC/chemistries, Giemsa or Periodic Acid Schiff stains, Intestinal biopsies	Supportive care, Tetracycline, Oxytetracycline
	Enterotoxemia (Clostridial: *Cl. spiroforme, Cl. perfringens, Cl. dificile, Cl. tympani, Cl. sordelli*)	History, Signalment, Physical, Fecal exam: gross, direct smear/flotation, Rectal temperature, CBC/chemistries	Supportive care, Enrofloxacin, Metronidazole
	Colibacillosis	History, Signalment, Physical, Fecal exam: gross, direct smear/flotation, Rectal temperature, CBC/chemistries	Supportive care, Enrofloxacin
	Intestinal coccidiosis	Fecal exam: flotation, smear	Supportive care, Sulfas, Sanitation
	Pseudomonas aeruginosa	History, Signalment, Physical, Fecal exam: gross, direct smear/flotation, Rectal temperature, CBC/ chemistries, Culture, Necropsy	Supportive care, Enrofloxacin
	Low dietary fiber (<18%)	History, Fecal exam: smear, flotation	Diet correction, Supportive care
	Cecal stasis (usually associated with clostridial enterotoxemia or other etiologies)	History, Signalment, Physical, Fecal exam: gross, direct smear/flotation, Rectal temperature, CBC/chemistries, Auscultation/percussion of abdomen	Supportive care, Metoclopramide or cisapride, High fiber feeding, Analgesics, Possible use of anti-microbials

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Dyspnea	Heat stress	History, Rectal/ambient temperature elevated, Physical exam	Correct temperature and husbandry, Fluids, Cool down if rectal temperature elevated
	Pneumonia (rule out *Pasteurella, Klebsiella, Bordetella, Staphylococcus, Pseudomonas*)	History, Physical exam, Auscultation, Thoracic radiographs, Thoracentesis, CBC, Pasteurella serology, C&S tracheal wash/exudates	Supportive care, Antibiotics, Oxygen
	Metastasis of neoplasia (rule out uterine adenocarcinoma)	History, Physical exam, Auscultation, Thoracic radiographs, Thoracentesis, CBC, Abdominal radiographs, Ultrasonography	Supportive care, Poor prognosis
	Pregnancy toxemia or ketosis (last week of gestation) Pseudopregnancy, Post parturient, resting does. Ketosis may occur in bucks. (mostly in Dutch, Polish, English breeds).	History (esp obesity & fasting), CBC/chemistries (esp. acid/base indicators), Urinalysis, Abdominal radiographs	Supportive care, Fluids, Correct acidosis, Supplemental feeding, C-section or hysterectomy, esp. if dead fetuses
	Pyothorax	History, Thoracic radiographs, Thoracentesis, Pasteurella serology, C&S	Supportive care, Chest drain, Antibiotics, Nonsteroidal anti-inflammatories

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Dyspnea	Conjunctivitis and rhinitis due to: bacterial (esp. Pasteurella), trauma, myxomatosis ("rabbit pox")	History, Physical exam, Ophthalmic exam, C&S lacrimal duct flush, Pasteurella serology, Fluorescein stain, Conjunctival smear, Biopsy of lesions suspected to be myxomatosis, Rule out other bacterial causes	For bacterial infections: topical/systemic antibiotics, corticosteroids as indicated. For myxomatosis: possibly no Rx except supportive care to control secondary bacterial infections. For trauma: Topical antibiotics, ophthalmic preps for conjunctival injuries, eye/cornea trauma as in other species, Corticosteroids if indicated
Dystocia	Rule out causes: stillborn, uterine inertia, infection, metabolic, breed/size, parity	Physical exam, History, Radiographs, CBC/chemistries, Ultrasonography	Supportive to doe, assist (hormonal) or C-section
Fever/hyperthermia	Septicemia (esp. *Pasteurella, Pseudomonas*), Pneumonia, Mastitis, Pregnancy toxemia, ketosis, Enterotoxemia, Colibacillosis, Myxomatosis, Bacteria cellulitis, Acute severe pain, Heat stress	Physical exam, History, CBC/chemistries, Appropriate microbiology, Radiographs	Aspirin/acetaminophen, Fluids, **Treat underlying etiology**
Hematuria (stranguria, urolithiasis secondary to calcinosis, cystitis/pyelonephritis)	Rule out bacterial component, systemic hypercalcemia	Physical exam, Urinalysis, CBC/chemistries, Radiographs, Contrast urograms, Diet history	Correct diet to lower calcium, Fluid therapy, Antimicrobials if bacteria, Analgesics, Cystotomy if necessary

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Incoordination, convulsions, seizures	Traumatic injury	Physical exam, History, Radiographs (skull), CBC/chemistries	Supportive, Corticosteroids, Analgesics, Anticonvulsants/ sedatives
	Otitis interna (see Torticollis)	Physical exam, History, Radiographs (skull), CBC/chemistries, Pasteurella serology	-
	Encephalitis and brain abscesses (see Torticollis)	Physical exam, History, Radiographs (skull), CSF tap, CBC/chemistries, *Pasteurella* serology, *Encephalitozoon cuniculi* serology	Antibiotics, Supportive care
	Toxicities (insecticides, fertilizers, toxic plants, lead ingestion)	History, Physical exam, Blood lead, CBC/chemistries	Specific antidotes if toxin known, otherwise general detox as in other mammals, Supportive care, CaEDTA if lead, Remove source
	Pregnancy toxemia/ketosis	History, Physical exam, CBC/chemistries, Acid/base balance, Urinalysis, Radiographs	Supportive care, Fluids, Correct acidosis, Supplemental feeding, C-section or hysterectomy (esp. if dead fetuses)
	Agonal phenomenon	Physical exam	(Heroics and prayer)
	Congenital, Epilepsy	Physical exam, Neurological workup (as in other mammals), Rule out other causes	Supportive care, Anti-seizure therapy, Diazepam if acute

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Incoordination, convulsions, seizures	Magnesium deficiency	Physical exam, Diet history, CBC/chemistries (blood magnesium)	Dietary correction and supplementation
Infertility	Immaturity or senescence	Review husbandry, habitat, diet, behaviors, Physical exam, Rule out medical causes	Correct husbandry problems
	Environmental stress	Review husbandry, habitat, diet, behaviors, Physical exam, Rule out medical causes	Correct husbandry problems
	Incompatible pair	Review husbandry, habitat, diet, behaviors, Physical exam, Rule out medical causes	Correct husbandry problems
	Bacterial infections (endometritis, pyometra, orchitis, venereal spirochetosis, *Treponema cuniculi*)	Physical exam, Ultrasonography, C&S, CBC/chemistries, Vaginal cytology, Urinalysis, Semen cytology	Appropriate antibiotic therapy, Sanitation
	Endometriosis or cystic endometrial hyperplasia	Ultrasonography, Biopsy	Hysterectomy, Analgesics, Anti-inflammatories, Many are asymptomatic except infertility
	Uterine adenocarcinoma	Physical, CBC, Radiography (thoracic for metastasis survey/abdominal), Ultrasonography, Histopathology	Laparotomy, Ovariohysterectomy
	Nutritional deficiencies	Diet review, CBC/chemistries	Improve diet, Supplementation

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Infertility	Pseudopregnancy	Ultrasonography, History, Physical exam, Abdominal radiographs	Time
Litter desertion or cannibalism	Maternal inexperience, Environmental disturbances, stresses, Split nest, Agalactia, Mastitis, Insufficient nesting material, Deformed young, Thirst, water deprivation, dehydration, Malnutrition	Review husbandry, diet, Physical exam, Rule out medical causes	Correct husbandry, diet, physical conditions
Nasal discharge	Rhinitis, Upper respiratory disease/infection (*Pasteurella, Bordetella, Klebsiella* spp., myxomatosis)	Physical exam, Cytology, Exudates exam, Gram's stain, C&S, Pasteurella serology, Head radiographs, CBC, Mucosal biopsy (if chronic, unresolved or if pox-like lesions are seen) Thoracic radiographs if auscultation indicates lung involvement	Appropriate antibiotic therapy, Systemic and/or topical (sinus, eye), Symptomatic and supportive care as necessary
	Pneumonia, Lower respiratory disease/infection (*Pasteurella, Bordetella, Klebsiella, Staphylococcus*), myxomatosis (rarely)	Physical exam, Cytology, Exudates exam, Gram's stain, C&S, Pasteurella serology, Head radiographs, CBC/chemistries, Mucosal biopsy (if chronic, unresolved or if pox-like lesions are seen), Thoracic radiographs if auscultation indicates lung involvement, Tracheal wash	Supportive care, Antibiotic therapy if bacterial

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Nasal discharge	Allergy	Rule out infections	Antihistamines, Decrease antigen exposure if possible
	Heat stress (serous nasal discharge)	History, Elevated rectal/ambient temperature	Correct temperature, husbandry
Paresis, paralysis, muscular weakness	Paraplegia — vertebral fracture or luxation (usually at L6 space)	Physical exam, Spinal radiographs (lat, VD)	Dexamethasone (4 mg/kg IM), Supportive care including enema, Evacuate urinary bladder, Analgesics if other trauma present
	Skeletal trauma (other than vertebral fracture): Long bone fractures, Soft tissue trauma	Physical exam, Radiographs, If wounds C&S swab before cleaning	Supportive care, Fluids, Antibiotics, Analgesics, Bandages, Collars as appropriate, Clean wounds and suture if necessary, Nonsteroidal anti-inflammatories
	Congenital abnormality (splay leg complex, ataxia)	History, Radiographs, Physical exam, Genetic/familial history	Proper nutrition, Non-slip surfaces, Splinting may help (very early)
	Sarcocystis spp. (most disease asymptomatic unless very high muscle load)	Physical exam, Muscle biopsy, Histopath, CBC with differential, Chemistries	Prevent exposure to carnivore feces, Analgesics, Supportive care, No therapeutics (amprolium is used as prophylactic in cattle and sheep)
Polydipsia	Lactation	History, Physical, Signalment, CBC/chemistries, Husbandry, diet review	Physiologic, no Rx

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Polydipsia	Heat stress	Physical exam, Rectal/ambient temperatures	Husbandry, Habitat correction, Fluids SC if rectal temp is elevated
	Febrile disease	History, Signalment, Physical exam, CBC/chem, Husbandry review, Diagnostics as indicated	Supportive care, depends on underlying etiology
	Enteropathy	History, Signalment, Physical exam, Fecal exam: gross, direct smear and flotation, Rectal temperature, CBC/chemistries	Supportive care, Metoclopramide or cisapride, Force feed high fiber, Analgesics, Antibiotics as indicated
	Diabetes mellitus or insipidus	History, Signalment, CBC/chemistries, Urinalysis, Physical exam	Treatment as in other mammals
Prenatal (& perinatal) mortality	Pregnancy toxemia, ketosis, Malnutrition, Nitrates in feed/water, Congenital abnormality, Environmental stress, noise, Uterine adenocarcinoma, Infectious disease (*Pasteurella, Listeria, Salmonella, Chlamydia*), Uterine crowding before 17 days gestation, Handling trauma at 17-23 days, Crowding	Review husbandry, diet, Physical exam, Rule out medical causes	Treat underlying etiology, Correct husbandry, diet

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Ptyalism or wet dewlap	Malocclusion, *Pasteurella* tooth root/bone infection, Genetic, Molar overgrowth	History, Physical/oral exam, Radiograph, Serology for *Pasteurella*, CBC/chemistries	Antibiotics, Dental correction, Incisor extraction in severe cases
	Abrasion on feeder	Check habitat	Husbandry correction, Topical treatment to skin if necessary
	Rule out Obstruction, Stasis, Diarrhea, Enteropathy, Abdominal pain	History, Physical exam, Radiographs, CBC/chemistries	Analgesics, Correct underlying etiology
Seizures, convulsions	Metabolic (hypo/hyperglycemia; hypo/hypercalcemia, ketosis, Mg deficiency, pregnancy toxemia), Cardiovascular compromise, Otitis interna, Trauma, Torticollis, Encephalitis, Brain abscess (bacterial), Toxicities, Epilepsy, Severe pain, GI obstruction, Neoplasia (CNS esp), Agonal phenomenon	Physical exam and history, Full workup when stabilized	Stop seizure — diazepam. Correct underlying condition and treat appropriately, Supportive care
Sudden death	Hypo/hyperthermia, Heat stress, stroke, Septicemia, Toxemia, enterotoxemia, Ketosis/pregnancy toxemia, Starvation, Dehydration, Chronic disease, Litter abandoned, Congenital abnormality, Trauma, Myxomatosis, Lymphosarcoma, Toxicity	Necropsy and histopathology, Appropriate diagnostics, History	Correct conditions of other rabbits in household

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Testicular swelling	Interstitial cell neoplasia, Myxomatosis ("Rabbit Pox"), Pasteurellosis, Orchitis bacterial	Physical exam, Histopathology, C&S excised testicular material, *Pasteurella* serology, CBC, C&S	Castration, Antibiotics, No Rx for Myxomatosis
Torticollis (see also Incoordination, Seizures)	Facial/head trauma (cranial nerve VIII)	Physical exam, History, Radiographs	Analgesics, Supportive care, Anti-inflammatories
	Otitis externa (parasitic, bacterial)	Physical exam, Otoscopic exam, Cytology exudate, C&S exudate	Antibiotic, Ivermectin if parasites, Analgesics/Anti-inflammatories
	Vestibular dysfunction - bacterial (otitis media/interna), Rule out *Pasteurella, Staphylococcus, Bordetella, E. coli, Pseudomonas aeruginosa*	Physical exam, Otoscopic exam, Neurologic exam, Radiograph head (tympanic bullae), Pasteurella serology, C&S exudate	Appropriate antibiotics (enrofloxacin), Analgesics if necessary
	Central vestibular/cerebellar disease - Encephalitis	Physical, Otoscopic, Neurologic exam, Radiograph head (tympanic bullae), *Pasteurella* serology, C&S exudate, CSF tap, Cytology, Culture (rule out *Pasteurella, Staphylococcus, Bordetella, E. coli, Pseudomonas, Listeria*) *Encephalitozoon cuniculi* serology, Histopath: Encephalomalacia with *Baylisascaris columnaris* & *B. procyonis*, eggs at necropsy, Exposure to raccoons, skunks	Supportive care, Appropriate antibiotics if bacterial, No direct Rx for *E. cuniculi*, No Rx for *Baylis* except limit access to areas frequented by raccoons or skunks

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Torticollis	Fungal brain infections	Physical exam, Neurological exam, CSF tap, Fungal culture	Supportive care, Systemic antifungals may be helpful
	Lead intoxication	Physical, Neurological exam, History of ingestion, Radiographs, Blood lead, CBC	Supportive care, EDTA as in other species, Removal of lead fragments
	General intoxication (insecticides, fertilizers, toxic plants)	History of ingestion, exposures, Urinalysis, CBC/chemistries, Physical exam	Antidotes as indicated, Supportive care
Vaginal discharge	Urine	Physical exam, History, Vaginal cytology, Urinalysis, Observation	Discussion with owner about colors of rabbit urine
	Uterine neoplasia, Pathology	Physical, Cytology/smear, Ultrasonography, Radiographs, Histopath.	Ovariohysterectomy
	Pyometra/metritis	Physical exam, Rectal temperature, CBC/chemistries, Vaginal cytology, C&S, Pasteurella serology, Ultrasonography, Radiography	Laparotomy, Antibiotics, Supportive care, Hysterectomy optional but should be considered
	Abortion, Rule out infectious cause: *Pasteurella, Listeria, Brucella*	Physical exam, Breeding history, Ultrasonography, Vaginal cytology, C&S, CBC/chemistries	If caused by infection, antibiotics, Supportive care
Weight loss	Malocclusion	Oral exam, Skull radiographs, Pasteurella serology, C&S, Diet history	Correct occlusion, Antimicrobial therapy

RULE OUT CHART FOR RABBITS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Weight loss	Trichobezoars	Diet history, Physical exam, Radiographs & contrast, Fecal exam	Hay, Roughage, Enzymes, Lactobacillus, Laxatives, Metoclopramide or cisapride, Surgery - gastrotomy if medical therapy fails
	Malnutrition/nutritional deficiencies/"agroceriosis" (ie, not getting food)	Review husbandry, social system, diet	Correct husbandry, diet, Supportive care as needed
	Chronic disease (pasteurellosis, yersiniosis, coccidiosis, salmonellosis, listeriosis, neoplasia, etc)	Physical exam, CBC/chemistries, Radiographs, Appropriate microbiology, Biopsy/histopathology	Appropriate antimicrobials, Antiparasitics, For neoplasia if possible, surgical excision
	Calcinosis (systemic hypercalcemia), Urinary calculi	Physical exam, Diet history, Radiographs, CBC/chemistries, Urinalysis	Correct diet (get off pellets, alfalfa), Supportive care, Cystotomy if bladder stones causing cystitis, Hematuria, Fluid therapy
	Pain (trauma, arthritis, chronic disease, etc.)	Physical exam, Radiographs, CBC/chemistries, History	Analgesics, Work on underlying etiologies.
	Ectoparasitism — severe	Physical exam, Skin scraping	Appropriate antiparasitic, Environmental control
	Arteriosclerosis, Cardiomyopathy (may show as heart failure, dyspnea, ascites, etc.)	Physical exam, Diet, History, Radiographs, CBC/chemistries, Cardiac evaluation (ECG, echocardiography)	Low fat, low calcium diet, Medicate as with other cardiomyopathies

FORMULARY FOR RABBITS

Drug	Route	Dosage	Comments
Acepromazine	IM	1-5 mg/kg	Can be used with ketamine
Amikacin	IM, SC	5-10 mg/kg q8-12h	Need fluid support
Aspirin	PO	100 mg/kg q4-6h	Mild pain
Atropine	IM	0.2 mg/kg	-
	SC	10 mg/kg q20 min	For organophosphate toxicity
Buprenorphine	SC, IM, slow IV	0.05-0.3 mg/kg q8-12h	Start low end dose range; for acute pain, may need up to 3 mg/kg
Butorphanol	SC	0.1-0.5 mg/kg q4-6h if needed	-
Calcium versenate (CaEDTA)	SC	27.5 mg/kg q6h x 2-5 days	Make at 10 mg/ml in 5% dex or saline
Carbaryl 5% powder	Topical	Dust lightly once weekly; comb through fur; wipe down excess with damp paper towel	-
Cephaloridine	IM	15 mg/kg q24h	-
Chloramphenicol palmitate	PO	30-50 mg/kg q8-24h	May prolong barbiturate anesthesia
Chloramphenicol succinate	IM	30-50 mg/kg q24h or ÷ q12h	Consider human health
Chlortetracycline	PO	50 mg/kg q12h	-
Ciprofloxacin	PO	10 mg/kg q12h	Mix 1 500 mg tab w/10 ml water
Cisapride (Propulsid 10 mg tab)	PO	0.25 mg/lb q8-24h (5-10 lb BW = 2.5 mg/dose; 11-40 lb BW = 5.0 mg/dose)	Dose may be increased over time; give no closer than 30 minutes to feeding

FORMULARY FOR RABBITS

Drug	Route	Dosage	Comments
Dexamethasone	IV, IM, IP, SC	0.5-2 mg/kg	Shock, anti-inflammatory
Dextrose 50%	IV	2 ml/kg	-
Diazepam	IM, IP, IV	2 mg/kg	Seizures, tranquilization
Dipyrone	IM	6-12 mg/kg q8-12h	-
Doxapram	IV	2-5 mg/kg	-
Doxycycline	PO	2.5 mg/kg q12h	-
Enrofloxacin (inj, tab, oral)	IM, SC, PO	5-10 mg/kg q12h	May cause tissue necrosis when delivered SC. IM sites may also develop sterile abscesses/necrosis in some circumstances. Can use injectable orally. Tablets: push to back of mouth or mix with jelly/Nutrical, put in mouth. Long term use OK.
Fenbendazole	PO	20 mg/kg q24h for 5 days	-
Fentanyl citrate + Droperidol	IM	0.13-0.22 ml/kg	Sedation
	IM	0.3-0.5 ml/kg	Anesthesia
Flunixin	IM, SC	0.3-1.0 mg/kg q12-24h	Analgesia, anti-inflammatory; Injectable can be put in palatable suspension and given PO; Long-term: 5 days on, 3 off to prevent GI upset. Do not use concurrently with corticosteroids. Can be used with buprenorphine.

FORMULARY FOR RABBITS

Drug	Route	Dosage	Comments
Furosemide	IM, SC, PO	5-10 mg/kg q12h	-
Gentamycin	IM, SC	5 mg/kg q24h	Need fluid support
Griseofulvin	PO	25 mg/kg q24h	Usually 28-40 days
Halothane	Inhalation	To effect	Anesthesia
Ibuprofen	IV	10-20 mg/kg q4hr	Anti-inflammatory, has analgesic properties
	PO	7.5 mg/kg	PRN
Isoflurane	-	3.0% induction, then to effect	Inhalation anesthetic of choice
Ivermectin	SC	0.2-0.4 mg/kg once, Repeat in 1-2 wk for 2-3 Rx	Higher dose for *Cheyletiella*. Hits ear mites, ascarids, pinworms
Ketamine	IM	50 mg/kg	-
Ketamine + acepromazine	IM	40 mg/kg ket + 0.5-1.0 mg/kg ace	-
Ketamine + diazepam	IM	20-40 mg/kg ket + 5-10 mg/kg diaz	Can be used for incisor extraction
Ketamine + xylazine	IM	35 mg/kg ket + 3 mg/kg xylazine	-
	IV	10 mg/kg ket + 3 mg/kg xylazine	-
	IP	35 mg/kg ket + 5 mg/kg xylazine	-
Ketoprofen	IM	1.0 mg/kg q8-12h	Nonsteroidal anti-inflammatory

FORMULARY FOR RABBITS

Drug	Route	Dosage	Comments
Lactobacillus (Probios powder, Lacto-sac, Benebac)	PO	1 notch daily of paste; powder = 1/4-1/2 tsp or per pkg label	Mix into food
Meperidine	SC, IM	10 mg/kg q2-3h	-
Metoclopramide (Reglan®)	IV,IM,SC,PO	0.2-1 mg/kg q12h	-
	SC, PO	0.5 mg/kg q4-8h	-
Metronidazole	PO	20 mg/kg q12h	For *Clostridium* sp, protozoa; use with caution when treating bacterial overgrowths - may contribute to *Clostridium* proliferation.
Morphine	SC, IM	2-5 mg/kg q2-4h	-
Nalbuphine	IV	1-2 mg/kg q4-5h	-
Neomycin	PO	30 mg/kg q12h	-
Nitrofurazone	-	0.1 mg/ml drinking water long-term	-
Nystatin	PO	3-5 ml/rabbit q12-24h	-
-	Topical	q12h	-
Oxytetracycline	SC, IM	15 mg/kg q24h, 400-1000 mg/L drinking water	Used primarily in lab animal/large group situations
Oxytocin	SC, IM	0.2-3.0 IU/kg PRN	-
Pentazocine	IV	5 mg/kg q2-4h	-

FORMULARY FOR RABBITS

Drug	Route	Dosage	Comments
Pentazocine	SC	10-20 mg/kg SC q4h	-
Piperazine	PO	500-1000 mg/kg every other week	Pinworms
Polysulfated glycosamino glycan (Adequan®)	IM, SC	40,000 - 80,000 IU/kg q24h	Arthritis
Praziquantel	SC, IM, PO	5-10 mg/kg	Repeat in 10 days - may be necessary
Prednisolone	IM, SC, PO	0.2-2.2 mg/kg q24h or q12h	Start/use low doses first
Procaine penicillin	IM, SC	20,000-60,000 IU/kg q8h	Do not give orally
Sulfadimethoxine	PO	25-50 mg/kg q24h, can give divided = 12.5 mg/kg q12hr	For coccidia: use 10-14 days
Sulfamerazine	PO	0.02% in drinking water	-
Sulfamethazine	Water	1 g/L drinking water 5 days	*Bordetella*
Sulfaquinoxaline	Water	0.25-1 g/L drinking water	30 days for coccidia
Tetracycline	PO	50 mg/kg q8-12h	Recommendations in the literature vary widely
Thiabendazole	PO	50-100 mg/kg q24h 5 days	Antipyretic, anti-inflammatory, anthelmintic
Tobramycin inj	-	0.20 ml/10 lb q12h	-
Tresaderm	Topical	Install 3 drops per ear q12hr 7 days	-

FORMULARY FOR RABBITS

Drug	Route	Dosage	Comments
Trimethoprim/sulfa (24% inj = 40 mg TMP + 200 mg sulfa; tab = 20 mg TMP + 100 mg sulfa)	IM, PO	IM = 20-30 mg/kg q12h; PO = approx 1 ml/kg; tablet = 15 mg/kg q12h	TMP-sulfa may cause necrosis if injected SC
Tylosin	IM, SC, PO	10 mg/kg q12h	-
Verapamil	PO, IV slowly	0.20 mg/kg postoperatively q8h for maximum of 8-9 doses	To decrease adhesion formation, Supraventricular tachycardia
Vitamin A	IM	500-1000 IU/kg once	Helps in chronic resp disease
Vitamin B complex	IM	0.02-0.4 ml/kg q24h	-
Vitamin E/Se (Seletoc)	IM	0.25 ml/rabbit	In feed: 3-5 IU Vit E + 3-5 mg Se per 0.5 lb of feed (1 Seletoc tab/5# feed)
Vitamin K_1	IM	1-10 mg/kg PRN	Warfarin/dicoumarin toxicity

Note: Some doses are not based on pharmacologic studies. For all analgesics, a range is usually listed. Start with low end and work higher according to animal, usage, circumstances and clinical response.
Antibiotic choice: Try to avoid beta-lactam antibiotics, macrolide antibiotics or any others that target gram-positive or anaerobic bacteria (except for Clostridium sp.). Better to use quinolones, TMP-sulfa combination, sulfa drugs or aminoglycosides. The reason is to not affect normal cecal-colic microflora.

NOTES

SMALL RODENTS

The Small Rodents chapter includes individual segments on rats, mice, gerbils and hamsters. The introductory topics listed below apply generally to all animals in this chapter.

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SMALL RODENTS — Rats, Mice, Gerbils, Hamsters

Order Rodentia

- Suborder Sciuromorpha ("squirrel-like"): squirrels, marmots, chipmunks, gophers, beavers, kangaroo rats, springhaas; 366 species
- Suborder Myomorpha ("rat-like"): rats, mice, hamsters, lemmings, voles; 1183 species
- Suborder Hystricomorpha ("porcupine-like"): porcupines, cavies, capybaras, chinchillas, agoutis; 180 species

Common Clinical Conditions in Small Rodents

- Trauma
- Comatose
- Respiratory signs
- Skin "scalding"
- Malocclusions
- Secondary GI problems
- Diarrhea

Zoonotic Potential of Small Rodents

- Salmonellosis (rare)
- Lymphocytic choriomeningitis (LCM)
- Acinetobacter
- Cestodiasis - *Hymenolepis nana*, *Taenia taeniaformes*
- Allergies to rodent proteins, antigens and dander
- Dermatophytoses
- Hantavirus (with exposure to wild rodents)
- Potential for domestic rodents to carry zoonotic diseases is minimized by eliminating exposure to wild rodents, screening colonies for LCM, Salmonella and Hantavirus, and eliminating parasitic infections.

Composition of Small Rodent Milk

	Mouse	Rat	Hamster
Water (%)	74.2	73.5	73.6
Total solids (%)	25.8	26.5	26.4
Fat	46.9	47.5	47.7
Protein	34.9	34.7	34.0
Carbohydrate	12.4	12.5	12.8
Ash	5.8	5.3	5.3

FORMULARY FOR SMALL RODENTS

Drug	Mice	Hamsters	Gerbils	Rats
Acepromazine	0.75 mg/kg IM	0.5-1.0 mg/kg IM	0.5-1.0 mg/kg IM	0.75 mg/kg IM
Acetaminophen	300 mg/kg PO q4h	-	-	100-300 mg/kg PO q4h
Acetylsalicylic acid	120 mg/kg PO q4h	240 mg/kg PO q4h	240 mg/kg PO q4h	100 mg/kg PO q4h
Amikacin	10 mg/kg q8-12h IM, SC	10 mg/kg q8-12h IM, SC	10 mg/kg q8-12h IM, SC	10 mg/kg q8-12h IM, SC
Amitraz (Mitaban®) make up as per package directions	-	Apply topically 3 to 6 treatments 14 days apart, Caution	-	-
Ampicillin	50-150 mg/kg divided dose q8h SC, 200 mg/kg PO divided q8-12h	DO NOT USE	20-100 mg/kg divided dose q8h PO, SC	50-150 mg/kg divided dose q8h SC, 200 mg/kg PO divided q8-12h
Amoxicillin	100 mg/kg SC q12h	-	-	150 mg/kg IM q12h
Atropine	0.02-0.05 mg/kg IM, SC	0.1-3.0 mg/kg SC	0.04 mg/kg IM, SC	0.04 mg/kg IM, SC
Buprenorphine	0.05-0.1 mg/kg SC q6-12h	0.05 mg/kg pre or intra-operatively SC or IV	0.05 mg/kg pre or intra-operatively SC or IV	0.05-0.1 mg/kg SC q12h; up to 0.5 mg/kg SC q12h
Butorphanol	5-10 mg/kg PO; 1-5 mg/kg SC q4h	-	-	0.4-2.0 mg/kg SC q4h
Carbaryl 5% powder	dust lightly, once weekly	dust lightly, once weekly	dust lightly, once weekly	dust lightly, once weekly
Cephalosporin	Cephalexin, 60 mg/kg PO, 30 mg/kg SC q12h	Cephaloridine, 30 mg/kg IM q12h		Cephalexin 60 mg/kg PO q12h, 15 mg/kg SC q12h

FORMULARY FOR SMALL RODENTS

Drug	Mice	Hamsters	Gerbils	Rats
Chloramphenicol palmitate	50-200 mg/kg PO q8h	50-200 mg/kg PO q8h	50-200 mg/kg PO q8h	50-200 mg/kg PO q8h
Chloramphenicol succinate	30-50 mg/kg IM SC q12h	30-50 mg/kg IM SC q12h	30-50 mg/kg IM SC q12h	30-50 mg/kg IM SC q12h
Chlorpromazine	-	-	-	20-30 mg/kg SC
Chlortetracycline	25 mg/kg IM, SC q12h	20 mg/kg IM, SC q12h	-	6-10 mg/kg IM, SC q12h
Clavulanatate potentiated amox. (50 mg amox per ml)	2 ml/kg PO q12h	-	-	2 ml/kg PO q12h
Cimetidine	5-10 mg/kg q12h, q6h	5-10 mg/kg q12h, q6h	5-10 mg/kg q12h, q6h	5-10 mg/kg q12h, q6h
Codeine	60-90 mg/kg PO (10-20 mg/kg SC) q4h	-	-	60-96 mg/kg SC q4h
Ciprofloxacin	10 mg/kg q 12 hrs PO	10 mg/kg q 12 hrs PO	10 mg/kg q 12 hrs PO	10 mg/kg q 12 hrs PO
Dexamethasone	0.1-0.6 mg/kg IM	0.1-0.6 mg/kg IM	0.1-0.6 mg/kg IM	0.1-0.6 mg/kg IM
Diazepam	5 mg/kg IP	5 mg/kg IP	5 mg/kg IP	2.5 mg/kg IP
Dichlorvos impregnated resin strip	(Vapona No Pest Strip®) - 1 inch square laid on cage for 24 hours once weekly for six weeks, Caution			
Dimetridazole	1 mg/ml drinking water	0.5 mg/ml drinking water; 0.25-0.1% in drinking water for 5-7 days	0.5 mg/ml drinking water	1 mg/ml drinking water
Diovol Plus®	0.1-0.3 ml PO as needed	0.1-0.3 ml PO as needed	0.1-0.3 ml PO as needed	0.2-0.3 ml PO as needed

FORMULARY FOR SMALL RODENTS

Drug	Mice	Hamsters	Gerbils	Rats
Doxapram	5-10 mg/kg IV	5-10 mg/kg IV	5-10 mg/kg IV	5-10 mg/kg IV
Doxycycline	2.5 mg/kg PO q12h	2.5 mg/kg PO q12h	2.5 mg/kg PO q12h	2.5 mg/kg PO q12h; for *Mycoplasma pulmonis*: 250 mg/l drinking water
Enrofloxacin	2.5 mg/kg PO q12h; for *Pasteurella pneumotropica* clearance: 25.5 mg/kg/day x 14 days SC ÷ q12h, or 85 mg/kg/day in drinking water 14 days; for *Proteus* clearance: 85 mg/kg/day x 14 days SC ÷ q12h or in drinking water	-	-	2.5 mg/kg PO q12h
Fenbendazole	20 mg/kg PO q24h 5 days; replace regular feed with fenbendazole sow cubes (Kent Feeds) for 3 days, repeat in 7 days.	20 mg/kg PO q24h 5 days	20 mg/kg PO q24h 5 days	20 mg/kg PO q24h 5 days
Fentanyl citrate/Droperidol	0.005 ml/kg IM	DO NOT USE	DO NOT USE	0.13 ml/kg IM
Flunixin	2.5 mg/kg SC, IM q12h	-	-	1.1 mg/kg SC, IM q12h
Furazolidone	-	30 mg/kg q24h PO	-	-

FORMULARY FOR SMALL RODENTS

Drug	Mice	Hamsters	Gerbils	Rats
Furosemide	5-10 mg/kg q12h	5-10 mg/kg q12h	5-10 mg/kg q12h	5-10 mg/kg q12h
Gentamicin	5 mg/kg q24h IM, SC, 1.2 g/L drinking water for 3 d.	5 mg/kg q24h IM, SC	5 mg/kg q24h IM, SC	5 mg/kg q24h IM, SC
Griseofulvin	25 mg/kg PO q24h 14 days	25-30 mg/kg PO q24h 21 d.	25 mg/kg PO q24h 14-28 d.	25 mg/kg PO q24h 14-28 d.
Ibuprofen	7.5 mg/kg PO q4h	-	-	10-30 mg/kg PO q4h
Innovar-Vet® 10% solution	0.2-0.5 ml/kg IM	0.66 ml/kg IM	-	0.2-0.4 ml/kg IM
Innovar-Vet® 10% solution and xylazine	-	-	-	0.1-0.15 ml/kg + 20 mg/kg IM
Isoflurane	To effect	To effect	To effect	To effect
Ivermectin	200-400 μg/kg PO; repeat in 8-10 days; 1 part ivermectin 1% with 10 parts water in 22 oz spray bottle, spray each box of mice q 7 days for 3 weeks	200-400 μg/kg PO; repeat in 8-10 days	200-400 μg/kg PO; repeat in 8-10 days	200-400 μg/kg PO; repeat in 8-10 days; 2 mg/kg gavage 3x at 7-9 day intervals, or 10 mg in 16 oz deionized drinking water for 3 consecutive days/wk for 3 wk
Ketamine	44 mg/kg IP	44 mg/kg IP up to 200 mg/kg, Poor analgesia	44 mg/kg IP	44 mg/kg IP
Ketamine + diazepam	90 mg/kg + 5 mg/kg IP	-	50 mg/kg + 5 mg/kg IP	40 mg/kg + 5 mg/kg IP

FORMULARY FOR SMALL RODENTS

Drug	Mice	Hamsters	Gerbils	Rats
Ketamine + xylazine	80 mg/kg + 16 mg/kg IP	80-200 mg/kg + 10-16 mg/kg IP	50 mg/kg + 10 mg/kg IP	60 mg/kg + 7.5 mg/kg IP
Lindane (0.03% solution)	Dip once weekly for 3 wks	-	-	Dip once weekly for 3 wks
Malathion (2% solution)	Dip every 10 days for 3 wks	-	-	Dip every 10 days for 3 wks
Meperidine	1-2 mg/kg IM, SC, IP q2-3h	1-2 mg/kg IM, SC, IP q2-3h	1-2 mg/kg IM, SC, IP q2-3h	1-2 mg/kg IM, SC, IP q2-3h
Metoclopramide (Reglan® 5 mg/ml)	0.5 mg/kg SC q8h PRN; be sure no obstruction	0.5 mg/kg SC q8h PRN; be sure no obstruction	0.5 mg/kg SC q8h PRN; be sure no obstruction	0.5 mg/kg SC q8h PRN; be sure no obstruction
Metronidazole	2.5 mg/ml drinking water for 5 days (add 1% sucrose for palatability)	7.5 mg/70-90 g hamster q8h PO	-	10-40 mg/day/rat PO, 2.5 mg/ml drinking water (add 1% sucrose for palatability)
Morphine	2-5 mg/kg IM, SC q4h	-	-	2-5 mg/kg IM, SC q4h
Nalbuphine	4-8 mg/kg IM q4h	-	-	1-2 mg/kg IM q3h
Naloxone	0.01-0.1 mg/kg IP, IV	0.01-0.1 mg/kg IP, IV	0.01-0.1 mg/kg IP, IV	0.01-0.1 mg/kg IP, IV
Neomycin	50 mg/kg q24h PO	100 mg/kg q24h PO	100 mg/kg q24h PO	50 mg/kg q24h PO
Oxytetracycline	10-20 mg/kg q8h PO	16 mg/kg q24h SC	10 mg/kg q8h PO, 20 mg/kg q24h SC	10-20 mg/kg q8h PO, 6-10 mg/kg q12h IM
Oxytocin	-	0.2-3.0 IU/kg IM, SC	0.2-0.3 IU/kg IM, SC	1 IU/kg IM, SC
Pentazocine	10 mg/kg SC q4h	-	-	10 mg/kg SC q4h

FORMULARY FOR SMALL RODENTS

Drug	Mice	Hamsters	Gerbils	Rats
Penicillin (Pediatric Pen VK Solution - 250,000 IU/5 ml)	Stock = 1/8 tsp/50 ml sterile water q48h; 1 ml stock/250 ml sterile drinking water	DO NOT USE	-	22,000 IU IM, PO q24h
Piperazine adipate	4-7 mg/ml in drinking water for 3-10 d.	3-5 mg/ml in drinking water for 7 d., off 7 d., on 7 d.	3-5 mg/ml in drinking water for 7 d., off 7 d., on 7 d.	4-7 mg/ml in drinking water for 3-10 d.
Piperazine citrate	4-5 mg/ml in drinking water for 7 d., off 7 d., on 7 d.	10 mg/ml in drinking water for 7 d., off 7 d., on 7 d.	4-5 mg/ml in drinking water for 7 d., off 7 d., on 7 d.	4-5 mg/ml in drinking water for 7 d., off 7 d., on 7 d.
Praziquantel	25 mg/kg PO, SC given twice at 10 day intervals	5.1-11.4 mg/kg IM, SC, PO; repeat in 10 days	5.1-11.4 mg/kg IM, SC, PO; repeat in 10 days	5-10 mg/kg IM, SC, PO; repeat in 10 days
Prednisone	0.5-2.0 mg/kg PO	0.5-2.0 mg/kg PO	0.5-2.0 mg/kg PO	0.5-2.0 mg/kg PO
Procaine penicillin G	DO NOT USE; PROCAINE MAY BE TOXIC	DO NOT USE; PROCAINE MAY BE TOXIC	-	DO NOT USE; PROCAINE MAY BE TOXIC
Sulfamerazine	0.02% in drinking water or 1 mg/4 g feed	-	-	0.02% in drinking water or 1 mg/4 g feed
Sulfamethazine	1-5 mg/ml in drinking water	1-5 mg/ml in drinking water	1-5 mg/ml in drinking water	1-5 mg/ml in drinking water
Sulfaquinoxaline	-	1 mg/ml drinking water	1 mg/ml drinking water	1 mg/ml drinking water
Terramycin® (long-acting oxytetracycline)	60 mg/kg SC, IM every 3 d	-	-	60 mg/kg SC, IM every 3 d
Tetracycline (oral)	10-20 mg/kg q8h PO	10-20 mg/kg q8h PO; caution, upsets GI flora	10-20 mg/kg q8h PO	10-20 mg/kg q8h PO

FORMULARY FOR SMALL RODENTS

Drug	Mice	Hamsters	Gerbils	Rats
Tetracycline (injectable @ 50 mg/ml)	100 mg/kg SC	-	-	100 mg/kg SC
Thiabendazole	100 mg/kg PO 5 days	100 mg/kg PO 5 days	100 mg/kg PO 5 days	100 mg/kg PO 5 days
Thiopental	50 mg/kg IP	40 mg/kg IP	-	40 mg/kg IP
Trimethoprim sulfadiazine (24% injection 40 mg/ml trimeth + 200 mg/ml sulph)	-	30 mg/kg q24h SC	30 mg/kg q24h SC	-
Trimethoprim sulfamethoxazole (sulfameth 20 mg tab; sulfadiazine 100 mg tab)	-	15 mg/kg q12h PO	15 mg/kg q12h PO	-
Tylosin	10 mg/kg q12h IM, SC, PO	10 mg/kg q12h IM, SC 5-7 days	10 mg/kg q12h IM, SC, PO	10 mg/kg q12h IM, SC, PO (500 mg/L drinking water Mycoplasma; may only control, not eliminate)
Vancomycin HCL	-	20 mg/kg for 3+ mos to control *Clostridium difficile* enteritis	-	
Vitamin K_1	1-10 mg/kg as needed	1-10 mg/kg as needed	1-10 mg/kg as needed	1-10 mg/kg as needed
Xenodyne	Swab infected areas PRN	Swab infected areas PRN	Swab infected areas PRN	Swab infected areas PRN

**compiled by Burgman P; revised by Johnson-Delaney C, 1995*

NOTES

Rats

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of companion rats and is not intended to replace comprehensive reference material.

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RATS	Order - **Rodentia**	Suborder - **Myomorpha**

Species *Rattus norvegicus*

Strains and Variations

Sprague-Dawley or Wistar-Lewis = white rat
Long-Evans = hooded rat (black and white or brown and white patterns; other colors from pet rat fanciers)

Behavior

- Rats are tame and intelligent pets. They rarely bite (unless significantly provoked).
- White rats, in particular, have placid temperaments; Hooded rats may be more aggressive, more active, and subsequently harder to handle.
- Rats are usually nocturnal.
- They are social rodents. Because they don't fight, both males and females can be housed in single sex groups.

Diet

- Commercial rat/rodent pellets with protein level of 20-27% for adults should be offered free choice (Ex: Mazuri Rodent Diet®, Purina Rat Chow Code 5012®, Purina Formulab Chow®, Wayne Lab Blox®). Special formulas are available for growing, breeding, nursing.
- Supplementation or "treats" are not recommended for rats on a good pelleted diet.
- Common seed-based "small rodent" feeds are inadequate to meet a rat's nutritional requirements.
- Rats are cautious feeders and may avoid strange foods.
- Fresh water should be available always.
- Softer pellets for rats <3 weeks old. Babies start gnawing pellets and drinking water around 2 weeks, wean at 3 weeks.
- Hand-raising is difficult, although it can be done by bottle q4h.

Housing

- Escape-proof, wire-mesh rodent enclosure with plastic or metal solid flooring is preferred housing.
- Rat enclosures need to be large enough to accommodate a large exercise wheel, nest or burrow area and feeding area.
- Minimum size for adult rat: 15-20" x 15-20" x 7-10" high.
- 15-20 gallon aquarium fitted with wire-screen clamped top may be used, but is harder to clean.

- Breeding pairs, females with litters require 2-4 x more space than does a single adult — a secluded nest box should be provided.
- Bedding should be 2-3" deep, and of non-allergenic, dust-free, absorbent, nontoxic material: shredded paper, hardwood chips, shavings, recycled newspaper composite materials or pellets.
- Bedding should be changed at least 1-2 x a week, more often if moisture/waste accumulates, or if any odor becomes noticeable.
- Nesting material may include a small cardboard or wood box, facial tissue, small hat, old sock, sleeve.
- Room temperatures of 65-80°F (avg 72°F) with 40-70% humidity are suitable for rats.
- Light/dark provided on a 12:12 hour cycle is preferred. Continuous light may repress the breeding cycle.

Preventive Care

- Proper husbandry, diet, sanitation, and handling.
- Periodic examination and screening of representative colony animals for subclinical disease.
- Prevent access to insects, wild rodents or other animals.
- Encourage monthly home health checks (weight, teeth, nails, feel for lumps, bumps) and daily observation of food and water consumption, activity and behavior, feces and urine amounts/characteristics.

Rats – Quick Facts

Physiologic	
Life span:	2-3.5 yr (record 4 yr)
Adult male body weight:	450-520 g
Adult female body weight:	250-300 g
Body surface area cm^2:	10.5 (wt. in grams)$^{2/3}$
Rectal/body temperature:	35.9-37.5°C (99.5-100.6°F)
Diploid number:	42
Food consumption:	10 g/100 g/day
Water consumption:	10-12 ml/100 g/day
GI transit time:	12-24 hr
Respiratory rate:	70-115/min
Tidal volume:	0.6-2.0 ml
Oxygen use:	0.68-1.10 ml/g/hr
Heart rate:	250-450/min

Physiologic	
Blood volume:	54-70 ml/kg
Blood pressure:	84-134/60 mm Hg
Dental Arch/Eruption Time:	1/1 incisors, 3/3 molars
Incisors:	open-rooted (hypsodont)
Molars:	closed, permanently rooted (brachyodont)
Anatomic note:	open inguinal canals
Reproductive	
Male: Sire, Female: Dam	
Breeding onset:	65-110 days
Breeding onset:	65-110 days
Cycle length:	4-5 days
Gestation period:	21-23 days (add 3-7 days if female is bred at the postpartum estrus)
Postpartum estrus:	Fertile
Litter size:	6-12
Birth weight:	5-6 g
Weaning age:	21 days
Breeding duration (commercial):	350-440 days (7-10 litters)
Young production:	4-5/mo
Milk composition:	13.0% fat, 9.7% protein, 3.2% lactose

Breeding

- Rats are classified as continuously polyestrous with minor seasonal variations.
- Actual estrus lasts 12 hours, usually beginning in the early evening hours.
- The female has a fertile estrus within 48 hours of giving birth, but many breeders do not use this as the male may disturb the neonates.
- Sire is usually removed just prior to parturition and returned to the female after babies are weaned.
- Several breeding systems are commonly used:

  Polygamous = 1 male is housed with 2-6 females. The females are removed to separate cages on day 16 of gestation. Postpartum estrus is not used. Larger young and litters result.

  Monogamous = The male is removed just prior to parturition or left for 2-3 days post-delivery, then removed. If successful use of postpartum estrus, number of litters is maximized. Young are removed at weaning or prior to the next delivery. Risk of disturbing young left in even the 2-3 days post-delivery.

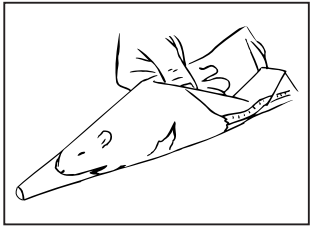
Communal = One male is moved in rotation between 7 females in separate cages, spending 1 week with each female. The male is always removed prior to the birth of the young to decrease the chances of litter desertion, cannibalism, or agalactia.

Pregnancy and Raising Young

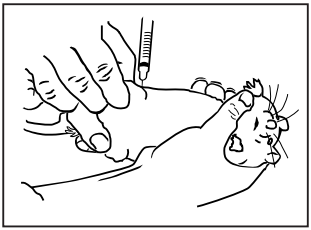
- A plug will be present 12-24 hours after mating occurs.
- Pregnancy can be detected in the female 14 days after mating by increase in weight, palpation, and mammary development.
- A pseudopregnancy may last 13 days if the mating was sterile.
- Dams build scant, shallow nests using tissues, shredded newspapers, bits of cloth, or wood shavings. Do not provide corn cob litter for this purpose.
- Clean the cage, transfer nest, and provide a good week's worth of food before delivery.
- Babies have open eyes and body hair by 1 week of age.
- Dam and neonates should not be disturbed for 3-4 days after delivery.
- If postpartum estrus was not used, female will cycle again 2-4 days after weaning of current litter.

Restraint of Rats

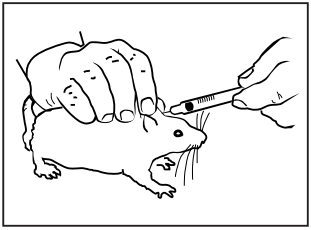
- Gently pick up rat by placing hand firmly over the back and rib cage.
- Restrain head with thumb and forefinger just behind the jaws.
- Alternatively, grip base of tail, then as above.
- The rat may also be picked up by the loose skin (scruff) of the neck method, as with other rodents.
- Pet rats may also just climb onto hands, but be sure they don't jump and fall.



If assistance is not available, rats can be held in disposable polythene restrainers (can be made out of a Ziploc bag with end cut open for air) to carry out IP, SC or IV injections.



The rat is restrained so that an assistant can inject into the quadriceps muscles.

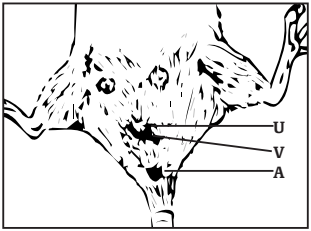


Subcutaneous injections can easily be made into the scruff.

Adapted from photographs in Beynon PG, Cooper JE (eds): *BSAVA Manual of Exotic Pets*. Cheltenham, BSAVA, 1991.

Sexing of Rats

External genitalia of male rat.
P = tip of penis
S = scrotal sac
A = anus



External genitalia of female rat.
U = urethral orifice
V = vaginal orifice
A = anus

Harkness and Wagner, 1989

First Visit/Annual Examination of Rats

Physical examination:

Include: temperature, weight, eyes, ears, teeth, heart & lung sounds, feet, fur and general condition. Also review nutrition, husbandry, behavior

Fecal flotation (nematodes)

Hanta virus serology test

Optional; only necessary if housed outdoors, wild-caught, exposure to wild rodent feces or recommended by public health department.

If abnormalities or illness:

CBC/chemistries

Fecal direct smear (protozoa), culture (Salmonella/ Campylobacter)

Blood Collection

Tail vein:	0.5 ml - 23 ga butterfly needle works well - warm tail for vasodilation
Tail artery:	22 to 25 ga needle/butterfly best. Warm for vasodilation dorsal recumbency - Works better in distal 2/3 of tail - often is more superficial. If blood flows well, collect into syringe without plunger or directly into tubes. Have piece of 1/2" adhesive tape 3" with 1/4" turned under at each end, ready as a bandage to apply pressure at site. Place the non-adhesive tab at the site of puncture, then wrap tail with tape. Tab at opposite end helps for removal in 5-10 minutes.
Retro orbital bleed: (not used in pets)	Max. amount 0.5 ml, do under isoflurane anesthesia. Break capillary tube in half and drop blood into collection tube. Use topical anesthetic in the eye, especially if animal starts to wake up before you are finished.
Anterior vena cava bleed:	Needs to be very well positioned. Go in to right of manubrium with 23 ga x 1" needle and direct toward umbilicus. Less morbidity/mortality than associated with cardiac puncture.

Fluid Therapy

Intramuscular:	Quadriceps, 23-25 ga needle, no greater volume than 0.2 ml at one site.
Subcutaneous:	Under skin overlying neck or thorax, 23-25 ga, up to 5 ml.
Intraperitoneal:	Best done with animal restrained by an assistant; one hind limb should be extended, 23 ga needle or smaller, introduce along the line of the leg into the center of the posterior quadrant of the abdomen. Approx. 5 ml can be administered.
Intravenous:	Lateral tail vein, 25 g needle. Warm tail first (animal incubator or tail immersed in warm water for about 15 minutes). Dilated vessels easy to see in young rats. In old rats, thickened skin makes it hard. May see if gently clean skin.

Hematology Reference Ranges - Rats

	Male Range	Female Range
Erythrocytes (RBC) ($x10^6/mm^3$)	8.15-9.75	6.76-9.20
Hemoglobin (g/dl)	13.4-15.8	11.5-16.1
MCV (μ^3)	49.8-57.8	50.9-65.5
MCH ($\mu\mu g$)	14.3-18.3	15.6-19.0
MCHC (%)	26.2-35.4	26.5-36.1
Hematocrit (PCV) (ml%)	44.4-50.4	37.6-50.6
Sedimentation rate (mm/hr)	0.68-1.76	0.58-1.62
Platelets ($x10^3/mm^3$)	150-450	160-460
Leukocytes (WBC) ($x10^3/mm^3$)	8.00-11.8	6.6-12.6
Neutrophils ($x10^3/mm^3$)	1.95-2.88	1.77-3.38
Eosinophils ($x10^3/mm^3$)	0.03-0.04	0.04-0.08
Basophils ($x10^3/mm^3$)	0.01-0.03	0.00-0.03
Lymphocytes ($x10^3/mm^3$)	6.03-8.90	4.78-9.12
Monocytes ($x10^3/mm^3$)	0.01-0.04	0.02-0.04

Protein Reference Ranges - Rats

Serum protein:	5.6-7.6 g/dl
Albumin:	3.8-4.8 g/dl
Globulin:	1.8-3.0 g/dl
$\propto$1 Globulin:	0.39-1.60 g/dl
$\propto$2 Globulin:	0.20-2.10 g/dl
β Globulin:	0.35-2.00 g/dl
τ Globulin:	0.62-1.60 g/dl
Albumin:globulin ratio:	0.72:1.21

Biochemistry Reference Ranges - Rats	
Serum glucose:	50-135 mg/dl
Blood urea nitrogen:	15-21 mg/dl
Creatinine:	0.2-0.8 mg/dl
Total bilirubin:	0.20-0.55 mg/dl
Serum lipids:	70-415 mg/dl
Phospholipids:	36-130 mg/dl
Triglycerides:	26-145 mg/dl
Cholesterol:	40-130 mg/dl
Serum calcium:	5.3-13.0 mg/dl
Serum phosphate:	5.3-8.3 mg/dl
Uric acid:	1.20-7.5 mg/dl
Sodium:	143-156 mEq/L
Potassium:	5.40-7.00 mEq/L
Chloride:	100-110 mEq/L
Bicarbonate:	12.6-32.0 mEq/L
Phosphorous:	3.11-11.0 mg/dl
Calcium:	7.2-13.9 mg/dl
Magnesium:	1.6-4.44 mg/dl
Amylase:	128-313 SU/dl
Alkaline phosphatase:	56.8-128 IU/L
Acid phosphatase:	28.9-47.6 IU/L
Alanine transaminase (ALT):	17.5-30.2 IU/L
Aspartate transaminase (AST):	45.7-80.8 IU/L
Creatinine phosphokinase (CPK):	0.80-11.6 IU/L
Lactic dehydrogenase (LDH):	61.0-121 IU/L

Radiography

In a normal radiographic appearance, the heart and caudal lung lobes can be distinguished. The abdominal organs are clearly defined. The liver is located entirely within the costal region. The kidneys are located directly posterior to the costal arches in a paramedian plane. Food masses may be present in the colon and rectum. Small intestinal loops in the ventral abdomen may contain gas. In the caudal abdomen, testes and fat pads may be visible.

Radiographic Positioning

(See Small Mammals, page 2)

Common Clinical Conditions in Rats

- Many clinical syndromes are similar to dogs and cats: pyometra, renal disease, arthritis, heart disease and failure, and liver disorders.
- Sick mouse and rat syndrome = nonspecific: listless, rough coat, brown encrustation around nose, eyes, immobile even when handled.
- Weight loss
- Overcrowding
- Malocclusion
- Ectoparasitism
- *Hymenolepis* spp.
- Respiratory disease (respiratory mycoplasmosis *M. pulmonis*)
- Sendai virus
- Cilia-associated respiratory (CAR) bacillus
- *Corynebacterium kutscheri*
- Sialodacryoadenitis virus (SDAV)
- Nephrosis
- Sudden death
- Overheating or chilling
- Trauma
- Septicemia
- Malnutrition
- Salmonellosis
- Stress
- Ptyalism
- Heat stress
- Suffocation
- Anemia
- Hemobartinellosis (colonies)

Mice

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medial topics of companion mice and is not intended to replace comprehensive reference material.

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MICE	Order - **Rodentia**	Suborder - **Myomorpha**

Species *Mus musculus*

Common Breeds and Variations

- Three kinds of domestic mice: pets, outbred and inbred.
- Pet mice are usually of indeterminate pedigrees. Available in white, black, tan, brown — may not breed true to color.
- Outbred: laboratory raised using a random mating system — many registered uniform strains.
- Inbred: mated on a controlled basis for precise mutations or genetic or environmental conditions for research purposes.

Behavior

- Mice are timid, social, territorial rodents that require gentle handling.
- They are escape artists, and active for periods both during the day and during the night.
- Mouse social system involves a male hierarchy — adult males may fight when initially caged together.
- Females with litters may defend their nests.
- May bite or pinch with their teeth if roughly handled or startled.

Diet

- Commercial rodent chows (greater than 14% protein - ideally 20-24%) are the recommended diet for pet mice.
- Softer pellets for mice <3 weeks old. Babies start gnawing pellets and drinking water around 2 weeks, wean at 3
- Handraising is difficult; it can be done by bottle q4h.
- Seed-based, boxed diets are incomplete and inadequate for mice.
- Sweets, veggies, cheese, liquid vitamins, salt blocks are not recommended for mice if they are fed a good quality pelleted feed and fresh water.

Housing

- Suggested minimum enclosure sizes are 12-15” x 12-15” x 6” high for each adult mouse. A female with a litter requires 2-3 times that amount of space.
- Enclosures may be metal (standard wire-mesh, rodent-type), plastic (shoebox style with mesh or slotted bar top), or converted aquarium with secure, metal mesh lid.
- Housing should be large enough to accommodate an exercise wheel, nest area, and feeding area.

- Bedding can be shredded paper, pine or hardwood shavings, or composite recycled paper pellets.
- Cedar shavings are not recommended as they can be irritating to skin and mucous membranes; contain aromatic oils which inhibit liver metabolism.
- Tissue paper, paper towels, tissue, old socks or mittens make excellent nesting material for mice.
- All bedding should be changed at least twice a week or more often if odor, urine/moisture, or feces builds up.
- House males separately to avoid fighting. Mice that have previously been housed alone are more likely to fight when introduced to other mice.
- Room temperatures of 65-85°F (average 72°) with humidity at 30-70% are ideal conditions.

Preventive Care

- Good husbandry, sanitation, diet.
- In colonies or breeding households, routinely screen representative colony animals for subclinical infections.
- In large colonies, filter cages and specially chlorinated water may be needed for disease control.

Mice – Quick Facts

Physiologic	
Life span:	2 yr (depends on strain of mouse)
Adult male body weight:	20-40 g
Adult female body weight:	25-40 g
Body surface area cm^2:	10.5 (wt. in grams)$^{2/3}$
Rectal/body temperature:	36.5-38.0°C (98-101°F)
Diploid number:	40
Food consumption:	15 g/100 g/day
Water consumption:	15 ml/100 g/day
GI transit time:	8-14 hours
Respiratory rate:	60-220/min
Tidal volume:	0.09-0.23 ml
Oxygen use:	1.63-2.17 ml/g/hr
Heart rate:	325-780/min
Blood volume:	76-80 mg/kg
Blood pressure:	113-147/81-106 mm Hg
Dental configuration:	1/1 incisors, no canines or premolars, 3/3 molars. No deciduous dentition. Open-rooted incisors (hypsodontic). Molars are brachiodontic, permanently rooted.

Reproductive	
Puberty (female):	28-40 days
Breeding onset (male):	50 days
Breeding onset (female):	50-60 days
Estrous cycle length:	4-5 days
Gestation period:	19-21 days (add 3-5 days if postpartum estrus is used).
Postpartum estrus:	Fertile
Litter size:	10-12
Birth weight:	0.5-2.0 g
Weaning age:	21-28 days
Breeding duration (commercial):	7-9 months (6-10 litters)
Young production:	8 months
Milk composition:	2.1% fat, 9.0% protein, 3.2% lactose

Breeding

- Mice are continuous, polyestrous rodents with only minor seasonal fluctuations.
- If the mouse is too young, or is over 10 weeks of age at first breeding, she may have reduced fertility.
- The first litter is usually smaller than subsequent litters.
- Estrus usually occurs in the evening and may last 12 hours.
- Female has a postpartum estrus (14-28 hours after giving birth), but none during lactation. Lactation may delay the implantation 3-5 days.
- Females who are not in heat can be synchronized by introducing a male. Usually all are ready within 72 hours.
- Most efficient breeding programs:

  Polygamous = 1 male and 2-6 females housed continually together. Females are removed to separate cages prior to parturition. Postpartum estrus is not utilized. Young are removed at weaning. Record keeping may be difficult; usually lower total litter numbers. Advantage: larger young and more weaned per litter.

  Monogamous = 1 male to 1 female kept together continuously. The young are removed prior to the next birthing. This system utilizes the postpartum estrus, produces the maximum number of litters, and makes record keeping easier. It does require more males, cages, labor.

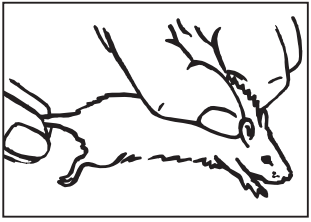
Pregnancy and Raising Young

- Post-breeding plug may be seen within 24 hours of mating.
- Weight gain and mammary development noticeable at 14 days.

- Female may go through a pseudopregnancy of 1-3 weeks duration if mating was sterile.
- Mouse prepares a brood nest late in gestation.
- Several mouse families may occupy the nest and the young may suckle several dams.
- Do not disturb females with babies for at least 2 days after birth.
- Anatomy: 3 pair thoracic, 2 pair inguinal mammary glands. Inguinal canals in males open for life.

Restraint of Mice

- One of the best restraint methods: grasp the tail at its base, place the mouse on a wire grid (like the top of the cage), and gently pull back. While mouse is distracted, place the thumb and forefinger on either side of its neck and grasp the scruff. One can then lift up and place a hand under the mouse.
- Pets may be used to climbing onto hands, but may jump and fall.

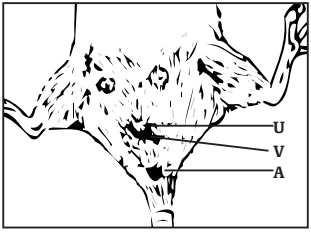


Restraint of mouse by grasping neck and tail base. Do not grasp by the tip of the tail — the skin may strip off.

One-handed restraint of mouse for injection or bleeding procedures.

Sexing of Mice

External genitalia
of male mouse.
P = tip of penis
S = scrotal sac
A = anus



External genitalia
of female mouse.
U = urethral orifice
V = vaginal orifice
A = anus

Harkness and Wagner, 1989

Blood Collection

- Do under anesthesia (isoflurane suggested).
- Warm tail (ventral artery)
- Lacerate or amputate tip of tail. To close: use tissue glue.

Injection Sites

Use 25 g needle:

Intramuscular:	0.05 ml	quadriceps
Subcutaneous:	2-3 ml	under skin overlying neck or thorax
Intraperitoneal:	1-2 ml	best to do with animal restrained by an assistant or use rat restrainer
Intravenous:		lateral tail vein with 25 g needle. Warm tail first (in animal incubator or immersed in warm water for 15 minutes) - dilated vessels easy to see in mice

Hematologic and Biochemistry Reference Ranges - Mice	
Erythrocytes:	7.0-12.5 x 10^6/mm^3
Hematocrit:	36-49%
Hemoglobin:	10.2-18 mg/dl
Leukocytes:	6-15 x 10^3/mm^3
Neutrophils:	10-40%
Lymphocytes:	55-95%
Eosinophils:	0-4%
Monocytes:	0.1-3.5%
Basophils:	0-0.3%
Platelets:	160-410 x 10^6/mm^3
Serum protein:	3.5-7.2 g/dl
Albumin:	2.5-4.8 g/dl
Globulin:	1.8-3.0 g/dl
Serum glucose:	62-175 g/dl
Blood urea nitrogen:	12-28 mg/dl
Creatinine:	0.3-1.0 mg/dl
Total bilirubin:	0.1-0.9 mg/dl
Cholesterol:	26-82 mg/dl
Serum calcium:	3.2-8.5 mg/dl
Serum phosphate:	2.3-9.2 mg/dl

Common Clinical Conditions in Mice

- Weight loss
- Ectoparasitism
- Epizootic diarrhea of infant mice
- *Hymenolepis* spp
- Pinworms
- Neoplasia
- *C. piliformes*
- Malocclusion
- Subclinical viral infections
- Salmonellosis
- Sudden death (or owners don't note subtle signs)
- Starvation/dehydration
- Bacterial septicemia
- Heat stress
- Viral infections including: adenovirus, Sendai virus, LCM, mouse hepatitis virus (MHV), mouse rotavirus, mousepox virus
- Malnutrition
- Trauma
- Mouse pox
- Toxicities/poisoning (procaine, organophosphate, chloroforms, streptomycin)
- Hexamitiasis
- Giardiasis
- Ptyalism

Therapy

(See Formulary for Small Rodents, page 3)

Pinworm Treatment of Mice

Topical:

Mix 1 part ivermectin 1% with 10 parts water in 22 oz spray bottle. Treat animals once a week for 3 consecutive weeks during routine weekly cage cleaning:

1. Transfer mice to clean cage.
2. Pick up spray bottle and shake once.
3. Spray animal with mist setting. When treating females with litters less than 2 weeks old, transfer mother, spray/mist her, then transfer litter.

Colony control:

Replace regular feed with fenbendazole sow cubes (Kent Feeds) for three days; repeat in seven days.

RULE OUT CHART FOR RATS AND MICE BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Abdominal enlargement (see also Swellings)	Ascites due to amyloidosis or pericarditis (*Strep. zooepidemicus*), Pregnancy, Obesity, Neoplasia	Urinalysis, Abdominocentesis, Abdominal/thoracic radiographs, Ultrasonography, Exploratory laparotomy, Fine needle aspirate	Supportive, Antibiotics (bacterial pericarditis)
Abortion and stillbirths	Secondary to systemic disease, Nutritional deficiencies, Environmental stress	History, Physical exam, CBC, Whole body radiographs	Supportive care, Review husbandry
Agalactia	Mastitis, Environmental disturbances, Overcrowding	Physical exam	Correct husbandry, If mastitis, appropriate antibiotics, Supportive
Alopecia	Abrasion, Bite wounds, Barbering, Idiopathic, Endocrine imbalance, Reovirus infection,	Physical exam, History, Serology/culture if colony	Correct husbandry, Supportive care
Anorexia	Malocclusion of incisors or molars, Salmonellosis (*S. typhimurium* or *S. enteritidis*)	Physical exam, Oral exam, Fecal C&S	Supportive care, Assisted feeding (blenderized food + Nutrical), Appropriate antibiotics, If malocclusion, correct teeth
Anuria, dysuria or hematuria	Sepsis (*Strep.*), Trauma, Cystitis, Nephritis, Urinary/renal calculi	History, Urinalysis, Radiographs (in urinary calculi)	Supportive, Fluids, Antibiotics, Analgesics

RULE OUT CHART FOR RATS AND MICE BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Appendage inflammation or amputation	Limb/tail necrosis, Ectromelia (mouse pox), *Streptobacillus moniliformis,* Fighting, Arthritis (*Mycoplasma arthritides*, *Corynebacterium* spp), Ringtail (too low humidity)	History, Physical exam, C&S, CBC	Supportive care, Analgesics, Antibiotics (if infectious), Correct humidity
Ataxia	Trauma, Pregnancy toxemia, Toxin exposure, Toxoplasmosis, LCM	Physical examination, Whole body radiographs, CBC/chemistries, Serology (LCM)	Supportive, Nutritional (assisted feeding if necessary), Vitamins C, E/selenium, B complex, Dexamethasone (if trauma), Fluids, C-section, Ovariohysterectomy (if pregnancy toxicosis), Cull if LCM
Conjunctivitis	Dacryoadenitis, *Corynebacterium* spp, *Mycoplasma* sp, *Bordetella bronchiseptica*, Dusts from bedding, Irritation from ammonia/urine build-up or wet bedding, Normal porphyria in rats (owner thinks eye is bleeding)	Physical and ophthalmic exams, C&S	Appropriate topical ophthalmics as in other mammals, Correct husbandry
Constipation or vomiting	Tapeworm infection (*Hymenolepis nana* or *H. diminuta*), GI torsion, intussusception or neoplasia, Cecal impaction	Fecal examination, Abdominal palpation, Abdominal radiographs with contrast (iohexol), Exploratory laparotomy with biopsy	Supportive, Fluids, Metoclopramide (if no obstruction), Anticestodals (if tapeworms)

RULE OUT CHART FOR RATS AND MICE BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Dermatitis	Wounds (fighting, self-trauma), Abscesses, Ectoparasites: mites, lice, fleas (pruritus, secondary bacterial, FAD, anemia)	Physical exam, Skin scraping, C&S	Parasite control, Correct husbandry, Antibiotics, Ivermectin
	Dermatophytosis (*Microsporum* spp)	Wood's light, KOH prep, Fungal C&S	Topical fungicides
	Ulcerative dermatitis, Ectromelia (mouse pox), Self-mutilation	History, Biopsy	Correct husbandry
Diarrhea	Protozoa (*Entamoeba muris, Trichomonas muris, Giardia, Eimeria*)	Fecal float, Fecal direct wet mount smear	Fluids, Supportive, Metronidazole, Sulfas for *Eimeria*, Sanitation
	Cestodes (*Hymenolepis* spp)	Fecal float/smear, Cellophane tape perianal region	Fluids, Supportive, Praziquantel
	Nematodes (*Aspiculuris* sp, *Syphacia obvelata* - will also cause rectal prolapse in mice)	Microscopic exam	Fluids, Supportive, Piperazine
	Bacterial (salmonellosis, normal flora overgrowth?)	Fecal/rectal C&S	Fluids, Supportive, Zoonotic potential, Antibiotics?
	Tyzzer's *Clostridium piliformes*	Fecal exam, C&S	Fluids, Supportive, Tetracycline
	Viral (esp neonates: reovirus, epizootic diarrhea infant mice, mouse hepatitis virus)	Serology of colony	Cull out

RULE OUT CHART FOR RATS AND MICE BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Dyspnea	Cervical lymphadenitis (*Streptococcus zooepidemicus*), Allergy (dry bedding and dusts), Foreign body in respiratory tract, Pneumonia due to *Mycoplasma*, *Streptococcus*, *Pasteurella*, *Bordetella*, *Klebsiella*, Sendai virus, Irritation from cedar oils (if cedar shavings used), Ammonia build-up in wet bedding	Auscultation, C&S discharge, Thoracic radiographs, Nasal cavity radiographs, CBC/chemistries	Oxygen, Antibiotic administration (chloramphenicol or enrofloxacin), Increase humidity of environment or nebulize, Replace shavings with towels or newspapers
Dystocia	Fetuses too large relative to pelvic canal (esp rats), Uterine torsion, Dam is compromised (malnutrition, illness, obesity)	History, Physical exam, Abdominal radiographs, Palpate pubic symphysis	Supportive care, Fluids, Consider oxytocin 0.2-0.3 mg/kg IM, C-section
Facial mass (deep)	Tooth abscess, Neoplasia	Oral examination	Appropriate antibiotic, Clean teeth, Extract abscess tooth, Biopsy/surgical excision
Hypersalivation	Dental malocclusion, Adrenocortical insufficiency, Oral foreign body, Rectal impaction, Pain (GI)	Oral examination, Abdominal palpation, Abdominal radiographs, Rectal temperature	Supportive care, Fluids, Analgesics (if pain)
Incoordination/Convulsions	Otitis interna, Trauma, Neoplasia, Encephalitis (bacterial, mycoplasma, LCM, mouse encephalomyelitis virus)	History, Physical exam, Radiographs, CBC, C&S exudate if any, Serology	Supportive, Diazepam for acute seizures, Analgesics PRN, Cull if LCM, Appropriate antibiotics if bacterial/mycoplasma

RULE OUT CHART FOR RATS AND MICE BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Infertility	*Mycoplasma pulmonis* infection (colonizes cervix, oviduct, uterus, ovarian bursa), Improper light cycle or intensity, temperature, humidity, Immaturity or senescence, Over-crowding, Inadequate bedding, Cystic ovaries, Inbreeding, Vit E deficiency (rats), Organophosphate poisoning, Pruritic ectoparasitism, Pyometra, Metritis	Physical exam, Husbandry review, Mycoplasma screening, Ultrasonography, C&S exudate, Vaginal smear cytology and C&S	Tetracycline for mycoplasma, Correct husbandry, Ectoparasite treatment, Ovariohysterectomy (cystic ovary), Appropriate antibiotics, Supportive per etiology
Litter desertion or cannibalism	Environmental disturbance, Lack of nesting material, Dead, deformed young, Agalactia, Small litter, Inexperienced dam, Overcrowding, Abrasion of pup's skin, Male present at parturition, Dirty cage, Mastitis	Physical exam, History, Husbandry review	Correct husbandry, Low stress environment for dam, Fresh foods available to dam, Separate male prior to parturition
Malocclusion	Lack of wearing, Tooth root abscess	Dental/oral exam, Skull radiograph	Trim teeth, Treat abscess (antibiotics PRN)

RULE OUT CHART FOR RATS AND MICE BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Nasal discharge, dyspnea, pneumonia	Dusts from bedding, *Pasteurella pneumotropica*, *Mycoplasma* sp (rat), Sendai virus infection (Para-influenza Type 1), *Klebsiella pneumoniae*, *Corynebacterium* sp, *Bordetella bronchiseptica*, *Streptococcus pneumoniae*, Sialodacryoadenitis virus, Pneumonia virus of mice	Physical exam, C&S exudates, CBC, Radiographs, Viral culture/ serology of colony	Correct husbandry (sanitation, ventilation), Appropriate antibiotics, Supportive care
Paresis/paralysis	Trauma, Brain lesions/neoplasia, Arthritis, Malnutrition, Polioencephalomyelitis, LCM	Physical examination, Radiographs, Serology (LCM)	Supportive, Dietary correction if malnourished, Analgesics, Cull if LCM (zoonotic potential)
Polydipsia/polyuria	Cystic renal disease, Renal amyloidosis	History, Urinalysis, Ultrasonography	Nonspecific, Antibiotics, Fluid therapy, Supportive care
Prenatal mortality (see Abortion)			
Rectal prolapse (see also Diarrhea)	"Wet tail" etiologies: Proliferative ileitis, *Campylobacter*, Desulfovibrio-like organism, *Syphacia obvelata* (mice)	Physical exam, C&S, Fecal float/smear, Gram's stain	Supportive fluids, Doxycycline/ chloramphenicol, Pepto Bismol, Reduce prolapse, Purse-string suture if necessary to hold reduction 28-48 hours
Rough hair coat	Senility, Debilitation, Dirty housing, Malnutrition, Febrile disease	History, Husbandry review, Physical exam	Correct husbandry & underlying health problems

RULE OUT CHART FOR RATS AND MICE BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Seizures	Lymphocytic choriomeningitis, Pregnancy toxemia, Enterotoxemia, Rabies, Calcium deficiency, Lead toxicity	Signalment, History, CBC/chemistries, Viral serology	Nonspecific, Supportive, Low stress environment, CaEDTA (lead), Diazepam, Correct electrolyte imbalances
Sudden death (or owner didn't notice symptoms)	Starvation or dehydration, Septicemia or toxemia, Chilling or overheating, Neoplasia, Litter abandoned, Acute gastritis, overeating, Bloat (gorging after fasting)	History, Necropsy	
Swelling (cutaneous, subcutaneous)	Follicular mite (*Psorergates simplex* in mice)	Deep scraping	Ivermectin
	Neoplasia (esp mammary tumors)	Biopsy, Cytology	Surgical excision, Supportive
	Abscess (*Pasteurella pneumotropica*, *Corynebacterium*, *Staphylococcus*, *Streptococcus*)	C&S	Drain, Appropriate antibiotics
	Mastitis	Rectal temp, C&S, Reproductive history	Supportive care, Antibiotics, Clean, Drain, Flush, Hot pack as needed
	Viral sialodacryoadenitis (rat)	SDA virus serology	Supportive, No Rx
	Testicles, Pregnancy	History, Physical, Radiographs	No Rx, Educate owner

RULE OUT CHART FOR RATS AND MICE BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Swelling (cutaneous, subcutaneous)	Myiasis, Cuterebriasis	Deep scraping, Biopsy, Cytology	Supportive, Ivermectin, Surgical excision, Clean, Drain, Flush, Hot pack as needed, Remove larvae (Cuterebra), Correct husbandry
Torticollis	Otitis media, interna (bacteria, mycoplasma)	Physical exam, Skull radiographs, CBC, C&S exudate if any	Supportive, Appropriate antibiotics
	Encephalitis (bacteria, mycoplasma), LCM, Mouse encephalomyelitis virus	Serology and/or viral culture if colony	Supportive, Appropriate antibiotics, Cull if LCM
Vascular signs (petechiation, edema)	*Leptospira icterohemorrhagica*, Exposure to warfarin	Whole body radiography, Dark field microscopy of urine, CBC, esp serum calcium	Nonspecific, Supportive, Correct diet, Vitamin C, Antibiotics, Vitamin K
Weakness	Sepsis (due to bacterial infection, mycoplasma, secondary to pyometra), Pregnancy toxemia/ketosis, Dietary/agroceriosis/malnutrition	CBC/chemistries, Abdominal palpation, Abdominal radiographs/ultrasonography, Blood culture	Nonspecific, Supportive, Correct diet, Treat bacterial infections
Weight loss	Nutritional deficiencies, Malocclusion, Neoplasm, *C. piliformes*	History, Physical exam, Radiographs	Appropriate Rx as in other species
Wounds	Bite wounds, Trauma from cage, Self-mutilation after IM infections (neuritis), Draining abscess, Burns (thermal/chemical/caustic)	History, Physical exam, Culture/sensitivity (wound)	Antibiotics (chloramphenicol or enrofloxacin), Wound cleansing, Consider surgical closure, Consider Elizabethan collar, Diazepam analgesics PRN

Gerbils

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medial topics of gerbils and is not intended to replace comprehensive reference material.

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GERBILS Order - **Rodentia** Family - **Gerbillidae**

Common Species and Variations

Mongolian gerbil *Meriones unguiculatus*
Libyan gerbil *Merionus libycus* (occasional)
Gerbils are illegal to possess in California.

Behavior

- Gerbils are friendly and rarely bite.
- Most gerbils are diurnal in activity, although some are nocturnal.
- They are diggers and burrowers and emit a faint "cheep" vocalization.
- Adults placed in a cage together for the first time will fight, often until death.
- Large groups established before puberty will often live together comfortably if they are not overcrowded, but it's best to separate the sexes.
- Females may be more aggressive fighters than males.
- Gerbils are territorial; both genders produce a yellow-brown musty-smelling secretion (scent marking) from a gland located on the stomach near the umbilicus. They also mark territory with urine, feces.
- 20% of gerbils exhibit brief (few seconds to a minute) epileptiform seizures following handling or other stressful experience. No treatment is necessary.
- Foot-drumming is general communication/alerting/excitement action.

Diet

- Commercial rodent pellets with 18-22% protein are recommended (Ex: Mazuri Rodent Diet®, Purina Lab Chow®, Formulab Chow®).
- Because gerbils selectively eat only sunflower seeds, seed-based feed mixes do not provide adequate nutrition (fractures, growth, bone development problems result).
- Gerbils conserve water by concentrating their urine, and drink very little, especially if they receive leafy greens. But fresh water in a sipper tube should always be provided.
- Young gerbils may begin sampling solid food at 15 days of age. Provide soft, small-sized pellets within reach and small sipper tube with water.

Housing

- Use wire and steel, aluminum, or plastic enclosures.
- Aquarium can be used with secure, wire-mesh lid, but moisture, urine and feces build-up is more problematic.
- Bedding: hardwood shavings or recycled composite bedding to depth of at least 3 inches; can also use shredded paper napkins, towels, or other clean, dry absorbent and nonabrasive material.
- Enclosure should be cleaned at least weekly due to fecal build-up.
- Avoid sand, corncob, cat litter as bedding — attempts to burrow and dig will cause abrasions to the face.
- Avoid artificial fiber bedding material sold for birds and hamsters — small fibers may wrap around legs, feet; GI impaction may occur if eaten.
- Provide cardboard roll or box for hiding, exercise wheel, and cleaned natural branch or other wood for chewing.
- Temperature: 60-70°F ideal with maximum relative humidity at 30-50%.
- 12/12 hour light/dark cycle used.

Preventive Care

- Good husbandry and sanitation.
- Use bedding that will not cause nose ulcertation when the gerbil burrows.
- Offer good quality formulated rodent diet.

Gerbils – Quick Facts

Physiologic	
Life span:	3-5 yr (females greater than males)
Adult male body weight:	65-100 g
Adult female body weight:	55-85 g
Body surface area cm^2:	10.5 (wt. in grams)$^{2/3}$
Rectal/body temperature:	37-39°C
Diploid number (karyotype):	44
Food consumption:	5-8 g/100 g/day (depends on moisture in food)
Water consumption:	4-7 ml/100 g/day or more (depends on moisture in food)
Respiratory rate:	90-140/min
Oxygen use:	1.4 ml/g/hr
Heart rate:	250-500/min
Blood volume:	6.6-7.8 ml/100 g body wt.

Reproductive - Gerbils	
Vaginal opening:	41 days or 28 g
Breeding onset (male):	70-85 days
Breeding onset (female):	65-85 days
Duration of estrus:	4-6 days (polyestrous)
Mating:	Evenings
Implantation:	May be delayed during lactation
Ovulation:	Spontaneous
Gestation period (nonlactating):	24-26 days
Gestation period (concurrent lactation):	27-48 days
Postpartum estrous:	Fertile
Litter size:	3-7 (avg 5) pups
Birth weight (depends on litter size):	2.5-3.5 g
Weaning weight:	3.3-6.0 g
Weaning age:	21-24 days
Breeding duration (commercial):	12-17 months (4-10 litters)
Litters per year:	7 avg
Average production index:	>1/wk per breeding pair

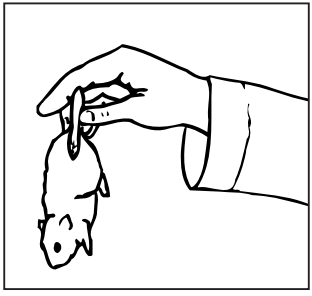
Breeding and Raising Young

- Gerbils will breed all year in captivity with controlled 12-14 hour daylight.
- Best to maintain as monogamous pairs.
- Polygamous harems can be successful if formed before the gerbils are 8 weeks of age, but they may fight.
- Young are born naked, hair begins at 6 days, with a good coat at 10 days. Eyes open at 16-20 days.
- Male can be kept with dam and pups.
- Infertile matings may be followed by a pseudopregnancy lasting 14-16 days.
- The female may destroy a litter if it's very small or if she stops lactating. This may be a wild, survival behavior — next mating/litter may be normal number of young.
- A dam may desert her litter or cannibalize it if she is disturbed, overcrowded, or ill.
- Most females are fairly reliable mothers. Fostering abandoned pups is possible if host dam has a litter of similar age.

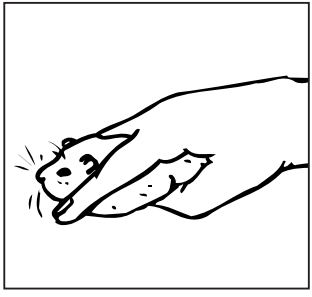
Restraint of Gerbils

- Gerbils jump and wiggle so they are best supported on palm of hand and restrained by holding the base of the tail to prevent leaping away.

- Gerbils should not be picked up by the end of the tail — the skin may slip off.
- Extra restraint can be used by holding the scruff over the shoulder/neck area or by restraining in a small cloth.

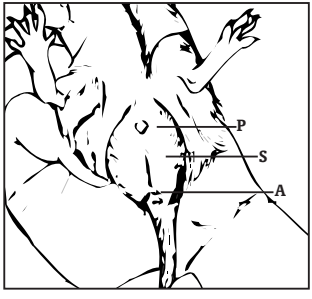


Pick up gerbil with grip at tail base. If the tail of a rodent is grasped distal to the base, the tail skin may be pulled off.

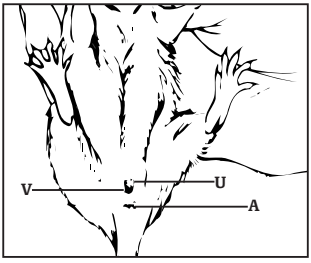


Over-the-back grip for restraining gerbil.

Sexing of Gerbils



External genitalia of male gerbil.
P = tip of penis
S = scrotal sac
A = anus



External genitalia
of female gerbil.
U = urethral orifice
V = vaginal orifice
A = anus

Harkness and Wagner, 1989

Blood Collection

Obtaining a blood sample is difficult. Laboratory methods:

- Cardiac puncture on anesthetized animals
- Orbital sinus bleed
- Toe nail clip
- Tail vein cut

Injection Sites

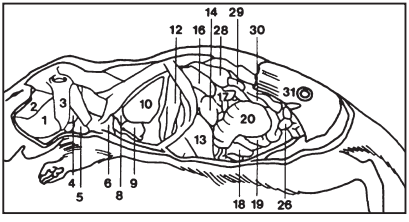
Intramuscular:	quadriceps	0.1 ml
Subcutaneous:	scruff	1.0 ml
Intraperitoneal:		4.0-5.0 ml
Intravenous:	Saphenous	0.2 ml
	Lateral tail vein	0.2-.5
	Penile	0.2 - very difficult

Hematologic and Biochemistry Reference Ranges - Gerbils	
Erythrocytes:	7-10.0 x 10^6/mm^3 (Avg 8.5; half-life approx 10 days)
Reticulocytes:	21-54/1000 RBC
Stippled RBC:	2-16/1000 RBC
Polychromatophilic RBC:	5-30/1000 RBC
Hematocrit (PCV):	41-52% (avg 48)
Hemoglobin:	12.6-16.2 mg/dl (avg 15)
Leukocytes:	4.3-21.6 x 10^3/mm^3 (avg 11)
Neutrophils:	5-34% (avg 29.9)
Lymphocytes:	60-95% (avg 73.5)
Eosinophils:	0-4%
Monocytes:	0-3%
Basophils:	0-1%
Platelets:	400-600 x 10^3/mm
Serum protein:	4.3-12.5 mg/dl
Albumin:	1.8-5.5 mg/dl
Globulin:	1.2-6.0 mg/dl

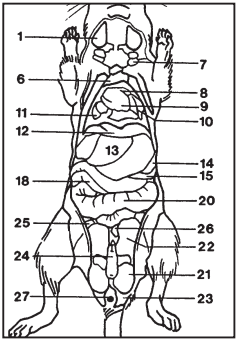
Hematologic and Biochemistry Reference Ranges - Gerbils	
Serum glucose:	50-135 mg/dl
Blood urea nitrogen:	17-27 mg/dl
Creatinine:	0.6-1.4 mg/dl
Total bilirubin:	0.2-0.6 mg/dl
Cholesterol:	90-150 mg/dl
Serum calcium:	3.7-6.2 mg/dl
Serum phosphate:	3.7-7.0 mg/dl

Radiography

A guide to location and size of organs in female (lateral) and male (ventrodorsal) Mongolian gerbils:



1. M. masseter
2. facial nerve
3. parotid gland
4. mandibular lymph nodes
5. mandibular salivary gland
6. thymus
7. clavicle
8. left atrium



9. left ventricle
10. lungs
11. right lung
12. diaphragm
13. liver
14. stomach
15. greater omentum
16. spleen
17. pancreas
18. jejunum
19. ileum
20. cecum
21. testes
22. fat pad & head of epididymis
23. tail of epididymis
24. penis
25. vesicular gland
26. bladder
27. anus
28. left kidney
29. ovary
30. uterus
31. acetabulum

Rübel, 1991

Common Clinical Conditions in Gerbils

Trauma, Malnutrition, Rough hair coat, "Sore nose," Epileptiform seizures, Diarrhea, Sudden death, Enteritis, Maloclussion

RULE OUT CHART FOR GERBILS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Alopecia	Neonatal runt syndrome, Hair chewing with crowding	History, Genetics	Supportive care, Correct husbandry
Conjunctivitis	Idiopathic in older gerbils, Bacterial, Foreign body, Trauma	Physical and ophthalmic exam, Stain	Treatment as in other species
Dermatitis	Trauma ("sore nose"), Rubbing on feeder, *Staph* or *Strep* are secondary	Physical exam, Skin scraping, C&S	Correct habitat, Antibiotics if severe
	Dermatophytosis, *Trichophyton microsporum*	Fungal C&S, KOH prep	Appropriate antifungal, Appropriate clean and treat wounds
	Bite wounds, Bacterial dermatitis	Physical exam, Skin scraping, C&S	Clean and treat wounds, Antibiotics
	Ectoparasitism: demodectic mange (*Demodex merioni*), fleas from other household pets	Physical exam	Amitraz or ivermectin, Control fleas on other pets and environment: tiny amount feline flea powder, wipe off excess
Diarrhea	*Clostridium piliformes* (Tyzzer's), *Salmonella enteridites*, *S. typhimurium*, *Hymenolepis nana*, Other enteropathies	Fecal exam, C&S	Fluids, Supportive care, Antibiotics (Salmonella - zoonosis, potential unknown if antibiotics eliminate or set-up carrier state), Praziquantel (for *Hymenolepis* spp.)

RULE OUT CHART FOR GERBILS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Incoordination or convulsions	Epileptiform seizures	Heredity, Physical exam, History	DO NOT BREED, No Rx, Decrease loud noises, abrupt stimuli, changes in environment, handling
	Encephalitis	Physical exam, Skull radiograph, C&S exudate (if present), CBC	Appropriate antibiotic, Analgesic, Supportive care
	Poisoning (including lead)	Blood lead, history	Treat as in other mammals (organophosphate), CaEDTA
	Trauma	History, Physical exam, Radiographs	Appropriate Rx as in other species, Diazepam, Analgesics as needed
Infertility	Incompatible pair, Immaturity or senescence, Overcrowding, Environmental disturbances, Cystic ovaries, Neoplasia, Nutritional deficiencies	Physical exam, History, Husbandry review, Palpation, Radiography, Ultrasonography (females >400 days old)	Correct husbandry, Ovariohysterectomy, Poor prognosis (neoplasia - possible surgical excision if skin tumor or of reproductive tract)
Litter desertion or cannibalism	Small litter, Exposed nest, Lack of material, Environmental disturbances, Overcrowding, Agalactia, Mastitis	Physical exam, Review husbandry	Correct husbandry, If mastitis appropriate antibiotics
Malocclusion	Tooth root abscess, Trauma, Genetics	Oral exam, Skull radiographs	Rx as in other rodents
Nasal discharge +/- dyspnea	Rhinitis and URI, Pneumonia (*Klebsiella, Mycoplasma, Pasteurella, Staph, Strep*), Heat stress (serous discharge)	Physical exam, Radiographs, C&S exudate, Ambient temp, rectal temp	Supportive, Appropriate antibiotics, Correct husbandry

RULE OUT CHART FOR GERBILS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Prenatal mortality	Nutritional deficiency, Environmental stress	Review husbandry	Correct husbandry
Rough hair coat	Humidity >50%, Improper, insufficient bedding, Leaky water bottle	History, Husbandry review	Correct habitat
	Chronic disease (infectious, neoplastic)	Full physical exam	Appropriate Rx
Sudden death (or owner didn't notice symptoms)	Starvation or dehydration, Septicemia or toxemia, Chilling or overheating, Neoplasia, Litter abandoned, Acute gastritis, Overeating, Bloat (gorging)	History, Necropsy	
Swellings, cutaneous or subcutaneous	Neoplasia, Abscess, Sebaceous gland (ventral, esp in male)	Physical exam, Fine needle aspirate, Biopsy/histopath, C&S exudate	Neoplasia excision, Drain if abscess, Appropriate antibiotics
Torticollis	Otitis interna and/or media (may be sequelae to rhinitis & URI), Encephalitis	Physical exam, Skull radiograph, C&S exudate (if present), CBC	Appropriate antibiotic, Analgesic, Supportive care
Weight loss	Nutritional deficiencies, Malocclusion, Neoplasia, *Clostridium piliformes*	History, Physical exam, Fecal exam, C&S	Fluids, Supportive care, Appropriate antibiotics, Correct husbandry

Hamsters

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medial topics of hamsters and is not intended to replace comprehensive reference material.

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HAMSTERS Order - **Rodentia** Family - **Cricetidae**

Common Species, Breeds and Variations

Golden (Syrian) Hamster (*Mesocricetus auratus*)
- Standard - Short-haired
- Teddy bear - Long-haired

Chinese (Striped-back) Hamster (*Cricetulus griseus*)
European Hamster (*Cricetus cricetus*)
Hungarian (Hairy-footed or Russian) Hamster (*Phodopus sungorus*)

- Color varieties: wild type (agouti or golden brown), cinnamon, creamy white, or combinations of colors in both short-haired and long-haired varieties.
- Chinese Hamster is smaller and dark brown; common or European Hamster is also smaller and used in biomedical research.

Behavior

- Nocturnal.
- Escape artists — well secured cages are mandatory.
- House in separate cages. Females will fight with other females. Males will fight other males. Females will attack introduced males except for few hours during estrus. Occasionally hamsters will do less fighting if housed together before sexual maturity.
- Avoid disturbing female with newborn young — she may stuff babies into her cheek pouches, along with food, bedding or other objects. The young may suffocate in the pouches.

Diet

- Feed commercial rodent/hamster pellets with at least 16% protein (Ex: Purina Mills Hamster Chow®, Purina Lab Chow Code 5001®, Wayne® Lab Blox, Mazuri Rodent Diet®).
- Softened pellets may be offered to babies <3 weeks old.
- Do not feed seed-type "pet" mixes as they do not provide adequate nutrition for growth and reproduction. Hamster may pick out few seeds he likes and stockpile or bury the rest.
- Check bedding, nest daily to remove uneaten food.
- Treats = salad sprouts, tiny pieces of apple, walnuts, raisins, various salad greens - no more than ½ tsp per 24 hr.
- Provide small pieces of dog biscuits, dry dog/cat foods, natural wood chew sticks or blocks to wear down front teeth.
- Provide water with sipper tube — also small size for young.
- Hamsters have predominantly gram-positive GI tracts.

- Females with litters should have the food placed directly on the cage floor — young start eating and drinking at 7-10 days of age.

Housing

- Adult enclosure: 20” x 20” x 6-10” high.
- Must be large enough for exercise wheel, nest area for sleeping, and 1-2 corners well away from eating/sleeping areas for defecation/urination.
- Female breeders: 2-3 times floor space — also need secure nest box to raise and hide young.
- Galvanized stainless steel mesh wire (open-sided) rodent enclosures with solid-floored bases of plastic or aluminum are recommended — easy to clean and keep track of food and animal.
- 10 gal aquarium OK with securely fastened, screened top.
- Do not use popular completely enclosed hamster housing — no ventilation so strong urine odor and ammonia vapors are trapped.
- Do not choose plastic, wood, soft metal materials or poorly constructed cages — hamsters can escape.
- Bedding: hardwood shavings, recycled newspaper, or composite pellets at a depth of 1-2 inches.
- Kleenex-type tissues work fine for sleeping/nesting material.
- Do not use commercial, synthetic small rodent nesting fiber — it often winds around small feet or teeth or is ingested and causes impactions within the cheek pouches or gut.
- Change bedding 1-2 times a week or more often if it becomes wet, or odor develops (exception: if babies are present).
- Wash dishes and sipper tubes at the same time.
- Clean entire cage with hot water and detergent/disinfectant (eg, Nolvasan® or Roccal-D®), rinse well and dry thoroughly.
- Replace tissue nesting material as it becomes matted — keep back one or two small “old” pieces to add to new tissues. Hamster may relocate nest at each bedding change.
- Ideal room temperatures: 65-70°F. If young present: 71-75°F.
- Humidity: 30-70%.
- A 12:12 light/dark cycle is adequate. Prolonged room temperatures of less than 55°F may induce a hamster to seek refuge in his nest and sleep until it warms up. This is not true hibernation, and is not recommended.

Hamsters – Quick Facts

Physiologic	
Adult male body weight:	85-130 g
Adult female body weight:	95-150 g
Life span:	18-24 mo (up to 3 yr recorded)
Body surface area cm^2:	10.5 (wt. in grams)$^{2/3}$
Rectal/body temperature:	37-38°C (101-103°F)
Diploid number:	44
Food consumption:	>15 g/100 g/day
Water consumption	>20 ml/100 g/day
Respiratory rate:	35-135/min
Tidal volume:	0.6-1.4 ml
Oxygen use:	0.6-1.4 ml/g/hr
Heart rate:	250-500/min
Blood volume:	78 ml/kg
Blood pressure:	150/100 mm Hg
Reproductive	
Puberty (male):	45-75 days
Breeding onset (male):	10-14 weeks
Breeding onset (female): (may be mature at 35-42 days, but first breeding should be withheld until adult weight)	6-10 weeks
Cycle length:	4 days (polyestrous)
Gestation period:	15-18 days
Postpartum estrus:	Infertile (Fertile estrus follows weaning by 2-18 days.)
Parturition:	>3 hr
Litter size:	5-9
Birth weight:	2 g
Weaning age:	20-25 days
Breeding duration (commercial):	10-12 months (5-7 litters)
Young production:	3 mo
Milk composition:	12.0% fat, 9.0% protein, 3.4% lactose

Breeding

- As estrus nears, thin mucus may be seen from the female's vulva.
- The morning following estrus, an opaque, stringy mucus will appear. During early evening, a receptive female will approach a male in a non-belligerent manner, which indicates mating probability.
- Group mating schemes or monogamous pair-mating used

with other rodent species are not advisable because hamsters tend to fight.

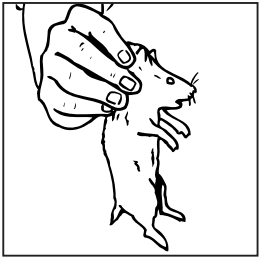
- For hamsters, the hand-mating system is preferred. The female is placed into the male's cage 1 hour before dark and the pair observed for mating activity or fighting. The male is removed following either outcome.
- Other systems used commercially: sequential monogamy increases litter size - 7 females rotated at 1 week intervals through a male's cage. Non-pregnant females may be rotated back sooner. Injured or exhausted males are either rested, replaced, retired or even euthanized if fatally injured. Not recommended for pet hamsters, as fighting may be severe.

Pregnancy and Raising Young

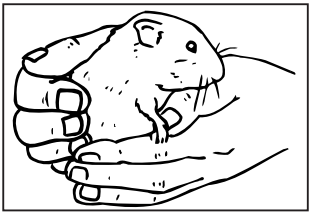
- After mating, the female should not have any discharge.
- Pregnancy indicated by weight gain and abdominal distention at 10 days.
- At day 13 after mating, female should be supplied with a week's supply of food, bedding, water.
- Pseudopregnancy which lasts 7-13 days may result following infertile mating or if females are crowded.
- Female becomes active, restless and has slight vaginal bleeding prior to delivery.
- Litter abandonment and cannibalism are fairly common (see Rule Out Chart). Do not disturb for at least 1 week after birth. Make small water tube available to babies at this time.
- Fostering and hand-raising are rarely successful.

Restraint of Hamsters

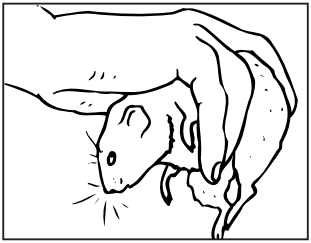
- Hamsters may bite if roughly handled, startled, injured, or abruptly awakened or disturbed from a sound sleep.



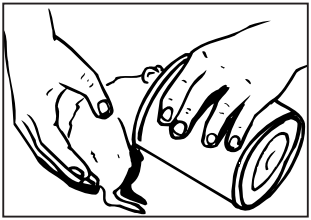
Scruff-of-the-neck grip for picking up and restraining hamster. Because of the cheek pouches, a hamster has ample loose skin about the neck.*



Two-handed technique for picking up and restraining hamster.*



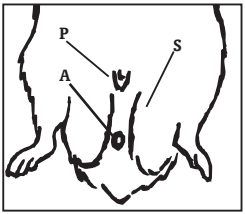
One-handed hold for restraining hamster. The thumb and third finger grasp the body.*



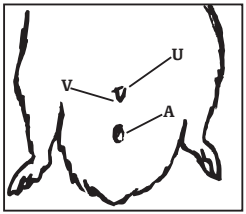
Picking up and restraining hamster with small container.*

** Illustrations adapted by permission from Hoffman RA, Robinson PF, Magalhaes H: The Golden Hamster. Ames, Iowa State University Press, 1968.*

Sexing of Hamsters



External genitalia of male hamster.
P = tip of penis
S = scrotal sac
A = anus



External genitalia of female hamster.
U = urethral orifice
V = vaginal orifice
A = anus

First Visit/Annual Examination

Physical examination:

- Include auscultation, temperature, weight, eyes, ears, skin, dental, abdominal palpation, genital exam
- Also review health, nutrition, husbandry, behavior

Fecal flotation, direct smear

If abnormalities or illness:

- CBC/chemistry panel
- Radiographs
- Fecal/rectal culture

Neutering/spaying options are also discussed with owners.

Blood Collection

Consider doing under isoflurane anesthesia:

- Lateral tail artery, tip of tail (clean skin well first and dry)
- Orbital sinus (not recommended in pets)
- Nail clip
- Intracardiac (not routinely used in pets).

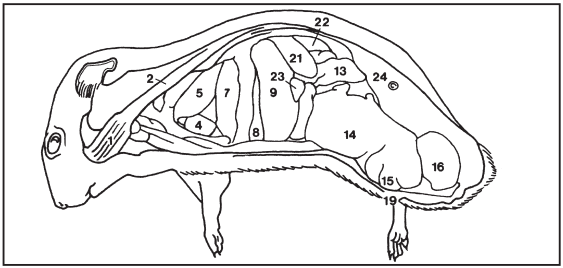
Injection Sites

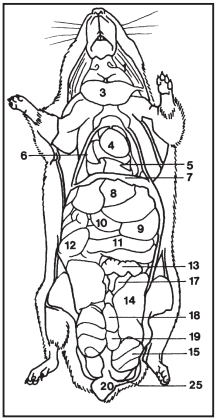
Intravenous:	Saphenous	0.2 ml - difficult access, general anesthesia required
	Penile	0.2 ml - very difficult, anesthesia required
Intramuscular:	Quadriceps	0.1 ml - can be hard to restrain
Subcutaneous:		1.0 ml - easy, loose skin
Intraperitoneal:		4.0-5.0 ml

Hematologic and Biochemistry Reference Ranges - Hamsters	
Erythrocytes:	5-10 x 10^6/mm^3
Hematocrit:	36-55%
Hemoglobin:	10-16 g/dl
Leukocytes:	6.3-8.9 x 10^3/mm^3
Neutrophils:	10-42%
Lymphocytes:	50-95%
Eosinophils:	0-4.5%
Monocytes:	0-3%
Basophils:	0-1%
Platelets:	200-500 x 10^6/mm^3
Serum protein:	5.9-6.5 g/dl
Albumin:	2.63-4.10 g/dl
Globulin:	2.7-4.2 g/dl
α1 - Globulin:	0.30-0.95 g/dl
$\propto$2 - Globulin:	0.90-2.70 g/dl
β - Globulin:	0.10-1.35 g/dl
τ - Globulin:	0.15-1.28 g/dl
Albumin:globulin ratio:	0.58:1.24
Serum glucose:	60-150 g/dl
Blood urea nitrogen:	10-25 mg/dl
Creatinine:	0.91-0.99 mg/dl
Total bilirubin:	0.25-0.60 mg/dl
Cholesterol:	25-135 mg/dl
Serum calcium:	5-12 mg/dl (usual 5-6.5)
Serum phosphate:	3.4-8.2 mg/dl
Amylase:	120-250 SU/dl
Alkaline phosphatase:	3.2-30.5 IU/l
Acid phosphatase:	3.9-10.4 IU/l
Alanine transaminase (ALT):	11.6-35.9 IU/l
Aspartate transaminase (AST):	37.6-168 IU/l
Creatinine phosphokinase (CPK):	0.50-1.90 IU/l
Lactic dehydrogenase (LDH):	56.0-170 IU/l
Uric acid:	1.8-5.3 mg/dl
Sodium:	106-146 mEq/L
Potassium:	4.0-5.9 mEq/dl
Chloride:	85.7-112 mEq/dl
Bicarbonate:	32.7-44.1 mEq/dl
Magnesium:	1.90-3.50 mg/dl

Radiography

Anatomic drawings with size, shape and location of organs in an adult male Chinese Striped-back Hamster:





1. cheek pouch, bursa buccalis
2. m. retractor bursae buccalis
3. fat pad
4. heart
5. left lung
6. right lung
7. diaphragm
8. liver
9. proventriculus
10. glandular stomach
11. jejunum
12. cecum
13. vesicular gland
14. fat pad and head of epididymis
15. testes
16. tail of epididymis
17. bladder
18. penis
19. preputial orifice
20. anus
21. spleen
22. kidneys
23. pancreas
24. acetabulum
25. scrotum

From Rübel GA: Atlas of Diagnostic Radiology of Exotic Pets and used with permission of Schlütersche, Hannover, Germany

Common Clinical Syndromes in Hamsters

- Cannibalism
- Diarrhea
- Skin wounds
- Dermatitis
- Polyuria
- Sudden death
- Weight loss
- Malocclusion
- Chronic disease including infectious, amyloidosis, nephrosis, hepatic cirrhosis, neoplasia, *Clostridium* spp.
- Nutritional deficiencies
- Gastric trichobezoar, foreign bodies
- Parasitism - *Hymenolepis* spp.
- Starvation or dehydration
- Septicemia or toxemia
- Chilling or overheating
- Litter abandonment
- Amyloidosis
- Congenital abnormalities
- Antibiotic toxicity
- Poisoning
- Cardiomyopathy/ atherosclerosis
- Sendai virus infection
- Tumors in elderly hamsters

Therapy

See Formulary for Small Rodents page 3

RULE OUT CHART FOR HAMSTERS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Alopecia	Genetic hairlessness, Demodectic mange, Adrenocortical neoplasia (hyperestrinism), Scalding (urine ammonia), Chronic disease, Hypothyroidism, Amyloidosis	Physical exam, Skin scraping, Housing evaluation, Serum estradiol, Thyroxine, CBC/chems, Histopathology	Amitraz or ivermectin, Correct husbandry, sanitation, ventilation, Prognosis poor (neoplasia): Rx as in ferrets for adrenocortical neoplasia and hyperestrinism, Thyroid supplementation
Conjunctivitis	Bacterial, Foreign body, Trauma	Ophthalmic exam, Fluorescein staining, C&S exudate	Appropriate topical ophthalmics as in other mammals
	LCM	Serology, Virus culture	No Rx, Zoonotic potential
Dermatitis	Ectoparasitism: *Demodex aurati*, *Demodex criceti*, Fleas (dog, cat), Demodex is secondary to immunosuppresion	Physical exam, Skin scraping, Visualization	Amitraz or ivermectin for demodex, Clean habitat, Control environment, Feline flea powder once lightly, wipe off excess for fleas, Consider cause of immunosuppresion
	Bite wounds	Physical exam, History	Clean & treat as in other mammals, Appropriate antibiotics topically or systemic
	Bacterial dermatitis (may be secondary to ectoparasites, wounds)	Physical exam, History, Skin scraping, C&S	Appropriate antibiotics

RULE OUT CHART FOR HAMSTERS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Dermatitis	Scalding (urine ammonia), Wet bedding build-up esp. cedar shavings in enclosed caging	Physical exam, Evaluate habitat and husbandry	Correct ventilation, Sanitation, Topical soothants, Analgesics PRN
Diarrhea/rectal prolapse ("wet tail")	Proliferative ileitis (*Campylobacter*, *Desulfovibrio*, Chlamydia-like org.)	Physical exam, C&S, Fecal float/smear/cytology	Supportive fluids, Doxycycline or chloramphenicol, Pepto Bismol
	Enteropathies: Colibacillosis, Tyzzer's (*Clostridium piliformes*), *Clostridium dificile, Salmonella* sp.	Physical exam, C&S, Fecal float/smear/cytology	Appropriate antibiotics, Supportive
	Cestodiasis (*Hymenolepis nana, Hymenolepis dimunata*)	Physical exam, Fecal float/smear	Praziquantel, Supportive, Sanitation, *H. nana* = zoonotic potential
	Antibiotic toxicity	Physical exam, History	Discontinue antibiotics, Supportive care, Probiotics, Healthy hamster flora slurry
Incoordination/convulsions	Trauma ("dropped/squeezed hamster"), Encephalitis (bacterial), LCM, Lead poisoning	History, Physical exam, Radiographs, CBC, Serology (LCM), Blood lead	Supportive, Diazepam (acute convulsions), Analgesics PRN, CaEDTA, If LCM, cull
Infertility	Immaturity or senescence, Nutritional deficiency, Environmental stress, Pyometra, Incompatible pair, Seasonal phenomenon	Physical exam, Husbandry evaluation (incl diet), C&S vaginal exudate, Cytology vaginal smear (pyometra)	Correct husbandry, Ovariohysterectomy, Appropriate antibiotics (pyometra)

RULE OUT CHART FOR HAMSTERS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Litter desertion or cannibalism	Environmental disturbance, Maternal inexperience, Mastitis, Agalactia, Reduced food/water intake, Young on wire caging	History, Physical exam, Husbandry review, C&S exudate (mastitis)	Correct husbandry, Offer nest box & materials, solid flooring, Appropriate antibiotics
Malocclusion	Genetics, Trauma, Tooth abscess	Dental/oral exam, Skull radiograph	Trim teeth, If abscess, antibiotics
Melena	Gastric ulcer	Physical exam, Fecal smear (examine cells), CBC, esp. Hct	Parenteral fluids, Sucralfate 50 mg/kg PO, Cimetidine
Nasal discharge, dyspnea	Rhinitis (dust, irritants, substrates)	Physical exam, Auscultate, Husbandry, Ventilation, Check substrate	Correct husbandry, ventilation, substrates
	Pneumonia (*Strep* pneumonia, *Pasteurella*)	Physical exam, Auscultate, Consider radiograph, C&S exudate	Appropriate antibiotics, O_2, Supportive
	Heat stress (serous discharge)	Physical exam, Auscultate, Rectal temperature, History	Cool temperature, O_2, Fluids
	Sendai virus infection (Parainfluenza Type 1)	Serology, Viral culture	Supportive, Limit secondary bacterial infections
Polydipsia and polyuria	Cystic renal disease, Renal amyloidosis	History, Urinalysis, Ultrasonography	Supportive care
Prenatal mortality	Nutritional deficiency, Infectious disease, Environmental stress, Large litter	Necropsy	As in other rodents per etiology, Correct conditions

RULE OUT CHART FOR HAMSTERS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Swelling (cutaneous, subcutaneous)	Cheek pouch: Abscess, Food impaction, Neoplasia	Physical exam, Biopsy/histopath, C&S	Remove food, Appropriate antibiotics (abscess), Excision surgery (neoplasia)
	Abscess (*Pasteurella pneumotropica, Staphylococcus aureus, Streptococcus, Cornebacterium*)	Physical exam, C&S of exudate, CBC	Clean, Drain, Flush, Appropriate antibiotics
	Arthritis (over joints), Infections, Purulent	Physical exam, Radiographs, Joint tap, C&S material	Analgesics, Soft bedding, Appropriate antibiotics if septic
	Normal pregnancy, Testicles	History, Physical, Radiographs	Owner education
	Mastitis	Physical exam, C&S exudate, CBC	Antibiotics, Hot pack, Drain PRN
	Neoplasia	Physical exam, Needle aspirate/biopsy, Histopath	Surgical excision
	Cuterebriasis	Physical exam, Husbandry review	Remove larvae, Correct husbandry
	Organomegaly (polycystic disease)	Abdominal radiographs, Exploratory laparotomy	Supportive
Torticollis	Otitis interna, Encephalitis, LCM, Trauma	Physical exam, Skull radiograph, C&S exudate if any, CBC	Appropriate antibiotics, Analgesics PRN, Supportive care, Cull if LCM

RULE OUT CHART FOR HAMSTERS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Sudden Death (Owner may not have noticed symptoms)	Starvation or dehydration, Septicemia or toxemia, Chilling or overheating, Chronic disease, Litter abandoned, Amyloidosis, Congenital abnormalities, Antibiotic toxicity, Poisoning, Cardiomyopathy/ atherosclerosis, Sendai virus	Necropsy	
Weight loss	Malocclusion, Chronic disease, Amyloidosis, Nephrosis, Hepatic cirrhosis, Neoplasia, Nutritional deficiencies, Gastric trichobezoar, Foreign bodies, Parasitism	Physical exam, History, Husbandry review, Radiographs, CBC	Fluids, Supportive care, Appropriate Rx

NOTES

GUINEA PIGS

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of guinea pigs and is not intended to replace comprehensive reference material.

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GUINEA PIGS Order - **Rodentia** Suborder - **Hystricomorpha**

Species *Cavia porcellus*

Common Breeds and Variations

Three main breeds: English/Common (short, straight, fine hair), Abyssinian (rough, wiry hair in rosettes or whorls), Peruvian (long, straight, silky hair). Crosses of all breeds result in a wide range of coat colors and patterns. A guinea pig is commonly known as a cavy.

Behavior

Cavies make good pets. They are nonagressive and they rarely bite or scratch. If frightened, they may run around enclosure at a very fast speed, which makes one hard to catch.

Diet

- Commercial guinea pig feed with 20% crude protein and 16% fiber is recommended (Ex: Mazuri Guinea Pig®, Purina Guinea Pig Chow Code 5025®, Wayne Guinea Pig Diet®).
- Cavies require a dietary source of supplemental vitamin C. Add 50 mg/cup (8 oz) drinking water daily and include one or more high vitamin C-containing foods daily: 1/4 orange or small handful cabbage or kale.
- Limit “treats” to no more than 1-2 Tbsp/24-hour period: timothy hay, alfalfa cubes, small amounts green vegetables, carrot tops, apple.
- Cavies have sensitive intestinal tracts; sudden alterations in diet (including change in food brand) may result in serious GI upset and anorexia.
- Feed bowls should be cleaned regularly as a cavy may sit in them to defecate.
- Sipper tubes should be thoroughly cleaned daily (use large pipe cleaner), and water changed daily.
- Guinea pigs have predominantly gram-positive GI tracts.

Housing

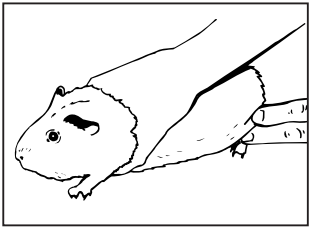
- Enclosure should be made of wire (mesh size: 1.2 x 3.8 cm) with minimal dimensions of 12" x 12" x 12" per adult.
- Breeders need twice the floor space.
- Bedding should be provided in abundance: hardwood shavings, composite recycled paper materials, pellets, shredded paper.

- Bedding must be changed frequently to prevent fecal material and urine moisture build-up.
- Hiding box is appreciated for sleeping or retreat if startled.
- Do not house guinea pigs with animal species that carry *Bordetella* bacteria as a subclinical infection (rabbits, cats, dogs), as this may cause severe disease in cavies.
- Room temperature range 55-70°F — above 80-85°F may cause heat stroke.

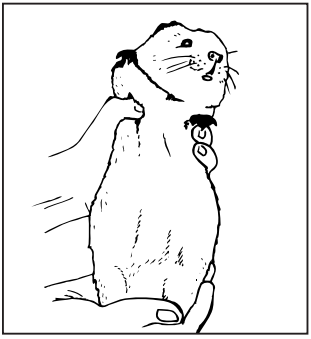
Preventive Care

- Feed quality guinea pig food plus daily supplemental vitamin C.
- Trim toenails if necessary; comb/brush long-haired breeds
- Front teeth may require trimming or filing as they may overgrow.
- Encourage client to weigh guinea pig monthly and check for abnormalities.

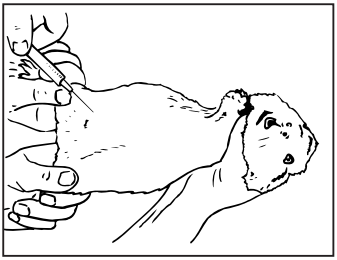
Restraint



The guinea pig should be restrained and picked up with one hand around the shoulders. As the animal is lifted clear of its cage, the hindquarters should be supported.



Restraint of pregnant guinea pig. Hand beneath rear quarters prevents struggling and supports heavy body.



Guinea pig restrained for intraperitoneal injection.

Guinea Pigs – Quick Facts

Physiologic	
Life span:	4-8 yr (avg 5 yr in home)
Adult male body weight:	900-1200 g
Adult female body weight:	750-900 g
Rectal/body temperature:	37.2-39.5°C (101.5-103°F)
Body surface area cm^2:	9.5 (body weight in g)$^{2/3}$
Diploid number:	64
Food consumption:	6 g/100 g/day
Water consumption:	10 ml/100 g/day
GI transit time:	13-30 hours
Respiratory rate:	42-104/min
Tidal volume:	2.3-5.3 ml/kg
Heart rate:	230-380/min
Blood volume:	69-75 ml/kg (7 ml/100 g)
Blood pressure:	80-94/55-58 mm Hg
Dentition:	All teeth open-rooted: 1/1 incisors, 1/1 premolars, 0/0 canines, 3/3 molars
Reproductive	
Male = boar, Female = sow	
Puberty (male):	9-10 wk
Puberty (female):	6 wk
Breeding onset (male):	600-700 g (3-4 months)
Breeding onset (female):	350-450 g (2-3 months)
Estrous (heat cycle):	15-17 days
Estrus (when accepts the male):	1-16 hr (avg 8 hr)
Gestation period:	59-72 days (larger litter, shorter duration)

Reproductive (cont.)	
Postpartum estrus:	Fertile, 60-80% pregnancy
Litter size:	1-6 (avg 3-4)
Birth weight:	60-110 g
Young development:	Precocial
Lactation:	Peaks by day 5-8 after parturition (agalactic by 23 days)
Weaning age:	150-200 g, 14-21 days
Breeding duration (commercial):	1.5-4 yr (4-5 litters)
Young production (index per female):	0.7-1.4/mo
Milk composition:	4% fat, 8% protein, 3% lactose, 83% water, 16% solids

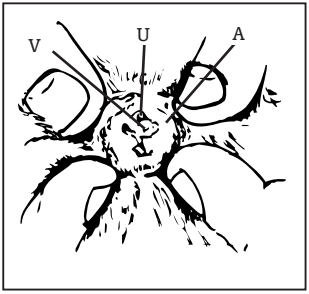
Breeding and Raising Young

- First breeding should be prior to 6 months of age (pelvic symphysis fusion) or the sow may have problems delivering the young (dystocia, even C-section).
- Cycling described as polyestrous with spontaneous ovulation.
- Following mating, a plug will form which is shed within the next day.
- Sow may double weight during pregnancy.
- Onset of birth may be hard to determine — no real nest is built.
- Pregnant sows should be separated from other cavies until litter is weaned, as adult pigs may inadvertently trample young.
- Babies are born with full body hair, open eyes, and ability to eat solid food within the first day.
- Sow suckles young in a "standing" position.
- Most efficient breeding programs:

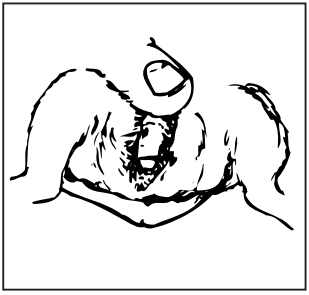
  Monogamous = 1 boar to 1 sow kept together. Remove weanlings at 21 days so boar doesn't breed to offspring. Usually male does not bother.

  Polygamous or harem = 1 boar to 4-10 sows. Optimal production. Remove weanlings at 21 days so boar doesn't breed to offspring. Problems: stampeding in heavily populated housing, may trample young; older offspring remaining in group nurse recently freshened sows, depriving the neonates. Prevent by removing juveniles or alternatively remove sow and litter to a separate cage a few hours after birth (subsequent to postpartum breeding).

Sexing



External genitalia
of female guinea pig.
U = urethral orifice
V = vaginal closure membrane
A = anus



Digital pressure will protrude penis.

Harkness, Wagner, 1989

First Visit/Annual Examination

Physical exam including dental exam, husbandry and diet review and evaluation, skin and otoscopic exam, fecal flotation and direct smear

Additional - particularly after 3 yr of age - geriatric screening, CBC/chems, urinalysis, radiographs

Blood Collection

Lateral saphenous vein	clip, wet with alcohol
Cephalic vein	25-27, 23 g needle
Jugular vein	restrain like a cat; if cavy stresses or becomes dyspnea, stop. Have short right vein, may be hard to find.
Cranial vena cava	dorsal position, under sedation; risk of subsequent traumatic bleeding into the thoracic cavity or pericardial sac
Cardiac puncture	requires deep sedation or anesthesia; large volumes; usually reserved for terminal procedure during euthanasia.
Maximum draw	10% blood volume (7 ml/100 g BW)= 0.7 ml/100g body wt (no more than every 2 weeks. If ill, consider 0.5 ml/100 g BW max).

Note: *Venipuncture of multiple veins is often necessary for collection of an adequate volume of blood for analysis. Be careful not to stress the cavy!*

Injection Sites

Intravenous

jugular catheter lateral, saphenous or cephalic (hard). If necessary for indwelling catheters, jugular cutdown (use anesthesia). If long-term IV therapy needed, install a vascular access port.

Intramuscular

gluteal or biceps muscle

Subcutaneous

upper back over shoulders - skin is thick, hard to penetrate with 25 ga needle or smaller

Intraperitoneal

hold on back with support under forelegs and hind quarters - head slightly lower than hind quarters — allows stomach and intestines to fall forward. Insert 23-25 ga needle to the right of midline 2.5 cm in front of pubis, directed forward at an angle of 45°. Can administer up to 15 ml.

Fluids

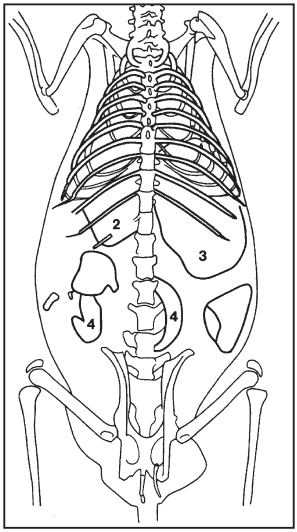
usually given SC via 25-22 ga butterfly catheter @ 100 ml/kg body wt/day divided q8-12h (25-35 ml per site).

Oral medications

by syringe into the side of the mouth.

Hematologic and Biochemistry Reference Ranges	
Erythrocytes:	4.5-7.0 x 10^6 /mm^3
Hematocrit:	37-48%
Hemoglobin:	11-15 g/dl
Leukocytes:	7-18 x 10^3/mm^3
Neutrophils:	28-44%
Lymphocytes:	39-72%
Eosinophils:	1-5%
Monocytes:	3-12%
Basophils:	0-3%
Platelets:	250-850 x 10^3/mm^3
Serum protein:	4.6-6.2 g/dl
Albumin:	2.1-3.9 g/dl
Globulin:	1.7-2.6 g/dl
Glucose:	82.0-107 mg/dl
Blood urea nitrogen:	9.0-31.5 mg/dl
Total bilirubin:	0.3-0.9 mg/dl
Creatinine:	0.62-2.18 mg/dl
Serum lipids:	95-240 mg/dl
Phospholipids:	25-75 mg/dl
Triglycerides:	0-145 mg/dl
Cholesterol:	16.0-43.0 mg/dl
Bicarbonate:	12.8-30.0 mEq/L
Calcium:	8.3-12.0 mg/dl
Chloride:	90-115 mEq/L
Magnesium:	1.8-3.0 mg/dl
Phosphorous:	3.00-7.63 mg/dl
Potassium:	3.80-7.95 mEq/L
Uric acid:	1.3-5.6 mg/dl
Sodium:	120-146 mEq/L
Amylase:	237.-357 SU/dl
Alkaline phosphatase:	54.8-108 IU/L
Acid phosphatase:	22.3-38.6 IU/L
Alanine transaminase (ALT):	24.8-58.6 IU/L
Aspartate transaminase (AST):	26.5-67.5 IU/L
Creatinine phosphokinase (CPK):	0.5-1.6 IU/L
Lactic dehydrogenase (LDH):	24.9-74.5 IU/L

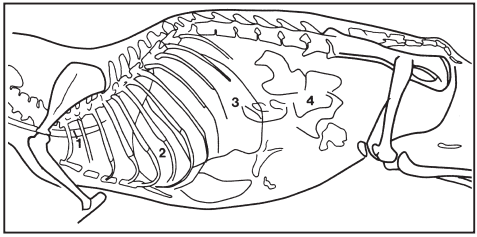
Radiography



In a normal radiographic appearance of an adult male guinea pig, the thoracic cavity is relatively small and reveals only a few details. Lung parenchyma and vasculature are difficult to evaluate because the lungs are small and not well-aerated. Extrathoracic structures such as ribs, sternum, spine and diaphragmatic outline are clearly visible.

1. trachea (lateral view)
2. liver
3. stomach
4. small bowel and cecum

Rübel, 1991



Common Clinical Conditions in Guinea Pigs

- Bite wounds
- Cervical abscesses
- Pregnancy-associated alopecia
- Malocclusion
- Anorexia
- Pneumonia
- Abortion
- Torticollis
- Scorbutus
- Weight loss
- Sudden death
- Diarrhea
- Trauma
- Pododermatitis

Zoonotic Potential

Dermatophytosis
Trichophyton mentagrophytes
Mange mites *Trixacarus caviae* - burrowing mite; sarcoptic mite
Salmonella - rare cavy pathogen
Yersinia pseudotuberculosis
Allergic responses to guinea pig allergens - hair, skin, rhinitis, rashes, asthma
Fleas - dog and cat

Therapy

- Guinea pigs are delicate creatures when ill; few antibiotics are safe to use in cavies.
- Do not use penicillin or erythromycin in guinea pigs.
- Sick guinea pigs stress easily and do not tolerate much handling.
- In general, with any disease or stress, supplement with vitamin C.
- Emphasis in health care is on prevention of problems.

RULE OUT CHART FOR GUINEA PIGS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Alopecia	Hormonal, Intensively bred females (cystic ovaries)	History, Ultrasonography	Reproductive rest, Ovario-hysterectomy (cystic ovaries)
	Barbering, Stress, Overcrowding, Aggression, Self-inflicted	Physical exam, History, Behavioral observation	Correct husbandry and stresses
	Wire abrasion, Mechanical	Physical exam, Habitat review	Correct housing
Anorexia	Malocclusion, Subclinical scorbutus, Tooth root abscess	Physical exam, Oral exam, Diet review	File, trim teeth, Parenteral & oral vitamin C, Supportive, Assisted feeding, If abscess, antibiotics, extraction(s)
	Gastrointestinal problems (see also Diarrhea)	Physical, Radiographs & contrast, Auscultation abdomen, History, Diet evaluation, Fecal float/smear, C&S	Supportive care, Force-feed lactobacillus, Antibiotic or antiparasitic, Fluids, Metoclopramide (if stasis & no impaction)
Cardiomyopathy	Linked to vitamin E/selenium deficiency, High fat, high calcium diets	Physical exam, Radiographs, Echocardiography, ECG	Vitamin E/selenium, Low fat diet, Symptomatic per cardiomyopathy
Condition, poor	Scorbutus (arthritis, anorexia, hemorrhage, malocclusion, poor hair coat, cervical lymphadenitis, nasal discharge, weight loss, reluctance to move, pododermatitis), May have concurrent 2° bacterial infections	Diet evaluation, Radiographs, C&S, CBC/chemistries	Vitamin C (parenteral + oral), Correct diet, Analgesics, Supportive care, Antibiotics (if concurrent secondary bacterial infections)

RULE OUT CHART FOR GUINEA PIGS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Conjunctivitis	Chlamydial neonatal conjunctivitis, *Streptococcus pneumoniae*	Ophthalmic exam including fluorescent staining, C&S	Tetracycline (for chlamydia), systemic and topical ophthalmics, Appropriate antibiotics, Vitamin C
	Foreign body or trauma	Physical and ophthalmic exam	Ophthalmic antibiotics +/- corticosteroids (as with other eye injuries)
	Ectoparasites	Skin scraping, Microscopic exam	Treat whole body problem, Antibiotic ophthalmic ointment to soothe
Dermatitis	Bite wounds, Secondary infection with *Staph*, *Strep*	C&S	Clean, Debride, Suture, PRN antibiotics
	Dermatophytosis (*Trichophyton* sp., Dermal cryptococcosis)	Fungal C&S, History	Appropriate anti-fungals
	Abrasions, Irritations, Self-inflicted chewing	History, Husbandry review, C&S if secondary infection	Correct housing & diet, Antibiotics if infected, Vitamin C, If self-chewing from boredom, provide enrichment toys, attention
	Pododermatitis, underlying vitamin C deficiency, injury from wire caging (see Pododermatitis)	Review husbandry, housing, diet	Soft bedding, Vitamin C, Topical antibiotics, Clean, debride lesions, Bandage if necessary

RULE OUT CHART FOR GUINEA PIGS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Diarrhea	Impaction, Flora upset (esp post-antibiotic), Cecal stasis, *Clostridium difficile* overgrowth, Enterotoxemia, *E. coli*, *Salmonella*, Antibiotic toxicity	Physical exam, Radiographs & contrast, Auscultation abdomen, History, Diet evaluation, Fecal float & smear, C&S	Supportive care, Force-feed lactobacillus, antibiotic, Fluids, Metoclopramide (if stasis & no impaction)
	Coccidia (*Eimeria caviae*), Parasitic causes: *Cryptosporidium*, *Paraspidodera uncinata*	Fecal flotation & smear	Sanitation, Sulfa (coccidia), TBZ @ 100 mg/kg PO or Piperazine for *P. uncinata*, No Rx (*Cryptosporidia*)
Ectoparasitism	*Chirodiscoides caviae* "fur mite" (rarely clinic signs)	Physical exam, Skin scraping, Microscopic exam, "tape test" (use clear tape to pick up parasite, fix to slide)	Topical carbaryl powder (as for cats) weekly, Clean housing
	Sarcoptes mite *Trixacarus caviae*, Pruritus (sometimes severe), Alopecia, Self-trauma, Scaly, thickened skin, Anorexia, Weight loss, Death in severe cases, Nervousness	Physical, Multiple skin scrapings	Ivermectin (300 μg/kg SC, repeat in 10 days), Diazepam to calm severe pruritic behavior, nervousness, Clean out housing
	Pediculosis: *Gyropus ovalis*, *Gliricola porcelli* (usually asymptomatic, some pruritus)	Physical exam, Microscopic exam of hairs, lice	Topical feline flea powder 1-2X week, Clean housing
Enteropathy (diarrhea)	Cecal stasis/impaction, Clostridial overgrowth, Antibiotic toxicity, Salmonellosis, *E. coli* (colibacillosis), Coccidia (*Eimeria caviae*), *Cryptosporidium*, *Paraspidodera uncinata*	History, Physical exam, C&S, Radiographs/contrast, Fecal flotation/smears	Supportive care, Fluids, Analgesics/antibiotics as needed, Healthy flora slurry & lactobacillus to recolonize gut, Sulfas & sanitation (*E. coli*, coccidia), No Rx *(Cryptosporidium)*, TBZ & piperazine (*P. uncinata)*

RULE OUT CHART FOR GUINEA PIGS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Incoordination, convulsions, seizures	Pregnancy toxemia/ketosis, Traumatic injury, Agonal phenomenon, Lead poisoning	Physical exam, Radiograph, CBC, History, Blood lead	Diazepam IM, Symptomatic or no Rx if agonal, CaEDTA (for lead - rabbit dose OK), Supportive care (remove lead, if possible), Analgesics if appropriate for injury
Infertility	Nutritional deficiency, Environmental stress, Bedding adhered to genitalia, Immaturity or senescence, Estrogen in feed, Seasonal phenomenon	Physical exam, History, Husbandry review	Treat underlying pathology if present appropriately, Correct husbandry, diet, timing
Leukemia/lymphosarcoma	Lymphadenopathy (splenomegaly, hepatomegaly, leukocytosis, anemia, tumors, thrombocyto-penia), etiology Type C leukovirus	Physical exam, CBC, Radiographs, Ultrasonography, Biopsy & histopathology	No treatment at this time, Poor prognosis, Euthanasia
Litter desertion or cannibalism	Mastitis, Maternal inexperience, Environmental disturbance	Physical exam, History, C&S mammary secretions, Rectal temperature, CBC	Correct husbandry, Appropriate antibiotics if infected
Mammary gland tumors	Fibroadenomas, Adenocarcinomas	Physical exam, Biopsy, Histopathology, Thoracic radiographs for metastasis	Excisional surgery

RULE OUT CHART FOR GUINEA PIGS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Masses (cutaneous or subcutaneous, neoplastic)	Trichofolliculoma (basal cell epitheliomas), Fibrosarcomas, Sebaceous adenomas, Lipomas	Physical , Fine needle aspirate, Biopsy & histopath, Radiographs (metastasis if suspect malignant)	Excisional surgery
Mastitis	Bacterial	Physical exam, C&S	Wean babies, Antibiotics, Drain as necessary, Hot pack, Analgesics
Nasal discharge and/or dyspnea	Pneumonia (scorbutus may contribute): *Bordetella bronchi-septica, Streptococcus pneumoniae, Klebsiella pneumoniae, Streptococcus zooepidemicus, Pasteurella multocida, Pseudomonas aeruginosa, Staphylo-coccus aureus*, adenovirus	Physical exam, C&S, Radiographs, CBC/chemistries	Supportive care, Vitamin C, Appropriate antibiotics, Nebulization +/or O_2, Humidity
	Rhinitis, (see above etiological agents) + chlamydia	Physical exam, Thoracic radiographs, C&S, CBC/chemistries	As above for pneumonia
	Heat stress (serous nasal discharge) ± ptyalism	Physical exam, History, Rectal tem-perature	Fluids, Cool down, Correct husbandry
	Pregnancy toxemia/ketosis	Physical, History, CBC/chemistries, Radiographs, Ultrasonography	Supportive, Fluids, Delivery-induced parturition or C-section
Osteoarthritis	Scorbutus, Luxation, Fracture, Vitamin E/selenium deficiency	Physical exam, Radiographs, Diet history, Muscle biopsy, CBC	Vitamin C, Analgesics, Diet correction, Treat as per underlying etiology (as with other mammals), Vitamin E, Selenium, Soft bedding

RULE OUT CHART FOR GUINEA PIGS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Pododermatitis	Erythematous, swollen, painful, proliferative, callouses infected with *Staph, Strep*, Injury	Physical exam, History, Evaluate housing, C&S feet wounds, CBC	Solid flooring, Soft bedding changed frequently, Vitamin C, Wound dressings, Antibiotics
Prenatal mortality	Nutritional deficiency, Bacterial (*Bordetella, Salmonella, Streptococcus*), Pregnancy toxemia, Environmental stress	Physical exam, History, C&S fetuses, Vaginal smears, Gram's stains, Ultrasonography, Radiography, CBC/chemistries	Correct husbandry & diet, Treat infections with antibiotics, vitamin C
Ptyalism	Malocclusion, Scorbutus, Tooth root abscesses, Hereditary (see also Heat stress)	Physical exam including oral, Head radiograph, C&S if abscess	Vitamin C, Appropriate antibiotic, Trim teeth (excise if abscess), Do not breed if hereditary link
Reluctance to move, Paralysis, Paresis	Scorbutus, Luxation or fracture, Chronic disease, Vitamin E (+/- selenium) deficiency (white muscle disease), Osteoarthritis	Physical exam, Radiographs, Diet history, Vitamin E/selenium muscle biopsy, Work-up any chronic disease	Vitamin C, Analgesics, Treat chronic diseases appropriately, Vitamin E/ selenium, Diet correction, Soft bedding, Antibiotics if osteoarthritis is septic
Swellings (cutaneous or subcutaneous)	Abscess (*Streptococcus zooepidemicus*), Cervical lymphadenitis (submandibular, ventral, cervical neck area nodes - enlarged, purulent), Septicemic form (abscesses throughout), Abrasions, Mucocutaneous oral abrasions, Coarse food	Physical exam, C&S lymph node aspirate	Excise multiple or very large nodes, Flush abscesses, Vitamin C, Systemic antibiotics 7-10 days, Avoid coarse foods

RULE OUT CHART FOR GUINEA PIGS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Swellings (cutaneous or subcutaneous)	Arthritis, Scorbutus with secondary abscesses	Radiographs, Diet, History, Physical exam, C&S abscesses	Vitamin C, Analgesics if abscesses, Antibiotics (osteomyelitis)
	Staphylococcus aureus-infected callouses)	Physical exam, History, Evaluate housing, C&S, CBC	Vitamin C, Wound dressings, Appropriate antibiotics
	Yersinia pseudotuberculosis (rare), Cervical lymph nodes, systemic form (usually acutely fatal)	C&S aspirate	Do not treat, Zoonotic risk, Must advise to euthanize
Torticollis	Otitis interna (bacterial respiratory pathogens), Bacterial encephalitis	Physical exam, Radiograph, C&S exudate, CBC, CSF tap for encephalitis	Appropriate antibiotics, Vitamin C, Supportive care
Trauma	Fractures, Luxations, Wounds, “Dropped pig syndrome”	Physical exam, History, Radiographs, CBC/chemistries (approach as in other mammals)	Treat for shock (dex), Fluids, Supportive care, Vitamin C, Appropriate orthopedics, Antibiotics, Clean debride wounds, Betadine
Weight loss/wasting	Malocclusion, Nutritional deficiency, Anorexia, Metastatic calcification, Chronic disease, Ectoparasitism, *Yersinia pseudotuberculosis*	Physical exam, Radiographs, CBC/chemistries, Skin scraping & evaluation, C&S, Dental exam	Treat underlying etiology, Do not treat *Y. pseudotuberculosis*

FORMULARY FOR GUINEA PIGS

Drug	Dosage
Acepromazine	0.1-0.5 mg/kg IM
Acetylsalicylic acid	270 mg/kg once daily IP
Amikacin	10 mg/kg q12h, q8h, IM, SC
Amitraz (Mitaban®) make up as per package directions	Apply topically 3-6 treatments 14 days apart CAUTION: may dilute more
Ampicillin	DO NOT USE
Atropine	0.1-0.2 mg/kg IM, SC; organophosphate poisoning = 100 g/kg SC
Carbaryl 5% powder (Diryl®)	Dust lightly once weekly
Cephalexin	50 mg/kg IM divided q12h, use for 14 days against *Strep*
Chloramphenicol palmitate	50 mg/kg q12h PO
Chloramphenicol succinate	30-50 mg/kg q12h IM, SC
Chlorpromazine	25 mg/kg SC
Cimetidine	5-10 mg/kg q6-12h
Dexamethasone	0.1 to 0.6 mg/kg IM, SC; ketosis IM
Diazepam	2.5 mg/kg IP
Dichlorvos-impregnated resin strip (Vapona No Pest Strip®)	Follow package direction for room size; hang in room for 24 hours once weekly for six weeks
Diovol Plus®	0.5-1 ml PO as needed
Doxapram	10 - 15 mg/kg IM, SC; 5 mg/kg IV
Doxycycline	2.5 mg/kg q12h PO
Enrofloxacin	2.5 mg/kg q12h PO
Kaopectate liquid	0.2 ml PO q6-8h/adult symptomatically
Fenbendazole	20 mg/kg PO q24h 5 days
Furazolidone	5.5 mg/ml drinking water
Furosemide	5-10 mg/kg q12h
Gentamicin	5 mg/kg q24h IM, SC
Griseofulvin	15-25 mg/kg PO q24h 14 to 28 days (can dose up to 100 mg/kg)
Human chorionic gonadotropin	1000 USP units IM repeat 7 to 10 days
Innovar-Vet® 10% solution	0.2-0.4 ml/kg IM
Isoflurane	To effect
Ivermectin	300 μg/kg, repeat in 8 to 10 days SC, Poor oral absorption
Kaopectate liquid	0.2 ml PO q6-8h per adult, symptomatically
Ketamine	44 mg/kg IP
Ketamine + diazepam	20-30 mg/kg + 1-2 mg/kg IM
Ketamine + xylazine	44 mg/kg + 5 mg/kg IP

FORMULARY FOR GUINEA PIGS

Drug	Dosage
Lime sulfur (2.5% solution)	Apply once weekly for 4-6 weeks
Lindane (0.3% solution)	Dip once weekly for three weeks
Malathion (2% solution)	Dip every 10 d. for three weeks
Meperidine	1-2 mg/kg IM, SC
Metoclopramide (Reglan® 5 mg/ml)	0.5 mg/kg SC q8h, PRN
Morphine	10 mg/kg IM, SC q4h
Naloxone	0.01-0.1 mg/kg IP, IV
Neomycin	5 mg/kg PO q12h, up to 30 mg/kg once daily PO
Nitrofurazone	50 mg/kg PO q24h for 3 days
Oxytocin	1 IU/guinea pig IM, SC
Piperazine adipate	4-7 mg/ml in drinking water for 3 to 10 days
Piperazine citrate	10 mg/ml in drinking water for 7 days; off 7 days; on 7 days
Praziquantel	5-10 mg/kg IM, SC, PO Repeat in 10 d.
Prednisone	0.5 to 2 mg/kg PO
Penicillin	DO NOT USE
Sulfamethazine	1 to 5 mg/ml drinking water
Sulfaquinoxaline	1 mg/ml drinking water
Tetracycline	5 mg/kg IM q8h, 10-20 mg/kg q8h PO, or 50 mg/kg per day in 3 divided doses PO
Thiabendazole	100 mg/kg PO for 5 days
Thiopental	20-55 mg/kg IP
Tresaderm	1 drop per ear daily 3 to 5 days
Trimethoprim sulfadiazine	20 mg/kg once daily, SC= 0.5 ml/kg SC/day
Trimethoprim 20 mg sulfamethoxazole or sulfadiazine 100 mg	15 mg/kg q12h PO, 1/4 tablet/adult cavy q24h - crush into powder, can give divided dose q12h
Vitamin C	10-30 mg/kg IM, PO, 200-400 mg/L drinking water daily
Vitamin K1	1-10 mg/kg as needed
Xenodyne	Swab infected areas as needed

NOTES

Special Rodents

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Chinchillas

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of chinchillas and is not intended to replace comprehensive reference material.

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CHINCHILLAS Order - **Rodentia** Family - **Chinchillidae**

Chinchilla laniger, Chinchilla brevicaudata

Common Variations

- The original silver-gray color now shares popularity with color mutations such as black, white, charcoal, beige and tan.

Behavior

- Basically nocturnal, but can be active during the day.
- Chinchillas are fast, agile, and seem to have a sense of humor as they entertain their families with their antics.
- They tend to urinate in their enclosure or litter box, but they are hard to litter-train with respect to their small, hard, dry fecal pellets. A vacuum or broom is all that is needed after playtime, however.
- Activity includes climbing and darting, both horizontally and vertically.
- Chinchillas rarely bite.
- Most like to be cuddled and carried.

Diet

- Because chinhillas are native to cool, dry areas of the Andes Mountains, they have adapted well to sparse food. They do well on a diet of hay and pelleted food, with some treats of produce.
- Commercial chinchilla chows (eg, PMI or Mazuri®) fed ad lib or at intervals should contain: 18-20% crude protein, 2.3-3% crude fat, 15-18% crude fiber, 9-10% ash + about 2% added minerals.
- Most adult chinchillas eat approx. 0.75-1.0 oz pellets/day.
- Supplement chow with 30-60 mg/day vitamin E for breeding, pregnancy.
- Also supply unlimited quantity timothy hay and small amounts alfalfa (loose or cubed) or clover hay (no more than 25% daily intake).
- Hay must be free from mold, insects, other animal fecal contamination, and insecticides.
- Treat foods are given sparingly (small portion of any one item; total treat supplement per day not to exceed 1 tsp/adult chinchilla): dried fruits, nuts, sunflower seeds, various green vegetables, fresh carrot.
- Approximate diet consumption per adult chinchilla per day:

1 oz pellets; 1/2 to 1 cup hay; 1 tsp. veggie treat. Hay can be available continuously.

- Chinchillas have relatively delicate digestive tracts that can be upset easily. They have a large cecum that is thin-walled and coiled, which acts like a rumen.
- "Calf Manna" is used as a supplement for pregnant, lactating and growing animals.
- Water can be supplied in dishes (which they love to overturn) or water bottles hung on the side of the cage.

Housing

- Chinchillas should be housed in large rabbit-sized enclosures (at least 4' x 4' x 3'), as they are very active, acrobatic animals. They appreciate a chance to come out and run around as often as possible.
- Welded wire mesh is acceptable, with or without solid flooring.
- Provide space in enclosure for dust box (sheet metal: 6" x 6" x 9").
- Dust baths are offered 10-15 minutes daily or at least 4-5 x a week.
- Dust should be 2-4 inches deep: Blue Cloud Chinchilla Dust or 9 parts Silver Sand and 1 part Fuller's Earth. Other brands of commercial chinchilla dust are available.
- Wooden nest box can be provided for sleeping.
- Optimal temperatures: 50-60°F (higher than 80°F can be fatal).
- Humidity: 40% or less.

Preventive Care

- Pediatric checkup, fecal parasite test and annual examinations.
- Provide good nutritional and sanitary conditions.
- Protect from injuries, and observe for signs of fur fungus (chinchillas are hardy and suffer few illnesses).

Chinchillas - Quick Facts

Physiologic	
Life span:	9-17 yr
Adult female body weight:	450-800 g (female larger than male)
Adult male body weight:	400-500 g
Body temperature:	38-39°C (100.5-102.25°F)
Rectal temperature:	38.9-39.4°C (102-103°F)
Respiratory rate:	45-80/min

Physiologic (cont.)	
Heart rate:	200-350 bpm
Feces:	slender, brown pellets 2-3 mm diameter, 5-12 mm long
Dental arch/eruption time:	1/1 incisors, 0/0 canines, 1/1 premolars, 3/3 molars
All teeth are open-rooted and grow continuously throughout life. Incisors are yellow, can grow 5.5 cm-6.5 cm (2.5-3") per year.	
Reproductive	
Sexual maturity:	7-10 mo
Estrus cycle:	30-50 days, polyestrous; postpartum estrus fertile
Gestation:	105-115 days
Birthing:	>4 hr
Birth weight:	30-60 g
Litter:	2 avg (up to 5)
Newborns:	precocious, fully furred
Weaning:	3-6 wk

Breeding and Raising Young

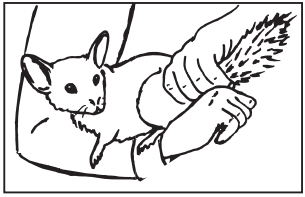
- Chinchillas are not prolific breeders. Breeding is not easy or predictable; small litter size keeps the numbers down and the price up when compared to other rodent pets.
- Can be kept as pairs, in colonies, or as polygamous units (1 male to 5-10 females).
- Seasonal breeding (November-May in northern hemisphere) with multiple heat periods/season.
- The male is usually removed/barred from the female shortly before or when the kits are born. However, if pair-housed, may be unnecessary to remove male. If female continues to accept his presence, he rarely bothers offspring.
- Newborn kits are fully furred with a complete set of teeth; eyes are open within a day.
- Newborn kits may be aggressive to each other, especially if there are more than 2.
- Small heating pads may be placed under the cage of young for a few days if room is kept quite cool.
- If insufficient mother's milk, kits can be fostered or hand-fed warm 50:50 evaporated milk/boiled water; add dextrose to make a 25% solution.
- Will nurse with an eyedropper: a few drops every 2-3 hours the first week, then as much as they want 3 times daily until weaned.

- Vitamin drops and baby cereal may be added to the formula beginning the second week.
- Can wean at 2-3 weeks of hand-feeding.
- Most females do not object to the young being handled for the few minutes it takes to hand feed.

Restraint of Chinchillas

- Restrain gently to avoid fur "slip" (fur may come off in your hand).

Pick up by the tail close to the body, then support body with other hand or place chinchilla on your arm.



Sexing of Chinchillas

- Females: The vagina is normally sealed by a membrane except during estrus (3-5 days) and parturition. The anus is immediately caudal to the urogenital openings. Cone-shaped urogenital papilla is ventral to vagina. Females have 1 nipple in each inguinal area and 1 in each lateral rib area.
- Males: The penis is separated from the anus by a considerable distance (anogentical distance twice that of female). Male has no scrotum. Testicles are in inguinal canal or subcutaneous.

Blood Collection

Peripheral veins:	Lateral saphenous or cephalic
Ear vein:	Prick (repetitive use can lead to thrombosis and trauma to the pinna)
Jugular vein:	Larger volume can be obtained

Injection Sites

Intravenous:	25 g or 28 g (insulin) lateral saphenous, cephalic
Intramuscular:	quadriceps, ferrous or semi-tendinosus, semimembranosus muscles: 23-25 g needle, max volume 0.3 ml single site/adult
Subcutaneous:	23 g under skin, neck or flank. Be careful of "fur slip."
Intraperitoneal:	Best done with animal restrained; one hind limb should be extended, introduce 23 ga needle or smaller along the line of the leg into the center of the posterior quadrant of the abdomen; up to 10 ml fluid can be given.

Hematologic Reference Ranges* - Chinchillas	
RBC:	6-8 x 10^6/mm^3
PCV:	27-54% (avg 38)
WBC:	6-15 x 10^3/mm^3
Hemoglobin:	8-15 gm/dl
Neutrophils:	40-55% (avg 43)
Lymphocytes:	45-60% (avg 54)
Eosinophils:	0.7% (0-9)
Monocytes:	1% (0-6)
Basophils:	0.6% (0-11)
Platelets:	45-740 x 10^3/ml (avg 274)

**Williams, 1976*

Biochemical Reference Values - Chinchillas**	
Bilirubin, total:	0.00-0.23
Calcium:	4.40-10.0 mg/dl
Chloride:	96.6-113.0 mEq/L
Cholesterol:	96.0-147.0 mg/dl
Glucose:	89.0-163.0 mg/dl
Lactic dehydrogenase:	406-636 U/dl
Phosphate, inorganic:	4.7-7.0 mg/dl
Potassium:	3.0-4.6 mEq/L

Biochemical Reference Values** - Chinchillas (cont.)	
Protein, total:	3.29-4.61 g/dl
Protein, electrophoresis	
Albumin:	55.8-73.5%
α1-Globulin:	4.0-10.4%
α2-Globulin:	5.30-9.70%
β-Globulin:	4.6-16.6%
τ-Globulin:	4.1-14.5%

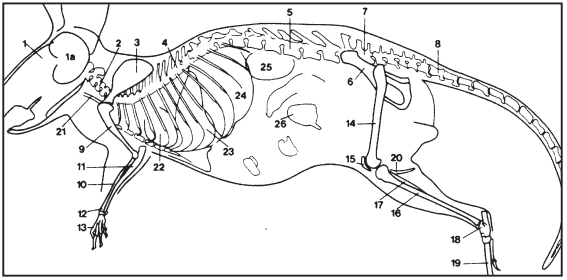
** *Mitraka & Rawnsley, 1981*

Normal Urinalysis *** - Chinchillas	
Color:	yellow to slightly amber
Turbidity:	usually cloudy
pH:	8.5
Protein:	negative to trace
Glucose:	negative
Nitrates:	negative
Ketones:	negative
Bilirubin:	negative
Urobilinogen:	0.1 -1.0 ng/dl
Blood:	negative
Specific gravity:	often exceeds 1.045

*** *Merry, 1990*

Radiography

In the normal radiographic appearance of an adult male chinchilla, the thorax is very small in comparison to the abdomen.



1. cranium
1a. bullae tympani
2. v. cervicales
3. scapula
4. v. thoracicae
5. v. lumbales
6. pelvis
7. v. sacrales
8. v. caudalis
9. humerus
10. radius
11. ulna
12. metacarpus
13. phalanges
14. femur
15. patella
16. tibia
17. fibula
18. tarsus
19. metatarsus
20. os penis
21. trachea
22. heart
23. liver
24. stomach
25. right kidney
26. intestines

Rübel, 1991

Emergencies in Chinchillas

- Upper respiratory tract infections *(Streptococcus* spp., *Pasteurella* spp., *Bordetella* spp., *Pseudomonas aeruginosa)*
- Choking (foreign body)
- Malocclusion, anorexia
- Reproductive disorders, dystocia, abortion, retained fetus, metritis, pyometra, puerperal septicemia, agalactia
- Enteropathy, diarrhea, gastroenteritis
- Gastric tympany, cecal stasis
- Abscesses
- Septicemia
- Rectal prolapse
- Dyspnea/pneumonia
- Heat stress
- Trauma
- Seizures/convulsions/torticollis

Common Clinical Conditions in Chinchillas

- Fur, skin disorders, hair rings (penis), dermatophytosis, fur-chewing, alopecia related to nutritional deficiencies
- Maloclussion/anorexia
- Eye irritation/conjunctivitis (foreign body, bacterial)
- Parasites
- Gastrointestinal disorders

Zoonotic Potential

- *Trichophyton mentagrophytes*
- *Microsporum canis, M. gypseum*
- Lymphocytic choriomeningitis (LCM)
- *Baylisascaris procyonis*
- Fleas
- *Listeria monocytogenes*
- Bacteria to contaminate bites or scratches

Surgical Considerations

Castration: It is necessary to suture the cremasteric sac with its outer layer of internal abdominal oblique muscle, as there is no internal inguinal ring to prevent loss of abdominal contents.

RULE OUT CHART FOR CHINCHILLAS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Alopecia (small, scaly patches on nose, ears, feet)	Dermatophytosis: *Trichophyton mentagrophytes*, *Microsporum canis*, *Microsporum gypseum*	Physical, Skin scraping, Fungal culture, Microscopic exam, Woods light (*M. canis*), KOH prep & cytology	Oral griseofulvin, Captan in dust baths, Lime sulfur topicals
Alopecia (poor coat, broken, clipped hair, +/- cutaneous ulcers)	Barbering, Fur chewing	Behavioral observation, Diet/husbandry evaluation, History, Physical exam	Correct diet, husbandry, Treat ulcers topically
Alopecia (poor hair coat)	Dietary imbalances/deficiencies (fatty acids, zinc), Hormonal stress, Hereditary factors	Evaluate diet, behavior, breeding status, husbandry, Check pedigree	Correct diet, husbandry
Alopecia (skin clean, smooth)	Fur slip	Physical, Rough handling	Time, Train owners how to handle
Anorexia	Malocclusion, Overgrown incisors, Teeth (molars) root abscesses, Genetics	Physical and oral exams, Radiographs	Trim teeth (frequent rechecks for trimming), Antibiotics (if root abscess), Extraction (be sure to do upper and lower if necessary)
	Enteritis (abrupt diet change), Stress, Diet low in fiber or high in fat or protein, Bacterial overgrowth, Enterotoxemia, Nematodes, Protozoal parasites, Inappropriate or prolonged use of antibiotics	History, Physical exam, Fecal floatation/smear, C&S, Radiographs + contrast, CBC/chemistries	Fluids, Supportive care, Diet corrections, Force-feed high fiber, Nutrical®, Appropriate antimicrobials, antiprotozoals, antiparasiticides
	Pneumonia, Rhinitis, Sinusitis	Physical, Rectal temp, Radiograph, Blood/trachea C&S, CBC/chems	Correct husbandry, O_2, Humidified, Antibiotics, Supportive care

RULE OUT CHART FOR CHINCHILLAS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Bite wounds, Abscesses	Housed in groups, Infection with *Streptococcus, Staphylococcus*	History, C&S of wound	Surgical debridement, Appropriate antibiotics, Correct housing
Constipation, lack of fecal pellets	Cecal stasis, Impactions, Enteropathy, Anorexia, Malocclusion, Refusal to eat (abrupt diet change), Dehydration	Physical/oral exam, History, Abdominal auscultation, Radiographs and contrast, CBC/chemistries	Fluids, Supportive care, Metoclopramide, Force feed high fiber, Analgesics PRN, Trim teeth if appropriate
Convulsions (circling)	*Listeria monocytogenes* (poor sanitation, contaminated feed)	CBC/chemistries, Husbandry, History, CSF tap and C&S	Diazepam to stop seizures, Oral chloramphenicol or injectable oxytetracycline
Convulsions (circling, ataxia)	Thiamine deficiency, Calcium deficiency	Husbandry, History, Diet evaluation, Physical exam, CBC/chemistries, (CSF tap, C&S)	Vitamin B, calcium added to diet
	Lead poisoning	History, CBC, Blood lead	Calcium EDTA, Supportive care
	LCM (lymphocytic choriomeningitis virus)	History (exposure to mice), Husbandry, Serology	No Rx, Zoonotic potential
Convulsions, Seizures (circling, ataxia, torticollis, paralysis)	*Baylisascaris procyonis*	Contact with raccoon feces	No Rx
	Otitis media/interna, *Streptococcus, Pasteurella*	Otoscopic exam, C&S of exudate, Physical exam	Appropriate antibiotics

RULE OUT CHART FOR CHINCHILLAS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Diarrhea, Enteritis (bacterial), Enterotoxemia	*Salmonella, Listeria monocytogenes*, *Yersinia pseudotuberculosis*, Enterotoxemias: *Clostridium perfringens*, *Clostridium* spp., *E. coli*, *Proteus, Pseudomonas*	History, Physical exam, Fecal flotation/smear, Gram's stain, C&S, Radiographs + contrast, CBC/chemistries	Fluids, Appropriate antimicrobials, Supportive care, Metronidazole for *Clostridium* spp., Lactobacillus
Diarrhea, Enteropathy (cecal stasis)	Colic, Fecal impaction, Intussusception, Mucoid enteropathy, Rectal prolapse, Abrupt diet change, Stress, Diet too low in fiber +/- high in fat, protein	History, Physical exam, Fecal floatation/smear, C&S, Radiographs + contrast, CBC/chemistries	Fluids, Diet corrections, Force-feed high fiber, Analgesics if abdominal pain, Surgery may be needed for intussusception, prolapse
Diarrhea	Intestinal parasites (nematodes rare), Giardia, Cryptosporidium	History, Physical exam, Fecal flotation/smear	Appropriate antihelminthics (nematodes), Metronidazole (giardia), No Rx for cryptosporidia, Supportive care, Fluids
	Inappropriate or prolonged use of antibiotics, Overgrowth of bacteria/bacterial imbalances, Enterotoxemia	History, Physical exam, Fecal C&S, Gram's stain, CBC/chems	Supportive care, Fluids, Fecal slurry from a healthy chinchilla, Lactobacillus, Possibly antimicrobials
Dyspnea (see also Anorexia, Emaciation)	Pneumonia due to poor husbandry, Overcrowding, High humidity, Poor ventilation, Stress	Physical exam, Radiographs, Tracheal wash or blood C&S, CBC/chems	Correct husbandry, Oxygen therapy, Antibiotics

RULE OUT CHART FOR CHINCHILLAS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Dyspnea (see also Anorexia, Emaciation)	Pneumonia due to bacterial infection (*Pasteurella, Bordetella, Streptococcus*)	Physical exam, CBC/chems, Tracheal wash or blood C&S, Radiographs	Supportive care, Oxygen therapy, Antibiotics
Emaciation, Weight loss	Pneumonia, Malocclusion, Enteropathy, Neoplasia, Arthritis, Renal/hepatic failure	Physical/oral exam, Radiographs +/- contrast, CBC/chemistries, Ultrasonography	Appropriate to etiology, Supportive care, Surgical excision of neoplasia if possible
Lymph nodes enlarged	Lymphadenitis: septicemia, bacterial, pneumonia, neoplasia	Physical exam, Radiographs, Aspiration/biopsy of node(s): histopathology, cytology, culture; CBC/chems	Appropriate antimicrobials, Neoplasia (excision but chemotherapies untried in chinchillas)
Paraphimosis ("fur ring")	Ring of fur caught around penis inside prepuce	Physical exam	Sedate, Lubricate, Remove ring
Pruritus	Ectoparasites (fleas, FAD)	Presence of flea dirt, Anemia, Visualization of fleas	History, Dog/cat in household. May become sensitized (Flea allergic dermatitis FAD), Control as in rabbits
Paresis/Paralysis	Septic arthritis (*Streptococcus*)	History, Physical exam, Joint tap (may also have respiratory disease, abscesses)	Appropriate antibiotics, Analgesics
Rectal prolapse	Enteritis: bacterial, protozoal, helminthic	Physical, Fecal float/smear, ELISA for giardia, Radiographs, CBC/chems	Reduce prolapse, Purse-string suture, Treat cause, Supportive care

RULE OUT CHART FOR CHINCHILLAS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Recumbency (panting, hyperthermia, cyanosis)	Heat stroke, May cause acute death	Rectal temperature, Ambient temperature above 80°F and high humidity, History	Cool water baths, IV, IO fluids, Supportive care
Sudden death	*C. perfringens*, Heat stroke, Trauma	Necropsy, Histopathology, History	If other chinchillas in household, advise owners of cause of death, Appropriate intervention to prevent further loss
Trauma	Fractures, Shock, "Dropped chinchilla syndrome"	History of trauma, Radiographs (as in other species), Hematocrit (hemorrhage from internal injuries)	May need dexamethasone, fluids, Fracture stabilization/repair (splint so they can't chew), Analgesics
Wet chin, face, chest, forepaws	Malocclusion	Physical and oral exams, Skull radiographs	Trim teeth (frequent rechecks for trimming), Antibiotics (if root abscess), Extractions (be sure to do upper and lower if necessary)

FORMULARY FOR CHINCHILLAS

Drug	Dosage
Acepromazine	0.5 mg/kg IM
Acetylsalicylic acid	100-200 mg/kg PO q6-8h PRN
Amikacin	2 mg/kg q8h, IM, SC, IV
Amitraz (Mitaban®)	Make up as per package directions
Ampicillin	DO NOT USE
Amoxycillin	DO NOT USE
Atropine	0.05 mg/kg IM or SC
Calcium (EDTA) disodium versenate	30 mg/kg SC q12h
Carbaryl 5% powder (Diryl®)	Dust lightly once weekly
Cephalosporin	25-100 mg/kg PO q6h, note: injectable suspension may be too thick to be delivered through a 23-25 gauge needle
Chloramphenicol palmitate	30-50 mg/kg q12h, PO; 10 mg/30 ml drinking water
Chloramphenicol succinate	50 mg/kg q12h, IM, SC
Chlortetracycline	50 mg/kg q12h, PO
Dexamethasone	0.5-2 mg/kg IV, IP, IM, SC
Diazepam	1-2 mg/kg IP, IM
Dichlorvos-impregnated resin strip (Vapona NoPest Strip®)	Follow package directions for room size; hang in room for 24 hours once weekly for six weeks
Diovol Plus®	1 ml PO as needed
Doxapram	2-5 mg/kg IV
Doxycycline	2.5 mg/kg q12h, PO
Enrofloxacin	5-10 mg/kg q12h, PO, SC, IM
Fenbendazole	20 mg/kg PO once daily for 5 days
Furosemide	5-10 mg/kg q12h
Gentamicin	2 mg/kg q8h, IM, SC, IV
Griseofulvin	25 mg/kg PO q24h 28-40 days
Halothane	To effect
Isoflurane	To effect
Ivermectin	(0.2 mg/kg) 200-400 μg/kg PO; repeat in 7-14 days
Ketamine	44 mg/kg IP
Ketamine + diazepam	20-40 mg/kg IM + 1.0-2.0 mg/kg
Ketamine + acepromazine	40 mg/kg IM + 0.5 mg/kg
Ketamine + xylazine	35 mg/kg + 5 mg/kg IP
Meperidine	1-2 mg/kg IM, SC
Metoclopramide HCl (Reglan®)	0.5 mg/kg q8h SC
Neomycin	15 mg/kg q12h, PO
Orthocide antifungal powder	Mix in dust bath @ 1 tsp/2 c dust
Oxytetracycline	50 mg/kg q12h, PO
Oxytocin	0.5-1 IU/chinchilla IM
Pentobarbital	30 mg/kg IV, 40 mg/kg IP

FORMULARY FOR CHINCHILLAS

Drug	Dosage
Piperazine adipate	0.5 g/kg/d for 2 days
Piperazine citrate	100 mg/kg/d. for 2 days
Praziquantel	5-10 mg/kg IM, SC, PO; Rpt in 10 d.
Prednisone	0.5-2 mg/kg PO
Procaine penicillin G	DO NOT USE
Sulfamethazine	1-5 mg/ml drinking water
Tetracycline (inj)	50 mg/kg q12h PO
Thiabendazole	50-100 mg/kg PO for 5 days
Thiopental	40 mg/kg IV
Tresaderm	1 drop each ear, massage in, swab out (q24h x 3-5d)
Trimethoprim sulfadiazine	30 mg/kg q12h SC, IM
Trimethoprim sulfamethoxanol (20 mg) or sulfadiazine (100 mg) tabs	30 mg/kg q12h PO
Vitamin K_1	1-10 mg/kg as needed
Xenodyne	Swab infected areas as needed
Vitamin B_1	1 mg/kg feed

NOTES

Prairie dogs

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of prairie dogs and is not intended to replace comprehensive reference material.

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PRAIRIE DOGS Order - **Rodentia** Family - **Sciuridae**

Cynomys ludovicianus - Black-tailed Prairie Dogs

Behavior

- Prairie dogs are diurnal.
- They do not hibernate, but may have dormant periods of several days during inclement weather.
- They "bark" when excited, see their owners, or as an alert status.
- They will attempt to climb, but are not agile, and fall easily.
- Social animals, they require attention and company.
- They like to dig, so provide enough bedding for them to do so.

Diet

- Rodent chow (1-2 blocks per week), alfalfa cubes, unlimited timothy/grass hay. Decrease chow and alfalfa after full grown to prevent obesity.
- Treats may include small amounts of various fresh greens.
- Prairie dogs will eat almost anything, but offering peanuts, raisins, french fries, cereals, bread, crackers, or dog biscuits will just lead to obesity and obnoxious begging behavior!
- Do not feed monkey chow, as hypervitaminosis D may occur.
- Water is offered in large sipper tubes. Clean frequently.

Housing

- Provide tunnels, darkened areas and plenty of deep bedding (hard wood shavings, recycled paper, pellets) for digging.
- Solid-sided housing helps keep bedding materials in.
- Large rodent/rabbit enclosure works, but place it in box to help control flinging of bedding during digging.
- Nest boxes act as "fake" burrows.
- Housing temperature: 69-72°F (20.5-22°C)
- Housing humidity: 30-70%

Preventive Care

- Nails need frequent trimming; consider use of cat "soft claws"-type nail covers.
- Wild-caught prairie dogs need to be checked for hanta virus, ectoparasites, respiratory parasites.

Sexing

- The scrotal sac is easily visualized in males.
- Anus and vaginal groove are in close proximity in females.
- Have open inguinal canal as in guinea pigs.
- Testicles may be retracted abdominally during surgery if anesthesia is light.
- Intraabdominal fat may make isolation of testicles difficult.

Blood Collection

Cephalic or lateral saphenous
Jugular venipuncture (under anesthesia)

Injection Sites

Intramuscular:	22-25 g needle in quadriceps, no more than 0.3 ml/adult
Subcutaneous:	22 g needle in dorsal aspect of neck & thorax, up to 12 ml
Intravenous:	cephalic, lateral saphenous

Prairie Dogs - Quick Facts

Physiologic	
Life span:	10 yr
Adult body weight:	0.5-2.2 kg (males usually heavier than females)
Body temperature:	35.3-39.0°C (95.7-102.3°F)
Heart rate:	83-318 bpm
Dentition:	Open-rooted incisors & cheek teeth
Miscellaneous:	Have trigonal anal sac ducts; Are hindgut fermeters
Reproductive	
Sexual maturity:	2-3 yr
Ovulation:	spontaneous, monestrous, cycle of 2-3 weeks during Jan-Mar
Gestation:	30-35 days
Litter size:	2-10 (mean 5)
Litters per year:	1
Normal lactation period:	6 weeks

Hematologic and Biochemical Reference Ranges* - Prairie Dogs	
WBC:	1.90-10.10 k/μl
RBC:	5.91-9.40 m/μl
HgB:	12.70-19.60 g/dl
HCT:	36.0-54.0%
MCV:	54.0-71.0 μ^3
MCH:	18.0-24.0 pgm
MCHC:	32.0-39.0%
Seg:	0.90-7.10 k/μl
Seg:	43.0-87.0%
Bands:	0.00-0.00 k/μl
Bands:	0.00-0.00%
Lymph:	0.30-3.50 k/μl
Lymph:	8.0-54.0%
Mono:	0.00-728.0/μl
Mono:	0.00-12.0%
Eos:	0.00-624.0/μl
Eos:	0.00-10.0%
Baso:	0.00-126.0/μl
Baso%:	0.00-2.00%
Total solids:	6.0-8.0 g/dl
Fibrinogen:	100-600 mg/dl
Total protein:	5.80-8.10 g/dl
Albumin:	2.4-3.9 g/dl
BUN:	21.0-44.0 mg/dl
Creatinine:	0.8-2.3 mg/dl
Glucose:	120-209 mg/dl
AST (SGOT):	16-53 IU
ALT (SGPT):	26-91 IU
Alk Phos:	25-64 IU
Calcium:	8.3-10.8 mg/dl
Phosphorus:	3.6-10.0 mg/dl
Sodium:	144-175 mEq/L
Potassium:	4.0-5.7 mEq/L
Total bilirubin:	0.1-0.3 mg/dl

* *Tell 1995*

Common Clinical Conditions in Prairie Dogs

- Obesity
- Malocclusion
- Dermatomycosis (*Trichophyton mentagrophytes, Microsporum gypseum*)
- Trauma - vertebral fractures from falling (prairie dogs should not be allowed to climb)
- Pododermatitis (bacterial — *Staphylococcus aureus*)
- Neoplasia (cortical adenoma kidney, adenocarcinoma stomach, primary hepatocellular carcinoma)
- Respiratory disease (bacterial, husbandry problems)
- Chronic hepatitis
- Wild-caught

Baylisascaris sp.	Ectoparasites (mites, fleas)
Pulmonary mites	*Y. pestis*
Intestinal trichomonads	Tapeworms and cysts
Rabies	Hanta virus (check CDC)

- Enteropathy/enteritis

Zoonotic Potential

- *Yersinia pseudotuberculosis*, *Y. pestis*, *Y. enterocolitica* (can be acute, subacute, chronic or latent; agent ingested, shed in feces).
- *Clostridium piliformes*
- Rabies (reported in free-ranging prairie dogs)
- *Trichophyton mentagrophytes, Microsporum gypseum*
- *Salmonella* sp.
- *Pasteurella multocida*
- Ectoparasites (mites, fleas, lice)
- Hanta virus (wild-caught)

Therapy

- Use only broad spectrum antibiotics (as with most rodents). Agents with a narrow spectrum can cause depopulation of the normal gut flora and allow overgrowth of gram-negative bacteria, which can rapidly lead to septicemia and endotoxemia.
- Because they are herbivores and hindgut/cecal fermenters, use dosages, antibiotic preferences as per chinchillas, guinea pigs.
- Ideally parenteral drugs are utilized over oral agents in order to maintain the normal gut bacterial flora.
- Extended antibiotic regimes should be accompanied with supplemental lactobacillus in the food.
- Do not use macrolides (lincomycin and erythromycin).

RULE OUT CHART FOR PRAIRIE DOGS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Alopecia (hyperpigmentation, hypelluratosis, pustules, no pruritus)	*Microsporum gypseum, Trichophyton mentarophytes* (source of infection may be bedding hay)	Skin scraping, Fungal culture, Wood's light, KOH prep & cytology, Physical exam, Husbandry evaluation	Bath in selenium disulfide shampoo, Topical tolnastate ointment q24h 2 wks and/or 4 treatments at 10 day intervals of griseofulvin 250 mg/kg PO on ground carrots. May relapse. Sanitation, get onto recycled product bedding or newspaper.
Anorexia (lethargy, nonspecific)	*Yersinia pestis* (enzootic in free-ranging prairie dog communities)	Physical exam (look for fleas, ticks, lice), C&S, Serology (reportable disease)	Broad-spectrum antibiotics, Sulfonamides, Nitrofurans as per sensitivity, Eliminate ectoparasites or use cat flea preventatives, Zoonotic potential if vector present
Anorexia	Enteropathy: Diet change or lack of fiber, Bacterial, Protozoal, Helmintic, Foreign body, Obstruction/impaction, Enterotoxemia, Cecal stasis, Neoplasia, Chronic hepatitis	Physical exam, History, Radiographs +/- contrast, CBC/chemistries, Fecal flotation/smear, Ultrasonography, Fecal C&S	Correct diet, Force-feed with high fiber, Supportive care, Appropriate antimicrobials, Antiprotozoals, Antihelminths, Metoclopramide if stasis, Exploratory laparotomy, Gastrotomy, Enterotomy if foreign body, Neoplasia, Histopathology and biopsy of liver
Anorexia (hypersalivation)	Malocclusion, Tooth root abscess	Physical exam, Oral exam, Radiographs	Trim teeth, Do not breed if hereditary, Appropriate antibiotics, If abscess drain

RULE OUT CHART FOR PRAIRIE DOGS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Dermatitis	Fleas, Ticks (on wild-caught)	Physical exam, Visualize parasite, flea feces	0.5% malathion dip or cat flea preventatives, Environmental control
	Trychophyton mentagrophytes, Microsporum gypseum	Fungal culture, KOH prep and cytology, Physical exam, Wood's light, Skin scraping, Husbandry evaluation	Bath in selenium disulfide shampoo, Topical tolnastate ointment q24h 2 wks and/or 4 treatments at 10 day intervals of griseofulvin 250 mg/kg PO on ground carrots. May relapse. Sanitation, get onto newspaper, recycled product-based bedding.
Diarrhea	Tyzzer's disease (*Clostridium piliformes*)	Physical exam, Fecal C&S	Tetracyclines, Supportive care
	Enteropathy: Diet change or lack of fiber, Bacterial, Protozoal, Helmintic, Foreign body, Obstruction/impaction, Enterotoxemia, Cecal stasis, Neoplasia, Chronic hepatitis, Enterotoxemia	Physical exam, History, Radiograph +/- contrast, CBC/chemistries, Fecal flotation/smear, Ultrasonography, Fecal C&S	Correct diet, Force feed with high fiber, Supportive care, Appropriate antimicrobials, Antiprotozoals, Anthelmintics, Metoclopramide if stasis, Exploratory laparotomy, Gastrotomy if foreign body, Neoplasia, Histopathology and biopsy liver
	Salmonellosis (septicemia)	Physical exam, C&S, CBC/chems	Fluids, Broad-spectrum antibiotics as per sensitivity, Supportive care, Zoonotic potential

RULE OUT CHART FOR PRAIRIE DOGS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Dyspnea	Pneumonia: *Pasteurella multocida*, Rhinitis/sinusitis	Physical exam, Radiographs, C&S exudates or tracheal wash, CBC/chemistries	Appropriate antibiotics, Supportive care, O_2
	Pulmonary mites (*Pneumocoptes penrosei*) (wild-caught prairie dogs)	Physical exam, Tracheal wash, Radiographs	May try ivermectin, Supportive care, Lung damage may be permanent
Neurologic signs (ataxia, torticollis, stumbling)	*Baylisascaris* sp.,	History (exposure to raccoons), Physical exam, Radiographs, CSF tap, CBC/chems, Rule out other causes	No treatment, Zoonotic potential
Neurologic signs (ataxia, torticollis, seizures)	Lead poisoning, Intoxications, Severe systemic disease (encephalitis), CNS neoplasia, Trauma	Physical exam, History, Radiographs, CBC/chemistries, CSF tap	CaEDTA and eliminate lead if lead poisoning, Diazepam to stop acute seizures, Supportive care per diagnosis including: Analgesics, Fluids, Antimicrobials
Pododermatitis	Bacterial (usually *S. aureus*) infections in feet, Ulceration	Introduced by rough cage floors, Poor sanitation, History, Husbandry evaluation	Correct husbandry, sanitation, Treat lesions as in rabbit
Subcutaneous swellings	*Pasteurella* abscesses, Neoplasia	Physical exam, Aspirate, Cytology, Culture	If abscess: lance, drain, antibiotics; Neoplasia: surgical excision

FORMULARY FOR PRAIRIE DOGS

Drug	Route	Dosage	Comments
Amikacin	SC, IM, IV	2.5 mg/kg q12h	Make sure well-hydrated, supplement with oral lactobacillus
Chloramphenicol	SC, IM, IV	50 mg/kg q12h	Supplement with oral lactobacillus
Isoflurane	Mask	To effect	Recommended anesthesia; Use heating pad during any sedation or anesthesia
Ketamine + acepromazine	IM	40-50 mg/kg + 0.4-0.5 mg/kg IM	Doses vary, as prairie dogs tend to be obese; Use heating pad during any sedation or anesthesia
Ketamine + xylazine	IM	100-150 mg/kg + 10-20 mg/kg	Use heating pad during any sedation or anesthesia
Ketamine + diazepam	IM	20-30 mg/kg + 0.4-0.6 mg/kg	Use heating pad during any sedation or anesthesia
Malathion dip 0.5%	Topical	As directed or use of cat flea preventatives (powder or spray cloth & rub all over).	If pet is parasitized
Trimethoprim sulfa	PO, SC, IM	30 mg/kg q12h	Supplement with oral lactobacillus

NOTES

Degus

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of degus and is not intended to replace comprehensive reference material.

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DEGUS (*Octodon degus*)

Characteristics

- Native to West Andean slopes of northern and central Chile (elevation to 1200 m).
- Upper pelage is grey/brown; underparts are creamy yellow.
- Tip of tail is black brush (if the fur is slipped or chewed off, section is not replaced).
- Fifth digit claw reduced; comb-like bristles over the claws of the hind feet.
- Anterior upper cheek teeth are kidney-shaped. Incisor enamel is pale orange.

Regulations

- Pet stores selling degus are now required to be licensed with the U.S.D.A. as Class B dealers.

Behavior

- Degus are diurnal and active throughout the year.
- They vocalize with soft chortles and whistles.
- Free-ranging degus construct burrows and have territorial markers.
- They live in colonies, where the females rear young in a common burrow.
- Degus are coprophagic.

Diet

- Natural diet consists of grass, leaves, bark, herbs, seeds, fruits, fresh cattle/horse droppings during dry season, crops.
- Captive diet may include grass hay, rodent chow (1-5 cubes/week), occasional bits fruit, seeds, herbs and small amounts fresh variety of greens.
- Degus store food for winter.

Housing

- In captivity degus may be housed as a pair or in groups.
- Degus may utilize chinchilla dust baths.
- A female with a litter should be housed separately from other females.

Sexing

- Testicles are prominent in males.
- External genitalia similar to rat.

Degus - Quick Facts

Physiologic	
Head, body length:	125-195 mm
Tail length:	105-165 mm
Body weight:	200-300 g
Life span:	10 yr (record)
Reproductive	
Sexual maturity:	3-6 mo
Females:	8 mammae
Breeding season:	year-round
Gestation period:	87-93 days (avg 90)
Birth weight:	14 g
Litters per year:	2
Number in litter:	1-10 (avg 6.8 in captivity)
Eyes open:	2-3 days
Normal lactation:	4-6 wk
Weaning:	4 wk

Preventive Care

- Proper husbandry, diet, sanitation, and handling.
- Periodic examination and screening of representative colony animals for subclinical disease.
- Prevent access to insects, wild rodents or other animals.
- Encourage monthly home health checks (weight, teeth, nails, feel for lumps, bumps) and daily observation of food and water consumption, activity and behavior, feces and urine amounts/characteristics.

First Visit/Annual Examination

- Physical examination: temperature, weight, eyes, ears, teeth, heart and lung sounds, feet, fur and general condition
- Also review nutrition, husbandry, behavior
- Fecal flotation/smear (nematodes, coccidia, protozoa)
- If abnormalities or illness: CBC/chemistries, fecal culture (*Salmonella* screen), radiographs

Restraint

- Gently pick up degu by placing hand firmly over the back and rib cage.
- Restrain head with thumb and forefinger just behind the jaws.
- Alternatively, grip base of tail, then as above.

- The degu may also be picked up by the loose skin (scruff) of the neck method, as with other rodents.
- Pet degus may climb onto hands; be sure they don't jump or fall.
- Do not hold by the tail; if the degu spins, the tail skin will slough off. The degu then bites off the naked vertebrae and tendons (minimal bleeding, heals without treatment). Lost tail sections are not replaced.
- Chemical restraint: 40-50 mg/kg ketamine + 0.8-1.0 mg/kg diazepam IM; isoflurane - chamber delivery to effect as with other rodents

Blood Collection

- Use saphenous, jugular veins.

Selected Hematologic Values for Degus	
PCV (%):	41 (26-54)
Hb (gm/dl):	12 (7.2-15.0)
RBC x 10^6:	8.8 (4.2-13.9)
MCV (μm^3):	49 (33-91)
MCH (pg):	14 (10-25)
MCHC (%):	29 (21-39)
WBC (x 10^3):	8.3 (3.2-20)
Neutrophils (%):	39 (11-91)
Bands (%):	0.3 (0-5)
Lymphocytes (%):	59 (9-86)
Monocytes (%):	1 (0-8)
Eosinophils (%):	1.2 (0-8)
Basophils (%):	0.5 (0-10)

Injection Sites

Intravenous:	jugular, saphenous, or cephalic. Jugular cut-down may be nec. to place indwelling catheter (anesthetize). If long-term therapy needed, install a vascular access port.
Intramuscular:	gluteal or biceps muscle
Subcutaneous:	upper back over shoulders

Common Clinical Conditions

- Tail slough/loss
- Gastroenteritis/anorexia/diarrhea (bacterial causes, improper roughage)
- Malocclusion
- Trauma/fractures
- Pneumonia

Zoonotic Potential

- Unknown, but it is assumed degus could transmit *Salmonella* sp., dermatophytosis.

Formulary for Degus

Because drug doses for degus are based primarily on empirical information adapted from chinchillas, it is the responsibility of the clinician to critically evaluate the contents, to stay informed of pharmacokinetic information and to observe recommendations provided in the manufacturer's insert.

Be sure degu is well hydrated during antibiotic therapy, particularly if using chloramphenicol, aminoglycosides or sulfa drugs. Follow recommendations listed for chinchillas, guinea pigs and hamsters with regard to antibiotic treatments and antibiotic-associated clostridial enterotoxemia especially when the antimicrobial has primarily a gram-positive spectrum.

FORMULARY FOR DEGUS

Drug	Dosage
Acepromazine	0.5-1.0 mg/kg IM preanesthetic dose
Acetylsalicylic acid	50-100 mg/kg PO q4h PRN
Amikacin	2-5 mg/kg SC, IM q8-12h
Ampicillin	DO NOT USE
Amoxycillin	DO NOT USE
Atropine	0.05 mg/kg IM or SC
Butorphanol	0.2 mg/kg IM, analgesic
Carbaryl 5% powder (Diryl®)	Dust lightly q7d x 3wk
Cephaloridine	10-25 mg/kg IM, SC q8-24h
Chloramphenicol palmitate	50 mg/kg q12h, PO
Chloramphenicol succinate	30-50 mg/kg q12h, IM, SC
Calcium (EDTA) disodium versenate	30 mg/kg SC q12h
Chlortetracycline	50 mg/kg q12h, PO
Dexamethasone	0.5-2 mg/kg IV, IP, IM, SC
Diazepam	1-2 mg/kg IP, IM
Diovol Plus	1 cc PO as needed
Doxapram	2-5 mg/kg IV
Doxycycline	2.5 mg/kg q12h, PO
Enrofloxacin	2.5-5.0 mg/kg q12h, PO, SC, IM, limit injections
Fenbendazole	20 mg/kg PO q24h x 5d
Flunixin meglumine	2.5 mg/kg q12-24h SC, NSAID
Furosemide	5-10 mg/kg q12h
Gentamicin	2-5 mg/kg q8-24h IM, SC; 2 mg/kg IV
Glycopyrrolate	0.01-0.02 mg/kg SC, to control excess oral/respiratory mucus secretions (helpful during dental work)

FORMULARY FOR DEGUS

Drug	Dosage
Griseofulvin	25 mg/kg PO q24h 28-40 days; do not use in pregnant animals; caution
Isoflurane	To effect
Ivermectin	(0.2 mg/kg) 200-400 μg/kg PO, SC repeat in 7-14 days
Ketamine	40 mg/kg IM, light sedation
Ketamine + diazepam	20-40 mg/kg IM + 1-2 mg/kg
Ketamine + acepromazine	40 mg/kg IM + 0.5 mg/kg IM
Ketamine + xylazine	35-40 mg/kg IM + 4-8 mg/kg IM
Meperidine	10-20 mg/kg IM, SC q3-4h PRN
Metoclopramide HCl (Reglan®)	0.5 mg/kg q8h SC, IM
Metronidazole	10-40 mg/kg PO q24h, may need to flavor - very bitter
Neomycin	15 mg/kg q24h, PO
Orthocide (Captan®) antifungal powder	Mix in dust bath @ 1 tsp/2 c dust
Oxytocin	0.5 -1.0 IU/animal SC, IM, IV
Pentobarbital	30 mg/kg IV; 35-40 mg/kg IP
Piperazine citrate	2-5 mg/ml drinking water x 7d, off 7d, repeat
Praziquantel	5-10 mg/kg IM, SC, PO; repeat in 10d
Prednisone	0.5-2.0 mg/kg PO
Procaine penicillin G	DO NOT USE
Sulfadimethoxine	10-15 mg/kg PO q12h
Sulfamerazine	1 mg/ml drinking water
Sulfamethazine	1-5 mg/ml drinking water
T-61	0.3 ml/kg IV
Tetracycline	50 mg/kg q12h PO
Thiabendazole	50-100 mg/kg PO q24h for 5 days
Thiopental	40 mg/kg IV
Tresaderm®	1 drop each ear, massage in, swab out q24h 3-5d
Trimethoprim/sulfadiazine	30 mg/kg q12h SC, IM
Trimethoprim sulfamethoxanol 20 mg or sulfadiazine 100 mg tabs	30 mg/kg q12h PO
Vitamin K_1	1-10 mg/kg as needed
Vitamin B_1	1 mg/kg feed
Xenodyne	Swab infected areas as needed
Yohimbine	0.5-1.0 mg/kg IV, reverses xylazine

Duprasi

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of duprasi and is not intended to replace comprehensive reference material.

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DUPRASI (Fat-tailed Gerbil) (*Pachyuromys duprasi*)

Characteristics

- Duprasi are native to the Northern Sahara Desert from western Morocco to Egypt, where they live in hamada (patches of vegetation).
- Pelage is yellow-gray to buffy brown above; underparts and feet are white. There is a white spot behind each ear. Tail is bi-colored.
- Duprasi have well-developed claws on their front feet.
- Their upper incisors are slightly grooved and open-rooted.
- Auditory bullae, mastoids extend beyond foramen magnum.

Behavior

- Duprasi are diurnal and docile.
- Being a social animal, they may live in a colony.
- They groom frequently.
- Duprasi will use an exercise wheel and a sand/dust bath like chinchillas.

Diet

- Duprasi are insectivorous. Hedgehog/insectivore diet is appropriate. May be offered ad lib unless adult is becoming obese — then can limit portions offered twice daily.
- Mealworms, crickets, moths, other insects (pet store grade preferably fed an enriched diet), should be offered.
- Duprasi may have small amounts of spinach, romaine lettuce, other leafy greens.
- They will become obese on seed- and grain-based diets commonly sold for gerbils and hamsters.
- They will eat rodent blocks, sunflower seeds, peanuts, but these are not appropriate, as they are grain/herbivore-based diets.

Sexing

- Testicles are prominent in males. External genitalia similar to gerbils and mice

Duprasi - Quick Facts

Physiologic	
Head, body length:	105-135 mm
Tail length:	45-60 mm; club-shaped
Body weight:	60-90+ g
Life span:	3 yr (avg); 4 yr 5 mo (max)

Reproductive	
Sexual maturity:	2.5-3.5 mo
Gestation period:	19-22 days
Litter size:	3-6
Weaning age:	3-4 wk

Breeding and Raising Young

- Breeding behavior: both sexes will stand on hind legs, wrestle, and make squeaking noises.
- If the female is not receptive, she will kick bedding at the male.
- When female is ready to give birth, she will make a nest. Do not handle at this time, she may get nippy and stressed.
- It is best to remove the male at this time.

First Visit/Annual Examination

- Physical examination: temperature, weight, eyes, ears, teeth, heart and lung sounds, feet, fur and general condition
- Also review nutrition, husbandry, behavior
- Fecal flotation/smear (nematodes, coccidia, protozoa)
- If abnormalities or illness: CBC/chemistries, fecal culture (*Salmonella* screen), radiographs

Blood Collection

- Obtaining a blood sample is difficult.
- Laboratory methods:
  Cardiac puncture on anesthetized animals
  Orbital sinus bleed
  Toe nail clip

Injection Sites	Volume limit
Intramuscular (quadriceps):	0.1 ml
Subcutaneous (scruff):	1.0 ml
Intraperitoneal:	4.0-5.0 ml
Intravenous: jugular - may need cut down under anesthesia	maximum determined as you calculate fluid replacement volumes, based on body weight

Common Clinical Conditions

- Obesity/malnutrition
- Trauma
- Diarrhea/enteropathy

FORMULARY FOR DUPRASI

Drug	Dosage
Acepromazine	0.5-1.0 mg/kg IM, preanesthetic
Acetylsalicylic acid	150 mg/kg PO q4-6h
Amikacin	5 mg/kg q8-12h IM, SC, keep well hydrated
Atropine	0.05-0.10 mg/kg SC
Buprenorphine	0.1-0.2 mg/kg SC q8h, analgesic
Butorphanol	1-5 mg/kg SC q2-4h, analgesic
Cephaloridine	25 mg/kg SC, IM q24h
Chloramphenicol palmitate	50-200 mg/kg PO q8h
Chloramphenicol succinate	30-50 mg/kg IM SC q12h
Chlortetracycline	20 mg/kg IM, SC q12h
Cimetidine	5-10 mg/kg q6-12h
Ciprofloxacin	10 mg/kg q12h PO
Dexamethasone	0.5-2.0 mg/kg IM, PO
Diazepam	3-5 mg/kg IM
Dimetridazole	0.5 mg/ml drinking water
Diovol Plus®	0.1-0.3 ml PO as needed
Doxapram	5-10 mg/kg IV, IP
Doxycycline	2.5 mg/kg PO q12h
Enrofloxacin	5 mg/kg PO, IM q12h
Fenbendazole	20 mg/kg PO q24h 5 days
Flunixin meglumine	2.5 mg/kg SC q12-24h, NSAID
Furosemide	5-10 mg/kg q12h IM, PO
Gentamicin	5 mg/kg q24h IM, SC
Griseofulvin	25 mg/kg PO q24h 14-60 days, do not use in pregnant animals, caution
Isoflurane	to effect
Ivermectin	200 μg/kg PO, SC q7d x 3wk
Ketamine	25-40 mg/kg IM
Meperidine	20 mg/kg SC, IM q3-4h
Metoclopramide (Reglan® 5 mg/ml)	0.5 mg/kg SC q8h PRN; be sure no obstruction
Metronidazole	25 mg/kg PO q12h x 5d (flagellates); 20-60 mg/kg PO q8-12h (anaerobes)
Naloxone	0.01-0.1 mg/kg IP, IV, SC
Neomycin	100 mg/kg q24h PO
Oxytetracycline	16 mg/kg q24h SC; 10 mg/kg q8h PO
Oxytocin	0.2-3.0 IU/kg IM, SC
Piperazine adipate	200-600 mg/kg PO q24h for 7 days, off 7 days, on 7 days
Piperazine citrate	4-5 mg/ml in drinking water for 7 days, off 7 days, on 7 days
Praziquantel	6-10 mg/kg SC, PO; repeat in 2 wks
Prednisone	0.5-2.0 mg/kg PO, SC, IM
Sulfamethazine	1 mg/ml drinking water

FORMULARY FOR DUPRASI

Drug	Dosage
Sulfamethoxine	10-15 mg/kg PO q12h
Sulfaquinoxaline	1 mg/ml drinking water
Tetracycline (oral)	10-20 mg/kg q8h PO
Thiabendazole	100 mg/kg PO q24h x 5d
Trimethoprim/sulfadiazine (24% inj 40 mg/ml trimeth + 200 mg/ml sulph)	30 mg/kg q12-24h SC, IM; SC may cause tissue necrosis
Trimethoprim/sulfamethoxazole (sulfameth 20 mg tablet; sulfadiazine 100 mg tablet)	15-30 mg/kg q12h PO
Tylosin	5 mg/kg q12h IM, SC, PO
Vitamin B complex	0.02-0.20 ml/kg SC, IM
Vitamin K_1	1-10 mg/kg IM as needed
Xenodyne	swab infected areas as needed

NOTES

Hedgehogs

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of hedgehogs and is not intended to replace comprehensive reference material.

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HEDGEHOGS Order - **Insectivora** Family - **Erinaceidae**

Common Species and Variations

- *Atelerix albiventris* (*A. pruneri, A. faradjius*): African hedgehog, West African hedgehog, African pygmy hedgehog, White-bellied hedgehog, Four-toed hedgehog;
  White and gray/brown ticked quills = "salt & pepper"; All white quills = "snowflake"; Males have large percentage of elongated white spines; Spines absent in narrow tract running cranial to caudal on head.
- *Erinaceus europaeus:* European hedgehog
- Pruners (Cape) hedgehog: has darker or masked face
- Egyptian (Long-eared) hedgehog: long ears, tends to be more aggressive and bites
- The legality of keeping hedgehogs as pets may vary. Check with local authorities regarding permits or licenses needed.

Behavior:

- Hedgehogs are nocturnal and therefore are active in the evenings.
- If they are allowed to run in the house, they tend to hide in corners or under furniture.
- Many hedgehogs dig in carpets or in houseplants and dirt if accessible and will forage for spiders and insects in the home.
- Most hedgehogs prefer quiet, dim environments and may react with fright at loud noises or bright sunlight.
- Although hedgehogs are being bred commercially, their behavior is that of a non-domesticated animal.
- While young hedgies do not mind being held, many adults resist handling and struggle to be let loose, especially males.
- Many individuals do not interact with humans, no matter how much handling they received when they were young.
- Very few hedgehogs bite, but they might "puff up," and adult males may hiss.
- They are solitary animals except for mating, and usually must be housed separately even if raised with a same-sex littermate.
- Their courtship may be noisy and prolonged.
- When encountering something new in the environment a hedgehog may "taste" it, then begin hypersalivating and create a foam, which is then spit onto itself. The process is called "anting" or "anointing." Most owners will promptly rinse or bathe the hedgehog to get rid of the material.
- The average life span of free-ranging European hedgehogs is low

because mortality of offspring during hibernation may reach 80%.
- Death due to traffic or pesticides is more common than old age or disease.

Diets

- Free-ranging hedgehogs are insectivore/omnivores.
- Captive diets should be fairly high in protein and low in fat, and in the past have been based on zoo formulations (see below for Diet Choices).
- Cat or dog foods alone do not seem to be adequate as the sole diet component.
- Commercial complete hedgehog diets are being developed and should be used if available.
- To introduce individuals to new diets, mix new foods gradually into the old. It helps to have all chunks or pieces of new and old diet the same size and relative consistency.
- To minimize obesity, ad lib feeding of adult hedgehogs should be discouraged.
- Feed a portion size in the evening that is almost completely consumed by morning. Only a small amount of food needs be present during the day for a snack.
- Younger hedgies may eat an adult quantity, depending on their stage of life and activity.
- Water should be available at all times.
- Many hedgehogs will use a water bottle or drink from a low dish or crock.

Diet Choice No. 1 (for one adult hedgehog of 550 g BW):

1 heaping tsp. bird of prey diet or insectivore diet
1.5 heaping tsp high quality cat/kitten chow*
1 heaping tsp fruit/vegetable mixture**
6-10 small mealworms or 1-2 crickets
(more if pregnant or lactating)

Diet Choice No. 2 (for one adult hedgehog per day):

3 heaping tsp high quality cat/kitten chow
1 heaping tsp fruit/vegetable mix
6 small mealworms or 1-2 crickets

Diet Choice No. 3 (for one adult per day)

3-4 teaspoons commercial insectivore diet
5-6 mealworms or 1-2 crickets

Diet Choice No. 4 (for several adults)

See Woodland Park Zoo Diet in Appendix IV

* For younger or pregnant/lactating hedgies, use kitten or ferret formulations; adult hedgies may use "Lite" adult cat foods.

** Fruit/vegetable mix: chop together 1/2 tsp diced leafy dark greens (spinach, kale, leaf lettuce), 1/4 tsp diced carrot, 1/4 tsp diced apple, 1/4 tsp diced banana, 1/4 tsp diced grape or raisin, 1/4 tsp vitamin/mineral powder (Vionate or crushed Feline Favor tab).

Diet Choice No. 5 (for one adult per day)

- 2-3 Tbls dry reduced-calorie cat food or mix of dry & canned food
- 1-2 Tbls mixed frozen vegetables
- 3-5 insects 3-4 times per week
- Can offer limited quantities (1-2 tsp 3-4 times per week max): baby food, hard-boiled egg, wax worms, pinky mice, horsemeat.

Housing

- Hedgehogs need a smooth-walled enclosure that is high enough to prevent escape.
- Aquariums 20 gallon or larger are acceptable.
- Enclosures made of wire should be avoided in order to prevent their feet from being caught.
- Preferred bedding is newspaper or recycled pelleted/absorbable material. Avoid ceder shavings.
- Bedding should be changed frequently and kept dry.
- Optimum environmental temperature: 75-85°F. Supplemental heating may be necessary under one section of the enclosure.
- Accessories may include a cut-out box, plastic log or flower pot for a hiding place.
- Although hedgehogs do not "play" with toys as do other small mammals, they will use an exercise wheel that is hung from the top of the enclosure or mounted.
- Hedgehog wheels are available commercially or can be constructed out of wood pieces such as popsicle sticks.
- Rodent wheels made of wire should not be used, as hedgehogs may get their feet caught.
- Toy should be cleaned frequently.
- A pan or shallow tub (warm water, warm ambient temperature) may be provided for swimming.
- For bathing, use Humilac (Allergroom) shampoo; Mycodex shampoo (safe for kittens, ferrets) is a soothing post-mite therapy.

Preventive Care

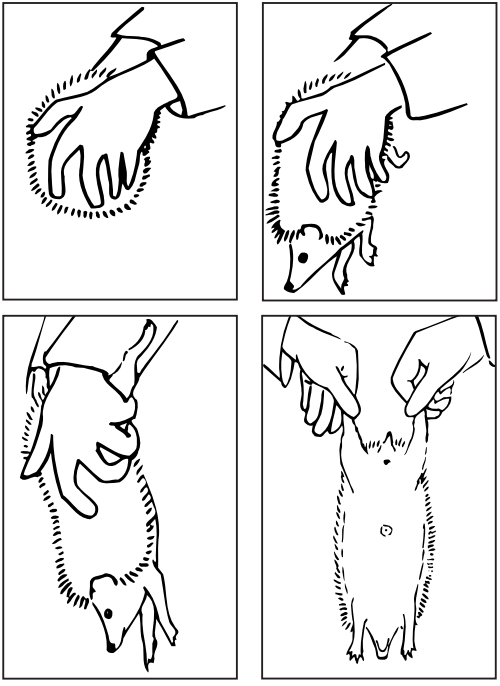
- Prevent obesity. Have owners weigh hedgies at least monthly.
- Dental prophylaxis = routine brushing, scaling.
- Nails need periodic trimming.
- Annual physical examination.
- Prevent chilling; provide heated environment with dry bedding.

Hedgehogs - Quick Facts

Physiologic	
Life span:	3-5 yr (6-10 yrs recorded in captivity)
Adult male body weight	
African:	500-600 g
European:	800-1200 g
Adult female body weight:	
African:	250-400 g
European:	400-800 g
Rectal temperature:	
African:	36.1-37.2°C (97-99°F)
European:	35.1°C (95.2°F)
GI tract:	Simple stomach, no cecum
Hibernation:	African do not hibernate; European do hibernate
Dentition:	36: 3.1.3.3
Formula:	2.1.2.3
Reproductive	
Sexual maturity:	>2 mo
Breeding:	year-round
Gestation length:	34-37 days
Litter size:	1-7 pups (avg. 3)
Cannibalism:	common if female stressed, disturbed. Remove male prior to parturition.
Birth weight:	8-13 g (depending on litter/dam size = avg 10 g)
Spines develop:	within 24 hours
Eyes open:	13-16 days after birth
Weaning:	4-6 weeks of age
Orphan milk replacement:	Puppy or kitten milk replacement

Restraint

- Examination is best done in subdued light; provide towel on table and eliminate loud noises. May need lightweight leather gloves.
- Use clear acrylic "ferret tunnel" (sold as a ferret toy); visual exam; can slide pediatric stethoscope under hedgie. May be able to get legs out as you slide hedgie out (takes practice).
- Some hedgies uncurl with back stroking of rump spines.
- Gentle but firm rolling of mantle outward (with time and quiet) with hedgie on its back, can present feet for nail tip; oral exam can also be done.
- Some hedgies need to be anesthetized with isoflurane.
- Note: some hedgies will vocalize with squeals!



Unrolling a hedgehog.

From Beynon PG, Cooper JE (eds): *BSAVA Manual of Exotic Pets*. Cheltenham, BSAVA, 1991, and used with permission.

Sexing

- Males have mid-ventral penis. Testicles are abdominal.
- Neutering requires abdominal approach. A fair amount of fat may surround the vas deferens and testicles.
- Perform ovariohysterectomy as in other small mammals. There may be a fair amount of peri-ovarian and uterine fat.

First Visit/Annual Examination

- Review of diet, husbandry, habitat, behavior, methods for handling
- Physical examination: include weight, visual inspection, auscultation, oral exam, body temperature, palpation, digit exam
- Fecal flotation and direct smear
- Optional (depending on history):
  Salmonella culture & screen
  (Under isoflurane anesthesia): toe nail trim, skin scraping, ear examination, fungal exam, culture, full dental examination, scaling, CBC, chemistry panel, radiographs
- Microchip transponder implantation recommended for permanent identification.

Blood Collection Sites

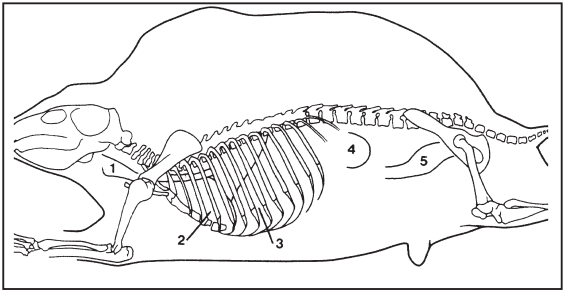
- Lateral saphenous vein (crosses below the stifle)
- Cephalic vein (dorsum of the forearm)
- Jugular vein
- Cranial vena cava
- If all else fails - toenail clip (1-2 hematocrit tubes and a smear)

Injection Sites

Subcutaneous:	back, flank. Be aware of fat layers - fluids may be slowly absorbed;large volumes (up to 100 ml/kg) possible
Intramuscular:	thigh
Intravenous:	lateral saphenous, jugular via catheter

Dental Care for Hedgehogs

- Use poultry flavor or malt flavor CET brand pet toothpaste.
- If you can unroll the hedgehog, put toothpaste on a Q-tip and actually "paint" the teeth. Most hedgehogs like the flavors and will lick it and assist (chomp on the Q-tip).
- Or, put some on a favorite crunchy snack to let the hydrolyzing toothpaste dissolve off tartar and plaque from teeth.
- Have teeth scaled, polished, fluoridated at next veterinary visit (under sedation); then offer 1-2 small "tartar control" dog food snack pieces a day.
- Tartar control snack foods work because fo the sodium hexametaphosphate coating of the food that helps prevent tartar, plaque and calculus buildup.



Radiography

In the normal lateral radiographic appearance of a European hedgehog, various organs such as the trachea (1), heart (2), liver (3), kidney (4), a few gas or feces-filled intestinal loops and the rectum (5) may be visible. In a ventrodorsal projection, differentiation between individual organs is more difficult due to superimposition of the muscle packets of the orbicular muscles, the cutis and the spines.

Radiographic appearance of the skull is typical of an insectivore: it is broad and powerful with pronounced cheek bones. The secondary dentition is complete within a year. In older animals, the teeth are worn down at a comparatively early age.

Common Clinical Conditions in Hedgehogs

- Obesity
- Dental: gingivitis, periodontitis
- Neoplasia: squamous cell carcinomas (particularly of dentition and jaws)
- Intestinal parasites
- Salmonella
- Trauma
- Dermatitis (chorioptic mange mites, fungal, bacterial)
- Fatty liver
- High tumor rate in animals over 3 yr of age
- Pneumonia

Hematologic and Biochemistry Reference Ranges*	
Hematocrit:	36.0-38.5%
Hemoglobin:	12.0-13.2 g/dl
RBC:	7.03-7.64 x 10^6/ml
MCH:	16.8-18.2 pg
MCHC:	33.3-35.2 g/dl
MCV:	49.1-53.2
Reticulocytes:	8-14%
Platelets:	230-430 x 10^3/ml
WBC:	6.3-9.6 x 10^3/ml
Neutrophils:	1.6-2.8 x 10^3/ml
Eosinophils:	0.36-2.4 x 10^3/ml
Basophils:	0.096-0.45 x 10^3/ml
Monocytes:	0-0.084 x 10^3/ml
Lymphocytes:	3.72-6.14 x 10^3/ml
Serum protein:	5.1-7.2 G/100 ml
BUN:	13.3-15.0 mmol/l
Sodium:	132-138 mmol/l
Potassium:	3.6-5.1 mmol/l
Calcium:	2.0-2.3 mmol/l
Phosphorus:	2.0-3.8 mmol/l

* *European hedgehog*

RULE OUT CHART FOR HEDGEHOGS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Anorexia	Dental disease, Gastrointestinal disease or parasites, Fatty liver, Neoplasia, Pneumonia, Chilling, Behavioral (mating distraction, diet change, husbandry change)	Physical exam (under sedation), Radiographs, CBC/chemistries, Fecal flotation/smear, C&S feces /exudates if present, Ultrasonography if masses found	Appropriate per etiology
Diarrhea	Gastrointestinal disease or parasites, Fatty liver, Dietary change	Physical exam, Fecal flotation, smear, C&S, CBC/chemistries	Supportive, Fluids, Antibiotics, anti-parasitics/etiology, GI protectants, Stabilize diet, If fatty liver: decrease fat in diet, B complex vitamins
Flaky/scaly skin, Broken quills	Sarcoptic mange mites, Ixodid ticks, Fleas, Flea allergic dermatitis, Fungal, bacterial dermatitis	Skin scraping and microscopic exam, Fungal/bacterial culture	Appropriate therapeutics per etiology, Bathing, Complete sanitation, For fleas: environmental control
Hypersalivation	"Anting" behavior: response to novel taste or substance, Defensive behavior, Dental disease, Oral neoplasia, Nausea (GI disease)	Physical examination, History, Oral exam (may need radiographs), Biopsy oral lesions, Fecal flotation, smear, C&S if GI disease	Appropriate per etiology, Dental care as in carnivores, Gastro-intestinal protectants, therapies as indicated
Lacerations, Wounds	Fighting when housed with other hedgehogs, Injuries, Environmental	Physical exam, Husbandry review	Systemic, topical antimicrobials, Repair as in other species
Lumps, Masses, Swellings	Neoplasia (squamous cell carcinoma, fibromas, fibrosarcomas, papillomas), Abscess, Cyst, Abdominal: rule out pregnancy	Physical exam, CBC/chemistries, Radiographs, Biopsy, Cytology, Histopathology	Surgical excision, Chemotherapies untried, Abscess: drain, anti-microbials, Cyst: drain and/or excise, antimicrobials, Pregnancy: discuss delivery, care of infants

RULE OUT CHART FOR HEDGEHOGS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Reluctance to move, Lameness	Debilitating systemic disease, Geriatric changes (spondylosis, arthritis), Chilling, Obesity, Neoplasia, Overgrown toenails, Pododermatitis, Fractures, Luxations, Nutritional deficiencies	Physical exam, Husbandry review, CBC/chemistries, Radiographs	Appropriate per etiology, Repair of fractures as in other mammals, Analgesics if necessary, Trim nails, Correct husbandry, bedding if necessary, Antimicrobials if pododermatitis,
Respiratory signs (snuffles, sneezing, congestion)	Defensive behavior vocalizations, Bacterial, fungal, viral pneumonia, Rhinitis, Sinusitis (*Bordetella*, *Pasteurella*, Cytomegalovirus, etc), Foreign body inhalation	Physical exam, Radiographs, Tracheal/nasal wash: C&S, Cytology; CBC/chemistries	Appropriate per etiology, Nebulization or oxygen therapy if severe congestion, If dyspneic, may be housed in a pediatric incubator to provide warmth
Sudden death (owner may not have noticed symptoms)	Fatty liver, Cardiomyopathy, Shock (severe trauma, fright), Pneumonia	History, Postmortem exam, Necropsy, Histopathology	None, Talk with owner (particularly if evidence of chronic disease)
Weight gain	Overeating (fat content/quantity), Pregnancy, Neoplasia, Lack of exercise	Physical exam, History, CBC/chemistries, Radiographs, If mass: biopsy, cytology, histopathology	Appropriate per etiology
Weight loss	Neoplasia, Anorexia, Pain, Chronic debilitating systemic disease, Behavioral (competition), Diet change and reluctant to eat novel food or poor diet, Environmental	Physical exam, Diet and husbandry history, CBC/chemistries, Radiographs, Rule out systemic diseases	Appropriate per etiology

FORMULARY FOR HEDGEHOGS

Drug	Route	Dosage	Comments
Amitraz (Mitaban®)	Topically	0.3% weekly for 2-3 wk	Mites, May dilute, Use with caution
Amoxicillin	PO, IM	15 mg/kg q12h	Broad spectrum
Ampicillin	IM	10 mg/kg q12h	Gram + rods, enterobacteria
Butorphanol	SC	0.05 mg/kg q8h PRN	Analgesic
Calcium gluconate 10%	IM	0.5 ml/kg	Fractures
Chloramphenicol	IM	30 mg/kg q12h	Bacteriostatic, Acute salmonellosis
	PO	50 mg/kg q12h	Acute salmonellosis
Dexamethasone	IM	0.1-1.5 mg/kg	Allergies, inflammation
	-	up to 5 mg/kg	Shock
Diazepam (combo with ketamine)	IM	0.5-2 mg/kg	Alone = anti-seizure, mild sedation; With ketamine = anesthesia
Enrofloxacin	PO, IM	2.5 to 5.0 mg/kg q12h	Broad spectrum: respiratory/GI/systemic infections
Erythromycin	PO, IM	10 mg/kg q12h	Penicillin-resistant gram + cocci, *Mycoplasma, Pasteurella, Bordetella,* Well accepted
Fenbendazole (Panacur®)	PO	10-30 mg/kg, repeat q2wk	Intestinal parasites
	-	10-30 mg/kg for 5 days	Crenosoma, Capillaria
Griseofulvin (microsize)	PO	50 mg/kg/day q8-12h	Skin, deep mycoses; Daily long-term Rx

FORMULARY FOR HEDGEHOGS

Drug	Route	Dosage	Comments
Isoflurane	Mask	To effect - as with other small animals	Anesthesia method of choice
Ivermectin (Ivomec® 1%)	PO, SC	0.2 mg/kg repeat q2wk	Nematodes, mites (may need to do third Rx q2wk)
Ketamine (alone or in comb with diazepam or xylazine)	IM	5-20 mg/kg	Sedation, narcoses, anesthesia; Do not use in neck area where there is brown fat
Ketoconazole (Nizoral®)	PO	10 mg/kg q24h	Mycoses; Daily long-term Rx; Best absorbed in acid environment
Mebendazole (Telmin®)	PO	15 mg/kg repeat 2 weeks*	Nematodes
	PO	<500 g BW = 25 mg q12h; >500 g BW = 50 mg q12h for 5 days, repeat after 2-3 weeks**	*Capillaria, Crenosoma, Brachylaemus, Hymenolepis, Physaloptera*
Metronidazole	PO	25 mg/kg q12h	Flagellates
Oxytetracycline	PO	50 mg/kg daily	*Bordetella*, broad spectrum, Administer in food 5-7 d.
Penicillin G	IM	40,000 IU/kg q24h	Gram + cocci
Praziquantel (Droncit)	PO, SC	7 mg/kg once, repeat q2wk	Cestodes
Prednisone	SC	2.5 mg/kg q12h PRN	Allergies
	-	10 mg/kg	Shock
Sulfadimethoxine	IM, SC, PO	2-20 mg/day	Coccidiosis, gram-neg bacteria; May have slight nephrotoxicity; Treat for 2-5 days, off 5, repeat.

FORMULARY FOR HEDGEHOGS

Drug	Route	Dosage	Comments
Tiletamine HCL/zolazepam (Telazol)	IM	1.0-5.0 mg/kg	Sedation, narcoses, anesthesia
Trimethoprim/sulfa (25 mg trimeth + 5 mg sulfa)	PO	30 mg/kg (combined drugs) q12h	Respiratory infections, gram-neg bacteria
Tylosin	PO	10 mg/kg q12h	Mycoplasma, clostridiosis; do not give IM (causes muscle necrosis)
Vitamin A	IM	400 IU/kg q24h 10 days	Skin disorders, excessive spine loss; rule out infections
Vitamin B complex	IM	1 ml/kg	CNS signs, paralysis of unknown origin, anorexia
Vitamin C	PO, SC	50-200 mg/kg	Vitamin C deficiency, infections, gingival disease; support of recovery from all infections: use 1000 mg ascorbic acid/ 1 L drinking water - change daily.
Xylazine (combo with ketamine)	IM	0.5-1 mg/kg	Anesthesia (with ket)

** Hoefer, ** Isenbügel & Baumgartner, Gregory/Stocker*

Marsupials

The Marsupials section includes individual chapters for Sugar Gliders, Brushtail Possums, Ringtail Possums, Short-tailed Opossums, Tammar Wallabies and Bennett's Wallabies. The topics listed below in this introductory chapter apply generally to all animals in this section

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MARSUPIALS

Characteristics of Marsupials

- Marsupial coats are generally woolly.
- Forelimbs are often foreshortened with hindlimbs elongated.
- In several families, the second and third toes of the hind feet have grown out into grooming claws.
- The first toe is always clawless (except in the shrew opossum and marsupial mole).
- Olfactory, tactile senses and hearing are well-developed; vision is poorly developed.
- The skull of marsupials has palatal windows.
- Cortisol is the most abundant corticosteroid in marsupials.
- The adrenals of females are twice the size of male adrenals (on the basis of mg per kg body weight).
- During lactation this discrepancy increases because of an enlargement in the "X" zone of the cortex, and an increase in a testosterone-like steroid has been detected.
- Kidneys: desert-adapted animals have enlarged medullas and an increased ability to concentrate urine.
- The cloaca is a common terminal opening for rectum, urinary ducts, genital ducts.
- Marsupial phalangers (Brushtail, Ringtail Possums) are similar to rabbits in metabolism of glucose.

Dentition

- In wallabies, there is horizontal replacement of the cheek teeth, whereby premolars drop out and are replaced from behind.
- The lower jaw of all marsupials does not have the same number of incisors as the maxilla.
- Teeth number between 40-50: 7-8 cheek teeth: 3 premolars, 4-5 molars. The processus angularis of the lower jaw is turned inward. (See page 10 for Dental Formulae.)

Marsupial Bones

- The marsupial bones, ossa marsupialia, serve as attachment surfaces for several abdominal muscles.
- They rest on the pelvic bones and the pubic bones, and articulate with them.
- They generally are boot-shaped, flattened, varied in size.
- They are considered comparable to abdominal ribs in reptiles, and are sometimes referred to as "Eupubic bones."
- They do not support the pouch, as they are present in males

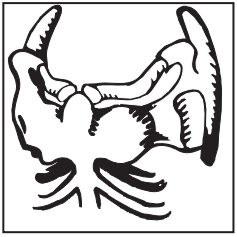
(no pouch) and are atrophied or absent in marsupial moles and *Petaurus* sp (the gliders).

Pouch

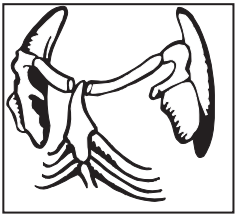
- The marsupium or pouch is found in a variety of degrees of enclosure.
- It develops from annular skin creasing around each teat (primal pouch found in more primitive marsupials), to a common marsupial wall surrounding all teats, to finally a closed marsupium with either a front or rear opening.

Shoulder Girdle

- The shoulder girdle of newborns consists of a continuous cartilaginous arc of primal elements found otherwise only in reptiles and egg-laying mammals.
- This provides adequate support for forelimbs and shoulders so that the newborn can make its way to the pouch.
- The most important role is played by the metacoracoid. Immediately following birth, the arc breaks up, and the shoulder girdle assumes the usual loss association with the sternum as in adult marsupials and placental mammals.
- The metacoracoid becomes the coracoid process of the shoulder blade.

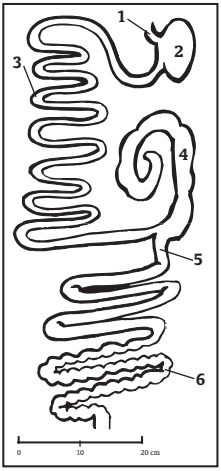


Neonate shoulder girdle.

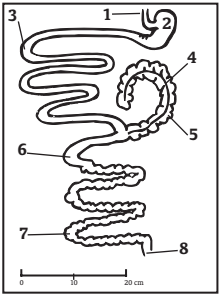


Adult shoulder girdle.

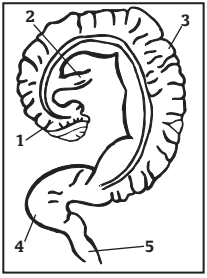
Comparative Anatomy of the Digestive Tract



Brushtail Possum gastrointestinal tract.
1. esophagus
2. stomach
3. small intestine
4. cecum
5. proximal colon
6. distal colon

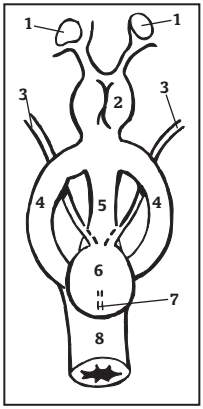


Ringtail Possum gastrointestinal tract.
1. esophagus
2. stomach
3. small intestine
4. taenia
5. cecum
6. proximal colon
7. distal colon
8. rectum



Macropod (wallaby) gastrointestinal tract.
1. sacciform forestomach (blind sac)
2. esophagus
3. tubiform forestomach
4. hindstomach
5. pylorus

Anatomy of the Marsupial Reproductive Tract



1. ovaries
2. uterus
3. ureters
4. lateral vagina
5. central vaginal canal
6. bladder
7. urethra empties into urogenital sinus
8. urogenital sinus

Temperature Regulation

- Marsupials are born without the ability to regulate body temperature.
- During the first half of pouch life, body temperature of the young will closely approximate ambient temperature if they are removed from the pouch.
- At about halfway through pouch life, young marsupials begin to regulate body temperature, and this timing coincides with the start of thyroid function.
- Species from tropical humid climates (*Phalanger* spp) are not capable of compensating for evaporative water loss and cannot survive dry heat.
- Macropods (wallabies, kangaroos) exposed to high temperatures seek the shade of trees or cool caves.
- Most marsupials avoid activity in the heat of the day.
- Cloacal temperatures are lower than actual body temperature, therefore ear (tympanic) temperature reading is probably more accurate.

Blood Collection

- Ventral coccygeal or femoral vein in small marsupials
- Cephalic or lateral caudal vein in wallabies (see page 40).

Physiologic Parameters of Marsupials and Eutherians*

Size: 20-40 g	Eutherians	Marsupials
Metabolic rate (kcal/kg/day)	186-156	130-109
Respiration (breaths/min)	136-116	95-81
Heart rate (beats/min)	640-538	449-378
Blood volume (ml total)	1.1-2.2	-
Size: 100-250 g	**Eutherians**	**Marsupials**
Metabolic rate (kcal/kg/day)	124-99	87-69
Respiration (breaths/min)	93-75	65-52
Heart rate (beats/min)	428-340	300-239
Blood volume (ml total)	5.6-14	-
Size: 400 g-1 kg	**Eutherians**	**Marsupials**
Metabolic rate (kcal/kg/day)	88-70	61-49
Respiration (breaths/min)	66-54	47-37
Heart rate (beats/min)	603-241	212-169
Blood volume (ml total)	22-55	-
Size: 1.5-2 kg	**Eutherians**	**Marsupials**
Metabolic rate (kcal/kg/day)	63-59	44-41
Respiration (breaths/min)	49-45	34-31
Heart rate (beats/min)	217-202	151-142
Blood volume (ml total)	82-109	-
Size: 3-5 kg	**Eutherians**	**Marsupials**
Metabolic rate (kcal/kg/day)	53-46	37-32
Respiration (breaths/min)	41-36	29-25
Heart rate (beats/min)	183-161	128-113
Blood volume (ml total)	163-270	-

** The first value in each range corresponds to the lowest and the second value to the highest weight in the corresponding small mammal weight group.*

Marsupial Housing Guidelines

- Marsupial enclosures in which various species have been bred fit the general formula:
  - Length: = body length x 8 (min. 1.2 m)
  - Width: = body length x 4 (min. 0.6 m)
  - Height: terrestrial = body length x 4
  - Height: small arboreal = 1.2 m if body length less than 20 cm
  - Height: large arboreal = 1.8 m
- Gliding possums/gliders do best in a cage twice the formula length (ie, 16 x body length) and at least 1.8 m high.

COMMON INFECTIOUS DISEASES OF MARSUPIALS

Disease (Pathogen)	Species/susceptibility	Clinical Signs	Diagnosis	Treatment
Adiaspiromycosis (*Chrysosporium parvum*)	Feral Brushtail Possums (New Zealand)	White foci or abscesses in lungs, No signs noted	Radiographs	
Candidiasis (*Candida albicans*)	Artificially reared pouch-young	White curd-like encrustations in mouth, lips, gums, tongue margins, Depression, Painful mouth, Won't suckle	Cytology, Culture	Clean out, Oral nystatin, Supportive care
Herpesvirus (Herpesvirus)	Wallabies (Parma, Tammar), Potoroos, Quokka	Transient infertility, Eye/nasal discharge, Lingual ulcers, Depression, Anorexia, Death	Titers, Histopath, Virus isolation, Virology	No therapy proven, Unknown if acyclovir would be effective
Infectious dermatitis (*Staphylococcus* sp, *Actinomyces dermatonomus*)	Brushtail possum	Generalized, Dehydration, Toxemia, Death	Culture	Antibiotics: penicillin may be effective, topical antibiotics to severe areas
Infectious dermatitis (*Pseudomonas pyocyanea*)	Brushtail possum	Localized form, skin in/around pouch	Culture	Antibiotics, Topical cleansing, bathing
Infectious dermatitis (*Trichophyton mentagryphytes*)	Brushtail possum	Sparse, scaly lesions, Generalized skin	Culture	Zoonotic - public health significance, Topical and systemic antifungals as in other species
Infectious dermatitis (*Staphylococcus* mixed with *Aeromonas* sp. + *Pasteurella* sp.)	Ringtail possum	Suppurative rhinitis, panophthalmitis, *Pasteurella* found post cat bite wounds.	Culture	Clean, debride wounds, Topical and systemic antibiotics

COMMON INFECTIOUS DISEASES OF MARSUPIALS

Disease (Pathogen)	Species/susceptibility	Clinical Signs	Diagnosis	Treatment
Lumpy jaw - necrobacillosis, actinomycosis (*Bacteroides* sp, *Fusobacterium necrophorum*, *Actinomyces* sp, *Corynebacterium* sp)	Macropods in captivity, Rare in wild	Swelling of mandible or maxilla, Poor prehension, Cellulitis/osteitis, Suppurative exudate, Depression, Abscesses	Clinical signs, Odor, Culture, Radiographs	Debridement, Parenteral antibiotics, Local disinfection, Husbandry, Measures to reduce crowding, Clean up environment, Proper diet *Note: Aggressive therapy, long term, may be necessary. Antibiotic-impregnated beads packed into the bone lesion may help. Radiograph head to assess. Teeth may be extracted for drainage. Overall therapy is similar to rabbits with similar disease/abscessing*
Mycobacteriosis (*Mycobacterium tuberculosis, M. bovis*)	Probably all, esp. Brushtail possums: common in New Zealand	Weight loss, Cachexia, Tubercles in viscera & bones	Clinical signs, Culture, Intradermal tuberculin test, Radiology, Acid-fast stains	Not responsive to treatment, Isolate, Cull, Public health significance?
Mycobacteriosis (*M. avium, M. intracellularis, M. scrofulaceum*)	Wallabies	Abscesses of skin, bone, Visceral organs involvement, Purulent arthritis	Acid-fast stains, Culture, Nonresponsive to Rx	Not responsive to treatment, Isolate, Cull, Public health significance?
Pasteurellosis (*Pasteurella multocida, P. haemolytica*)	All, especially possums	Cellulitis, hemorrhagic septicemia, bronchopneumonia	Clinical signs, Culture	Parenteral antibiotics, Reduce stress, Fighting
Pneumonia (*P. multocida, Klebsiella* spp.)	Macropods	Dyspnea, Coughing, Frothy nasal or oral discharge, Death	Clinical signs, Auscultation, Radiology	Parenteral antibiotics, Supportive therapy

COMMON INFECTIOUS DISEASES OF MARSUPIALS

Disease (Pathogen)	Species/susceptibility	Clinical Signs	Diagnosis	Treatment
Pneumonia (Various organisms)	All species, More common in winter or in wild-caught animals, Chilled	Dyspnea, Coughing, Frothy nasal or oral discharge, Death	Clinical signs, Auscultation, Radiology	Parenteral antibiotics, Supportive therapy
Pouch infections (*Pseudomonas aeruginosa*)	Macropods	Dirty pouch, Odor, Brown, thick discharge	Clinical signs, Culture	Disinfection, cleaning, Topical and systemic antibiotics
Salmonellosis (*Salmonella* spp.)	All, especially young	Diarrhea, Depression, Enteritis, Septicemia	Fecal C&S	Oral/parenteral antibiotics, Electrolytes, Fluids, Hygiene, Isolation

Dental Formulae of Marsupials*

	Caenolestidae (Short-tailed Opossum)	*Phalangeridae* (Brushtail, Ringtail Possum)	*Macropodidae* (wallaby)
I	4/3 or 4	2 or 3/1 or 3	3/1
C	1/1	1/0	0-1/0
PM	3/3	1 or 3/1 or 3	2/2
M	4/4 x 2	3 or 4/3 or 4 x 2	4/4 x 2
TOTAL	46 or 48	22-42	32-34

*maxilla/mandible

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Therapy

- For carnivorous/insectivorous marsupials (sugar gliders, some exotic possums): base dosages on the low end of range cited for cats/ferrets/hedgehogs.
- For herbivorous marsupials (wallabies, Brushtail Possums): base dosages on the low end of range cited for rabbits.
- Lactobacillus supplementation may be of benefit during/after antibiotic therapy.
- Note: shock in the small species of marsupials may occur rapidly and can be caused by pain resulting from an IM or IP injection. An injection as small as 0.1 ml has been known to lead to shock in marsupials as large as 350 g.
- Surgical procedures: use IV fluid/electrolyte therapy at rate of 3-4 ml/kg body weight over the time period.

Antibiotic Choice

- The author has found that the antibiotic use guidelines accepted for rabbits, chinchillas, and guinea pigs have relevance for the herbivorous marsupials.
- Antibiotic choice: try to avoid beta-lactam antibiotics, macrolide antibiotics or any others that target gram-positive or anaerobic bacteria.
- Recommended antibiotics include those that predominantly target gram-negative bacteria: TMP-sulfa combination, sulfa drugs, aminoglycosides, or the quinolones. Some of the third generation cephalosporins and the advanced generation penicillins (piperacillin) with predominantly gram-negative spectrum of activity may be acceptable.

Allometric Scaling

- Marsupial metabolism in general is considered to be lower in respect to BMR and calories, and possibly in relation to drug metabolism, although pharmacokinetics and efficacy studies for veterinary therapeutics have not been published.
- Allometric scaling for drug dosing in placental mammals may not be appropriate for marsupials.
- The placental mammal value of k in the allometric scaling equations is 70, whereas the marsupial value of k is 49, which is indicative in the mathematics of the slower metabolism.

Formulary for Herbivorous Marsupials (Wallabies, Brushtail possums)

- Because little has been published about the pharmacokinetics of marsupials, it is the responsibility of the clinician to critically evaluate drug doses.
- Macropods (wallabies, kangaroos) depend on foregut bacterial fermentation. Flora is reported to be similar to that in ruminants and that of cecal (hindgut) fermenters in species of placental mammals.
- Brushtail possums depend on hindgut flora for digestion, similar to rabbits, chinchillas, and guinea pigs.

FORMULARY FOR HERBIVOROUS MARSUPIALS (wallabies, Brushtail Possums)

Drug	Route	Dosage	Comments
Amikacin	IM, SC	2-5 mg/kg q8-12h	Need fluid support
Atropine	IM, SC	0.2 mg/kg	-
	SC	10 mg/kg q20 min	For organophosphate toxicity
Buprenorphine	SC, IM, slow IV	0.01 mg/kg q8-12h	Analgesic
Butorphanol		0.1-0.5 mg/kg q4-6h as needed	Analgesic
Calcium versenate (CaEDTA)	SC	27.5 mg/kg q6h x 2-5 days	Make at 10 mg/ml in 5% dex or saline; lead toxicity
Carbaryl 5% powder	Topical	Dust lightly once weekly; comb through fur; wipe down excess with damp paper towel	Treat environment
Cephaloridine	IM	11 mg/kg q12-24h	-
Chloramphenicol palmitate	PO	25 mg/kg q8-12h	May prolong barbiturate anesthesia; review safe handling procedures for owners
Chloramphenicol succinate	IM, SC, IV	30 mg/kg q12-24h	Consider human health
Chlortetracycline	PO	30-50 mg/kg q24h	-
Ciprofloxacin	PO	5 mg/kg q12h	Unknown if quinolones cause arthropathies in young marsupials
Cisapride (Propulsid® 10 mg tab)	PO	0.25 mg/kg q8-24h	Dose may be increased over time; give no closer than 30 minutes to feeding

FORMULARY FOR HERBIVOROUS MARSUPIALS (wallabies, Brushtail Possums)

Drug	Route	Dosage	Comments
Dexamethasone	IV, IM, SC	0.2 mg/kg q12-24h	Anti-inflammatory
	IV, IM, SC	0.5-1 mg/kg q12-24h	Shock or stress
Dextrose 50%	IV	2 ml/kg	-
Diazepam	IM, IV	1-2 mg/kg	Seizures, tranquilization
Doxapram	IV, SC	2 mg/kg	Respiratory stimulant
Doxycycline	PO	2.5 mg/kg q12h	-
Enrofloxacin (inj, tab, oral)	IM, SC, PO	2.5 mg/kg q12-24h	May cause tissue necrosis when delivered SC. IM sites may also develop sterile abscesses/necrosis in some circumstances. Can use injectable orally. Tablets: push to back of mouth or mix with jelly/Nutrical, put in mouth. Long term use OK.
Fenbendazole	PO	5-10 mg/kg repeat in 2 weeks	-
Flunixin	SC, IM	1 mg/kg q12-24h	Analgesia, anti-inflammatory, NSAID
Furosemide	IM, SC	1-4 mg/kg q6-8h	Diuretic
	PO	1-5 mg/kg q12h	Diuretic
Gentamicin	SC, IM, IV	1.5-2.5 mg/kg q12h	Need fluid support
Griseofulvin	PO	20 mg/kg q24h*	30-60 days; *Trichophyton* spp.

FORMULARY FOR HERBIVOROUS MARSUPIALS (wallabies, Brushtail Possums)

Drug	Route	Dosage	Comments
Halothane	Inhalation	To effect	Anesthesia
Isoflurane	-	3-4% induction, then to effect	Inhalation anesthetic of choice
Ivermectin	SC, PO	0.2 mg/kg, Repeat in 1-2 wk PRN	-
Ketamine	IM	15-30 mg/kg	Macropods
Ketamine + acepromazine	IM	30 mg/kg ket + 2 mg/kg ace	Brushtail possums
Lactobacillus (Probios,® Lacto-sac,® Benebac®)	PO	1 notch daily of paste; powder = 1/4-1/2 tsp or per pkg label	Mix into food
Levamisole	PO	10 mg/kg*	Nematodes
Mebendazole	PO	25 mg/kg q24h for 2d*	Nematodes
Metoclopramide (Reglan®)	IV,IM,SC,PO	0.05-0.1 mg/kg q6-12h PRN	GI motility enhancer
Metronidazole	PO	10-20 mg/kg q12-24h	For *Clostridium* sp, protozoa; use with caution when treating bacterial overgrowths
Nitrofurazone	PO	4.5 mg/kg q8h x 4-7d*	Enteritis due to *Klebsiela*, *E. coli* in wallabies
Nystatin	PO	5,000 IU/kg q8h	Oral candida
Penicillin	IM, PO	22-25,000 IU/kg q12h*	Use inj. initially, follow oral with lactobacillus. May be effective against *Streptococcus*, gram-positive anaerobes
Piperazine	PO	100 mg/kg*	Nematodes
Prednisolone	IM, SC, PO	0.1-0.2 mg/kg q24h	-

FORMULARY FOR HERBIVOROUS MARSUPIALS (wallabies, Brushtail Possums)

Drug	Route	Dosage	Comments
Sulfadimethoxine	PO	5-10 mg/kg q12-24h	Antibiotic; make sure well hydrated
	PO	50 mg/kg 10 days*	For coccidia; make sure well hydrated
Sulfamethazine	PO	50 mg/kg q24h x 10d*	For coccidia, toxoplasma; make sure well hydrated
Tetracycline	PO	25 mg/kg q12h	Recommendations in the literature vary widely
	IM	10 mg/kg q5-10d*	
Thiabendazole	PO	50-100 mg/kg q24h max 5 days	May be antipyretic, anti-inflammatory, anthelmintic
Trimethoprim/sulfa (24% inj = 40 mg TMP + 200 mg sulfa; tab = 20 mg TMP + 100 mg sulfa)	IM	10-20 mg/kg q12-24h	TMP-sulfa may cause necrosis if injected SC; make sure well hydrated
	PO	PO = 10-15 mg/kg q12-24h	
Vitamin B complex	IM	0.01-0.02 ml/kg	Be careful of "sting;" adm. under anesthetic or dilute
Vitamin E	PO	25 mg/animal/day*	Check CPK levels, Correct diet
Vitamin K_1	IM	1 mg/kg PRN	Warfarin/dicoumarin toxicity

**Wallach & Boever*

Sugar Gliders

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of sugar gliders and is not intended to replace comprehensive reference material.

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SUGAR GLIDER (*Petaurus breviceps*)

Characteristics

- Sugar gliders are native to New Guinea and Australian rain forests or coastal forests.
- They live in groups of 7-12 animals; all females in a group reproduce.
- Scent marking allows mutual recognition by group members. They defend individual trees with territories up to 2.5 acres.
- Their gliding membrane (patagium) extends from the fifth digit of forepaws to the ankles, and allows them to glide up to 150 feet.
- The first and second digit of their hind feet are partially fused (syndactylous), and their tail is well furred and weakly prehensile.
- They have specialized incisors for gouging.
- They have a blue-gray coat with a dark longitudinal stripe.
- They are nocturnal and arboreal, and their natural predators include owls, snakes, monitor lizards and cats.

Regulations

- Check local laws regarding legality, permits or licenses required for sugar glider ownership.

Behavior

- Sugar gliders are social animals and should not be kept as a solitary pet.
- Considerable playing attention must be provided if a single sugar glider is in the home.
- Vocalizations include an alarm “yap” and a scream.
- Tame sugar gliders bond with their owners and like to ride around in pockets.
- The animals best adapted as a companion animal are socialized by the breeder when they are very young.
- They usually are not provoked to bite, although they may investigate fingers with their mouth.

Diet

- The natural diet of free-ranging sugar gliders in winter includes the gum of eucalyptus or acacia trees. The rest of year, it is mainly insectivorous.
- Sugar gliders cannot rely on nuts, grains, or seeds despite published information to the contrary.

- In the wild, foliage is not a major food item. Insects are high in protein, and plant exudate is high in sugar content.
- Fruit is not a major component of the free-ranging diet.
- Sugar gliders also eat manna, a deposit of white encrusting sugars left where sap has flowed from a wound produced by sap-sucking insects in a tree trunk or branch.
- They also consume honeydew, an excess sugar that is secreted by sap-sucking insects. Honey and fruit may be partial substitutes for honeydew in captivity.
- Feed a diet containing a variety of foods appropriate for insectivores/carnivores (at least 50% of total intake particularly if they are active breeders) along with sources of fruit sugars.
- Feed fresh portions in the evening.
- Avoid preservatives, pesticides and excessive fat in the diet.
- Acceptable treats: meats, diced fruits with multiple vitamin/mineral powder, bee pollen, worms, crickets, various insects (gut-loaded with good cricket diet with additional calcium).
- Treats should be no more than 5% of daily intake!
- Do not let sugar glider choose foods from among wide selection.
- In Australia, owners put lights within the cages to attract insects at night.

Sugar Glider Diet 1

(Based on research and consultation with Australian zookeepers, veterinarians, and naturalists)

- 50% Leadbeater's Mixture*
- 50% insectivore/carnivore diet**

*Leadbeater's Mixture:

150 ml warm water
150 ml honey
1 shelled hard-boiled egg
25 grams high protein baby cereal
1 tsp vitamin/mineral supplement

Mix warm water and honey. In separate container, blend egg until homogenized; gradually add honey/water, then vitamin powder, then baby cereal, blending after each addition until smooth. Keep refrigerated until served.

**Insectivore diets available from Reliable Protein Products, Zupreem, Mazuri.

Sugar Glider Diet 2 (one daily portion)

- Include equal amounts of: chopped apple, grapes or mango, carrot, sweet potato, hard-cooked egg yolk, zoo formula insectivore or exotic feline diet, plus one tablespoon volume of pet industry raised insects.
- Pet industry raised insects have been fed a commercial cricket diet or enriched feed.
- Or, owner can dust all insects, fruits and moist foods with a complete vitamin/mineral powder such as Vionate.®
- Insects include meal worms, crickets, waxworms, moths.
- One tablespoon insects equals one dozen small meal worms or 4 small and 2 large or 2 waxworms.
- Nectars formulated for lories/lorikeets can be given as a fruit-portion substitute or as a treat.
- Foods should be "chopped together" to decrease the ability of the glider to pick out only the favorite parts.

Sugar Glider Diet 3* (feeds one sugar glider)

- 1 teaspoon-sized piece each, chopped: apple, carrot, sweet potato, banana
- 1 teaspoon leaf lettuce
- 1/2 hard-cooked egg yolk
- 1 tablespoon Nebraska Feline Diet (or other good quality zoo feline diet such as ZuPreem or Mazuri)
- 1 dozen meal worms

**Chicago Zoological Park adapted from AAZK Animal Diet Notebook*

Sugar Glider and Squirrel Glider Diet 4 (feeds 2 sugar gliders)**

- 3 grams apple
- 3 grams banana/corn
- 1.5 grams dog kibble
- 1 tsp fly pupae
- 3 grams grapes/kiwi fruit
- 2 tsp Leadbeater's mix *(see previous page)*
- 4 grams orange with skin
- 2 grams pear
- 2 grams cantaloupe/melon/papaya
- 3 grams sweet potato
- On Wednesdays: feed day-old chick; when available, large insects (meal worms)

***Taronga Zoo, Sydney Australia*

Housing

- Relative to other animals, the sugar glider cage should be extremely large.
- They do best in a cage at least 16x body length and at least 1.8 m high.
- Wire spacing should be under 1 inch square to prevent escape.
- Free-ranging sugar gliders nest in leaf-lined tree holes with up to six other adults and young.
- Trees placed at either end of the cage allow gliding activity.
- Branches from nontoxic trees should be available for climbing.
- Nesting boxes should be provided and placed near the roof of the enclosure.
- Crocks for food and water should be placed away from branches to prevent wastes from contaminating bowls.
- Sugar gliders can be let out of their enclosure every day for supervised play.
- Avoid bright lights, excessive heat and unsupervised freedom in the home.

Sexing

- The female has the typical marsupial bilobed uterus with lateral vaginas and central birth canal and developed pouch.
- Males have a midventral fur-covered scrotum, and a bifurcated penis with a preputial covering at the base of the tail. The pouch is absent.
- Males develop a scent gland on the forehead which they may rub on the female's chest. Males also have anal glands and scent glands on the chest.
- Both sexes scent-mark territory.
- The female just marks with urine. Her scent glands are within the pouch.

Sugar Gliders - Quick Facts

Physiologic	
Head/body length:	120-132 mm
Body length:	16-21 cm (6.4-8.4 in)
Tail:	16.5-21 cm (6.6-8.4 in)
Total length with tail:	150-480 mm
Body weight:	Males: 115-160 g (4.1-5.7 oz) Females: 90-130 g (3.4-4.8 oz)
Life span:	7-8 yr (free-ranging); 12-14 yr (captivity)
Body temperature:	89.6°F

Reproductive	
Sexual maturity:	Male: 12-14 mo Female: 8-12 mo
Breeding season:	Throughout year
Gestation period:	16 days
Pouch time:	70 days
Birth weight:	190 mg
Litter size:	2
Number litters/yr:	2
Pouch:	2 teats
Weaning:	3-4 months
Independent offspring:	17 wk

Breeding and Raising Young

- Sugar gliders are relatively easy to breed in captivity.
- The female will secrete and increase marking to indicate breeding readiness to the male.
- The gestation period is only 16 days, at which time the infants make their way to the pouch where they attach to a nipple and stay for two months.
- Ten days after they emerge from the pouch they open their eyes, and wean a month after that, but they may remain in the parental nest.
- Males help with the care and feeding of the babies.

First Visit/Annual Examination

- Physical examination:
  - Diet and husbandry review
  - Dental check
  - Stool flotation/smear for parasites/protozoa
- As indicated:
  - CBC/chemistry
  - Additional diagnostic tests
  - Radiographs to check bone density

Hematologic and Biochemistry Reference Ranges*

There are no published reference ranges for sugar gliders; however, the following values from the Short-nosed Bandicoot (*Isoodon macrourus*) and Barred Bandicoot (*Permaeles gunii*)* may be useful, as these species are similar in metabolism and diet to sugar gliders.

Hbg (g/dl)	14.5-16.1
PCV (%)	44-45
WBC (cells/mm^3)	2800-3600
Neutrophils (%)	46.7-53
Lymphocytes (%)	31-34
Monocytes (%)	8-13
Eosinophils (%)	1-9
AST (SGOT) (SF units/L)	35-75
ALT (SGPT) (IU)	43-76
LDH (WU)	800
Protein (g/dl)	4.9-6.4
Albumin (g/dl)	2.75-3.5
Na^- (mEq/L)	129-141
K^+ (mEq/L)	3.3-4.6

**Fowler ME (ed): Zoo and Wild Animal Medicine 2nd ed.*

Blood Collection

Medial tibial artery, jugular vein, lateral tail vein, saphenous vein, femoral vein

Injection Sites

Intramuscular: thighs, arm muscle mass (Do not use injectable medications that sting badly.)

Subcutaneous: Intrascapular, flank area (Be aware fluids may pool in patagium - gliding membrane.)

Common Clinical Conditions

- Malnutrition and its consequences
- Hind leg paralysis, paresis: usually nutritional in origin
- Trauma (fractures, injuries); self-inflicted wounds (particularly solitary animals)
- Stress-related disease: coprophagia, hyperphagia, polydipsia, behavioral signs such as pacing, self-chewing, cannibalism of young
- Pneumonia
- Diarrhea, enteropathy, gastroenteritis, constipation/impaction
- Intestinal parasites *(Capillaria* sp.)
- Blindness/cataracts

Parasites of Sugar Gliders

- Diagnose with fecal flotation/smears, histopathology.
- Guidelines for treatment follow those of other animals.
- Trematodes:
  Family Dicrocoeliidae - *Asthemia* spp.
  Family Lecithodendiidae - unidentified genus and species

- Nematodes:
  Family Strongyloidea; Rhabditoidea - *Parastrongyloides* sp.
  Family Trichostronyloidea; Subfamily Herpetostrongylinae - *Paraustrongylus* sp.
  Family Oxyuroidea - *Paraustroxyuris* sp.
  Family Spiruroidea - unnamed "larvae" encysted in liver

Therapy

For carnivorous/insectivorous marsupials (sugar gliders, exotic possums), there is some rationale for basing dosages on the low end of range cited for cats/ferrets/hedgehogs; however, any use of these drugs is at the discretion of the clinician.

Client Resource

MacPherson C: Sugar Gliders. Barron's Educational Series, Hauppage, NY.

Brushtail Possums

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of Brushtail possums and is not intended to replace comprehensive reference material.

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BRUSHTAIL POSSUM (*Trichosurus vulpecula*)

Characteristics

- Widely distributed over Australia, Tasmania, many offshore islands, although numbers in Australia have been reduced.
- New Zealand has over-population: brushtails were introduced and now cover 90% of land area of North and South Islands. Introduced possums detrimentally alter the composition of the indigenous broadleaf/podocarp forests by their browsing and competition with native birds and insects.

Behavior

- Brushtail possums are large solitary animals.
- They prefer large trees with hollows for resting, and use shelters of other animals such as termite mounds excavated for nests by kingfishers. On islands, they will utilize rabbit burrows.
- They are territorial, and they scent mark areas using a sternal gland (reddish secretion), as well as a gland under the chin, and anal glands.
- Home ranges of males tend to be larger than females, up to 2-5 hectares.
- Generally brushtails rely on avoiding confrontations with one another.
- In urban areas, they will utilize the space between the roof and ceiling of a house.

Diet

- Free-ranging Brushtail possums eat primarily eucalyptus leaves, flowers and fruit.
- They will also eat many other plant species as well as a wide variety of grasses and herbs.
- In urban areas, they will raid garbage cans and will also accept meats.

Maintenance Diet for Brushtail Possums

Component	Inclusion (% of air-dried feed)
Ground alfalfa hay	24.0
Crushed Weetbix cereal	16.0
Rolled oats	16.0
Infant milk replacer (lactose free)	4.0
Honey	24.0
Water	16.0

Housing

- Enclosure should be:
  Length: = body length x 8 (min. 1.2 m)
  Width: = body length x 4 (min. 0.6 m)
  Height: large arboreal = 1.8 m
- Arboreal habitat is desired to simulate natural environment.
- Housing in pairs is acceptable as a social grouping.
- Roofed enclosure should include numerous branches with hollow limbs.
- Brushtail possums are nocturnal animals, therefore the light cycle should be reversed.
- Environmental temperature range is 50-86°F (10-30°C).

First Visit/Annual Examination

- Physical examination:
  Diet and husbandry review
  Stool flotation/smear
- Other diagnostic screening as indicated by history of origin, exposure to wild-caught:
  Skin scraping
  Radiographs

Restraint and Handling

- Can restrain similar to a cat.
- Animal is fairly docile, but claws should be kept under control.

Sexing

- Male has bifurcated penis in floor of cloaca.
- Female has developed pouch.

Brushtail Possums - Quick Facts

Physiologic	
Body weight:	4500 g
Life span:	10-12 yr (free-ranging); longer in captivity
Body temperature:	97.2°F (36.1°C)
Reproductive	
Sexual maturity:	1 yr
Gestation period:	17-18 days
Leave pouch:	120 days

Breeding and Raising Young

- Birth season is usually autumn, with a small season in spring.
- There is a higher success rate in reproducing during the second breeding season after birth.
- Usually only a single joey is born, and is carried in the forward opening pouch with two teats.
- Joey is unfurred for first 80 days in the pouch.

Blood Collection

- Ventral coccygeal or lateral tail vein, saphenous, possibly cephalic

Injection Sites

Intravenous:	saphenous vein
Intramuscular:	thigh muscle mass (dilute or avoid using injectables that sting)
Subcutaneous:	intrascapular as with other animals

Hematologic Reference Ranges for Brushtail Possums*	
PCV (%):	51
Hg (gm%):	16
MCHC (%):	32
WBC ($10^3/mm^3$):	13
Neutrophils (%):	31
Lymphocytes (%):	68
Monocytes (%):	1
Blood Chemistry Values for Brushtail Possums	
Total protein (gm%):	6.1-7.0
Albumin (gm%):	2.4-3.3
α-glob (gm/dl):	1.36
β-glob (gm/dl):	0.86
δ-glob (gm/dl):	0.99
BUN (mg%):	91
Glucose (mg%):	140
Uric acid (mg%):	2.4
Total bili (mg%):	0.0
Chol (mg%):	104
Calcium (mg%):	3.4-5.8
Alk Phos (K-A units):	12
SGOT (Ku):	39
SGPT (IU):	9
Na (mEq/l):	136-158
K (mEq/l):	4.2-5.0
LDH (WU):	400

Blood Gasses of Brushtail Possums	
pH:	7.4
pCO_2 (mm Hg):	72.0
CO_2 (m/ml):	43.9
HCO_3 (mEq):	42.0
$p0_2$ (mm Hg):	57.0
0_2 (%sat):	86.0
* *Wallach & Boever, Fowler*	

Common Clinical Conditions

- Malnutrition and its consequences (pneumonia and death)
- Enteropathies
- Dental/oral problems
- Trauma
- Obesity

Parasites of Brushtail Possums

Fasciola hepatica:	intermediate host - snail; cholangitis, hepatitis
Ascaridoidea:	*Amplicaecum robertsi*: definitive host is python. Larvae in body cavities, liver
Filarioidea:	*Sprattia venacavincola*: hepatic vasculitis
Cestoda:	*Anoplotaenia dasyuri*
Sarcoptes scabiei:	mange mite

Zoonotic Potential

- In New Zealand, Brushtail possum is a reservoir for bovine tuberculosis (*Mycobacterium bovis*) resulting in the cut off of importation of these animals from New Zealand (but not until substantial numbers were brought in for the US pet trade).
- These are frequently referred to as Phalangers in exotic animal markets to avoid the *M. bovis* implication.
- If brushtails are presented to a practice, find out as much as possible about the breeder and acquisition, and if the animal was exposed to free-ranging imports.
- Discuss zoonosis potential with the owner.
- Screening may be difficult in the well animal. In an ill animal, *M. bovis* may play a role. Literature suggests intradermal skin test, but diagnostic test is unproven.
- Can carry *Sarcoptes scabiei*.
- Can carry *Salmonella* sp.

NOTES

Ringtail Possums

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of Ringtail possums and is not intended to replace comprehensive reference material.

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RINGTAIL POSSUM (*Pseudocheirus peregrinus*)

Characteristics

- The range of the ringtail possum is east coast of Australia, extreme southwest corner of Western Australia and Tasmania.
- Forepaw differs from brushtails in that the first and second digits oppose the other three when grasping (forcipate paw or hand).
- The ringtail has a distinctive white-tipped prehensile tail that is used as a "fifth hand."

Behavior

- Ringtails live in coastal bushland and wetter forests.
- They are nocturnal animals.
- Nests are called dreys, and are constructed spherically in shape, from available materials such as stringy bark, tea tree twiglets and ferns carried to the nest by the prehensile tail.
- Both males and females construct and share dreys.
- They may reuse past nesting sites within their area.
- In urban areas ringtails may construct dreys in exotic trees such as conifers and creepers as well as in native plant species.
- On rare occasions they will inhabit buildings.

Diet

- Ringtail possums eat young leaves, flowers, and fruits from a large variety of shrubs and trees.
- Favorite trees are the Proteaceae and Myrtaceae families: banksias, hakeas, callistemons, melaleucas, leptospermums, acacias, and eucalypti.

Diet of Common Ringtail Possums (National Zoological Park)

Component	Daily Intake/g (of air-dried feed)
Ground alfalfa hay	1.6
Banana (without skin)	16.5
Carrot	17.6
Celery stems	9.7
Grapes	12.1
Kale	9.8
Primate diet (ZuPreem canned)	12.7

Housing

- Ringtail possums are nocturnal animals, therefore the light cycle should be reversed.

- Housing should simulate arboreal habitat with artificial nest and materials for nest construction.
- Ringtail possums can be housed in pairs.

First Visit/Annual Examination

- Physical examination:
  Diet and husbandry review
  Fecal parasite examination
- Diagnostics as indicated.

Ringtail Possum - Quick Facts

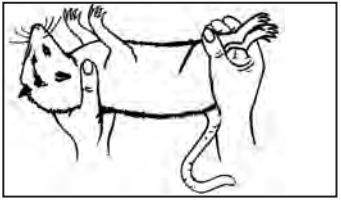
Physiologic	
Body weight:	650-1000 g
Life span:	5 yr
Reproductive	
Sexual maturity:	12-18 mo
Gestation period:	1 mo
Mammae:	4 teats/pouch
Litter size:	2-4
Litters per year:	1
Eyes open:	95-106 days
Fully furred:	105-112 days
Young leave pouch:	120 days
Weaned:	180 days

Breeding and Raising Young

- Ringtails breed throughout the year, but peak in fall and spring.
- Female has four teats in the pouch, with the anterior pair small and inverted; anterior opening.
- Young make a high-pitched twittering.

Restraint and Handling

- Handle similar to other small mammals of similar size.



Blood Collection

- Ventral coccygeal or femoral vein

Injection Sites

- Do not use injectable medications that sting badly.

Intramuscular:	Thighs, arm muscle mass
Subcutaneous:	Intrascapular, flank area

Common Clinical Conditions

- Malnutrition and its consequences (pneumonia and death)
- Trauma
- Enteropathies

Zoonotic Potential

- Potential carrier of *Salmonella*, dermatophytes, but largely unknown at this time.

Short-tailed Opossums

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of short-tailed opossums and is not intended to replace comprehensive reference material.

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SHORT-TAILED OPOSSUM (*Monodelphis domestica*)

Characteristics

- Natural habitat is eastern and central Brazil, Bolivia, Paraguay.
- Stocky and shrew-like with short wavy fur, a short, bare tail, and no brood pouch.
- Males emanate unpleasant odor (for other males); odor is from chest and neck glands.
- They have been used as a laboratory animal, particularly for models for UV-induced sarcomas and melanomas.
- Tail is about half as long as the head and body (always shorter than the body alone) and sparsely haired.

Behavior

- Short-tailed opossums are basically nocturnal.
- They usually dwell on the ground, but they can climb.
- Individuals are highly intolerant of each other, though conflicts rarely result in serious injury.
- Nests are usually built in hollow logs and in foundations of buildings.
- They destroy rodents and insects.
- They search for food mainly near the ground.

Diet

- Free-ranging short-tailed opossums eat small prey (mice, insects), fruit, grains, carrion.
- In laboratory facilities, they eat pelleted fox diet (National Complete Fox Food Pellets, Mazuri Exotic Canine Diet 5M52, Mazuri Carnivore Diet 5636) insects, pinkie mice.
- They are prone to atherosclerosis following hyperlipidemia and hypercholesterolemia.
- Fasting plasma cholesterol on Natl Fox Food (3.1% fat dry weight): 85±22 mg/100 ml.
- 17.7% fat diets (equal to 40% calories from fat) produces elevated cholesterol of 1000-1900 mg/100 ml after 8 weeks.
- There are high responders and some genetically lower responders (304-593 mg/100 ml).

Housing

- Enclosure should be:
  Length: = body length x 8 (min. 1.2 m)
  Width: = body length x 4 (min. 0.6 m)
  Height: small arboreal = 1.2 m

- Provide abundant branches for climbing and to simulate various levels, and nest areas.
- Use substrate such as shredded recycled newspaper bedding for foraging.

First Visit/Annual Examination

- Physical examination:
  Diet and husbandry review
  Fecal parasite exam (flotation and smear)
- CBC
- Blood chemistry, especially cholesterol level
- Dental/oral exam

Restraint and Handling

- Restrain and handle in a gentle manner as with other small mammals.

Sexing

- Females have poorly developed folds around teats; that is not a true pouch.
- Mammae are arranged in a circle on the abdomen: 8-14 in number.
- Male penis is in the floor of the cloaca.

Short-tailed Opossums - Quick Facts

Physiologic	
Body weight:	Males: 90-150 g Females: 80-100 g
Head, body length:	110-200 mm (2.8-6.4 in; 7-16 cm)
Tail length:	45-80 mm (1.6-3.2 in)
Life span in captivity:	up to 6 years
Reproductive	
Sexual maturity:	4-5 mo
Estrus:	3-12 days, up to 1 mo
Estrous cycle:	bimodal distribution
Gestation period:	14-15 days
Weight at birth:	>0.03 oz (1 g)
Litter size:	5-14
Liters per year:	up to 4
Postpartum dependence:	50 days
Reproductive life:	Males: 39 mo Females: 28 mo

Breeding and Raising Young

- Breeding occurs throughout the year in tropical ranges.
- Estrous cycle has been noted to vary between captive groups: 2 weeks, 1 month.
- Newborn cling to the nipples of the mother, later they ride on the back and flanks.

Blood Collection

- Use ventral tail artery.
- Collect under isoflurane anesthesia.
- Nick the vessel with a scalpel blade or large syringe needle and let it drip into a collection tube.
- Hemostasis can be done with gentle pressure, or dab of surgical glue.
- Note whenever doing tails (like with rats, mice or rabbit ears): warm first to help dilate vessels.
- Femoral vein may be possible site; cardiocentesis (not recommended for pets).

Injection Sites

- Do not use injectable medications that sting badly.

Intramuscular:	Thighs, arm muscle mass
Subcutaneous:	Intrascapular, flank area (Be aware fluids may pool in patagium (gliding membrane)

Common Clinical Conditions

- Malnutrition and its consequences: hypercholesterolemia, hyperlipidemia, cardiovascular disease/atherosclerosis
- Enteropathies
- Dermatitis
- Trauma - fight wounds

WALLABIES

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of wallabies in general, and for the Bennett's wallaby and Tammar wallaby in particular, and is not intended to replace comprehensive reference material.

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WALLABIES

Species

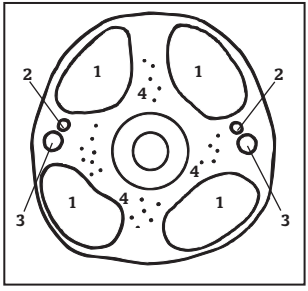
Two species in the pet trade are:

- Tammar (Dama) Wallaby *Macropus (Prionotemnus) eugenii* (Taxonomy disputed: *Prionotemnus* considered the subgenus to assign all small and intermediate- sized wallabies)
- Bennett's Wallaby *Macropus rufogriseus rufogriseus*

Characteristics (see also general Marsupial information)

- They are forestomach fermenters (pseudoruminants). They recycle urea via saliva, which is swallowed and then used in the stomach.
- Macropods can utilize nitrogen well even when the diet is poor.
- Water restriction does not influence nitrogen balance, but they will excrete less urea and maintain higher plasma urea concentrations. They will excrete less water in feces, but the urine volume remains normal.
- They do not conserve energy or protein efficiently.
- They must be fed high quality fiber diets.
- Maintenance nitrogen requirement (mg dietary N/kg .75/day): 290
- The glucose metabolism of macropods (wallabies) is similar to eutherian ruminants.
- Little carbohydrate is absorbed from the intestine: they are dependent on absorption of volatile fatty acids (VFA).
- VFA are converted to glucose in the liver. After feeding, blood glucose rises, then falls sharply to a relatively low resting level.
- Macropods are tolerant of a very low blood glucose level. They are very sensitive to hyperglycemia, and respond to small doses of insulin.

Cross Section of Tail of Macropod



1. muscle
2. artery
3. vein
4. coccygeal vertebrae

Diet

- Free-ranging wallabies eat grasses and herbaceous plants.
- Recommended diet is alfalfa hay and 50:50 mix of horse and rabbit pellets.
- Timothy hay may be provided ad lib and also used as bedding.

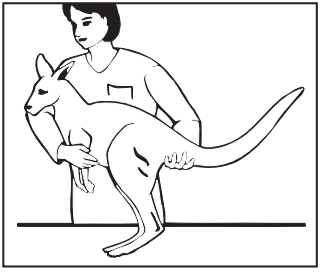
Sexing

- The forked penis of the male is found in the ventrum of the cloaca. Testes are external.
- Female has a well-developed pouch.

Restraint

- Restraint of a young wallaby can be facilitated by placing a pillowcase over its head; it will climb in, allowing an easy examination within a simulated pouch.

- The wallaby's front legs are restrained with one hand and the tail is controlled with the other hand, in effect tipping the animal off balance to prevent use of its powerful hindlimbs.



Orphan Care for Wallabies and Kangaroos

- Milk Replacer Formula A:
  Pasteurized cow's milk - 120 ml
  Glucose - 0.5 tsp
  Vitamin drops (ABDE) - 2 drops
- Milk Replacer Formula B:
  Esbilac powder - 10 g
  Warm water - 100 ml
  Vitamin drops (ABDE) - 0.1 ml
- Two major problems associated with evicted joeys are dehydration and heat loss.
- Artificial pouch can be made from terry cloth towel hung in

an incubator: 36.5°C (95°F) with 70% relative humidity.

- Feeding of older joeys may be done with a doll's bottle or a rubber stomach tube 3 mm in diameter attached to a 20 ml syringe.
- Smaller animals should be fed with capillary tubes or micropipettes, 22 gauge venous catheters, or finch-sized feeding needle.
- Feed every 3-4 hours until completely furred.
- Joeys require digital stimulation of urogenital opening to stimulate proper defecation and urination.

Medicating Joeys in the Pouch

- Medication can be administered to joeys still on the maternal nipple by employing polyethylene tubing with an ID of 0.011 mm and an OD of 0.024 mm for the first 30 days of pouch life.
- The end of the tube is inserted 1-2 mm into the joey's mouth parallel to the nipple.
- The infant's sucking reflex will cause it to take the medication.

Blood Collection

- Cephalic or lateral caudal vein (just dorsal to lateral of the vertebral processes on either side of the tail), possibly saphenous

Hematology Reference Values for Wallabies	
RBC (10^6/mm^3):	3.8-4.6
PCV (%):	38-45
Hemoglobin (gm%):	15.5-20
WBC (10^3/mm^3):	6.8-14.0
Neutrophils (%):	60-82
Lymphocytes (%):	16-35
Monocytes (%):	0-2
Basophils (%):	0-1
Eosinophils (%):	0-1
MCHC (%):	35

Most Common Clinical Conditions

- Injuries
- "Lumpy jaw" problem

"Lumpy Jaw"

- May be caused by various organisms, esp *Actinomyces bovis, Bacteroides* sp.
- Chronic problem: natural tooth eruption process with the cheek teeth erupting posteriorly in the jaw and migrating

anteriorly before being lost adjacent to the diastema.

- May be altered due to the diet in captivity. The disruption of the mucous membranes becomes a way for bacteria to enter the jaw.
- Coarse, sharp feeds such as oat awns should be avoided, since they can cause trauma to the mouth and the tissues can be invaded by the bacteria mentioned above.
- Provision of materials such as long dry grass or fibrous tree bark for the animals to chew on appears to reduce the incidence of the disease. Chewing on these presumably toughens the oral mucosa.
- Provide the molar teeth with sufficient work to enable them to be properly shed.

Parasites of Wallabies*

Parasite	Clinical signs
Toxoplasma gondii:	myocarditis
Cestodes: *Progamotaenia festiva*:	cholangitis
Echinococcus granulosus (metacestode):	hydatid cysts in lungs
Filarioidea: *Breinlia* spp.: (*Breinlia mundayi* in red-necked wallabies)	pleuritis, splenic microfilarial granulomatata, epicarditis, pericarditis
Muspiceoidea: *Durikainema macropi*:	hepatic phlebitis
Rhabditoidea: *Strongyloides* spp.:	common, nodular, hemorrhagic gastritis
Strongyloidea: *Hypodontus macropi*:	common, enteritis, typhlitis
Labiostrongylus spp:	common, granulomatous gastritis (larvae). Thiabendazole, meben-dazole treatment for strongyloidea.
Trichostrongyloidea: *Globocephaloides trifidospicularis*:	common, anemia
Insecta: Diptera: *Tracheomyia macropi* (larvae):	common, erosive tracheitis
**Beveridge I:* In *Fowler 2nd ed.*	

NOTES

Tammar Wallaby

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TAMMAR or "DAMA" WALLABY (*Macropus eugenii*)

Characteristics

- Tammar wallabies are native to a southwestern coastal area in Western Australia (south of Perth).
- They have been released on several islands in New Zealand where they have caused considerable damage to forests and tree farms.
- Color: gray to yellow belly, red legs, gray-brown back, paler colors than the Parma wallaby.
- Natural enemies are dingoes and birds of prey.
- Free-ranging Tammar Wallabies drink salt water, but in captivity they should have access to fresh water at all times.

Behavior

- Tammar wallabies are terrestrial.
- They are social animals and form mixed sex "mobs" with a hierarchy.
- In the wild, they live in thickets and on the edges of forests, with territories of more than 0.6 mi (1 km) in diameter.

Housing

- The environment for Tammar wallabies must be kept above 60°F (16°C), with shade provided and normal light cycles maintained.
- Tammar wallabies can be group-housed with several males.
- They must have room to run without obstacles, and have dense vegetation for escape routes.
- Housing should include both an area for running and dry bedding sections.

Tammar Wallaby - Quick Facts

Physiologic	
Life span:	9-14 yr
Body length:	Males 1.9-2.2 ft (59-68 cm) Females: 1.7-2.1 ft (52-63 cm)
Tail length:	Males: 15.2-18 in (38-45 cm) Females: 13.2-17.6 in (33-44 cm)
Height:	approx 18 in (45 cm)
Weight:	Males: 13.2-22 lb (6-10 kg) Females: 8.8-13.2 lb (4-6 kg)
Cloacal temp:	95-96.0°F (35-36.0°C)
Heart rate:	125-150 bpm

Reproductive	
Sexual maturity:	Female: 9 mo Male: 2 yr
Estrus cycle:	30 days
Gestation:	25-28 days
Pouch period:	8-9 mo
Young at term:	1
Weight at birth:	<0.03 oz (1 g)
Weaning:	10-11 mo

Breeding and Raising Young

- *M. eugenii* is not a continuous breeder, but has a postpartum estrus.
- If the pouch young is lost while the season is in progress, the next birth will occur in 27 days.
- If the first pouch young survives, the dispausing embryo is retained through the anestrus period of the female and resumes development at the beginning of the next breeding season, about 11 months after fertilization took place.

Hematology Reference Values for Tammar Wallaby*	
Hgb (gm/dl):	17.2
MVC (μm^3):	70
MCHC (%):	34.6
WBC (cells/mm^3):	4500
Serum Chemistry Reference Values for Tammar Wallaby*	
Protein (gm/dl):	7.43
Albumin (gm/dl):	4.57
α-glob (gm/dl):	0.19
β-glob (gm/dl):	0.76
δ-glob (gm/dl):	0.84
Na (mEq/l):	154
K (mEq/l):	3.9
**Finnie*	

NOTES

Bennett's Wallaby

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of Bennett's wallabies and is not intended to replace comprehensive reference material.

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BENNETT'S WALLABY (*Macropus rufogriseus rufogriseus*)

Characteristics

- Tasmanian subspecies of the Red-necked Wallaby (*Macropus rufogriseus*).
- Coloration is gray-brown.
- Natural enemies are dingoes.
- Free-ranging animals live in brush and forests.

Behavior

- The Bennett's wallaby is mainly crepuscular and nocturnal.
- Groups may be seen at feeding areas and water holes, but it is not a cohesive social group.
- Adolescent males stay with mothers beyond weaning and into the following year. Daughters wean sooner than sons.
- Related females form "clans" with common feeding areas.
- Large dominant males reserve certain areas of their territory for their own use and have exclusive mating rights in those areas.

Bennett's Wallaby - Quick Facts

Physiologic	
Body length:	Males 2.4-3.1 ft (71.2-92.3 cm) Females: 2.2-2.8 ft (65.9-83.7 cm)
Tail length:	Males 2.3-2.9 ft (69.1-87.6 cm) Females: 2.1-2.6 ft (62.3-79 cm)
Height:	approx 2.5-2.6 ft (75-80 cm)
Weight:	Males: 33-59 lb (15-26.8 kg) Females: 24-34 lb (11-15.5 kg)
Life span:	12-15 yr
Cloacal temp:	95-96.90°F (35-36.0°C)
Heart rate:	125-150 bpm
Dentition:	3/1 0-1/0 2/2 4/4 x 2 32-34
Reproductive	
Sexual maturity:	Females: 14 mo Males: 19 mo
Breeding:	strictly seasonal
Gestation period:	30 days
Pouch period:	7-8 mo
Young at birth:	1
Weight at birth:	<0.03 oz (1 g)
Wean:	12-17 mo

Hematology and Blood Chemistry Reference Ranges of Red-necked Wallaby (*Macropus rufogriseus*); use as guideline for subspecies "Bennett's" (mean ± standard deviation)*

WBC (10^3/mm^3):	5.864 ± 1.873
RBC (10^6/mm^3):	5.21 ± 0.64
Hemoglobin (gm/dl):	16.4 ± 2.1
Hematocrit (%):	45.5 ± 7.0
MCV (μ^3):	87.1 ± 7.2
MCH ($\mu\mu$g):	31.5 ± 1.9
MCHC (gm/dl):	36.1 ± 2.6
Neutrophils (10^3/mm^3):	2.187 ± 1.252
Lymphocytes (10^3/mm^3):	3.452 ± 1.690
Monocytes (10^3/mm^3):	0.157 ± 0.189
Eosinophils (10^3/mm^3):	0.103 ± 0.114
Basophils (10^3/mm^3):	0.019 ± 0.055
Band Neutrophils (10^3/mm^3):	0.099 ± 0.306
Platelets (10^3/mm^3):	224 ± 119
Calcium (mg/dl):	10.1 ± 0.9
Phosphorus (mg/dl):	6.8 ± 2.0
Sodium (mEq/L):	141 ± 5
Potassium (mEq/L):	4.5 ± 0.7
Chloride (mEq/L):	97 ± 5
Iron (μg/dl):	196 ± 75
Magnesium (mg/dl):	1.78 ± 0.75
HCO_3 (mEq/L):	24.5 ± 0.7
BUN (mg/dl):	24 ± 5
Creatinine (mg/dl):	1.2 ± 0.3
Uric acid (mg/%):	0.5 ± 0.5
Glucose (mg/dl):	117 ± 35
Cholesterol (mg/dl):	83 ± 29
Triglycerides (mg/dl):	56 ± 30
CK (CPK) (IU/L):	1083 ± 1466

**ISIS Physiological Data Reference Values August 1996*

NOTES

Exotic Carnivores

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Skunks

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of skunks and is not intended to replace comprehensive reference material.

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SKUNKS

Common Species and Variations

North American spotted skunk (*Spilogale putorius*, *Spilogale pygmaea*)

- Natural range is Mexico and Central America, most commonly in Sonoran zones.
- Spotted skunk color pattern: basic color is black with white blotches on the head, sides, back. Distal half of the tail may be white.

North American striped skunk (*Mephitis mephitis*)

- Natural range is from southern Canada into the U.S. and northern Mexico.
- Striped skunk color pattern: black, except white on the top of its head and nape, extending backward separately as two stripes. The amount of white varies considerably.
- Brown fur instead of black is considered the "albino" mutation.
- Free-ranging striped skunks are found in a variety of habitats from woods to plains to deserts.
- Striped skunk is more common in the pet trade.

Regulations

- Check with local laws concerning legality of owning a skunk or permits required.
- Pet stores selling skunks are required to be licensed with the USDA as Class B dealers.
- Many skunks from game-farms or exotic breeders are sold neutered/spayed/descented (at 2-4 weeks).
- Public health departments will not recognize rabies vaccinations of skunks. Vaccination will not protect the skunk from sacrifice should it be involved in a biting incident.

Behavior

- Skunks are basically nocturnal.
- They are non-domesticated, yet are fairly docile and friendly when raised socially with people or other skunks.
- Juveniles can be caged together, but adults should be caged separately. Adults can socialize outside of cages when supervised.
- When antagonized, they will stomp with their forepaws and sometimes vocalize, which is a warning. Further antagonism results in the skunk's balancing heavily on its forepaws, advancing, then pivoting for the spray.

- Skunks can be trained to use a litter box and walk with a harness and leash.
- They should always be supervised around children or other pets, and caged when unattended.
- Skunks tend to want to gain weight for the fall, and are less active in the fall and winter, although indoor animals do not show these tendencies as dramatically.

Diet

- Skunks are omnivorous in nature, eating insects, rodents, vegetable matter, fruits/berries.
- Provide basic dry dog food ("lite" for those older than one year), supplemented with fruits, vegetables, blackberry branches with young leaves.
- Mealworms and other insects can be used as treats.
- Dog bones and tartar control-type treats are useful for reducing tartar on teeth.

Housing

- Most skunks need to be caged individually once they are adults.
- Only young skunks and nonpregnant females seem to tolerate the company of other skunks.
- Minimum cage space requirements: floor space in square meters for 1 spotted skunk: 3.66; 2 spotted skunks: 4.57 with height in meters: 0.61
- Striped skunk floor space in square meters: 1 animal: 3.66; 2 animals: 4.80 with height in meters: 0.9.
- Nest box and litter box should be provided in enclosure.
- Temperatures in indoor housing should be kept below 70-75°F (15.5-18°C).
- Caging must be sturdy as skunks try to chew and dig their way out with their long claws.
- Nail trims are necessary if they are kept in wire bottomed cages.
- "Soft Claws" type glue-on tips designed for cats may be used for indoor pet skunks.

Sexing

- In the male, the testicles are close to the anus, and the penis is situated on the ventral abdomen (similar to the ferret).

Skunks - Quick Facts

Physiologic	
Head, body length:	Striped skunk: 280-280 mm Spotted skunk: 115-324 mm
Tail length:	Striped skunk: 180-435 mm Spotted skunk: 70-200 mm
Body weight:	Striped skunk: 0.75-4.0 kg Spotted skunk: 0.2-1.0 kg
Life span:	8-10 yr
Body temperature:	102°F (38.9°C)
Heart rate:	140-190 bpm
Urine pH:	6.0
Feces:	resemble cat feces, very dark color
Dental formula:	3/3, 1/1, 3/3, 1/1
Reproductive	
Sexual maturity:	1 yr
Estrus:	monestrous
Breeding cycle:	mating in Feb/March; single litter in early May
Gestation period:	62-66 days (delayed implantation observed)
Number in litter:	range 6-9; usually raise 6-7
Birth weight:	1 oz
Eyes open (pupils):	3-4 wk
Lactation:	4-6 wk
Weaning:	7-8 wk

Breeding and Raising Young

- Adult males are usually solitary in summer but may share a den with several females in the winter.
- Striped skunk females remain receptive to the male until conception occurs.
- In captivity, pregnant females are usually separated from the males. Breeding is in late winter or early spring.
- Orphaned kits can be fed commercially prepared kitten milk replacement (KMR - Borden®). First week, feeding should be every two hours; during the second week may fit feedings into a 12 hour day. Kits should wean to solid food and be vaccinated at 6-8 weeks.

Restraint of Skunks

- Skunks may be grasped by the scruff with the right hand while the left hand extends the rear legs and tail. When scruffing, be sure to also support the hindquarters.

Pet skunks may be handled like pet ferrets.

Chemical restraint/anesthesia:

Ketamine HCl:	10-20 mg/kg IM + xylazine 2 mg/kg IM (caution with cardiomyopathy or obesity)
Ketamine HCl:	20-40 mg/kg IM
Telazol:	1.5-10 mg/kg IM
Isoflurane:	to effect in a chamber, then mask or intubate
Pentobarbital:	15-30 mg/kg IP

Neutralizing Skunk Musk

- Intact skunks can eject musk accurately from the anal glands for a distance of three meters! The principal component is normal-butyl-mercaptan (butanethiol).
- N-butyl-mercaptan can be made soluble, harmless and odorless by the application of a strong oxidizing agent such as sodium hypochlorite (household chlorine bleach). It should be diluted to approximately 500-1000 ppm of available chlorine before it is applied, and rinsed with copious amounts of water.
- If an item cannot be bleached, it is doubtful odors can be removed.
- Skin surfaces can be washed briskly with a carbolic soap (tincture of green soap) and warm water, then rinsed with a dilute bleach solution.

- For animals, closely clip hair coat, then rinse repeatedly with a dilute bleach solution followed by repeated shampooing.
- Clinical signs in humans sprayed with skunk musk include skin burns, temporary blindness, nausea, convulsions, and loss of consciousness.
- Spray should be washed from the eyes with copious amounts of water. Lacrimal secretions will also clear the eyes of chemical within 15 minutes - secretions must also be rinsed from skin surfaces.

Demusking Surgery

- For demusking procedure see Fowler ME: Descenting carnivores. *In* Fowler ME (ed): Zoo and Wildlife Medicine 2nd ed. Philadelphia, WB Saunders Co, 1986, pp 807-809.
- Veterinarians who perform demusking should work behind a plastic shield for protection or wear waterproof clothing.
- Some veterinarians perform the surgery outdoors.
- The demusking procedure is similar to that done in the domestic ferret, except that the glands are positioned more ventrally, with the ducts opening at approximately the 5 and 7 o'clock positions (in ferrets it is approximately 10 and 2 o'clock positions with the glands positioned laterally).

Preventive Care

- Free-ranging striped skunks are important wildlife reservoirs of rabies in North America.
- Public Health officials do not recognize rabies vaccination of skunks, and no vaccine is licensed for use in captive skunks.
- Pets may receive killed rabies vaccine (Imrab), as used in ferrets.
- Caution owners that if the skunk bites someone, the rabies vaccine will not protect the skunk from sacrifice and rabies testing by Public Health officials.
- Traditional vaccinations of skunks also include combination canine and feline vaccines (eg, Galaxy DA2PPvL+Cv and Eclipse 4).
- Pet skunks should not be exposed to dogs or cats of uknown vaccination status.
- Weight control program is usually necessary.
- Administer preventive parasite control.
- Skunks need prophylactic dental care and routine nail trims.

First Visit/Annual Examination

- Physical examination:
  Include check of heart and lung sounds, temperature, weight, eyes, ears, teeth, fur and general condition.
  Vaccination against canine distemper, adenovirus, leptospirosis.
  Vaccination against feline panleukopenia
  Fecal flotation, direct smear
- In addition, it may be advisable to have:
  Rabies vaccination
  General blood panel CBC/chemistry
  Transponder scanning
  Radiographs
  Stool culture

Blood Collection

- Jugular, saphenous, cephalic, or femoral veins.

Injection Sites

Intramuscular:	thigh, biceps
Subcutaneous:	between shoulder blades, or laterally on flank
Intravenous:	cephalic or saphenous vein

Hematologic Reference Ranges I*	
PCV:	40%
RBC:	10 x 10^6/mm^3
WBC:	16 x 10^3/mm^3
Neutrophils:	50%
Lymphocytes:	40%

Hematologic Reference Ranges II**	
RBC:	10 x 10^6/mm^3
WBC:	12.0-15.0 x 10^3
Neutrophils:	47%
Lymphocytes:	50%
Monocytes:	1%
Eosinophils:	2%
Basophils:	0%
Hbg:	15.1 g/100 ml
PCV:	35-40%

Blood Chemistries - Spotted Skunk**	
Na:	143.5-148.5 mEq/L
Cl:	101.1-115.2 mEq/L

K:	5.1-7.1 mEq/L
Ca:	9.5-10.7 mg%
Phos:	4.2-6.9 mg%
Total bili:	0.0-0.12 mg%
Albumin:	1.90-1.61 gm%
Globulins:	5.98-6.49 gm%
Gluc:	127-247 mg%
BUN:	15.6-20.0 mg%
Cholesterol:	163-221 mg%
** Williams, ** Wallach & Boever*	

Common Clinical Conditions

- Obesity, fatty liver, amyloidosis
- Cardiomyopathy
- Nematodes/cestodes
- Ectoparasites (fleas, mites)
- Abscesses (*Streptococcus* spp, *Staphylococcus* spp)
- Dental disease including gingivitis
- Dermatitis (nutritional deficiencies, parasitic, fungal, bacterial)
- Herpes necrotizing encephalitis (Herpes simplex virus - human)
- Gastroenteritis

Client Resource

American Domestic Skunk Association, Inc.
800 Skunk Hollow Road
Cleveland, GA 30528
706-865-7734

Author's Note

The author utilizes ferret doses for antimicrobials, antiparasitics, fluid therapy, cardiovascular, analgesic medications. The clinician is advised to consult current pharmacologic information on feline medications to extrapolate doses for adult skunks on other medications not listed or commonly used in ferrets.

INFECTIOUS DISEASE CONDITIONS OF CAPTIVE SKUNKS

Disease	Clinical Signs	Diagnosis	Treatment/Prevention
Canine distemper	Crusted eyes, swollen feet, dyspnea, neurologic signs, terminal convulsions	Serology, Postmorten, Histopathology	Annual vaccination with canine distemper vaccines suitable for use in the domestic ferret should be given. Follow ferret vaccination schedule.
Canine infectious hepatitis (fox encephalitis)	Mucopurulent ocular discharge, anorexia, depression, diarrhea, hemorrhagic enteritis, pharyngitis, tonsillitis, emesis and icterus.	Acute, fatal viral hepatitis with clinical course of 24-48 hours. Postmortem: acute hemorrhagic necrosis of the liver. Pathognomonic edema of the gallbladder wall.	Supportive only: parenteral vitamin K, vitamin B complex, fluid and electrolyte therapy, broad spectrum antibiotics. Vaccination with commercial canine hepatitis vaccine concurrent with canine distemper and leptospirosis vaccines on an annual basis may be recommended if there is potential contact with unvaccinated dogs.
Feline panleukopenia/enteritis	Similar to those in cats. Mucoid to hemorrhagic enteritis, leukopenia, anorexia, depression, death within 3-5 days of onset (in 10-80% affected), pyrexia	CBC-WBC, Clinical signs, Postmortem	Feline inactivated vaccine can be given, with annual boosters. Supportive care including fluids, electrolytes, antibiotics to control secondary infections while leukopenic.
Toxoplasmosis (*Toxoplasma gondii*)	Fever, lymphadenitis, splenomegaly, myocarditis, pneumonitis, hepatitis, hydrocephalus, encephalitis, dermatitis	Serology	Pyrimethamine, sulfonamides or triple sulfas

INFECTIOUS DISEASE CONDITIONS OF CAPTIVE SKUNKS

Disease	Clinical Signs	Diagnosis	Treatment/Prevention
Herpes necrotizing encephalitis (herpes simplex virus - human)	Tremors, lethargy, bobbing of head, profuse salivation. Clinical course may run 3-7 days, and the skunk may recover.	Serology, or on postmortem with necrosis/hemorrhage in liver, adrenal glands. Encephalitis: necrotizing meningoencephalitis, of gray matter of cerebral cortex. Intranuclear inclusions are found in the nerve and glial cells.	If you have active herpes lesions, do not handle animal. Acyclovir (Zovirax®) could be tried, Supporitve care.
Lungworms (*Crenosoma mephitidis*) - primary location: bronchi	Depression, coughing, dyspnea	Finding first stage infective larvae in fecal samples. *Crenosoma* spp. produces verminous bronchopneumonia with occlusion of bronchi, bronchioles, and emphysema.	Levamisole or tetramisole is effective
Roundworms (*Baylisascaris columnaris*)	None to poor growth, dull coat, depression, coughing, diarrhea, anemia, emaciation, pot-belly in young similar to ascarid infestation in dogs, cats	Fecal flotation/smear, ova identification, handle stool sample carefully (wear gloves, mucous membrane protection). Instruct owners in safe handling of the stool.	Piperazine@ 50-100 mg/kg, repeat q2wks, stop fecal/oral cycle. Free-ranging skunks may carry *B. columnaris*. This is a risk to other animals as it causes CNS damage in many species (possibly including humans). Recheck the stool frequently for ova.
Tapeworms (*Atriotaenia procyonis, Oschmarenia* spp., *O. mephitis*)	Weight loss, enteritis, anemia	Proglottids or ova in feces	Droncit at feline doses
Other parasites: Liver worms (*Capillaria hepatica*), Acanthocephala (*Macracanthorhynchus ingens)*, Lung flukes (*Paragonimus kellicotti*)			

ZOONOTIC POTENTIAL (wild-caught/free-ranging skunks)			
Disease	**Clinical Signs**	**Diagnosis**	**Treatment/Prevention**
Listeriosis (*Listeria monocytogenes*)	Septicemia, "rabies-like" symptoms, ataxia	History, culture of gram-positive rods. Postmortem lesions include miliary areas of necrosis in the liver, lung, spleen and heart similar to tularemia and pseudotuberculosis.	Broad-spectrum antibiotics
Rabies	Vary. Incubation period is from 2 weeks to 6 months. Furious form: virus is present in saliva one to six days prior to death; however, peak levels occur during the furious stage. In other manifestations: skunk may appear "tame." The virus is transmitted to suckling skunks.	Postmortem lesions are limited to microscopic changes. Petechial hemorrhages and perivascular cuffing occur in the brain stem and hippocampus where most of the damage occurs. Infected orphan skunks have passed the virus to foster mothers.	Vaccination of captive skunks with an inactivated rabies vaccine (one safe for domestic ferrets) at 4 - 6 months of age and then annually is probably protective, however if the skunk bites someone, this vaccination will not be recognized by public health authorities.
Tularemia	Course is peracute to acute, anorexia and sudden death. Source of organism is usually infected fish, rabbits, or rodents.	Usually at postmortem: typical lesions are miliary granulomas, abscesses scattered throughout lungs, liver, mesenteric lymph nodes, and spleen. Culture of organism is definitive.	Not treated.
Leptospirosis (*Leptospira* spp.)	Anorexia, emesis, lethargy, anemia, hemoglobinuria, icterus, fever, abortions and death.	History, observation, serologic testing. Usual transmission is contamination of feed or water by urine.	Penicillin-streptomycin, parenterally. Leptospirosis vaccines

BIRDS

This section includes individual chapters for Psittacines, Passerines & Softbills, Pigeons, Poultry & Waterfowl, Raptors and Ratites. The topics listed below in this introduction apply generally to all birds in this section. Updates were provided by Storm Hudelson, DVM, Dipl ABVP-Avian, Paul Hudelson and Donald Zantop, DVM, Dipl ABVP-Avian.

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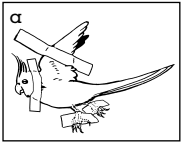
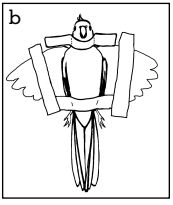
Identification

- Microchips provide permanent marking of companion birds for identification purposes. Placement is within the pectorial muscle. It is suggested that the bird be anesthetized for the procedure. If performed with the bird awake, provide analgesia prior to implantation. Most commercial chips are approximately 12 ga diameter.
- Individually numbered leg bands or rings are unreliable as identification methods and may cause injury.
- Each psittacine bird is alleged to have a unique scale pattern on the feet. Photographs of the feet, which are updated as the bird ages, can be maintained in the bird's record to confirm its identity and to prevent fraud with other techniques.

Radiographic Positioning

- In order to minimize movement for a radiograph, avian patients are best anesthetized with isoflurane or sevoflurane.
- In the lateral view, the bird is positioned on its right side. Tape may be used to help secure the wings and legs (a).
- In the ventrodorsal view, the bird is positioned on its back with the spine superimposed over the sternum (b).





Blood Collection Sites

- Preferred: jugular
- Can also use medial metatarsal vein located along the medial aspect of the leg just distal to the hock
- Can use cutaneous ulnar vein located on the ventral aspect of the wing at the elbow

Bone Marrow Collection Sites

- Tibiotarsus (enter from proximal end)
- Sternum
- Performed under anesthesia. Provide analgesia whenever bone is penetrated

Injection Sites

- Intramuscular: pectorals
- Intravenous: cutaneous ulnar vein, jugular, medial metatarsal
- Intraosseous: distal ulna preferred. Can use tibia in an emergency. Provide analgesia

- Subcutaneous fluids: intrascapular region, inguinal web area of legs

Barium Sulfate Transit Times*

	Stomach	Small Intestines	Large Intestines	Cloaca
African grey	10-30	30-60	60-120	120-130
Budgerigar	5-30	30-60	60-120	120-140
Racing pigeon	5-10	10-30	30-120	120-240
Indian hill mynah	5	10-15	15-30	30-90
Hawk	5-15	15-30	30-90	90-360
Amazon parrot	10-60	60-120	120-150	150-240
Canary	5	10-15	15-30	30-90
Pheasant	10-45	45-120	120-150	150-240

*Times in minutes for barium sulfate administered by crop gavage to reach and fill various portions of the GI tract.

Supportive Care

The three first aid essentials are heat, fluids and gavage.

HEAT

- Provide a warm zone of at least 85-90°F; the bird will seek its optimal temperature.
- Can use heating pad, clamp lamp, ceramic heat emitter, light bulb on one side of bird's own cage wrapped in plastic wrap or a cage placed in a room with a space heater.
- Must use a thermometer to monitor cage temperature.
- Advise client to transport sick bird to hospital in warm enclosure.
- In the hospital use heated enclosure, incubator, heated room.

FLUID THERAPY

Indications include birds that:

- are critically ill or injured
- are dehydrated (for any reason).
- present for a surgical procedure.
- present with a hematocrit value above 55%.
- present with a total protein level of <2.0 mg/dl or >3.5 mg/dl (with caution).
- present with a blood glucose level of <200 mg/dl or >600 mg/dl.

- If prolonged fluid therapy is indicated, or if serum potassium values are low (<4.0 mEq/L), potassium may be added to fluids.
- Rate of administration of potassium should not exceed 0.5 mEq per kg body weight per hour.
- Commercially prepared fluids may be used.
- Preference: 2.5% dextrose in half-strength lactated Ringer's; 2.5% dextrose in 1/2 normal saline; Ringer's, 5% dextrose/water.
- Fluids should be warmed and delivered at 38-39°C (91-102°F) over ~10 minutes.
- Approximate maximum initial IV bolus fluid doses:

Finch:	0.5 ml
Budgerigar:	1.0 ml
Cockatiel:	2.0 ml
Conure:	6.0 ml
Amazon	8.0 ml
African grey:	8.0 ml
Cockatoo:	12-14.0 ml
Macaw:	12-14.0 ml

- Subcutaneous fluid doses:

Budgerigar:	1-2 ml
Cockatiel:	3-8 ml
Amazon:	15-20 ml
African grey:	15-20 ml
Macaw:	20-35 ml

GAVAGE

- If the bird will eat on its own, place familiar foods for easy access by the bird; use gavaging for supplementing calories.
- Commercial emergency formulas: Recovery® (www.harrisonsbirdfoods.com), Emeraid I®, Emeraid II® (www.lafeber.com), Vivonex® (www.novartisnutrition.com)
- Homemade gavage formula: 1 cup baby oatmeal, 1 Tbs Nutrical® and enough warm water to make a thin cake batter consistency; add small amount of soluble vitamins.
- Must mix to consistency for easy passage through gavage tube.
- Give warmed mixture slowly.
- Begin with approximately ½ of the suggested volume and increase as needed.
- Use metal feeding "needles" or soft red rubber French catheter; if a soft catheter is used, a mouth speculum is necessary.
- Hold the patient in a towel with the neck completely extended by placing the fingers around the mandible.

- Pass the tube from the left commissure of the beak (to prevent chewing) down the esophagus on the right side of the patient's neck.
- Prior to dispensing the contents of the syringe, palpate the tube in the crop as well as the trachea as a separate entity.
- Withdraw the tube and release the bird.
- If the formula backs up, stop, re-aspirate excess, remove tube and let bird rest. Most birds cough, splutter, gurgle and shake out overload.
- If bird continues to vomit or regurgitate, give only warmed fluids. Consider motility modifier medications.
- The crop should be empty before you gavage!
- The bird should be well hydrated. Concurrent fluid therapy may be necessary.
- Approximate doses for gavaging birds:

Budgerigar:	0.5-1.0 ml
Cockatiel:	1.0-2.5 ml
Amazon:	5-10 ml
Macaw:	10-20 ml

Treatment for Shock

- Handle only minimally; provide warm environment, oxygen.
- Presumptively diagnose shock. The bird will not be in shock if the condition has gone on for several hours/days.
- Place an intraosseous or intravenous catheter, use only in birds that do not need to fly. Provide analgesia.
- Take baseline blood samples for packed cell volume, total protein and bicarbonate; record weight. Additional glucose determination may be performed. Postpone other lab tests.
- Calculate degree of dehydration and fluid requirements.
- Initiate isotonic fluid solution at half of fluid deficit for the first 12 hours and give as bolus over ~20 min.
- If blood loss, give vitamin B complex (10 mg/kg thiamine).
- Provide parenteral nutritional support if necessary.
- Initiate antibiotics if fractures, open wounds, or soft tissue injuries are found, or if infectious disease is suspected.
- Monitor PCV, TPR, bicarbonate and urine output.
- Obtain a complete history and initiate diagnostic testing.
- Begin maintenance fluids and start gavage feeding.
- Monitor weight daily until bird is able to self-feed and is sent home, then at least weekly until clinically normal.

Treatment for Non-specific Ingested Toxins

- First aid includes use of GI protectant: slurry of fine activated charcoal (Toxiban®) with water as directed to 15 ml; add 15 ml Pepto Bismol® and ¼ tsp Metamucil®; give 15 ml/kg via stomach tube. Anecdotal efficacy.
- Follow label for dilution of commercial preparations.
- Volume given per bird should be appropriate for crop capacity:

Finch:	0.1-0.5 ml
Canary:	0.25-0.5 ml
Budgie:	1 ml
Lovebird:	1-4 ml
Cockatiel:	2-4 ml
Small parrot:	3-6 ml
Medium parrot:	10-15 ml
Large parrot:	20-30 ml

- General GI protectant/cathartic: combine 50 g activated charcoal, 25 g lite MgO, 25 g kaolin, 25 g tannic acid. Dissolve 25 g of mixture in 240 ml water, gavage.

Euthanasia

- Overdose of barbiturate by IV injection.
- Isoflurane anesthesia delivered with oxygen until death.
- Can use cotton ball soaked in isoflurane in a small cone or syringe casing. Bird may need to be tranquilized first. (Avoid holding wet cotton directly on nares — it is an irritant, the bird panics, and employee will be exposed). Better to place it in the end of a container and have bird breathe close to it, but not touching.

Professional Associations for the Avian Practitioner

- Association of Avian Veterinarians (www.aav.org)
- American Association of Avian Pathologists (www.aaap.info)
- American Association of Wildlife Veterinarians (www.aawv.net)
- American Association of Zoo Veterinarians (www.aazv.org)
- American Board of Veterinary Practitioners (www.abvp.com)
- American College of Poultry Veterinarians (www.acpv.info)
- American College of Zoological Medicine (www.aczm.net)
- Wildlife Disease Association (www.wildlifedisease.org)

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Available from the Association of Avian Veterinarians
www.aav.org

- Proceedings of Annual Conferences of the AAV, 1982 to present
- Proceedings of Conferences of the European Committee of AAV, 1991 to present (odd years only)
- Journal of Avian Medicine and Surgery, 1994 to present

Available from Krieger Publishing
www.krieger-publishing.com

- Tully TN, Shane S (eds): Ratite Management, Medicine & Surgery, 1996.

Available from American Board of Veterinary Practitioners
www.abvp.org

- Reading list for practitioners interested in avian board certification.

Conversion Factors: SI Units/Gravimetric Units

Analyte	To convert		Multiply by	To convert		Multiply by
	From	To		From	To	
Albumin	g/dl	g/L	10.0	g/L	g/dl	0.1
Ammonia	μg/dl	μmol/L	0.5871	μmol/L	μg/dl	1.7
Bilirubin	mg/dl	μmol/L	17.1	μmol/L	mg/dl	0.059
Calcium	mg/dl	mmol/L	0.25	mmol/L	mg/dl	4.0
Chloride	mEq/L	mmol/L	1.0	mmol/L	mEq/L	1.0
Chloride	mg/dl	mmol/L	0.272	mmol/L	mg/dl	3.5
Cholesterol	mg/dl	mmol/L	0.02586	mmol/L	mg/dl	38.7
Corticosterone	μg/dl	nmol/L	28.9	nmol/l	mg/dl	0.0346
Cortisol	μg/dl	nmol/L	27.59	nmol/l	mg/dl	0.0362
Creatinine	mg/dl	μmol/L	88.4	μmol/L	mg/dl	0.0113
Globulin	mg/dl	g/L	10.0	g/L	mg/dl	0.1
Glucose	mg/dl	mmol/L	0.05551	mmol/L	mg/dl	18.0
Insulin	μU/ml	pmol/L	7.175	pmol/L	μU/ml	0.1296
Iron	μg/dl	μmol/L	0.1791	μmol/L	μg/dl	5.58
Lead	μg/dl	μmol/L	0.04826	μmol/L	g/dl	20.72
Magnesium	mEq/L	mmol/L	0.5	mmol/L	mEq/L	2.0
Magnesium	mg/dl	mmol/L	0.4114	mmol/L	mg/dl	2.43
Phosphate (inorganic)	mg/dl	mmol/L	0.3229	mmol/L	mg/dl	3.097
Potassium	mEq/L	mmol/L	1.0	mmol/L	mEq/L	1.0
Pressure	mmHg	Pa (pascal)	0.1333	Pa (pascal)	mmHg	7.5
Progesterone	ng/dl	nmol/L	0.032	nmol/L	ng/dl	31.25
Protein	g/dl	g/L	10.0	g/L	g/dl	1.0
Sodium	mEq/L	mmol/L	1.0	mmol/L	mEq/L	1.0
Thyroxine	μg/d	nmol/L	12.87	nmol/L	μg/dl	0.0777
Triglycerides	mg/dl	mmol/L	0.01129	mmol/L	mg/dl	88.5
Urea	mg/dl	mmol/L	0.167	mmol/L	mg/dl	6.0
Urea nitrogen (BUN)	mg/dl	mmol/L	0.7140	mmol/L	mg/dl	1.4
Urea nitrogen (BUN)	mg/dl	mmol urea/L	0.3670	mmol urea/L	mg/dl	2.72
Uric acid	mg/dl	mmol/L	59.48	mmol/L	mg/dl	0.0168

Although every effort has been made to ensure the accuracy of the information presented herein (particularly doses), in all cases the clinician is responsible for the use of any pharmaceuticals. Most drugs used in exotic companion species are considered extra-label, and few pharmacokinetic studies have been conducted; therefore, the clinician must critically evaluate the information provided and stay informed of recommendations in the literature. See also specific formularies for Pigeons and Raptors in those sections.

AVIAN FORMULARY

DRUG	ROUTE	DOSAGE	COMMENTS
Acetic acid (apple cider vinegar) organic, non-filtered, non-pasteurized	PO	15 ml/qt drinking water	For asymptomatic birds with gram-negative rods and/or yeast on oral or fecal Gram's stain
Acetylsalicylic acid (5 gr tab). Can also use 4 "baby aspirin" at 80 mg ea	PO	1 tab/250 ml water (change water q12h), 5 mg/kg q8h	Analgesic, antipyretic, anti-inflammatory, anticoagulant, uricosuric, Efficacious for egg-related embolisms and peritonitis, Don't combine with tetracycline, insulin or allopurinol or other NSAIDs
Aspirin	PO	0.5-1.0 mg/kg q12h	May combine with omega fatty acid therapy for histopath-confirmed glomerulonephropathy
ACTH stimulation test	IM	Baseline at 0 h, Give 16-26 IU, Sample at 1-2h	May not be valid in birds because of the stress of handling and venipuncture
Activated charcoal	PO	200-800 mg/kg as needed	Antitoxin, May cause constipation, Chronic use depletes vitamins, esp. vitamin B
Acyclovir (200 mg cap/tab, 50 mg/ml suspension)	PO, IV, IM	80 mg/kg q8h, Up to 240 mg/kg food (400 mg/qt food), 20 mg/kg PO q12h x 7d, 50 mg/4 oz H_2O x 21d	Antiviral activity against avian herpesvirus, Potentially nephrotoxic, Anecdotal evidence for use against polyoma-virus

AVIAN FORMULARY

DRUG	ROUTE	DOSAGE	COMMENTS
Allopurinol (100 mg tab)	PO (water)	Budgerigar: crush 1 tab in 10 ml water, Give 1 ml/30 ml water, Make fresh several times daily. Psittaformes & Columbiformes: 10-30 mg/kg q24h longterm	Gout (effect is not understood - different mechanism in birds), Possible hepatotoxicity, Monitor uric acid levels weekly, If overdosed, birds get hyperactive, Toxic in red-tailed hawks at 50 mg/kg PO q24h
Aloe vera solution	Topical	0.5 oz/pint of water, use as spray, Formula: 0.5 oz aloe vera oral liquid with 1 tsp ammonium solution (Penetran®) + 2 drops mild detergent to 1 pint water	Solution for treating pruritic skin lesions, Caution when using any solution containing soap, Avoid in birds that show post-use depression
		5 ml aloe vera juice + 1000 units heparin + distilled water to equal 120 ml (4 oz). Keep refrigerated. Apply with cotton swab q8-12h	Solution for wing web/axial lesions (eg, lovebirds), This is Dr. Greg Harrison's solution reduced to a 4 oz size, which is easy to dispense in a bottle
Amikacin (50 mg/ml and 250 mg/ml)	IV, IM, SC	10-15 mg/kg q8-12h, Cockatiels: 15-20 mg/kg q8-12h	Can be nephrotoxic, Maintain hydration
Aminopentamide hydrogen sulfate (Centrine® 0.5 mg/ml)	IM, SC	0.05 mg/kg q8-12h x 3d with tapering dose, 5 doses maximum	Anti-emetic, Cholinergic blocker, Do not use with GI obstruction (see notes on atropine)
Aminophylline (25 mg/ml)	IV, PO	10 mg/kg IV q3h, After initial response can be given orally	Diuretic, Vasodilator, Cardiac stimulant, For lung edema

AVIAN FORMULARY

DRUG	ROUTE	DOSAGE	COMMENTS
Amitryptiline HCl	PO	1-2 mg/kg q24h	Tricyclic antidepressant, Do not use in birds on thyroid replacement or with impaired liver function (see notes on doxepin)
Ammonium solution (Penetran® ointment)	Topical	As needed. Follow application instructions as for humans	Analgesic, antipruritic, anti-inflammatory, Reduces swelling and relaxes muscles, Can be used on fresh wounds, Avoid overuse
Amoxicillin (250 mg/ml injectable)	IM	150 mg/kg q8h	Used to prevent pasteurellosis from animal bites, May require other antibiotics if bite is severe (eg, IV cefazolin)
Amoxicillin w/ clavulanate (Clavamox®)	PO	125 mg/kg q12h	Don't use with allopurinol, May have variable absorption
Amoxicillin	PO	200-400 mg/L in drinking water, 300-500 mg/kg in soft food	Canaries
Amphotericin B (5 mg/ml)	IV	1.5 mg/kg q8-12h for 3-7d	Fungal infections, Nephrotoxic, Maintain diuresis, Caution: extravascular reactions can be severe, Will precipitate out in saline, Once diluted with sterile water, freeze in 10 ml aliquots at -20°C, dilute 1:50 with 5% dex prior to IV or nebulization use (final concentration 0.1 mg/ml)
	In trachea, air sac	1 mg/kg q8-12h	
	Nebulize	1 mg/ml water (15 min q12h)	
Amphotericin B (3% cream)	Topical	q12h	

AVIAN FORMULARY

DRUG	ROUTE	DOSAGE	COMMENTS
Ampicillin	PO, IM	100-200 mg/kg q6-8h, Chicken: 150 mg/kg PO q6h, Blue-naped Amazon: 50-100 mg/kg IM q48h, Emus, cranes: 15-20 mg/kg IM q8h, Gallinules: 25 mg/kg IM q8h	Erratic absorption orally (this form is of little value for avian diseases)
	PO	1000-2000 mg/L drinking water, 2000-3000 mg/kg in soft food	Canaries
Ampicillin (100 mg/ml)	IM	Psittacines: 100-150 mg/kg q4h	To prevent pasteurellosis from animal bite, May require other antibiotics if wounds are severe (eg, IV cefazolin)
Amprolium (Corid® 9.6% solution)	Water	2-4 ml/gallon x 5d	Coccidiostat, Birds may not drink medicated water
Arginine vasotocin	IV	Physiological chicken dose: 40 mg/kg, Desert quail: 10 mg/kg	Antidiuretic, Causes shell gland contraction, possibly causing premature ovulation and oviposition, May cause hypertension from fluid overload, Freeze small volumes in sterile vials for long-term storage
Ascorbic acid (Vitamin C) (250 mg/ml), chewable flavored tablets in various strengths available	IM	20-40 mg/kg, daily to weekly	Support for infectious or debilitating metabolic diseases, Augments conversion of folic acid to its active form, Increases iron absorption (caution in those birds prone to hemochromatosis), May cause diarrhea, Do not use if oxalate crystals in urine
Atipamazole (Antisedan®)	IM	250-380 mcg/kg	Reverses medetomidine action

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DRUG	ROUTE	DOSAGE	COMMENTS
Atropine (0.5 mg/ml or 15 mg/ml)	IM, SC	0.2-0.5 mg/kg until cessation of clinical signs, Repeat as needed	Anticholinergic for organophosphate or carbamate toxicosis, May cause increased viscosity to respiratory secretions, Decrease in gut motility, Make sure well oxygenated, Normally not used as avian preanesthetic
Azithromycin (250 mg capsules)	PO	Make solution of 250 mg capsule per 0.25 oz lactulose, Give 1 drop solution/ 100 g BW q12h x 14d, 50-80 mg/kg q24h, Stable if refrigerated for 3-4 wk, Blue & gold macaw: 10-20 mg/kg PO q48h x 5 tx for non-intracellular infection. 40 mg/kg PO q48h x 5 tx for intracellular infections (*Chlamydophila*)	For mycoplasmosis: on 3d off 4d for 21d, For chlamydiosis: on 3d off 4d for 6 wk, May cause overgrowth of *Clostridium* sp. in GI tract, Do not use with hepatic or renal impairment, May cause GI upset, Very expensive drug
Benzathine penicillin G	IM	100 mg/kg q24-48h (turkeys)	May cause death if administered IV
Buprenorphine	IM	0.02 mg/kg q8-12h	Opiate analgesic, Can have some respiratory depression in debilitated or dehydrated birds
Butorphanol tartrate - Torbubesic® (1,5,10 mg); Torbutrol® (10 mg/ml)	PO, IV, IM	1-4 mg/kg PRN not to exceed q4h	Synthetic opiate used for abdominal and post-surgical pain
Calcitonin	IM	4 IU/kg q12h 2 wk	Treatment of hypercalcemia secondary to neoplasia or choleciferol analogs (rodent poison) toxicity. Monitor calcium levels, Diurese, May also require steroids and activated charcoal for toxicity

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DRUG	ROUTE	DOSAGE	COMMENTS
Calcium disodium versenate (CaEDTA 200 mg/ml)	IM	35 mg/kg q12h x 5 d, off 3-4d, then repeat	For chelation of heavy metal toxicosis: beryllium, copper, cerium, iron, zinc, lead, May add 2% Metamucil® in peanut butter to help remove metal particles, Keep hydrated, Caution with renal or hepatic impairment
Calcium gluconate	Water	5 ml/30 ml of water	Use as calcium supplement
Calcium gluconate (50 mg/ml), calcium lactate (50 mg/10 ml)	IM, SC, IV	5-10 mg/kg q12h as needed	When giving calcium, hydration must be maintained, Be careful when administering lactate, Bird needs a well functioning liver to break it down to bicarbonate
Calcium gluconate	IV- diluted	50-100 mg/kg, slowly to effect	For hypocalcemic tetany, Maintain hydration
Caprillic acid (325 mg)	PO	1/4 capsule/300 g BW	Empirical use in birds, Positive clinical results seen when used with antifungals for aspergillosis in parrots
Carbaryl (5% powder)	Topical	Dust lightly or add to nest box litter for 24h	Used to control mites and ants, only when necessary
Carbenicillin	IM, IV, PO	IM, IV = 100-200 mg/kg q6-12h PO = 200 mg/kg q12h	Good frozen for 30d, Active against some *Pseudomonas* sp. and *Proteus* sp. Renally excreted, May cause GI upset, Maintain hydration
Carnidazole (10 mg tablet)	PO	20-50 mg/kg once	Trichomoniasis, hexamitiasis, histomoniasis, cockatiels with giardia, May need to be repeated in 10-14d

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DRUG	ROUTE	DOSAGE	COMMENTS
Carprofen (Rimadyl®)	PO, IM	5-10 mg/kg q8-12h; IM: 5 mg/kg q12h	NSAIDs, Can be used with opiate analgesic for severe pain
Cefazolin (Ancef®)	IM, IV	25-50 mg/kg q12h	All cephalosporins excreted by kidneys, Reduce dose with renal impairment, Good for staph, strep and gram-negative bacteria, May cause diarrhea, secondary candidiasis, increase in hepatic and renal blood values, Stable for 10d in refrigerator, 48h room temp, Can be frozen
Cefotaxime sodium (Claforan® 10-300 mg/ml)	IM, IV	75-100 mg/kg q4-8h; Blue-fronted Amazon: 100 mg/kg IM q6-8h, 50-100 mg/kg q8h	Broad-spectrum, Penetrates CSF, May be frozen for 13 wk (thaw at room temperature), refrigerate for 5d
Cefoxitin sodium (Mefoxin® 10-400 mg/ml)	IM, IV	50-100 mg/kg q8-12h	
Ceftriaxone (10-250 mg/ml)	IM, IV	75-100 mg/kg q4-8h	May prolong bleeding times
Celecoxib (Celebrex®)	PO	10 mg/kg q24h, Can make suspension of 10 mg/ml, Keep refrigerated, Lasts 14 days	Adjunct therapy for PDD osteoarthritis
Cephalexin oral suspension (Keflex® 25-100 mg/ml)	PO	Psittacines: 50-100 mg/kg q8h, Emus, cranes: 35-50 mg/kg q6h, 50-100 mg/kg q8h, Quail, ducks: 35-50 mg/kg q2-3h	Varied efficacy for many gram-negative bacteria

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DRUG	ROUTE	DOSAGE	COMMENTS
Chloramphenicol (succinate 100 mg/ml, suspension, palmitate 30 mg/ml)	IM	50 mg/kg q12h	Budgerigars, turkeys, chickens, Egyptian geese
	IM	50 mg/kg q24h	Peafowl, eagles, hawks, owls
	PO	100-200 mg/L drinking water, 200-300 mg/kg soft food	Canaries
Chlorhexidine solution, 2%	PO, topical	10-25 ml/gallon, For wound flush = 1 ml to 39 ml sterile water	Do not use with finches (topical can be fatal in nun and parrot finches)
	Water	10 ml/gal x 7-14, 5-10 mg/kg	Psittacines - to help control virus activity amplification
Chloroquine (Aralan®)	PO	Dissolve 500 mg tab in 5 ml H_2O, Human dose: 10 mg/kg PO once, then 5 mg/kg PO at 6, 24, 48h	For acute plasmodium infections (erythrocytic forms) and extra-intestinal amoebiasis. Will suppress extra erythrocytic forms, May cause visual impairment (irreversible) or seizures, vomiting, Many strains are resistant, Accumulates in the liver (caution in liver impairment), Control mosquitoes
Chloroquine + primaquine		Combine 500 mg chloroquine + 25 mg primaquine in 333 ml H_2O, Give 10 ml/kg PO x 7d for prevention, For treatment = give at 0, 6, 24 & 48 h (0.75 mg/kg primaquine + 15 mg/kg chloroquine)	For plasmodium infection, Stable in refrigerator for 2 wk
Chlortetracycline (25 mg tab)	PO	95 mg/kg q6h, 190 mg/kg q8h	

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DRUG	ROUTE	DOSAGE	COMMENTS
Chlortetracycline	Feed	1% in pelleted feed; only food source x 45d	Psittacines (concurrent treatment for yeast infections)
	Feed	0.5% in millet; only food source x 45d	For small psittacines/finches, Need concurrent treatment for yeast infections
	PO	1000-1500 mg/L drinking water, 1500 mg/kg soft food	Canaries: treat for 30d for chlamydiosis
Chlorsulon 8.5% (Curatrem®)	PO	20 mg/kg q2wk x 3	For flukes
Cimetidine (200, 300, 400, 800 mg tabs, 60 mg/ml suspension, 60 mg/ml, 150 mg/ml injectable solution)	PO, IM, IV	Mammal dose: 2.5-5 mg/kg q6-12h IV (very slow infusion over 30-40 min) 5 mg/kg q6-8h PO	Use for gastric ulcerations, Decreases cloacal acidity, Aids in tenesmus, cloacal papillomas, May potentiate anti-seizure drugs and tricyclic antidepressants, May cause drowsiness
Ciprofloxacin (Cipro® - 250, 500, 700 mg tab, 200, 400 mg/ml injectable)	PO, IV	20-40 mg/kg q12h	Broad spectrum except against most anaerobes, *Pseudomonas, Streptococcus* are becoming resistant, Run sensitivity testing, *Chlamydophila*, *Mycoplasma* only moderately susceptible.
Cisapride (Propulsid®)	PO	0.5-1.5 mg/kg q8h	Gastrointestinal prokinetic agent, Stimulates motility
Clazuril (Appertex®)	PO (feed)	Sand hill cranes: 1.1 ppm in feed x 15d	

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DRUG	ROUTE	DOSAGE	COMMENTS
Clindamycin hydrocholoride (Antirobe®) 25 mg/ml suspension	PO	100 mg/kg q24 h x 7d	For some aerobic/most anaerobic bacteria and clostridia, Good for bone and joint infections
Cephalothin (100 mg/ml)	IM, IV, PO	100 mg/kg q6h, Quail, ducks: 100 mg/kg q2-3h	
Cephradine (25 or 50 mg/ml)	PO	35-50 mg/kg q4h	
Chloramphenicol (succinate 100 mg/ml, suspension, palmitate 30 mg/ml)	IM, PO (SC - cranes)	80 mg/kg q12h or q8h parenteral, 30-50 mg/kg PO q6-8h, Cranes: 100 mg/kg SC q8h	Good tissue penetration, Broad-spectrum bacteriostatic antibiotic, Causes blood dyscrasis in humans, not reported in birds, Wear gloves when handling
	IM, IV	100 mg/kg q6h	Chinese spot-billed ducks
	IM	50 mg/kg q6h	Macaws, nanday conures, sun conures
Clomipramine hydrochloride	PO	3 mg/kg q12h	May help increase cloacal sphincter tone in prolapsing birds
Clotrimazole (Lotrimin® 1%) solution	Nebulize	30-45 min q24h x 3d, off 2d, May need for 1-4 mo	Fungicide, For patients with aspergillosis when stable and out of respiratory distress
Colchicine (0.5 mg tab, 0.5 mg/ml injectable)	PO, IV	0.04 mg/kg q24h, gradually go to q12h	Uricosuric, Prevent hepatic fibrosis, Will inhibit tubular excretion of penicillins, May cause hypertension, hypothermia, Potentiates CNS depressants

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DRUG	ROUTE	DOSAGE	COMMENTS
Copper sulfate (51% powder)	Topical	q24h	Not for deep wounds, Very caustic, Destroys granulation bed, If ingested, causes gastric irritation and possible copper toxicity
Cyanocobalamin (vitamin B_{12} 1, 3 μg/ml)	IM	250-500 μg/kg once/week	
Danofloxacin	Water	50 ppm for 3d (day-old chicks)	Superior to tylosin for treating *M. gallisepticum*
Deferoxamine mesylate (Desferal® 500 mg/via, Reconstitute to 250 mg/ml)	SC, PO	100 mg/kg q24h (may take 3 mo)	Iron chelation in hemachromatosis, Suggest monthly biopsies to quantitate liver iron, May give reddish color to urine, Don't use if renal impairment
Desoxycorticosterone acetate		4 mg/kg q24h	For confirmed Addisonian (ACTH test)
Derm caps liquid	PO	0.1 ml/kg q24h	
Dexamethasone	IM, IV	0.5-2 mg/kg q24h, Use 1 mg/kg with HcG	Use with caution, Consider antimicrobial therapy, Use as in mammals: shock, inflammation, egg-related peritonitis, Use in chronic egg layers in combination with HcG. DO NOT use concurrently with NSAIDs
Dextrose (5% = 50 mg/ml, 50% = 500 mg/ml)	IV	50-100 mg/kg, slowly	Should measure blood glucose level prior to use, For seizuring birds

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DRUG	ROUTE	DOSAGE	COMMENTS
Diazepam (5 mg/ml injectable, Do not dilute)	IM, IV	0.5-1 mg/kg q12h, q8h	For seizures, Cimetidine delays clearance, May cause hypotension, Rapid IV can exacerbate seizures, increase intracranial and intraocular pressure, Caution in renal and liver impairment
	PO	2.5-4 mg/kg as needed	For calming effect
Digoxin solution (0.05-15 mg/ml)	PO	0.02-0.05 mg/kg q12h, then maintenance at 0.01 mg/kg q12h	For congestive heart failure in conures, parakeets, Positive inotrope, negative chronotrope, Caution in patients with impaired renal function (give lower dose), Monitor closely: potassium, magnesium, calcium levels
Dimercaprol (BAL®)	IM	2.5-5.0 mg/kg q4h x 2d, then q12h x 10d or until recovery	For arsenic and gold toxicosis; mercury if ingestion <2h, With CaEDTA helps in lead excretion
Dimethyl sulfoxide 90% (DMSO®)	Topical	1 ml/kg q4-5d or weekly	For edema, pain, swelling, Paint a thin film over the area, Wear gloves when applying, Absorbed cutaneously and distributed systemically, Causes vasodilation and histamine release
Dimetridazole (Emtryl®)	PO (gavage)	Budgerigar stock solution = 1 tsp/pt water, dose = 0.5 ml/30 g repeat at 12 and 24h	Giardia, anaerobes, Not available in the US, Extremely hepatotoxic, Can cause death, Watch hydration
Dimetridazole (Emtryl®)	PO (water)	1 tsp/gallon (lories & mynahs = ½ tsp/gal), Canaries = 100 mg/L	

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DRUG	ROUTE	DOSAGE	COMMENTS
Diphenhydramine HCl (25, 50 mg cap, 2.5 mg/ml oral, 10 or 50 mg/ml injectable)	PO, IM, IV	0.5 tsp/8 oz water or 2-4 mg/kg q12h	Has calming effect in some anxious birds, Do not give with monoamine oxidase inhibitors (see atropine precautions), May cause hypotension
Doxepin (Sinequan®, Adapin®)	PO	0.5-1.0 mg/kg q12h	Tricyclic antidepressant, Rotation trials in feather picking birds, May temporarily increase liver enzymes, May increase intraocular pressure, cause urinary retention and seizures, Do not use with MOA inhibitors, crimetidine, anticholinergics, Discontinue in a tapering dose
Doxycycline (Vibravenös®)	IM	75-100 mg/kg SC or IM q7d x 4 then q6d then q5d x 2	May cause injection site hemorrhage and necrosis in all IM or SC dosing, Only available in Europe and Canada
Doxycycline (Vibramycin® calcium syrup 10 mg/ml)	PO	50 mg/kg q24h	Cockatiels, orange-winged Amazons, blue-fronted Amazons
Doxycycline	PO	0.1% in feed	Amazons, cockatoos, African grey parrots
	PO	25-50 mg/kg q24-48h	Green-winged macaws
	PO	25 mg/kg q24h	African greys, goffin's cockatoos, blue and gold macaws
	PO	25 mg/kg q12h	Senegal parrots
	PO	250 mg/L water, 1000 mg/kg soft food	Canaries: treat for 30d for chlamydiosis
	PO	8 mg/kg q12-24h	For nectar eaters

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DRUG	ROUTE	DOSAGE	COMMENTS
Doxycycline (Vibramycin® hyclate 10 mg/ml)	IV	25-50 mg/kg	Use once to get peak dose in critical cases (psittacines)
d-penicillamine (125, 250 mg caps, 250 mg tabs)	PO	55 mg/kg q12h on 1-2 wk, off 1 wk, repeat as needed	For heavy metal toxicity, esp copper, lead, zinc, mercury, Often used with EDTA until asymptomatic, Give on empty crop/proventriculus
d-penicillamine 125 mg cap in 15 ml lactulose		1 drop/100 g BW PO q12h x 5-10d	
Echinacea	PO	Mix 15-28 drops with 1/2 oz lactulose: 1 drop mix/100 g q12h (<200g BW), 1 drop/300 g q12h (>200g BW)	Immunostimulant, anecdotal efficacy, Use alcohol-free
Enalapril	PO	0.2-0.5 mg/kg q24h Up to 1 mg/kg PO q24h	ACE inhibitor, hypotensive for use in early cardiac disease. May try before digoxin. Can combine with diuretic. May titrate dosage upward as needed. Evaluate effectiveness with echocardiography
Erythromycin (powder)	Water	500 mg/gallon drinking water, Finches for mycoplasma: 300 mg/L H_2O x 10d	Will form L-bodies esp when treating salmonellosis, Don't use with hepatic impairment, Hepatotoxic, concentrates in the liver, May not have good absorption in birds, Don't use with lincomycin or clindamycin, theophylline
Erythromycin (100-200 mg/ml injectable)	Nebulize	200 mg/10 ml saline, 15 min q8h	Nebulize with caution as vehicle is polyethylene glycol, Can cause severe necrosis IM, Cannot be given IV

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DRUG	ROUTE	DOSAGE	COMMENTS
Enrofloxacin (Baytril® 22.7 mg/ml injectable)	IM, PO	7.5-15 mg/kg q12h, Finches: 100-200 mg/L drinking water x 5-10d, Senegals: 15 mg/kg IM q8-12h (no good if MIC is > 30), Budgies, African greys, cockatoos: 15 mg/kg q12h	African greys, Amazons, cockatoos: can use injectable orally, Should not be used with liver or renal impairment, Do not use in growing animals, May no longer be effective against *Pseudomonas* sp., May cause *Streptococcus* and *Clostridium* spp. overgrowth
	Feed	500 mg/kg mixed with cooked corn x 14d, 200 ppm x 14d	
	PO	200 mg/L drinking water, 200 mg/kg soft food	
Fenbendazole (100 mg/ml suspension)	PO	For ascarids: 20-50 mg/kg, repeat 10d, For flukes and microfilaria = 20-50 mg/kg q24h x 3d, For capillaria: 20-50 mg/kg q24h x 5d, Ratites: 15 mg/kg PO, Finches: 50 mg/L drinking water x 3d, For giardia in cockatiels: 1 drop/day x 2d, repeat in 14d	Dangerous in canaries, possibly ibis, California quail and pigeons, Do not use during a molt or in pinfeather stage, Low margin of safety
Ferric subsulfate	Topical	As needed	Restrict use to hemorrhage of beak and nails as it will cause tissue necrosis
5-fluorocytosine	Gavage	250 mg/kg q12h or 120 mg/kg q8h	Psittacines, mynahs: antifungal, Caution with renal or liver impairment, Excreted by kidneys, May cause anemia & GI upset

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DRUG	ROUTE	DOSAGE	COMMENTS
Erythromycin	PO	125 mg/L drinking water, 200 mg/kg soft food	Canaries
Erythromycin (40 mg/ml)	PO	45-90 mg/kg q12h x 5-10d	May cause GI upset
Ethambutol (100-400 mg tab)	PO	15 mg/kg q12h	Controversial therapy for TB, Caution with renal or hepatic impairment, May cause visual impairment, carditis, GI upset
Flucytosine	PO (feed)	50-250 mg/kg feed	
	PO	African grey: 50 mg/kg q8h or 60-100 mg/kg q12h, Psittacines: 150-250 mg/kg q12h or 75-120 mg/kg q12h x 2-4 wk	
Fluconazole (50, 100, 200 mg tab, 2 mg/ml injectable)	PO, IV	May dissolve 200 mg in 1 ml HCl then add 99 ml sterile H_2O, Cockatoo, African grey, Amazon: 20 mg/kg PO q48h, For *Cryptococcus* in psittacines: 8 mg/kg PO q24h x 30d, For *Candida* in psittacines: 10 mg/kg PO q24h x 10-30d	May cause regurgitation
Flunixin-meglumine (50 mg/ml injectable)	IV, IM	1-10 mg/kg	NSAID, analgesic, anti-inflammatory, antipyretic (hyperthermia), Can cause GI ulceration, Do not combine with other NSAIDs or steroids

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DRUG	ROUTE	DOSAGE	COMMENTS
Furazolidone	Oral	100-200 mg/L water, 200 mg/kg soft food	Canaries
Furosemide (50 mg/ml injectable)	IV, IM	0.15-2 mg/kg q12-24h	Diuretic, Low therapeutic index, Lories: very sensitive, watch potassium levels, Will increase nephrotoxicity of aminoglycosides and should not be used to treat anuria secondary to aminoglycoside toxicities, Do not use with steroids (including K+ loss), Caution with liver impairment
Furosemide (oral)	PO	0.1-0.2 mg/kg/day	Useful edema, pericardial effusion, reduces cardiac pre + after load. Long term use may lead to K+ deficiency (may cause arhythmias). Observe for dehydration. Good in combination initially with ACE-blocker or glycosides.
Gentamicin	IM	Cockatiels: 5-10 mg/kg q8-12h	Only for resistant infefctions, Maintain hydration
Gentian violet (powder, 16 mg/ml solution)	Feed, topical	0.5-1.0 g/kg of feed, Paint lesions with 0.25-0.5%	Resistant *Candida* strains, Caution when using in feed, May cause ulceration of mucous membranes and mucosa laryngeal paralysis, Other anti-fungals may be safer
Glipizide	PO	1.25 mg/kg q24h	In mammals stimulates insulin secretion, Metabolized in liver, Do not use if ketoacidotic, Efficacy not established in birds, May precipitate cardiovascular collapse and GI upset, Caution in liver and/or renal impairment

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DRUG	ROUTE	DOSAGE	COMMENTS
Guanidine	PO	15-30 mg/kg	As adjunct therapy for treatment of botulism
Haloperidol (50, 100 mg/ml injectable)	IM	1-2 mg/kg every 2-3 weeks	Seldom used
Haloperidol (2 mg/ml solution)	PO	0.2 mg/kg q12h for birds <1 kg, 0.15 mg/kg q12-24h for birds >1 kg	For compulsive/obsessive behavior, Commonly fails, May work because increases prolactin levels, May cause neuroleptic malignant syndrome, hypotension, anorexia, impaired liver function, broody behavior, cataracts, Do not use with anti-seizure drugs
Hemicellulose (psyllium, sterilized by autoclave)	PO	<1% of diet or hand-feeding formula	Improves calcium absorption, hypercholesterolemia, Bulk laxative to remove GI metal, Caution: gel may form in crop of some birds and act as foreign body in neonates (day 1-7), Use with caution in cockatiels
Heparin	Topical	PRN, 1000 IU/150 mg aloe vera	Treatment for sores, Anti-inflammatory properties
	IV	5 IU/ml blood	For transfusions
	IV	300 IU/kg q4h	For treatment of PTFE toxicosis: use in conjunction with aminophylline (0.75 mg/kg q4h) and dexamethasone (0.8 mg/kg q4h) until dyspnea is controlled
	Catheter flush	0.25 ml in saline	Flush catheter q4h

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DRUG	ROUTE	DOSAGE	COMMENTS
Heparin 1000 units/ml sodium injection	SC, IV, topical	SC: 40-50 U/kg q8h, IV: 300 U/kg q12h, Topical: 1000 U/ml aloe vera	Helps decrease swelling, inflammation, Given IV for non-stick coating toxicity
Hetastarch (6% in 0.9% NaCl)	IV	Use at fluids dose	Blood replacement to increase total solids
Hetastarch colloid (starch-base colloid solution)	IV	10-15 ml/kg given slowly	Give 1-4 treatments over 24 hours. For hypoproteinemia, hypovolemia (helps intravascular volume expansion to increase perfusion pressure and oxygen delivery)
Human chorionic gonadotropin (HCG - 10,000 IU/10 ml vial)	IM	500-1000 IU/kg (generally effective) q3-6wk, Give with dexamethasone on days 1,3,7,14 for egg-laying	Used for sexual feather plucking in female birds and for egg-laying, More research needed
Human gamma globulin (Gammar)	IV	150 mg/kg q7d for 4 wk then q4wk for 5 mo	Efficacy in birds unknown, anecdotal, Anaphylactic reactions may occur
Hyaluronidase (Wydase®) 1500 IU/10 ml vial	PO	1 ml/L fluids	Mix freshly weekly, Store in refrigerator, For rapid administration of SC fluids
Hydrochloric acid (1 m/L solution)	Water	30 ml/gallon drinking water x 10d	Enterobacteriaceae, macrorhabdosis, candidiasis in asymptomatic birds, Use alone or in combination with lactulose, hemicellulose and pharmaceuticals in ill birds
Hydroxyzine HCl syrup	PO	2.2 mg/kg q8h or 4 mg/4 oz drinking water	Lowers the threshold for seizures, Hypotensive, anti-anxiety, antipruritic and antihistamine action

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DRUG	ROUTE	DOSAGE	COMMENTS
Insulin NPH U40	IM	Cockatiel: 1.4 units/kg q12-24h, Toco toucan: 0.01 to 0.1 units/kg q12-24h, Budgie: 0.3 to 3.0 units/kg q12-24h	Must monitor with glucose curve, Use appropriate insulin diluents, Many birds have normal insulin and high glucagons levels, May not work
Interferon (Actimmune)	SC	1-2 IU q24h on 7d off 7d	Caution with liver impairment, Anecdotal efficacy
Iron dextran (100 mg/ml)	IM	10 mg/kg, repeat in 7-10d if needed	Used in malnourished and iron deficient birds, Contraindicated in potentially hemachromatosis birds
Isoniazid (300 mg tab)	PO	15 mg/kg q12h	Controversial for TB treatment, May cause fatal hepatitis, peripheral neuropathy and vomiting
Itraconazole (100 mg caps & 10 mg/ml syrup), European formulation may have better oral absorption (human trials)	PO	5-10 mg/kg q12h, *Candida* in cockatiels: 5 mg/kg q24h, Double yellow-headed Amazons: 5-20 mg/kg q12h x 10d	Aspergillosis, candidiasis, *Cryptococcus* in Psittaciformes, Anseriformes, penguins, Reported side effects in parrots, Caution in African greys (may cause hepatitis, hypokalemia and bone toxicity)
Ivermectin (10 mg/ml injectable)	IM, PO, Topical	200 μg/kg, repeat 10-14d, Budgies: 67 μg/kg	Nematodes, lice, mites, Reported toxicity in finches/orange-cheeked waxbills
	PO	0.8-1.0 mg/L H_2O (not water soluble)	Canaries

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DRUG	ROUTE	DOSAGE	COMMENTS
Ketoconazole (200 mg tab)	PO	Gavage or by dropper: 20-30 mg/kg q12h for 21d, Psittacines: 30 mg/kg q12h, For candidiasis in swans: 12.5 mg/kg q24h x 30d	Hepatotoxic in mammals
	PO	Dissolve 1/4 tab (200 mg) in 0.2 ml N HCl and 0.8 ml water, Mix with lactulose	Canaries
	PO	200 mg/kg in soft food	
Ketoprofen (Ketofen®)	IM	5-10 mg/kg	NSAIDs, Better than flunixin but not as good as carprofen, meloxicam
Lactobacillus (avian)	PO	1 pinch/day/bird or 1 tsp/ quart of hand-feeding formula	Avian *Lactobacillus* sp, Probiotic for stimulation of autochthonous bacterial regrowth
Lactulose (667 mg/ml suspension)	PO	0.3-0.7 ml/kg q8-12h	To reduce toxins, Restore GI flora in liver-damaged birds, Carrier for oral meds, Overdose causes diarrhea, Can use for 7d to months, Decrease dose if diarrhea, Caution in birds with diabetes mellitus
Leuprolide acetate 7.5 mg 30 day formulation (Lupron® kit = dilute to concentration of 500 μg/ml)	IM	One injection q2wk x 3, <300 g BW give 750 μg/kg, >300 g give 500 μg	Use for treatment of chronic egg laying, cystic ovulation, egg yolk peritonitis, ovarian granulomas, feather picking, behavior problems related to sexual aggression

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DRUG	ROUTE	DOSAGE	COMMENTS
Levamisole (136.5 mg/ml injectable, 20 mg tab)	Gavage	Australian parakeets: 15 mg/kg, repeat in 10d, Anseriformes: 20-50 mg/kg, Ratites: 30 mg/kg PO q10d,	Low therapeutic index, Seldom used, Metabolized in the liver and renally excreted, Lethal in white-faced ibis
	PO (water)	5-15 ml/gallon x 1-3d, Finches: 80 mg/L drinking water x 3d	
	IM, SC	2 mg/kg IM q14d x 3, Immune modulator	Most dangerous route, immunomodulator reactions seen in white cockatoos
Levothyroxine (0.1, 0.2, 0.3, 0.5, 0.8 mg tabs, 0.4 mg/ml suspension)	PO	20 μg/kg q24h-q12h	For true hypothyroidism, Chronic disorders (respiratory, dermal), Use is controversial, Can cause hypertrophic cardiomyopathy if levels are above euthyroid levels, Should first diagnose with a TSH stimulation test
Lincomycin	PO	100-200 mg/L water, 200 mg/kg soft food	Canaries
Lugol's iodine	Water	2 ml/20 ml water for stock solution, Give 1 drop/250 ml water	For goiter, Excess may cause thyroid hyperplasia, Unnecessary if bird is being fed a formulated diet
Mannitol (20 or 180 mg/ml)	IV	0.5 mg/kg slowly q24h	Brain edema, osmotic diuretic, caution if intracranial hemorrhage

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DRUG	ROUTE	DOSAGE	COMMENTS
Mebendazole (40 mg/g soluble powder, 33.3 mg/ml suspension)	PO	Psittacines: 25 mg/kg q12h x 5d, Anseriformes:5-15 mg/kg q24h x 2d	For nematodes, May need to repeat monthly, May not work for ventricular/proventricular parasites, Reports of toxicity in finches, psittacines, pigeons (12 mg/kg), Necrotic enteritis in penguins, cormorants, pelicans
Medazoline	IM	Amazons: 2-3 mg/kg, Waterfowl: 4-6 mg/kg	See diazepam
Medroxyprogesterone acetate (100 mg/ml injectable, 2.5, 5, 10 g tabs)	IM, SC	5-25 mg/kg q4-6wk	May increase or decrease LH depending on time in cycle given or increase or block ovulation, If given to a bird without an oviduct, ovulation into the coelomic cavity may occur, Seldom used due to side effects, primarily obesity, diabetes mellitus, salpingitis, molt, PU/PD, lethargy, thromboemboli, liver impairment, prolonged bleeding times, hypothyroidism
Meloxicam (Metacam®)	SC, IM, PO	0.2-0.4 mg/kg q12-24h, May need higher doses in smaller psittacines	NSAIDs, Can be combined with opiate analgesics. Do not use with other NSAID or corticosteroids, Injectable form may be irritant, Use acutely and switch to oral
Meperidine (Demerol®)	IM	1-4 mg/kg. Short duration of action compared to other opiates	Do not use with other CNS depressants, Hypotensive, Decreases respiratory effort, increases airway resistance, May aggravate cardiac arrhythmias and seizure activity, Caution with renal, hepatic impairment, hypothyroidism, Addison's disease or urethral stricture

AVIAN FORMULARY

DRUG	ROUTE	DOSAGE	COMMENTS
Methocarbamol (Robaxin-V®)	IV, PO	Swans, demoiselle cranes: 50 mg/kg slow IV, avoid extravasation, 32.5 mg/kg PO q12h	For capture myopathy, CNS depressant, Do not use injectable with renal impairment (polyethylene glycol vehicle)
Methylprednisolone acetate (20, 40 mg/ml injectable)	IM, PO	0.5-1 mg/kg	To control allergies (eg, Amazon foot necrosis), Orally once a week, then taper off to once a month, then stop
Metoclopramide (Reglan® 10 mg tabs, 1 mg/ml syrup, 5 mg/ml injectable)	IM, IV, PO	Most species: 0.1-0.5 mg/kg q 8-12h PO, IM, IV; Raptors, waterfowl/ileus, crop stasis: 2 mg/kg IM, IV q 8h; Ostriches: 0.1 mg/kg IV	GI prokinetic agent, For limited success with GI stasis, Do not use with GI obstruction/ hemorrhage or hypertension, Do not use in epileptics (lowers the threshold for seizures), Caution in the renally impaired, Antagonized by narcotics, Do not use with monoamine oxidase inhibitors. Oral formulation may cause hyperexcitability and seizures in macaws. Injectable may cause seizures at 0.5 mg/kg but not at 1/4 of the dose. Prolactin agonist and may help in egg-related peritonitis
Metronidazole (250 or 500 mg tabs)	PO	10-30 mg/kg q12h x 10d	For limited success treatment of giardia, hexamita, anaerobic bacteria, Caution in renal or hepatic impairment, May cause seizures, peripheral neuropathies, anorexia or GI upset, May enhance candidiasis, Toxic in finches
Metronidazole (5 mg/ml injectable)	IM	10 mg/kg q24h x 2d	Toxic in finches
	PO	100 mg/L drinking water or /kg soft food	Canaries

AVIAN FORMULARY

DRUG	ROUTE	DOSAGE	COMMENTS
Miconazole (10 mg/ml injectable, 1-2% ointment/ cream)	IV, Topical	20 mg/kg q8h, Can nebulize diluted 15-20 min q12h	Candida, cryptosporidiosis, coccidiomycosis, pseudoallescheriosis and paracoccidioidomycosis, IV must be given diluted in 0.9% NaCl and very slowly or death may occur, Do not use with rifampin, hypoglycemic agents, anti-coagulants, Caution with CNS-active drugs, Adverse reactions include death, phlebitis, pruritus, nausea, fever, rash, Metabolized in liver, excreted in urine
Midazolam	IM	Amazons: 2-3 mg/kg, Waterfowl: 4-6 mg/kg, Ratites: 0.3 mg/kg, Most birds: 1.5 mg/kg	See diazepam
Monensin	PO (feed)	Sand hill cranes: 100-400 ppm in feed (low dose best)	For control of *Eimeria* sp., Wear rubber gloves, protective clothing and mask when mixing, Mix thoroughly
Naloxone	IV	2 mg q14-21h if needed	Antagonist for opiates and to some degree agonist/ antagonists (butorphanol), Repeat if necessary, Some narcotics have longer t1/2 than naloxone
Neomycin	PO	80-100 mg/L drinking water, 100 mg/kg soft food	Canaries
Neomycin ointment	Topical	q6-12h	Caution: ointments may grease feathers (best to use under a bandage), Use on small superficial wounds only, May be absorbed systemically and cause ototoxicity and nephrotoxicity

AVIAN FORMULARY

DRUG	ROUTE	DOSAGE	COMMENTS
Nitrofurazone (93 g/kg soluble powder)	Water	1 tsp/gal water	Contraindicated in lories, lorikeets, mynahs, Do not use in renal impairment
Norcuronium ophthalmic prep	Topical	2 drops in eye q15min x 3 for papillary dilation	Takes about 60 min, Should return to normal by 7h, Watch for toxicity (muscle relaxation)
Nortriptyline HCl syrup (2 mg/ml)	PO	2 mg/4 oz water	Tricyclic antidepressant, Do not use with cardiac disease, Discontinue on a tapering dose (see notes for doxepin)
Nystatin (100,000 IU/ml suspension)	Gavage	Psittacines: 300,000 IU/kg q8-12h x 7-14d, Passerines: 100,000 IU/L and 200,000 IU/kg soft food	Not absorbed from gut, only good when in contact, For oral candida, must paint oral cavity, Resistance common, Rarely causes nausea or diarrhea, Canaries: treat *Candida albicans* for 3-6 wk
Omega fatty acids (N-3 FA, N-6 FA) Flaxseed Oil	PO	N-3 FA:N-6 FA of 4-5:1 to 1:3 (0.22 ml/kg q24h)	May combine with low dose aspirin in histologically-confirmed glomerulopathy
OPDDD (Mitotane)	PO	Mix corn oil with 1000 mg to make 20 mg/ml solution, To get dosage divide body weight in grams by 1000 and this gives ml to administer	Used to inhibit tumor growth/ metastasis, May cause toxicity in canaries, Do not use if organophosphate has been used in environment
Oxpernolol	PO	2 mg/kg q24h	β blocker, possibly protective effect against development of atherosclerosis plagues

AVIAN FORMULARY

DRUG	ROUTE	DOSAGE	COMMENTS
Oxytetracycline	IM	50 mg/kg q12h	Psittacines other than Amazons: caution - some injectables contain lidocaine, Renal impairment may lead to excessive systematic accumulation and hepatoxicity, May cause photosensitization and myonecrosis, When given SC may lead to an area of skin necrosis that heals with or without treatment in about 3 wk
Oxytetracycline (Long-acting 200 mg/ml)	IM	Amazons: 58 mg/kg q24h, Pheasants: 43 mg/kg q24h	Initial chlamydiosis treatment, Secondary yeast infection common
	IM, SC	Cockatoos: 50-100 mg/kg q2-3d	
Oxytocin (20 U/ml injectable)	IM, IM, SC	5 U/kg once	For egg expulsion, To stop uterine bleeding, Should not be used with a closed utero-vaginal sphincter, May cause cardio arrhythmias, Provide fluids, supportive care
Pancreatic enzymes (Viokase®, Prozyme®, Pancrezyme 2400 g tab)	PO (feed)	2400-4800 g/kg	To dissolve plant-based foods and fibers, Many products are made from pork pancreas (e.g., Viokase®), If in mouth may cause digestion of tissues, Don't inhale, High doses may raise uric acid levels, Safest to mix with food and let stand 30 min
Paramomycin (Humatin®) 250 mg capsule	PO	100 mg/kg PO q12h, 1 capsule in 10 ml sterile water (this is good for one week), Add 1 ml to 5 ml LRS, Give 0.1 ml /85 mg q24h x 7d	For cryptosporidiosis, *Giardia* in cockatiels, Overdose may result in polydipsia, polyuria, vomiting, coma, death

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DRUG	ROUTE	DOSAGE	COMMENTS
PGF_2 (Lutalyse®) 5 mg/ml	IM (systemic effects)	0.00004 to 0.000004 ml/g	Not recommended for use in birds, Will cause uterine contractions, Better to use Prepidil gel (PGE_2) or oxytocin
Phenobarbital (16.2 mg tab, 3 mg/ml elixir, 4 mg/ml solution)	PO	1-5 mg/kg q12h, Red-lored Amazon: 5 mg/kg q12h or 8 mg/120 ml H_2O, Lovebird (50-75 g BW): 0.08-1.8 ml/60 ml H_2O	For controlling seizures, Will diminish oviduct contractions, May cause osteomalacia, Regular hepatic function test should be performed, Caution in the liver impaired, Addictive, Shortens half-life of doxycycline
Phenylbutazone (200 mg/ml injectable, 100 or 400 mg tab)	IV, PO	3.5-7.0 mg/kg q8-12h	NSAIDs, GI ulcers, blood dyscrasia, Do not use if liver, kidney or cardiac abnormalities exist
Pimaricin (Natamycin® 5% ophthalmic solution)	Ophthal	1 drop q6h, After 14-21d, taper off	For ocular mycosis, Do not use with steroids, Very expensive, Surgery may be more beneficial
Pimobendan	PO	0.25-0.5 mg/kg/day possibly up to 1.0 mg/kg/day	Calcium sensitizer. Inotropic, used in heart dilatation, pericardial effusion, May not be as effective as ACE-blockers
Piperacillin (200 mg/ml injectable)	IM, IV	100-200 mg/kg q6-8h, Budgerigars: 200 mg/kg q8h, Blue-fronted Amazons: 100 mg/kg q6h	Excellent clinical antibiotic alone or combined with amikacin (never in the same syringe), Effective against many gram-negative, gram-positive, anaerobes, *Pseudomonas* sp., Decrease to ½ in renal impairment, Excreted in urine/bile, Good for liver infections, dog bite wounds, May be contraindicated in neonates, Reconstituted good for 24h at room temp, 7d in refrigerator, 30d at -10° to -20°C

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DRUG	ROUTE	DOSAGE	COMMENTS
Piperacillin/tazobactam sodium (Zosyn®)	IM	Same as plain piperacillin above	Current available form of piperacillin in US. Do not combine with aminoglycosides. Has improved spectrum of activity.
Piperazine	PO	100-500 mg/kg q10-14d	Not effective in psittacines, Good for poultry for *Toxacara canis, Toxacara leonine,* Do not use with kidney impairment
Polymixin	PO	50,000 IU/L drinking water or /kg soft food	Canaries
Polysulfated glycosamine glycan (Adequan®)	IM, PO	5 mg/kg	Cartilage precursor used for arthritis
Potassium chloride	IV	0.1-0.3 mEq/kg	Potassium replacement in conjunction with ECG & electrolyte analysis
Pralidoxime chloride (Protopam®)	IM, IV, slow	10-30 mg/kg q24h or until cessation of clinical signs, Repeat as needed	For organophosphate toxicities, Use with atropine (use lower dose in conjunction w/ atropine) and oxygen therapy, Reduce dose with renal impairment, Cholinesterase reactivator, May increase carbamate toxicity, Good for up to 36 hours after exposure
Praziquantel (Droncit® 23 or 34 mg tab, 56.8 mg/ml injectable)	PO	100-500 mg/kg q10-14d	Not effective in psittacines, Good for poultry for *Toxacara canis, Toxacara leonine,* Do not use with kidney impairment

AVIAN FORMULARY

DRUG	ROUTE	DOSAGE	COMMENTS
Praziquantel (Droncit® 23 or 34 mg tab, 56.8 mg/ml injectable)	IM	For flukes: 9 mg/kg q24h x 3d then PO x 11d, For tapeworms: 9 mg/kg once, then repeat in 10d	Metabolized in liver, Toxic to finches, Caution in neonates and juveniles (esp African greys)
Prednisolone sodium succinate (10 or 50 mg/ml injectable solution)	IM, IV	Anti-inflammatory: 0.5-1 mg/kg once, Immunosuppressive: 2-4 mg/kg, Appropriate for shock (dog shock dose: 5-20 mg/kg IV)	IM injections may cause myonecrosis at site of injection, May cause GI ulcers. DO NOT use with NSAIDs
Prepidil gel (PGE_2) 0.5 mg/3.0 g (2.5 ml)	Topical	+/- 1 ml/kg applied to utero-vaginal sphincter, As little as 0.05 ml/kg may be sufficient	Dilates sphincter, Allows for expulsion of egg. Provide supportive care, post expulsion may need analgesic (NSAIDs)
Primaquine (15 mg tab = 26.3 mg primaquine phosphate)	PO	(Child's dose: 0.3 mg primaquine/kg q24h x 14d), Bird: 0.75 mg/kg, Game birds: 0.03 mg/kg q24h x 3d	For treatment of *Plasmodium* sp., Metabolized in liver, Usually used with chloroquine
Probucol (Lorelco® 250 mg, 500 mg tabs)	PO	250 mg/0.25 oz lactulose, 1 drop q12h/300 g BW for 2-4 mo	To lower cholesterol, control lipemia/lipomas, Contains iron (use with caution in those birds that are susceptible to hemachromatosis), May increase bile acids when assayed, Should only be used in birds with primary LDL-cholesterolemia, All birds should be on a low fat, low cholesterol diet with adequate exercise

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DRUG	ROUTE	DOSAGE	COMMENTS
Procaine penicillin G + (aqueous formula best)	IM only	100 mg/kg q24-48h	Turkeys: drug of choice for *Clostridium tetani* infections, Slowed excretion with renal impairment, Many birds are sensitive to procaine, Procaine should never be used in parrots or passerines!
Propranolol (1 mg/ml injectable)	IM	0.2 mg/kg	For tachycardia, Do not use with ventricular tachycardia secondary to A-V block, Causes broncho constriction, hypotension, Use with supraventricular arrhythmias. atrial flutter or fibrillation, Do not use in diabetics or when hypoglycemia is present, Decreases myocardial oxygen consumption
	IV	0.04 mg/kg slowly	Monitor with ECG during and for several hours after administration
Psyllium (Metamucil®)	PO	1%	Increases electrolyte absorption matrix to enhance normal flora, Bulk fiber to cleanse GI tract of viruses, bacteria, metal, Decrease transit time in neonates or sick birds to enhance nutrient absorption
Pyrantel pamoate (4.5 mg/ml suspension)	PO	4.5 mg/kg, repeat 10-14d	GI nematodes
Pyrethrins (0.15%)	Topical	PRN	Kitten flea spray for resistant lice, Avoid contact with eyes, Some sprays may cause pneumonitis when inhaled

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DRUG	ROUTE	DOSAGE	COMMENTS
Pyrimethamine (25 mg tab)	PO	0.5 mg/kg q12h	*Plasmodium*, toxoplasmosis, *Sarcocystis*, Competes for folic acid, When combined with sulfonamides the treatment of toxoplasmosis is enhanced, May also help for sarcocystis infections, Should not be used for acute plasmodium attacks, Use chloroquine or quinine, Caution with liver or kidney impairment, Sulfas with pyrimethamine may cause bone marrow suppression, Decrease dose if vomition, Discontinue if rash or hematologic disorders observed (see chloroquine)
Pyrimethamine + trimethoprim/ sulfadiazine (TMS)	PO	Pyrimethamine: 0.5 mg/kg q12h (may drop to 0.25 mg/kg after 2-4); TMS (combined mg): 30 mg/kg IM q12h	For sarcocystis treatment for at least 30 days, Re-biopsy q4-8wk
Quinacrine (Atabrine® 100 mg tab)	PO	5-10 mg/kg q24h x 7d	For giardia, tapeworms, plasmodium, Don't use with primaquine, Many P*lasmodium* spp. are resistant; Concentrates in liver (caution with liver impairment), May cause yellow color skin, seizures, Give with food
Renografin®	IV right medial metatarsal vein	400 mg/kg	Excretory urography. (Amazon: Rad image of kidneys at 1, 2, 7, 10 min. post injection)

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DRUG	ROUTE	DOSAGE	COMMENTS
Rifampin (150 or 300 mg capsule)	PO	10-20 mg/kg q12h	*Mycobacterium* sp., *Haemophilus,* influenza, *Staph. aureus, Staph. epidermis, Neisserria* sp., Rifampin has .numerous drug interactions, Never use halothane, Side effects are numerous and associated with most body systems, Hepatotoxic (do not use with liver impairment), Usually use with other drugs to treat mycobacteriosis, Resistance occurs rapidly, Absorption reduced with food.
Selenium	IM	0.06 mg/kg q3-14d	Cockatiels
Silver sulfadiazine	Topical	Apply q12-24h	For burns, ulcers, under bandage, Good to help rehydrate wounds when applied under a transparent dressing, If used over large areas, make sure hydration is maintained
Sodium bicarbonate (1 mEq/ml)	IV	1-4 mEq/kg slowly over 15-30 minutes	Do not exceed 4 mEq/kg, Do not use with hypochloremia (vomiting), Don't use with calcium-containing fluids, Best to use only when blood pH values are known
Sodium iodide 20%	IM	0.3-1 mg/kg q24h x 2-5d	Budgies: for dyspneic birds secondary to goiter
Spectinomycin	PO	200-400 mg/L H_2O, 400 mg/kg soft food	Canaries
Spiramycin	PO	200-400 mg/L H_2O, 400 mg/kg soft food	Canaries

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DRUG	ROUTE	DOSAGE	COMMENTS
Stanozolol (Winstrol® - 2 mg tablet, 50 mg/ml injectable)	PO, IM	0.5-1.0 mg/kg IM q3-7d	Synthetic derivative of testosterone, Schedule drug, Do not use with renal impairment, Repeat use with caution, Consider adverse effects as with humans
STA solution (salicylic aced, tannic acid in ethyl alcohol)	Topical	As needed	Moist fungal dermatitis, May burn, Tannic acid is caustic/drying
Streptomycin	IM	Large birds:10-30 mg/kg q8-12h	More nephrotoxic than most aminoglycosides, Diurese when using, Not for use in psittacines, passerines
Sucralfate (1 g tab)	PO	25 mg/kg q8h (maximum)	For upper GI bleeding, Should be given 1 hr before food or other drugs, 2 hr prior to H_2 blockers, May cause constipation
Sucralfate syrup (Carafate®)	PO	Volume dependent on size of bird, crop. Not to exceed 100 mg/kg over 24 hr	Can soothe esophagitis, ingluvitis.
Sulfachlorpyrizidine (5 g packet)	Water	1/4 tsp powder/L for 5-10d, Canaries: 150-300 mg/L drinking water	Most species, Don't use sulfa drugs in birds laying eggs
Sulfamethazine (12% solution)	PO	Mix to 30 mg/oz drinking water, For coccidia in chickens: 128-187 mg/kg q24h x 2d than 1/2 dose for 4d	For *Coccidia, Haemoproteus, Pasteurella, Salmonella* in small psittacines, Make sure hydration is maintained
Sulfadimethoxine (Albon®)	PO	50 mg/kg q24h for 5d, off 3d repeat for 5d	
Sulfadimidine	PO	150 mg/L drinking water	Canaries

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DRUG	ROUTE	DOSAGE	COMMENTS
d-tubocurarine in 0.025% benzalkonium Cl ophthalmic prep	Ophthal-mic	Mix fresh, apply 3 drops to eye q15 min	For dilation of pupil, Watch for toxicity (muscle relaxation)
Terbinafine hydrochloride (250 mg tablets, Lamisil®)	PO	10-15 mg/kg daily	Alternate treatment for aspergillosis
Tiletamine HCl/zolazepam HCl (Telazol®)	IV	Ratites: 2-8 mg/kg - induction 15 sec/ duration 20-40 min, May add 0.5 mg/kg xylazine IV and carfentinil 0.015 mg/kg IV	Monitor heart rate (xylazine can cause A-V block), May pretreat with azapaerone IM or post-induction for smoother recovery at 1-2 mg/kg, Do not use Telazol with cardiac, pancreatic, renal, pulmonary disease, Eyes remain open so apply ointment to eyes, Very similar to ketamine, Good for 14 days in refrigerator once reconstituted, Do not use with psittacines, passerines
	IM	Mallards: 44-55 mg/kg, Black swans: 6.6 mg/kg	
Testosterone (10 mg or 25 mg tab, 200 mg/ml inj)	PO, IM	8 mg/kg weekly as needed	Anabolic steroid, Lymphocytotoxic
Tetracycline (soluble powder, 250 mg caps, suspension)	Water	0.25-1 tsp/gallon	Seldom used, Birds may not drink sufficient water
Tetracycline	PO	50 mg/kg q8h	Psittacines
Thiabendazole (4 mg/30 ml suspension)	PO	Ascarids: 250-500 mg/kg, repeat 10-14d, For *Syngamus:* 100 mg/kg q24h x 7-10d	Possibly toxic in ostriches/ ducks/ cranes, May have CNS side effects (nausea, hypotension), hyperglycemia crystaluria, leukopenia

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DRUG	ROUTE	DOSAGE	COMMENTS
Thyroxine (Synthroid® - best quality, less fluctuation in mg/tab)	PO	0.02-0.04 mg/kg q24h in confirmed hypothyroidism, Check blood levels: 4 hr post meds = 3 mg/dl; 12h post med = 2 mg/dl	May cause recrudescence of thymus in adults, Toxic levels cause hypertrophic cardiomyopathy and heart failure. Will initiate feather growth.
Ticarcillin (30-40 mg/ml injectable)	IM, IV	150-200 mg/kg q6-8h	Effective against many gram-positive and gram-negative organisms including *Pseudomonas* sp. and some anaerobes, Synergistic with aminoglycosides (do not mix together), Resistance may develop rapidly
Tobramycin (40 mg/ml injectable)	IM	2.5-5 mg/kg q12h	Oto and nephrotoxic, Diurese while using, Do not use furosemide, Caution with renal impairment, Dose by lean body weight
Triamcinolone acetonide (Vetalog® suspension for injection 2 mg/ml)	PO	2 ml/½ oz lactulose, 1 drop/1000 mg q12h	Used for allergic respiratory conditions and allergic dermatitis. Caution using corticosteroids in birds
Trimethoprim + sulfadiazine (Tribrissen®, Di-Trim® 24% suspension)	IM	0.22 ml/kg q12-24h	Don't use sulfas in birds laying eggs or those with hepatic or renal compromise, Maintain hydration
Trimethoprim + sulfamethoxazole (Bactrim® = 8 mg trim + 40 mg sulfa/ml suspension, Septra®)	PO	25 mg/kg q12h, 50 mg/kg q24h	GI and respiratory infections in neonates (use lower dose in neonates because of incompetent kidneys), May cause vomiting esp in blue and gold macaws. Maintain hydration.

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DRUG	ROUTE	DOSAGE	COMMENTS
Trimethoprim + sulfamethoxazole	PO	25 mg/kg q24h	Toucans, mynahs for coccidia
	PO	50-100 mg/L drinking water (trimeth part)	Canaries
Trimethoprim + sulfaquioxaline 1:3 ratio	PO	30 mg/kg/day (186 mg/L ad lib water or 332 mg/kg feed)	Chickens: >0.25% in feed or 0.012% sulfaquinoxaline for 72 hr may cause death
Trimethoprim + sulfachloropyridazine Na (1:5 ratio)	PO	0.04% in feed	Geese
Trimethoprim + sulfachloropyridazine Na and sulfamethoxazole (1:5 trim to combined sulfas)	PO	0.04% in feed	Geese
TSH (thyroid stimulating hormone)	IM	1 IU/bird	Difficult to get but can be obtained, Take 0 time blood sample and 4-6h post TSH blood sample, Normal = 2x baseline. Validation of hormone levels not done at most laboratories so interpretation difficult
Tylosin (50 or 200 mg/ml injectable)	IM	Poultry: 10-40 mg/kg q6-8h, Quail, emus: 15-25 mg/kg q6-8h, Cranes: 15 mg/kg q6-8h	Good for some *Mycoplasma* sp., *Pasteurella* sp., *Fusobacterium* sp., *Actinomyces pyogenes*, May cause diarrhea

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DRUG	ROUTE	DOSAGE	COMMENTS
Tylosin (soluble powder or injectable)	Eye spray	Mix 1 ml injectable with 100 ml sterile water, Apply q8-12h or 1:10 powder to water	Discontinue immediately if pain or redness occurs after instillation
Tylosin (250 mg/8.81 oz soluble powder)	Water	2 tsp/gallon	Many sick birds do not drink sufficient water
Tylosin	PO	250-400 mg/L drinking water, 400 mg/kg soft food	Canaries
Tylosin	Nebulize	1h q12h, Mix 200 mg with 50 ml DMSO	See DMSO notes
Tyrode's solution	PO	8.00 g NaCl, 0.13 g $CaCl_2$, 0.20 g KCl, 0.10 g $MgCl_2$, 0.05 g Na_2HPO_4, 1.00 g $NaHCO_3$, 1.00 g glucose: add to 1 L water	Useful in restoring renal medullary gradient PU/PD cockatiels, Should see improvement in 4 days if sole source of drinking water
Urographine 76	IV Basilic vein	2 mg/kg	Excretory urography 20-50 seconds post injection. Do not use if bird is in renal compromise
Vitamin A, D_3, E (injection)	IM	Large birds: 0.3-0.6 ml/kg q7d, Finches, canaries: 0.02 ml/kg	Not to be used in birds on formulated diets, Vitamin A stored in the liver, Carotene may be better in birds, Never give IV, Vitamin A toxicity in humans includes: lethargy, anorexia, vomiting, premature growth plate closure, increased intracranial pressure, dry cracking of skin and hepatosplenomegaly, Vitamin D_3 may not be the active metabolite in birds

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DRUG	ROUTE	DOSAGE	COMMENTS
Vitamin B complex	IM	10-30 mg/kg thiamine q7d	Most birds, Stings at injection site
	PO	1-2 g/kg food, Raptors, cranes, penguins: 1-2 mg/kg q24h PO	Daily
Vitamin B_{12}	IM	200-500 g/kg q7d	Do not combine in same syringe with anything other than saline or water diluent
Vitamin E/ selenium (1 mg Se, 50 mg vit E/ml)	IM, SC	0.05-0.1 ml/kg q14d	IM best
Vitamin K_1 (10 mg/ml)	IM	0.2-2.5 mg/kg, as needed, Warfarin poisoning: 0.2-2.5 mg/kg q12 x 7d, Other vit K_1 inhibitors: x 21d	For anticoagulant rodenticide toxins, Don't give IV, Can give prior to liver biopsy
Yeast cells derivatives (Preparation H® cream only)	Topical	q24h with bandage change	For healing wounds, Avoid ingestion or contact with eyes

INJECTABLE ANESTHETICS FOR BIRDS

ANESTHETIC	ROUTE	DOSAGE	COMMENTS
Alphaxalone/alphadalone (Saffran®)	IV, IM, IP	5-10 mg/kg IV, 36 mg/kg IM, IP	Good anesthetic agent but with transient apnea following IV administration (the preferred route) due to large volumes required (this can be alarming, a disadvantage), Actually has a wide safety margin, short duration of action.
Atipamazole (Antisedan®)	IM	250-380 μg/kg	Reverse medetomidine action, Also reverses xylazine
Ketamine	SC, IM, IV	20-50 mg/kg	Smaller species require higher dose rate by itself-good sedative, poor anesthetic, poor muscle relaxation, little analgesia, eliminated in kidneys
Ketamine + diazepam	IM	25 mg/kg ketamine + 1-2 mg/kg diazepam	Better relaxation than ketamine alone
Ketamine + midazolam	IM	25 mg/kg ketamine + 0.2 mg/kg midazolam IM or SC	Better relaxation than ketamine alone
Ketamine + medetomidine (Dormitor®)	IM	1.5-2.0 mg/kg ketamine + 60-85 μg/kg medetomidine	Combo provides deep sedation and good muscle relaxation with no arrhythmias or respiratory depression, Very good combo for waterfowl, Antisedan reverses medetomidine.
Ketamine + xylazine	IV	4.4 mg/kg ketamine + 2.2 mg/kg xylazine	Ketamine/medetomidine is a better combo, but xylazine is cheaper. Need to reverse (unreversed = prolonged recovery, post-op depression), Can have bradycardia, A/V block, respiratory depression

INJECTABLE ANESTHETICS FOR BIRDS

ANESTHETIC	ROUTE	DOSAGE	COMMENTS
Propofol	IV	1.33 mg/kg	Metabolized very rapidly, Not good for induction, Usually too short for intubation (for continued isoflurane) unless using infusion of propofol
Tiletamine/zolazepam (Telazol®)	IM	5-10 mg/kg	Phencyclidine derivative more potent than ketamine, Good immobilization, Considered safe, Causes hallucinations and psychotic reaction that may last several hrs/days in mammals
Xylazine (Rompum®)	IM, IV	1-20 mg/kg	By itself, unreliable, May cause bradycardia, A/V block, respiratory depressant, Reverses with yohimbine, atipamezole
Yohimbine	IM	0.1 mg/kg	Reverses xylazine

PSITTACINES

The information presented here has been compiled from the literature. It is intended for use as a quick guide to selected husbandry and medical topics of psittacine birds and is not intended to replace comprehensive reference material. Updates were provided by Storm Hudelson, DVM, Dipl ABVP-Avian Practice, Greg J. Harrison, DVM, Dipl ABVP-Avian Practice, Dipl ECAMS and Donald Zantop, DVM, Dipl ABVP-Avian Practice.

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PSITTACINES

- **Order:** Psittaciformes
- **Family:** Psittacidae
- **Common Species and Variations:**

African grey parrot	*Psittacus erithacus*
Amazon parrots	*Amazona* spp.
Australian parakeets/ grass parrots	*Neophema* spp., *Psephotus* spp.
Budgerigars	*Melopsittacus undulatus*
Cockatiels	*Nymphicus hollandicus*
Cockatoos	*Cacatua* spp., *Calyptorhyncus* spp., *Callocephalon* sp., *Probosciger* sp., *Eolophus roseicapillus*
Conures	*Aratinga* spp., *Thectocercus* sp., *Eupsittula* sp., *Pyrrhura* sp., *Psittacara* sp., *Nandayus* sp., *Guaruba* sp.
Eclectus parrot	*Eclectus roratus*
Grey-cheeked parakeets	*Brotogeris pyrrhopterus*
Hyacinth macaw	*Anodorhynchus hyacinthinus*
Lories, lorikeets	*Eos* spp., *Trichoglossus* spp., *Lorius* spp., *Pseudeos* sp., *Psitteules* spp., *Glossopsitta* spp.
Lovebirds	*Agapornis* spp.
Macaws	*Ara* spp.
Pionus parrots	*Pionus* spp.
Rosellas	*Platycercus* spp.

- Color mutations of budgerigars, cockatiels and lovebirds often have genetic disorders such as decreased disease resistance, reduced longevity and hatching defects that appear to be associated with in-breeding. Lutino cockatiels may have decreased crop size.
- Colors that are found in normal free-ranging birds (e.g., gray cockatiels, green budgerigars) are the most desirable for long-lived, relatively disease-free pet species.
- Most cockatiel mutations have developed from lutinos (with a red iris color); hardier pied mutations have a dark, almost black, iris color.
- Hybrids are not recommended.

Quick Facts

African Grey Parrots	
Body length:	13 in
Body weight:	330-500 g
Age of sexual maturity:	4-6 yr
Recorded maximum life span:	50+ yr
Average captive life span:	15 yr*

Amazon Parrots	
Body length:	10-18 in
Body weight:	350-600 g
Age of sexual maturity:	4-6 yr
Recorded maximum life span:	80 yr
Average captive life span:	15 yr*

Budgerigars	
Body length:	7 in
Body weight:	30 g
Age of sexual maturity:	6 mo
Recorded maximum life span:	18 yr
Average captive life span:	6 yr*

Cockatiels	
Body length:	12.5 in
Body weight:	75-125 g
Age of sexual maturity:	6-12 mo
Recorded maximum life span:	32 yr
Average captive life span:	6 yr*

Cockatoos	
Body length:	12-26 in
Body weight:	300-1100 g
Age of sexual maturity:	small = 1 yr; medium, large = 4-6 yr
Recorded maximum life span:	60+ yr
Average captive life span:	15 yr*

Conures	
Body length:	9-21 in
Body weight:	50-200 g
Age of sexual maturity:	1-3 yr
Recorded maximum life span:	35 yr
Average captive life span:	10 yr*

Quick Facts

Eclectus Parrots	
Body length:	12-14 in
Body weight:	380-450 g
Age of sexual maturity:	3-6 yr
Recorded maximum life span:	20 yr
Average captive life span:	8 yr*

Lories	
Body length:	6-13 in
Body weight:	100-300 g
Age of sexual maturity:	2-3 yr
Recorded maximum life span:	15 yr
Average captive life span:	3 yr*

Lovebirds	
Body length:	5-7 in
Body weight:	38-56 g
Age of sexual maturity:	8-12 mo
Recorded maximum life span:	12 yr
Average captive life span:	4 yr*

Macaws	
Body length:	12-39 in
Body weight:	200-1500 g
Age of sexual maturity:	mini = 4-6 yr large = 5-7 yr
Recorded maximum life span:	50+ yr
Average captive life span:	15 yr*

*The relatively short life span in captivity is frequently due to improper feeding and husbandry practices.

Behavior

- Nearly every non-endangered psittacine bird species has acceptable pet qualities.
- The most desirable birds are those that are domestically bred.
- Birds are better adjusted pets if they are raised by their parents with clutch mates until weaning.
- Human handling and interaction during this time helps result in birds that are tame as adults.
- The current trend is to include a pet bird in daily family activities, eg, take for walks or bike rides.
- In general, young, tamed psittacines adapt readily to new

surroundings and handling procedures; they should be exposed early in life to novel situations — car travel, hospital visits, multiple visitors in the household, other household pets (except cats) — so they are well adjusted to these events.
- Most species are easily trained with behavior modification techniques.
- Most psittacine birds are intelligent and curious and will investigate anything new in their environment.
- They are playful and easily amused with simple toys; toys must be free of toxic metals, hooks or sharp objects. Toys should not be a replacement for owner interaction.
- Introduction of young birds to environmental enrichment (e.g., hiding food in rolled up paper or stuffed in toys) has proven to help prevent feather picking.
- Birds that are allowed unrestricted access in the home can encounter numerous physical dangers or toxins. Wing clipping is recommended for safety reasons; additional trimming may be required 8-12 weeks after the start of a molt cycle.
- Birds housed in a safe area, eg, large room with covered windows, enjoy supervised flight.

Diet

- A fresh, high quality, pesticide-free diet specifically formulated for psittacine birds is essential.
- Supplementation should be limited to extremely small amounts of treats: chopped dark green or dark yellow vegetables or fruit <10% of diet (preferably organic).
- Grit is probably not necessary with a formulated diet.
- Three kernels of grit/year is a safe amount for a budgerigar.
- Clean, fresh, uncontaminated water should be provided (try using water bottles).
- Lories require specialized diets that include soft gruels, nectars and special powders, but care should be exercised in selecting the food, as many commercial formations contain excessive levels of nutrients, especially vitamin A, that are toxic.

Housing

- Housing should be as large as possible (at least big enough for the bird to fully extend its wings and flap without touching the sides of the enclosure, especially if the bird is not allowed outside this enclosure daily).
- Enclosure should be clean, secure, safe, easy to service, and be constructed of durable, nontoxic material.
- Variable-sized perches made of clean, nontoxic, pesticide-free

tree branches should be provided. One should check with local authorities for recommendations of safe trees.

- Food and water containers may be placed at opposite ends of the enclosure to encourage activity.
- Avoid locating perches directly over food containers in order to prevent fecal contamination.
- Many birds appreciate an occasional opportunity for a bath, shower or misting. Tropical rain forest birds may require daily misting at least part of the year.
- Offer outdoor exposure to sunlight 15-20 minutes twice a week, if available. Ensure that shade is available. Sun and fresh air stimulate exercise and assure adequate vitamin D levels. If this is not possible, full-spectrum lighting is encouraged. Access to natural light is preferable to artificial lighting and light cycles.
- Prevent access to: ceiling fans; hot cooking oil; fumes from overheated non-stick surfaces; leg chains; sandpaper-covered perches; tobacco and cigarette smoke; chocolate, avocado, salt, alcohol; toxic houseplants; pesticides; carpet cleaners; fumes from air fresheners or scented candles and those with metal wicks; easily dismantled toys; dogs, cats and unsupervised young children; cedar, redwood and pressure-treated wood cage liners; sources of lead or zinc.
- Many birds enjoy a nest box or hide box for privacy or retreat. However, if the bird becomes obsessive or protective of this box, it should be removed to discourage breeding activity or egg laying.

Sexing

- Most pet psittacine species are difficult to sex visually.
- Endoscopically viewing the gonads is one way to determine sex in monomorphic species.
- DNA testing (preferably of a pin feather sample) is an accurate and cost-effective sexing tool. It may not be validated for all species; check with laboratory.

Examples of Sexually Dimorphic Psittacines

	Male	Female
Budgerigar	Cere lavender to dark blue (green bird)	Cere pink-brown to light-blue (green bird)
Cockatiel	Bright yellow face and cheek patch, lacks barring; whistles or talks	Tail and flight feathers have barring on underside, monotonous chirp or song
Cockatoo	Adults have black irides	Adults have reddish-brown irides
Eclectus parrot	Green body color	Red and purple body colors
Ring-necked parakeet	Colored ring around neck	No ring
White-fronted Amazon parrot	Red alula and primary covert feathers	Slight to no red in primary covert feathers

Not all members within a genus will portray the listed sexual differences. Differences are usually observable only in mature species.

Blood Parameters

The best method for evaluating blood parameters of a bird during illness is to have on file reference values developed for each individual bird when it appeared clinically normal. It is best to use values obtained in the laboratory that routinely performs the clinician's avian profiles. Published values obtained from other laboratories can be used as a guide, but may differ from the avian clinician's routine laboratory.

HEMATOLOGY REFERENCE RANGES FOR SELECTED PSITTACINE SPECIES*

	AFRICAN GREY	AMAZON	BUDGERIGAR	COCKATIEL	COCKATOO	CONURE	ECLECTUS
WBC x $10^3/\mu l$	5-11	6-11	3.0-8.5	5-10	5-11	4-11	4-10
RBC x $10^6/\mu l$	2.4-3.9	2.4-4.0	2.4-4.0	2.2-3.9	2.4-4.2	2.5-4.1	2.4-3.9
HCT (%)	40-48	40-50	40-50	40-49	40-48	40-49	40-47
Hets (%)	55-75	55-80	50-75	55-80	55-80	55-75	55-70
Eos (%)	0-2	0-1	0-2	0-2	0-2	0-2	0-1
Baso (%)	0-1	0-1	0-1	0-2	0-1	0-1	0-2
Monos (%)	0-3	0-3	0-2	0-2	0-1	0-2	0-2
Lymphs (%)	25-45	20-45	25-45	20-45	20-45	25-45	30-45

*From the University of Miami Avian and Wildlife Laboratory: RBC and WBC count by Unopette method from 24-hour-old blood collected in EDTA; Spun HCT; Diff based on 100-cell count using smear made at the time of sample acquisition.

HEMATOLOGY REFERENCE RANGES FOR SELECTED PSITTACINE SPECIES*

	JARDINE'S	LORY	LOVEBIRD	MACAW	PARAKEET	PIONUS	QUAKER	SENEGAL
WBC x $10^3/\mu l$	4-10	4.5-8.5	3.0-8.5	6-12	4.5-9.5	4.0-11.5	4-10	4-11
RBC x $10^6/\mu l$	2.4-4.2	2.5-4.1	2.3-3.9	2.4-4.2	2.2-3.9	2.4-4.0	2.3-4.1	2.4-4.1
HCT (%)	38-48	39-50	38-50	39-48	39-48	40-47	40-49	39-48
Hets (%)	55-75	50-70	55-80	58-78	50-75	50-75	55-80	55-75
Eos (%)	0-1	0-2	0-1	0-1	0-2	0-2	0-1	0-1
Baso (%)	0-1	0-1	0-1	0-1	0-1	0-1	0-2	0-1
Monos (%)	0-2	0-2	0-3	0-3	0-2	0-2	0-3	0-2
Lymphs (%)	25-45	23-45	20-45	20-45	25-45	25-45	20-45	25-45

*From the University of Miami Avian and Wildlife Laboratory: RBC and WBC count by Unopette method from 24-hour-old blood collected in EDTA; Spun HCT; Diff based on 100-cell count using smear made at the time of sample acquisition.

BIOCHEMISTRY REFERENCE RANGES FOR SELECTED PSITTACINE SPECIES*

	AFRICAN GREY	AMAZON	BUDGERIGAR	COCKATIEL	COCKATOO	CONURE	ECLECTUS
Alk phos (U/L)	20-160	15-150	10-80	20-250	15-255	80-250	150-350
ALT (U/L)	5-12	5-11	5-10	5-11	6-12	5-13	5-11
AST (U/L)	100-365	130-350	145-350	95-345	145-355	125-345	120-370
Amylase (U/L)	210-530	205-510	200-500	205-490	200-510	100-450	200-645
BUN (mg/dl)	3.0-5.4	3.1-5.3	3.0-5.2	2.9-5.0	3.0-5.1	2.8-5.4	3.0-5.5
Ca (mg/dl)	8.5-13.0	8.5-14.0	6.5-11.0	8-13	8-13	7-15	7-13
Chol (mg/dl)	160-425	180-305	145-275	140-360	145-355	120-400	130-350
Creat (mg/dl)	0.1-0.4	0.1-0.4	0.1-0.4	0.1-0.4	0.1-0.4	0.1-0.4	0.1-0.4
CO_2 (mmol/L)	13-25	13-26	14-25	13-25	14-25	14-25	14-24
CPK (U/L)	165-412	55-345	90-300	30-245	95-305	35-355	220-345
GGT (U/L)	1-10	1-12	1-10	1-30	1-45	1-15	1-20
Glu (mg/dl)	190-350	190-345	190-390	200-445	185-355	200-345	145-245
LDH (U/L)	145-465	155-425	145-435	120-455	220-550	120-390	200-425
Lipase (U/L)	35-350	35-225	30-300	30-280	25-275	30-290	35-275
Phos (mg/dl)	3.2-5.4	3.1-5.5	3.0-5.2	3.2-4.8	2.5-5.5	2-10	2.9-6.5

BIOCHEMISTRY REFERENCE RANGES FOR SELECTED PSITTACINE SPECIES*							
	AFRICAN GREY	AMAZON	BUDGERIGAR	COCKATIEL	COCKATOO	CONURE	ECLECTUS
Potassium (mmol/L)	2.9-4.6	3.0-4.5	2.2-3.9	2.4-4.6	2.5-4.5	3-4.5.0	3.5-4.3
Sodium (mmol/L)	157-165	125-155	139-165	130-153	130-155	135-149	130-145
Total bili (mg/dl)	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1
Total protein (g/dl)	3.0-4.6	3-5	2.5-4.5	2.4-4.1	3-5	3.0-4.2	2.8-3.8
Trig (mg/dl)	45-145	49-190	105-265	45-200	45-205	50-300	70-410
Uric acid (mg/dl)	4.5-9.5	2.3-10.0	4.5-14.0	3.5-10.5	3.5-10.5	2.5-11.0	2.5-11.0
Bile acids (μmol/L)	13-90	18-60	15-70	20-85	25-87	15-55	10-61
T_4 (μg/dl)	0.2-1.5	0.1-1.1	0.3-1.5	0.4-1.9	0.3-1.8	0.3-1.9	0.3-2.0
Pre-albumin (g/dl)	0.03-1.35	0.35-1.05	0.48-1.21	0.8-1.6	0.24-1.18	0.18-0.98	0.05-0.74
Albumin (g/dl)	1.57-3.23	1.9-3.52	0.79-1.35	0.7-1.8	1.8-3.1	1.9-2.6	2.3-2.6
Alpha-1 (g/dl)	0.02-0.27	0.05-0.32	0.08-0.21	0.05-0.30	0.05-0.18	0.04-0.23	0.09-0.19
Alpha-2 (g/dl)	0.05-0.25	0.07-0.32	0.05-0.16	0.05-0.30	0.04-0.36	0.08-0.26	0.11-0.21
Beta (g/dl)	0.35-0.66	0.38-0.76	0.35-0.75	0.3-0.78	0.35-0.82	0.38-0.77	0.35-0.62
Gamma (g/dl)	0.11-0.71	0.17-0.76	0.15-0.55	0.11-0.53	0.21-0.65	0.32-0.61	0.22-0.51
A/G ratio	1.6-4.3	1.9-5.0	1.5-4.1	1.5-4.3	2.0-4.5	2.2-4.3	2.6-4.1

BIOCHEMISTRY REFERENCE RANGES FOR SELECTED PSITTACINE SPECIES*

	JARDINE'S	LORY	LOVEBIRD	MACAW	PARAKEET	PIONUS	QUAKER	SENEGAL
Alk phos (U/L)	80-156	75-155	10-90	20-230	20-120	80-290	70-300	70-300
ALT (U/L)	5-12	5-13	5-13	5-12	5-12	5-12	5-11	5-11
AST (U/L)	150-278	150-350	110-345	100-300	145-395	150-365	150-285	100-350
Amylase (U/L)	100-425	90-422	90-400	150-550	150-525	200-500	100-400	190-550
BUN (mg/dl)	2.8-5.6	2.7-5.7	2.8-5.5	3.0-5.6	3.1-5.3	3.0-5.4	2.9-5.4	2.9-5.4
Ca (mg/dl)	7-13	6.5-13.0	8-14	8.5-13.0	5.5-13.5	7.0-13.5	7-12	6.5-13.0
Chol (mg/dl)	100-300	95-295	95-335	100-390	150-400	130-295	100-295	130-340
Creat (mg/dl)	0.1-0.4	0.1-0.4	0.1-0.4	0.1-0.5	0.1-0.4	0.1-0.4	0.1-0.4	0.1-0.4
CO_2 (mmol/L)	14-25	14-26	14-25	14-25	14-25	14-24	14-26	14-25
CPK (U/L)	110-310	110-330	52-245	100-300	50-400	100-300	110-320	100-330
GGT (U/L)	1-15	1-16	2.5-18.0	1-30	1-12	1-18	1-15	1-15
Glu (mg/dl)	199-348	200-300	195-405	145-345	205-345	125-300	200-350	140-250
LDH (U/L)	119-335	115-330	105-355	70-350	145-445	125-380	120-300	150-350
Lipase (U/L)	30-255	25-250	30-320	30-250	30-220	30-250	25-225	35-250
Phos (mg/dl)	2-6.8.0	2.0-6.5	2.8-4.9	2-12	2.9-4.9	2.9-6.6	2.9-6.5	2.5-9.5

BIOCHEMISTRY REFERENCE RANGES FOR SELECTED PSITTACINE SPECIES*

	JARDINE'S	LORY	LOVEBIRD	MACAW	PARAKEET	PIONUS	QUAKER	SENEGAL
Potassium (mmol/L)	3.0-4.5	3.0-4.4	2.1-4.8	2-5	2.3-4.2	3.5-4.6	2.8-4.6	3-5
Sodium (mmol/L)	133-153	130-155	125-155	140-165	138-166	145-155	140-155	130-155
Total bili (mg/dl)	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1
Total protein (g/dl)	2.8-4.0	2.0-3.5	2.8-4.4	2.1-4.5	3.0-4.4	2.2-4.0	2.8-3.6	3.5-4.4
Trig (mg/dl)	60-130	65-140	45-200	60-135	55-250	60-225	50-200	45-145
Uric acid (mg/dl)	2.5-12.0	2.8-11.5	3.5-11.0	2.5-11.0	4.5-12.0	3.5-10.0	3.5-11.5	2.3-10.0
Bile acids (μmol/L)	25-65	20-65	13-65	6-35	18-79	14-60	25-65	20-85
T_4 (μg/dl)	0.2-1.5	0.3-1.2	0.2-2.3	0.2-1.9	0.4-1.8	0.5-1.9	0.4-2.1	0.5-2.3
Pre-albumin (g/dl)	0.18-0.32	0.48-0.76	0.6-1.2	0.05-0.7	0.6-1.0	0.19-0.93	0.48-1.13	0.19-0.64
Albumin (g/dl)	1.85-2.23	1.26-1.96	2.0-2.8	1.24-3.11	1.9-3.0	2.19-3.29	1.26-2.52	1.45-2.28
Alpha-1 (g/dl)	0.07-0.15	0.04-0.14	0.08-0.21	0.04-0.25	0.06-0.16	0.1-0.19	0.04-0.25	0.02-0.20
Alpha-2 (g/dl)	0.08-0.15	0.04-0.23	0.08-0.25	0.04-0.31	0.07-0.20	0.08-0.15	0.05-0.28	0.08-0.16
Beta (g/dl)	0.38-0.66	0.35-0.58	0.34-0.68	0.48-0.68	0.22-0.45	0.30-0.60	0.41-0.63	0.36-0.58
Gamma (g/dl)	0.26-0.51	0.13-0.29	0.2-0.48	0.2-0.5	0.19-0.3	0.18-0.42	0.13-0.48	0.14-0.23
A/G ratio	2.9-3.5	2.3-4.0	2.5-4.6	1.6-4.3	4.0-5.3	3.4-5.0	2.2-3.2	2.2-3.9

*University of Miami Avian & Wildlife Laboratory: All reference ranges obtained from 24-hour-old heparinized plasma samples. Regular chemistry performed on Ortho (Kodak Ektahem) 700XR; TP by non-temperature compensated refractometer; Bile acids and T_4 by RIA; EPH by Beckman Paragon SPEP II gels.

Heart and Respiratory Rates (Resting)

	Heart Rate (bpm)	Respiratory Rate (bpm)
Budgerigar	260-270	60-75
Lovebird	240-250	50-60
Cockatiel	210-220	40-50
Conure	165-220	30-50
Amazon	125-160	15-45
Cockatoo	125-170	15-40
Macaw	115-135	20-25

Electrocardiogram Values

Parameter	Budgerigar	Amazon	African grey
P-S (sec)	0.01-0.04	0.04-0.08	0.040-0.055
QRS (sec)	0.01-0.03	0.010-0.015	0.010-0.016
MEA	-83 to -106	-90 to -162	-79 to -103
P (sec)	0.01-0.02	0.01-0.02	0.012-0.018
HR (bpm)	400-600	340-600	340-600
P (mV)	NA	NA	0.25-0.55
QS (mV)	NA	NA	0.9-2.2

NA = not available; MEA = mean electrical axis; HR = heart rate

Incubation Periods for Selected Psittacines in Aviculture

	Incubation Period (days)	Pip-to-hatch Interval (hours)
African grey	26-28	24-72
Amazon	24-28	24-48
Brotogeris	22	24-36
Budgerigar	18	24-Dec
Caique	25	24-48
Cockatiel	21	24-48
Cockatoo (small)	22-25	24-72
Cockatoo (large)	26-29	24-72
Conure	23-24	24-48
Eclectus	28	24-72
Lory	26-27	24-36
Lovebird	22	24-48
Macaw (mini)	23-27	24-60
Macaw (medium)	24-28	24-72
Parrotlet	19	24-36
Pionus	25-26	24-48
Psittacula	24-26	24-48
Quaker	23	24-48

SAMPLE WEIGHTS (g) OF SELECTED HAND-RAISED PSITTACINE CHICKS AND ADULTS

Age (days)	0	3	7	14	21	28	35	42	49	Adult
Cockatiel	4-6	5-6	12-14	45-65	72-108	80-120	80-90	80-95	90-110	90-110
Golden conure	7-11	10-12	12-23	20-25	30-100	45-150	90-240	125-270	180-310	90-110
Green-cheeked Amazon	10-14	15-22	30-50	90-135	200-250	225-310	280-350	290-350	—	360
Lilac-crowned Amazon	11-13	15-20	25-35	75-140	160-240	250-300	300-350	310-350	—	360
Blue-fronted Amazon	14-17	20-25	35-60	100-170	240-280	280-370	350-420	380-440	380-430	432
Yellow-headed Amazon	12-21	16-30	25-50	75-200	140-300	230-450	270-580	310-560	380-565	568
Yellow-crowned Amazon	12-15	15-33	25-55	70-170	175-260	250-360	350-440	400-480	—	500
Yellow-naped Amazon	11-18	16-35	28-75	60-200	170-360	275-500	420-600	500-650	500-650	596
Eclectus	12-20	16-35	23-60	60-150	110-240	190-350	260-440	300-450	320-480	432
African grey	11-17	15-21	25-40	70-120	135-250	240-335	300-440	380-470	435-500	554
Red-vented cockatoo	11	16-20	25-30	70-100	145-200	230-280	250-300	275-350	280-350	298
Citron-crested cockatoo	12-15	15-23	26-84	78-144	148-265	208-366	292-430	319-445	320-464	357
Bare-eyed cockatoo	8-14	11-35	18-70	48-170	99-308	167-363	238-415	283-410	289-415	375
Goffin's cockatoo	8-11	10-15	20-45	70-100	125-240	175-275	220-325	250-350	250-350	255
Lesser sulphur-crested cockatoo	8-15	12-22	25-60	65-120	140-250	225-320	280-340	315-380	320-410	450
Rose-breasted cockatoo	7-12	10-17	15-40	35-100	70-200	115-300	175-370	220-400	240-423	403

SAMPLE WEIGHTS (g) OF SELECTED HAND-RAISED PSITTACINE CHICKS AND ADULTS

Age (days)	0	3	7	14	21	28	35	42	49	Adult
Medium sulphur-crested cockatoo	12-15	18-25	35-70	65-140	160-250	240-350	340-450	400-525	450-550	465
Major Mitchell's cockatoo	9-13	13-22	25-55	55-130	140-220	210-300	270-375	290-450	340-500	423
Umbrella cockatoo	12-20	15-20	25-55	75-150	170-300	280-400	350-530	450-600	500-725	577
Triton cockatoo	11-19	15-30	30-70	90-170	200-325	290-475	400-650	450-750	490-800	643
Moluccan cockatoo	16-22	21-30	35-55	90-170	190-300	330-450	470-650	600-750	680-825	853
Greater sulphur-crested cockatoo	16-20	18-35	35-80	100-200	220-330	370-525	450-625	500-725	550-880	843
Yellow-collared macaw	9-15	12-20	25-35	60-90	110-160	190-240	230-280	250-290	270-300	250
Red-fronted macaw	12-16	18-25	25-45	70-130	140-225	230-360	330-470	405-530	465-580	490
Caninde macaw	14-22	19-25	30-45	70-120	165-250	275-420	420-600	520-725	600-800	752
Military macaw	17-26	24-45	35-170	85-300	220-425	360-650	500-800	600-950	680-1050	925
Scarlet macaw	17-26	25-45	40-65	90-175	200-400	380-625	540-800	720-1050	830-1150	1001
Blue and gold macaw	16-27	25-40	40-100	90-250	200-450	350-650	525-900	670-1100	800-1200	1039
Green-winged macaw	17-28	30-55	45-80	100-250	225-450	400-650	610-900	830-1130	990-1190	1194
Buffon's macaw	20-26	25-35	40-70	100-170	250-500	450-750	650-900	850-1100	1050-1350	1290
Hyacinth macaw	20-27	25-35	45-75	110-180	250-400	450-600	600-750	800-1000	900-1200	1355

Weight ranges are provided as suggestions only, because growth of an individual chick is dependent on hatch weight, body structure, sex, husbandry, diet and feeding procedures.

Egg Weight Formulas

- Weight loss trend to pip:
  ([laid weight] - [current weight]) ÷ (# days incubated) = (average daily weight loss)
  (average daily weight loss) x (total incubation period prior to pip) ÷ (laid weight) = (decimal percentage)
  (decimal percentage) x 100 = (weight loss trend to pip)
- To hatch properly, psittacine eggs generally need to lose 12-13% of the laid weight up to pipping with another 3% lost at pipping.

Common Clinical Disorders of Psittacine Chicks

- Crop disorders, dysfunction*
- Stunting*
- Trauma (parental, cage mate)
- Foreign body aspiration (hand-feeding formula)
- Crop burn
- Bacterial overgrowth/infections*
- Candidiasis*
- Polyomavirus infection
- Constricted toe syndrome
- Musculoskeletal deviations*
- Hypothermia

* These conditions may be primarily due to malnutrition or improper food preparation and feeding techniques.

Common Clinical Disorders of Psittacine Adults

All psittacine birds are susceptible to common disease conditions, including bacterial, viral and fungal infections, chlamydiosis, parasites, neoplasia, toxins and reproductive dysfunctions. A few selected conditions frequently associated with a specific species are listed below. Many of these are related to malnutrition and mismanagement practices and are often resolved with improved husbandry.

AFRICAN GREY PARROTS

- Feather picking*
- Respiratory diseases* ^
- Aspergillosis* ^
- Hypocalcemic syndrome*
- Atherosclerosis*
- Circovirus (PBFD virus)* ^
- Behavioral: screaming, biting* ^

AMAZON PARROTS
- Obesity, atherosclerosis*
- Respiratory infections* ^
- Discolored feathers (hepatopathy or malnutrition)*
- Chlamydiosis
- Fatty liver*
- Papillomatosis

AUSTRALIAN PARAKEETS
- Intraspecific aggression
- "Wall crashing" of fledglings
- Bacterial infections
- Parasites

BUDGERIGARS
- Neoplasia (lipoma, testes, ovary, liver, kidney)*
- Overgrowth of beak and nails (malnutrition, hepatopathy, *Knemidocoptes* mites)*
- Egg-binding, other reproductive disorders (salpingitis, ovarian cysts)*
- Obesity*
- Chlamydiosis
- Macrorhabdosis
- Polyomavirus
- Circovirus (PBFD virus)

COCKATIELS
- Obstetrical problems (obsessive egg-laying, egg-binding, egg-related peritonitis, yolk emboli)*
- Upper respiratory infections*
- Feather picking*
- Liver disease: fatty liver, cirrhosis, neoplasia
- Idiopathic neurologic dysfunctions (esp. lutinos)
- Renal disease (PU/PD)*
- Chlamydiosis

COCKATOOS
- Feather picking, self-mutilation*
- Obesity, lipomas (esp. in rose-breasted, sulphur-crested)*, atherosclerosis
- Circovirus (PBFD virus) - acute/chronic
- Behavioral abnormalities, esp. mate aggression
- Cloacal prolapse (idiopathic)

CONURES
- Behavioral problems (severe feather picking, screaming, cannibalism)*

- Feather and skin disorders*
- Injuries
- Pacheco's virus carriers ^

ECLECTUS PARROTS
- Hypovitaminosis A*
- Feather picking*
- Circovirus (PBFD virus), polyomavirus
- Female aggression, male docility*
- Toe-tapping*

GREY-CHEEKED PARAKEETS AND OTHER *BROTOGERIS* SP.
- Mycobacteriosis ^
- Injuries
- Chlamydiosis
- Feather picking refractory to therapy

LORIES/LORIKEETS
- Hepatopathy*
- Fungal infections
- Bacterial infections
- Parasites

LOVEBIRDS
- Feather abnormalities, circovirus (PBFD virus)
- Aggression
- Lovebird pox
- Obstetrical disorders*
- Macrorhabdosis

MACAWS
- Proventricular dilatation disease (PDD)
- Reproductive disorders*
- Feather picking, mutilation
- Oral, cloacal papillomatosis
- Drug sensitivities (doxycycline, trimethoprim, gas anesthetics)
- Microhepatia*
- Atherosclerosis, cardiac disease*

ROSELLAS
- Feather picking
- Circovirus (PBFD virus)
- Aggression
- Pododermatitis* (often severe)
- Motile protozoa (fatal intestinal disease)

*These conditions may be primarily due to malnutrition.

^ These conditions are seen less often in domestically raised birds than in wild-caught birds.

Zoonotic Potential of Bacteria from Psittacine Birds

- *Campylobacter*: Undetermined, possible *C. laridis* (diarrhea in children)
- *E. coli:* Possible; prevention: good hygiene
- *Erysipelothrix*: Persistent dermatitis, avoid contact with infected birds
- *Listeria*: Conjunctivitis when infected from birds
- *Mycobacterium*: Possible; immunosuppressed humans
- *Pseudomonas*: Possible; prevention: good hygiene
- *Vibrio*: Mild enteritis; good hygiene
- *Yersinia pseudotuberculosis*: High potential, transmission documented
- *Chlamydophila*: possible; prevention: good ventilation, screen birds

RULE OUT CHART FOR PSITTACINES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Anorexia	Systemic disease (bacterial, viral, fungal, chlamydial), Liver disorders, Oral abscess, Mouth trauma, Paralysis of head muscles, Blindness, Inaccessibility of food, Psychologic, Foreign body in mouth, Egg-related disorder, Neoplasia	Physical exam, Cytology, Microbiology, CBC/chemistries, Radiography, Endoscopy, Serology, Viral testing, Chlamydial testing, History, Ultrasonography	Supportive care, Appropriate therapy per etiology, Decrease stresses
Beak abnormalities	Circovirus (PBFD virus), Trauma, Mites, Liver or pancreatic disease, Malnutrition, Neoplasia, Bacterial or yeast infection	Physical exam, History, Cytology, Endoscopy, Biopsy, Radiography, Circovirus testing	Supportive care, Therapy per etiology, Protect other clinic birds from circovirus suspect, Remove and isolate carriers
Bleeding into tissues	Polyomavirus, Erythemic myelosis, Malnutrition, Trauma, Coagulopathy, Liver disease, Anti-coagulant rodenticides, Herpesvirus	Physical exam, Histopathology, CBC, Polyomavirus testing, virus isolation or serology	Vaccinate flock, Vitamin K_1, Calcium, Supportive care, Antibiotics, lactulose, depending on etiology
Blood (in droppings or urine)	GI bleeding, Toxins (eg, lead), Coagulopathy, Hepatic disease, Vitamin K deficiency, Viral diseases (reovirus, herpesvirus, polyomavirus), Cloacal papillomatosis, Tumor, Foreign body, Ulcer, Parasites, Impending egg laying, Aflatoxin	Physical exam, History, Fecal exam, Cytology, Radiography, Endoscopy, Microbiology, Serology, Viral testing, Toxicologic testing (lead), Ultrasonography	Supportive care, Therapy per etiology, Vaccinate if appropriate for flock mates, Remove and isolate carriers, Heavy metal chelation

RULE OUT CHART FOR PSITTACINES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Cere, enlarged or swollen	Chronic rhinitis (bacterial, mycotic, mycoplasmal, chlamydial), Foreign body, Trauma, Allergy, Toxic insult (smoke or other airborne irritants), Malnutrition (chronic), Avian poxvirus, *Knemidokoptes* sp. mites, Normal for breeding female budgerigar	Physical exam, History (evaluate diet), CBC/chemistries, Radiography, Microbiology, Chlamydial screening, Toxicology, Cytology	Treat per etiology
Cloacal protrusions	Cloacal papillomatosis, Cloacal prolapse secondary to malnutrition, Diarrhea, Egg binding, Psychological	Physical exam (differentiate cause), History of overly attentive owners, Endoscopy, Cytology, Histopathology	Hemostasis, Supportive care, Barium enema, Possible surgical removal, If prolapse, temporary purse-string or stay sutures, Repair with cloacopexy or mucosal resection, Treat underlying cause (behavior), Try clomipramine
Comatose	Shock, Trauma, Pansystemic disease, Toxemia, Blood loss, Hypoglycemia, Hypocalcemia, Advanced cardiac disease	Physical exam, History, Diagnostic workup	Supportive care, Treat underlying etiology

RULE OUT CHART FOR PSITTACINES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Coughing (acute) (See also Dyspnea)	Foreign body inhalation, Inhalation pneumonia (neonates), Trauma, Upper respiratory infection, Abscess or neoplasia in lungs or body cavity, Air sac mites, Infectious tracheitis, Avian viral serositis, Mimicry of humans, Bleeding into body cavity, Sarcocystosis, Syringeal granuloma, Malnutrition, Airborne toxins (PTFE gas), Cardiac disorders	Physical exam, Fecal wet mount, Cytology (feces, exudates, flush, scraping), Radiography, Rhinoscopy, C&S, Biopsy of lesions, Paracentesis, Microbiology, Toxicology, Tracheal wash, Echocardiography, ECG	Supportive care (+oxygen), Air sac tube, Therapy per etiology, Appropriate antimicrobials, Nebulization therapy, Correct diet
Coughing (chronic) (See also Dyspnea)	Infections (bacterial, viral, fungal, chlamydial, parasitic, yeast, mycobacterial), Ascites, Abscess or granuloma, Malnutrition, Air sac mites, Mimicry of humans, Airborne toxins (eg, cigarette smoke)	Physical exam, Fecal wet mount, Cytology (feces, exudates, flush, scrapings), Radiography, Biopsy of lesions, Paracentesis, Laparoscopy, Tracheoscopy, Biopsy of air sacs, Surgical intervention, Histopathology, Bacterial, chlamydial, fungal, viral, mycobacterial screening, Tracheal wash, ECG, Imaging	Supportive care (+ oxygen), Abdominal air sac tube, Nebulization therapy, Antimicrobials per etiology, Correct ventilation, diet
Crop stasis	Laceration/rupture/scalding of crop (neonates), Improper nursery environment, Foreign body, Impaction, Infectious diseases, Parasites, Proventricular dilatation disease, Metabolic disease	Physical exam, Husbandry review, Endoscopy (oral entry), Radiography, Cytology (crop flush), Microbiology, Fecal exam, Crop biopsy	Surgical repair, Flush crop, Treat per etiology, Metoclopramide to enhance motility, Supportive care, Proventricular tube, Improve husbandry

RULE OUT CHART FOR PSITTACINES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Diarrhea	Dietary change, Infectious disease (bacterial, viral, mycotic, chlamydial), GI obstruction, Hepatitis, Malnutrition, Pancreatitis, Toxins, Fecalith, Over-treatment with antibiotics, Impending egg laying, Egg-related disorder, Parasites	Fecal cytology/ float/wet mount, Cloacal evaluation via endoscopy, Chlamydial screen, Radiography (+ contrast), Microbiology, Fecal Gram's stain	Supportive care, Therapy per etiology
Dyspnea (acute) (See also Coughing)	Aspergillosis, Infectious disease, Foreign body inhalation, Internal bleeding, Allergy, Toxin (eg, PTFE fumes) inhalation, Plugged nares, Avian viral serositis, Sarcocystosis, Anemia, Chlamydiosis, Trichomoniasis, Inhalation pneumonia (neonates)	Physical exam, History, CBC/chemistries, Cytology, Radiography, Microbiology, Toxicology, Nasal flush, Chlamydial screening, Endoscopy	Supportive care (+ oxygen), Install abdominal breathing tube or tracheotomy, Appropriate antimicrobials, Nebulization therapy, Prevent stress, PTFE toxicity: heparin, dexamethasone, aminophiline IV
Dyspnea (chronic) (See also Coughing)	Infectious disease, Liver disease, Kidney disease, Ascites, Cardiac disease, Neoplasia, Air sacculitis, Malnutrition, Sarcocystosis (lung edema), Proliferative tracheitis, Pericardial effusion, Egg-related peritonitis, Hemochromatosis, Anemia, Obesity, Thyroid enlargement, Goiter, Herpesvirus	Physical exam, CBC/chemistries, Cytology, Radiography, Endoscopy, Fecal cytology/smear, Microbiology, Viral screening, Ultrasonography	Supportive care (+ oxygen), Drain fluid if possible for enhanced movement, Appropriate antimicrobials, Nebulization therapy, Correct underlying condition per etiology

RULE OUT CHART FOR PSITTACINES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Fainting/exercise intolerance	Cardiac disease, Systemic disease, Neurologic disease	PE, ECG, Echocardiography, Radiography, CBC, Chemistries, Blood pressure	Correct diet for cardiac (low fat, sodium), Cardiac medications, Treat other underlying disease
Feather dystrophy	Circovirus (PBFD virus), Polyomavirus, Feather cysts, Stress, Malnutrition	Serology, Biopsy, Histopathology Circovirus, polyomavirus testing	Supportive care, Protect other birds in clinic from viral suspect, Vaccinate flock for polyomavirus, if appropriate, F10 to disinfect premises. Feather cysts may need surgical excision, may return
Feather picking	Nutritional, Psychological, Reproductive frustration, Parasites, Endocrine disruption, Systemic disease, Dermatitis, Pox, Liver disease, Polyfolliculitis/ dermatitis of budgies and African lovebirds	Physical exam, Fecal parasite exam, CBC/chemistries, Full workup: DNA probe, serology, microbiology, endocrine evaluation, Psychologic evaluation: History of over-indulgence or neglect	Supportive care, Environmental enrichment, Response to modification in diet & behavior, Treat underlying medical conditions, Chemical behavior modifiers (antidepressants, tranquilizers) only if in conjunction with behavioral training, Temporary mechanical blockers (collars)
Lameness	Fracture, Gout, Luxations, Arthritis, Systemic disease, Neuritis, Neoplasia (esp. budgies), Avian tuberculosis (esp. grey-cheeks), Cardiac disease	Physical exam, Diet, History, Cytology including acid-fast stain, Radiography, CBC/chemistries, Full workup. Ultrasonography, ECG	Treat per etiology, TB therapy controversial (zoonotic potential)

RULE OUT CHART FOR PSITTACINES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Neurologic signs	Nutritional, Metabolic (heat stress, hypocalcemia, hypoglycemia, hepatic encephalopathy), Toxins (heavy metals, insecticides, PTFE), Infectious (bacterial, fungal, viral, chlamydial or parasitic), Traumatic, Neoplastic, Ascarid migration (esp. rosellas, cockatiels, budgies), Epilepsy (esp. red-lored Amazons), Egg-related peritonitis, Terminal behavior, Peripheral neuropathy, Sarcocystosis, Cardiac disease	Physical exam, CBC/chemistries, History, Radiography, CSF tap, Microbiology, Serology, Toxicology, Chlamydial screening, Ultrasonography, ECG	Stop seizure with diazepam, Supportive care, Treat underlying etiology, Head trauma: oxygen, keep cold (50°F) +/- ice to head +/- mannitol, Steroids of little use (may cause other problems). If cardiac/atherosclerosis: low fat/sodium diet, Cardiac treatment
Oral lesions	Candidiasis, Lith (in salivary tissues – resembles abscess), Burn, Sinusitis, Malnutrition, Parasites, Circovirus (PBFD virus)	Physical exam, History, Gram's stain (lesion, fecal), Cytology, Microbiology, Radiography, DNA probe, Chlamydial screen, Wet mount of saliva, Fecal/urine parasite check	Address diet, Appropriate antimicrobials, If circovirus (PBFD virus): supportive, protect other birds, If sinusitis: flush, treat respiratory disease, Antiparasitics (if needed)
Paralysis (unilateral or bilateral)	Trauma, Malnutrition, Fracture, Neoplasia, Toxin, Luxation	Physical exam, History, Radiography, Endoscopy, Toxicology	Supportive care, Therapy per etiology, Analgesia

RULE OUT CHART FOR PSITTACINES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Passing whole seeds (See also Weight loss)	Inflammation, infection or dysfunction of GI tract, Pancreatitis or pancreatic deficiency, Liver disease, Parasites, Food allergy, Dehydration, Grit impaction, PDD	CBC/chemistries, Fecal enzyme testing, Cytology, Radiography, Crop endoscopy/biopsy	Appropriate antimicrobials, Antiparasitics, Motility modifier drugs, Fluid therapy/supportive care, Pancreatic enzyme supplements (if indicated), Diet therapy, Mineral oil for grit impaction, For PDD try Celebrex® (earlier, the better)
Polyuria/Polydipsia	Dietary-induced, Excitement or nervousness, Apparent psychogenic polydipsia, Medications (corticosteroids, diuretics, progesterones), Toxins (eg, gentamicin, lead), Diabetes insipidus, Diabetes mellitus, Renal glucosuria, Liver disease, Renal disease (gout), Malnutrition, Excess dietary protein (eg, cockatiels on formulated diet), Excessive fruit consumption, Starvation, Systemic disease (viral, bacterial, fungal)	Physical exam, History, CBC/chemistries (esp. Ca, P, electrolytes Na, K, uric acid), Urinalysis, Radiography, C/S, Water deprivation test, Blood glucose, Cytology, Endoscopy	Treat per etiology, Supportive care, Electrolytes, For cockatiels (renal disease), add 20% millet to diet if previously on high percentage pelleted diet
Poor condition (budgies, cockatiels)	Giardiasis, Chlamydiosis, Neoplasia (>5 yr budgie), Dietary deficiency syndrome, “lutino syndrome,” Candidiasis, Nephropathy/hepatopathy due to in-breeding	Physical exam, CBC/chemistries, Fecal float/direct smear, Chlamydial testing, Cytology (biopsy, necropsy), Radiology	Supportive care, Appropriate antimicrobial, antifungal, antiparasitic, Dietary improvement, Avoid over-treatment, stress, Prognosis is often grave

RULE OUT CHART FOR PSITTACINES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Regurgitation	Neoplasia, Bacterial infection, Foreign body, Proventricular dilatation disease, Pancreatitis, Behavioral (reproductively motivated "courting" behavior), Goiter, Candidiasis	Physical exam, CBC/chemistries, Cytology, Microbiology, Radiology, Endoscopy, Biopsy, History, Crop wash	Appropriate antimicrobials, Supportive care, Surgery (cropotomy or endoscopy if foreign body in crop), Behavioral/environmental modifications (if psychologic causes), Iodine in diet
Respiratory signs	See Coughing, Dyspnea		
Sick bird syndrome (SBS)	Infectious disease (bacterial, chlamydial, viral, mycoplasmal), Parasites, Malnutrition, Dehydration, Reproductive disorders, Liver and other organ failure	Physical exam, CBC/chemistries, Cytology, Microbiology, Fecal exam, Chlamydial screen, Serology, Ultrasonography, Radiography, Endoscopy, Necropsy	Supportive care, Appropriate antimicrobials, antiparasitics
Self-mutilation (See also Skin lesions, Feather picking, Feather dystrophy)	Behavioral/psychologic, Poxvirus (lovebirds), Infectious dermatitis, *Staphylococcus* sensitivity, Indication of pain or irritation (may be deep to the skin), Amazon foot necrosis	Physical exam, History, Cytology, CBC/chemistries, Microbiology, Full workup, Biopsy	Appropriate antimicrobials, Analgesics, Behavioral counseling +/- collar
Sinusitis	Mycoplasmosis, Bacterial infection, Mycotic infection, Chlamydiosis, Nutritional rhinitis, Foreign body, Papillomatosis, Occluded choana (atresia), Uncomplicated viral infections, Sunken eye of macaws, Allergies, Irritating aerosols (tobacco smoke)	CBC/chemistries, Cytology, Microbiology, Physical exam, Chlamydial screening, Radiography	Appropriate antimicrobials, Supportive care, Sinus flush/trephination, Remove allergen

RULE OUT CHART FOR PSITTACINES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Skin lesions (See also Self-mutilation, Feather dystrophy, Feather picking)	*Knemidokoptes* mites, Herpesvirus (cockatoos), Poxvirus, Annular toe deformity, Bacterial dermatitis, Trauma (rule out self-exacerbation), Amazon foot necrosis	Physical exam, Cytology, Microbiology, Biopsy	Ivermectin (if *Knemidokoptes*), Appropriate antimicrobials, Supportive care, Acyclovir oral & cream (if herpesvirus), May need collar (if picking at lesions), Isolation, Insect control (pox), Sanitation, Surgical intervention
Straining (See also Cloacal protrusion, SBS)	Obstetrical problems (egg binding, peritonitis, egg-laying), Cloacalith, Diarrhea	Physical exam, CBC/chemistries, Radiography, Ultrasonography, Fecal Gram's stain, Cloacal endoscopy	Supportive care, Egg-binding: PGE_2, surgery if necessary, calcium (only if not on a formulated diet)
Sudden death	Dietary deficiency syndrome (obese cockatiel), Polyomavirus, Parasites, Cardiopathy, PTFE inhalation, Ingested toxins, Systemic disease, Pacheco's disease	Physical exam, Husbandry review, History, DNA probe for cage mates, Necropsy, Histopathology, Microbiology	Survivors: appropriate therapy per cause, Consider infectious agents if other birds in home
Swelling (abdomen)	Neoplasia, Cardiac disease, Ascites, Polyomavirus infection, Hemochromatosis, GI disorder, Impending egg laying, Egg binding, Organomegaly	Palpation, CBC/chemistries, Ultrasonography, Cytology, Radiology, ECG, Blood pressure, Endoscopy, Histopathology, DNA probe test, Chlamydial screening	Drain ascites fluid, Supportive care, Vaccinate flock (polyoma-virus), Treat underlying etiology

RULE OUT CHART FOR PSITTACINES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Swelling (cutaneous or subcutaneous)	Hypothyroidism, Lipomas, Obesity, Feather cysts, Trauma (bite wound), Neoplasia, Hematoma, Subcutaneous emphysema	Physical exam, CBC/chemistries, Endoscopy, Biopsy, Radiography	Supportive care, Dietary improvement, Surgical removal, if possible, Stent for SC emphysema, Treat per etiology
Swelling (joints)	Bacterial infection (including *M. avium, Salmonella* spp.), Gout, Fracture	Physical exam, Cytology, Radiology, Microbiology, CBC/chemistries	Treat per etiology, Analgesics, *M. avium* treatment controversial (zoonotic potential)
Tachypnea	Heat stress, Fear, Severe respiratory compromise	Physical exam, History, Radiography	Supportive, Fluids, Cool down, O_2
Trauma (See also Neurologic signs for head trauma treatment)	Mate aggression, Intraspecific aggression, Fight wounds, Injuries, "Night panic" syndrome in lutinos, Wall crashing, Malnutrition	Physical exam, History, Radiography, CBC (esp. blood loss assessment)	Hemostasis, Splints, Suture, Surgery, Supportive care, Leave night light on, Antimicrobials/ anti-inflammatories as needed, Improve diet
Weakness	Neoplasia, Cardiac disease, Malnutrition, Systemic disease, Infectious disease	Diet history, CBC/chemistries (esp. glucose), Biopsy, Radiography, Cardiac screen, Microbiology, Ultrasonography	Supportive care, Treat per underlying etiology, Antimicrobials, Antiparasitics, Improve diet

RULE OUT CHART FOR PSITTACINES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Weight loss (acute) (See also SBS, Passing whole seeds)	Infectious disease, Parasites, PDD, Neoplasia, Foreign body ingestion, Renal disease, Malnutrition	Physical exam, CBC/chemistries, Fecal float/direct, Radiography, C&S tracheal swab, Biopsy, Cytology, Endoscopy, Crop biopsy, Ultrasonography	Appropriate therapy per etiology, Supportive care, Surgery (eg, cropotomy) if foreign body, Improve diet
Weight loss (chronic) (See also Passing whole seeds)	*Mycobacterium avium*, PDD, Chronic zinc toxicosis	Acid-fast stains, Microbiology, Radiography, Crop biopsy	Treatment for TB is controversial (zoonotic potential), Consider euthanasia, Sanitation, Ventilation

Supportive care = environmental heat, fluids and tube-feeding (gavage)

PASSERINES and SOFTBILLS

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of passerines and softbills and is not intended to replace comprehensive reference material. Updates for Canaries and Finches were provided by Storm Hudelson, DVM, Dipl ABVP-Avian Practice. Updates for Mynahs and Ramphastids were provided by Amy Worell, DVM, Dipl ABVP-Avian Practice.

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Diagnostic Sampling in Small Passerines

FECAL EXAMINATION

- A direct wet mount of fresh, warm stool should be examined for *Cochlosoma*, *Giardia*, *Candida*, *Macrohabdus*, bacteria, plant material, chitin skeletons, urates and powderdown feathers.
- A Gram's stain should be free of *Macrohabdus* sp., yeast or bacteria and should have only low numbers of gram-positive rods or cocci.
- Flotation can reveal coccidian oocysts (common) or helminth eggs (uncommon).

CROP SWABS

- A crop swab can be obtained by using a cotton-tipped applicator moistened in saline or by administration of 0.2 ml saline into the crop using a syringe and small feeding needle and then reaspirating.
- A direct warm wet mount can reveal the presence of *Trichomonas*, *Candida* or *Macrorhabus* spp. or bacteria.

BACTERIOLOGY

- Samples for bacteriology may include feces, cloacal swab, nasal discharge or skin swab.

BLOOD COLLECTION

- Caution: avoid hematomas, as they may cause significant intravascular blood loss.
- The right jugular vein is the best site for blood collection.
- A skin prick technique with the above site or with the external thoracic vein can be used.
- Nail clip, medial metatarsal vein or cutaneous basilic vein may provide inadequate sample volume.
- The lymphocyte is the predominant white cell, which tends to increase in stress-related conditions.

Breeding Characteristics of Selected Passerine Birds

	Eggs per clutch	Incubation (days)	Fledging (days)
Australian grass finch	4-8	12-17	21-25
Bird of paradise	1-2	17-21	17-30
Bowerbird	1-2	19-24	18-21
Bulbul	2-5	12-14	14-18
Frigillid finch	3-5	12-14	11-17
Cardinal	2-5	11-14	9-15
Crow and jay	2-8	16-22	20-45
Java finch	4-8	14-14	26-28
Sparrow and weaver	2-5	13-14	21-24

See also individual Rule Out Charts for Canaries, Finches, Mynahs and Toucans.

GENERAL RULE OUT CHART FOR PASSERINES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Conjunctivitis (proliferative eyelid lesions)	Poxvirus	Histopathology, Culture (viral), C&S for secondary bacterial infections	Vaccination, Isolation, Sanitation, Vector control, Supportive care, Antimicrobials if secondary bacterial infection
Conjunctivitis (scabs, crusts)	*Knemidokoptes* mites, Secondary bacterial, fungal infection	Scraping & microscopic exam, C&S	Invermectin, Sanitation, Treat secondary infections, Supportive care
Conjunctivitis (+/- respiratory signs)	Mycoplasmosis, Chlamydiosis, Cytomegalovirus, Bacteria (may also have sinus abscesses), Malnutrition	Rule out other causes, Chlamydial testing, Histopathology, C&S	Antimicrobials for mycoplasma, chlamydia, bacteria, May excise/drain abscesses, Sinus trephination/flush, Supportive care, Formulated diet
CNS signs (+/- respiratory or systemic signs)	Newcastle disease, Listeriosis, Cerebral vascular accident, Epilepsy, Toxoplasmosis, Bacterial/fungal encephalitis, Lead poisoning	Physical exam, Neurologic exam, CBC/chemistries, Radiographs, Blood culture, Blood lead, Toxicosis, Necropsy/histopathology	Appropriate antimicrobials, Chelation (lead) plus removal if ingested, Improve husbandry, Anti-seizure medications (epilepsy)

GENERAL RULE OUT CHART FOR PASSERINES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Diarrhea (abnormal droppings, SBS*, +/- abnormal urates)	Bacterial or fungal gastroenteritis or hepatitis, Chlamydiosis, *Mycobacterium avium*, Peritonitis, Neoplasia, Systemic disease, Coccidia, *Atoxoplasma, Cryptosporidium, Trichomonas, Giardia*, Cestodiasis, Nematodiasis, Polyomavirus	Physical exam, History, Fecal Gram's stain, C&S, CBC/chemistries, Radiography, Chlamydial testing, Fecal flotation/direct smear, Specialized tests for *Giardia*/crypto/polyomavirus, Coccidia usually shed in feces in late afternoon	Appropriate antimicrobials, Treat underlying disease, Appropriate antiparasitics, Sanitation, Correct husbandry to prevent vectors
Dyspnea	Inhalant toxins	Physical exam, History, CBC/chemistries, Cytology of oropharyngeal/tracheal mucosa, Radiography, Tissue toxicology upon necropsy	Supportive care, Anti-inflammatories as indicated, Antidote, Direct treatment if known, Eliminate contact
	Air sac mites (*Sternostoma tracheacolum*), Nematodes (*Syngamus trachea*)	Tracheal transillumination, Visualization of parasite, Cytology, Rule out secondary problems	Mites: ivermectin (oral/topical), nebulization with pyrethrins, Syngamus: levamisole, ivermectin or fenbendazole + mechanical removal of tracheal worms to prevent obstruction
	Infectious: *Pasteurella, Klebsiella,* other bacteria, fungi (aspergillosis), paramyxovirus, chlamydiosis, cytomegalovirus, mycoplasma, *Mycobacterium avium*, poxvirus, influenza virus	Physical exam, Radiography, Gram's stain/cytology of tracheal wash/swab, C&S, Chlamydial testing, Acid-fast staining, Mycoplasma culture, CBC/chemistries, TB serology	Appropriate antimicrobials, Isolation, sanitation (viral), *Mycobacterium*: zoonotic potential, therapies not proven, Supportive care

*SBS = Sick Bird Syndrome: lethargy, fluffing, drooping, sitting on cage bottom, anorexia

RULE OUT CHART - PASSERINES

GENERAL RULE OUT CHART FOR PASSERINES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Dyspnea	Abdominal enlargement (hepatomegaly = chlamydiosis, iron storage disease, amyloidosis, hepatic lipidosis), Neoplasia, Ascites, Egg binding, Egg-related peritonitis, Cryptosporidiosis	Physical exam, Radiography, Ultrasonography, Cardiac evaluation, CBC/chemistries, Abdominal tap/cytology, C&S, Biopsy, Histopathology	Relieve egg binding, Appropriate supportive care, Dietary management, Cardiac disease management, Appropriate therapeutics (chlamydia)
Sudden death (nestlings/fledglings, stressed birds)	Polyomavirus, *E. coli*, Mycobacteriosis, Macrorhabdosis, Yersinosis, Poxvirus, Rule out other infectious agents, Hypothermia, Aspiration pneumonia, Toxins, Trauma	History, Necropsy, Histopathology, Polyomavirus DNA probe test	Isolation, Sanitation, Supportive care to polyomavirus survivors, Vaccinate flock (?), Survivors may develop abnormal feathers/misshapen beaks
Sudden death (CNS signs)	Listeriosis, PMV-3, Atoxoplasmosis, Trauma, Toxins, Pharmacologic sensitivity	Culture, Necropsy/histopathology	Antibiotics, Supportive care to flock
Swelling (abdomen)	Leukosis complex, Neoplasia, Hepatomegaly/ splenomegaly (rule out blood parasites, iron storage disease, amyloidosis, hepatic lipidosis, infectious causes), Ascites, Egg binding	Physical exam, Radiography, CBC/chemistries, Blood parasite examination, Ultrasonography, Biopsy/histopathology, Chlamydial testing	No treatment for leucosis complex, Appropriate therapy per etiology, Relieve egg binding, Supportive care and dietary management, Iron chelation

GENERAL RULE OUT CHART FOR PASSERINES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Swelling (around eye & beak)	Poxvirus	Physical exam, Histopathology, Viral culture, C&S if secondary bacterial infections	Supportive, Antiviral treatments not proven, Antimicrobials for secondary infections, Eliminate exposure to vector, Sanitation
Swellings (feet, legs, including proliferations, crusts, scabs)	Papillomavirus, *Knemidokoptes* mites, Poxvirus, Strangulating fibers, Insect bites, Bacterial infection	Physical exam, Husbandry review, Skin scraping/cytology/ histopathology, Gram's stain/culture	Ivermectin for *Knemidokoptes*, Sanitation, Excision of papillomatous tissue, Remove fibers, Appropriate antimicrobials, Improve husbandry, If pox, eliminate insect exposure
Weight loss (chronic), SBS*	Pseudotuberculosis, *Mycobacterium avium*, Macrorhabdosis,Blood parasites (*Leukocytozoon, Haemoproteus*), Iron storage disease, Neoplasia, Amyloidosis, Chronic malnutrition/sub-nutrition, Chronic bacterial/fungal infections	Physical exam, History, Gram's stain, C&S, CBC/chemistries, Blood parasite exam, Radiography, Necropsy/histopathology	Appropriate antiparasitics may be tried, *Mycobacterium* treatment controversial (zoonotic potential), Other bacteria/fungi: appropriate antimicrobials, Sanitation, Correct husbandry, diet

*SBS = Sick Bird Syndrome: lethargy, fluffing, drooping, sitting on cage bottom, anorexia

Therapeutics via Soft Food or Water for Flock Treatment of Small Passerines*

Drug	Concentration in Drinking Water (mg/L)	Concentration in Soft Food (mg/kg)
Amoxicillin	200-400	300-500
Amphotericin B	100-200	100-200
Ampicillin	1000-2000	2000-3000
Chlortetracycline	1000-1500	1500
Dimetridazole	125	—
Doxycycline	250	1000
Enrofloxacin	200	200
Fenbendazole	25	25
Furazolidone	200-300	300
Ivermectin	9	—
Metronidazole	100	100
Neomycin	200	200
Nystatin	200,000 IU	200,000 IU
Polymyxin	100,000 IU	100,000 IU
Ronidazole	350	350
Spectinomycin	200-400	400
Spiramycin	200-400	400
Sulfachloropyridazine	150-300	—
Sulfadimidine	150	—
Toltrazuril	180	—
Trimethoprim/sulfonamide	200	200
Tylosin	250-400	400

Note: The birds should be treated at the same time through the drinking water and through the food.

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*From Sandmeier P, Coutteel P, Canaries, Finches and Mynahs. *In* Harrison GJ, Lightfoot T (eds): Clinical Avian Medicine Vol II Special Species, 2005.

CANARIES

- **Order:** Passeriformes
- **Family:** Fringillidae
- **Sub-family:** Carduelidae

Common Species and Variations

Serinus canarius

- Varieties such as Norwich, Glouster and Yorkshire canaries are bred for morphologic characteristics.
- New color canaries are bred for their color mutations.
- Canaries have a small gene pool.
- Feather mutations may be associated with genetic disease: feathering that impairs flight, interferes with normal ambulation, accumulates excrement pericloacally and protrudes into the cornea.

Canaries - Quick Facts

Physiologic	
Length:	4.5-7.0 in
Body weight:	12-30 g
Maximum life span:	20-25 yr
Average captive life span:	5-15 yr
Resting heart rate:	265-325 bpm
Resting respiratory rate:	60-80 breaths/min
Reproductive	
Age of sexual maturity:	1 yr
Eggs per clutch:	3-5
Incubation:	12-14 days
Fledging:	11-17 days

Diet

- A formulated diet for canaries is recommended.
- Feather color is dietary dependent in species with carotenoid pigmentation; red factor and new color canaries require exogenous sources of carotenoid.
- Commercial diets that contain algae (spirulina) provide carotenoid for proper feather color (eg, Harrison's Bird Foods).
- If unable to feed a formulated diet, egg food is traditionally fed to canaries during reproduction to boost a nutritionally lean diet of seeds.

Housing

- Indoor, temperature-controlled rooms are preferred for raising canaries in mosquito-prone areas (to protect from pox).
- At the very least, size enclosure requirements are: 12" x 12" x 10", although it is best to provide a large enclosure that encourages flight to keep the bird in good physical condition.
- Natural branches of varying widths are best for perches.
- The light cycle should follow the natural cycle: gradual increased length of daylight in preparation for breeding season.
- Gravel perches/paper are not recommended. Enclosure can be lined with newspaper, butcher paper or plain brown paper.
- A source of fresh water must be available. Most small passerines drink 250-300 ml/kg body weight of water daily.

Behavior

- Canaries are tidy and easy to care for, but do not like handling.
- If a male canary becomes ill, it may stop singing and may not recommence vocalizations until the following spring, even though the initial illness has resolved.
- Some canaries, even some females, sing all year round.
- Males may be housed separately from other males but preferably are kept within visual/auditory range to stimulate singing.
- Group housing with mixed ages and both sexes works well if aviary provides multiple high-placed perches and feeding stations, abundant foliage for cover and a large enough enclosure for flying.

Sexing

- Males are more vocal and usually sing best in the spring in response to endogenous testosterone "surge."
- During the breeding season, the cloaca swells and pushes caudally in the male.

Preventive Care

- Keep nails trimmed.
- Check leg band for irritation or constriction.
- Before adding into a collection, new birds must be quarantined, tested and treated for parasites and infectious diseases.
- Avoid providing fine synthetic fibers for nesting materials as they may entangle feet, toes or other body parts.
- Avoid access to outdoor aviaries by free-ranging birds and predators.
- Weigh birds at least semi-annually, quarterly if breeders.
- Feed a formulated diet.
- An annual examination should consist of physical examination, CBC, history of illness and parasitic examination (feathers, trachea, air sacs), fecal flotation and smear.

Hematology Reference Ranges for Canaries*

WBC (x $10^3/\mu l$):	4-9
RBC (x$10^6/\mu l$):	2.5-3.8
HCT (%):	40-49
Heterophils (%):	50-80
Eosinophils (%):	0-2
Basophils (%):	0-1
Monos (%):	0-1
Lymphocytes (%):	20-45

*University of Miami Avian and Wildlife Laboratory: RBC and WBC count by Unopette method from 24-hour-old blood collected in EDTA; Spun HCT; Diff based on 100 cell count using smear made at the time of sample acquisition

Biochemistry Reference Ranges for Canaries*

Alk phos (U/L):	20-135
ALT (U/L):	5-11
AST (U/L):	145-345
Amylase (U/L):	190-485
BUN (mg/dl):	3-5
Ca (mg/dl):	5.5-13.5
Chol (mg/dl):	150-400
Creat (mg/dl):	0.1-0.4
CO_2 (mmol/L):	14-26
CPK (U/L):	55-350
GGT (U/L):	1-14
Glu (mg/dl):	205-435
LDH (U/L):	120-450
Lipase (U/L):	29-255
Phos (mg/dl):	2.9-4.9
Potassium (mmol/L):	2.2-4.5
Sodium (mmol/L):	135-165
Total bili (mg/dl):	0-0.1
Total protein (g/dl):	2.8-4.5
Trig (mg/dl):	60-265
Uric acid (mg/dl):	4-12
Bile acids (μmol/L):	23-90
T_4 (μg/dl):	0.3-1.8
Pre-albumin (g/dl):	0.35-0.98
Albumin (g/dl):	0.81-1.23
Alpha-1 (g/dl):	0.08-0.16
Alpha-2 (g/dl):	0.05-0.22
Beta (g/dl):	0.3-0.71
Gamma (g/dl):	0.16-0.63
A/G ratio:	1.3-4.5

*University of Miami Avian and Wildlife Laboratory: All reference ranges obtained from 24-hour-old heparinized plasma samples. Regular chemistry performed on Ortho (Kodak Ektahem) 700XR; TP by non-temperature compensated refractometer; Bile acids and T4 by RIA; EPH by Beckman Paragon SPEP II gels, represent adult ranges.

Therapy Sites

- IV: Right jugular vein; maximum IV bolus fluid = 0.5 ml very slowly
- IO: 26-ga needle for catheterization
- IM: Locate injection site in anterior third of chest muscles; use 25-ga needle; aspirate first, apply pressure afterward to reduce hemorrhage potential in pectoral muscles.
- SC: 30-ga needle for fluids (may not be absorbed if bird is moderately dehydrated or cold)
- Drug dosing must be based on exact weight (in grams) and delivered with precise microliter or insulin syringe.
- Tube-feeding: anorectic canary - 0.1-0.3 ml q4h if crop is empty

Common Clinical Disorders in Canaries

- Feather cysts
- Alopecia syndrome*
- Straw feathers and other feather abnormalities
- Obesity (+ lipomas)*
- Poxvirus infections
- Parasites
- *Knemidokoptes* sp. mite infection
- Air sac and tracheal mites
- *Plasmodium* sp. and toxoplasmosis
- *Trichomonas* sp. infection
- Constricted feet and digits
- Damaged nails and beak
- Obstetrical problems (egg binding, egg-related peritonitis, yolk emboli)*
- Dyspnea (acute: lith)*
- Cataracts*
- Bacterial diseases
- Tibiotarsal fractures
- Papillomatosis
- Polymavirus
- Paramyxovirus
- *Yersinia* sp.
- *Salmonella* sp.
- *Chlamydophila* sp.
- *Streptococcus* sp. (pneumonia)
- *Pseudomonas* sp. (diarrhea)
- *Mycobacterium* sp., especially in red-hooded sisken
- *Macrorhabdus* sp. (megabacteria)
- Toxoplasmosis

*Often related to malnutrition

See also General Rule Out Chart for Passerines Based on Clinical Signs, page 5.

RULE OUT CHART FOR CANARIES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Abdominal enlargement, SBS*	Egg binding, Leukosis, Ascites, Egg-related peritonitis, Cryptosporidiosis, Organomegaly	Physical examination, Radiography, CBC/chemistries, Aspiration of ascitic fluid: cytology, C&S	Relieve egg binding, Supportive care as in other birds, Leukosis: corticosteroids may help slow progression
Black spot (SC on abdomen)	Atoxoplasmosis, Bacteremias, *Plasmodium*	Physical examination, CBC/blood parasite examination, Blood culture/Gram's stain, Atoxoplasma: necropsy, impression smears of spleen, liver, buffy coat examination	Appropriate antimicrobials, *Plasmodium*: antimalarial drugs may be effective (lasting immunity not proven), Eliminate exposure to insects, Atoxo: currently no therapy, Sanitation & clean up environment
Diarrhea (nestlings), SBS*	Bacterial infections, I*sospora*, *Atoxoplasma* sp., *E. coli* - esp. nestlings, *Pseudomonas* sp., *Macrorhabdus* sp.. Trichomoniasis, Paramyxovirus, Yersiniosis, Salmonellosis	Physical examination, Gram's stain/C&S cloaca, Fecal flotation/direct smear, Atoxo: impression smears of spleen, liver, buffy coat	Appropriate antimicrobials, Sulfas or amprolium for *Isospora*, No proven treatment for *Atoxoplasma*, Sanitation to decrease exposure

*SBS = Sick Bird Syndrome: lethargy, fluffing, drooping, sitting on cage bottom, anorexia

RULE OUT CHART - CANARIES

RULE OUT CHART FOR CANARIES BASED ON CLINICAL SIGNS			
CLINICAL SIGNS	**DIFFERENTIAL DIAGNOSES**	**DIAGNOSTIC OPTIONS**	**POSSIBLE THERAPY**
Digit necrosis	Strangulating fibers, *Staphylococcus* infections, Aflatoxin/ergotism, dry gangrene	Physical exam, Husbandry history, C&S exudates if present, Review diet/seed source, CBC/chemistries	Fibers: remove, topical, Supportive care, Amputation if necrosis, desiccation, Staph: debride, topical and systemic antimicrobials, Adjust housing to minimize digit/foot trauma, Minimize exposure to aflatoxins/ergots (fungi), processed foods, Remove potential of moldy seeds
Feather disorders	Feather cysts (*Hypopteronosis cystica*)	Physical exam, Incise cyst for examination	Excision (with magnification), Bandage to control minor bleeding, Avoid breeding (genetic component)
Feather loss (head)	Feather mites, Lice, Male baldness, Aggression, Malnutrition, Male plucking female during breeding	Physical exam, History, Diet and husbandry review, Microscopic examination of feathers, follicle, Skin scrape	Mites/lice: ivermectin, clean out aviary and continue sanitation, treat all birds in the aviary, may need to retreat weekly for several weeks in heavy infestations, Correct diet, Aggression: separate adult males or breeders as necessary

RULE OUT CHART - CANARIES

RULE OUT CHART FOR CANARIES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Neurologic signs (torticollis)	Paramyxovirus, Listeriosis, Cerebral vascular accident (CVA) (trauma?), Toxins	Physical examination, CBC, Blood culture, History (if cerebral hemorrhage, may be able to see hemorrhage within cranium), Paramyxovirus: viral culture, serology, histopathology at necropsy	Broad spectrum antibiotics for *Listeria,* Supportive care for CVA, Head trauma: oxygen, cold (approximately 50°F), Tube feed if necessary to keep from losing weight, Steroids no value +/- mannitol
Respiratory signs	*Mycobacterium* sp. (esp. red-hooded sisken), Toxoplasmosis, Trichomoniasis, Poxvirus, Paramyxovirus, Influenza virus, Chlamydiosis, Air sac/tracheal mites, Yersiniosis, *Streptococcus* sp. persistent tracheitis, *Enterococcus fecalis, Pseudomonas* sp.	Physical exam, Chlamydial screen, Transilluminate trachea for mites, Tracheal C&S	Supportive care, Appropriate antimicrobials, Ivermectin for mites
SBS*, Blackened toes	Aflatoxins dry gangrene (may be systemic effects), Liver disease, Ergots from fungus *Claviceps purpurea* is a potential cause	Physical exam, History, Diet review, CBC/chemistries	Surgery, Supportive care, Diet improvement to minimize exposure to potential sources of aflatoxins/ergots
Straining, SBS*	Egg binding	Physical examination, Radiography, History, Transillumination	Supportive care, Relieve egg binding as in other birds (PGE_2, heat, fluids +/- calcium)

*SBS = Sick Bird Syndrome: lethargy, fluffing, drooping, sitting on cage bottom, anorexia

RULE OUT CHART FOR CANARIES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Sudden death (adults)	Bacterial septicemias (esp. colibacillosis and yersiniosis), Polyomavirus, Malnutrition	Physical exam/necropsy, Culture/Gram's stains	Appropriate antimicrobials to survivors, Sanitation, Supportive care, Screen environment for polyomavirus
Sudden death (hens)	Egg peritonitis (often due to *E. coli*)	Physical exam/necropsy, Culture/Gram's stains	Screen aviary for bacterial infections, Maximize nutrition, husbandry, sanitation, Minimize stress
Swellings on head (masses, caseations)	Poxvirus, Sinus abscesses, *Mycoplasma* sp. Secondary crusts to *Knemidokoptes*	Physical exam, Scraping/cytology/ histopathology, Gram's stain/C&S	Supportive care, Eliminate exposure to pox vector, Appropriate antimicrobials, Ivermectin for mites, Sanitation, Excise abscess & flush
Swellings on legs and feet (masses, proliferations)	Pox, Insect bites, Strangulating fibers, *Knemidokoptes* mites, *Staphylococcus* sp. infection ("bumblefoot"), Malnutrition	Physical exam, History, Skin scraping, Cytology, C&S exudates	Mites: ivermectin, Fibers: remove, supportive care, Sanitation, Control secondary infections, Antimicrobials, Improve husbandry, diet
Swelling of feet, scales on legs	Genetic, Nutritional, Normal aging sign	Physical exam, Scraping/cytology, History, Husbandry/diet review	Sanitation, Dietary maximization

FINCHES

- **Order:** Passeriformes
- **Families:**

Estrildidae (some finches, waxbills, nuns, manikins and Java rice sparrows)
Fringillidae (green singing finch, chaffinches, bramblings and the European gold finch)
Carduelidae (song birds)
Emberizidae
Ploceidae (weavers)

- **Common Species and Variations:**
  (There may be some discrepancies in nomenclature, depending on text or field guide.)

Cordon bleu	*Uraeginthus bengalus* or *Uraeginthus angolensis*
Lady Gouldian	*Poephila gouldiae* or *Chloebia gouldiae* or *Erythruria gouldiae*
Society	*Lonchura domestica*
Zebra	*Poephila guttata* or *Taeniopygia guttata*
Java Sparrow (rice bird)	*Padda oryzivora*
Pekin Robin	*Leiothrix lutea*

- Zebra finch is the most popular, while the Lady Gouldian is considered the most beautiful.
- Gouldian and zebra finches are bred for their color mutations.
- Line-breeding and in-breeding to achieve color or morphologic mutations produce a weaker bird with greater potential for genetic abnormalities.
- A mutation finch may have a reduced life span in comparison to its wild-type conspecifics.

Finches - Quick Facts

Physiologic	
Body length:	3-8 in (tail can be long)
Body weight:	10-16 g
Maximum life span:	17 yr
Average captive life span:	5 yr
Age at sexual maturity:	2 mo
Resting heart rate:	300-350 bpm
Resting respiratory rate:	90-110 breaths/min

Behavior

- Society finches have been domesticated for centuries and are friendly and easy to breed in captivity; Java, zebra and Gouldian finches also breed intensively in captivity.
- Finches are popular, hardy birds that are easy to maintain.
- They are quiet birds with a pleasant, melodious song.
- Some species are territorial in aviary situations and others have well developed pecking orders.
- Finches are less likely to develop a bond with family members than parrot-type birds.
- Finches prefer the company of other finches. They are considered "skittish" and will usually fly away when approached, although some can be finger-trained.

Diet

- Among the many breeds of finches, granivorous, nectivorous, fructivorous, omnivorous or insectivorous diets may be preferred. Field guides of free-ranging species may be helpful to owners to learn more about their finch.
- Some species adapt well to commercial formulated diets; even finches that are considered omnivorous or insectivorous can be raised on balanced vegetarian diets.
- Some species require live food and are difficult to maintain in captivity.
- The diet should be fresh, high quality, and toxin-free.
- Do not over-supplement with vitamins and minerals, as they do not sufficiently improve poor diets.
- Provide clean, fresh, uncontaminated water daily.
- Free-ranging green finches may become bronze or reddish if they are exposed to excessive carotenoids in the diet.

Housing

- Depending on the climatic conditions and the durability of the species, many finches can be maintained in attractive, outdoor aviaries planted with nontoxic vegetation.
- Full flight should be allowed in a well-protected enclosure.
- Vegetation or visual barriers (burlap sheets) should be provided to offer less dominant birds an escape area and privacy.
- The enclosure should be as large as possible with low housing density.
- The enclosure should be clean, secure, safe, easy to service, and be constructed of durable, nontoxic material.

- A fine-gauge wire should be used to surround an outdoor aviary to prevent access by snakes.
- Multiple perches made of clean, nontoxic, pesticide-free tree branches and multiple feeding locations and nesting sites should be provided.
- Perches should not be located directly over food containers.
- Nest boxes or baskets with safe nesting material, such as small burlap squares, strips of plain facial tissue or coconut fiber, may be provided. Do not use synthetic fibers frequently sold as nesting material; fibers can entangle feet or toes, causing loss of a limb or even death.
- The preferred substrate for a finch enclosure should provide a way for the owner to monitor the amount and quality of droppings. Newspaper, butcher paper or brown paper is acceptable. Wire-bottomed enclosures should be kept clean.
- Maintain subdued lighting in indoor housing areas.
- Many species enjoy daily bathing, so a bath cup should be available frequently.

Restraint

- A finch can be restrained by placing the head between two fingers so that the body rests in the palm of the hand, or it can be restrained by holding the head gently between the thumb and first finger.

Sexing

- In some finches, there are obvious or subtle appearance differences or behavioral distinctions between the genders.
- Males are generally brightly colored or elaborately marked, particularly during the breeding season.
- Males usually have melodious songs, perform a dance, hop in various postures and build the nest.
- Females often have a chirp or single-note call and are more passive in the courtship role.

Breeding and Raising Young

- Finches are prolific breeders.
- The offspring are usually parent-raised, especially in insectivorous species.
- Society finches make good foster parents for young of other finches.

First Visit/ Annual Examination

- If capture of a finch is necessary, one useful approach is to remove all perches and other furnishings and turn off the lights before reaching into the enclosure.
- Collecting samples from small birds may limit diagnostic and treatment options (see Blood Collection and Therapy Sites under Canaries)

Common Clinical Disorders in Finches

- Polyomavirus
- Paramyxovirus
- Papillomavirus
- Influenza virus
- *Chlamydophila* sp.
- *E. coli* infections
- Gape worms
- Trichomoniasis
- *Erysipelothrix* sp.
- *Listeria* sp.
- *Pasteurella* sp.
- *Citrobacter* sp.
- *Campylobacter* sp.
- Mycotic infections
- Air sac mites
- *Cochlosoma*
- Tapeworms
- *Acuaria skrjabin*
- Cryptosporidiosis

See also General Rule Out Chart for Passerines Based on Clinical Signs, page 5.

RULE OUT CHART FOR FINCHES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Diarrhea (nestlings)	Bacterial infections, Coccidiosis, Atoxoplasmosis, Polyomavirus, *Cochlosoma* (in Gouldians cross-fostered on Bengalese)	Physical exam, Fecal flotation/smear, CBC, Buffy coat smear, Polyomavirus DNA probe, Wet mount for cochlosoma, C&S/Gram's stain	Appropriate antimicrobials, Coccidia: sulfas, Cochlosoma: carnidazole or ronidazole, Isolate infected birds with polyomavirus, Vaccinate, Supportive care
Digit necrosis	Strangulating fibers from nesting material, Aflatoxin/ergotism, Dry gangrene, *Claviceps purpurea*	Physical exam, History, Husbandry, Diet evaluation, CBC/chemistries	Removal of fibers, Supportive care, Antimicrobials as needed, Amputation if necessary, Diet corrections
Droppings (voluminous white)	Campylobacteriosis, Pancreatic insufficiency	Physical exam, C&S, CBC/chemistries, Fecal direct smear, Evaluate undigested material	Appropriate antimicrobials, Pancreatic enzymes, Supportive care, Easily digestible diet
Droppings (undigested seeds)	Cochlosoma infections, Vitamin E/selenium deficiency, Enteritis (bacterial, *Giardia*), Lack of grit, Hypermotility, Pancreatitis	Physical exam, Wet mount (fresh droppings or postmortem, intestinal contents for cochlosoma), C&S/ Gram's stains, CBC/chemistries, Diet and husbandry evaluation	As per etiology, Dietary supplementation vitamin E/selenium, Appropriate antimicrobials, Correct husbandry, Formulated diet
Dyspnea	Air sac mites (Gouldians)	Physical exam, Transillumination, Cytology/histology	Supportive care, O_2, Ivermectin, Appropriate antimicrobials if secondary infections

RULE OUT CHART - FINCHES

RULE OUT CHART FOR FINCHES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Dyspnea (SBS*, chemosis, conjunctivitis)	Finch herpesvirus (cytomegalovirus)	Physical exam, Necropsy, Histopathology	No known effective therapy
Dyspnea	Bacterial/mycoplasmal/ fungal infection, Inhalant toxins, Lymphoproliferative disease	Physical exam, Gram's stain, C&S, Cytology, History, CBC/chemistries, Radiography	O_2 nebulization, Supportive care, Appropriate antimicrobials, Appropriate therapy (toxins)
Feather loss (head)	Feather mites, Aggression from enclosure mates, Malnutrition	Physical exam, Microscopic exam of feathers/skin/follicles, Evaluation of husbandry and social system	Mites: topical pyrethrins or carbaryl (with caution), Sanitize environment, Separate aggressive birds, Provide hiding places, Feed formulated diet
Neurologic signs	Paramyxovirus, Head trauma, Toxins Encephalomalacia	Physical exam, Serology, Virus isolation, Heavy metal screen, Review husbandry	Supportive care, Remove toxin, For encephalomalacia: vitamin E/selenium, For head trauma: 50°F, tube feed PRN, oxygen
Respiratory signs	Chlamydiosis, air sac mites	Physical exam, Chlamydial screening, Transilluminate trachea to see mites	Doxycycline for chlamydosis, Ivermectin for mites
SBS*	Bacterial infections, Systemic disease, Polyomavirus, Mycotic infections	Physical exam, CBC/chemistries, Gram's stain/C&S of blood, choana, cloaca, Radiography	Appropriate antimicrobials, Supportive care, Sanitation, Fluids

*SBS = Sick Bird Syndrome: lethargy, fluffing, drooping, sitting on cage bottom, anorexia

RULE OUT CHART - FINCHES

RULE OUT CHART FOR FINCHES BASED ON CLINICAL SIGNS			
CLINICAL SIGNS	**DIFFERENTIAL DIAGNOSES**	**DIAGNOSTIC OPTIONS**	**POSSIBLE THERAPY**
Scales on legs	Common aging change, Genetics, Malnutrition, papillomavirus	Physical examination, History, Skin scraping, Biopsy, Cytology	Sanitation of environment, Formulated diet
Straining (+SBS*)	Egg binding	Physical exam, Transillumination, Radiography, Necropsy	Relieve egg binding, Supportive care
Sudden death (adults)	Bacterial septicemias (colibacillosis, yersiniosis), Tapeworms or gizzard worms (insectivorous finches), Mycobacteriosis (esp. siskins), Avian malaria (parrot finches), Polyomavirus	Physical exam, CBC/chemistries, Blood culture/parasite exam, Acid-fast stain, C&S, Fecal/intestinal contents parasitic exam	As per etiology, *Mycobacterium* sp. (zoonotic potential)
Swellings (on legs and feet), proliferations, masses	*Knemidokoptes* (esp. European goldfinches), Strangulating fibers, Insect bites, Poxvirus, Papillomavirus	Physical exam, Skin scraping/cytology, Husbandry review, Biopsy	Mites: ivermectin, Sanitation of environment, Remove fibers, Supportive care, Correct husbandry, Minimize exposure to insects

*SBS = Sick Bird Syndrome: lethargy, fluffing, drooping, sitting on cage bottom, anorexia

RULE OUT CHART FOR FINCHES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Weight loss (+SBS*, diarrhea, death if stressed)	Tapeworm infestation, cochlosomosis, *Acuaria spiralis*	Physical exam, Fecal exam (proglottids/larvae present) on direct smear, History of exposure to insects in environment or as part of diet, CBC/chemistries (general condition)	Anticestodal medications, Prevent exposure to intermediate hosts including diet changes, Prevent stress, Antiflagellate therapy (*A. spiralis* is resistant), Try oxfendazole (toxicity unknown)
Weight loss (SBS*, +/- respiratory distress)	Trichomoniasis	Physical exam, History, Crop wash wet mount, cytology	Carnidazole, Ronidazole, Sanitation, Supportive care

*SBS = Sick Bird Syndrome: lethargy, fluffing, drooping, sitting on cage bottom, anorexia

MYNAHS

- **Order:** Passeriformes
- **Family:** Sturnidae
- **Common Species:**

Common mynah	*Acridotheres tristis*
Indian hill mynah	*Gracula religiosia*

Mynahs - Quick Facts

Physiologic	
Life span:	up to 25 yr
Body length:	30-45 cm (12-18 in)
Body weight:	160-180 g
Reproductive	
Eggs in clutch:	2-7
Incubation:	11-18 days
Fledging:	18-30 days
Season:	Spring/summer

Behavior

- Mynahs are considered quite intelligent.
- They need an environment enriched with toys, various branches and opportunities for activity.
- Mynahs can be charming pets with extraordinary mimicking ability.
- They are extremely messy and produce copious amounts of loose feces, which result in many layers and frequent changes of enclosure liners.
- Mynahs fed primarily formulated diets with limited fruits have more formed feces.
- Some mynahs prefer not to be handled, but many are trained to sit on a hand or shoulder.
- They are nondestructive birds.
- They may collect, play with or pile up shiny objects — some have color preferences.
- For nesting, they will accept a cockatiel nest box with twigs, straw, dried leaves or coconut fiber.

Diet

- Feed commercial mynah pellets (low-iron formulation = <100 ppm); several brands are available.
- A low-iron formulated diet should be 75% or more of the daily intake.

- Supplement with a variety of fruits and vegetables (low-iron, diced and mixed, approximately 25% daily intake; may also be used as treats for training).
- Avoid fruits containing high levels of vitamin C (in humans this increases the uptake of iron and may apply also to birds).
- Mealworms may be given as an occasional treat.
- Mynahs may enjoy fruit juices, nectars or balanced electrolyte formulas such as Gatorade.
- Fresh water should always be available.

Housing

- Mynahs are social birds that prefer to be housed near the activity center of a household.
- The enclosure should be made of metal and shaped as a horizontal rectangle to allow for lateral movement, such as hopping from perch to perch.
- Minimum size is 18 cubic ft: 2' x 3' x 3'.
- The enclosure should have a tray lined with newspaper or recycled newspaper absorbent bedding located underneath a wire bottom.
- Natural branch perches in a variety of sizes should be offered.
- Some toys designed for smaller birds with a mirror, beads or shiny bells can be offered.
- A large dish (allowing 1½-2" depth of water) should be provided for bathing. Some mynahs enjoy mist baths and showers. Baths are usually preferred in the morning.

Sexing

- Both genders look alike although males may be slightly larger and have a bolder stance.
- Males may have larger skin flaps on the neck than females.

Common Clinical Disorders in Mynahs

- Hepatopathies, hepatic cirrhosis or neoplasia
- Iron storage disease*
- Cirrhosis of liver*
- Congestive heart disease*
- Epilepsy
- Aspergillosis*
- Eye diseases (corneal scratches, keratitis, chronic keratoconjunctivitis)*
- Bacterial upper respiratory infections*
- Mycobacteriosis

*Often related to malnutrition

See also General Rule Out Chart for Passerines Based on Clinical Signs, page 5.

RULE OUT CHART FOR MYNAHS BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Conjunctivitis (blepharospasm, corneal ulcers, keratitis, conjunctival hyperemia)	Corneal trauma, Chronic lesions (*aspergillosis*), Herpesvirus	Ophthalmic exam, History, CBC/chemistries, Screen for *Aspergillus*, herpesvirus	Most heal without treatment (may have corneal scarring, opacities), Suspected herpesvirus: try acyclovir (systemic & ophthalmic ointment), Treat systemic aspergillosis
Conjunctivitis (+respiratory signs)	Bacterial upper respiratory tract infections, Malnutrition	Physical exam, C&S exudates, Sinus flush, Evaluate diet, Radiographs, CBC/chemistries, Ophthalmic exam to rule out corneal ulcers/erosions	Appropriate antimicrobials, Supportive care, Correct diet deficiencies
Conjunctivitis (+proliferations on face/lids)	Poxvirus	Physical exam, Cytology/histopathology, Rule out secondary bacterial infections	Time, Supportive care, Sanitation of environment, Treat for secondary bacterial infections
Dyspnea (distended abdomen +/- ascites)	Hepatopathies: iron storage disease, cirrhosis, neoplasia, chronic active hepatitis, Congestive heart failure, Malnutrition	Physical exam, CBC chemistries, Cytology/ascites evaluation, Cardiac evaluation, Ultrasound, Liver biopsy, If infectious hepatitis: consider blood/abdominal fluid C&S	Tap abdomen, Appropriate therapy per etiology, Antimicrobials, Supportive care, Lasix, Decrease dietary iron and vitamin C, Phlebotomy for iron depletion, Iron chelation, Cardiac therapy

RULE OUT CHART FOR MYNAHS BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Dyspnea, SBS*	Bacterial respiratory infections, Fungal respiratory infections (aspergillosis)	Physical exam, Radiography, CBC/chemistries, Tracheal/sinus washes: cytology, Gram's stain/C&S	Appropriate antimicrobials, Supportive care
Dyspnea (no abdominal enlargement)	Congestive heart failure	Physical exam, Cardiac evaluation, Radiography, Rule out concurrent liver disease, Ultrasonography	Supportive care, Cardiac therapy (digoxin, furosemide)
Neurologic signs	Epilepsy, Toxicosis, Lead or zinc poisoning, Encephalitis, Trauma	Rule out causes, Full work-up	Supportive care, Anticonvulsant/ epileptic medications may be helpful, Chelation drug
SBS* (+/- diarrhea, polyuria, anorexia)	Bacterial infections, Fungal infections (aspergillosis)	Physical exam, CBC/chemistries, C&S blood, cloaca, choana, Gram's stain, KOH prep/cytology, Fungal culture, Radiography	Appropriate antimicrobials, Supportive care
Weight loss (chronic)	Aspergillosis, Mycobacteriosis	Physical exam, Radiography, CBC/chemistries, Microscopic exam/ evaluation of tracheal wash, feces	Systemic antifungals, Supportive care, *Mycobacterium* (zoonotic potential): therapies not proven

*SBS = Sick Bird Syndrome: lethargy, fluffing, drooping, sitting on cage bottom, anorexia

RAMPHASTIDS

- **Order:** Piciformes
- **Family:** Ramphastidae
- **Common Species:**

Toco toucan	*Ramphastos toco*
Sulfur-breasted toucan	*Ramphastos sulfuratus*

Toucans - Quick Facts

Physiologic	
Maximum life span:	15-25 yr
Body length: Toucans:	40-45 cm (16-18 in)
Toucanets:	37.5-42.5 cm (15-17 in)
Body weight:	125-1000 g
Resting heart rate:	130-165 bpm
Resting respiratory rate:	15-45 breaths/min
Reproductive	
Sexual maturity:	3 yr
Eggs per clutch:	2-4 (white eggs)
Incubation:	18 days (red-breasted: 16-17 days)
Eyes open:	2 wk
Fledging:	45 days
Weaning:	2-4 mo
Season:	Spring/summer

Behavior

- Toucans are inquisitive, antic and highly territorial.
- Although some species are relatively quiet, others make loud and annoying sounds.
- They have messy, loose droppings.
- They are very active and require spacious housing.
- Some birds can be tamed to where they enjoy being handled.
- They may injure their beak if they bite down on a solid object.
- Most require a lot of attention and prefer to be housed in a home's activity center, except for breeding pairs in the nest.
- They enjoy sun-bathing, but must have access to shade.

Diet

- Free-ranging toucans eat fruits, insects, spiders, bird eggs and small vertebrates.
- Careful attention to proper diet in captivity is essential.
- Adequate maintenance diet for toucans would consist of a low-iron formulated diet supplemented with diced fresh fruits (melons, papaya, berries).

- Paprika may be added to maintain bright coloration of the beak.
- During the breeding season, diet should be supplemented with crickets, small mice and crushed hard-boiled eggs.
- Diet should be low in iron (<100 ppm) to reduce chances of iron storage disease.
- Consider limiting citrus fruits and other high vitamin C-containing foods in case research shows that these may enhance absorption of iron in birds as they do in humans.
- Toucans produce large quantities of malodorous excrement, especially if fed excess fruit.
- Fresh water for drinking should always be available.

Housing

- A single bird requires a minimum size of 3' x 4' x 4', although a larger enclosure would be preferable.
- Most toucans enjoy flight enclosures. Breeders should have a large, planted flight with plenty of privacy.
- Walls of the enclosure can be covered with a cloth or plastic barrier to protect young birds from collision injuries.
- Toucans are curious about objects in their habitat, which often leads to foreign body ingestion.
- Toucans like to bathe and should be provided with large, easy-to-clean water containers.
- The floor of a toucan enclosure should be well drained and easy to clean.

Restraint

- Toucans can snap at handler's eyes. Caution is recommended when handling toucans, and one must keep aware of the proximity of the bird to the handler's head.
- A net or towel may be needed to capture a bird in an aviary.
- With the beak held in one hand, a towel can be loosely wrapped around the body to control the wings and feet.

Sexing

- In general, males have a larger beak than females. To measure the beak's length: measure lower margin of upper mandible from the edge of the facial skin outward toward the tip (eg, Toco male ≥ 16 cm; Toco female ≤ 15.5 cm.
- *Selenidera* sp., *Pteroglossus viridis*, *P. inscriptus* - adult males have black head feathers; females have brown head feathers.
- *S. culik* - adult male has black neck and underparts; female has chestnut neck, grey underparts.

Breeding and Raising Young

- Toucans are best bred in large planted flight enclosures with plenty of privacy. Human visitation should be minimal.
- Toucans are cavity nesters; natural palm logs or plywood boxes (6′ x 1′ square) work for nesting.
- Both adults share incubation and rearing responsibilities.
- Toucans prefer some live food (eg, rodents) during the breeding season.
- Cannibalism of young chicks by parents is common if the diet is not supplemented with crickets, mice or mealworms.
- Chicks can be hand-fed from hatching by offering small diced fruits and pinkie mice by forceps. Some breeders successfully use parrot hand-feeding formulas with strained baby fruits added.
- Neonates are fed every 2 hours for the first 12 hours and then every 3 hours for 16 days.
- Toucans do not have a crop; therefore, neonates must be fed smaller quantities than psittacine babies.

Common Clinical Disorders in Toucans

- Hepatopathies
- Bacterial infections
- Beak injuries
- Diabetes mellitus (Toco and sulfur-breasted toucans)
- Iron storage disease

Hematologic and Biochemical Reference Ranges*

RBC ($x10^6/mm^3$):	2.5-4.5 106/
WBC ($x10^6/mm^3$):	4.0-10.0
PCV:	45-60%
Buffy coat:	0-1%
Het:	35-65%
Lymph:	25-50%
Baso:	0-5%
Eosin:	0-4%
Thromb:	present
Calcium (mg/dl):	10-15
Glucose (mg/dl):	220-350
LDH (U/l):	200-400
AST (U/l):	130-330
TP:	3-5 g/dl
UA:	4-14 mg/dl
Bile acids:	2-40 mmol/L
Iron:	<350 mg/dl
TIBC:	<550 mg/dl

*Cornelissen, 1994. These values are offered only as a guide. The practitioner is encouraged to develop his/her own set of reference ranges based upon the laboratory and collection/evaluation methods.

See also General Rule Out Chart for Passerines Based on Clinical Signs, page 5.

RULE OUT CHART FOR TOUCANS AND TOUCANETS BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Anorexia, abnormal stool	Foreign body ingestion, Impaction, Gastroenteritis	Physical exam, Review of environment, Radiography (contrast), CBC/chemistries, Fecal direct smear	Impaction/perforation: may need surgery, Antibiotics, Supportive, Fluid therapy, Conservative use of fluids/laxatives to shift foreign material, Assess as in other species
Beak damage	Trauma, Aggression	Physical exam, History, Radiography	Stabilize bird, Supportive care (assisted feeding), Analgesics pre/post repair
Diarrhea (+SBS*)	Bacterial gastroenteritis, Flukes, Ascarids, Capillaria, Reovirus (isolated in toucanets)	Physical exam, Fecal flotation, Direct smear, Protozoal diagnostics, C&S cloaca, CBC/chemistries, Reovirus: viral isolation	Coccidiosis: sulfa drugs, *Giardia*: metronidazole, Bacterial: antimicrobials per sensitivity, Supportive care, Fluids, Sanitation to prevent reinfection, Flukes: praziquantel, Nematodes: anthelmintics as in psittacines, Supportive therapy for viral enteritis

*SBS = Sick Bird Syndrome: lethargy, fluffing, drooping, sitting on cage bottom, anorexia

RULE OUT CHART FOR TOUCANS AND TOUCANETS BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Digit necrosis (constriction)	Ergotism, Strangulation by fibers	Physical exam, Diet history, Fungal culture samples of diet	Ergotism: change diet, possibly treat fungal infection, Amputation of affected digits may be necessary, Remove improper bedding materials
Neurologic signs	Lead/zinc poisoning, Herpesvirus (similar to Marek's)	Physical exam, History, Radiographs, Blood lead/zinc, CBC/chemistries, Histopathology (for possible virus)	Lead poisoning: treat as in other birds
SBS* (+/- enlarged abdomen, chronic poor feathering)	*Mycobacterium avium*, Reproductive disorders in female, Iron storage disease	Physical exam, History, Radiography, CBC/chemistries, C&S of cloaca/ choana, Gram's stain, Acid-fast stain, Necropsy (gross signs)	Supportive, Therapy per etiology, For *M. avium*, consider zoonotic potential (therapies not proven for clearance of organism)
SBS* (+ yellow droppings)	Hepatopathies (iron storage disease = hemochromatosis vs hemosiderosis), Cirrhosis, Chronic/acute hepatitis	Physical exam, CBC/chemistries, Cloacal/blood C&S, Liver biopsy, Diet history	Iron storage disease: low iron diet (<100 mg/kg or ppm), weekly phlebotomies, iron chelation therapies being tried, Cirrhosis: low fat diet, Infectious/ bacterial: appropriate antimicro-bials plus supportive care

*SBS = Sick Bird Syndrome: lethargy, fluffing, drooping, sitting on cage bottom, anorexia

RULE OUT CHART FOR TOUCANS AND TOUCANETS BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
SBS* (chronic)	*Plasmodium* sp.	Blood parasite exam, Physical exam, CBC/chemistries, Rule out other parasitic infections	Antimalarial drugs may be tried, Prevent exposure to insect vector, Supportive care
Sudden death	Hemochromatosis	Necropsy: enlarged, yellow liver, iron deposits in hepatocytes, tissue iron levels, Antemortem: liver biopsy	For survivors: Low-iron diet (<100 mg/kg), Weekly phlebotomies, Iron chelation therapies being tried
Sudden death (following brief depression, anorexia)	Toucan herpesvirus	Necropsy: hepatomegaly/ splenomegaly, yellow/ friable liver, histopathology	No treatment
Sudden death (toucanets)	Mycotic respiratory infection (*Penicillium griseofulum*)	Necropsy: culture visible mold, Antemortem: Physical exam, Endoscopic exam air sacs, trachea, Radiography, Cytology/culture tracheal wash	Systemic antifungals, antimicrobials, Sanitation of aviary
Vomiting (+ SBS*)	Proventricular dilatation disease	Physical exam, History of passage of undigested food, Radiography + contrast study, Proventricular biopsy/histopathology	Diet therapy, Minimize stress, Treat secondary bacteria/fungi, Isolate bird, Interferon therapy has been advocated by some clinicians

*SBS = Sick Bird Syndrome: lethargy, fluffing, drooping, sitting on cage bottom, anorexia

RULE OUT CHART FOR TOUCANS AND TOUCANETS BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Weight loss (+ chronic SBS*)	*Yersinia pseudotuberculosis*	Physical exam, CBC/chemistries, C&S blood/cloaca, Radiographs	Appropriate antimicrobials, Experimental vaccine, Rodent-proof the aviary, Use only lab-raised rodents as food
Weight loss (+ SBS*, abdominal enlargement)	Hemochromatosis	Physical exam, CBC/chemistries, Diet history, Liver biopsy, Histopathology	Low iron diet (<100 mg/kg), Weekly phlebotomies, Iron chelation therapies being tried
Weight loss (+ polyuria, polydipsia)	Diabetes mellitus, Pancreatic neoplasia	Physical exam, Blood glucose, Urinalysis, Dietary history, Blood chemistries, CBC, Pancreas biopsy	NPH insulin, Diet therapy (formulated diet plus pancreatic enzymes added), Supportive care

*SBS = Sick Bird Syndrome: lethargy, fluffing, drooping, sitting on cage bottom, anorexia

PIGEONS

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of pigeons and is not intended to replace comprehensive reference material. Updates were provided by David Rupiper, DVM.

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Pigeons

- **Order:** Columbiformes
- **Family:** Columbidae
- **Common Species:**

Rock dove	*Columba livia*
Wood pigeon	*Columba palumbus*
Speckled pigeon	*Columba guinea*
Crested pigeon	*Ocyphaps lophotes*
Mourning dove	*Zenaida macroura*
Blue-crowned pigeon	*Goura cristata*
Stock dove	*Columba oenas*
Turtle dove	*Streptopelia turtur*
Collared dove	*Streptopelia decaocto*
Diamond dove	*Geopelia cuaneata*
Ringed turtle dove	*Streptopelia risonria*
Chinese spotted dove	*Streptopelia chinensis*

Behavior

- Racing pigeons have an innate homing ability that has been enhanced through selective breeding and continuous training.
- Four to five training flights are necessary to develop sufficient navigational data to reach the "home loft" target.
- Male Columbiformes can be rather aggressive, particularly during the reproductive cycle.
- Unlike most birds, pigeons and doves drink by placing the beak up to the nares in water and sucking rather than billing.

Diet

- Nutritional requirements and quantity of food consumed vary, based on species, body mass, season, climatic condition, housing, stage of reproduction, growth or molting, amount of exercise, type of feed and method of feeding.
- The natural food of most pigeon families, except fruit doves, consists of seeds and grains.
- In addition, they pick up small stones, grit and sand, which are necessary for grinding seeds and grains.
- Diets for pigeons should be rich in concentrated nutrients, but should not contain high amounts of water or fiber; 14-16% protein is recommended.
- Grain and pelleted diets are readily available for pigeons.

Housing

- Breeds maintained for flying ability must have opportunity to fly daily in order to maintain a proper level of health.
- Lofts should be partitioned so that several pens are provided, with one or more for breeding pairs, young birds, hens, cocks and training birds.
- Birds should have individual pad perches to prevent aggression.
- An entrance room should be provided for storing necessary equipment, tools and feed and to serve as a safety area.
- Excrement should be removed on a routine basis or the birds placed on gratings so the feces can drop through. It is recommended that the person cleaning the loft wear a respirator mask to prevent the inhalation of pigeon dust antigens.
- Acceptable environmental temperatures: 5-28°C (41-82°F)
- Companion pigeons and doves may be housed in large flight cages suitable for passerines or small psittacines. Provide horizontal space with less vertical dimensions. Perching: various natural branches. Water and food dishes should be positioned to minimize droppings falling in and facilitate cleaning. Cage should be covered at night.

Preventive Care

- Quarantine and vaccinate any new birds before adding them to the flock. Do not keep free-ranging pigeons that appear at the loft.
- Provide optimal housing, feeding, lighting, ventilation and cleanliness to increase productivity, performance and health of pigeons.
- Excrement and discarded food should be removed from the loft and flypens daily.
- Drinking containers, hoppers and cafeteria troughs should be cleaned daily and disinfected weekly.
- Have an ongoing biosecurity and management program.
- Recognize and treat pathogens, including vaccination, 4 weeks before the breeding and racing season.
- Vaccines are available for pigeon pox, paramyxovirus-1 and salmonellosis.

Pigeons - Quick Facts

Physiologic	
Body weight:	240-550 g (can be up to 2000 g)
Body size:	12.5-40 cm
Body temperature (cloacal):	39.8-43.3°C
Heart rate:	160-300 bpm
Heart rate (during flight):	5.2-6.2 beats per second
Resting respiratory rate:	20-30 per minute
Longevity:	15-20 yr (males live longer than hens)
Feed intake (adults):	5-20% BW/day (~30 g/day)
Feed intake (squabs):	5-15%/feeding, up to 100% BW/day
Water consumption:	30-60 ml (depending on environmental temperature); 5-8% BW
Flying speed:	>104 km/hr
Flying heights:	3,800-5,700 m (record)
Homing distance:	500 km (some >1,000 km)
Molt:	Annually (Autumn, starting late August)
Blood volume:	100 ml/kg BW (10%)
Gavage volume (adults):	15-30 ml/pigeon
Subcutaneous fluid volume:	2.5% BW

Reproductive	
Male:	Cock
Female:	Hen
Sexual maturity:	4 mo
First breeding:	7-8 mo
Clutch size:	2 (first egg is laid in late afternoon; second is laid about 40-44 hr later)
Incubation period:	17-18 days
Incubation:	Both sexes (male during day, hen at night)
Unfledged young:	Squab
Recently weaned young:	Squeaker
Feathers appear:	6-7 days
Plumage complete:	1 mo
Molting juvenile plumage:	Starts 7th wk, finishes by 28th wk
Nestling period:	21-28 days
Reduced productivity in hen:	>6 yr

Special Notes About Racing Pigeons

- Sick birds are often culled, and no veterinary attention is sought.
- Pigeon breeders may seek professional advice only after home treatments have been tried and failed, and poor performance or disease still exists.
- Before racing their birds, pigeon breeders often use vitamin and/or mineral supplements, antibiotics, coccidiostats, antiprotozoals and herbal teas. Some may administer antimalarials unnecessarily.
- The use of sub-therapeutic doses of antibiotics by pigeon breeders may be the reason for antibiotic resistance in many lofts.

Sexing

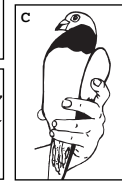
- Pigeons are monomorphic, but with experience, some bolder appearance to the head may be seen in males.

Breeding and Raising Young

- During courtship display, the male adopts a more upright stance, performs a full circle "tap dance" accompanied by loud cooing with inflation of the cervical air sacs and tail sweeping.
- Ritual feeding by the male precedes copulation.
- A bonding and nest-building period of 7-10 days precedes egg laying.
- Pigeons are monogamous and pair-bond for life, but this can be manipulated.
- The average hatch produces one of each sex.
- Young are fed within a few hours of hatching.
- Crop milk is a secretion produced by both parents by the 6th day of incubation. The secretion stops 16 days after hatch. Composition = 75-77% water, 11-13% protein, 8.5% fat and 1.2-1.8% mineral matter.

Restraint

- The basic method of restraint in pigeons is the horizontal hold (a).
- Large pigeons may require both hands for proper restraint; a second person may be needed to facilitate the physical examination (b).
- The bird is held upright with the vertical restraint technique (c).



Hematologic Reference Ranges*

Blood collection volume: 10 ml/kg BW (1%) usually up to 3 ml		
PCV (%):	39.3-59.4	
RBC ($10^6/\mu l$):	2.1-4.2	
Hb (g/dl):	10.7-14.9	
MCV (fl):	118-144	
MCH (g/dl):	20-30	
WBC ($10^3/\mu l$)	10-30	
Heterophils (%):	15-50	1500-15000 cells/μl
Lymphocytes (%):	25-70	2500-21000
Monocytes (%):	1-3	100-900
Eosinophils (%):	0-1.5	0-450
Basophils (%):	0-1	0-300
H:L ratio:	0.21:2	
Blood differential:	Lymphocytic	

*Lumeij, 1987 (converted by Rupiper, 1995); Adapted from Carpenter JW, Mashima TY, Rupiper DJ: Exotic Animal Formulary 2nd ed, Philadelphia, WB Saunders, 2001, pp 205, 218-219.

Common Clinical Disorders of Pigeons

- Adenovirus
- Herpesvirus - inclusion body hepatitis
- Paramyxovirus-1 (PMV-1 pigeon)
- Pigeon pox
- *Chlamydophila psittaci*
- *Mycoplasma* spp.
- *Salmonella typhimurium* var. *copenhagen*
- *Candida* sp.
- *Trichomonas gallinae*
- Coccidia
- *Haemoproteus* sp. and *Plasmodium* sp.
- Helminths (*Tetrameres* sp.)
- Ectoparasites (lice, pigeon flies)
- Obesity in companion pigeons, doves
- Trauma in companion pigeons, doves (collisions with walls, windows, attacks by cats, dogs)

Biochemistry Reference Ranges*

AP (IU/L):	160-780
ALT (IU/L):	19-48
AST (IU/L):	45-123
Bile acid (μmol/L) (RIA):	22-60
Ca (mg/dl):	7.6-10.4
CK (IU/L):	110-480
Cl (mEq/L):	101-113
Creatinine (mg/dl):	0.3-0.4
GGT (IU/L):	0-2.9
Glucose (mg/dl):	232-269
LDH (IU/L):	30-205
Phosphorus (mg/dl):	1.8-4.1
Potassium (mEq/L):	3.9-4.7
Sodium (mEq/L):	141-149
Total protein (mg/dl):	2.1-3.3
Uric acid (mg/dl):	2.5-12.9
Prothrombin time:	11.5-18.7 sec
Albumin (g/dl):	1.5-2.1
Globulin (g/dl):	0.6-1.2
A:G ratio:	1.5:3.6
Pre-albumin (g/dl):	0.1-0.4
Alpha globulin (g/dl):	0.2-0.3
Beta globulin (g/dl):	0.3-0.6
Gamma globulin (g/dl):	0.1-0.3
Basal (nmol/l):	5.3 + 1.5
Peak (nmol/l):	2.6 + 10

*Lumeij, 1987 (converted by Rupiper, 1995); Adapted from Carpenter JW, Mashima TY, Rupiper DJ: Exotic Animal Formulary 2nd ed, Philadelphia, WB Saunders, 2001, pp 205, 218-219.

Electrocardiogram Values in Pigeons

P-R (sec)	0.045-0.070
QRS (sec)	0.013-0.016
QT (sec)	0.060-0.075 MEA -83 to -99
P (sec)	0.015-0.02
HR (bpm)	160-300
P (mV)	0.4-0.6
T(mV)	0.3-0.8
QS (mV)	1.5-2.8

MEA = mean electrical axis; HR = heart rate

RULE OUT CHART FOR PIGEONS BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Alopecia	Normal "heavy" molt, Ectoparasitism (esp. *Knemidokoptes laevis*, quill mite (*Syringophilus columbae*), Barbering, Nutritional or thyroid deficiencies	Physical exam, Microscopic exam skin and feathers, Serum chemistries, CBC, Evaluate husbandry	Supportive, Eliminate ectoparasites, Correct diet, husbandry
Depression, weakness	Cestodiasis, Trematodiasis	Fecal exam	Praziquantel
	Pigeon fly	Flies on bird	Dust nest monthly with insecticide, Decrease population density, Remove feces daily
Dermatitis	*Knemidokoptes mutans* infestation (scaly leg)	Physical exam, Microscopic exam of scraping	Invermectin, Clean housing
Diarrhea, enteritis	Trichomoniasis, Coccidiosis, Helminthiasis, Hexamitiasis, Enteric bacteria, Chlamydiosis, Paramyxovirus-1, Pigeon herpesvirus, Adenovirus, Toxicosis, Candidiasis	Fecal flotation/smear/wet mount, Microbiology, Viral isolation, Necropsy, History, Histopathology, Serology, Chlamydial screening, Oral and crop swabs for bacterial culture and sensitivity	Sanitation, Appropriate antibiotics or anthelmintics, Vaccination (PMV-1)
	Salmonellosis	Microbiology, Histopathology, Serology	Sanitation, Antibiotics or anthelmintics, Vaccination (*Salmonella*), Owner education for potential zoonosis, May be reportable
	Iatrogenic toxicity (NFZ, dimetridazole, copper sulfate)	History, Necropsy	Supportive, Decrease exposure

RULE OUT CHART FOR PIGEONS BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Dyspnea	Aspergillosis	Radiography, Endoscopy, Microbiology, Review loft husbandry, flock medications, Serology	Imidazole antifungals, Improve ventilation, husbandry, Decrease dusting frequency, Decrease population density
	Trichomoniasis, PHV, Chlamydiosis, Mycoplasmosis, Bacterial respiratory infections	Physical exam, Microbiology, Serology, Diet history, Endoscopy, Chlamydial screening, Oral swab, Wet mount, Histopathology	Treat per etiology, Supportive care, Evaluate loft/flock husbandry
Feathers (broken)	Trauma, Ectoparasitism (lice and mites)	Physical exam, Microscopic exam skin, feathers, History	Topical ectoparasiticides, Sanitation, Use ivermectin as dewormer during molt
Feathers (stunted)	Ectoparasitism, esp. quill mite	Physical exam, Microscopic exam	Topical insecticide, Clean housing, Correct diet
Feathers (ruffled)	Any systemic disease, Ectoparasitism	Physical exam, CBC/chemistries, History, Microbiology, Serology	Supportive, Treat per etiology
Neurologic signs	Paramyxovirus infection (PMV-1)	History, Physical exam, Microbiology, Serology, Viral isolation, Necropsy/ histology, CBC/chemistries, Blood lead, Radiographs	PMV-1: none, vaccination, Others: per etiology, Lead: chelation plus therapies as in other birds

RULE OUT CHART FOR PIGEONS BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Ophthalmic disorder (blindness)	Salmonellosis, Head trauma	Microbiology, Ophthalmic exam, Bruising on head	Antibiotics per sensitivity, Disinfect premises, If flock, may consider carriers, vaccination. If *Salmonella* - discuss zoonotic potential, source of infection
Ophthalmic disorder (discharge)	Irritants (dust, ammonia from excessive excreta in environment), Chlamydiosis, "one-eyed cold" syndrome, PHV, Mycoplasmosis, *Haemophilus* infection	Physical exam, History, CBC/chemistries, Serology, Microbiology, Ophthalmic exam, Chlamydial DNA, PCR probe	Per etiology, Correct husbandry and improve ventilation
Ophthalmic disorder (swollen eyelids)	Pox	Physical exam, Histopathology, Cytology, Look for scabs on skin around head and neck	Supportive care, Sanitation, Eliminate vector, Vaccination (pox)
Oral lesions (palatal, pharyngeal)	Trichomoniasis, Candidiasis, Malnutrition, Poor husbandry	History, Direct smears of exudates, wet mount, Cytology	Sanitation, Improve husbandry, Carnidazole/ metronidazole/ ronidazole antiprotozoal, Nystatin or sensitive antimicrobial, Vitamin supplementation
Oral lesions (diphtheritic, esp. at commissures)	Pigeon pox, PHV, Hypovitaminosis A, Bacterial, Trichomoniasis, Candidiasis	Wet smear/mount, Physical exam, Microbiology, Serology, Histopath/cytology, Diet history	Isolate affected birds, Vaccination (pox), Sanitation, Correct diet, Appropriate antimicrobials and antiprotozoals

RULE OUT CHART FOR PIGEONS BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Orthopedic (bent legs, reluctance to stand)	Rickets, Osteomalacia, “Pinwheel” or head fractures	Physical exam, Diet history, Radiographs	Correct diet, Surgical correction rarely done
Orthopedic (swollen hock, stifle, elbow or carpal joints)	Salmonellosis, Trauma	Physical exam, Radiography, CBC, Arthrocentesis with microbiology and cytology	Antibiotics based on C&S results, Vaccination (*Salmonella*), Cull affected birds, Trauma: external splint
Orthopedic (splay leg)	Inappropriate nest/nesting material, Inadequate parent diet	Physical exam, Diet, Husbandry history	Correct diet, Splinting early on as in psittacines, Use round-bottomed nests
Paresis or paralysis	Herpesvirus encephalomyelitis (PHEV), Trauma, PMV-1, Salmonellosis, Hypovitaminosis B complex (esp. thiamine), Some toxins (avitrol, lead, zinc), Abdominal swelling/ neoplasia	Physical exam, History, Microbiology, Radiography, Serology, CBC/chemistries, Blood lead	Treat per etiology, Supportive care, Avitrol: diazepam, crop lavage, activated charcoal. Lead: as in other birds. No treatment for PMV-1, Vaccinate flock
Polydipsia	Coccidiosis, Salmonellosis, PMV-1, Renal disease, Heavy metal toxicosis	Physical exam, History, Fecal flotation, Microbiology, Serology, Radiography	Supportive care, Appropriate treatment per etiology, Vaccination (PMV-1)
Polyurates	Nephrosis (non-specific) secondary to infectious and systemic disease	Physical exam, CBC/chemistries Urinalysis, Serology	Treat per etiology, Supportive as in other birds

RULE OUT CHART FOR PIGEONS BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Poor condition (poor performance)	Adenovirus, PHV, PMV-1, Salmonellosis, Colibacillosis, Candidiasis, Trichomoniasis, *Plasmodium* spp., Chlamydiosis, Coccidiosis, Helminthiasis (*Tetrameres* spp., ascarids), Cardiac disease.	Serology, Cytology, Chlamydial screening, Oral/ crop/ fecal wet mounts, Hematology, Microbiology, Necropsy, Histopathology, For cardiac: echocardiology, ECG	Treat per etiology: appropriate antimicrobials and anthelmintics, Vaccination. Cardiac disease treat as in other birds
Pruritis	Ectoparasitism (depluming mite, lice, red mites)	Physical exam, Microscopic exam skin, feathers	Topical ectoparasiticides, Clean housing, Treat all birds
Regurgitation	Trichomoniasis, Crop infection, Candidiasis, Ingluvial foreign body	Cytology/analysis of contents, Microbiology, Wet mount, Fecal exam, Radiography	Appropriate per etiology, Supportive care, Endoscopy to remove foreign body.
Respiratory signs	Excessive dusting for ectoparasites, Dusty litter	History, Physical exam, Histopathology (lungs)	Improve ventilation, Decrease dusting amount/frequency
	Pasteurellosis, Mycoplasmosis, Chlamydiosis, Salmonellosis, Aspergillosis, Haemophilosis	Microbiology, chlamydial screening, Serology	Appropriate antimicrobials, Sanitation, Supportive care
	Trichomoniasis	Physical exam (tracheal and pharyngeal obstruction), History, Microbiology	Supportive care, Metronidazole antiprotozoal
Sudden death	Internal hemorrhage (trauma, ruptured liver, heart or spleen), Influenza, Septicemia	Necropsy, History, Microbiology	Survivors: If due to improper husbandry, correct housing, Preventive measures if infectious

RULE OUT CHART FOR PIGEONS BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Swelling (abdominal)	Egg peritonitis, Impaction of oviduct, Herniation, Ascites (cardiac disease), Neoplasia	Physical exam, Radiography, Ultrasonography, Abdominal tap, Cytology, Microbiology, CBC/chemistries, Cardiac evaluation	Antibiotics, Supportive, Surgery (in valuable bird), Retire older breeding hens, Calcium supplementation, If cardiac, treat as in other birds
Swelling (ball of foot)	Bumblefoot (*Staphylococcus* spp. or *E. coli* infection - pododermatitis)	Physical exam, Microbiology exudates/aspirate, Cytology	Drain, Appropriate antibiotics, Bandage pad & minimize trauma, Prevent obesity, Remove wire flooring
Swelling (hard around head, feet)	Pox	Physical exam, Histopathology	Supportive, Vaccination, Eliminate vector, Sanitation
Swelling (hocks in juveniles)	Rickets or osteomalacia, Malnutritional perosis	History, Diet review, Radiography, Blood chemistries	Correct diet, Supplementation with minerals
Swelling (joints)	Salmonellosis, Gout (rare)	Physical exam, Joint aspirate, Serology, Microbiology, Radiography, Diet history, CBC/chemistries, Histopathology	Antibiotics based on C&S results, Vaccination, Cull affected individuals if severe, Gout: supportive care, analgesics
Swelling (skin "air puffs")	Subcutaneous emphysema	Physical exam, Radiography	Deflate, Supportive care, Crop inflation is normal for some breeds (croppers, pouters)

RULE OUT CHART FOR PIGEONS BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Swelling (soft)	Abscess, Hematoma	Physical exam, History, Microbiology	Appropriate antibiotics if abscess, Supportive for hematoma, Prevent recurrence
Swelling (throat)	Trichomoniasis, Candidiasis, Impaction of crop	Physical exam, Microbiology, Pharyngeal and crop cytology	Appropriate per etiology, Crop impaction: may need to remove material, Supportive care, Appropriate antimicrobials
Weight loss	Capillariasis, Tetrameriasis, Trichomoniasis, Coccidiosis	Ova in feces, Fecal parasite exam	Fenbendazole (capillaria), Mebendazole
	Chronic malnutrition, Chronic infections (eg, PMV-1, chlamydiosis, salmonellosis, tuberculosis, aspergillosis, candidiasis, trichomoniasis, coccidiosis, plasmodial malaria, helminthiasis), Excessive training, Overpopulation	History, Physical exam, Chlamydial screening, Oral/crop/fecal wet mounts, Fecal exam, Hematology, Microbiology, Serology, Necropsy, Histopathology	Treat per etiology, Appropriate antimicrobials and anthelmintics, Vaccination, Population reduction, Improve husbandry and training methods

FORMULARY FOR PIGEONS

DRUG	ROUTE	DOSAGE	COMMENTS
Amikacin (Amyglyde-V®)	IM, IV, SC	15-20 mg/kg q12h	5 days maximum, Fluid support
Amoxicillin	IM, PO	150 mg/kg q4h	Little use other than *Strept. bovis* infections
	Water	7.5 g/8 L x 7-14d	Change daily
Amoxicillin trihydrate	PO	100-200mg/kg PO, IM q4-8h	Salmonellosis, colibacillosis, Well absorbed and nontoxic
Amoxicillin + clavulanate (Clavamox®)	PO	125 mg/kg q12h	To prevent bacterial infections associated with injury, Broad spectrum
Ampicillin trihydrate	PO	25-175 mg/kg q12-24h	Higher dosage for gram-negative infections
Ampicillin sodium (100 mg/ml)	IM	150 mg/kg q12-24h	Gram-positive influence only, May require other antibiotics if bite wounds are severe
Amprolium (9.6% solution)	Water	8 ml/gal x 5d	Change daily
Amprolium (20% powder)	Water	1 tsp powder/4 L x 3-5d	Change daily
Atropine (0.54 mg/ml)	IM, IV	0.5 mg/kg	PRN for organophosphate seizures
Butorphanol	IM, SC	0.05-0.4 mg/kg q6-8h	Analgesia, sedation
Calcium EDTA	IM	30 mg/kg q12h x 3-5d	Chelation for lead and zinc
Calcium gluconate	IM, IV (diluted for both)	50-100 mg/kg q12h x 1-2d	Give fluids

FORMULARY FOR PIGEONS

DRUG	ROUTE	DOSAGE	COMMENTS
Calcium gluconate	PO	25-150 mg/kg PO q12-24h	Calcium deficiency
	Water	23 mg/30 ml	
Carbenicillin	IM	100 mg/kg q8-12h	Bacteriocidal, Wide gram-negative spectrum
Carnidazole (10 mg tablet)	PO	1 tablet per pigeon 20 mg/kg once, 5 mg/dove once	Trichomoniasis (only drug labeled for pigeons in the US)
Cefadroxil	PO, IM, IV	100 mg/kg PO q12h x 7d	
Cefotaxime	IM	100 mg/kg q8-12h	Excellent gram-negative spectrum, Penetrates CSF
Cephalexin	PO	100 mg/kg PO q4-6h	Varied efficacy for many gram-negative bacteria
	IM	35-50 mg/kg IM q6h	
Cephalothin	IM	100 mg/kg IM q6h	
Chloramphenicol palmitate	PO	250 mg/kg q6h	Bacteriostatic, Not absorbed from GI tract well, Avoid contact with human skin
Chloramphenicol succinate	IM	60-100 mg/kg q8h	Avoid contact with human skin
Chloramphenicol ophthalmic eye drops	Topical	1 drop q6-8h	Avoid contact with human skin

FORMULARY FOR PIGEONS

DRUG	ROUTE	DOSAGE	COMMENTS
Chlortetracycline	Water	500 mg/L x 45d; 1-1.5 g/gal	Change daily, May precipitate out, Bitter taste, Use in food
	PO	40-50 mg/kg PO q8-12h	Use higher frequency dose with grit
Ciprofloxacin (Cipro®)	PO	5-20 mg/kg q12h x 5-7d	Excellent gram-negative spectrum with oral administration
	Water	250 mg/L x 5-7d	Change daily
Chloroquine	PO	25 mg/kg PO at 0 h, then 15 mg/kg at 12, 24 and 48 h	*Plasmodium* sp. malaria, Use with primoquine 0.75-1.0 mg/kg, Palliative - not curative, *Haemoproteus* sp. rarely, if ever, requires treatment
Clindamycin	PO	100-150 mg/kg PO q24h x 3-5d	May form L-forms with salmonella, Can cause fatal colitis, Good for *Staph.* spp. and anaerobes
		200 mg/L drinking water	
Clazuril	PO	5 mg/kg once (2.5 mg tab/racing bird)	Coccidiostat
Dexamethasone sodium phosphate	IM, IV	1-4 mg/kg q8-24h x 1-2d	Head trauma, hyperthermia
		2-4 mg/kg q12-24 x 1-2d	
Diazepam	IM, IV	0.5-1.0 mg/kg	As needed for seizures and sedation
Dimetridazole (182 g powder/6.42 oz)	Water	1/2 tsp/gal x 5d	Change daily, US product unavailable
		400 mg/L x 3d	
Doxycycline (Vibramycin®)	PO, IM	7.5 mg/kg q12h	Withhold grit

FORMULARY FOR PIGEONS

DRUG	ROUTE	DOSAGE	COMMENTS
Enroflaxin (Baytril®)	PO, IM	5-10 mg/kg SC, IM q24h	Excellent wide gram-negative spectrum, *Salmonella typhimurium*
	Water	200 mg/L x 5-7d	Change daily, Some *Pseudomonas* resistance
Erythromycin	PO	71 mg/kg PO q24h	For *Strep. bovis*
		1 g/L drinking water	
Fenbendazole (100 mg/ml suspension)	PO	25-50 mg/kg q24h x 3d	Do not use during a molt (causes feather breakage)
	Water	125 mg/L x 5d	
Furosemide 1%	PO, IM, IV	2.2 mg/kg q12h	PRN
Hydroxychloroquine sulfate (Plaquenil®)	Water	100 mg/120 ml x 6wk	Change daily; not effective against chloroquine-resistant *Plasmodium* strains
Ipronizadole (61 g/2.65 oz)	Water	500 mg/4 L x 7d	Change daily, Unavailable in the US
Ivermectin 1%	PO, IM, SC	0.2 mg/kg once	Make a 1:9 dilution with sterile water
Ketoconazole (Nizoral®)	PO	20-40 mg/kg q12h x 15-60d	*Candida* infections, Systemic mycoses
Levamisole	Water	250-300 mg/L x 1-3d; 1-15 g/gal x 1-3d	Change daily
	PO	40 mg/kg once	Effective against ascarids, May cause vomiting after administration

FORMULARY FOR PIGEONS

DRUG	ROUTE	DOSAGE	COMMENTS
Lincomycin	PO, IM	35-50 mg q24h x 7-14d	Used primarily for resistant *Staph*. and *Strep*. spp., Monitor liver and kidney function and hemograms, Can be used in combination with spectinomycin
Mebendazole (33.3 mg/ml susp)	Water	1.25-2.5 ml/4 L x 3-5d	Repeat in 21 days, Change water daily
	PO	5-6 mg/kg q24h	
Mebendazole (40 mg/g powder; 333 mg/ml susp.)	PO	See Avian Formulary under general Birds	For nematodes, May need to be repeated monthly, May not work for ventricular or proventricular parasites, Reports of toxicity in pigeons (12 mg/kg)
Meloxicam	PO	0.2 mg/kg q24h	NSAIDs, Analgesic
Metronidazole (tab)	PO	50 mg/kg q12h x 5d	For trichomoniasis, protozoa, anaerobic bacteria
Metronidazole (inj)	IM	10-20 mg/kg q24h x 2d	
	Water	4000 mg/gal x 3-7d	
Nystatin	PO	100,000-150,000 IU/kg q12h x 7d	Used orally for candidiasis
Oxfendazole	PO	10-40 mg/kg once	Nematodes
Piperacillin, tazobactam sodium (Zosyn®)	IM	100-200 mg/kg q8-12h x 7d	Wide gram-negative spectrum

FORMULARY FOR PIGEONS

DRUG	ROUTE	DOSAGE	COMMENTS
Piperazine	PO	250 mg/kg PO once	Ascarids only (rarely used)
	Water	1 g/L x 3d	
Praziquantel (5.75 mg cat tab)	PO	0.258 tab/pigeon; repeat in 14 days	Tapeworms
Primaquine	PO	0.75-1.0 mg/kg once	*Plasmodium* sp. malaria, Use with chloroquine 25 mg/kg at 0 hr, then 15 g/kg at 12, 24, 48 hr, Palliative - not curative, *Hemoproteus* rarely, if ever, requires treatment, Water treatments not efficacious or recommended
Pyrantel pamoate (50 mg/ml)	PO	20-25 mg/kg, May repeat in 10-14d	Nematodes
Pyrethrin/permethrin	Topical	Apply powder liberally under wings & tail, vent, breast and neck	Control of mites and lice
Quinacrine	Water	100-300 mg/gal x 10-21d	*Plasmodium* sp. malaria, Quinacrine/primaquine preferred, *Haemoproteus* sp. rarely, if ever requires treatment
	PO	5-10 mg/kg q24h x 7d	
Ronidazole	Water	400 mg/gal (1/2-3/4 tsp) x 3-5d	Drug of choice for protozoal disease in flocks, Not available in the US
Spectinomycin	IM	25-35 mg/kg q8-12h	
	Water	600-1000 mg/gal H_2O	

FORMULARY FOR PIGEONS

DRUG	ROUTE	DOSAGE	COMMENTS
Sulfachlorpyridazine (Valasalid®)	Water	1.25-2.5 ml powder/L x 5-10d or 1200 mg/gal x 7-10d	Change daily, Coccidia and secondary bacterial enteritis
Sulfadimethoxine (Albon®)	PO	25 mg/kg q12h x 5d, 1.25-1.5 g/gal x 24h, then 0.75-1.0 g/gal x 4d	For coccidia, bacteria, Half-life is longer than other sulfas in pigeons
Sulfamethazine (94.6 g active sulfa/107 g powder)	Water	1500 mg/gal for 1 day, then 750-1000 mg/gal H_2O x 4d	Change daily
Sulfaquinoxaline (Sulquin 6-50®)	Water	500 mg/L x 6d, off 2d on 6d (1.8 ml/L ~ 500 mg/L)	Coccidiosis
Tetracycline (10 g/6.4 oz)	Water	15 ml (1Tbs) powder/4L x 5-10d	Change daily, May precipitate out, Bitter taste
Tiamulin (Denegard®)	Water	250 mg (2.2 g powder)/L x 7d	*Mycoplasma*
Ticarcillin	IM, IV	200 mg/kg q8-12h x 7d	*Pseudomonas*, Resistant enterics
Trimethoprim	PO	15-20 mg/kg PO q8h	Best for *E. coli, Proteus mirabilis, Klebsiella pneumonia, Enterobacter* spp. and coagulase-neg *Staph*. spp.
Trimethoprim + sulfamethoxazole susp	PO	60 mg/kg q12h x 7d or 1.8-3.6 g/gal H_2O	Maintain hydration

FORMULARY FOR PIGEONS

DRUG	ROUTE	DOSAGE	COMMENTS
Trimethoprim + sulfamethoxazole	PO	60 mg/kg q24h	One-half to one 30-mg tablet approximates one/pigeon
	Water	360 mg/L x 10-14d	Suspension mixes well with water, Reduce dose if regurgitation or hot weather
Tylosin (100 g packets powder)	Water	3 g (2 tsp)/gal	Always add water to powder, Change daily, For gram-positives, spirochetes, mycoplasma, *Pasteurella* spp., May be combined with tetracycline in treating "ornithose" complex
Tylosin (20 or 200 mg/ml injectable)	IM	25 mg/kg IM q6h	Good for most *Mycoplasma, Pasteurella* spp., *Fusobacterium* spp., *Actinomyces pyogenes*, May cause diarrhea, Very irritating to muscle, Avoid if possible in homers

Carpenter/Moshima/Rupiper, 2001; Rupiper, 1994, Vogel, 1994, Hudelson, Harlin 1994

POULTRY and WATERFOWL

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of poultry, other gallinaceous birds and captive waterfowl and is not intended to replace comprehensive reference material. Updates were provided by Gwen B. Flinchum, DVM. For drug doses, please refer to the Avian Formulary under the "Birds" introductory section.

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POULTRY

- **Order:** Galliformes
- **Families and Subfamilies:**

Phasianidae - 3 sub-families (New World quail, Old World quail, pheasant/chicken/peafowl): 177 species
Tetraonidae (grouse, ptarmigan): 18 species
Meleagrididae (turkey): 2 species
Numididae (guinea fowl): 7 species
Cracidae (curassows): 38 species
Megapodiidae (megapodes): 11 species

- **Common Species:**

Bobwhite quail	*Colinus virginianus*
Button quail (Chinese painted quail)	*Excalfactoria chinonsis*
Chukar partridge	*Alectoris chukar*
Common francolin	*Francolinus francolinus*
Common quail	*Coturnix coturnix*
Domestic fowl or chicken	*Gallus gallus, forma domesticus*
Domestic guinea fowl	*Numida meleagris, forma domesticus*
Domestic turkey	*Meleagris gallopavo, forma domesticus*
Hungarian partridge	*Perdix perdix*
Golden pheasant	*Chrysolophus pictus*
Japanese quail	*Coturnix japonica*
Lady Amherst pheasant	*Chrysolophus amherstiae*
Peafowl (Indian or green)	*Pavo crestatus, P. muticus*
Ruffed grouse	*Bonasa umbellus*
Willow ptarmigan	*Lagopus lagopus*

Galliformes - Quick Facts

Physiologic		
Life span:	Bobwhite quail:	6 yr
	Cracids:	>20 yr
	Domestic chicken:	10-11 yr
	Commercial production birds:	2.5 yr max
	Grouse:	8-10 yr
	Peafowl:	20 yr
	Pheasants:	10-18 yr
Respiratory rate:	Domestic fowl:	12-37 per minute
	Domestic turkey:	28-49 per minute
	Pheasant:	12-37 per minute
	Common quail:	40-85 per minute
Heart rate:	Domestic fowl:	220-360 bpm
	Domestic turkey:	93-163 bpm
	Common quail:	249-494 bpm
Reproductive		
Sexual maturity:	Common pheasants:	1 yr
	Congo peafowl: Hens Cocks	2 yr 3 yr
	Cracids:	2 yr
	Domestic chickens (leghorns):	4.5-5 mo (begin laying; sexually matured by 1 yr
	Golden pheasant: Hens Cocks	1 yr 2 yr
	Jungle fowl:	1 yr
	New World quail:	1 yr
	Turkey:	2 yr
Laying pattern:	Nondeterminant (hen continues to lay if eggs removed)	

Diet

- Many diseases and problems in captive Galliformes are directly or indirectly related to malnutrition.
- Use commercially available diets:
  * Domestic fowl: Chick Start, Layer, Broiler, Adult Maintenance
  * Domestic turkey: Turkey Start, Maintenance
  * Exotic gamebirds: Formulated diets such as Mazuri's Exotic Gamebird Starter, Grower & Developer, Breeder and Maintenance, www.mazuri.com
- Best to get commercial diets without coccidiostats, antiflagellates or antimicrobials.

- The additives halofuginone and monensin are toxic to common pheasant, guinea fowl and the common partridge.
- Antiflagellates in turkey feeds are potentially toxic and disrupt cecal flora in grouse, capercaillies and ptarmigans.
- Provide various sizes of grit.
- Provide fresh clean water daily; use shallow bowls for chicks.
- To make a feeding change: mix new feeds into the daily diet slowly over a few days, gradually converting to new diet.
- All feed should be stored in cool, dry areas, in containers appropriate to prevent vermin and insect contamination.

Housing

- Shelter should be dry, draft-free, ventilated, include shaded portion and be easy to sanitize.
- Outdoor caging wire mesh should be of a size to prevent the bird from sticking its head through.
- To prevent access from predators: extend wire sides underground or use sheet metal 20 inches down and then angled for another 15-20 inches; cover top with wire mesh.
- Leave some slack in wire or use nylon netting to provide slightly cushioned surface if gallinaceous bird flies straight up when frightened and hits it.
- Avoid sharp corners; plant dense, nontoxic bushes in corners.
- Tropical/subtropical species require indoor or heated shelter for winter housing.
- Indoor/outdoor aviaries should be as large as possible (with extra height for roosting).
- Roosts should be placed so that the tail or wing of a roosting bird does not touch sides of the aviary.
- Best to maintain space between aviaries so that birds (especially of same species) do not see each other (particularly during breeding season). If not possible, provide solid barrier 1-2′ high on shared fence side to prevent birds flying at each other and fighting.
- Pheasants can be maintained and bred in a pen 12′ x 18′.
- Peafowl require 9′ x 9′ x 9′ enclosure.
- Provide separate housing for different species and ages within a species.
- Avoid making any abrupt food or housing changes.
- Natural turf surfaces are best; allow an area for dust/sand baths.
- Litters include shavings, sawdust, straw or recycled paper pellets to a depth of 6-8 inches.

- Litter should be changed routinely to prevent ammonia buildup. Excess feed and waste should be removed to discourage vermin and wild bird intrusions.
- Galvanized metal can cause zinc toxicity if the birds peck at the wire.
- Small quail such as button quail are best kept in flights with grass and plant cover available (vs. open enclosures). This is more conducive to their natural behavior of taking cover from predators and being able to forage for food.
- Providing plant cover will provide females with nesting materials and privacy for nest building.
- When kept in cages with low covers, frightened quail will fly straight up and hit the top of the enclosure, resulting in head trauma. Keeping quail in finch flights or padding low covers will help solve this problem.
- An example size for a finch flight for small quail would be 4' high x 3' wide x 2' deep.
- Larger quail (such as bobwhite) can be kept in wood frame cages with non-galvanized wire on all sides and one end closed to protect birds from the weather. General guidelines for space: quail from 1-10 days of age, nine birds per square foot; quail 10 days to 6 weeks of age, six birds per square foot; quail 6-14 weeks, two birds per square foot.
- Surrounding or adjacent areas should incorporate vermin control (rodents, insects).

Restraint

- The face and eyes of handlers should be protected from possible injury from spurs (cocks) or beaks.
- A hooked long stick can be used to gently catch gallinaceous birds in an aviary.
- The legs of gallinaceous birds should be restrained first and the abdomen supported from below.
- A large bird can be restrained by placing it under one arm and pressing it gently against one's body.
- Birds can be calmed by placing a loose-fitting lightweight cotton sock over the head to reduce vision.

Breeding and Raising Young

- Males can very aggressive during the breeding season. Do not house more than one male per enclosure if females are present.
- House monogamous species in pairs.

- Most species incubate eggs on the ground; provide flat trays with moss, foliage or hay for nesting.
- Hatching is genetically determined and should not be assisted.
- Most gallinaceous chicks are independent by 3 months of age.
- Quail are monogamous pairs with their current chicks. Males assist with chick rearing.
- Quail that are kept in large groups, especially more males than females, will not form the monogamous pair bond as readily, resulting in a decline in nesting behavior by females.
- Mealworms are important from a behavioral aspect in quail. Male quail will use worms in courtship by offering them to the female. Parents will also offer them to chicks after hatching.

Incubation Period and Clutch Size of Various Gallinaceous Birds

Species	Clutch Size	Incubation (days)
Capercaillie	5-12	26-28
Domestic chicken	5-8	19-22
Prairie chicken	5-17	21
Francolin	4-8	19-21
Guinea fowl	8-12	26-28
Jungle fowl	5-8	19-21
Grouse, ruffed	11	24
Partridge, common	4-8	22-24
Peafowl	3-5	28
Pheasant, ring-necked	8-12	22-24
Ptarmigan, willow	6-9	21-23
Quail, common	7-14	17-28
Roulroul	4	18-20
Tragopan	4-10	26
Domestic turkey	8-15	26-28

Hematologic Reference Ranges for Turkeys, Quail and Chickens*

	Turkey	Quail	Chicken
Erythrocytes (RBC) ($x10^6/mm^3$)	1.74-3.7	4.0-5.15	1.25-4.5
Hemoglobin (g/dl)	8.8-13.4	10.7-14.3	7.0-18.6
MCV (μ^3)	112-168	60-100	100-139
MCH ($\mu\mu$g)	32.0-49.3	23-35	25-48
MCHC (%)	23.2-35.3	28.0-38.5	20-34
Hematocrit (PCV) (ml %)	30.4-45.6	30.0-45.1	23-55
WBC ($x10^3/mm^3$)	16.0-25.5	12.5-24.6	9-32
Neutrophils (%)	29-52	25.0-49.5	15.1-50.0
Basophils (%)	1-9	0-1.5	0-8
Eosinophils (%)	0-5	0-15	0-16
Lymphocytes (%)	35-48	50-70	29-84
Monocytes (%)	3-10	0.5-3.8	0.05-7.0
Sedimentation rate (mm/hr)			0.5-6.5
Platelets ($x10^3/mm^3$)			13-70

Hematologic Reference Ranges for Pheasant, Guinea Fowl and Peafowl*

	Pheasant	Guinea fowl	Peafowl
Erythrocytes (RBC) ($x10^6/mm^3$)	2.2-3.6	1.7-2.8	2.1
Hemoglobin (g/dl)	8.0-18.9	11.4-14.9	12
Hematocrit (PCV) (ml %)	28-42	39-48	33-41
WBC ($x10^3/mm^3$)		15.5	

Note: In both curassows and guans, hemolysis occurs in EDTA tubes.

Biochemistry Reference Ranges for Selected Gallinaceous Birds*

	Domestic fowl	Domestic turkey	Pheasant	Guinea fowl	Common quail
Total protein (g%)	3.3-5.5	4.9-7.6	6.9	3.5-4.4	3.4-3.6
Albumin (g%)	1.3-2.8	3.0-5.9	5.2		
Globulin (g%)	1.5-4.1	1.7-1.9	1.7		
Creatine (mg%)	0.9-1.8	0.8-0.9			
Uric acid (mg%)	2.5-8.1	3.4-5.2	2.3-3.7	2.9-5.1	
Glucose (mg%)	227-300	275-425	335-397		
Choles (mg%)	86-211	81-129			
Ca (mg%)	13.2-23.7	11.7-38.7			
P (mg%)	6.2-7.9	5.4-7.1	164-172		
Na (mEq/L)	131-171	149-155		149-157	180
K (mEq/L)	3.0-7.3	6.0-6.4			1.4

	Bobwhite quail	Japanese quail	Peafowl	Rock partridge	Chachalac a
Albumin (g%)		1.2-1.9			
Uric acid (mg%)			1.8-3.7	2.5-4.2	3.7-7.9
Glucose (mg%)			273-357	270-312	235-345
Ca (mg%)	14.1-15.4				
Na (mEq/L)			154-162	145-163	158-164

Common Diagnostic Tests for "Pet" Galliformes

- CBC, serum chemistries
- Culture, sensitivity (state diagnostic lab)
- Fecal Gram's stain
- Fecal flotation, direct smear
- Radiography
- Ultrasonography
- Serology
- Necropsy (state diagnostic lab), histopathology

Vaccines

VACCINES ROUTINELY USED FOR CHICKENS
- Marek's disease
- Newcastle disease
- Infectious bronchitis
- Infectious bursal disease
- Poxvirus (for flocks housed outdoors)

VACCINES ROUTINELY USED FOR TURKEYS
- Newcastle disease
- Hemorrhagic enteritis

VACCINE DELIVERY SYSTEMS
- In ovo injection
- Aerosol
- Spray
- Drinking water
- Eye drop
- Wing web injection

Diseases of Gallinaceous Birds by System Affected

RESPIRATORY
- Newcastle disease
- Infectious bronchitis
- Abdominal mass or fluid
- Mycoplasmosis (*M. gallisepticum*)
- Aspergillosis
- Chlamydiosis
- Bordetella rhinotracheitis
- General bacterial infection, pneumonia, air sacculitis
- Obesity

DIGESTIVE
- Vitamin A deficiency
- Salmonellosis
- Hemorrhagic enteritis (turkeys)
- Infectious bursal disease
- Marek's disease
- Endoparasitism: protozoan and helminth
- Gastroenteritis from improper treat foods

MUSCULOSKELETAL
- Nutritional myopathy
- Arthritis: viral, staphylococcal, geriatric
- Infectious synovitis (mycoplasmosis)

- Bumblefoot
- Biotin deficiency (turkey poults)
- Toxicity, foreign body ingestion
- Trauma
- Overgrown, torn nails

CENTRAL NERVOUS SYSTEM
- Newcastle disease
- Marek's disease
- Encephalitis/encephalomyelitis
- Vitamin E deficiency (encephalomalacia)
- Botulism
- Fowl cholera
- Salmonellosis
- Toxicity (metal, organophosphate)

SKIN
- Poxvirus
- Photosensitization
- Xanthomatosis
- Malnutrition (biotin, riboflavin, pantothenic acid deficiency)
- Dermatopathy
- Gangrenous dermatitis
- External parasites: *Knemidokoptes, Dermanyssus, Ornithonyssus* (chicken mites), *Echidnophaga gallinacea* (sticktight flea), *Ornitromyia avicularia* (Hippoboscid lousefly)
- Contact dermatitis
- Viral (Marek's disease, reticuloendotheliosis)
- Genetic disorders
- Enlarged sternal bursa

MISCELLANEOUS CONDITIONS SEEN IN PET FOWL
- Cardiovascular disease
- Neoplasia
- Renal disease
- Hepatopathies including fatty infiltration, liver fibrosis
- Cataracts

Zoonotic Potential

- Colibacillosis (*Escherichia coli*) - Ingestion
- Erysipelas (*Erysipelothrix insidiosa*) - Contact
- Tuberculosis (*Mycobacterium avium*) - Ingestion, inhalation
- Salmonellosis (*Salmonella pullorum*) - Ingestion
- Chlamydiosis (*Chlamydophila psittaci*) - Inhalation, aerosol
- Staphylococcosis (*Staphylococcus aureus*) - Ingestion, contact

- Pasteurellosis (*Pasteurella multocida*) - Bites, contact, ingestion
- Gas gangrene (*Clostridium* spp.) - Wound infection
- Streptococcosis (*Streptococcus pyogenes*) - Ingestion, contact
- Yersiniosis (*Yersinia pseudotuberculosis*) - Ingestion, contact
- Listeriosis (*Listeria monocytogenes*) - Ingestion (common source)
- Q fever (*Coxiella burnetti*) - Airborne (environment)
- Ringworm (*Microsporum* spp., *Trichophyton* spp.) - Direct contact, fomites, environment
- Candidiasis (*Candida albicans*) - Endogenous, environment
- Newcastle disease (RNA virus) - Contact, aerosol
- Eastern encephalitis (RNA virus) - Mosquito vector
- Western encephalitis (RNA virus) - Mosquito vector
- St. Louis encephalitis (RNA virus) - Mosquito vector
- Toxoplasmosis (*Toxoplasma gondii*) - Ingestion, intrauterine
- Sacrosporidiosis (*Sarcocystis lindemanni*) - Ingestion
- Acariasis (lice, mites) - Contact
- Sparganosis (*Diphylobothrium* spp., *Spirometra* spp.) - Ingestion, contact
- Cercarial dermatitis (*Schistosoma* spp.) - Skin penetration
- Echinostomiasis (*Echinostomatidae genera*) - Ingestion of raw mussels and snails
- Eosinophilic allergic alveolitis (danders - avian proteins via urine/feces, dusts) - inhalation and sensitivity

Resources

- Cooperative Extension Service (check local telephone directory)
- The Game Bird Gazette - hobbyist magazine <www.gamebird.com>
- Avian Diseases - journal of the American Association of Avian Pathologists <www.aaap.info>
- Journal of Wildlife Diseases - journal of the Wildlife Disease Association <www.wildlifedisease.org>
- Poultry Science - journal of the Poultry Science Association <www.poultryscience.org>
- Avian Pathology <www.tandf.co.uk/journals/titles/03079457.asp>

WATERFOWL

- **Order:** Anseriformes
- **Family:** Anatidae
- **Subfamilies:**

Anseranatinae (pied goose): 1 species
Cygninae (swans): 7 species
Anserinae (geese): 14 species
Dendrocygninae (whistling or tree ducks): 8 species
Tadorninae (shelducks, shelgeese): 20 species
Cairininae (perching ducks): 12 species
Merganettinae (torrent ducks): 1 species
Anatinae (surface-feeding ducks): 41 species
Aythyinae (diving ducks): 16 species
Merginae (sea ducks): 20 species
Oxyurinae (stiff-tailed ducks): 9 species

Common Species:

Fulvous whistling duck	*Dendrocygna bicolor*
Egyptian goose	*Alopochen aegypticus*
Mandarin duck	*Aix galericulata*
Muscovy duck	*Cairina moschata*
Mallard duck	*Anas platyrhynchos*
Redhead duck	*Aythya americana*
Black swan	*Cygnus atratus*
Black-necked swan	*Cygnus melanocoryphus*
Mute swan	*Cygnus olor*
Trumpeter swan	*Olor buccinator*
Whistling swan	*Olor columbianus*
Domestic Chinese goose	*Anser cygnoides*
Domestic or Embden goose	*Anser "domesticus"*
Greylag goose	*Anser anser*
Canada goose	*Branta canadensis*
Snow goose	*Chen caerulescens*

Waterfowl - Quick Facts

Physiologic

Life span:	Mute swan:	25-30 yr
	Trumpeter swan:	32.5 yr
	Canada goose:	33 yr
	Greylag goose:	26 yr
	Magpie goose:	26 yr
	Egyptian goose:	25 yr
	Hawaiian goose:	15-20 yr
	European pochard:	20 yr
	Canvasback:	19 yr
	Common mallard:	20 yr
	Northern green-winged teal:	20 yr
	Common goldeneye:	17 yr
	Redhead:	16.5 yr
	Whistling duck:	15 yr
	Muscovy duck:	10-15 yr
	Mandarin duck:	10-15 yr
	Common eider:	10-15 yr

Normal Parameters in Pekin and Muscovy Ducks

Parameter	Pekin Duck	Muscovy Duck
Cloacal temperature	40.5-41.6°C	39.1-41.1°C
Heart rate	150-250 bpm	
Respiratory rate	15-23 bpm	
Mean arterial BP (mmHg)	111-142.5	
PaO_2 (mmHg)	73-109.1	80-83
$PaCO_2$ (mmHg)	28.9-43	32-39
HCO_3 (mEq/L)	19.6-24.8	
Blood pH	7.36-7.48	7.48-7.53
Tidal volume	40-58 ml	
Minute ventilation	0.67-0.97 L/min	

In general, swans and geese have a respiration rate of 13-40 bpm, a heart rate of 80-150 bpm and a cloacal temperature of 40.5°C (105°F). Ducks have a respiration rate of 30-95 bpm, a heart rate of 180-230 bpm and a cloacal temperature of 41°C (106°F).

Reproductive

Sexual maturity	Ducks (most):	1 yr
	Geese:	2 yr
	Swans:	5 yr

Diet

- Commercial diets for various needs and life stages, such as growth, maintenance and breeder, are available for waterfowl. Mazuri <www.mazuri.com> and Reliable Protein Products <www.zoofood.com> are two companies that produce waterfowl diets.
- Young, growing waterfowl should have less than 18% protein in the diet to avoid limb deformities.
- Most species are omnivorous.
- Waterfowl should have access to fresh greenery; however, oversupplementation may result in dietary imbalances.
- Many geese are grazers, and most lush grasses seldom exceed 17% protein; consult field guides and wildlife rehabilitators for diets of free-ranging geese.

Housing

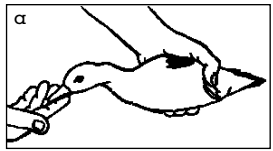
- Waterfowl are commonly kept as pairs in small, planted, open pens with a small pool or stream, or in large open mixed species groups with a large pond.
- Some plants that may be suitable for areas around lakes/ponds: palms, juniper, pines, nontoxic evergreens, bird of paradise, coral tree, natal plum, philodendron.
- A grass surface or sand is better than concrete, as either of these lessens the incidence of bumblefoot.
- Burying the fence line will discourage some predators from digging under the fence, and electric fencing will discourage terrestrial predators.
- Covered enclosures allow birds to be full-flighted (most are typically pinioned or wing-clipped to prevent escape from open enclosures).
- Large ponds should have islands to provide nesting areas and privacy for the birds.
- Grazing species, such as geese, require more land area than do diving ducks.
- Small ducks can be maintained in small, planted pens with an elevated cement water container that holds 3-5 gallons.
- A high water flow rate or filtration is important for maintaining clean water and reducing the incidence of disease.
- Cold water is better for ponds than warm water.
- A depth of 2 feet of water is adequate for most Anseriformes, although swans and some diving ducks require 3-4 feet of water.

Hospitalization

- A dry, warm enclosure with good footing is suitable for brief hospitalization.
- A quiet, dimly light enclosure should be provided, if possible.
- Hay or straw provides a soft warm surface. Bales of hay may be used for recovering birds to prevent injury (eg, flapping, thrashing against walls).
- If longer hospitalization is required, an enclosure with an accessible pool and padded flooring is necessary to prevent leg and foot problems. Access to water is necessary to maintain waterproofing in species prior to release.
- Chain-link enclosures should be protected with burlap to prevent birds from abrading their wings, head or eyes.

Restraint

- Primary defenses are scratching with toenails, pinching with bills, striking with wings; wear eye/face protection.
- Special care should be taken when handling large waterfowl. If the handler's head is near the bird's body, head injuries can be inflicted with the bird's wings.
- Nets can be used to catch waterfowl in confines of an aviary.
- A wrap using Velcro® straps can be used to encircle the wings. Other options include: wrapping the bird in a towel or cotton sheet or putting the bird inside a pillow case, then wrapping with Vetrap® tape to secure.
- Large waterfowl should not be wrapped for long periods of time to prevent muscle paralysis and stress.
- A pillowcase-like bag with a hole for the head and neck can be used.
- For larger birds, the base of both wings should be grasped with one hand while the other hand and arm support the body.
- Heavy-bodied species should never be carried by the wing or feet alone.
- Pinioning is the amputation of the distal portion of the wing, permanently handicapping a bird's flight abilities; it is commonly done in captive waterfowl at 1-4 days of age.
- Restraint of small waterfowl and larger species (a,b).



Body Weight, Eggs/Nest and Incubation Data of Selected Anseriformes

	Male body weight (g)	Female body weight (g)	Average eggs/ nest	Average incubation (days)
Black swan	6270	5100	4-10	35-40
Whistling swan	7100	6200	3-5	30-32
Mute swan	12000	9000	3-7	35-36
Trumpeter swan	11900	9400	4-9	32-40
Western greylag goose	3531	3105	5-6	24-30
Lesser snow (blue) goose	2744	2517	4-5	22-23
Nene (Hawaiian) goose	2212	1923	3-5	29
Atlantic Canada goose	3809	3310	4-6	28
Australian shelduck	1559	1291	10-14	30-32
Egyptian goose	1900-2550	1500-1800	6-12	30
American (baldpate) wigeon	770	680	7-9	24-25
Fulvous whistling duck	675	690	8-16	24-26
Northern mallard	1261	1084	8-12	23-29
Northern pintail	820	759	8-10	21-26
Canvasback	1252	1154	8-10	24-25
Redhead	1080	1030	7-8	24
Lesser scaup	850	800	8-10	23-25
Mandarin (Pekin) duck	440-550	440-550	9-12	28-30
North American wood duck (Carolina duck)	680	539	10-15	28-30
Muscovy duck	2000-4000	1100-1500	8-15	35-37
Atlantic harlequin duck	680	540	4-8	28-29
Barrow's goldeneye	1110	800	9-11	32
Hooded merganser	680	540	9-11	32-33
Common red-breasted merganser	1133-1209	907-959	9-10	32
North American ruddy duck	550	500	6-9	23-24

Breeding and Raising Young

- Waterfowl maintained in captivity will interbreed with their relatives. This frequently results in congenital defects such as eye problems. Therefore, related species should not be housed together.
- The behavior of aggressive species, such as Cape Barren geese, sheldgeese, swans and bronze-winged ducks, must be carefully monitored during the breeding season.
- Mixed aviaries must be large enough to allow birds involved in territorial aggression to escape.
- Male ducks frequently leave after the eggs are laid, and the pair may or may not re-mate the following season.
- Swans and geese are monogamous and bond to their mates for life. If this bond is broken by death, the surviving bird may have difficulty forming another bond and may not breed again.
- Waterfowl nest in a variety of locations: cavities, thick vegetation or open areas. Nests are very simple and are constructed from whatever materials can be found near the nest site.
- Waterfowl generally lay their eggs in the early morning.
- Smaller species usually lay one egg a day, while large species lay an egg every other day.
- Once incubation begins, the hen rarely leaves the nest, except briefly in the morning or afternoon to feed, drink and bathe.
- During incubation, it is not uncommon for some free-ranging migratory waterfowl to lose up to 40% of their peak weight.
- Because incubation of the clutch usually begins at the same time, most eggs in a clutch will hatch within a day or two of each other. Once an egg pips, there is usually an interval of 16-24 hours before hatching is complete.
- In some species (swans and geese), both parents protect the young, while in other species, only the hen cares for the brood.
- The young are covered in down and can eat, swim and dive almost from hatching.
- Smaller species will fledge and can fly at about 40 days of age.
- Larger birds may take 2-3 months to fledge.

Gas Anesthetic Parameters in Pekin Ducks

	Baseline	Halothane	Isoflurane
Induction time (min):	5-9		3-5
Respiratory rate (bpm):	15-23	4-6	7-11
Heart rate (bpm):	173-207	230-388	176-310
Blood pressure (mmHg):	114-142	96-128	107-131

Values at 30 minutes post-induction

Hematologic Reference Ranges for Ducks and Swans

	Ducks	Swans
Erythrocytes (RBC) ($x10^6/mm^3$)	1.8-3.82	1.9-2.9
Hemoglobin (g/dl)	9-21	11.0-16.5
MCV (μ^3)	115-170	—
MCH ($\mu\mu g$)	32-71	52.9-65.5
MCHC (%)	20.1-52.0	29.0-36.5
Hematocrit (PCV) (ml%)	32.6-47.5	32-50
Leukocytes (WBC) ($x10^3/mm^3$)*	13.4-33.2	6.3-22.0
Heterophils	19.3-49.8%	3.3- 4.7 $x10^3$/uL
Basophils	0-4.5%	0-0.8 x 10^3/uL
Eosinophils	1.6-2.65%	0.1-3.5 x 10^3/uL
Lymphocytes	13.0-73.5%	0.9-9.8 x 10^3/uL
Monocytes (%)	0.5-11.5%	0.05-1.4 x 10^3/uL

*WBC may vary considerably depending on the molt stage.

Hematologic Reference Ranges for Geese

	Canada Goose	Aleutian Canada Goose	Snow Goose	Nene Goose
RBC ($x10^6/mm^3$)	1.6-2.6	2.6	2.25	2.6
PCV (%)	38-58	42	46	46
Hg (g/dl)	12.7-19.1	13.48	14	15.25
MCV (μ^3)	145-174	32		—
MCH (mg)	53.7-70.0	5.2		32.5
MCHC (%)	28-29			33.8
RBC size (μ)	6.9 x 13.2		0.2	
WBC ($x10^3/mm^3$)	13.0-18.5		20.1	
Heterophil ($x10^3/mm^3$)	23.0-42.8			
Lymph ($x10^3/mm^3$)	47.8			
Monocytes ($x10^3/mm^3$)	5.1			
Basophil ($x10^3/mm^3$)	2.4			
Eosinophil ($x10^3/mm^3$)	1.9			

Biochemistry Reference Ranges for Selected Anseriformes

	White-winged wood duck	Canada goose	Aleutian Canada goose	Tule white-fronted goose
Total protein (g/dl)	3.4-5.4	5.09-5.63	4.1-5.5	4.0-4.8
Albumin (g/dl)	1.0-2.5	2.05-2.31	1.9-2.3	1.5-1.9
Globulin (g/dl)	2.64-2.91	2.03-4.26	2.2-3.4	2.4-3.0
A/G ratio	—	—	0.63-0.89	0.56-0.72
Glucose (mg/dl)	144-241	207.11-231.89	179-241	193-249
Calcium (mg/dl)	8.04-10.8	8.95-9.349	9.5-10.9	9.5-10.7
Phosphorus (mg/dl)	1.7-5.1	—	1.9-3.7	3.0-4.2
Sodium (mEq/l)	—	—	138-146	141-151
Chloride (mEq/l)	—	101-133	101-109	89-135
Potassium (mEq/l)	—	3.9-4.7	2.8-4.0	2.7-3.9
Uric acid (mg/dl)	—	5.46-6.64	6.0-10.6	9.8-11.8
Creatinine (mg/dl)	0.06-0.16	0.04-0.12	0.5-1.1	0.7-1.1
Blood urea nitrogen (mg/dl)	—	—	1-5	2-5
AAT (U/l)	—	—	56-94	80-116
ALP (U/l)	0-198	0-149	29-115	34-122
LDH (U/l)	—	145-435	221-381	165-557
GGT (U/l)	0-14	1.0-10.5	0-5	0-2
ALT (U/l)	0-67.5	—	32-54	41-59
AST (U/l)	9.8-43.2	—	58-92	89-119
Amylase (U/l)	—	—	386-754	253-655
Total bilirubin (mg/dl)	—	—	0.13-0.27	0.21-0.81
Iron (mg/dl)	—	—	162-306	186-366
Total lipids (g/dl)	—	—	0.71-2.05	1.626-1.754
Triglyceride (mg/dl)	—	258±60.83	123-179	164-266
Total cholesterol (mg/dl)	—	239.25±9.91	144-200	120-148

Biochemistry Reference Ranges for Selected Anseriformes

	Nene goose	Embden goose	Swan
Total protein (g/dl)	3.7-5.1	3.4-5.4	3.6-5.4
Albumin (g/dl)	1.5-1.9	1.3-1.7	1.2-2.2
Globulin (g/dl)	2.1-3.1	—	2.3-3.6
A/G ratio	0.62-0.8	—	0.4-0.7
Glucose (mg/dl)	175-195	199-261	112-230
Calcium (mg/dl)	9.4-10.6	9.5-10.7	8.8-11.6
Phosphorus (mg/dl)	2.3-3.1	2.0-4.6	2.2-7.4
Sodium (mEq/l)	143-149	140	132-150
Chloride (mEq/l)	95-103	101	—
Potassium (mEq/l)	2.1-2.9	3.1	—
Uric acid (mg/dl)	6.4-9.6	5.6-9.4	2.1-11.8
Creatinine (mg/dl)	0.6-1.0	0.8	1.4-10.1
Blood urea nitrogen (mg/dl)	1-3	3-5	—
AAT (U/l)	28-62	44-68	—
ALP (U/l)	25-41	19-47	—
LDH (U/l)	188-324	340-978	165-724
GGT (U/l)	0-4	1	4-26
ALT (U/l)	30-44	—	10-59
AST (U/l)	27-53	43-207	17-112
Amylase (U/l)	792-856	653	—
Total bilirubin (mg/dl)	0.08-0.16	0.05-0.33	—
Iron (mg/dl)	—	261	—
Total lipids (g/dl)	1.402-1.546	—	—
Triglyceride (mg/dl)	121-205	—	—
Total cholesterol (mg/dl)	197-263	99-147	115-300

RULE OUT CHART - WATERFOWL

RULE OUT CHART FOR WATERFOWL BASED ON CLINICAL SIGNS			
CLINICAL SIGNS	**DIFFERENTIAL DIAGNOSES**	**DIAGNOSTIC OPTIONS**	**POSSIBLE THERAPY**
Anorexia	Foreign body ingestion, Parasitic infection, Heavy metal toxicosis, Bacterial, viral, fungal infection, Avian tuberculosis, Pain, Trauma, Stress including exclusion from food source by others	Physical exam, CBC, Fecal direct smear, Fecal Gram's stain, Radiography, Endoscopy	Antibiotic, antifungal treatment, Chelation for heavy metal, Surgical removal of foreign bodies, Anthelmintics, Assess environment and flock dynamics for food accessibility and hierarchy
Beak abnormalities	Trauma, Fishing hook, Tumor, Parvovirus infection	History, Biopsy, Radiography	Surgical/debridement repair, Antibiotics if secondary infection occurs, Supportive care
Blood in droppings	Heavy metal toxicity, Foreign body ingestion, Endoparasites, Tumor, Rule out reproductive tract as a source for hemorrhage	Physical exam, Radiography, Fecal flotation,, Cloacal endoscopy, Blood heavy metal levels, CBC, Chemistries	Chelation therapy if heavy metal, Surgical removal of foreign body, Anthelmintic administration, Supportive care
Diarrhea with strong odor	Endoparasites, Bacterial infection, Fungal infection, Avian tuberculosis	Fecal flotation, Fecal Gram's stain, Culture/sensitivity, Radiography, Endoscopy	Anthelmintics, Antiprotozoal medication, Antibiotics, antifungal agents (Many free-ranging waterfowl normally have diarrhea due to high plant fiber diet and constant water consumption)

RULE OUT CHART FOR WATERFOWL BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Dyspnea	Respiratory parasites, Fungal, bacterial, viral or chlamydial infection	Endoscopy, CBC, Radiography, Blood serum testing	Anthelmintic administration (ivermectin), Antibiotic, anti-fungal treatment, Supportive care
Feather abnormalities	Lack of preening due to illness, Oil contamination, Lice infestation, Feather mold, Malnutrition, Trauma from flockmates	History and husbandry information, Gross and microscopic examination of feathers, Overall physical exam	Treat underlying illness, Clean feathers with mild solution of Woolite® or Dawn® detergent, If oiled follow current de-oiling washing recommendations and adjunctive therapy. Follow-up CBC, chemistries esp. liver evaluation, If ectopurasites found follow appropriate insecticide dusting, Evaluate flock dynamics and environmental conditions
Foot problems	Bumblefoot, Frostbite, Fire ant bites, Poxvirus	History of management, Characteristic appearance of lesions, Biopsy	House birds on soft substrate and improve husbandry, Surgical debridement, Antibiotic therapy, NSAIDs, Bandage and pad as needed, Mosquito/insect control
Head/face swelling	Trauma, Parasitic lesions, Bacterial, viral disease (sinusitis), Chlamydial infection	History, Microscopic examination/ stain of smear from affected area, Blood serum testing, CBC	Supportive care, Ivermectin, Antibiotic/antifungal therapy, Antihistamines, NSAIDs

RULE OUT CHART FOR WATERFOWL BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Juvenile/neonatal diseases	Retained yolk sac, Musculoskeletal disease, Viral or bacterial infection, Aspergillosis, Endoparasites	Characteristic appearance, Radiography, Fecal direct, Gram's stain, C&S	Surgical resolution, Improve diet and husbandry (especially sanitation), Antibiotic/antifungal therapy, Anthelmintics
Lameness	Foot problems, Leg deformities, Arthritis, Malnutrition, Mycoplasmal infection, Avian tuberculosis, Aflatoxicosis (young birds), Trauma	History and husbandry information, Joint aspiration, C&S, CBC, Radiography	Antibiotic/antifungal therapy, Cage rest to take weight off affected leg, Anti-inflammatory therapy, Improve diet and housing substrate, Avoid inbreeding
Neurologic signs	Toxicity (metal, organophosphate), Botulism infection, Plant poisons, Vitamin deficiency/malnutrition, Trauma, Viral/bacterial infection, Blindness (cataracts or central)	History and husbandry information, Ophthalmic exam, Neurologic exam, CBC, Gram's stain, Radiography, Blood metal levels, Response to treatment, Necropsy if several birds are affected, Submit tissues to state lab if toxin, infectious agent suspected	Correct dietary/management problems, Supportive care, Remove source of toxins, Vaccination for some diseases, Chelation therapy if metal toxicity, Antibiotic treatment for infection, If botulism give antitoxin and improve water quality
Reproductive problems	Egg-related peritonitis, Salpingitis, Cloacitis with ascending infection, Infertility	Radiography, Endoscopy, CBC, Chemistries, Gram's stains, C&S, Necropsy	Antibiotic therapy, Proper nutrition and management, Supportive care

RULE OUT CHART FOR WATERFOWL BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Sudden death	Noninfectious amyloidosis, Egg-related peritonitis, Toxicity, Chronic bacterial infection	Necropsy with histology, Survivors: physical exam, CBC, Gram's stain	Survivors: Antibiotic therapy, Proper nutrition, Determine cause of death through necropsy for future prevention
Wing abnormalities	Angel wing (flipped wing), Bent bones, Fractured bone/trauma	History and management practices, Radiography, Physical exam	Angel wing strap wing up before growth stops, Improve nutrition, Avoid high levels of protein in young birds, Surgical resolution

RAPTORS

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of raptors and is not intended to replace comprehensive reference material. Updates were provided by Storm Hudelson, DVM, Dipl ABVP-Avian Practice.

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Raptors

- **Order:** Falconiformes, Strigiformes
- **Common Free-ranging and Captive Species:**

Red-tailed hawk	*Buteo jamaicensis*
Golden eagle	*Aquila chrysaetos*
European sparrow hawk	*Accipiter nisus*
Cooper's hawk	*Accipiter cooperii*
Harris' hawk	*Parabuteo unicinctus*
Common buzzard	*Buteo buteo*
Northern goshawk	*Accipiter gentilis*
Sharp-shinned hawk	*Accipiter striatus*
American kestrel	*Falco sparverius*
Common kestrel	*Falco tinnunculus*
Merlin	*Falco columbarius*
Prairie falcon	*Falco mexicanus*
Gyrfalcon	*Falco rusticolus*
Peregrine	*Falco peregrinus*
Barn owl	*Tyto alba*
Great horned owl	*Bubo virginianus*
Barred owl	*Strix varia*

Raptor Considerations in the Clinic

- A practice that chooses to offer help to wild bird casualties must have a management protocol.
- Gloves are required to protect both bird and handler. Welder's gloves are adequate for smaller species. Specialty gloves and hoods are available from falconry equipment companies.
- Raptors will not perch on dowel-type perch scales. To weigh, tape their feet with padding to prevent self-talon puncture, wrap in a towel and weigh on a platform or dish scale (depending on the size of bird). Or use flattop scale covered with Astroturf®.
- A variety of block perches should be available to accommodate different species.
- Disinfect perches, leashes, swivels and jesses between birds.
- Hoods can be used. They must fit properly to cover the eyes and sit on the back of the head. Some raptors are hood-shy.
- Check with falconer before using a hood on a private bird (the falconer may provide own hood).
- The physical exam should be done in a step-wise fashion.
- The physical exam and workup must not fray, break or damage feathers. Two people should be present during handling.

- Free-ranging raptors may "freeze" when handled, while captive birds may struggle. Isoflurane may facilitate examination.
- When administering IM injections into the pectorals of raptors, pay close attention to any myonecrosis that may compromise the bird's flight.
- Be aware that injections must go into the upper 60% of pectoral muscles to avoid shunt by the renal portal vein.
- Keep environmental noise to a minimum.

Preventive Care for Long-term Patients/Captives

- Weigh monthly.
- Provide semi-annual complete check-up.
- Deworm if the bird is not easily maintaining weight. (Excessive deworming does not allow for self-immunization to parasites.)
- Offer diet variation (whole fresh or frozen prey).
- Disinfect chamber semi-annually to annually.
- Use air filters in enclosure if maintained indoors.
- Encourage exercise by training unless birds are chamber breeders.

Common Clinical Disorders Seen in Raptors

- Trauma
- Toxicosis
- Poxvirus
- Tuberculosis
- Damaged nails, beak, feathers
- Trichomoniasis (in the West)
- Malnutrition in captive birds
- "Bumblefoot" (bacterial) in captive birds
- Aspergillosis in captive birds
- West Nile Virus infection (some species, susceptibilities and viral range still evolving in North America)
- *Caryospora* coccidial infections esp. in Falconiformes (Europe, UK, Middle East)

Selected Hematologic Reference Ranges

Parameter	Barn Owl	Spectacled Owl
Hb (g/dl)	12.7-16.4	14.2
RBC (x 10^{12}/L)	2.7 ± 0.3	1.6
PCV (%)	46 ± 3	40 ± 3
MVC (fl)	176 ± 22	261
MCH (pg)	51.1 ± 5.7	87.8
MCHC (g/dl)	31.8 ± 2.2	33.7
WBC (x 10^9/L)	16.6 ± 4.2	9.6
Heteros (x 10^9/L)	8.9 ± 3.0	4.9
Lymphs (x 10^9/L)	5.0 ± 1.7	4.3
Thrombos (x 10^9/L)	33 ± 15	18
Fibrinogen (g/L)	2.7 ± 0.5	7.0

Selected Biochemistry Reference Ranges

Test	Red-tailed Hawk	Bald Eagle
Uric acid (mg %)	8.1-16.8 (11.8)	5.5-14.8
Glucose (mg/dl)	292-390 (349)	285-400
AST - SGOT (IU/L)	136-307 (208)	153-370
ALP (mU/ml)	18-30 (23)	23-30
Total protein (g/dl)	4.8	3.0-4.1
Calcium (mg%)	10.0-12.8 (11.1)	8.2-10.6
Phosphorus (mg%)	1.9-4.0+ (3.1)	2.4-4.3
Sodium (mEq/L)	143-162 (155)	—
Potassium (mEq/L)	2.6-4.3 (3.6)	—
Chloride (mEq/L)	118-129 (122)	—

RULE OUT CHART FOR RAPTORS BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Anorexia	Bacteria, Fungi, Parasites (trichomonads), Pox, Toxicity, Offered wrong kind of food, Stress environment, Pain, Dehydration, Electrocution, Blindness (neurologic problem)	Physical exam including ophthalmic check, Microbiology, Endoscopy, CBC/chemistries, Fecal exam, Oral wet mount for trichomonads, Biopsy for pox	Appropriate antimicrobial, anthelmintic or antiprotozoal agent, Supportive care, Improve environment and food type, Analgesic and/or NSAIDs if painful condition
	Ingestion of foreign body	Physical exam, History, Radiography, CBC/chemistries	Remove foreign body, Supportive care, Repair as needed
Anorexia & death in 2-3 days	Herpesvirus	Necropsy	No treatment, Don't feed pigeons
Diarrhea	Endoparasites, Nutritional, Toxins (lead), Adenovirus may cause hemorrhagic enteritis (rare)	Physical exam, Fecal flotation/ smear, C&S, CBC/chemistries, Radiography + contrast	Supportive care (fluids, electrolytes), Appropriate therapy per etiology
Dyspnea	Trichomoniasis, Fungal, mycoplasmal, bacterial (rare) infections	Physical exam, Tracheal culture, Radiography, Endoscopy	Appropriate antimicrobial agents, Supportive care, Oxygen, Nebulization
Neurologic signs	Head trauma, Toxins, Brain abscess (bacterial, fungal), Viral (West Nile)	Clinical examination, Microbiology, CBC/chemistries, Radiography, Toxicology, MRI, Serology	Appropriate antimicrobial or anti-parasitic treatment, Supportive, Vaccination for PMV (Middle East), If trauma, analgesics as needed

Note: Consider secondary aspergillosis as a complication in any stressed or hospitalized wild bird.

RULE OUT CHART FOR RAPTORS BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Poor condition	External parasites (mites, ticks, lice, hippoboscid flies, occasionally fleas - usually secondary problem)	Physical exam, Cytology of feathers and skin	Parasiticides, Improved hygiene, Treat bird's housing
	Cestodes, Coccidia (*Caryospora* sp.)	Fecal exam	Anthelmintics, Control of intermediate hosts
	Nematode (*Trichinella pseudospiralis*)	Detection of parasites in muscle biopsy or necropsy	None, Feed uncontaminated prey in captivity
	Trauma (fractures, concussion, luxations), Gunshot (Secondary problem may be starvation)	Physical exam, History, Radiography, Screen for *Aspergillus*, CBC/chemistries	Orthopedic repair, Appropriate antimicrobials, Analgesics, NSAIDs and supportive care per injury
	Non-whole prey diet	Review diet	Correct diet
Swelling, cutaneous or subcutaneous	Abscess (bacterial, rarely fungal), Cavitations from mites, Poxvirus, *Mycobacterium*, Neoplasia (rare), Cactus spines (common in desert)	Physical exam, Isolation of organism, Cytology, Acid-fast stain, Histopathology, Microbiology, Biopsy	Appropriate antimicrobials, Debridement/excision (abscess), Neoplasia: excision/surgery, *Mycobacterium* has zoonotic potential (see under Weight Loss), Correct husbandry, diet
Swollen foot	Bacteria (esp. *S. aureus*), Visceral gout, Trauma	Clinical signs, C&S, Aspiration	Appropriate antimicrobial agent, Improve management (esp. diet), Possible surgery, Immunostimulation, Protective bandaging, NSAIDs

Note: Consider secondary aspergillosis as a complication in any stressed or hospitalized wild bird.

RULE OUT CHART FOR RAPTORS BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Weight loss	Nematodes	Fecal flotation /smear	Fenbendazole, Improve hygiene
	Aspergillosis	Tracheal culture, Radiography, Endoscopy, Ultrasonography, Hematology, ELISA serology, CT scan	Itraconazole (severe lesions do not respond), Amphotericin B, Nebulization with clotrimazole
	Flukes	Fecal examination	Praziquantel
	Mycobacterium avium	Physical exam, Radiography, Endoscopy/biopsy, CBC, Acid-fast stain, Microbiology	None, Isolate or cull affected birds, Thoroughly disinfect premises, Potential zoonosis: safeguard personnel during necropsy, caging & cleanup
	Pain, Blindness	Neurologic exam, Physical exam, Ophthalmic exam, Diagnostic testing as indicated including CT, MRI	Analgesic, NSAIDs, Appropriate ophthalmic treatment, Supportive care, Determination of quality of life, possible euthanasia

Note: Consider secondary aspergillosis as a complication in any stressed or hospitalized wild bird.

FORMULARY FOR RAPTORS

DRUG	ROUTE	DOSAGE	COMMENTS
Amikacin (Amiglyde-V® 50 mg/ml)	IM	15-20 mg/kg q24h	Not recommended in raptors except in resistant infections diagnosed by C&S, Fluid support is a necessity, Often used once daily in combination with another drug
Amoxicillin/clavulanate (Clavamox®)	PO	50 mg/kg q12h	Good first choice for preventing secondary bacterial infections with mild injury, Do not use with allopurinol, May have variable absorption
Ampicillin	IM	15-20 mg/kg q8h	—
Amphotericin B (Fungizone® 10 mg/ml)	IV, IT, Nebulize	1.5 mg/kg IV, 1 mg/kg IT q8h, For nebulization: 0.1 mg/ml 5% dextrose or sterile H_2O (15 minutes) — if no response increase to 0.5-1.0 mg/ml	Use for aspergillosis treatment, Nebulization, IT may cause inflammatory reactions
Calcium versenate (CaEDTA)	IV, IM	35 mg/kg q8h	Treat 3-4 days on, 2 days off for lead toxicity, May need treatment for up to one month
Carbenicillin (Geopen® 100 mg/ml)	IM	250 mg/kg q12h	Don't give orally: poor GI absorption & may cause nausea, Used extensively with DMSO and steroids as a topical treatment for bumblefoot, Effective against some *Pseudomonas, E. coli,* and *Proteus* spp.
Carnidazole	PO	50 mg/kg once	Designed to treat trichomoniasis in pigeons, Lesions will fall out in 5-7 days if left undisturbed
Carprofen	PO, IM	4 mg/kg q12-24h	NSAID, Analgesic

FORMULARY FOR RAPTORS

DRUG	ROUTE	DOSAGE	COMMENTS
Cefotaxime (Claforan®)	IM	100 mg/kg q12h	Excellent and safe injectable antibiotic, May be used with aminoglycosides, Wide gram-negative spectrum
Chloramphenicol (Chloropalmitate 30 mg/ml, Chlorosuccinate 100 mg/ml)	PO, IV, IM	50 mg/kg q8h, Eagles: 50 mg/kg IM q24h, Hawks (red-tailed, broad-winged, red-shouldered, Cooper's) & barred owls: 50 mg/kg q12h	Broad spectrum, Good tissue penetration, Bacteriostatic, Poorly absorbed from GI tract, Useful for IV administration in septicemia, Often replaced by recently developed pharmaceuticals
Ciprofloxacin (Cipro®)	PO	10-20 mg/kg q12h, Red-tailed hawk: 50 mg/kg q12h	Excellent gram-negative spectrum with oral administration, May get overgrowth of *Streptococcus* sp., *Pseudomonas* sp. and anaerobes
Clotrimazole (Lotrimin® 1% solution)	Nebulize	30-45 min daily for 3 days, then off 2 days (in vaporizer delivering particles <1 micron)	Fungicidal, For nebulization of patients with aspergillosis, O_2 flow 8-10 L/min for clotrimazole, Treatments may be required for 1-4 mo
Diazepam (Valium® 5 mg/ml)	IM, IV	0.25-0.5 mg/kg as needed	Useful for seizure control, Safe as a tranquilizer
Doxapram (Dopram®)	IV	5 mg/kg	To stimulate respiration during an anesthetic crisis or respiratory arrest
Doxycycline (Vibramycin®)	PO	25 mg/kg q12h	Major use is for chlamydiosis treatment, May be used for some gram-negatives and possible *Leucocytozoon* (Chlamydiosis has not been proven to be a concern in raptors)

FORMULARY FOR RAPTORS

DRUG	ROUTE	DOSAGE	COMMENTS
Enrofloxacin (Baytril®)	PO, IM	10 mg/kg q12h	May cause anorexia, regurgitation in falcons, Myonecrosis at injection site in any species, No longer effective against *Pseudomonas* sp., Suggest 2 or 4 injections followed with orals, May get *Streptococcus* sp. overgrowth, esp. with its use in orthopedic cases, Not effective against anaerobes
Fenbendazole (Panacur® 10%)	PO	10-50 mg/kg, repeat in 2 weeks, Or 25 mg/kg q24h x 3d, repeat in 21d	For ascarids and flukes
Fluconazole	PO	10-20 mg/kg x 30d	Red-tailed hawks, gyrfalcons
5-fluorocytosine (Ancobon®)	PO, IV, IT	Jerkin: 50 mg/kg q12h, Falcons: 75 mg/kg q12h as prophylactic, Red-tailed hawk, great horned owl: 75-120 mg/kg PO, IV, IT q6h, Other raptors: 20-30 mg/kg PO q6h, 50-75 mg/kg PO q12h	For prophylaxis aspergillosis treatment, For treatment of aspergillosis, Is effective against *Candida* sp., May destroy anaerobic flora of GI tract, May cause bone marrow suppression
Iron dextran (Ferdextran®)	IM	10 mg/kg	For treatment of iron deficiency, repeat weekly PRN
Itraconazole	PO	5-10 mg/kg q12-24h x 10-14d, then e.o.d.	Red-tailed hawks
Ivermectin (Ivomec® 1%)	IM, PO	0.2 mg/kg	Effective against a wide range of internal and external parasites. Give once and repeat in 2 weeks.
Ketoconazole (Nizoral®)	PO	15 mg/kg q12h	For resistant *Candida* infections. May cause anorexia and regurgitation

FORMULARY FOR RAPTORS

DRUG	ROUTE	DOSAGE	COMMENTS
Levamisole	PO	20 mg/kg	Repeat in 10 days
Mannitol (20 or 180 mg/ml)	IV	0.5 mg/kg slowly q24h	Brain edema, Osmotic diuresis, Caution if intracranial hemorrhage
Mebendazole (40 mg/g soluble powder; 33.3 mg/ml suspension)	PO	25 mg/kg q12h x 5d	Nematodes, May need to be repeated monthly, May not work for ventricular or proventricular parasites, Reports of toxic hepatitis in raptors
Meloxicam (Metacam®)	PO, IM	0.2 mg/kg q12-24h	NSAID, Analgesic
Metronidazole (Flagyl®)	PO	30-50 mg/kg	Use one or two times, May be used to treat anaerobic infections of the GI tract
Mineral oil	PO	5 mg/kg	Aids in grit removal and in egesting an impacted pellet
Nystatin (Mycostatin®)	PO	100,000 U/kg q12h	Used orally for *Candida*
Oxytetracycline	IM, SC	16 mg/kg q24h	Owls
Piperacillin sodium/ tazobactam sodium (Zosyn®)	IM	100 mg/kg q8-12h or 100 mg/kg IV q6h for severe polymicrobic bacteremia	Safe & effective injectable, Wide gram-negative spectrum
Piperazine (Pipcide®)	PO	100 mg/kg once	For ascarids, Repeat in 2 wk, Do not use with renal impairment
Praziquantel (Droncit®)	PO, IM	30-50 mg/kg once; may repeat in 2 wk	For cestodes, flukes

FORMULARY FOR RAPTORS

DRUG	ROUTE	DOSAGE	COMMENTS
Sulfadimethoxine (Albon®)	PO	25-50 mg/kg q24h x 3d, off 2d, then q24h x 3d, Or 50 mg/kg PO followed by 25 mg/kg PO q24h x 7-10d	For coccidia, May regurgitate, Metabolized in liver, Excreted by kidneys, Good tissue penetration, Consider supplementation with B complex
Ticarcillin (Ticar®)	IM	200 mg/kg q12h	Safe in birds, Effective against gram-negatives
Trimethoprim/sulfadiazine (Tribrissen® 24% or 48%)	IM, PO	30 mg/kg q12h or 53 mg (combined)/kg IM q24h	Sulfa derivative, Safe broad-spectrum, May cause anorexia and regurgitation in a large number of raptors, Maintain hydration
Toltrazuril (Baycox®)	PO	7 mg/kg q12h x 2d	Coccidiostat from Europe/Australia
Vitamin B complex	PO	1-2 mg/kg q24h	Supportive, Adjunct to sulfa therapy
Vitamin B_1 injectable	IM	1-2 mg/kg thiamine q24h	For birds showing CNS signs, Cachexia, Lead poisoning

RATITES

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of ratites and is not intended to replace comprehensive reference material. Updates were provided by Bob Doneley, BVSc, MACVSc (Avian Health).

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RATITES

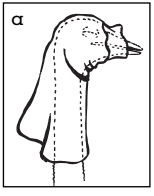
The term "ratites" describes a group of flightless birds that includes the ostrich, emu, cassowary, rhea and kiwi. General characteristics and those particular to the ostrich are addressed first, followed by variations for the emu, cassowary, rhea and kiwi.

Diet

- Several commercial rations are available for ratites.
- Diets with the following composition seem to be adequate for good health and reproduction: 16-20% protein, 10% fat, 10% fiber.
- High-protein (27%) and high-energy diets fed to chicks have been linked to accelerated growth and predisposition to leg deformities.
- Good quality grazing areas should be provided.

Restraint

- Restraint is best done in an area with solid walls and dim lights.
- Care must be taken with handling to avoid scarring or bruising damage to skin (hide).
- Cover head with a dark, tight-fitting cloth hood or sweatshirt sleeve (a).
- The emu can be crowded into a corner and restrained (b).



Venipuncture

- Ostrich chicks and sedated adults: jugular, brachial and medial metatarsal veins
- Cassoway, emu: jugular, medial metatarsal vein

Breeding and Hatchery Requirements for Ratites*

	Ostrich	Emu	Cassowary	Rhea	Kiwi
Eggs per year	40-60	20-40	3-10	40-60	1-6
Egg weight (g)	900-1700	500-700	500-700	400-700	400-450
Incubation period (days)	41-43	48-50	47-54	36-41	70-90
Temperature (°C)	36.0-36.4	35.2-35.5	36.1-36.7	36.0-37.2	35.5-36.5
Relative humidity (%)	22-36	35-50	55-70	55-70	60-65

*From Doneley B: Ratites. *In* Harrison GJ, Lightfoot T (eds): Clinical Avian Medicine Vol II Special Species, 2005.

Preventive Care

- Manage ratites similar to commercial food animals.
- Keep species and age classes separated.
- Emphasize prevention of disease through good feeding, water management, sanitation, ample exercise, restriction of visitors and attention to human movement patterns within the flock.
- For identification, implant a microchip immediately after hatching in the left side of the pipping muscle 2-3 cm below the ear. Adult birds should be microchipped on the left lateral thigh.
- Weigh chicks daily for the first 2-3 weeks after hatching to monitor growth.

Common Clinical Disorders in Ratites*

CHICKS

- Omphalitis
- Yolk sac retention
- Aspergillosis
- Ammonia toxicosis
- Bacterial enteritis
- Endoparasitism
- Congenital deformities of the beak
- Mycotic dermatoses
- Candidiasis
- "Wry neck"
- Angular limb deformity
- Rickets
- Chick fading syndrome

ADULTS

- Skin lacerations
- Ectoparasites
- Mycobacterial infections
- Foreign body ingestion
- Air sacculitis associated with aspergillosis
- Newcastle disease
- Yolk-related peritonitis
- Salpingitis
- Phallic prolapse
- Infertility
- Salmonellosis
- Endoparasitism

*Adapted from Doneley B: Ratites. *In* Harrison GJ, Lightfoot T (eds): Clinical Avian Medicine Vol II Special Species, 2005.

Hematologic and Biochemistry Reference Ranges for Ratites*

	Ostrich	Emu	Cassowary	Rhea	Kiwi
PCV (%)	45 (41-57)	47.4 (39-57)	48.1 (33.5-58.0)	45.5 (29-59)	46 (38-54)
Hb (g/L)	140-172	136-170	174 (135-200)	126 (64-170)	—
MCHC (g/L)	347-412	352-433	451 (444-457)	250 (110-333)	—
WBC (x 10^9/L)	18.7 (10-24)	14.9 (8-21)	17.55 (8.6-31.6)	11.8 (4.1-25.7)	11.6 (8.7-14.5)
Heterophils (x 10^9/L)	10.8-16.6	8.0-13.1	11.1 (6.4-20.9)	7.4 (0.5-20.0)	6 (4.0-8.2)
Lymphocytes (x 10^9/L)	2.2-7.7	1.5-6.6	5 (2.0-9.5)	3.6 (0.5-7.0)	4.2 (2.5-5.9)
Eosinophils (x 10^9/L)	0-0.37	0-0.9	0.3 (0.2-0.4)	0.4 (0.05-0.7)	0.18 (0.7-0.29)
Monocytes (x 10^9/L)	0-0.75	0-0.15	1.1 (0.1-2.8)	0.5 (0.04-1.6)	0.3 (0.1-0.5)
Basophils (x10^9/L)	0-0.37	0.15	0.4 (0.19-0.8)	0.4 (0.07- 1.6)	0.56 (0.09-1.3)
CK (U/L)	800-6508	70-818	365-1335	0-2640	521-971
AST (U/L)	226-547	80-380	269-1399	20-192	64-138
Bile acids (μmol/L)	2-34	2-30	—	—	—
Serum Protein (g/L)	24-53	34-44	45-75	34-62	54-62
Ca (mmol/L)	2.0-3.4	2.2-3.2	2.3-3.0	2.6-8.2	1.85-3.1
Glucose (mmol/L)	9.1-18.3	5.6-13.5	5.5-12.8	2.1-8.8	3.0-3.9
Uric acid (mmol/L)	0.59-8.9	0.59-8.3	0.24-4.5	0.17-1.4	0.3-0.38
LDH (U/L)	408-1236	318-1243	—	269-1640	2380

*From Doneley B: Ratites. *In* Harrison GJ, Lightfoot T (eds): Clinical Avian Medicine Vol II Special Species, 2005.

OSTRICHES (*Struthio camelus*)

- **Order:** Struthioniformes
- **Family:** Struthionidae
- **Common Subspecies:**

North African ostrich	*S. c. camelus*
Male: red color of skin of neck and thighs, bald crown of head.	
East African or Masai ostrich	*S. c. massaicus*
Male: red neck and thigh, feathered crown of head	
Somali ostrich	*S. c. molybdophanes*
Male: blue-gray neck and thighs, bald crown of head	
South African ostrich	*S. c. australis*
Male: gray neck and thighs, feathered head	

- The hybridized ostrich is referred to as a "domestic" or "African black" ostrich

Ostriches - Quick Facts

Physiologic	
Life span:	80 yr
Weight:	80-150 kg
Height:	2.7 m (8 ft)
Heart rate:	30-60 bpm
Respiratory rate:	6-12 per minute
Native foods of adults:	Herbivorous (leaves of herbs and grasses, fallen figs, succulents during droughts)
GI transit time:	36-48 hr

Reproductive	
Puberty:	1.5-2 yr
Reproductive maturity:	3-4 yr
Mating:	Polygamous - 1 cock to 3-5 hens
Breeding period:	Summer
Clutch size:	15-25
Annual production:	Up to 70-100 eggs
Cessation of breeding:	42 yr
Laying cycle:	Indeterminate (if eggs are removed, hen will lay every other day throughout the season)
Reproductive quiescence:	Both sexes, 3-4 wk/season
Chicks:	Precocial

Behavior

- Ostriches can run up to 40 mph for several miles and are good swimmers.
- They can kick forward with powerful and accurate blows.
- They have large eyes with substantial visual acuity and a keen sense of hearing.
- Ostriches are curious birds and commonly ingest foreign bodies (even jewelry from a person).

Housing

- Adult ostriches are housed in outdoor paddocks, with shelter/protection from wind.
- Ostriches in temperate climates may need completely enclosed housing during the winter.
- A common housing arrangement is a harem with one male and one to three females.
- It may be necessary to house groups physically distant from each other, or with a visual barrier between them, so that the male is not preoccupied with the males in the adjacent pens and neglects his hens in favor of challenging these neighboring males.
- The minimum paddock size for a pair of adult ostriches is 5,000 square feet; breeding paddocks are ¼ to ½ acre in size.
- Fencing needs to be approximately 2 m tall and made of materials clearly visible to a running bird.
- Fences should be designed to prevent entanglement of feet or neck. The bottom of the fence should be raised at least 40 cm from the ground.
- Electric fencing may be needed to prevent predators from entering the compound.
- Stranded wire fencing materials (barbed or smooth) should never be used for ratites.

Sexing

- Gender determination is easiest in chicks between 1-3 months of age.
- The ventral floor of the cloaca is palpated by gently inserting 1-2 fingers into the cloaca or by gently everting the cloaca. Either a phallus or a clitoris will be palpated or visualized.
- The male ostrich chick has a phallus that is laterally compressed, has a firm cartilaginous core and a dorsal seminal groove.
- The clitoris in the hen is conical in cross section, soft, and lacks the seminal groove.

- Occasionally juvenile birds will be difficult to sex. Do not be afraid to declare your uncertainty, and re-sex the bird in 1-2 months' time.

Breeding and Raising Young

- Incompatible pairings are common if birds are not allowed to choose their mates.
- There is a marked courtship display by both sexes.
- Secondary sexual characteristics in males include reddening of beak and legs, vocalization and territorial displays (kanteling).
- Hens will lower their head and "cluck" their beak, at the same time extending and flapping their wings.
- Breeding males are territorial and aggressive, and interactions between breeding groups may decrease reproductive behavior and egg fertility. It is best to erect visual barriers between breeding groups.
- At the end of the breeding season the female will stop laying and the male "goes out of color" (bright red color on face and legs fades).
- Ostrich nests are a shallow depression in the ground. The male protects the nest.
- Ostriches usually lay eggs in the afternoon or evening.
- The male incubates the eggs at night and the female incubates during the day.
- Nondominant hens are bred by several males and may lay in several nests.
- If the nest is overcrowded (20-25 eggs), the hen will remove eggs laid by rival females.
- Both sexes brood the chicks.
- Chicks should be fed pellets with 19-21% protein content supplemented with fresh grazing as soon as possible. (Free-ranging young eat insects during first few days.)

EMUS *(Dromaius novaehollandiae)*

- **Order:** Casuariiformes
- **Family:** Dramaiinae

Emus - Quick Facts

Physiologic	
Life span:	30 yr
Height:	1.7 m (5-6 ft)
Weight:	35-55 kg
Heart rate:	42-76 bpm
Respiratory rate:	13-21 per minute
Native foods of adults:	Omnivorous (leaves, grasses, fruits, flowers, insects)
Reproductive	
Puberty:	20-24 mo
Reproductive maturity:	20-24 mo
Sexing:	Cloacal examination as per ostriches:
Male:	Juvenile: hollow tube 0.5-1.0 cm, spirals as bird gets older Adult: spiraled phallus, hollow tube, 3-12 cm long
Female:	Genital mound, slight prominence on genital mound
Clutch size:	7-12 eggs

Behavior

- Emus are good runners and swimmers.
- Their defense is with powerful forward and backward kicks and blows; they may also swing laterally.
- They are curious and frequently ingest foreign bodies.

Housing

- Emus are managed similarly to ostriches, but with proportionately smaller facilities.

Breeding and Raising Young

- Emu breeders are commonly maintained in pairs or colonies.
- Free-ranging emus are gregarious most of the year, but may form pairs or trios during the breeding season.
- Eggs are laid in grass or straw and are partially hidden.
- The male conducts the incubation and chick raising. The male may not leave the nest during the entire incubation period and may have substantial weight loss.
- Some references state the hen also rears the young, suggesting emus may be monogamous.
- Emus are short-day breeders, which in North America is October through March.

CASSOWARIES (*Casuarius* sp.)

- **Order:** Casuariiformes
- **Family:** Casuariidae
- **Species:**

Southern/double-wattled cassowary	*Casuarius casuarius*
Bennett's/little cassowary	*C. bennetti*
Northern/single-wattled cassowary	*C. unappendiculatus*

Cassowary - Quick Facts

Physiologic	
Height:	1.5 m (4.5-5 ft)
Weight:	85 kg (70-120 lb)
Heart rate:	35-90 bpm
Respiratory rate:	20-44 per minute
Native environment:	Dense, tropical, rain-soaked forests
Native foods of adults:	Frugivorous (not citrus), fallen fruit, fungi, snails and rats

Reproductive	
External sexing:	Monomorphic; Cloacal examination shows the cock to have a triangular phallus, while the hen has a genital mound
Mating:	Only possible when pair brought together in full breeding condition (rare in captivity)
Clutch size:	5-6
Egg characteristics:	Pale green, granular
Parental care:	Cock

Behavior

- Identified by bony casque on top of skull.
- Cassowaries are solitary birds and are extremely bad-tempered.
- They can kick both forward and backward and can swing their legs laterally.
- The innermost of 3 toes has a long sharp claw for defense.
- Males can be highly aggressive with forward kicks and blows.
- When restrained, they will roll onto their backs with legs flailing.

Housing

- Cassowaries do better in paddocks with vegetation and shrubs for hiding.
- Shelters often resemble enlarged coops used in poultry/pheasantry enclosures, but proportionately larger.
- Cassowaries are often housed individually, except during the breeding season, due to the aggressive nature, particularly of the males.

RHEAS (*Rhea americana*)

- **Order:** Rheiformes
- **Family:** Rheidae

Rheas - Quick Facts

Physiologic	
Height:	1.5 m (5 ft)
Weight:	25 kg (44-60 lb)
Native foods of adults:	Omnivorous (grasses and herbs, insects, small rodents, seeds)
Reproductive	
Sexing	
Male:	Slightly taller than female
Female:	Markings are not so black; cloacal palpation is similar to that of emus
Mating:	1 male with 5-7 females
Clutch size:	18

Behavior

- The general attitude of rheas is fractious.
- All males are particularly aggressive during the breeding season.
- All jump well.

Housing

- Rheas should be housed in paddocks with vegetation and shrubs for hiding. Shelters often resemble enlarged coops used in poultry/pheasantry enclosures, but are proportionately larger.

Breeding and Raising Young

- Rheas usually lay eggs in the afternoon or evening.
- The male performs courtship displays, builds the nest, incubates the eggs and rears the young.
- Several females will lay eggs near a nest established by the male. The male collects eggs for one week, then initiates incubation of all the eggs at the same time.

KIWIS*

- **Order:** Apterygiformes
- **Family:** Apterygidae
- **Species:**

Tokoeka kiwi	*Apteryx australis*
Brown kiwi	*A. mantelli*
Little spotted kiwi	*A. oweni*
Great spotted kiwi	*A. haasti*
Rowi kiwi	*A. arowi*

Kiwi - Quick Facts*

Physiologic	
Weight:	1.5-4 kg
Heart rate:	70-240 bpm
Respiratory rate:	12-60 per minute
GI transit time:	5-20 hr
Reproductive	
Sexual maturity:	42-54 mo
Sexing	
Male:	Triangular-shaped phallus pointed caudally; cloacal palpation is difficult and sex is generally determined by the length of the bill and tarsus (both being longer in the larger female). This difference becomes evident at approximately 6 months of age.
Female:	Two functional ovaries and oviducts
Eggs per year:	1-6
Egg weight:	400-450 g
Incubation period:	70-90 days
Temperature:	35.5-36.5°C

*From Doneley B: Ratites. *In* Harrison GJ, Lightfoot T (eds): Clinical Avian Medicine Vol II Special Species, 2005.

Diet

- Free-ranging kiwis feed in leaf litter, eating 40-45% small invertebrates, 40-45% earthworms and 10-15% plant material.
- The Auckland NZ Zoo feeds captive kiwis lean ox heart, diced fruit and vegetables, yeast, wheat germ, sunflower oil, calcium carbonate and a vitamin-mineral premix, supplemented with earthworms and invertebrates contained in provided leaf litter.

Behavior

- Kiwis are highly territorial, solitary birds.
- They are strictly nocturnal and have a highly developed sense of smell.

Restraint

- Grasp both legs above the hock joint between the thumb and middle finger of the right hand with the index finger between the two legs.
- The left hand supports the ventral and lateral body into a sitting posture in the crook of the right elbow.

Breeding and Raising Young

- During the breeding season, free-ranging kiwis live in stable pairs within an aggressively protected territory.
- Captive kiwis must be paired carefully or fighting will result.
- Birds can be introduced outside the breeding season in a neutral territory.
- Kiwis tend to pair for life.
- Eggs are incubated by the male (except in the brown kiwi, where the female assists incubation).
- Chicks are precocial and are fully independent after 3 weeks but remain with parents.

RULE OUT CHART FOR RATITES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Cataracts	Bilateral or unilateral	Physical exam, Ophthalmic exam	None if unilateral, Surgical removal as in other species if bilateral
Conjunctivitis	Irritants (dust, alfalfa, flies), Bacterial infection (*Staphylococcus, Haemophilus*), Nematode (*Philophthalmus gralli*)	Physical exam, History, Cytology, C&S	Treat per etiology, Irritants: changes in husbandry, Bacterial: appropriate topical antibiotics, Nematode: topical 5% carbamate powder or ivermectin
Conjunctivitis (+corneal edema, epiphora, dyspnea)	Ammonia toxicity from poorly ventilated barn	Physical exam, History, Ophthalmic examination	Correct ventilation, sanitation, Topical ophthalmics
Conjunctivitis (+blepharitis)	Trauma, Foreign body	Physical exam, Ophthalmic exam including fluorescein stain	Remove foreign body if present, Treat as in other species
Conjunctivitis (+sinusitis, rhinitis)	*Chlamydophila psittaci*	Physical, CBC/ biochem, Organism isolation from feces, Chlamydial testing as in other (accuracy unclear)	Doxycycline, Chlortetracycline, Supportive care
Dermatitis (proliferative lesions on face, ears, neck)	Poxvirus (+possible secondary *Staph.* infections)	History, Presence of insect vectors, Cytology/histopath, Virus isolation	Eliminate vectors, Vaccination of flock during outbreak

RULE OUT CHART FOR RATITES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Dermatitis (head, neck)	Vitamin B deficiency, Zinc deficiency, Biotin deficiency	Diet history (particularly if on home-made diet), Antibiotic history (may be due to interference of antibiotics on gut microflora/vitamin B production)	Supplementation (parenterally, orally), Diet correction, Probiotics, Evaluate use of antimicrobials
Dermatitis	Ectoparasites: biting lice (*Struthioliperurus struthionus*), ticks, feather mites	Physical exam of skin, feathers	5% carbaryl dust every 2 weeks, Feather mites may be treated with ivermectin
Diarrhea	Sudden change in diet	History	Correct diet, Pepto Bismol®, Always acclimate to new diets gradually
	Bacterial (*E. coli, Salmonella, Pseudomonas, Campylobacter, Streptococcus, Staphylococcus, Klebsiella, Clostridium perfringens, C. colinum, Mycobacterium*)	C&S	Appropriate antibiotics, Symptomatic and supportive care, Identify and correct source, Sanitation
	Toxins (solanine, silverleaf, nightshade, cantharidin from blister beetles)	History, Examine feces/remnants, Check environment	Supportive, Follow antidote recommendations as in other species
	Malabsorption syndrome (associated with feed additives such as furazolidone, monensin, gossypol)	History, Diet contents, Rule out other causes	Change diet, Supportive, Exogenous digestive enzymes (Prozyme®)

RULE OUT CHART FOR RATITES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Diarrhea	Viral (suspected: reovirus, herpesvirus, paramyxovirus, adenovirus, enterovirus, coronavirus, birna-like)	Histopathology, Rule out other causes, Possible virus isolation, serology	Supportive, Decrease exposure to free-ranging birds
	GI obstruction/impaction, Rule out cause (sand, concentrated feeds and forage materials, foreign bodies such as hardware, rocks, jewelry, stone fruit pits, eg, cherries)	Physical exam, Examination of feces, History, Radiography/ultrasonography	If sand, concentrated feed: supportive care, psyllium, Others may need surgery, Correct environmental problems, Supportive post op
	Candidiasis	Physical exam, History of antibiotic use, Fecal Gram's stain, culture (high # yeast organisms)	Discontinue antibiotics, Consider anti-yeast, antifungals, Supportive care, Probiotics
	Protozoa (*Hexamita, Giardia, Trichomonas, Cryptosporidia, Toxoplasma, Coccidia*)	Physical exam, Fecal exam, including wet mount	Metronidazole effective against most, No treatment for crypto except supportive, Sulfas for coccidia
Dyspnea	Poor ventilation, Stress (shipping), Environmental changes (cold, wet climates)	Physical exam, Husbandry/history, CBC, Tracheal wash, C&S	Correct husbandry, Decrease stress, Environmental: bring into dry, warm barn

RULE OUT CHART FOR RATITES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Dyspnea	Infectious (*Staphylococcus, E. coli, Pseudomonas, Haemophilus, Aspergillus, Cryptococcus*)	Physical exam, CBC, Tracheal wash, C&S	If possible, bring into dry, warm barn with good ventilation, Appropriate antimicrobials per agent/sensitivity, If *Aspergillus* or *Cryptococcus*: itraconazole, fumigate to decrease contamination, Treatment of adult ratites can be expensive and infection may recur
	Lungworm *Paronchoceca struthionus* (will also be present in heart, body cavity, subcutaneous tissues)	Physical exam, Tracheal wash, Histopathology	Eliminate insect vector, Ivermectin to treat larval stages
Dyspnea (+CNS signs)	Toxins (nitrates, ammonia, other)	Physical exam, History, Blood work/chemical analysis	If environmental, correct with improved ventilation, removal of sources and general guidelines as in other birds
Eggs, infertile	Incompatibility, Environmental stress, Seasonal, Obesity/nutritional deficiencies, Physical anomalies	History, Physical exam, Diet/husbandry review, Full workup if abnormalities	Correct deficiencies (environmental, behavioral), If underlying disease, treat as per etiology.

RULE OUT CHART FOR RATITES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Eggs (abnormal eggs or production)	Bacterial salpingitis and/or metritis, Associated peritonitis (*E. coli, Pseudomonas, Acinetobacter, Streptococcus, Staphylococcus*, possibly *Mycoplasma*)	Physical exam, CBC, Cytology (exudates/discharge from cloaca), C&S	Antibiotics per sensitivity, Flush oviduct (if large amount exudates)
Lameness (+arthritis, tenosynovitis)	Bacterial, Viral (primary or secondary to septicemia)	Physical exam, Cytology, C&S (joint tap), Viral isolation?	Supportive including NSAIDs, Appropriate antimicrobials
Lameness (chicks)	Rickets, Tibiotarsal rotation, Curly toes, Pathologic fractures (tibiotarsus, tarsometatarsus), Luxation of phalanges, Slipped tendon	History, Diet history/evaluation, Husbandry evaluation including bedding/footing, Radiography	Correct diet, husbandry, Surgical correction/splinting/casting per etiology (equine methods of arthrodesis, tendon repair helpful)
Lameness	Capture myopathy, Myositis	History, Palpation, CBC/chemistries (evaluation of severity)	Supportive, NSAIDs, fluids, rest, Decrease stress, Proper transport
	Trauma, Injuries (fencing often implicated)	History, Physical, Radiography (may redo weekly checking for stress fractures even if not apparent acutely)	Surgically clean/debride wounds as in other animals, Standard wound management, bandaging
Lameness (+/- swollen joints)	Gout	Physical exam, Radiographs, Joint taps (evaluation of synovial fluid or peritoneal fluid), Serum chemistries (particularly uric acid)	Low protein diet, Analgesics, NSAIDs, Anti-gout medications? Prognosis: guarded (possible surgical removal of joint deposits)

RULE OUT CHART FOR RATITES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Neurologic signs	Bacterial encephalitis (may be extension of rhinitis/sinusitis or septicemia)	Physical exam, CBC, C&S exudates (nasal/sinus) or blood, CSF tap	Appropriate antibiotics, Supportive care including NSAIDs
	Viral encephalitis (paramyxovirus, PMV-1, West Nile virus)	Physical, CBC, Serology/necropsy/ histopathology, Viral isolation	Supportive care only (if VVND, contact authorities)
	Parasitic: *Chandlerella quiscali, Baylisascaris,* aberrant migrations	Physical exam, CBC, Rule out other causes, Serology?, Histopathology at necropsy	Probably no treatment, For *Chandlerella*: control vector, eliminate environmental conditions conducive to transmission, prevent larval transmission, For *Baylisascaris*: prevent exposure to raccoon/skunk feces.
	Toxins (nicotine from ingested cigarette butts, insect bites, sodium [overconsumption of water containing electrolytes], plant sources of various toxins)	History, Observation, Fecal examination, CBC/chemistries, Physical exam	Symptomatic and specific per toxin as in other species, Prevent access to identified toxic plants, Clean up grounds
Scant feces (+abdominal enlargement, vomiting)	Intestinal (colon) torsion/volvulus	Physical, History of diet change, Radiography, Abdominocentesis	Surgical correction early, Supportive care

RULE OUT CHART FOR RATITES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Scant feces (+anorexia)	*Libyostrongylus douglassi* (wireworm)	Fecal flotation is not sufficient, Larval culture & identification are necessary to confirm diagnosis	Levamisole monthly to chicks, quarterly to adults, Fenbendazole, ivermectin also considered effective
Sinusitis (+rhinitis)	Poor ventilation, Bacterial infections (*Pseudomonas, E. coli, Haemophilus, Bordetella*)	Physical exam, Husbandry review, C&S	Improve ventilation if husbandry problem, Bacterial: appropriate antibiotics, Surgical drainage of sinuses may be necessary
Sinusitis (+CNS signs, abnormal urates)	Avian influenza (note: this has not been isolated yet in US)	Physical exam, Viral isolation, Serology, Necropsy/histopathology	No treatment (notify authorities)
Swelling, abdominal	Egg binding, Complication of poor nutrition, Obesity, Metritis, Yolk-related peritonitis	Physical exam, Radiography and/or ultrasonography, History, Abdominocentesis	Systemic multiple vitamins, Calcium, Oxytocin, Surgical intervention, Correct vaginal prolapse if necessary
	Cystic ovarian follicles (rule out bacterial involvement)	History of high production, Radiography +/- ultrasonography	HCG has been tried, efficacy questionable
	Neoplasia (reproductive tract, abdominal viscera, mediastinal lymphatics, lipomas)	Physical exam, Radiography +/- ultrasonography, Biopsy, Histopathology	Excision of superficial lipomas or other neoplasia, Follow guidelines for other species

RULE OUT CHART FOR RATITES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Swelling in vent area	Prolapsed cloaca (secondary to diarrhea or impactions)	Physical exam, History, Diagnostic work-up to determine diarrhea or impaction	Correct underlying condition, Reduce prolapse with hypertonic dextrose solution, dexamethasone, purse-string suture to hold for 24-48 hrs if necessary, NSAIDs
	Prolapsed phallus (secondary to debilitation, fatigue, severe weather fluctuations, other diseases: hardware, peritoneal hernia, sand impaction)	Physical exam, CBC/chemistries, C&S, Fecal exam	Clean and replace 3 times a day until bird can retain it, If >3 days, use purse-string suture, Systemic antibiotics, NSAIDs for 5-7 days, Separate from females (sexual rest is important), Correct underlying condition
	Prolapsed vagina (secondary to cold weather stress), Fluid-filled sac (in young hens)	Physical exam, History	If due to cold move indoors, clean tissue, treat to decrease edema and replace, NSAIDs, In young hens, lance sac
	Peritoneal hernia (secondary to egg peritonitis, internal ovulation)	Physical exam, Ultrasonography	Surgical repair, Antibiotics, NSAIDs

RULE OUT CHART FOR RATITES BASED ON CLINICAL SIGNS

CLINICAL SIGNS	DIFFERENTIAL DIAGNOSES	DIAGNOSTIC OPTIONS	POSSIBLE THERAPY
Vomiting /reflux	Megaesophagus (esp. near sexual maturity), Persistent right 4th aortic arch, Trilogy of Fallot, Ventricular impaction	Physical exam, History, Radiography/contrast study, Cardiac evaluation	Supportive, Offer feed/water at elevated position to decrease signs, Surgery or flushing to relieve impaction, Prognosis: poor
Weight loss (+dyspnea?)	Hemochromatosis	Physical exam, CBC/chemistries, Liver biopsy, Histopath	Remove access to soil, Lower dietary iron, Phlebotomy?
Weight loss (polyuria, polydipsia)	Hyperglycemia, Glucosuria (diabetes, insulin resistance?)	Physical exam, CBC, Blood glucose, Urine glucose	Protamine zinc insulin therapy, Dietary regulation
Wings, abnormal position	Fractures or luxations	History of hauling or breeding, Physical exam, Radiography	Tape wings over back, External fixation or IM pinning if necessary
Yolk sacculitis, omphalitis	Tied off or bandaged yolk sac, Improper egg handling/storage, Gram-negative bacteria, Slow absorption of yolk sac	Physical exam, History of incubation/hatching practices, C&S	Surgical removal of yolk sac, Fluid replacement, Appropriate antibiotics, Correct conditions/ practices

Reptiles

The Reptiles section includes individual chapters for Snakes, Turtles & Tortoises, and Lizards. The topics listed below in the introductory chapter apply generally to all animals in this section. Printed hematologic and biochemistry reference values represent ranges derived from the literature. Individual practitioners should strive to establish their own "normals" with their own laboratories.

Although every effort has been made to ensure the accuracy of the information presented herein (particularly drug doses), in all chapters the clinician is responsible for the use of any pharmaceuticals. Most drugs used in exotic companion species are considered extra-label and few pharmacokinetic studies have been conducted; therefore, the clinician must critically evaluate the information provided and stay informed of recommendations in the literature. All reptiles must be well hydrated before and during administration of all medications.

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REPTILES

Orders and Suborders

- Reptiles include 6547 species, 6280 of which are members of the Order Squamata.
- The following are suborders:
  Sauria (lizards): 3750 species
  Serpentes (snakes): 2400 species
  Amphisbaenia (worm lizards): 21 genera, 140 species
  Sphenodontia: The tuatara (*Sphenodon punctatus*) is the only species.

Hematologic Reference Ranges for Selected Reptiles

Test	Boa	Python	Iguana	Tortoise
WBC (x 10^3)	4-10	6-12	6-14	3-8
PCV (%)	20-40	25-40	30-45	20-40
Hets (%)	20-50	20-60	40-70	35-65
Lymphs (%)	10-40	10-40	20-45	25-50
Monos (%)	0-2	0-2	0-2	0-2
Eosino (%)	0-2	0-2	0-1	0-2
Baso (%)	0-6	0-5	0-2	0-6
RBC (x 10^6)	1.0-2.5	1.0-2.5	1.5-3.5	1.5-2.5

* *University of Miami Avian and Wildlife Laboratory*

Whole Body Radiographic Techniques*

Animal	Film	mA	kVp
Lizard (large)	Par speed intensifying	300	36
Snake (large python)	Par speed intensifying	300	64
Snake (medium)	Ultradetail	300	42
Turtle (small - DV & lat)	Ultradetail	300	54
Turtle (medium - DV & lat)	Ultradetail	300	68

* *Nongrid 40" FFD, tabletop; Exposure time: 1/30 second*

Guidelines for Fluid Therapy

- Reptiles should be rehydrated before starting any aminoglycosides, carbenicillin, calcium or sulfas.
- Use mild hypotonic solutions first (they provide intracellular diffusion of water): Solution of choice is 1 part D5W (5% dextrose) and 1 part Normosol; administer up to 4% of BW q12-24h. Dextrose 5% is mildly hypotonic alone.
- Fluids can be administered subcutaneously, intracoloemically, intravenously (lizards: ventral abdominal vein, tail vein; turtles/tortoises: jugular), and intraosseously.
- Do not administer intracolemically if suspected space-

occupying lesion, pneumonia, obstipation, egg retention or preovulatory follicles.
- Give warmed fluids to warmed reptile based on ideal body temperature range per species.
- Calculate volume as per mammal: 20-25 ml/kg/day.
- Hospitalized reptiles may receive bath or soak daily to aid with hydration, even if parenteral nutrition/fluids are being given.

Guidelines for Gavage Assisted Feeding

- For orals and assisted feeding: estimate stomach volume as 2% of body weight or 20 ml/kg when administering by stomach tube to snakes.
- Carnivorous snakes, lizards and chelonians: blenderize small mice with water for gavage.
- Most chelonians can use avian tube-feeding formula.
- Herbivorous lizards, tortoises: strained green beans, other green vegetable foods and calcium-enriched fruit juices; blenderized alfalfa added for large tortoises. Add multiple vitamins (eg, Polyvisol) dosed by vitamin A content, not more than 1 IU/g BW weekly.
- Feed every other day. On alternate days: water or Pedialyte®.

Guidelines for Pre-surgical Fasting

- Tortoises: 18 hr; Lizards: 18 hr; Snakes: 72-96 hrs
- Small or debilitated reptiles (<300 g): isotonic fluids may be given within 3-4 hours of surgery

Anesthetic Monitoring in Reptiles

- Reflexes (corneal reflex, palpebral reflex, tongue flick, tail pinch, pedal withdrawal, jaw tone)
- Respiration
- Cardiac function, heart rate (decreases 20-30% in surgical plane)

Zoonotic Potential of Reptiles

- *Salmonella*
- *Aeromonas*
- *Campylobacter*
- *Enterobacter*
- *Klebsiella*
- *Erysipelothrix rhusiopathiae*
- *Pseudomonas*
- *Mycobacterium* sp.
- *Coxiella burnetii:* "Q fever"
- *Aspergillus*
- Zygomycosis
- *Candida*
- *Trichosporon*
- *Trichophyton*
- Ticks: *Ornithodoros turicata, Ixodes* spp., *Haemaphysalis* spp.

Recommendations for Preventing Transmission of Salmonella from Reptiles to Humans*

- Persons at increased risk for infection or serious complications of salmonellosis (eg, pregnant women, children aged <5 yrs, and immunocompromised persons such as with AIDS) should avoid contact with reptiles.
- Reptiles should not be kept in child-care centers and may not be appropriate pets in households in which persons at risk for infection reside.
- Veterinarians and pet store owners should provide information to potential purchasers and owners of reptiles about the increased risk of acquiring salmonellosis from reptiles.
- Veterinarians and operators of pet stores should advise reptile owners always to wash their hands after handling reptiles and reptile cages.
- To prevent contamination of food-preparation areas (eg, kitchens) and other selected sites, reptiles should be kept out of these areas — in particular, kitchen sinks should not be used to bathe reptiles or to wash reptile dishes, cages, or aquariums.

* *Centers for Disease Control, Atlanta*

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REPTILE FORMULARY

Drug	Route	Dosage	Comments
Acepromazine	IM	0.1-0.5 mg/kg (B)	Admin 1 hr prior to anesthesia induction
Acyclovir (Zovirax®)	PO, topical 5%	80 mg/kg q24h (F)	Anti-viral, viral dermatosis
Althesin (Saffan®)	IV, IM	9 mg/kg IV, 9-18 mg/kg IM (R)	-
Allopurinol	PO	10 mg/kg q24h (Mt)	Tortoise gout; may not be effective
Amikacin sulfate (Amikin®, Amiglyde-V®)	IM	Gopher snake, tortoise: 5 mg/kg 1st dose, then 2.5 mg/kg q72h (J, Ja)	Give SC fluids; may cause renal disease with >4 injections
Amikacin sulfate	IM	Water turtle, land turtle: 5 mg/kg IM q72h x 3 wk (R)	
Amikacin sulfate	IM	2.5 mg/kg IM q5d	Tuatara
Amikacin	IM	2.25 mg/kg IM q4d x 3 wk (R)	Crocodilians
Aminophylline	IM, suppos	2-4 mg/kg, up to 10 mg/kg IM q12h PRN	Bronchodilator
Amoxicillin	PO, IM	22 mg/kg q24h, q12h; 10 mg/kg IM q24h	Ineffective unless used with aminoglycosides
Amphotericin B	Nebulized q12h	5 mg/kg BW in 150 ml saline for 1 hr plus (thiabendazole 50 mg/kg and ketoconazole 50 mg/kg PO daily) (Bi)	For deep fungal infections
	IC	1 mg/kg q24h x 2-4wk (R)	

REPTILE FORMULARY

Drug	Route	Dosage	Comments
Ampicillin trihydrate (Polyflex®)	IM, SC	3-6 mg/kg q12-24h (F, Bi)	Will affect normal flora, Good for vibrio in sea turtles
	IM, SC	20 mg/kg IM q24h x 1-2wk (Mt)	Chelonians
Arginine vasotocin	IV, IP	0.01-1 μg/kg	-
Ascorbic acid (vitamin C)	IM	10-250 mg/kg IM PRN; Chelonians: 10-20 mg/kg q24h (Mt)	Therapy adjunct, use with infectious stomatitis, renal disease in snakes (dose depends on size and condition).
Atropine sulfate	SC, IM	0.01-0.02 mg/kg (B)	Preanesthetic medication; may cause increased viscosity of respiratory fluids & gut atony; not to be used routinely.
	IM, IV, SC, PO	0.04 mg/kg PRN until CNS signs resolved (F)	Organophosphate poisoning antidote
Benzathine penicillin (Flocillin®)	IM	10,000 units total penicillin activity/kg q24-72h (F)	Frequency varies with temperature; may be up to 96 hr intervals.
Calcitonin (Calcimar®, Miacalcin®, 100 IU/ml 2 ml vial)	IM	50 IU/kg once; repeat in 2 wk as needed (M)	Make sure animal is not hypocalcemic before treatment. Use Neocalglucon daily for three days prior to use. Always give fluids.
	SC, IV, IC	1.5 IU/kg q8h SC; 10-15 ml/kg IV, IC (F)	For hypercalcemia; additional fluids needed for diuresis
Calcium lactate (Calphosan®)	IM, IV	250 mg/kg q12h	Always give fluids; lactate is a concern - most species are lactic acidotic; other products are better
Calcium gluconate injectable USP	IV, IM	100 mg/kg up to q6h IM PRN (F)	Administer slowly IV PRN - give to effect; in iguanas: give until eyelids open; may then go to oral calcium; must give fluids

REPTILE FORMULARY

Drug	Route	Dosage	Comments
Calcium - oral (Neocalglucon® grape-flavored 230 mg/ml)	PO	1 ml/kg q12h as needed until clinical signs resolve (M); 1 ml/oz drinking water (R)	
Carbaryl (Sevin®) powder	Topical	Dust lightly	Clean off after <24h; should be ≤5%; very toxic
Carbenicillin disodium (Geocillin®)	IM, IV	50-100 mg/kg initially, 50-75 mg/kg thereafter q12-24h (F); 200 mg/kg q12h (L)	May cause sloughing in desert tortoises
Carbenicillin (Geopen®)	PO, IM	100 mg/kg q24h; Snakes with ulcerative dermatitis: 400 mg/kg PO q24h; Tortoises: 400 mg/kg PO q48h x 2 wk (R); 200 mg/kg IM q12h (L)	-
Cefotaxime (Claforan®)	IM	Chelonians: 20-40 mg/kg q24h 7-14 days (Mt); Lizards: 20 mg/kg q3d IM or SC (B); Snakes: 20 mg/kg q72h x 2-3 wks (J)	-
Ceftazidime (Fortaz®)	IM	20 mg/kg q72h (Bi)	-
Cephalothin sodium (Keflin®)	IM	20-40 mg/kg q12h	-
Chloramphenicol (Chloromycetin®)	IM, SC, PO	All reptiles: 20-25 mg/kg q12h (M) or 40-50 mg/kg q24h (Ja)	Potentially hepatotoxic
Cloroquine	PO	Tortoise: 125 mg/kg q48h x 3 doses (R)	
Chlortetracycline	PO	200 mg/kg q24h (Bi)	May be added to drinking water
Cimetidine (Tagamet®)	PO	4 mg/kg q6-12h (F)	-

REPTILE FORMULARY

Drug	Route	Dosage	Comments
Ciprofloxacin	PO	10 mg/kg q48hr (J, R)	-
Cyanocobalamin (vit B_{12})	IM, SC	100 μg/kg IM; 0.05 mg/kg (JD)	Appetite stimulant
Demerol	IM	1.1-2.2 mg/kg (J)	
Dexamethasone (Azium®)	IM, IV	0.1-0.25 mg/kg IV (shock); 0.03-0.15 mg/kg	As needed for shock; anti-inflammatory
Diazepam	IM	0.37-0.5 mg/kg (R); 0.22-0.62 mg/kg IM (L)	
Dihydrostreptomycin	IM	5 mg/kg q12h (F)	Potentially nephrotoxic, parenteral fluids recommended
Di-iodohydroxyquin	enema	650 mg/150 ml 0.9% saline q24h (S)	Amoebiasis
Dimetridazole (Emtryl®)	PO	40 mg/kg PO q24h x 5; 20-40 mg/kg q24h; 40-100 mg/kg repeat in 14 days	No longer available in United States; 10d for entamoeba, 5d for flagellates
Doxycycline calcium syrup (Vibramycin®)	PO	10 mg/kg q24h x 10d (S); 2.5-5 mg/kg PO q12h	-
Emetine hydrochloride	SC	44-80 mg/kg (F) q24h x 7-10d	-
Emetine hydrochloride	IM	0.5 mg/kg q12-24h x 7-10d (F)	-
Enrofloxacin (Baytril®)	PO, IM, SC, IC	5-10 mg/kg q24-72h	
Flunixin meglumine (Banamine®)	IV, IM	0.1-0.5 mg/kg q12-24h for 1-2 days	-

REPTILE FORMULARY

Drug	Route	Dosage	Comments
Furosemide (Lasix®)	IV, IM	5 mg/kg q12-24h (R)	Watch hydration; may not work
Furazolidone (Furoxone®) suspension	PO	24-40 mg/kg q24h (F)	For possible use in salmonella (doesn't necessarily clear but would stop shedding)
Gentamicin sulfate (Gentocin®)	IM	2-4 mg/kg IM q72h; Aquatic turtles: 10 mg/kg q48h; Box turtles: 2-3 mg/kg q48h (must keep in water, may go to 96h); Blood pythons: 2.5 mg/kg followed in 96h with 1.5 mg/kg q96h; Crocodilians, respiratory fungal infections: 1.75 mg/kg IM q4d; Sliders: 6-10 mg/kg q48-120h (J); Tortoise: 2.5 mg/kg q72h IM (Ja)	Potentially nephrotoxin, parenteral fluids necessary
Glucose	PO	3 gm/kg	Via stomach tube
Glycopyrrolate (Robinul-V®)	SC, IM, IV	0.01 mg/kg or 0.05 ml/kg (S)	Premedication; will increase viscosity of respiratory fluids and contribute to gut atony
Griseofulvin	PO	20-40 mg/kg q72h for 5 treatments	Mycotic skin
Halothane (Fluothane®, Astra®)	Mask, intubate	Induction: 3-5%; maintenance: 1-3%	Recovery variable, 2-7h
Hydrazoline	IM	2 mg/kg q12h	Iguanas with arterial hypertension
Isoflurane (AErrane®) 3.0%	Mask, intubate	Induction: 3-5%; maintenance: 2-4%; anesthetic of choice in all reptiles because it is safe & quick	

REPTILE FORMULARY

Drug	Route	Dosage	Comments
Ivermectin (1% solution)	IM, PO	0.2 mg/kg IM once, rpt in 4wk; Snakes: 0.2 mg/kg IM, PO once, repeat in 2wk; Ectoparasites: 0.5 ml of 10% solution/qt of H_2O, use as a topical spray q7-10d; Chuckwallas: 0.1 mg/kg (Ja)	Do not use in chelonians, indigo snakes; caution in skinks; do not give within 10 days of diazepam; overdose induces flaccid paralysis; may recover if supported; be sure of life status before necropsy or disposal
Kanamycin sulfate (Kantrax®)	IV, IM, IC or wound irrigation	10 mg/kg q24h (R)	Potentially nephrotoxic, parenteral fluids recommended; temperature at 24°C
Ketamine HCL (Ketaset®)	IM	Snakes: 20-60 mg/kg (large animal, large dose) (Jo)	Poor muscle relaxation, long recovery
	IM	Lizards: 25-60 mg/kg sedation, then intubate (Jo)	Renally excreted
	IM, SC, IC	Turtles: sedation = 20-40 mg/kg IM, SC; Sea turtles: 50-70 mg/kg IC; Tortoise: sedation 15-30 mg/kg IM, anesthesia 30-60 mg/kg (Ja)	
	IM	Crocidilians: 12-25 mg/kg; 60-100 mg/kg (F)	Induction up to 1 hr, Recovery up to 7 hr
Ketoconazole	PO	Tortoises: 15 mg/kg q24h x 14-28d; Turtles: 25 mg/kg q24h x 2-4 wks	Both doses reached therapeutic levels in gopher tortoises; Use of this drug concurrent with antibiotic therapy helps prevent fungal superinfections
	PO	50 mg/kg q24h (S)	Crocodilians
Kymar ointment	Topical	PRN (F, Ja)	For viral dermatosis
Lidocaine 1%	Infiltrate area -local	4-6 mg/kg total dose, dilute standard concentrations (Br)	-

REPTILE FORMULARY

Drug	Route	Dosage	Comments
Levamisole (Tramisol 13.65%)	IM, IC	5-10 mg/kg, repeat in 2 wk (Mt) or SC (Ja)	For lungworms in snakes; be careful in tortoises
Levamisole phosphate	IM, IC, SC	10-20 mg/kg IM, IC once, repeat in 2 wk (S)	-
Lincomycin (Lincocin®)	IM	5 mg/kg q12-24h	Pepto-streptococcus wound infections; parenteral fluids recommended; potentially nephrotoxic
	PO	10 mg/kg q24h	-
Mebendazole (Telmin®)	PO	Ascardis in snakes & lizards: 100 mg/kg PO once; strongyles & ascarids: 20-25 mg/kg, repeat in 2 weeks; 25 mg/kg q24h x 3d	May produce colic in tortoises
Metronidazole (Flagyl®)	PO	Indigo snakes, Milk snakes: 40 mg/kg PO once, repeat at 2, 4 wk; Snakes other than Indigos, Milk snakes, Rattlers: 180 mg/kg; Chameleons, chelonians: 100 mg/kg, rpt in 10d; Lizards other than chameleons: 150 mg/kg; Flagellates: 250 mg/kg once, repeat 2 wk; Anaerobes: 50 mg/kg PO q24h x 5-7d	May cause disruption in chelonian normal flora used for food digestion; increased doses will cause seizures; when treating flagellates, re-check in 2-3 weeks, only repeat dose if positive for H*examita* or entamoeba, repeat dose in 10-14d
Metoclopramide	SC, PO	0.2-0.5 mg/kg SC q24h (Ja); 0.06 mg/kg PO q24h x 7d (L)	GI motility enhancer
Miconazole (Conlite® 1%)	Topical	q12h (F)	Antifungal
Neomycin with polymyxin B (Darbiotic®)	Intralesion	10 mg/kg q24h	Wound irrigation intralesionally; parenteral fluids recommended
Neomycin oral solution	PO	2.5 mg/kg q12-24h (F)	Use with care; parenteral fluids suggested

REPTILE FORMULARY

Drug	Route	Dosage	Comments
Nitrous oxide	Mask	75% NO_2: 25% O_2 for induction (Ja); 1:1 - 1:3 NO_2:0_2 induction maintenance (S)	Difficult to obtain stage III or IV
Nystatin	PO	100,000 IU/kg PO q24h (BSAVA); 100,000 IU PO q12-24h x 10 d (S)	Enteric fungal infections
Organophosphate (No-Pest Strip®)	Attach to cage	1-2 cm^2; 6 mm/10 cubic foot cage x 4 days max	Mites may be resistant; Sevin or Neguvon better; may be toxic; keep out of direct contact
Oxytetracycline (Terramycin®, Liquamycin®)	IM, PO	5-10 mg/kg q24h (Bi), x 7 d (S)	For *Arizona, Salmonella, Pasteurella* spp in lizards, chelonians; inflammation at the injection site
Oxytocin	IM	20 IU/kg; Tortoises: 10-40 mg/kg; Turtles: 5-10 mg/kg; Chelonians: 1-2 IU/kg (Ja)	Chelonian eggs usually in 2 hr
Paromomycin	PO	35-60 mg/kg PO q7d x 2-3 Tx (R)	Keep from shedding cryptosporidia, but may not cure; becoming drug of choice for protozoal overgrowths; is water soluble for dilutions in small reptiles; poor absorption, low toxicity
Piperacillin (Pipracil®)	IM	50-100 mg/kg q24h x 1-2wk (F)	Parenteral fluids recommended
	IM	Snakes: 80-100 mg/kg q48h (W) or 50 mg/kg IM initially, then 25 mg/kg IM q24h x 10d	Parenteral fluids recommended
	IC, IM	Prehensile-tailed skinks: 200 mg/kg q24h	-
Piperazine (50 mg/tabs)	PO	50 mg/kg rpt in 2wk (dose range 40-60 mg/kg)	Ascarids
Polymyxin B	Topical	1-2 mg/kg q24h	Low margin of safety

REPTILE FORMULARY

Drug	Route	Dosage	Comments
Potassium penicillin G	IM, IV, SC, wound flush, IC	10,000-20,000 units/kg q6-8h (F)	-
Prednisolone sodium succinate (Solu-Delta Cortef®)	IV, IM	5-10 mg/kg as needed	Shock
Quinacrine hydrochloride (Atabrine®)	PO	6.6-11 mg/kg q12-24h x 5d (dog/cat dose)	-
Quinine sulfate	PO	1.75 mg/kg q48h for several weeks	Drug is toxic at dosages exceeding 100 mg/kg daily. Success of treatment varies with the species of parasite.
Sodium iodide injectable (20% solution)	IV	0.25 -3.0 ml, not established (F)	-
Stanzolol (Winstrol®)	IM	5 mg/kg q20-30d (Ja)	Debilitation, post-surgical; can inhibit hibernation; don't use in renally compromised patients, controlled drug
Streptomycin sulfate	IM	10 mg/kg q24h; 5 mg/kg q12h	Potentially nephrotoxic, parenteral fluids recommended
Succinylcholine chloride (Sucostun®)	IM, IV	Iguanas: 1-2 mg/kg; Chelonians: 0.5-2.0 mg/kg; Crocodilians: 0.5-1 mg/kg; 0.4-5.0 mg/kg (R); Caimans: 3 mg/kg (R)	Induction in 20-30 min; no analgesia; good for immobilization, then intubation, maintenance with gas anesthesia; must maintain respiration
Sucralfate (Carafate®)	PO	500-1000 mg/kg q6-8h (F)	Gastric irritation
Sulfadiazine (Suladyne®)	PO	75 mg/kg day 1, then 45 mg/kg q24h 5 more days; 25 mg/kg q24h (R)	Parenteral fluids recommended

REPTILE FORMULARY

Drug	Route	Dosage	Comments
Sulfadimethoxine (Bactrovet®, Albon®)	IV, IM, PO	90 mg/kg 1st day, 45 mg/kg q24h 2nd-6th days PO (F); 30 mg/kg PO, IM, IV day 1, 15 mg/kg for 3 days (Bi); 75 mg/kg PO q24h x 7d (coccidia) (J)	Potentially nephrotoxic; parenteral fluids recommended
Sulfamethazine	PO	500 mg/kg 1st day, then 250 mg/kg PO q24h (R); 1 oz of 33% sol per gal drinking water (8 ml/L) (Bi); Stomach tube: 0.3-0.6 ml/kg of 33% initial dose, half thereafter (M); 75 mg/kg q24h x 7d (L)	Parenteral fluids recommended
Sulfamethoxydiazine	SC, IM	80 mg/kg once, then 40 mg/kg q24h x 4 (Bi)	Parenteral fluids recommended
Sulfadimidine (33% solution)	PO	Diluted in the drinking water at the rate of 1 oz/gallon of water; 0.3-0.6 ml/kg x 10d; 0.3-0.6 ml/kg once; half dose on subsequent days	Parenteral fluids recommended
Sulfamerazine	PO	25 mg/kg PO q24h x 21 treatments; 75 mg/kg PO q12h once, then 40 mg/kg x 5 treatments; 90 mg/kg PO once, then 45 mg/kg x 4 treatments	Parenteral fluids recommended
Sulfaquinoxaline	PO	0.04% in drinking water q24h (F)	-
Tetracycline (Panmycin®)	PO	10 mg/kg q24h (BSAVA)	General antibiotic
Thiabendazole (Mintezol®, Omnizole®)	PO	50-100 mg/kg once, repeat in 2 weeks (Bi)	Ascarids, strongyles; efficacy questionable
	PO	50 mg/kg q24h x 2wk	Mycotic pneumonia
Ticarcillin (Ticar®)	IM	50-100 mg/kg q24h (F); 50 mg/kg q24h (Bi); Chelonians: 20 mg/kg q24h	Turtles, tortoises

REPTILE FORMULARY

Drug	Route	Dosage	Comments
Tiletamine HCL and zolazepam HCL (Telazol®)	IM	Snakes: 10-30 mg/kg; Rattlesnakes: 50-75 mg/kg; Lizards: 10-25 mg/kg; Turtles/tortoises/ iguanas: 3-10 mg/kg (Jo); Crocodilians: 1-2 mg/kg; Monitors: 1-1.5 mg/kg (R)	Induction = 5-20 min, Recovery = 2-10 hr; may require much higher dose for stage III or IV anesthesia
Tobramycin (Nebcin®)	IM	2.5 mg/kg q24h; Water turtles: 10 mg/kg IM q24h; Terrapines tortoises: 10 mg/kg IM q48h	Concurrent fluid therapy
Trimethoprim sulfadiazine or sulfasoxazole (Bactrim®, DiTrim®, Septra®, Tribrissen®)	PO, IM	15-25 mg/kg PO q24h (R); Chelonians: 25 mg/kg q24h x 2d then q48h x ≤20d; Others: 30 mg/kg q24h x 2d then q48h x ≤20d; with liver compromise	Parenteral fluids recommended
Tylosin (Tylan®)	IM	25 mg/kg once (JD)	Lung/air sac pneumonia
	IM	5 mg/kg q24h 10 days (BSAVA)	
Vitamin A	IM	Chelonians: 1000 IU/kg single dose IM, rpt in 10d (Ja) (depend upon BW & condition)	Most over-used drug in reptiles; toxicity will cause skin sloughing
Vitamin B complex	IM	0.1 ml/kg PRN	-
Vitamin D_3	IM, SC, PO	100 IU/kg BW weekly; Chelonians: 1650 IU/kg single dose (Mt)	Probably not the active metabolite, sunshine 2h more effective
Vitamin E	IM	50-100 mg/kg (S)	Preventive, avoid overfeeding fish

Special formulations and some manufacturer discontinued drugs can be obtained from Mortar and Pestle 800-279-7054
Key to drug dosages: (B) = Barten; (Bi) = Bielitzki (Merck); (Br) = Brunson, 1993; (BSAVA) = (BSAVA); (D) = Diltom; (F) = Frye; (H) = Hilf, et al; (J) = Jacobson; (Ja) = Jarchow; (Jo) = Johnson; (JD) = Johnson-Delaney, 1988; (L) = Lloyd, 1996; (M) = Mader, 1993; (Mt) = Mautino; (N) = Nelson; (P) = Page, 1991; (R) = Rafael; (S) = Stein, 1995; (W) = Wagner

Snakes

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of snakes and is not intended to replace comprehensive reference material.

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SNAKES

Families of Serpentes

- Leptotyphlopidae (thread snakes): 2 genera, 78 species
- Typhlopidae (blind snakes): 3 genera, 180 species
- Anomalepidae (dawn blind snakes): 4 genera, 20 species
- Acrochordidae (Asian wart snakes): 2 genera, 3 species
- Aniliidae (false coral snakes): 9 species
- Uropeltidae (shield tail snakes): 8 genera, 44 species
- Xenopeltidae (sunbeam snake): 1 genus, 1 species
- Boidae (boas, pythons): 27 genera, 88 species
- Colubridae (colubrids, boomslang, bird snake): 292 genera, 1562 species
- Elapidae (cobras, mambas, coral): 61 genera, 236 species
- Viperidae (vipers): 7 genera, 187 species
- Hydrophidae (sea snakes)

Common Snakes in Captivity

- African rock python *Python sebae*
- African house snake *Boaedon fuliginosus*
- Black rat snake *Elaphe obsoleta*
- Boa constrictor *Boa constrictor*
- Garter snake *Thamnophis sirtalis*
- Corn snake *Elaphe guttata*
- Grass snake *Natrix natrix*
- Burmese, Indian python *Python molurus*
- King snake *Lampropeltis getulus*
- Ball, Royal python *Python regius*
- Sand Boa *Eryx* sp.

Food Preferences of Selected Snake Species

- Anaconda: small mammals, birds, fish
- Boa, Python (Reticulated, Ball, Burmese): mammals, birds
- Cobra (except King Cobra): small mammals, birds (quail chicks)
- Coral: other snakes, lizards, small mammals, fish occasionally
- Copperhead: Adults: small mammals; Young: lizards, amphibians
- Garter: small mammals, amphibians, fish, earthworms, slugs
- Gopher, Bull, Pine: small mammals, birds
- Green: Insects
- Hog-nosed: Frogs, toads, salamanders, tadpoles, mammals
- Indigo: Adults: small mammals, birds, fish; Young: amphibians, lizards, other snakes
- King Snake: small mammals, lizards, other snakes
- King Cobra: other snakes
- Racer: small mammals, birds, lizards, amphibians

- Rainbow: Adults: mammals, birds; Young: fish, aquatic salamanders
- Rat, Chicken: small mammals, birds, eggs
- Rattlesnake: Adults: small mammals, birds; Young: lizards
- Ribbon: small mammals, amphibians, fish, earthworms
- Ring-necked: amphibians, snakes, invertebrates

Feeding Tips

- Train snake to eat prey dead (especially rodents).
- If must initially feed live prey, make sure snake is not attacked or traumatized by prey. Observe snake until prey is killed or remove live prey from cage if you leave the room.
- Offer food on solid surface to avoid ingestion of substrate.
- Amount and frequency of feeding is based on observation, routine of defecation, behavior, and physiological needs. Increase frequency during growth, before reproductive output.

Housing

- Enclosure must be appropriate for terrestrial or arboreal snake.
- Enclosures should have sealed seams, be steam cleanable, and be secure enough to prevent escape (snakes are escape artists).
- Materials: glass aquariums, fiberglass, homemade wooden (polyurethane sealed), acrylic/plexiglass.
- Substrates: Newspaper, pine/ash wood shavings, synthetic/paper-type (like Celludry).
- Branches should be provided at various heights, sizes.
- Hiding places should be provided within the enclosure (opaque box, log, secured rocks forming a cave, artificial vegetation).
- Water container depends on species; heavy ceramic crocks large enough for soaking add humidity for ecdysis; Emerald tree boas drink from water on their bodies after misting.
- Some species need drip systems onto vegetation.
- Water container must be changed and cleaned daily.
- Provide optimum temperature with gradient so snake may seek preferred temperature; use thermometers to monitor.
- Heat tape, pads or platform work well.
- Mount incandescent lights high enough to avoid contact burns.
- Food, water, and “hide” spots should be located at various temperature gradients.
- Humidity: 30-60%. Desert species may be lower.
- Humidity too low at shedding = dysecdysis.
- If air exchange is <5-15/hr, may get skin lesions from build-up of urine, feces or bacterial growth.

Environmental Requirements for Some Snake Species

Species	Temp.* °F	Rel. humidity %	Habitat
Boa constrictor	77-85	50-70	arboreal
Sand boa	77-85	20-30	burrowing
Burmese, Indian python	77-85	30-70	arboreal
Ball, Royal python	77-85	30-70	terrestrial
Garter snake	70-80	30-70	semi-aquatic or terrestrial
King snake	73-85	30-70	terrestrial

** Ambient daytime gradients; night = decrease lower end by 5-10°F; "hot spot" = increase upper end by 5-10°F.*

Preventive Care

- All new snakes should be quarantined for at least 90 days (no air exchange with rest of collection).
- Routine health check includes full physical exam, fecal exam/smear, ectoparasite exam & control, weight (weekly).
- Hibernate only temperate species after full health check.

Restraint

- Venomous species: Anesthetize with isoflurane (in confined chamber or plexiglass tube). Once anesthetized, place cork over fangs prior to intubation; leave in place until extubating; remove with tongs.
- Aggressive species: Hold securely behind head and support body.
- Manual restraint: support at two points on snake's body.
- Caudal section may be placed in a bag or pillowcase during handling to catch urination, defecation or anal gland secretions.

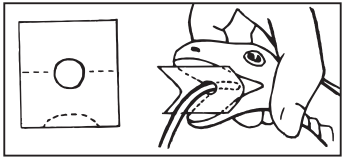
Physical Examination

- Observe unrestrained first, preferably in habitat, housing or carrier to assess locomotion, respiration, general attitude.
- Remove small venomous or aggressive snakes with tongs.
- Assess stage/cycle of ecdysis (depends on age, nutrition, size, temperature; counsel owner to keep track)
  - Entering cycle: eyes/skin may appear milky, cloudy
  - Mid-cycle: eyes, skin turn clear
  - Shed cycle: 1-4 days after the clearing.
- Do not handle during shed cycle; skin is fragile and old skin may come off on hands; otherwise palpate entire length.
- Check teeth: most snakes have 4 rows on upper arcade, 2 rows on lower arcade; all curve caudally; replaced continuously.

- Normal oral mucosa should be pale, glistening and moist with no stringy, tenacious mucus present.
- Lack of tongue flicking is nonspecific indicator of illness.
- Internal nares should be clear - can flush with saline.
- Epithelial surface of tongue gets shed periodically (often will be left in water bowl).
- Distinguish normal hissing/exaggerated breathing sounds (species' traits when alarmed) vs respiratory disease (expelled exudate from glottis).
- Auscultation of heart, respiratory system may be difficult. Can palpate heart in most small species; palpate other organs.
- Check vent. Examine stool/urates sample following manual massage to stimulate defecation.
- Snake should urinate/defecate on a routine schedule often with feeding. A change in the routine may indicate illness.
- Snakes store urine in ureters and colon, not bladder; a urine sample may be collected from the exam table.

Oral Access for Examination and Medicating

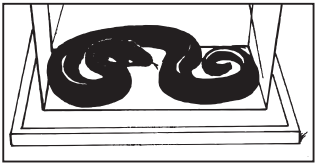
- Restrain the head with thumb and forefinger caudolateral to the skull. Gently force 2 cotton-tipped applicators between the anterior jaws, directing them as far caudally as possible, then spreading them dorsally and ventrally.
- A rubber spatula may be used to initially enter the mouth; it is turned to allow the opportunity to visualize the oral cavity before cotton swabs are inserted.
- A business card or a small piece of radiographic film may be used as a speculum (with a hole cut in the center) to open the mouth and hold it open during the tubing process without damaging the teeth.



Radiographic Positioning

- An anesthetized snake can be taped directly onto the cassette.
- For the respiratory system, the cranial two-thirds of the body is usually radiographed.
- For the gastrointestinal system, the entire body is radiographed; several films may be necessary in overlapping sections for large snakes. The thickest portion of the patient is

measured, and this setting is used for the entire study.
- Contrast studies: barium sulfate suspension can be administered through stomach tube for GI evaluation.
- Passage can be accelerated if the body is held vertically, head upright, and the belly is massaged gently from neck to cloaca.
- Body temperature should be optimal for GI transit.



A large snake may be restrained in a radiolucent container. The x-ray cassette is placed under the patient.

Sexing

- Snakes are sexed by "probing" with an clean, lubricated metal probe or cannula into the inverted hemipenis (entry just inside caudal edge of the cloaca).
- In males, which have hemipenile openings, the probe will reach 6-8 sub-caudal scale lengths (sometimes more).
- In female snakes, the two scent sacs (similar to anal sacs) are near this site; the probe only reaches 2-4 sub-caudal scale lengths. Some females have vestigeal hemipenes.

Reproductive Parameters for Some Species of Snakes

Species	Method*	Gestation/incub. period (days)	Incub. Temp. (°C)	Incub. rel. humidity %
Boa constrictor	L	120-240	-	-
Sand boa	L	120-180	-	-
Burmese python	E	56-65	30-32	80-100
Ball python	E	90	30-32	80-100
Garter snake	L	90-110	-	-
King snake	E	50-60	25-30	80-100

* *L = live bearing; E = egg laying*

Blood Collection

- Use Microtainer brand blood collection tubes.
- Use lithium heparin as anticoagulant.
- Use plasma rather than serum from a separator tube.
- Aseptically prepare skin for tail, cardiac, jugular sampling.
- Use palatine (sublingual) veins, ventral tail vein, cardiocentesis, jugular veins (best on the right side as in birds).

Injection Sites

Ventral tail vein	The needle is angled at 45°, initially placed between paired caudal scales. Do not damage hemipenes in males.
Palatine and sublingual veins	These vessels are readily seen when the mouth is open. Sedate reptile. Bending the needle may be necessary.
Jugular veins	As per mammals, requires practice.
Cardiac puncture	Potentially dangerous; takes practice and a steady hand, but is used as a standard method by experienced reptile practitioners. Use 25-27 ga needle.

Fluid Therapy

(see also general guidelines in introductory Reptile chapter)

- Small amount only in terrestrial snakes, as can compromise respiratory system (intraceolomically).
- Give small volumes in multiple sites in bilateral grooves between vertebrae and lateral longissimus muscles and in another groove ventral and lateral to the longissimus muscles.
- Keep the needle parallel to the skin and slightly lift skin to avoid intrapulmonary injection.
- Avoid area 20-40% of distance between the snout and cloaca to avoid lung area. In aquatic species, air sacs extend to cloaca.
- Large volumes should be given ventrally at midline or ventrolaterally in the left caudal quarter of the body or just cranial to the cloaca; don't give in females with follicles, it may puncture a follicle.

Common Clinical Conditions of Snakes

- Trauma
- Bite wounds from prey
- Spinal fractures
- Burns from improper heating/lights
- Anorexia
- Secondary systemic infections
- True rectal/colon or uterine prolapse (not hemipenes extrusion)
- Dystocia
- Obstipation/Constipation

Special Resources for Snakes

- For suspected OPMV (Ophidian paramyxovirus): Elliott Jacobson, DVM, PhD (Univ of FL, College of Vet Med, 352-392-4751).
- For suspected retro-like virus (Boid inclusion body virus: Michael Garner, DVM, ACVP (NW Zoo Path, 360-668-6003).

RULE OUT CHART FOR SNAKES BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Ambulatory problems (spinal rigidity, weight loss, muscle mass, atrophy)	Osteoarthritis (bacterial esp. *Salmonella*, other gram-negatives), Degenerative arthritis (aging), Neoplasia	History of rodent bites, stomatitis, illness, Radiographs, Histopath, CBC/chemistries, C&S pharyngeal/ other systems	Osteoarthritis lesions may be irreversible, Supportive care, Anti-inflammatories, Analgesics, Optimal husbandry, Curette lesion
Anorexia (physiologic/management related)	Improper husbandry (temperature, stress, food competition, excessive handling), Reproductive or pre-ecdysis anorexia (normal)	CBC/chemistries, Radiograph, History, Review husbandry	Correct husbandry problems, Supportive care (light therapy, fluids, assisted feeding) as needed
Anorexia (infectious etiology)	Bacterial, Fungal, Parasitic (amoebiasis, other protozoa, helminths, severe ectoparasites), Boid inclusion body virus, Systemic or chronic disease	Physical exam, History, CBC, Chemistries, C&S exudates, blood, Fecal float/direct/C&S, Radiographs, GI biopsy, Boid inclusion body virus tests	Supportive, Treat underlying etiology, Fluid therapy, Assisted feeding
Anorexia (mechanical, other pathology)	Foreign body ingestion, including substrate, Impaction, Obstruction, Intussusception secondary to other GI disease, Liver disease, Neoplasia, Renal disease	Physical exam, History, Husbandry review, Radiograph +/- contrast, Palpation, Liver biopsy, Urinalysis	Impaction/obstruction: enemas, parenteral fluids, Gavage with petroleum laxative mixed with water, Surgical removal/resection, Change substrate, Supportive
Constipation	Obstruction, GI disease or stasis, Inappropriate food, Reproductive tract disease, Dehydration, Bacterial infections, Neoplasia, Colonoliths, Ingested substrates, Motor nerve deficit	Physical exam, Radiographs, Husbandry review, CBC/chemistries (esp. PCV/TP), High rectal swab C&S (aerobic/ anaerobic)	Conservative: DSS enema, Oral DSS in 1:10 dilution, Fluids, Appropriate temps, Soak in fluids, warm water, K-Y jelly enema in large snakes, Dilute soapy enema in small snakes, Milk out material or surgery

RULE OUT CHART FOR SNAKES BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Dermatitis	Ectoparasites (mites, leeches, ticks), Contact dermatitis (bedding, chemicals, irritants)	Physical exam (check under scales, around nostrils, eye scales, for inflammation, magnification), Skin/scale biopsy	Ivermectin, Bathing, Substrate control (bake organic beddings if they must be used; preferably switch to paper, sterile recycled products)
Diarrhea	Amoebiasis, Salmonella, Enteric bacterial disease/necrosis, Parasites, Adenovirus, Parvovirus, Picornavirus, Herpesvirus	Physical exam, Fecal flotation/smear, C&S (aerobic/anaerobic) rectal/vent/feces, CBC/chemistries	Supportive fluids, Appropriate antimicrobials, Anthelmintics, Supportive for crypto (paromomycin questionable efficacy against crypto)
Dyspnea	Pneumonia, Respiratory infection, Hyperthermia, Trematodes, Nematodes, Pentastomid, Ophidian paramyxovirus (OPMV), Mimic of respiratory symptoms prior to shedding	Physical and oral exams, History, Fecal flotation/direct, C&S glottal/pharyngeal exudates, Lung wash, Radiograph lung field, Serology, viral isolation (OPMV)	Supportive O_2, Antimicrobials, Fluids, Optimum temperature and humidity, Nebulization
	Airway obstruction, Fluid-filled coelomic cavity, Glottis inflammation, Obstructed nasal passages	Watch breathing cycle while holding mouth open (watch glottis), Tracheal wash, Radiographs, Aspirate fluid for evaluation	Remove obstruction, Antibiotics if indicated, Surgery
Dystocia	Egg binding, Neoplasia, Obstipation/constipation, Motor nerve deficit, Foreign bodies, Too low environmental temp, humidity, Poor nutritional status, Infections in reproductive tract, Systemic infectious disease	Physical exam, History, Radiographs	Correct environmental temps, Calcium gluconate followed by oxytocin or arginine vasotocin, Fluids

RULE OUT CHART FOR SNAKES BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Lethargy	Hypothermia, Exposure to cold, Chilling, May be predisposed to pneumonia, Just ate, Ready to shed	Physical exam, History, May regurgitate if had just eaten, Auscultate lung	Bring slowly to preferred optimal body temperature, Fluids, Supportive care
	Visceral gout/renal disease, Primary renal disease, History of water deprivation, Aminoglycoside administration, Renal neoplasia	Physical exam, Radiographs, History, CBC/chemistries	Supportive, Fluids, Discontinue or don't use in the future (aminoglycosides), Limit parenteral administration of vitamin D_3
Nasal exudate	Infectious (necrotic) stomatitis, Pneumonia, Systemic disease (bacterial, fungal), Upper respiratory infection	Oral exam, Dental/skull radiographs, C&S, CBC/chemistries	Antibiotics, Debride all necrotic tissue, Flush with mouthwash/dilute tamed iodine/chlorhexidine
Neurologic signs	Boid inclusion body virus, Ophidian paramyxovirus (OMPV), Trauma, Toxicity (medications, cedar shavings), Neoplasia, Renal disease (visceral gout), Severe dehydration, Insecticides, Bacterial/parasitic/fungal encephalitis	Necropsy, Histopath (viral), Physical exam, History (esp. aminoglycosides, exposure to insecticides), Brain histopath (in pythons), CBC, OMPV: serology/viral isolation, Blood culture, Fecal exam	No treatment for viral, Symptomatic (for trauma), Specific antidote (if known toxicity), General supportive, Appropriate antibiotics, If head trauma keep at 75°F
Ophthalmic disorders	Bacterial, fungal infections (may involve nasolacrimal duct), Trauma to eye/head, Panophthalmitis	Ophthalmic exam, C&S eye, Oral exam	Antibiotics (topical/systemic), Remove portion of spectacle for drainage/flushing, Enucleation (if panophthalmitis)

RULE OUT CHART FOR SNAKES BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Ophthalmic disorders	Retained spectacles, History of abnormal shed, Underlying corneal/eye pathology, Systemic disease, Too low humidity, Low ambient temp	Physical exam, Eye exam, History, CBC/chemistries, C&S (if other signs of systemic disease)	Increase humidity, access to water, Improve husbandry, optimal temperatures, Moist compress on for 15-20 minutes, Ophthalmic drops, Lift gently with moist gauze
Oral lesions (petechiae, granulomas, oropharyngeal mucus)	Necrotic infections, Stomatitis, Iatrogenic oral trauma, Systemic disease, Pneumonia	Physical exam, C&S oral exudates, Tracheal wash, Radiographs (dental, skull, lung), History	Antibiotics, Debride necrotic tissue, Flush mouth (tamed iodine or chlorhexidine), Gentle oral manipulation
Regurgitation	Handling too soon or chilling after eating, Boid inclusion body virus, Cryptosporidia, Entamoebiasis, Toxicity, Any severe gastroenteritis, gastritis, OPMV, Nematode infections, Obstipation, Salpingitis, Neoplasia, Mechanical blockage, Liver disease	Physical exam, History, Exam regurgitated substance, C&S esophageal/vent/fecal, Fecal float/smear, CBC/chemistries, For Boid inclusion body virus: liver/gastric biopsy, post mortem histopath and/or buffy coat exam	Correct husbandry, Supportive, Antimicrobial, Anthelmintic, Treat per etiology
Regurgitation	Foreign body ingestion (substrate, accessories), Impaction, Obstructions	History, Husbandry review, Radiograph +/- contrast, Palpation	Conservative: enemas, parenteral fluids, gentle intestinal palpation & time, Gavage petroleum laxative mixed with water, Surgical removal/resection if nec., Change substrate

RULE OUT CHART FOR SNAKES BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Retained skin (shed skin comes off in pieces, sticks to snake; may have retained eye caps)	Improper temperature, humidity, handling during molt, Absence of bathing area or rubbing stones, Systemic illness, Ectoparasites	Physical exam	Remove pieces of retained skin, Place snake in wet towels, May help to rub skin from nose to tail with wet then dry gauze, Correct underlying systemic illness, Identify and treat ectoparasites
Tachypnea	Hyperthermia (overheating, heat stress)	History (may have been trying to get against cool surfaces, into water bowl)	Slowly cool with water bath (keep head above), SC fluids, Drugs PRN to decrease brain swelling
	Pneumonia	Physical exam, CBC/chemistries, Radiographs, Microbiology	Appropriate antimicrobials, Supportive
	Pain	Physical exam, History, Find source of pain	Analgesics, Appropriate supportive per underlying etiology
Trauma	Rodent/prey bites, Cage trauma (bumping, bruising, abrading), Other prey injuries (fish scales, bones, quills)	Physical exam, History, C&S exudates, CBC/chemistries, Radiographs (+ contrast), Esophageal and GI lesions: endoscopy	Suture if possible, Flush dilute tamed iodine or chlorhexidine (topicals), Duoderm®/ Dermaheal® or silver sulfadine 1% cream, Topical and systemic antibiotics
	Burns, Secondary bacterial infections (esp. *Pseudomonas*)	History, Husbandry, C&S burn, CBC, TP, Assess hydration	Correct husbandry (accessories, heating), Supportive care, Fluids, Antibiotics (topical, water-based)

Turtles and Tortoises

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of turtles and tortoises and is not intended to repleace comprehensive reference material.

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TURTLES AND TORTOISES Order - **Testudinata (Chelonia)**

Common Chelonian Species

Aldabra tortoise *Geochelone gigantea*
Alligator snapping turtle *Macrochelys temminckii*
Box turtle *Terrapene* sp.
Desert tortoise *Gopherus (Xerobates) agassizi*
Gopher tortoise *Gopherus polyphemus*
Hermann's tortoise *Testudo hermanni*
Map turtle *Graptemys* sp.
Mud turtle *Kinosternon* sp.
Painted turtle *Chrysemys picta*
Pond turtle *Clemmys* sp.
Red-eared slider turtle *Trachemys scripta elegans*
Snapping turtle, common *Chelydra serpentina*
Spur-thighed tortoise *Geochelone sulcata*

Diet Preferences of Selected Chelonians

Aldabra tortoise, Desert tortoise, Gopher tortoise, Hermann's tortoise, Spur-thighed tortoise: grasses, alfalfa, clover, dichondra, mulberry leaves, grape leaves, hibiscus flowers
Alligator snapping turtle: fish, insects, worms, slugs, snails
Box turtle: vegetables, fruits (strawberries, raspberries, blueberries, melons), flowers, insects, worms, slugs, snails, fish
Map turtle*, Mud turtle, Painted turtle*, Pond turtle*, Red-eared slider turtle, Snapping turtle: fish, insects, worms, slugs, snails, water plants
** Juveniles are more carnivorous than adults.*

Environmental Requirements for Selected Chelonians

Species	Temp.* °C	Rel. humidity %	Habitat
Spur-thighed tortoise	19.4-26.9	10-50	terrestrial
Common box turtle	23.9-28.1	60-80	semi-aquatic
Red-eared slider turtle	19.3-22		aquatic

** Ambient daytime gradients; night = decrease lower temperature by 5°C; "hot spot" = increase higher temperature by 5°C.*

Housing

- All Terrapin species require a predominantly aquatic environment with a dry "haul out" area that is heated.
- The enclosure depends on the species: glass/plexiglass aquarium, galvanized livestock pen or wire caging, or even fenced outdoor enclosures may be used.

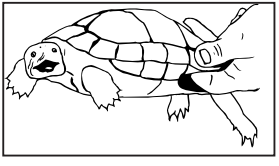
- All housing must facilitate sanitation and should be easy to clean.
- Box turtles like to spend a considerable time each day partially immersed in water to a depth of approximately 5 cm; therefore, the water area of the enclosure must be large.
- The habitat should be constructed so turtle/tortoise can climb in and out of water easily.
- A filtration system is necessary to keep the water clean; it is preferred to have frequent complete water changes.
- The water should have a thermostatically controlled water heater to provide preferred optimum temperature range for turtles kept inside during the winter.
- The general habitat can be heated by radiant heat sources such as heat strips or pads under or on one side of habitat, and should be designed to provide hiding area(s), basking area and feeding area.
- The basking place can be heated with an overhead radiant heat source or sunlamp with ultraviolet spectrum; the heat source for basking should be recessed from above to prevent burning.
- It may be advisable to have a separate smaller tank for feeding. The turtle should be rinsed clean and returned it to its primary enclosure.
- Full spectrum lighting is necessary; sunlight is best in normal photoperiods.
- Box turtles also like to bury themselves in leaf litter, so this may be provided in a corner of the pen.
- Acceptable substrates: newspaper, alfalfa pellets, large gravel.
- Unacceptable substrates: sand, ground corncobs, walnut shell, artificial grasses, wood chips, aquarium gravel, pea gravel — anything that can be ingested and cause impaction; cedar chips may cause toxicity.
- Aquarium plants (plastic) can be used to decorate habitat (if they are easy to clean).

Incubation Parameters for Three Turtle Species

Species	Incubation Period (days)	Temp. °C	Rel. humidity %
Spur-thighed tortoise	60	28-32	60-90
Box turtle	50-90	25-30	60-90
Red-eared slider turtle	59-93	25-30	60-90

Restraint

- Small tortoises, turtles: pick up by holding the whole shell between both hands, slightly cranial to the hind limbs; grip both sides of the carapace just above the hind limbs or via the supracaudal shields.
- Box turtles (hinged plastron): place index fingers under carapace in front of the hind legs (hind legs then are out and turtle won't close the shell); be prepared for a pinch.
- If turtle has withdrawn its head deeply, it may need to be accessed by applying sponge-holding forceps or small whelping forceps to the head over the cranium and under the mandible. Withdraw *very* slowly and gently against the muscular pull of the retractor muscle. Anesthesia may be necessary. Once the head is exposed, hold the head with your finger and thumb behind the occipital condyles. Tipping tortoise forward helps.
- If legs are withdrawn, it is usually possible to force the forelegs and head out slowly by pressing both hind legs deeply into the inguinal fossae. Sometimes pressing forelegs into the cranial openings will slightly force out the hind legs.
- A quiet room, subdued lighting and optimal temperature range help facilitate getting the turtle to extend its head and legs.



For turtles that are prone to bite (Soft-shelled, Red-eared Slider, others): it is safe to hold them at the rear end of the carapace just cranial to the hind leg.

First Visit/ Annual Examination

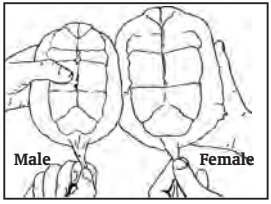
- Physical exam should include weight, review of husbandry and diet.
- Carapace, plastron and integument - examine for evidence of trauma, fungal disease, bacterial dermatitis, ectoparasites
- Eyes, nares, oral cavity - should be clean of exudates
- Tympanic membrane - no swellings or discolorations
- Heart, lungs - auscultate by placing a damp cloth between carapace and head of stethoscope; observe respirations.
- Percussion over carapace for dull spots indicating lack of air space, possible densities.
- Motor function - check locomotion, swimming (aquatic turtles should float symmetrically horizontal in water); aquatic turtles that float at the surface are in trouble.

- Fecal flotation and direct smear (If chelonian is anorexic, flush cloaca with a #5 or #8 French red rubber catheter and a small amount of saline or use a wet Q-tip; this provides enough sample for a direct exam). Set aquatic turtles on damp paper towels to collect feces after removing from water.

If pet is ill or history warrants, further diagnostics may be needed such as:

- Tracheal wash is indicated only if there is evidence of pneumonia on percussion or radiograph - cytology & microbiology can be useful to pick up parasites (eggs, larvae), bacteria, fungi; pass sterile cannula through the glottis, instill sterile saline and aspirate after inverting turtle (head down, tail up).
- Radiography (+ contrast), ultrasound, CBC and chemistries may also be included.

Sexing



The tail of the male is often longer and wider at the base than the female, and the cloaca of the male is more caudal than the female's when compared with the rear edge of the plastron.

- Male tortoises, Box turtles and other terrestrial species have a concavity in the caudal half of the plastron.
- In some species the males have longer front claws than the females (eg, the Red-eared terrapin and some marine turtles).
- The iris of the mature male Common Box turtle is frequently red, while in the female it is usually brown.
- Males are often smaller and lighter than females (eg, Map turtles), but the opposite holds true for some species (eg, Gopher tortoises).
- Sometimes the penis will evert with warm water soaking and vent massage.

Blood Collection and Intravenous Injection Sites

Jugular vein	Vessel of choice; is palpable and can be catheterized. Use sodium heparin or lithium heparin.
Venous plexus (femoral)	In caudal femoral area of back leg. Extend leg by grasping foot and pull laterally. Insert

	needle caudal to stifle and direct it proximally. Apply gentle suction as soon as it enters the skin. Plexus is fairly superficial. May get lymph mixed with sample.
Brachial vein	Extend forelimb. Easier to access in large land tortoises. May get lymph mixed in with sample.
Dorsal venous	Located on the dorsal midline of the tail. The needle is angled at 45° cranially and advanced until bone is reached, then withdrawn slightly.
Cardiocentesis	Use as a last resort, only with anesthesia. Drill through with a sterile intramedullary pin. After sample is drawn, fill with epoxy resin or dental acrylic.

Hematology Reference Ranges for Tortoises*

WBC:	3-8 x 10^3
PCV:	20-40%
Hets:	35-65%
Lymphs:	25-50%
Monos:	0-2%
Eosino:	0-2%
Baso:	0-6%
RBC:	1.5-2.5 x 10^6

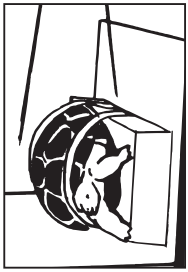
• *University of Miami Avian and Wildlife Laboratory; These values are to be used as a guide only; species and seasonal differences are significant.*

Hematologic/Biochemistry Reference Values in Selected Turtles

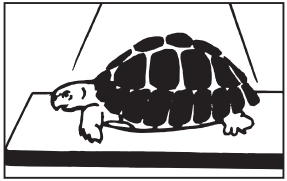
	Common Box Turtle	Red-eared Slider
RBC:	2.35-7.55 x $10^6/\mu L$	2.57-8.35 x $10^6/\mu L$
PCV:	28%	26%
Hbg:	5.9 g/dL	8.0 g/dL
TP:	4.5 g/dL	3.6 g/dL
Glucose:	36 mg/dL	70 mg/dL
BUN:	30 mg/dL	22 mg/dL
Uric acid:	2 mg/dL	1 mg/dL
Na:	130 mEq/L	121 mEq/L
K:	4.7 mEq/L	4.1 mEq/L
Mg:	3.5 mEq/L	3.2 mEq/L
Cl:	108 mEq/L	81 mEq/L
Phos:	2.4 mg/dL	1.1 mg/dL
Ca:	1.3*	2.8*

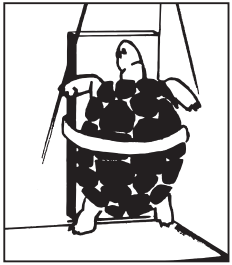
* *low value may reflect lab method. Baselines of "normals" should be established for individual patients for laboratory or in-house use. Values will vary with age, sex and season of the year.*

Radiographic Positioning



Laterolateral: Position cassette vertically close to carapace. For evaluation of impacted shell injuries and lungs.

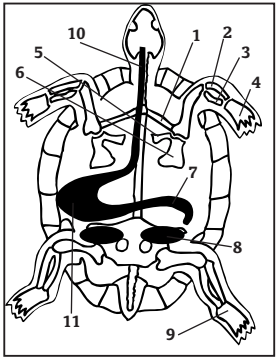




Dorsoventral: Position patient in prone position; use vertical X-ray beam, For skeletal surveys and the evaluation of the genitourinary and digestive systems.

Craniocaudal: Vertical X-ray beam with tortoise fixed upright. Can evaluate shell injuries and lung pathology.

Radiographic Anatomy of Chelonians



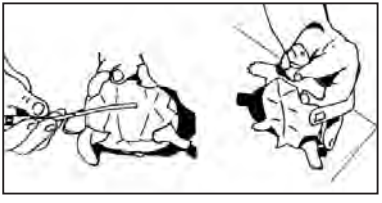
1. scapula
2. ulna
3. radius
4. carpals, metacarpals, phalanges
5. acromion process
6. coracoid process
7. pyloris
8. kidney
9. tarsals, metatarsals, phalanges
10. esophagus
11. stomach

Common Emergency and Clinical Conditions in Chelonians

- Trauma: Shell damage, fractures, wounds, burns
- SCUD: Bacterial/fungal infection of the shell (shell is soft, has odor, collapses, turns color)
- Respiratory disease: Bubbles from nose, turtle floats asymmetrically, pneumonia
- Neoplasia
- Prolapse of hemipenes: Differentiate from true rectal prolapse due to bacterial or parasitic gastroenteritis
- Bacterial infections secondary to malnutrition: depression, anorexia, swollen eyes, peeling skin

Supportive Care

- Parenteral (most reliable): intramuscular injections: forelimbs muscle mass; subcutaneous injections: forelimbs, axial skin fold area
- Oral (via gavage): if multiple dosing is required that may cause extra stress and/or chelonian is anorexic and gavage feeding will be required, consider placement of a pharyngotomy/esophagostomy tube.
- A stomach tube is used for single or limited doses.



The length of stomach tube for oral dosing is measured and marked. The tortoise is held upright to allow the esophagus to straighten out for insertion of the tube.

- Vegetable baby foods, alfalfa pellets soaked in water or Pedialyte® blenderized into a gruel suitable for the feeding tube can be used; Emerald II® (Lafeber) avian feeding formula works as a quick source of nutrients.
- Rate of feeding = 10-15 ml/kg daily, divided into 2 meals.
- Food should be at 80-85°F; chelonian should be at optimum preferred body temperature.
- For fluid therapy, the rule of thumb = 20 ml/kg/day plus bath/soak in water at preferred optimum body temperature. See general Reptile chapter for fluid therapy guidelines.
- After antibiotic theapy, use stools from disease-free individuals for replacement of flora. Use soil in enclosure to replace cellulose fermenters.

Fluid Administration

Intracoelomic:	Not advisable, may compromise lung space, air sac areas.
Subcutaneous:	Small amount only (under finely scaled skin of limbs) as can compromise respiratory system. Avoid injecting through scaled areas on limbs.
Epicoelomic:	Preferred site for large volumes; is the potential space above the plastron and below the pectoral muscles and coelom. The needle should be long enough to just clear the pectoral girdle, and is inserted along the plastron on the left side ventral to scapular/humeral joint. Direct the needle caudally along the plastron.
Body soaks	Use of warm water soaks helps with oral, cloacal intake of fluids.Tortoises may be soaked in shallow water to encourage drinking, urinating and defecating.

Shell Repair Basics

- Shell is living bony tissue; consider analgesic use. Always follow with antibiotics.
- Before beginning, give supportive care: optimum temperature, hydration, antibiotics, fluids.
- Apply ophthalmic ointment to eyes.
- Ensure good ventilation in the work place when working with resins and acrylics.
- Use gas-sterilized or autoclave-fitted covers over drills and good sterile technique.
- To enter shell, use rotary, oscillating, high-speed orthopedic saw, hand-held electric drill, Dremel fitted with a circular blade or Stryker oscillating saw (larger patients).
- Debride and remove devascularized fragments of bone.
- Lavage with sterile saline to reduce infection (culture if exudative when presented). Site must be *very* clean. Use dilute Betadyne solution to prepare.
- Control hemorrhage as needed (surgical glue, gelfoam, liquid hemostats like Nexaband).
- If contaminated fractures, old injuries, delay further repair until healthy granulation tissue is present.

- Rebuild defects: It is important that none of the repair material is trapped between edges of the shell being repaired - it should cross over the surface. Shells heal from deeper endochondral layers; those are the surfaces that should not be covered with repair material.
- Procedure: use wires to hold pieces in apposition; add layers of sterile fiberglass cloth and rapid polymerizing epoxy resin.
- Autoclaved fiberglass cloth patch should be 2-3 cm larger than defect (edges rounded).
- Clean periphery of defect with ether or acetone. An antibiotic ointment may be applied into gaps first, so that the resin does not get down between the tissue and edges.
- Mix epoxy resin and apply to defect. Avoid contact with edge or soft tissues.
- Allow resin to set-up slightly, then stretch patch over the defect. Work resin across the edges of the weave and allow to set.
- Coat the patch with more resin until weave becomes transparent.
- If large lesion/defect, additional layers of cloth, resin can be added.
- In aquatic species: add final layer of marine resin.
- If growing chelonia, use a Dremel drill or file to route repair materials away from growth margins of scutes.
- If soft tissue is exposed at all, dental acrylic is useful - does not generate heat like epoxy & is nontoxic to tissue.

Large Tortoise Shell Repair

- Hoof acrylic may be strong enough.
- If soft tissue or skin has been torn, it should be reattached as anatomically appropriate as possible.
- Repair should include debridement, cleaning, flushing; then reattach with sutures through small holes drilled in shell margin (use IM pin or drill). Allow non-absorbable suture to stay in at least 30 days.
- If coelom is exposed, use adhesive bandages with plastic backing or Saran Wrap® taped into place to prevent desiccation prior to repair.
- Once finished, a light spray of vegetable oil pan coating will eliminate epoxy tackiness. Leave patch on shell 6 to 24 months.
- Remove patch and replace if necessary (annually in growing chelonians).

RULE OUT CHART FOR CHELONIA SPECIES BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Anorexia (inanition, ± dehydration)	Inappropriate husbandry, diet, Too cold, GI obstruction, Respiratory disease, Neoplasia, Severe underlying disease, Parasite load, Gastroenteritis, Egg binding, Hypovitaminosis A, Herpesvirus-like infection	Physical exam, History, Fecal float/direct smear, Vent rectal wash, Radiographs, CBC/chemistries	Supportive, Treat underlying condition, Fluid therapy, Vitamin B complex, Vitamin A, Appropriate antiparasitics, Acyclovir (for herpesvirus-like infection), Ensure optimal temperature of enclosure
Anorexia (weight loss, lack of stool)	Foreign body impaction (see also Constipation)	Husbandry review (substrate and opportunities), Radiography (+ contrast?)	Laxatives if appropriate, Possible surgical intervention, Supportive
Anorexia	Middle ear infection, Bacterial or fungal infection secondary to hypovitaminosis A	Physical exam, C&S exudate, Diet history, CBC/chemistries, Radiography	Ear: anesthetize & incise membrane, curette out debris and flush 1:30 chlorhexidine in water or dilute tamed iodine, Systemic and topical antibiotics (preferably ophthalmic rather than otic), Other antimicrobials
Anorexia (aquatic turtles)	SCUD (septicemic cutaneous ulcerative disease), Fungal or parasitic lesions, Myiasis	Physical exam, C&S lesions, History of sanitation and water system, Gram's stain/cytology of lesion flush or exudate	Antibiotics, Gently clean lesions (diluted chlorhexidine, tamed iodine), Warm water bath then rinse and dry off, Supportive care: fluids, alimentation.

RULE OUT CHART FOR CHELONIA SPECIES BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Anorexia (box turtles)	Preparation for hibernation, Malnutrition, Inappropriate environment	Physical exam, CBC/chemistries, Radiographs, Husbandry review	Improve husbandry, temperature, UV light cycle, Supportive, Fluids, Offer live foods (sick, convalescing turtles should not go into hibernation)
Anorexia (tortoises)	Post-hibernation, Liver glycogen depletion	Physical exam, History, Weight, CBC/chemistries	Provide optimum temperature, light cycle, Rehydrate and provide easily assimilated diet, Fluids, Monitor PCV and urea/uric acid levels
Burns (thermal or chemical)	Sequelae: secondary bacterial or fungal infections, Necrosis	History, Check husbandry, Physical exam, CBC with TP, Assess hydration, C&S deep layers	Gently clean with water-soluble disinfectant/antibiotic cream topically, Antibiotics, Systemic fluids, Weigh daily, Assess hydration, House on nonstick substrate
Conjunctivitis (± nasal exudate, blepharitis)	Bacterial infection secondary to hypovitaminosis A, True conjunctivitis, Respiratory infection, Eye injury	Physical exam, Diet history, C&S exudates, Radiographs, Assess respiratory system, Float test, Ophthalmic exam, Fluorescein stain	Peritoneal and/or oral vitamin A (only if confirmed hypovitaminosis A), Correct diet, Topical ophthalmic preps, Systemic antibiotics for bacterial/ respiratory, Supportive care
Conjunctivitis (edematous with squamous metaplasia)	Hypovitaminosis A	Physical exam, Diet history, C&S exudate, CBC/chemistries, Radiographs to assess respiratory system	Supplement vitamin A, Correct to a balance diet, Antibiotics, Supportive care, Monitor closely

RULE OUT CHART FOR CHELONIA SPECIES BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Constipation	Impaction, Foreign body ingestion (substrate, fish hook), Environment too cold, Severe gastroenteritis, Parasite load, Egg binding, Neoplasia, Organomegaly, (usually causes or is the result of severe disease)	Physical exam, Husbandry review, Radiographs (+ contrast?), Fecal flotation/ direct smear, Cloacal wash, C&S, CBC/chemistries, Endoscopy	Soak in warm water, Dilute soap enema, Correct environment, Gavage with petroleum-based laxative mixed with water, Surgical excision, Provide optimum body temperature, If not large impaction metoclopramide or cisapride may be useful (*reptile dose not established*), Fluid therapy, Treat per etiology
Diarrhea (see GI disease)			
Dry, flaky skin (+/- large sheets skin slough)	Fungal infections, Protein deficiency, Hepatopathy, Hypervitaminosis A	Physical exam, Diet and therapy history, C&S	Supportive, Clean environment, Correct underlying problem, Do not handle animal (can damage tissue further), Discontinue vitamin A "therapies," Correct diet: lower vitamin A content, decrease veggies high in carotinoids, 1% silver sulfadiazine ointment
Dyspnea	Airway obstruction, Fluid-filled coelomic cavity, Large bladder stones, Glottis inflammation, Obstructed nasal passage	Tracheal wash, Radiography, Watch breathing cycle while holding mouth open, Aspirate fluid for evaluation	Antibiotics if warranted, Surgery to remove obstruction

RULE OUT CHART FOR CHELONIA SPECIES BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Dystocia (+anorexia, depression, constipation)	Egg binding, Fractures, Anatomic abnormalities in oviposition, Malnutrition	Physical exam, History, CBC/chemistries, Radiographs (check for eggshell), Palpate eggs in smaller chelonia (direct forefinger anteromedially in inguinal fossa while gently rocking the turtle)	Possible surgical intervention, Yolk serocoelomitis: repair and copiously lavage coelomic cavity, Rehydrate, Provide optimal temperature, environment, substrate, Oxytocin, Antibiotic therapy, Possible calphosan, Possible low dose of ketamine may facilitate egg laying.
Emaciated (but heavy)	Fluid-filled coelomic cavity, Intestinal impaction, Cystic calculi	Radiographs, CBC/chemistries, Urinalysis	Correct underlying problem
Fractures, deformities	Metabolic bone disease, Deformities of carapace ("parrot jaw"), Severe traumatic lesions, evidence of poor healing	Physical exam, Diet history, Husbandry history (light), Radiographs, Serum calcium/phosphorus, CBC/chemistries	Correct diet: calcium:phosphorus ratio 2:1, Natural or artificial UV light, Monitor serum calcium levels and give calcium gluconate if indicated, Splint fractures
Gastrointestinal disorders	Salmonellosis, Other bacterial infections, Amoebic enterohepatitis, Chronic parasites (nematodes), Foreign body ingestion, Obstruction/impaction, Neoplasia, Inappropriate diet (too much fruit, fat)	Physical exam, CBC/chemistries, Cloacal wash, Fecal float/direct smear, C&S, Radiography, Endoscopy	Supportive, Fluids, Assisted feeding, Appropriate antimicrobials, Metronidazole for amoebic hepatitis, trichomoniasis, Correct diet

RULE OUT CHART FOR CHELONIA SPECIES BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Lameness	Septic arthritis, Fractures, Luxations, Trauma, Metabolic bone disease, Dehydration/ poor water intake, Renal disease, Nephrosis, Articular gout, High doses of aminoglycosides or sulfonamides	Physical exam, CBC/chemistries, Radiographs, Fine needle aspirate/cytology of joint (crystals), C&S, Monitor serum uric acid, phosphorus, calcium levels	If possible, surgical removal of urate deposits, Possible intraarticular corticosteroids, Lower dietary protein, Fluid therapy, Allopurinol or colchicine (may not work), Analgesics?, Soft padded environment to ease mobility
Lethargy	Exposure to cold, Systemic disease, Pneumonia, Overchilled (depending on species), Respiratory disease (may take 4 weeks before signs are obvious in tortoises)	History, Physical exam, Cool body temp, Consider workup for systemic disease/pneumonia: CBC/ chemistries, Radiography	Slowly warm to preferred optimal body temperature, Warm fluids SC, IM, IV (if dehydration apparent), Supportive care, Correct husbandry!
	Soft tissue mineralization (smooth muscle, renal), Gout (elevated serum uric acid	Physical exam, Diet history, Radiographs, History of parenteral calcium therapy, Monitor serum uric acid, phosphorus, calcium levels	Correct diet, Monitor for renal disease, Ensure hydration of animal
Lethargy (+ swelling around neck)	Hypoproteinemia, Hypoiodinism, Hypothyroidism, Systemic disease: edema due to hepatic or cardiac disorders, Renal disease	Diet history (consumption of low dietary iodine and goitrogenic plants), Radiographs, Physical exam, CBC/ chemistries, Assess for systemic disease.	Correct diet and environment, Remove goitrogenic plants, exogenous iodine, Prepare diet without goitrogenic plants, Short-term thyroxine if hypothyroid

RULE OUT CHART FOR CHELONIA SPECIES BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Lethargy (aquatic turtles)	SCUD (septicemic cutaneous ulcerative disease), Fungal infection, Parasitic lesions, Myiasis, Malnutrition (thiamine deficiency)	Physical exam, C&S lesions, History (sanitation and water system), Gram's stain/cytology of lesion flush or exudate	Antibiotics, Gently clean lesions (diluted chlorhexidine, tamed iodine), Warm water bath then rinse & dry, Supportive care: fluids, alimentation, Antifungal agents, Thiamine
Nasal exudate	Pneumonia, Rhinitis (bacterial), Pasteurellosis, Mycoplasmosis, Hypovitaminosis A (rare)	Physical exam, Diet history, Float test, C&S exudate, Radiographs, Cytology of exudate, CBC/chemistries	Optimum temperature per species, Sanitation, Fluids, Supportive care, Antimicrobials if warranted
Neurologic signs	Skull fracture, Spinal cord trauma, Otitis interna/media, Toxicity (medications, environment), Lead poisoning, Cerebral edema (hyperthermia)	Physical exam, History, Radiographs, CBC/chemistries, C&S exudates	Appropriate trauma treatment, Fluids, Analgesics, Antibiotics, Repair wounds, CaEDTA (if lead) plus gavage laxative to remove or surgery, Toxin antidote, Time, Supportive care, Corticosteroids, Osmotic diuretics (if cerebral edema)
Panting (+ salivation, uric acid over body from voiding bladder)	Overheating, Turned over	PCV, TP, Uric acid	Slowly bring to preferred optimal body temperature, Fluids

RULE OUT CHART FOR CHELONIA SPECIES BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Prolapse from cloaca	Penile (phimosis), Female reproductive tract, Cloacal/rectal tissue, Cystic calculi, Bladder	Physical exam, Neurological exam, History, Radiographs, Urine/urates analysis, History of dehydration incidence (severe)	Clean, lubricate and replace, Use temporary cloacal pursestring suture, If swelling: apply hygroscopic fluid and antibiotic/cortisone ointment to reduce swelling, If traumatized or desiccated: careful amputation, Antibiotic therapy depending on etiology, tissue damage, Fluid therapy, Supportive, Cystic calculi: celiotomy and removal, Correct diet, Female: hysterectomy (if necrotic)
Shell disease (non-traumatic)	Old "myiasis," Spirorchid flukes, Scars, Metabolic bone disease, SCUD, General subnutrition, Renal failure, Ulcerations (usually opportunistic bacterial infection from dirty environment)	History, Physical exam, Cytology, C&S, CBC/chemistries, Radiographs	Debridement of lesions, Topical antimicrobial therapy, Tamed iodine added to bath water then rinse and dry, Systemic antibiotics, if severe, Repair defects when infection resolved, If myiasis: remove larvae, flush with tamed iodine
Shell disease (traumatic)	Generalized infections, SCUD, Neurologic/spinal injury, Myiasis	History, Physical, Radiographs, CBC/chemistries, C&S lesions if purulent	Shell repair, Antibiotic therapy, Fluids, Supportive care
Skin (exudative blisters)	Burns (especially chemical), Fungal dermatitis, Secondary bacterial skin infection	Physical exam, Review environment, History, C&S, Cytology	Supportive care, Clean environment, Antimicrobials, Artificial skin products to protect large sloughed areas, Do not handle animal

RULE OUT CHART FOR CHELONIA SPECIES BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Skin cysts	Myiasis: *Sarcophaga* sp, *Lucilia* sp. (larvae deposited in broken skin, around cloaca, pocket of skin at base of tail), Bacterial abscess	Physical exam (may see crusty black discharge at margin skin and shell), History	Topical or systemic anesthesia to remove maggots with hemostats (use hair dryer on low to activate larvae), Flush wounds, tissue with tamed iodine, Antibiotics if necessary, Supportive care, Correct husbandry
Swelling/edema	Hepatic or cardiac disease, Obesity, Hypothyroidism, Hypoiodinism, Renal disease from hypoproteinemia, Goiter (rare)	Diet history (consumption of low dietary iodine, goitrogenic plants), Physical exam, CBC/chemistries, TP	Diet change: exogenous iodine, protein, Thyroxine may be needed short-term (only if confirmed), If systemic disease treat appropriately.
Trauma	Bite wounds, Shell injury, Punctures	History, Physical exam, Radiographs, CBC, C&S (deep wounds)	Deep wounds: clean & disinfect, Topical and systemic antibiotics, Analgesics, Supportive care
Weight loss	Seasonal, Malnutrition, Suboptimal temperatures, Neoplasia, Foreign body GI obstruction, Systemic disease, Parasitism, Pneumonia, Maladaptation to captivity	Physical exam, Radiographs, CBC/chemistries, Cytology, Fecal float/smear, C&S cloacal exudates/lesions, Ultrasonography	Correct diet and husbandry, Treat etiologies
	Presence of uroliths, cystic calculi, Nephritis, Renal disease, Malnutrition (thiamine deficiency)	Physical, History, Radiographs/ultrasound (swollen kidneys), CBC/chems, C&S exudate, Urinalysis, Fresh direct cytology (protozoa), Analysis of calculi, Renal biopsy, Confirm histopath	Metronidazole (for protozoa), Sanitation, Correct diet, Keep well hydrated, Supportive care, Appropriate antibiotics, Thiamine

Lizards

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of lizards and is not intended to replace comprehensive reference material.

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LIZARDS Order - **Squamata** Suborder - **Sauria**

Families

Gekkonidae (Geckos): 85 genera, 800 species
Pygopodidae (Snake lizards): 31 species
Xantusiidae (Desert night lizards): 16 species
Dibamidae (Blind lizards): 4 species
Iguanidae (Iguanas): 55 genera, 650 species
Chamaeleontidae (Chameleons): 4 genera, 85 species
Agamidae (Agamas, flying dragons): 53 genera, 300 species
Scincidae (Skinks): 85 genera, 1275 species
Cordylidae (Girdle-tailed lizards): 10 genera, 50 species
Lacertidae (Wall and sand lizards): 25 genera, 200 species
Teiidae (Whiptails): 39 genera, 227 species
Anguidae (Anguids): 8 genera, 75 species
Xenosauridae (Crocodile lizards): 4 species
Varanidae (Monitor lizards): 31 species
Helodermatidae (Beaded lizard, gila monster): 2 species

Common Lizards in Captivity

Bearded dragon *Pogona vitticeps*
Cayman Island ground iguana *Cyclura nubila caymanensis*
Chuckwalla, *Sauromalus obesus*
Common or black tegu lizard *Tupinambis teguixin*
Common (green) iguana *Iguana iguana*
Cuban giant anole *Anolis luteogularis*
Gila monster *Heloderma suspectum*
Green anole *Anolis carolinensis*
Green water dragon *Physignathus cocincinus*
Jackson's chameleon *Chamaeleo jacksoni*
Leopard ground gecko *Eublepharis macularius*
Mexican beaded lizard *Heloderma horridum*
Monitor lizard *Varanus* sp.
Panther chameleon *Chamaeleo pardalis*
Parson's chameleon *Chamaeleo parsoni*
Plumed basilisk *Basiliscus plumifrons*
Prehensile-tailed (monkey-tailed) skink *Corucia zebrata*
Savannah monitor lizard *Varanus exanthematicus*
Spiny-tailed lizard *Uromastyx* sp.
Spiny-tailed iguana *Ctenosaura* sp.
Tokay gecko *Gekko gecko*
Water dragon *Physignathus lesueri*

Behavior

- Do not mistake two lizards laying next to each other as a relationship. It is usually just tolerance or need for the hot spot.
- Lizards are not social animals. They may become accustomed to human touching, but excessive handling may cause stress and result in food refusal.
- Lizards as a rule are highly territorial; males more than females; males react more violently to other males than to females.
- Seasonal hormonal fluctuations may contribute to more aggression during the breeding season.
- When two or more lizards are housed together, the larger or more aggressive individual may attack the subordinate or may keep the subordinate away from food or heat sources.
- The subordinate lizard will suffer from chronic stress, ill health or starvation.

Diet - Herbivorous Lizards

Suitable for green iguana, ground iguanas, prehensile-tailed skink, chuckwalla:

- Iguanas are folivorus (leaf eaters) - feed dark green, leafy vegetables, grape leaves, mulberry leaves, hibiscus leaves and flowers, rose petals one or two times daily.
- All plant material should be washed, chopped, mixed, and served at room temperature or slightly warmer.
- Include calcium-rich vegetables: turnip greens, mustard greens, beet greens, kale, collards, bok choy, Swiss chard, dandelions, parsley, escarole, spinach, alfalfa pellets, cilantro.
- Small amounts tofu may be chopped into vegetable mix weekly.
- For hatchlings up to 14" in length: Feed q12h or have food continuously available; plant matter is finely chopped or shredded.
- For juveniles up to 2.5 years or 3 feet in length: Feed q24h; plant matter is chopped fine to medium or shredded.
- For adults over 2.5 years or 3 feet in length: Feed q24h; plant matter is coarsely chopped.
- Commercial pet diets (dog foods, primate diets, trout chow) are not advised.
- Addition of canned commercial iguana diets may be OK; results of long-term feeding trials on canned foods are not available.
- Vitamin/mineral supplementation is advised *in moderation*; calcium and fat-soluble vitamins (A, D, E, K) can be over-supplemented. Best to provide these from fresh leafy sources.
- Use powdered calcium carbonate, calcium gluconate or cuttlebone shavings, Tums, or Neocalglucon syrup weekly.

Converting a Herbivorous Lizard to a Good Diet

- Gradually decrease "old" diet ingredients and increase quantity of "new" diet items.
- Chop or dice ingredients in equal-sized pieces, shreds or chunks and mix well so lizard cannot pick out favored items.
- Feed flowers (hibiscus or nasturtium in red or bright colors).
- Feed in early morning or late afternoon (optimal temperature).

Diet - Omnivorous Lizards

Suitable for Spiny-tailed Iguanas, *Uromastix* sp.:

- Feed iguana diet plus insects, pinkies.

Diet - Carnivorous Lizards

- Offer pre-killed, whole, appropriately sized prey. Do not offer live rodents (unless you stay and observe until prey is eaten).
- Feed most lizard species daily; monitor weights to prevent obesity.
- If mice, rats, rodents, rabbits, chicks make up bulk of diet, vitamin/mineral supplements are probably not needed.
- If pinkie mice or meal worms are fed, calcium supplementation is recommended.
- Do not feed ground beef, heart, liver - inadequate nutrition.
- Avoid dog, cat, trout or monkey chows (may result in hypervitaminosis D, hypercalcemia and fat metabolism problems).
- Horned lizards eat nearly exclusively ants and termites; small crickets sometimes work as a substitute.
- Geckos (*Phelsuma* sp.) are insectivorous; may also lap flower nectar.
- Fence lizards, skinks, alligator lizards, anoles and Old World chameleons eat appropriate-sized insects, wingless fruit flies, crickets, grasshoppers, katydids and moths.
- Caiman lizards eat fish, mollusks and gastropods.
- Crickets should be "gut loaded" with 4 parts chicken starter mash to 1 part $CaCO_3$ for 3-4 days prior to feeding (an organic avian formulated diet has also been used to "gut load" crickets).

Preventive Care

- Quarantine all new reptiles in separate areas of the house for 2-3 months.
- Perform regular veterinary examinations and screens.
- Record normal patterns of eating, defecating, weight gain and behavior for the individual.
- Provide optimum husbandry for each species including proper enclosure, temperature, humidity, light and food.

Housing

- Enclosure should be secure with tight-fitting lid.
- It should be simple and easy to clean with smooth sides to prevent rostral abrasions.
- Plexiglass, acrylic or glass are preferred materials. If wood is used, seal with polyurethane or waterproofing agent and caulk the joints to allow for cleaning and disinfection. (Allow to air out before placing reptile in.)
- The enclosure should be large enough for climbing and other activity; provide climbing branches of appropriate diameter.
- Food, water bowls and water pools should be placed for easy access and frequent cleaning.
- A good disinfectant is 3-10% chlorine bleach; rinse well and dry before exposing lizard!
- Avoid allowing lizards free roam of the house to prevent chilling (no access to heat source), trauma and escape.
- If it's absolutely necessary to house two of the same species together, make sure they are the same size animal, they are not both males, the enclosure is large enough with lots of complexity so they can stay out of sight of each other, and separate accesses are available to heat, UV light, food, water.
- Avoid reflective surfaces and mirrors.
- Acceptable substrates are newspaper, brown butcher paper, cypress mulch, organic (recycled) cellulose fiber, lab animal bedding pellets.
- Wood shavings may be acceptable for large monitors.

Environmental Requirements for Some Lizard Species

Species	Temp.* °F	Rel. humidity %	Habitat
Common (green) iguana	80-85	60-80	arboreal
Leopard ground gecko	77-85	20-30	terrestrial
Green anole	73-83	70-80	arboreal
Jackson's chameleon	75-85	50-70	arboreal
Plumed basilisk	73-85	70-80	arboreal
Water dragon	75-85	80-90	arboreal

** Ambient daytime gradients; night = decrease lower end by 5-10°F; "hot spot" = increase upper end by 5-10°F.*

Light

- Full spectrum light is essential for most lizards for behavioral & psychological benefits, and activation of vitamin D.
- Sources of light (decreasing effectiveness): unfiltered direct sunlight, UV-B sun lamp - medical grade, FS-type fluorescent sun lamp, Black Light fluorescent tubes (General Electric Co), Vita-

Lite fluorescent tubes (Duro-Lite Lamp - replace every 9-12 mo).
- Of no value to reptiles are: wide spectrum plant lights, wide spectrum aquaria white lights or black light blue tubes.
- Artificial UV sources should be 18-24” away from reptile.
- Light should not be filtered by glass or plastic.
- Sunlamps (medical grade UV-B) can be put on timer for 15-20 min/day; (caution: avoid human exposure, eye contact).

Heat

- An incandescent lamp may be used in the daytime as an additional source of heat (turn off at night).
- If hot rocks or logs are used, they should be covered with fabric to prevent contact burns on animal.
- Radiant heat is best; provide heating gradients with both horizontal and vertical axis, and allow reptile to bask and seek its optimal temperature.
- Can use combinations: thermal pads under substrate, thermal pads along back or side of enclosure, spot heat lamps, reflector lamps or coils on timers for several hours mid-day (lamps can raise focal spot temperature 10-15°).
- If absolutely necessary to maintain ambient temperature at night and thermal pad heating is not sufficient, red or amber lamps can be used at night (avoid Teflon-coated heat lamps).
- Monitor areas of cage with thermometers and observe where lizard is spending time.
- Temperature ranges preferable: tropical species = 26.5-37°C, temperate species = 24-29.5°C.

Humidity and Water

- Most desert species need <50% humidity. Tropical forest species need 60-80%.
- Good ventilation is required to prevent mold, bacteria growth.
- Drinking water can be provided in bowls or crocks for most.
- Chameleons, geckos and anoles require water droplets from leaves; mist enclosure daily or provide drip system.
- Provide humidity monitor within cage.
- To correct low humidity: place damp sponges in hide boxes, create humidity box (holes in side of plastic food containers & partially fill with damp sphagnum moss), frequently mist with plant mister, use room humidifier or vaporizer.
- Hide box for visual security can be made from cardboard box or plant pot.
- Real or artificial plants can be used in enclosure.

Restraint

- Avoid handling for several hours after the lizard has eaten.
- Lizards should never be caught or lifted by the tail; many species will shed their tail (autotomy is natural defense mechanism against predators).
- Lizards can bite, scratch with their claws and lash out with their tails; therefore, they should be held by the neck and pectoral girdle with one hand (which also controls the forelimbs), while the other hand supports the body near the pelvis and holds the hind limbs.
- It may be necessary to apply additional control of the head of some larger lizards (eg, monitors).
- The hind limbs and tail of large lizards can be taped together to avoid injury to handler, and gloves can be worn for protection.
- Care should be taken with tiny animals to prevent either an escape or application of too much pressure on the body.
- The skin of geckos is delicate and easily damaged; therefore a soft cloth can be used to catch these animals.
- The head of a small lizard can be controlled between the index finger and thumb to prevent it from biting.
- If lizard bites and holds on, a few drops of isopropyl alcohol in the mouth induces it to let go. A cotton swab moistened with alcohol may also work.
- Claws tend to be very sharp; trim or cover before full exam (unless animal is extremely ill or moribund so that additional handling would cause severe stress).
- Claw covers (eg, Soft Paws) may be used on iguanas to decrease injuries to handlers without diminishing climbing ability.
- Gila monsters and beaded lizards are the only venomous lizards, and, although they are not particularly aggressive, the handler must take care to avoid their bite. It may be advisable to use a snake hook to control the animal's head before picking it up, and hold the neck to restrain the head.
- Tube chambers including syringe casings (small lizards) with or without isoflurane sedation aid in visualization during restraint.

Quick Facts

Reproductive Parameters for Some Species of Lizards

Species	Method*	Gestation/incub. period (days)	Incub. Temp. (°C)	Incub. rel. humidity %
Common (green) iguana	E	73-93	27-35	75
Leopard ground gecko	E	55-60	26-33	80-100
Green anole	E	60-90	28-30	80-100
Jackson's chameleon	L	90-180	-	-
Plumed basilisk	E	60-64	27	-
Water dragon	E	90	-	-

** L = live bearing; E = egg laying*

Longevity

Common (green) iguana:	13-29 yr
Cayman Island ground iguana:	33 yr
Spiny-tailed iguana:	5-17 yr
Prehensile-tailed (monkey-tailed) skink:	17 yr
Green water dragon:	11 yr
Bearded dragon:	10 yr
Jackson's chameleon:	8 yr
Panther chameleon:	5 yr
Parson's chameleon:	1 yr
Tokay gecko:	24 yr
Leopard gecko:	21 yr
Mexican beaded lizard:	34 yr
Green anole:	7 yr
Common or black tegu lizard:	14 yr
Savannah monitor lizard:	13 yr

First Visit/Annual Examination

- Physical examination: Include sexing, review of husbandry (diet, sanitation), zoonosis (salmonella) discussion, handling (nail trimming or soft claws). Review bathing, misting, humidity delivery. Weigh and set up weight/growth chart.
- Fecal flotation and direct smear
- Vent/choanal culture and sensitivity (gives good indication of normal flora, salmonella will be intermittently cultured in any given individual).
- Depending on diet history, overall appearance: CBC and chemistries (esp blood calcium, phosphorous); cultures may be recommended if animal is ill.
- If warranted (ie, diet/husbandry history is questionable/ marginal): radiographs to diagnose bone disease, ingestion of substrates, metabolic calcification, egg retention.

- Annual visits: Physical exam, weight/growth. Repeat of above tests as per history.

Physical Examination

- Observe at rest, alertness level, posture, respiratory pattern.
- Begin rostrally, cranially and work caudally as in other animals. A rubber bowl scrapper, plastic card or cotton swab technique is useful for opening mouth (without breaking teeth). Some lizards will gape when gently tapped on nose, or when gentle traction is applied to the dewlap if present.
- Auscultation of heart, lungs. A thin damp towel or gauze between stethoscope diaphragm and reptile's skin facilitates auscultation. Observe defensive hissing vs respiratory pathology.
- Abdominal palpation.
- Skin evaluation.
- Sex determination - per species.

Sexing

- Iguanas can be sexed by visual examination: it is more difficult in juveniles.
- Males have taller dorsal spines, a larger dewlap, larger operculum scales, bilateral hemipenes bulges at base of tail, and large, well-developed femoral pores.
- Females have smaller dorsal spines, operculum scales and femoral pores.
- Gecko males have prominent femoral and precloacal pores.
- Sexing probes may be used with some reliability in monitors and tegus.
- Hemipenes can be everted through injection of saline into the base of the tail (prevent trauma to exposed hemipenes). Gentle digital pressure is applied to the base of the tail just caudal to the cloaca to evert hemipenes; cotton swabs can be used.
- Radiographs of older male monitors may reveal calcified hemipenes.
- Chameleon males have head ornamentation of horns, crests or plates.

(For other sexual dimorphisms, consult species descriptions in texts.)

Blood Collection Sites

- Aseptically prepare skin.
- Use Microtainer brand blood collection tubes.
- Use lithium heparin as anticoagulant — use plasma rather than serum from a separator tube.

Ventral tail vein	Vessel of choice for iguanas and monitors; located on the ventral mid-line aspect of the tail. Angle the needle at 45-90° cranially and advance to the midline aiming between the coccygeal vertebrae. The tip will just touch the ventral surface of the vertebrae, then withdraw slightly while negative pressure is applied.
Ventral abdominal	Located in the midline of the abdominal wall. Can develop hematoma or extensive hemorrhage. When withdrawn, apply digital pressure on site for 5-10 minutes.
Axillary plexus	On posterior aspect of proximal humerus and scapulohumeral joint. Requires practice. Lymph contamination.
Cephalic vein	Requires cut down procedure midway between elbow and carpus located in dorsomedial groove between extensor and flexor muscle groups.
Cardiac puncture	May be approached from the ventral abdomen, angling needle cranially under the coracoids. Good technique with practice: insert needle straight in and pull straight out. Problems occur if you try to modify the needle position while in the heart.

Hematologic & Biochemistry References for Selected Lizards

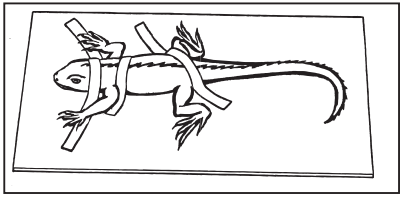
	Monitor Lizard	Green Anole	Green Iguana
PCV:	27	28	30
Hbg:	-	7.0	7.1
TP:	6.9	4.1	4.5
Glucose:	106	172	155
BUN:	2	7	1
Uric acid:	-	8	5
Na:	181	157	157
K:	3.5	4.6	3.5
Ca (mg/dl):	3.1*	2.9*	8-12
Mg:	2.3	-	0.9
Cl:	148	127	118
HCO_3:	31	15	24
Phos:	2.5	2.6	2.0

** published values may be too low - may reflect lab methods (Baselines of "normals" must be established per patient and per laboratory or in-house reference. Values vary by season of year, sex, breeding condition and diet.)*

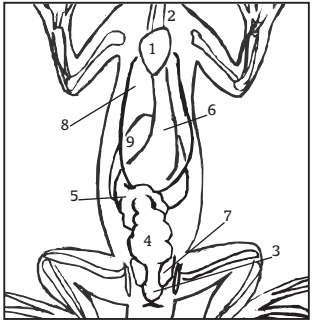
Hematology Reference Values for Iguanas*	
WBC:	6-14 x 10^3
PCV:	30-45%
Hets:	40-70%
Lymphs:	20-45%
Monos:	0-2%
Eos:	0-1%
Basos:	0-2%
RBC:	1.5-3.5 x 10^6
** University of Miami Avian and Wildlife Laboratory*	

Radiographic Positioning

For a routine dorsoventral view, the patient is placed directly on the X-ray cassette in a prone position; restraint may not be required. In active reptiles, masking tape may be used to secure the neck, front legs, pelvis, and tail (if necessary).



Radiographic Anatomy



1. heart
2. esophagus
3. cloaca
4. large intestine
5. small intestine
6. stomach
7. kidneys
8. lungs
9. liver

Radiographic Contrast Studies

- For contrast examination of GI tract, the dosage of barium sulfate is up to 50 ml/kg body weight.
- The passage of time in active carnivorous lizards such as monitors is short = 3-6 days.
- In herbivorous lizards (with considerable quantities of plant material), passage time can be 15 to 30 days.
- Passage time also depends on temperature and activity.
- In lizards with a low oral water uptake and long passage time, barium sulfate suspension can become dehydrated in the digestive tract and can cause constipation. To avoid this, add 5 percent iodinized contrast medium and administer sufficient water to lizard. Maintain hydration and optimal temperature.

Common Emergency and Clinical Conditions in Lizards

- Metabolic bone disease
- Trauma
  - Burns from cage heating devices, UVB lights.
  - Fractures (due in part to MBD)
  - Wounds inflicted by other animals
- Dystocia
- Anorexia
  - Improper husbandry, light cycle
  - Too cold temperatures
  - Endoparasites
  - Bacterial gastroenteritis

Rehydration and Fluid Administration

- Gavage
- Subcutaneous: laterally between front and hind legs, in lateral skin fold if present, in body wall dorsal to femur or lateral to tail base.
- Intracoelomic: through lateral body wall midway between last rib and pelvis; avoid viscera (not recommended if dyspnea or ascites/effusions present); extreme caudal coelom, craniodorsal to femur and ventral to lumbar musculature.
- Intravenous: cephalic, ventral abdominal vein in larger lizards.
- Intraosseous: as in mammals and birds (cut down may be needed); exercise care to prevent fracture if MBD present.
- Avoid lung/air sac areas.

- Start with mild hypotonic solution parenterally: 20-40 ml/kg/24 hrs (2 parts 2.5% dextrose in 0.45% sodium chloride, 1 part Ringer's solution), or 1 part D5W and 1 part non-lactated electrolyte solution (Normosol).
- Go to balanced (isotonic) once normal hydration, or can continue to use the mild hypotonic.
- Carefully evaluate use of intraosseous cannulas in iguanas because of potentially compromised renal function.
- Shallow pan with warm water level sufficient to cover up midway on body should be provided for soaking; this may help by stimulating drinking and defecating
- Lizards can be misted or sponged at least once daily. Care is taken not to soak substrate or cage bottom. This helps to raise the humidity in the cage or indoor environment.
- Reptiles should be kept at optimal body temperature during therapy.

Therapy

- Oral medications may not be effective in reaching blood levels.
- Oral meds may be given by stomach tube or squirted into open mouth; chameleons may have medications dripped onto lips.
- Parenteral administration is method of choice.
- Inject SC or IM in front half of body because of renal portal system.
- Beware some medications may lead to darkening of skin or sloughs at the site.
- Use topical medications for localized infections.
- Inappropriate use of metronidazole in an herbivorous reptile may cause an imbalance of its gut flora, leading to diarrhea and gaseous bloat. It may be necessary to repopulate the flora of the animal's intestine using fecal material from healthy conspecifics or other appropriate microbial material.
- For surgery, use synthetic absorbable sutures; in skin use non-absorbable sutures, leave in 5-6 weeks.

Euthanasia

- Use standard euthanasia solutions: intracardiac, intravenous, intracoelomic.
- Cold and freezing techniques are considered painful; ice crystals may form before full loss of consciousness; not approved as humane method.

RULE OUT CHART FOR LIZARDS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Anorexia (starvation, dehydration)	Respiratory disease (chronic), Chronic egg retention, Systemic disease, Parasites, Improper diet, husbandry, Metabolic bone disease, Renal disease/failure, Systemic calcinosis, Enteropathy, Cystic calculi, Caging stress, Foreign body ingestion, Constipation, Steatitis in monitors, Fatty liver disease, Normal with shedding cycle	Physical exam, Full husbandry review, CBC/chemistries, Radiographs, Rectal/pharyngeal C&S, Fecal examination, urates and urinalysis (when available), Abdominal palpation, Monitor serum phosphorus, calcium	Supportive, Rehydrate, Gavage feed, Work on underlying problem, Conservative (constipation): Enema, Parenteral fluids, Gentle intestinal palpation, Proper ambient temp; More severe: Prophylactic antibiotics, Fluids, Petroleum (cat-type) laxatives mixed with water via stomach tube; If very severe/large foreign body: surgical removal; Metoclopramide
Anorexia	Metabolic bone disease (fibrous osteodystrophy)	History, Diet, Blood calcium, phosphorus, Weight, Radiographs, Physical exam (gentle)	If vigorous: oral calcium gluconate and exposure to UVB light, Monitor blood calcium, phosphorous closely; If prone with muscle fasiculations: injectable calcium gluconate, then calcitonin, Full spectrum lighting, Diet correction
	Renal failure (visceral gout), Primary kidney disease, Systemic calcinosis, Renal tubular toxicity from aminoglycosides, sulfonamides	History, CBC/chemistries (esp calcium, uric acid, phosphorous), Radiographs, Biopsy/histopath of kidney	Rehydrate/keep well hydrated, Low protein diet, Do not feed rhubarb, spinach, Do not use aminoglycosides or sulfonamides, Supportive

RULE OUT CHART FOR LIZARDS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Constipation	Kidney enlargement, GI stasis (too low ambient temp), foreign body obstruction/impaction	History, Radiographs, Physical exam, CBC/chemistries, Assess kidney function, Kidney biopsy	Warm to proper body temp, Fluid therapy, Enema, Gavage mineral oil in small lizards; oral psyllium in large lizards; Supportive care
Cystic calculi	Neoplasia, Renal disease	Radiograph (radiopaque mass in caudal ½ of iguana), Palpation, CBC/chems esp. calcium/phosphorous	Surgical removal, Cystotomy, Fluid therapy, Limit protein in diet (kidney damage probable)
Dehydration	Renal failure (visceral gout), Primary kidney disease, Renal tubular toxicity from aminoglycosides, sulfonamides, Glomerulonephritis, Systemic debilitating disease, Poor environment, Inappropriate diet, water source, Parenteral calcium	History, CBC/chemistries (esp calcium, uric acid, phosphorous), Radiographs, Biopsy/histopath of kidney	Rehydrate/keep well hydrated, Low protein diet, Do not feed rhubarb or spinach, Do not use aminoglycosides or sulfonamides, Supportive care, Correct underlying etiology in systemic disease cases, Correct environment, water source, diet
Dyspnea	Bacterial/fungal involvement, Parasitic involvement, Hyperthermia, Pneumonia, Airway obstruction, Fluid-filled coelomic cavity, Large bladder stone, Glottis inflammation, Obstructed nasal passage	History, C&S glottal or tracheal wash (aerobic + anaerobic), Cytology of washes, Radiographs, Watch breathing cycle	Warm environment, Fluids, Support, Antibiotics and/or antifungals, Antiparasitic if necessary If aerobes: enrofloxacin or aminoglycosides (keep well hydrated); Surgery to remove obstruction

RULE OUT CHART FOR LIZARDS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Dystocia (lethargy, +/- anorexia, swollen abdomen, constipation)	Egg binding, Abdominal mass, Neoplasia, Enteropathy, Calcinosis	Palpation, Radiography, Ultrasonography, Physical exam, Husbandry, History	Proper ambient temp and nests, Rehydrate, Quiet! Oxytocin or arginine vasotocin, Calphosan or calcium gluconate, If condition >2 weeks: ovariohysterectomy
Fractures	Metabolic bone disease, Trauma	Radiographs, History, Diet/husbandry review	Splints, casts, Supportive care, Remove climbing branches, Surgery (rare)
Lethargy	Dystocia, Egg binding, Abdominal mass, Neoplasia, Enteropathy, Metabolic bone disease, Injury	Palpation, Radiography, Ultrasonography, Physical exam, Husbandry, History, CBC/chemistries	Dystocia: (see above), Others: treat per etiology
	Hypothermia, Prolonged development of pneumonia (may show up in 2-3 weeks)	History, Consider if a tropical or temperate species, Age, Overall health status	Warm slowly to optimal temperature, Do not soak in warm water, Prophylactic antibiotics, Minimize handling
Muscle tremors	Nutritional (def: Ca, thiamine, vitamin E,/selenium); (excess: vitamin D, phospohorus), Septicemia, Trauma, Neoplasia, Liver or kidney failure, Parasites, Epilepsy, Hypoglycemia, Toxicities	History, CBC/chemistries (esp Ca, AST, Phos, Uric acid), Radiographs	Supportive, Fluids, Oral lavage nutrition, If suspect hypocalcemia, give IV calcium gluconate until eyes open, + parenteral fluids, Appropriate treatment for other etiologies

RULE OUT CHART FOR LIZARDS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Reluctance to move	Metabolic bone disease (fibrous osteodystrophy), Cellulitis, Trauma, Renal failure, Dystocia	History, Diet, Blood calcium and phosphorus, Weight, Radiographs, Physical exam (gentle)	If vigorous: oral calcium gluconate and exposure to UVB light or 2 hours sunshine daily, If prone with muscle fasiculations: injectable calcium gluconate; then calcitonin, Full spectrum lighting, Diet correction, Fluids
Swelling (cutaneous or subcutaneous)	Abscess, Granuloma, Metazoan parasites, Foreign bodies, Neoplasia (rare), Pox-like lesions (chameleons, tegus)	Physical exam, C&S, Acid-fast staining, Histopathology, Cytology of exudate, Radiography, CBC	Surgical debridement, Topical creams, aqueous solutions, Systemic antimicrobials, Excise if granulomas, parasites, foreign bodies, neoplasia (if possible), Supportive care as needed, Screen for metastasis
Swelling (cutaneous or subcutaneous, nodular)	Papillomas, Herpesvirus, Reovirus, +/- Papovavirus-like particles	Histopath via biopsy/excision	Prevent contact with other lizards, Topical palliative treatment to prevent secondary bacterial infection
Swelling (skin)	Pox-like lesions (chameleons, tegus), Concurrent infection with chlamydia-like organism (chameleons)	CBC, Differential (inclusions in monocytes), Histopath, Biopsy	Prevent contact, Sanitation, Topical Rx to limit secondary infections
Tachypnea	Hyperthermia, Heat stress	History, Ambient temperature, Observation: animal may retreat to water bowl, press body to cool surfaces)	Slowly cool to preferred optimum body temperature or wrap loosely in cool, moist towel, SC fluids, Drugs to decrease brain swelling

RULE OUT CHART FOR LIZARDS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Trauma (digital/tail)	Avascular necrosis, Septicemia, Mycotoxicosis, Mycobacteriosis, Mycosis, Retained molted skin (inadequate humidity/ambient temperature)	History, Husbandry review, CBC, C&S, Radiographs if suspect infectious process	Amputation (if severe necrosis in lizards with tail autotomy), Suture toes (local anesthesia 1% lidocaine), Do not suture tail tip (encourage regrowth), Nonsurgical tail amputation preferred (lidocaine SC)
Trauma (oral)	Granulomas, Oral trauma secondary to infection: teeth, gingivitis, Bacterial, Fungal, Parasitic	Skull/dental radiographs, Oral tissue cytology, C&S	Flush/swab mouth with dilute tamed iodine or chlorhexidine, Systemic antimicrobial (>2wk), Supportive care, Assisted feeding (if necessary)
Trauma	Thermal burns, Other trauma	History, Husbandry, C&S burns, exudates, CBC/chemistries, Monitor electrolytes	Replace offending cage heaters, Properly set lights/heaters, Gently clean with dilute tamed iodine or chlorhexidine and rinse, Use water-soluble antibiotic or water-soluble disinfectant or cream, Systemic antibiotic therapy, Fluid therapy, Weigh daily to check hydration
Trauma	Wounds	C&S open wounds, History, Review management	Supportive, Clean, Flush, Debride, Repair wounds, Sutures may stay in, Antibiotics systemically plus topically, Correct housing

AMPHIBIANS

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of amphibians and is not intended to replace comprehensive reference material.

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AMPHIBIANS

Classification

Anura (tailless adults, frogs and toads)
Caudata (adults with tails: newts, salamanders)
Apoda (tropical legless species)

Common Species

African bullfrog *Pyxicephalus adspersus*
African clawed frog *Xenopus laevis*
Bullfrog *Rana catesbeina*
Colorado River toad *Bufo alvarius*
Fire-bellied toad *Bombina* sp.
Green tree frog *Hyla cinerea*
Leopard frog *Rana pipiens*
Marine (cane) toad *Bufo marinus*
Mexican axolotl *Ambystoma mexicanum*
Mudpuppy *Necturus maculosus*
Poison dart frogs *Denbrobates* sp.
Tiger salamander *Ambystoma tigrinum*
White's tree frog *Litoria caerulea*

Diet - General

- Offer variety of appropriate foods.
- Increase nutritional value during winter by "gut loading" meal worms, super worms or wax worms in nutrient-rich medias.
- Crickets should be fed for 3 days on 4 parts laying mash to 1 part calcium carbonate or a commercial cricket diet. An organic formulated avian diet has also been successfully used.

Diet - Salamanders

- Insects, invertebrates, earthworms, slugs
- Terrestrial: aphids, fruit flies, caterpillars
- Aquatic: tubiflex worms, daphnia, freshwater shrimp, earthworms, insect larvae

Diet - Frogs & Toads

- More terrestrial species are insectivorous: fruit flies, crickets, meal worms, wax worms
- Large toads may eat mice, rat pups
- Aquatic species: insects, earthworms, fish, crayfish, meal worms, tubiflex worms, fish, or commercially prepared diet
- Feed in the water.

Diet - Tadpoles

- Feed filamentous algae - grows "spontaneously" in a tub of water left in the sunlight.
- Boiled dark greens may be substituted short-term for algae.
- Vitamin C is essential in tadpole diets.
- Feed frequently or they will cannibalize each other.
- Stop feeding as their legs emerge and mouth widens.
- 30% dry weight protein gives optimal weight gain.

Housing

Optimal Environmental Conditions:

- Temperate species salamanders: 10-16°C (some believe above 20°C, they can't eat enough to maintain body weight; increase metabolism and decrease assimilation.); Tropical salamanders: 15-20°C (+ very high humidity).
- Temperate frogs: 20-25°C; Tropical frogs: 25-30°C.
- Monitor both air and water habitats for temperature; monitor air humidity.
- Aquarium heaters are suitable for water heating. Reptile under/side tank style heaters work well for "land" section.
- Avoid sunlight/heat lamps - may decrease humidity and desiccate an amphibian.
- Full spectrum lighting on timer; nonbreeding cycle = 14 hr light, 10 hr dark.
- Maintain aquatic & larval forms in dechlorinated water.
- Optimal pH of water varies with species and stage of development; usually 6.5-8.5
- Water quality, cleanliness are essential; standard fish filtration systems adequate only for "gilled" amphibians; all others need daily entire water change. Siphon from the bottom to remove particulates, feces, debris.
- Frequency of water changes increased if biomass of system is high (lots of waste material, uneaten foods).
- Always wear gloves and face protection while cleaning amphibian tanks to prevent zoonotic disease exposure.

Preventive Care

- Quarantine all new acquisitions.
- Screen with appropriate diagnostic tests (blood work, radiographs, parasitic exams and washes).
- Practice good husbandry (appropriate housing, nutrition, lighting, temperature, humidity).
- Avoid mixing species.

Restraint

- Most species are fairly docile.
- Large toads, hellbenders, giant salamanders may bite; control head.
- All amphibians have mucous secretions, so are slippery. Rough handling and/or drying out may abrade epithelium = portal for infectious agents.
- Fine mesh nets can be used to transfer individuals from tank.
- For giant salamanders that resent being moved, use a small plastic container - immerse & entrap.
- Wet paper towel or smooth (linen-type) dishcloth is useful in wrapping loosely for exam, gavage, medications.

A small frog may be restrained with one hand. Two hands may be necessary to control a slippery salamander.

Sexing

- Dimorphism (size) exists in some amphibian species.
- During the breeding season, dimorphism in some species may be more evident due to skin color changes.

Quick Facts - Biological

- Metamorphosis from egg to larvae to adult in most species.
- Skin is permeable to water, gases, electrolytes and ionized metals in both directions; systemic medications can be administered via dips (best in most permeable skin).
- Because of skin permeability, amphibians are highly susceptible to water toxins, pH changes, dehydration.
- Gills are present in some stage of life cycle.
- Respiration is via skin, oral cavity, gills, lungs.
- There are lungless forms that depend on cutaneous respiration.
- Skin has glands that secrete toxins; some secrete over whole body, some just via parotid glands behind eyes.
- Amphibians can change pigmentation in skin for camouflage.
- Terrestrial amphibians excrete urea.
- Aquatic amphibians excrete ammonia.
- Jacobsen's organ is present for detecting "odors" in water.
- Lateral line organs sense pressure waves in water and aid in

keeping balance.
- Amphibians have renal portal system.
- Lower temperatures (0-20°C) of the stated optimal range may be immunosuppressive, whereas the higher end temperatures may enhance immune responses.

Quick Facts - Reproductive

- Consult reference texts for reproductive strategies and requirements for various individual species.
- Environmental arrangements need to change to mimic natural settings.
- Environmental changes to induce reproduction = raining, misting, cooling, heating, lack of food, overabundance of food, varying day/night length.
- Light cycle may be varied in reproducing situations.
- Exogenous hormones may be used to induce or enhance reproduction (see Formulary).
- All hormone injections are given once per attempt at oviposition and fertilization.

Physical Examination

- Try to observe in usual environment if possible.
- Note alertness, color, position in water and posture, respiratory rate before handling.
- Moisten hands before handling.
- Observe heartbeat on ventral body surface.
- Minimize handling time.
- Replace in water or physioglocal saline bath periodically during prolonged exam or special procedure.
- Have moistened towel for animal instead of bare table.
- Wash hands well after handling to prevent zoonotic diseases.

Blood Collection

- Animal should be in dorsal recumbency.
- Cardiac puncture: 25 g needle under Xiphoid @ 10-15° angle to ventrum of body
- Venipuncture: central ventral abdominal vein

Clinical Pathology Sample Collection

- As in other species: culture swabs, skin scrapings for direct wet mounts, fecal flotation, direct wet mounts.
- Abdominal fluid tap from ventrolateral quadrant.
- Lymph: dorsal lymph sac or legs after animal held vertically so

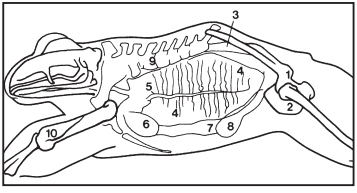
lymph accumulates in distal extremities; C&S lymph for systemic infections.

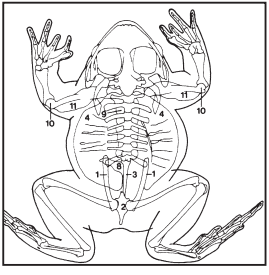
Radiology

- Cover with moist paper towel while positioning.
- Contrast media can be used (dilute 1:10 with water) to evaluate GI tract.
- Dental X-ray film provides good detail for small amphibians.
- Use water-filled plastic bag or container to minimize contact.

Radiographic Anatomy

Normal radiographic appearance of a male South American Bullfrog:





1. ilia
2. pelvis
3. sacrum
4. lungs
5. pulmonary vasculature
6. cardiac shadow
7. liver shadow
8. intestines
9. spinal bone formation
10. spherical elbow joint
11. tendon plates

Rübel, 1991

Hematologic Reference Ranges for Selected Frog Species*	
Erythrocytes:	307,700 - 565,800 mm^3
Leukocytes:	6,050 - 14,400 mm^3
Thrombocytes:	16,300 - 20,800 mm^3
Hemoglobin:	9.7 - 14.86 gm/dl
Early stages leukocytes:	0.7 - 1.5%
Neutrophils, juveniles:	1.1 - 1.5%
Neutrophils, granulocytes:	5.0 - 7.4%
Eosinophils, juveniles:	0.1 - 0.7%
Eosinophils, granulocytes:	0.5 - 18.7%

Basophils, juveniles:	0.1 - 0.7%
Basophils, granulocytes:	7.8 - 24.1%
Monocytes:	0.5 - 1.3%
Plasmocytes:	0.2 - 1.0
Lymphocytes:	52.0 - 68.5
** Rana esculenta, Xenopus laevis, Rana temporaria*	

Injection Sites and Medicating Routes

Intramuscular:	should be in front limbs (because of renal portal)
Subcutaneous:	dorsal area over shoulders
Intraperitoneal:	ventrolateral quadrant
Baths:	most common & effective, can be used for rehydration. Use isotonic solutions
Intravenous:	ventral abdominal vein
Intralymphatic:	usually easy and effective, locations vary among species (usually dorsal)

Common Clinical Conditions in Amphibians

(Isolate all ill animals and minimize handling.)

- Nutritional
- Toxicosis (chlorine, ammonia, lead, disinfectants, pesticides)
- Fungal infections
- Viral (Lucke's tumor herpesvirus, tadpole edema virus)
- Neoplasia (Lucke's tumor herpesvirus, renal adenocarcinoma)
- Corneal pathology (lipid keratopathy, edema, other keratopathies)

Zoonotic Potential

- *Mycobacterium* sp.
- *Basidobolus ranarum*
- *Aeromonas* sp.
- *Yersinia enterocolitica*
- *Listeria monocytogenes*
- *Leptospirosis*
- *Gnathostoma spinigerum*
- Trypanosomiasis
- Sparganosis
- *Chlamydia psittaci*?

Surgery

- Abdominal surgery - paramedian incision to avoid ventral abdominal vein.
- Always close skin with nonabsorbable suture material.

Euthanasia

- Overdose of barbiturates by intracardiac or intracoelomic routes.
- Overdose of MS-222 in water.
- Decapitation, freezing or pithing are considered inhumane.

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ANESTHESIA IN AMPHIBIANS

Drug	Species	Dosage	Comments
MS-222 (bath*)	Tadpoles, newts	200-500 mg/L	To effect
-	Frogs, salamanders	500-2000 mg/L	Buffer with $NaHCO_3$
-	Toads	1-3 g/L	Buffer with $NaHCO_3$
MS-222 (inj)	All	50-150 mg/kg	SC, IM
Benzocaine	Larvae	50 mg/L	Dissolve in ethanol first
-	Frogs, salamanders	200-300 mg/L	-
Ketamine	All	50-150 mg/kg	SC, IM
Isoflurane, halothane	All	4-5% - Bubble through water or place animal on moistened paper towels in induction chamber.	
-	-	Intubate: Use small endotracheal tubes (short tracheas) or flexible IV catheters.	
Methoxyflurane 3.0%	All	0.5 -1.0 ml 2 min. in Liter container (cotton-soaked)	Surgical anesthesia 30 min, recovery <7 hr

** Animal placed in low dish of MS-222 anesthesia solution for procedure. To reverse, rinse in clean water. Dopram hydrochloride use to stimulate breathing.*

RULE OUT CHART FOR AMPHIBIANS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Anorexia	Poor husbandry, Behavioral, Seasonal, Parasites, Infections, Toxins, Occular disease	Review husbandry (temperature & light cycle), C&S, CBC/chemistries, Fecal float/direct mount, Gastric wash, Radiography, Endoscopy	Treat underlying problem
Anorexia (abnormal stool, diarrhea or lack)	Foreign body impaction (gravel, twigs), Bacterial infections, Parasites, Toxins	Physical exam, Palpation, Radiography, C&S, Fecal exam, CBC/chemistries, Gastric wash, Endoscopy	Lubricants (impactions): mineral oil, cat laxative by gavage, mineral oil by enema, Retrieve via bronchoscope (if possible), Gastrotomy/enterotomy, Appropriate antibiotics, antiparasitics, Environmental cleanup
Anorexia (+ cottony-white growths)	Fungal infection (may be multi-organ, systemic), esp. *Saprolegnia*, Fungal infection secondary to trauma in skin, Saprophytic, Systemic fungal infections if kept too cool	Biopsy of affected areas, Exfoliative cytology wet preps	Topical antifungal (often curative), Systemic infections = poor response to treatment, Remove source of trauma, Topical antiseptics, Water changes
Bloat	Intragastric fermentation, Air-swallowing (aquatics)	Physical exam (congestion of skin, legs, abnormal distress movements)	Removal of air (stomach tube or transabdominal needle)
	Peritoneal effusions assoc. with *Aeromonas* infections	Radiograph, Peritoneal tap and evaluation of fluid	Treat underlying cause

RULE OUT CHART FOR AMPHIBIANS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Cloacal prolapse	Tenesmus, Local irritation, Parasites, Foreign bodies, Cloacal masses, Gastroenteritis	Physical exam, Fecal exam	Small prolapse may resolve spontaneously, Keep in water; If larger prolapse: reduce and replace as in other species, Eliminate underlying cause
Conjunctivitis	Bacterial infection, Trauma, Hypovitaminosis A (rare)	Culture, Cytology	Appropriate ophthalmic antimicrobial, Oral vitamin A, Improve diet
Diarrhea (enteritis)	Bacterial infection, Parasites, Toxic insult	Cloacal culture, Fecal exam for parasites, Check water quality	Appropriate antimicrobials, Parasiticides, Keep well hydrated, Supportive, Maintain optimal water quality
Edema, ascites (+/- abdominal enlargement)	Abscess, Coelomic mass, Organomegaly, Hepatopathy, Hypoproteinemia, True ascites, Viral, bacterial infection, Water quality, Parasites, Organ failure, Water osmolarity change	Physical exam, CBC/chemistries, Culture lymph, Test water, Radiograph, Abdominal tap, evaluation of fluid, Fecal parasite exam	Supportive, Treat underlying etiology, Correct water osmolarity
Lethargy	Environmental factors, Nutrition, Possible chlamydia	Review husbandry & diet, C&S, CBC/chemistries	Appropriate therapy, Possible oxytetracycline for chlamydia
	Bacterial or fungal infection, Parasites, Toxic insult, Foreign body, Granulomas	Physical exam, C&S, Husbandry review (water quality), Tracheal wash, Cytology of skin, Radiography	Appropriate antimicrobials, Toxin antidote, Surgical curette or excision (granulomas), Remove foreign body
Masses (nodular, musculoskeletal)	Parasites, Bacterial abscesses, *Mycobacterium* sp., Neoplasia	Aspiration/biopsy, Cytology, C&S, Acid fast stain, Radiographs	Excision if possible (neoplasia or parasitic), Drain abscess, Appropriate antiparasitics, antimicrobials

RULE OUT CHART FOR AMPHIBIANS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Neurologic signs	Septicemia, Trauma, Thiamine or vitamin E deficiency, Toxins	Radiography, C&S, Husbandry review (water quality), Review handling	Vitamins B_1, E, Appropriate antimicrobials, Supportive care
Ophthalmic disorder (conjunctivitis)	Bacterial infection, Trauma, Hypovitaminosis A	C&S, Cytology, Review diet	Appropriate antimicrobials, Vitamin A, Correct diet
Ophthalmic disorder (corneal edema)	Poor water quality, Trauma	Ophthalmic exam, Stain, History, Test water, Review husbandry, Cytology	Correct water quality (may need to raise salinity), If injury, appropriate antimicrobials
Ophthalmic disorder (keratopathy)	Idiopathic hypercholesterolemia, Trauma, Environmental insult	CBC/chemistries, Review diet, husbandry, Ophthalmic exam, Stain, Corneal cytology, Possible C&S if Gram's stain indicates	Supportive, Diet evaluation, Topical ophthalmic as in other species, For trauma, appropriate antimicrobials
Ophthalmic disorder (ophthalmitis)	Bacterial infection (eye), Septicemia	C&S cornea, exudates, lymph, CBC/chemistries, Cytology	Antimicrobials
Orthopedic disorders	Fractures, Trauma, Nutritional deficiency (Calcium: phosphorus imbalance, Vitamin D deficiency), Congenital defects	Radiography, Review diet and husbandry	Correct husbandry & nutrition, Splint fractures (use non-water-soluble materials such as acrylics), External fixation, Supplement diet with calcium, Provide access to sunlight or UV light
Poor condition	Nematodes, Cestodes, Septicemia, Pneumonia secondary to larval migration	Review husbandry, Fecal float/direct smear, Cytology, C&S lymph, Tracheal wash	Appropriate antimicrobial & antiparasiticide, Change substrate

RULE OUT CHART FOR AMPHIBIANS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Poor condition	Liver degeneration: parasitic, dietary (hypervitaminosis A), Environmental toxins	Diet history (excess vitamin A in raw liver diet), Biopsy, CBC/chemistries, Review husbandry, water quality, Parasitic screening	Feed balanced varied diet, Appropriate antiparasitics
Poor condition (tadpoles)	Renal calculi	Husbandry review (oxalate toxicity due to overfeeding spinach)	Feed varied foodstuffs
Regurgitation	Parasites, Foreign bodies, Bacterial infections	C&S GI, Gastric wash, Cytology, Endoscopy, Radiography, Fecal exam for parasites	Appropriate anti-parasites, antimicrobials
Skin discoloration (erythema)	Behavioral/seasonal, Thermal stress, Early bacterial infection, Gas bubble disease	Review husbandry, CBC/chemistries, C&S water, skin, lymph	Correct husbandry, Antibiotics per sensitivity, Decrease aeration to water
Skin discoloration (petechiation or ecchymosis)	Bacterial septicemia, Cutaneous insult, Toxic insult, Clotting disorder, Viral infection	C&S water, skin, lymph, Review husbandry	Antimicrobials based on sensitivity, Clean water, Vitamins B & K, Supportive, No treatment (viral)
Skin discoloration (nonspecific, pigmentation change)	Behavioral, Chromomycosis, Algae, Trematodes	Cytology of skin, Review husbandry, water quality	Appropriate antimicrobial, antiparasitic, Improve water quality
Skin lesions (cottony material)	Fungal (skin, gills, multi-organ)	Culture, Cytology of cutaneous swab, Biopsy	Topical antifungal, If systemic may not respond
Skin lesions (erosion/ulceration)	Bacterial, Fungal, Mycobacterial infection, Parasites, Chemical insult	C&S biopsy lesion, Acid fast and Gram's stain of cutaneous swab, Wet mount skin	Improve water quality, Appropriate antimicrobial/antifungal

RULE OUT CHART FOR AMPHIBIANS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Skin nodules	Mycobacterial infection, Parasitic granuloma, Mites, Bacterial abscess, Fungal infection, Neoplasia	Needle aspirate, Biopsy, Acid fast stain, Culture, Cytology, Radiograph	Improve water quality, Appropriate antimicrobials, antiparasitics, Excision if possible, *Mycobacterium* spp: isolate, wear gloves and mask
Swelling, abdomen	Retained ova	Observe and monitor closely, Radiographs, Ultrasound	If gravid female, ensure external stimuli (temperature, cue, housing sites) to induce oviposition, Oxytocin, Hormonal therapy
	Ascites, Peritonitis, Coelomic mass, Organomegaly, Hepatopathy	Physical exam, CBC/chemistries, C&S lymph or abdominal tap fluid, Radiographs, Biopsy	Supportive, Treat underlying etiology
Swelling, subcutaneous	Tadpole edema virus, Bacterial infection, Parasites, Renal failure	Test water, C&S, CBC/chemistries, Fecal float/direct smear, Necropsy, Histopathology	Appropriate antibiotics or antiparasitics, Improve water quality, No Tx virus, renal failure
Tachypnea	Thermal stress, Behavioral stress, Poor water quality	Check water quality, Observe behavior	Correct husbandry
Weakness	Nutritional deficiencies, Generalized infection, Poor husbandry	Review of diet, Biopsy, Necropsy, Radiographs, C&S lymph	Appropriate antimicrobial, Correct environment and diet, Supplement vitamins and minerals
Weight loss	Mycobacterial infection, Fungal infections, Parasites	Radiography, CBC/chemistries, Cloacal culture, Acid fast stains, Liver biopsy, Fecal exam	Appropriate antibiotics, antiparasitics, antifungals

FORMULARY FOR AMPHIBIANS

Drug	Dosage
Acriflavine (bath*)	500 mg/L for 30 minutes or 0.025% in water for 5 days
Amikacin	5 mg/kg SC, IM, IP q24-48h
Benzalkonium chloride	1:4,000,000 change water 3x weekly (for saprolegniasis)
Benzalkonium chloride (bath*)	0.25 mg/L bath 72h or 2 mg/L dip 1 hr q24h to effect
Carbenicillin	200 mg/kg SC, IM, IP q24h
Chloramphenicol	50 mg/kg SC, IM, IP q24h
Chloramphenicol	20 mg/L bath, change daily
Copper sulfate (bath*)	1 mg/ml or 0.5 parts per trillion for 1 min or 500 mg/L dip for 2 min daily to effect
Distilled water (bath*)	2-3 hours
Enrofloxacin	1.5-10 mg/kg IM, SC; 0.3 mg/ml bath
Fenbendazole	10 mg/kg PO once
Formalin 10% (bath*)	1.5 ml/L dip 10 min q48h to effect
Gentamicin	0.45-5.0 mg/kg SC, IM, IP q24h x 5 days (use with caution, may cause nephrotoxicity) 2-4 mg/kg q72h IM x 4 Rx for salamanders 5 mg/L H_2O dip 1 hr per day
Gonadotropin-releasing hormone (GnRH)	100 μg/kg IM, SC, inject females 8-12 hours before males
Human chorionic gonadotropin (HCG)	2,000-5,000 IU/kg IM (or SC in dorsal lymph sac) *Xenopus* sp = 300-400 IU IM, SC *Ambystoma* sp = 250 IU IM, SC to females, 300 IU IM, SC to males
Hypertonic saline (bath*)	6 g NaCl/L for 5-10 minutes 4-6 g NaCl/L bath 25 g NaCl/L dip for 10 minutes
Ivermectin	0.2 mg/kg SC once (except *Rana* sp.)
Ivermectin	2.0 mg/kg topical on thorax (*Rana* sp.)
Ketoconazole	10 mg/kg PO q24h
Levamisole	300 mg/L bath for 24 hrs
Levamisole	10 mg/kg BW IM once, rpt in 2 wks
Malachite green (bath*)	0.15 mg/L water dip 1 hr daily to effect
Mebendazole	20 mg/kg PO once, repeat in 2 wks
Mercurochrome	3 mg/L bath for 72 h
Methylene blue (bath*)	2-4 mg/L bath to effect
Metronidazole	500 mg/100 g food for ciliates for three to four feedings
Metronidazole	10 mg/kg PO q24h x 5 treatments 100-150 mg/kg PO; repeat in 10-14 d

FORMULARY FOR AMPHIBIANS

Drug	Dosage
Metronidazole	500 mg/L water (bath*, aquatic species)
Nalidixic acid	10 mg/L bath to effect
Nitrofurazone	10-20 mg/L bath chg daily; to effect
Oxytetracycline	1 g/kg diet for 7 days
Oxytetracycline	50 mg/kg PO q12h or 25 mg/kg SC, IM q24h
Paromomycin	55 mg/kg PO; repeat in 14 days 25 mg/kg; repeat in 7 days
Potassium permanganate (bath*)	1:5000 dip for 5 min or 7 mg/L water dip for 5 min daily to effect
Pregnant mare serum gonadotropin (PMSG)	50 IU IM or SC, then 600 IU in HCG IM, SC after 72 hours
Ronidazole (bath*)	6 grams of a 10% formula in 10 liters of water for 10 days
Saline (bath*)	0.6% sodium chloride for 3-5 days
Spiramycin	125 mg/kg q24h
Sulfadiazine	132 mg/kg q24h
Sulfamethazine	1 g/L bath change daily to effect
Tetracycline	50 mg/kg PO q12h
Trimethoprim/sulfa	3 mg/kg SC, IM, PO q24h

* Therapeutic baths for aquatic amphibians. Make up in separate container - temperature same as in home tank. Do not put chemical in home tank.
Special formulations and some manufacturer discontinued drugs can be obtained from Mortar and Pestle 800-279-7054.

NOTES

Invertebrates

Tarantulas 1

Tarantulas

The information presented here has been compiled from the literature. It is intended to be used as a quick guide to selected husbandry and medical topics of pet tarantulas and is not intended to replace comprehensive reference material.

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TARANTULAS Suborder - **Mygalomorphae** Family - **Theraphosidae**

Phylum: *Arthropoda;* Subphylum: *Chelicerata;* Class: *Arachnida*
Suborder: *Mygalomorphae* (or *Orthognatha*)
Family: *Theraphosidae* (also known as *Aviculariidae* or *Mygalidae)*

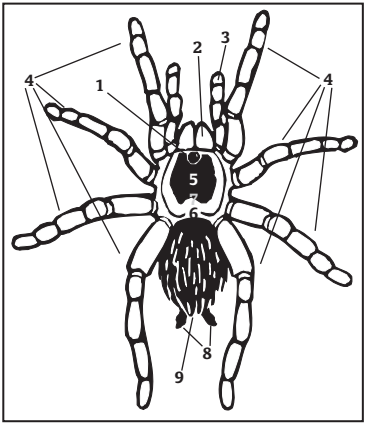
Common Species and Variations

- Species in pet trade:
  Aphonopelma eutylenum: Brown tarantula, California Brown, native to southern California
  Aphonopelma chalcodes
  Euathlus (Brachypema) smithii: Red-kneed, South American/ Mexican Red-kneed tarantula
  Grammostola spathulata: Rose-haired tarantula
  Lasiodora klugi: Bahia, Scarlet, bird-eating or monkey tarantula
  Theraphosa leblondi: Goliath bird-eating tarantula
- The Mygalomorphs include the largest spiders.
- In the U.S., it is the "hairy mygalomorphs" that are called tarantulas.
- In Europe, the term "tarantula" is reserved for *Lycosa tarentula*, a harmless wolfspider (suborder Araneomorphae).
- Nomenclature varies between the scientific literature and the common, trade names for many of the species.
- Many of the species have multiple names in the pet industry, and ascertaining the scientific name may be crucial to determining if the species is a desert or a tropical one, which in turn determines proper husbandry and care.
- Hairy mygalomorphs are also known as "bird-eating or bird spiders." In Africa, these may be known as "monkey or baboon spiders."
- There are about 30 species that occur in the U.S. (mostly in the Southwest), as well as a number of species from Central/South America and Africa.
- Most tarantulas in the pet trade in the U.S. are native to the western hemisphere.
- Common names in the pet trade that may represent more than one species: Mexican Hairy, Mexican Red-leg, Blonde, Haitian Black, Honduras Black Velvet.
- Arid, desert habitat tarantulas include Mexican Red-leg, Mexican Red-kneed, Hairy, California Brown and Blonde.
- Tropical habitat tarantulas include South American Red-kneed, Haitian Black and Honduras Black Velvet.

Basic Anatomy and Physiology

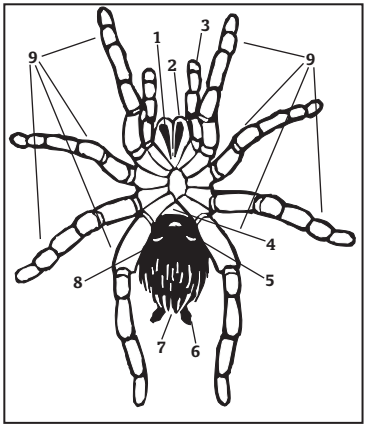
- The body consists of two sections: a cranial segment, "prosoma or cephalothorax," and a caudal segment, "opisthosoma or abdomen," joined by a narrow waist, "pedicel."
- Attached to the prosoma (cephalothorax) are: four pairs of walking legs, one pair of chelicerae (paired, pincer-like appendages used in feeding), and one pair of pedipalps (second pair of appendages used for transfer of spermatozoa to the female).
- Four pairs of eyes (without eyelids) are mounted on the carapace. There are two kinds of eyes: one pair of primary eyes with a lens and direct-type retina, and three pairs of secondary eyes with retinal cells faced away from the light source (indirect type retina). Tarantulas have a tapetum lucidum for night vision. They are nearsighted.
- On the ventral opisthosoma (abdomen) are apertures (spiracles) leading to two pairs of book lungs.
- Hairy mygalomorphs do not have tracheae, although these are present in most other species of spiders. There is also a genital pore, and usually two pairs of spinnerets (some spider species have three).

Dorsal View of a Hairy Mygalomorph



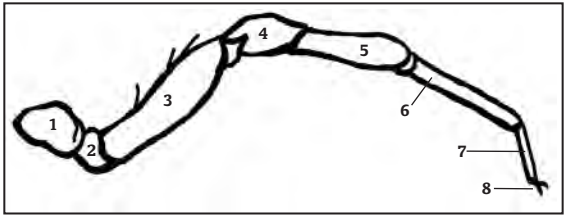
1. eyes
2. chelicera
3. pedipalps
4. walking legs
5. carapace
6. area of pedicel
7. apodeme - small craterlike depression in the carapace. Underneath it is where the leg muscles attach.
8. spinnerets
9. anus

Ventral View of a Hairy Mygalomorph



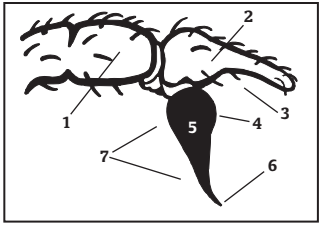
1. fang
2. chelicera
3. pedipalp
4. pedicel
5. genital opening
6. spinnerets
7. anus
8. lung spiracle
9. walking legs

Anatomy of the Spider Leg



1. coxa
2. trochanter
3. femur
4. patella
5. tibia
6. metatarsus
7. tarsus
8. tarsal claw

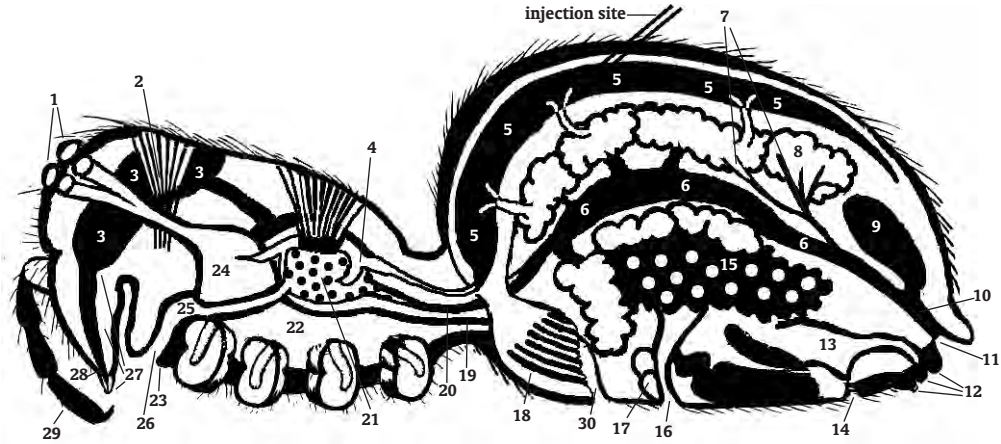
Schematic of the Male Pedipalp with the Cymbium



1. tibia
2. tarsus
3. groove in tarsus where cymbium is stored (alveolus)
4. bulbus
5. spermaphore - stores sperm
6. embolus - contains ejaculatory tract
7. cymbium - copulatory organ

Internal Anatomy of a Female Hairy Mygalomorph

See figure legend on next page.



Internal Anatomy of a Female Hairy Mygalomorph

1. eyes
2. pumping pharynx
3. poison gland
4. aorta
5. heart
6. middle intestine
7. malpighian tubules
8. digestive gland
9. cloaca
10. rectum
11. anus
12. spinnerets (2 pair)
13. silk glands
14. trachea
15. ovary
16. genital pore
17. seminal receptacles
18. book lung
19. central nervous tissue
20. intestine
21. sucking stomach
22. "brain" nervous tissue
23. labium
24. brain
25. pharynx
26. mouth
27. chelicera
28. poison duct
29. pedipalp
30. spiracle for book lung

Circulatory System

- The heart pumps blood through the aorta and into sinuses among the tissues; it then passes to the book lungs for aeration, returning via "pulmonary veins" to the pericardial cavity to reenter the heart through the ostia.
- Arachnid blood is colorless, contains amoeboid corpuscles and dissolved hemocyanin as the respiratory pigment.

Digestive System

- The digestive system includes the mouth, a slender esophagus connecting it to a sucking stomach in the cephalothorax (foregut) and the straight intestine, which has many ducts or diverticula into the large digestive gland, and extends to the rectum and anus.
- There is an enlarged "cloaca" or stercoral pocket prior to the rectum that collects digested waste and urine formed by the paired malpighian tubules connected posteriorly to the intestine.
- Another excretory product that is used in digesting prey is eliminated via coxal glands in the floor of the cephalothorax, which empty by ducts between the walking legs. This excretion is rich in sodium, although some of this sodium remains in the prey after it is fully digested.
- The major excretory product of protein digestion is guanine. Freshly deposited guanine is excreted as a white slurry, that is pasty-to-firm and chalk-like in consistency.
- Under weekly feeding schedules, guanine is passed at approximately two-week intervals. It is relatively insoluble and may

accumulate if the tarantula becomes dehydrated.
- Sufficient water must always be available to prevent "constipation."

Cuticle

- The cuticle should be smooth, intact, and have a satin gloss. It forms the exoskeleton and is made of chitin (polymerized polysaccharides).
- The cuticle is thinner and more supple on the opisthosoma than on the prosoma so it can accommodate volume changes due to breathing and feeding.
- In the starving or dehydrated spider, the abdomen may have a puckered or shriveled look.

Extremities

- The extremities are hollow bulges of the cuticle filled with muscles, nerves, and circulatory vessels.
- At the joints, the cuticle is thinner to allow bending. The extremities are bent by muscles and can be extended by a rise in hydrostatic pressure.
- The walking legs have seven segments. The joint sections are named and correspond to vertebrate legs.
- The pedipalps lack the metatarsal segment. They serve as tactile sense organs, and are used in feeding, and in the males, to transfer the sperm to the female.

Urticating Hairs

- The urticating hairs on the dorsal opisthosoma are used in self-defense.
- When threatened, a tarantula faces its opponent and flicks its hind legs quickly through these hairs. A cloud of prickly hairs is thrown into the face of the attacker, which may allow the spider a chance for escape.
- These hairs can cause irritation to human eyes, mucous membranes, and even bare skin, so it is advisable not to hold the tarantula near your face!
- The hairs consist of a smooth basal part, which remains attached to the spider, and a barbed part. The barbs facilitate deep penetration.
- There are four types of barbs (I to IV). The native American species have the least irritant type I. *Euathlus (Brachypema) smithii*, Mexican Red-kneed tarantula, has type III, which is most likely to penetrate human skin.

Molting (Ecdysis)

- Shedding of old cuticle occurs at varying rates: from twice yearly up to every two years.
- It is replaced with a soft new cuticle that allows growth until it is hardened.
- During this period of molting and hardening of the cuticle, the spider is vulnerable, should not be handled, and should be left alone!
- The process is easier and quicker in younger tarantulas.
- The first sign of ensuing ecdysis is the change to a darker color. The tarantula then stops eating, finds a suitable place on the ground or in a protective web and becomes motionless.
- During this period the new cuticle is secreted beneath the old one and part of the old cuticle is resorbed.
- Ecdysis is induced by a hormone, ecdysone, and starts by a tearing of the seam between the carapace and sternum. Movements of the spider enlarge this tear, which continues over the opisthosoma, opening up the cuticle. Further movements free the legs.
- Ecdysis is facilitated by a fluid between the old and new cuticle. This fluid is resorbed just prior to the opening of the cuticle and the space left is filled with air.
- When the spider is completely freed it will stay in its hiding place to “blow up” the new cuticle to as large a size as possible.
- Continuous flexing and extending of the legs keep the joints supple while the segments harden.
- Ecdysis can take one or more hours. Do not interfere or “help” the spider as this may injure or kill it.
- During molting, a higher humidity is required.
- If a male breaks off a pedipalp or cymbium, he will not regrow it, as males do not molt after reaching maturity. Females are able to molt after maturity.

Reproductive System

- Sexual maturity occurs after approximately 7 molts or from 3-12 years of age (dependent on species). Females may have more molts before maturity than males.
- The male has two tube-like testes with their respective vas deferens that fuse at the genital pore.
- Sperm is collected from the genital pore and stored in the cymbium, the specialized copulatory structure on the male’s pedipalps.

- The female has paired ovaries that empty into a single uterus.
- The transition of the uterus to the vagina is marked by the openings of at least two spermathecae (where the sperm is stored after mating) and several accessory glands.

Sense Organs

- Tarsal organs (chemoreceptors) on the pedipalps and the end segments of the walking legs "smell" food and water.
- Hairs at the end of the walking legs have a function in taste.
- The body is covered with tactile hairs that react to movement independently.
- Trichobothria (fine hairs standing straight on a membrane in a dimple in the cuticle) are found on certain segments of the walking legs. The hair can move in all directions and is innervated by a few nerve endings so the direction can be detected. The smallest displacement of air is detected and aids in sensing distance.
- The slit organs in the cuticle sense changes in cuticle tension through movements of the spider itself, gravity or vibrations in the environment.
- Thermoreceptors are thought to be present, but have not been anatomically identified.

Digestive Flora

- Normal flora cultured from healthy *Euathlus (Brachypema) smithii* and *Aphonopelma* sp. included: *Staphylococcus aureus*, *Staphylococcus* sp., *Bacillus megatherium*, *Pseudomonas diminuta*.
- It is thought that many pathogens are gram-negative bacteria.

Behavior

- Tarantulas are solitary animals except at breeding.
- They are very territorial and may cannibalize others within a captive environment.
- Captive mature males may become aggressive during the mating season.
- All tarantulas are primarily nocturnal feeders.
- Arid, desert habitat tarantulas (Mexican Red-leg, Mexican Red-kneed, Hairy, California Brown, Blonde) are primarily ground-dwelling.
- Tropical habitat tarantulas (South American Red-kneed, Haitian Black, Honduras Black Velvet) are primarily arboreal.
- Generally only males are captured for the pet trade because females stay in their underground burrows.

DEVELOPMENTAL DATA ON SELECTED TARANTULA SPECIES

Species	Development	Number of Molts to Adult	Adult Life Span	Total Life Span
E. californica male (female)	11-12 yr (12-13 yr)	22 (not reported)	a few months (>10 yr)	not reported (>20 yr)
Grammostola male (female)	4 yr (not reported)	not reported	not reported (13 yr)	not reported (>25 yr)
D. hentzi male (female)	9-10 yr (9-10 yr)	15 (15)	1-3 mo (16 yr)	not reported
P. cancerides	not reported	not reported	not reported	22-24 yr
A. smithii	not reported	not reported	not reported	26 yr
A. avicularia male (female)	2-2.5 yr (2.5-3 yr)	10-13 (11-14)	5-7 mo (>8 yr)	3 yr (>10 yr)
P. lesserti	3 yr	not reported	not reported	not reported
Pterinochilus male (female)	500 days (not reported)	not reported	not reported	2.5-3 yr (5-6 yr)
S. griseipes male (female)	394-581 days (483-604 days)	8-10 (9-11)	71-266 days (>10 yr)	535-678 days (>12 yr)
A. sternalis male (female)	4-6 yr (6 yr)	16-20 (20-21)	11 mo-2 yr (11 yr)	8 yr 7 mo (>18 yr)

Diet

- Feed a varied diet: newborn mice, crickets, grass-hoppers, beetles, other tarantulas, spiders, moths, small lizards, frogs, meal worms, waxworms. Little is known about special dietary requirements.
- Food should be fed live, as dead prey may be rejected or go unnoticed.
- Prey should be of a size similar to the spider. It should be offered once a week.
- The owner should observe eagerness of the spider to eat and adjust the feeding frequency accordingly.
- Prey animals that are not eaten within 24 hours should be removed.
- Prey should be introduced in the early evening.
- Dusting the prey with a complete vitamin/mineral powder prior to feeding it to the tarantula may be beneficial.
- A known nutrient important for cuticle health is the amino acid tyrosine.
- Captive-bred insects are considered superior to wild-caught as they usually have been fed optimal diets.
- If the owner insists on catching insects for food, advise them to consider environmental conditions including exposure to cars, industrial fallout, pesticides or agricultural products in the area of capture.
- Do not feed known poisonous insects.
- During feeding, the opisthosoma (abdomen) can increase up to two times its original volume. Feeding on a very large prey item may take as long as two days.
- A tarantula may sit motionless for hours or even days, and then pounce on food.
- Drinking water should be provided in a shallow dish that is large enough to allow the spider to tilt itself easily onto the water's surface, but not so deep that the animal might topple in and not be able to crawl out.
- An alternative is a wet piece of cellulose sponge, though care must be taken to prevent it from getting moldy.

Housing

- Tarantulas must be housed individually.
- A terrarium, glass or plastic fishbowl or aquarium, with a screened, well-clamped or locked lid works well.
- Silk lines can be used by the tarantula to climb to any surface, and escape if the lid is not very heavy or firmly fastened.

- A volume of at least three gallons (12 liters) is suitable.
- Appropriate substrate may include pea gravel, large size aquarium gravel, Astroturf or recycled paper pellets (consider the ease of sanitizing).
- Habitat for tropical tarantulas (South American Red-kneed, Haitian Black, Honduras Black Velvet) may require additional humidity, but moisture must not be allowed to accumulate under bedding as algae/fungi/molds may grow.

Accessories

- Accessories are necessary in the tarantula enclosure: they can be arranged to form dens and burrows as hiding places, hunting areas and shelter from light.
- Examples of accessories are rocks, pieces of clay pots, non-resinous wood, toilet paper rolls, small boxes or plastic pipes.
- Arboreal/tropical species need branches.
- Artificial or potted live plants (nontoxic plants from native habitat) are useful and should be potted in sterilized potting soil.

Light

- Full spectrum lighting is acceptable as well as red, blue or ultraviolet lighting used for reptiles.
- Luminosity may be minimal as most tarantulas hide during "daylight" hours.
- Avoid direct sunlight as the tank may overheat and kill the tarantula.
- A 12-14 hour day/night cycle on a timer works well.
- Do not depend on the light as a heat source!

Humidity

- Desert species: tank humidity should be low. No moisture should appear on the tank flooring or walls. (May be increased to approximately 50% during ecdysis).
- Tropical species: humidity should be approximately 70%. Plants and accessories can be misted or large, very shallow water dish(es) can be provided.
- The substrate must remain dry.

Heat

- Temperatures need to be in optimal range for activity: 73.4°F (23°C) to 86°F (30°C); rule of thumb: night temperature of air in the tank, when the tarantula is active, should be about 80°F (27°C).

- Heat sources: under-tank platforms, heating sheets/cables or pads that should cover approximately half the bottom of the container, and perhaps part of one side to create temperature gradients (similar to set-up for reptiles).

Disinfection

- Thorough cleaning and disinfecting of the housing should be done several times a year. Bedding should be changed at least monthly to prevent accumulation of wastes, food items or molds.
- Feces, prey remains, and sloughs should be removed as quickly as possible to prevent bacterial and fungal contamination. (The sloughs should be examined for completeness.)
- Recommended disinfectants for housing and accessories after removal of organic material: 10% bleach solution (sodium hypochlorite), quaternary ammonium, or glutaraldehyde. All should be rinsed many times and allowed to air dry (follow safety guidelines as for birds, amphibians and reptiles).
- Detergents, disinfectants, cleaning chemicals, insecticides/pesticides are potentially toxic to tarantulas and should not be used in rooms where tarantulas are housed.

Sexing

- Males are often smaller and more slender than females. Males have proportionately longer legs.

Male Reproductive Behavior

- Approximately two weeks after its final molt, the male tarantula will build a sperm web, a sheet-like web hung closely over the ground.
- Laying on his back, he positions himself between the web and the ground.
- In this position, he deposits a drop of sperm on the web. He then climbs back on top of the web, reaches beneath it with his outstretched pedipalp, and collects the sperm in his cymbium.
- This process is called sperm induction, and may take as long as three hours. He then destroys the web.
- With his cymbii loaded, that night he will go in search of a female.
- The chemotactic hairs on his legs detect pheromones or silk wires of the female of his species.
- When he finds one, he taps the wires, and the female will emerge from her hiding place.

- She will stand on her rear legs, not out of aggression, but to present her fangs to the male, so that he can place them behind the tibial spurs on his first pair of legs.
- The male then pushes the female upwards so her genital pore is within his reach, and positions himself under her. He puts his cymbii, one after the other, in the female's genital pore where he deposits his sperm.
- The sperm is stored in the spermathecae until it is needed to fertilize the eggs. Sperm held in the spermathecae may be viable for at least six months to a year (variable among species).
- Copulation often takes no longer than a minute. When finished, the male quickly runs away, although females are seldom aggressive towards their mates.
- Arboreal species mate on a vertical surface so it is important to supply them with a steady surface that provides adequate grip.

Female Reproductive Behavior

- Optimal conditions are needed for successful mating in captivity: a male with fresh sperm in his pedipalps, and a well-fed, recently molted adult female.
- The female should not be overfed, because she may molt again in a shorter interval than usual and lose the stored sperm in the spermathecae with the molted exoskeleton.
- Sometime after mating the female will weave a small web.
- She deposits her eggs on the web, and pours the sperm over them.
- She then weaves a second web to cover the eggs. Both webs are joined and wrapped in silk to form a cocoon (the egg sac).
- Dependent on the species, the egg sac may be hidden in the burrows or carried around attached to the spinnerets.
- The number of eggs per egg sac, and the number of egg sacs per season is species dependent.
- Most tarantulas lay eggs at regular intervals during their adult lives.

Care of the Egg Sac

- During periods of molting, egg laying, and caring for the egg sac, the ambient temperature and humidity should be increased, but if the egg sac is too damp, it may mold.
- If the egg sac is infected, or the female tarantula is stressed or disturbed, she may eat the sac.
- To prevent this, it is possible to artificially incubate the sac.

The sac has to be turned over several times daily, the correct temperature and humidity need to be established, and the egg sac should be disinfected.

- If at all possible, it is advisable to present to the mother spider an optimal habitat with temperature and humidity range so that she can choose the ideal location.
- Placement of heat source at one end of the habitat, and a shallow water dish in another corner is usually adequate. Then leave her alone except for refilling the water container during the day, and checking on temperature and humidity until they hatch!
- Food should not be offered to the female until young are present, as most do not feed while they are taking care of an egg sac.
- Young will need food appropriate for their size, and in most captive habitats, it is advisable to remove them to a new habitat after hatching.

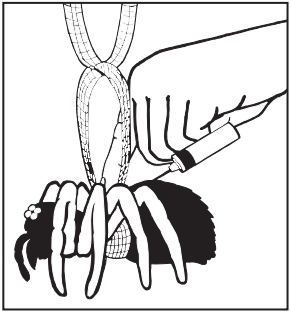
Number of Eggs Laid in Egg Sac and Time Elapsed Between Laying and "Hatching" in Some Theraphosidae

Species	Number of Eggs	Time Elapsed (days)
Acanthoscurria sternalis	1050-1130	18-20
Acanthoscurria sp.	700-800	-
Aphonopelma chalcodes	454-555	39+
Avicularia avicularia	97-120	30
Ceratogyrus darlingii	60	13
Dugesiella hentzi	500-1000	45-65 (56)
Eurypelma californica	621-1018	50-53
Grammostola lasiodora	400-500	-
Grammostola spathulata	300	-
Grammostola pulchripes	260	28
Pterinochilus sp.	70-80	18-31
Scodra griseipes	112-375	55.3

Restraint and Handling

- The American and English Tarantula Societies discourage handling of tarantulas. Although many species are fairly docile, most should be handled as little as possible.
- The veterinarian should ask the owner if it is safe to handle the tarantula, and/or what type of handling it is accustomed to.
- Tarantulas accustomed to walking onto an outstretched hand by gently prodding it from behind will tolerate it well. Ensure that the tarantula does not fall or run off the hand when it is lifted.
- The handler should protect himself from the hairs on the legs, and from the tarantula's getting its claws caught in clothing.

- It is advisable to wear latex examination gloves or thin leather gloves while working with tarantulas. This also protects the tarantula from the bacteria on the handler's skin.
- Another way is to push the tarantula gently down with the index finger and put the thumb and middle finger on either side between the second and third pair of legs and lift the tarantula off the surface. When the tarantula does not feel any support under its legs, it will stay fairly motionless.
- Hypothermia may be used for a very brief period to immobilize the healthy tarantula for an examination or non-painful procedure. Regular refrigerator temperatures of approximately 39-45°F (4-7°C) for no more than 30 minutes has proven effective.
- Hypothermia is not recommended in debilitated arachnids. It will further decrease their metabolism and immune responses.



The author uses the gauze sling to restrain for injections. Gauze is positioned at the pedicel and loosely looped to allow a finger to immobilize the caudal cephalothorax/cranial abdomen. This can be done with the tarantula suspended (which minimizes leg movements) and decreases the surface area actually touched. The sling facilitates post-injection inspection of ventral orifices for excretions. Release by loosening the gauze and allowing the tarantula to walk out of it.

- Tarantulas may bite. The bite does contain a venom and may feel similar to a bee sting, and it may trigger an allergic reaction in some individuals. Treat as any animal bite/puncture wound and clean immediately. Consult your physician, particularly if you are susceptible to allergic reactions to stings, or if there is swelling, nausea, or fever.
- Usually the tarantula will give warning of the impending bite: it will flick hair first, then rear on back legs and expose fangs. Best protection against the bite: leave the tarantula alone if it shows any of the above behaviors!

Physical Examination

- History should include the following: species, sex, acquisition (source, country of origin, time since purchase or placement in

captivity), age (or number of molts, length of time has been owned), husbandry (including housing, temperature, humidity, substrate, use of pesticides/chemicals in the environment), diet/appetite, drinking and type of dish/availability, defecation and character of feces, exposure to other tarantulas/animals, course of last ecdysis, reproductive cycle, previous health problems, nature/duration of current problem.

- Owners should be encouraged to keep a calendar with molt dates, feeding dates (amount, type), noted excrement, weight, reproductive activity.
- Physical examination should include the following:
  - Visual assessment of hydration (turgor of appendages, cephalothorax/abdomen) (size, time of last meal will influence abdominal size). An increase or decrease of the abdomen independent of meals or egg laying is indicative of disease.
  - Check for alopecia or loss of hairs pattern, signs of abscess/infection, missing or damaged body parts, locomotion (or lack of) and coordination.
  - Check for abnormal discharges from spiracles/orifices, including presence of hemolymph.
  - Place in a transparent container large enough for the spider to walk several body lengths. The transparent container makes it easy to examine the ventrum, and should be warmed to 75-80°F (24-27°C). The container should be of known weight, and then can be re-weighed with the tarantula for body weight assessment.
  - Observe behavior, posture, gait while it is in the container. A normal, healthy animal will sit still in a corner, or may investigate its new surroundings. If the spider assumes a defensive posture, leave it alone for a while or the handler will risk being bitten or bombarded with the urticating hairs. You can encourage the spider to walk by nudging it with a tongue depressor.
- Microscopic exam for ectoparasites.
- Cultures (bacterial, fungal) can be obtained from lesions, hemolymph.

Therapy and Injection Sites

Therapeutic measures in tarantulas are based solely on empirical information. The clinician must assume full responsibility for use of any of these recommendations.

- Injections have been made by the author into the heart/

pericardial cavity for fluids and IV medications. Heart and respiration rates vary greatly with ambient temperature, but may be difficult to assess.
- Use intravenous preparation of antibiotics, single doses, based on spectrum of activity for cultured bacteria.
- Dosage used by author are low doses published for the antibiotic for reptiles, calculated for hydrated weight.
- Hydration should be maintained.
- Theoretically isotonic, intravenous formulated medications may be safe for administration. Proceed with caution.
- Consider using other poikilotherm doses.

Fluid Therapy

- Author bases choice of fluid and dosage on reptile information. Base replacement amount on estimated hydrated weight and subtract current weight.
- Rehydration is readily apparent during administration.
- Do not overhydrate (will see abdomen "bulge" beyond normal).

Fluid Therapy: Sample Case

- Presented tarantula looks shriveled, barely moving, weighs 12 g, estimated hydrated weight (estimate that does not account for fat reserves or weight of ingesta in intestinal tract): 14 g.
- At 20 ml fluids/1000 grams body weight, dose would be 0.28 ml. Because of the variations in weight due to amount of ingesta present, the tarantula may not be able to take the full amount, but have it prepared.
- Injection can be made into the pericardial fluid or the heart directly with a 27-30 g needle, slow injection (usually at least 5 minutes—keep abdomen immobilized to minimize potential trauma).
- If pressure increases and hemolymph/fluids begin to come out of injection hole, stop immediately, remove needle, allow minimal seepage, and apply direct pressure (cotton swab usually works well) for a few seconds.
- The author has not used tissue glue to seal the injection site.
- The tarantula should be in optimal temperature range, and fluids should be the same temperature.

RULE OUTS FOR TARANTULAS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Abscesses	Previous injury, Parasitism, Contaminated housing, Poor husbandry, Suboptimal temperatures, Humidity, Excrement/waste food buildup	Culture for gram-negative bacteria, fungus	Correct husbandry, Tetracycline solution for external irrigation of wounds (dissolve 50 mg tetracycline in 25 ml of fluid if appropriate for bacteria identified from wound/exudate). Author has used antibiotics delivered via intracardiac/pericardiac injection (intravenous preparation), single doses, based on spectrum of activity for cultured bacteria. Dosage used was low dose published for the antibiotic for reptiles, calculated for hydrated weight. Hydration should be maintained.
Anorexia	Husbandry-related (too cold or damp, no hiding, too much light, too much vibration/noise), Septicemia, Gastrointestinal infections or toxicity from poisoned prey, Bacteria within prey, Parasites, Nearing ecdysis, Reproductive-physiologic, Multiple etiologies	History, Physical exam, Culture/sensitivity from hemolymph, Fecal check, Evaluate environmental toxicity	Correct husbandry, diet, other illness problems, Supportive care: vitamin B complex @ .01 ml diluted slightly and administered intracardiac/pericardial. If toxicity from insecticide/pesticide: No specific antidote, Place in well-ventilated area with optimal temperature, Fluid therapy may help, Mist/rinse tarantula with clean, warm water if topical contamination is suspected.
Baldness/alopecia on abdomen (opisthosoma)	Age (geriatric), Systemic illness/septicemia, Cuticle infection, Behavioral (excessive hair flicking for defense)	Scraping of cuticle, wet mount for cytology, Gram's stain, Culture	Correct husbandry, Appropriate antimicrobials, Supportive care

RULE OUTS FOR TARANTULAS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Dehydration/starvation (shriveled abdomen opisthosoma, sits "hunched," immobile)	Lack of access to water, Inappropriate food items (size, live/dead, nutritional value), Housing-related: non-optimal temperature, humidity, substrate/furnishings for hunting, too light, handled too much—not left alone, Parasites, Injury, Septicemia, Toxic, Multiple etiologies	History, Weight, Physical exam	Adjust husbandry (dehydration is common problem with captive tarantulas with inadequate access to water), Offer a jar lid or petri dish with water right in the examination room. This may be all that is needed for mildly dehydrated tarantulas that are otherwise healthy. Be sure the spider is at optimal body temperature, and water is warm. If moribund, or too weak to drink, inject parenteral fluids. If toxicity from insecticide/pesticide: No specific antidote, Place in well-ventilated area with optimal temperature, Fluid therapy may help, Mist/rinse tarantula with clean, warm water if topical contamination is suspected.
Ectoparasites, endoparasitism	Mites, Parasitic fly/wasp larvae	Microscopic examination	Ectoparasites (mites): Anesthetize the tarantula (3-4% isoflurane in container), brush mites off with a camel hair brush or stiff paint brush. Do not use insecticides! To prevent access by acrocerid parasitoids to lay their eggs in the tarantula, screen the container/environment. There is no treatment for endoparasitism — it will eventually kill the tarantula.

RULE OUTS FOR TARANTULAS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Incoordination, twitching	Age-related (eg, may be dying), Toxic (poisoned prey, bacterial endotoxins), Environmental toxins (pesticides, insecticides, aerosols), Dehydration/weakness, Septicemia, Dietary deficiencies	History if suspect septicemia, Culture & sensitivity of hemolymph	Appropriate for etiology: Supportive fluids, Vitamin B complex, Possibly corticosteroids, If dietary: parenteral animo acids, electrolytes.
Lethargy	Inappropriate husbandry, Behavioral vs illness	History & husbandry review, Physical exam, Check hemolymph for bacteria/fungi, possibly culture, Check stool for bacteria, parasites	Correct husbandry, Appropriate therapeutics if due to systemic illness
Oozing hemolymph	Missing or torn legs, pedipalps	Physical exam	Quickly clean and seal to prevent tarantula from bleeding to death or allowing infection in. Dab with cotton swab dipped in chlorhexidine or dilute povidone solution, dry with sterile swab, seal with cyanomethacrylate (tissue glue). Other substances that have been used to stop hemolymph from small wounds or torn legs/pedipalps include beeswax, surgical “plastic skin,” or surgical celluloid (Surgicel®) (see also Wounds in cuticle). Large tears in the cephalothorax or abdomen can be sutured.

RULE OUTS FOR TARANTULAS BASED ON CLINICAL SIGNS

Clinical Signs	Differential Diagnosis	Diagnostic Options	Therapy
Retained or incomplete molt (dysecdysis)	Improper habitat, husbandry, temperature, humidity, nutrition, Systemic illness, Interference/stress/handling during molting	History & husbandry review, Physical exam, Scrape and check for ectoparasites	Place in optimal temperature, humidity. May need to anesthetize to remove dry, old exoskeleton. Be very careful, as new tissue underneath may be compromised (see Molting). Severely damaged limbs may need to be amputated. If underlying conditions are corrected, the tarantula may need to molt again in a short time, as the elasticity of the new exoskeleton may be lost in a partial molt.
Wounds in cuticle	Trauma	Physical exam	Anesthetize the tarantula, clean edges of wound with chlorhexidine or dilute povidone, creating as clean a surgical field as possible. Irrigate the wound with sterile saline. Use 5-0 or 6-0 synthetic suture (Dexon®), ophthalmic needle. Suture will be shed with next molt. Take care to not puncture underlying structures.

Common Clinical Conditions in Tarantulas

- Lethargy, dehyration, starvation/anorexia
- Trauma
- Baldness, molt irregularities
- Incoordination, twitching
- Abscesses
- Parasites
- Congenital deformities
- Neoplasms (identified by cytology and histopathology)

Special Notes on Tarantula Parasites

- Nematode parasites may result in juvenile spiders with developmental abnormalities such as malformed palpi, short, thick legs, poorly developed secondary sexual organs, poor growth, or paralysis.
- If a nematode is noted emerging from a tarantula it should not be placed in alcohol since this prevents identification. It is recommended that the worm should be placed in a small dish with a layer of gravel covered by water, changed daily for about a month until the adult appears, at which stage it can be heat-killed in water at 55°C, then placed in 3% formalin or 70% alcohol for identification.
- The Acroceridae (Diptera) parasitoids seek and infect their hosts over a period as long as 24 hours after which time the larvae enter the book lungs. They then undergo a diapause or resting stage that may last as long as ten years.
- On leaving this resting stage, the parasitoid larvae grow in size and enter a destructive stage, which is when they become obvious. They emerge from the abdomen of the adult spider, causing its death. Pupation then gives rise to the adult fly. As many as 14 larvae have been recorded emerging from one Mygalomorphae.

Theraphosidae and Their Parasitoid Taxa

Spider Species	Parasitoid Taxa
Phrixotrichus roseus	*Arrhynchus maculatus*
Chaetopelma sp.	*Astomella gravis*
Lasiodora klugi	*Exetasis eickstedtae*
Grammostola actaeon	*Exetasis* ssp.
Dugesiella hentzi	*Lasia purpurata*
Aphonopelma sp.	*Ocnaea* sp.

Anesthesia

- Hypothermia is not considered appropriate for anesthesia or analgesia in vertebrate poikilotherms/ectotherms — use the same rationale as for vertebrates.
- Administer inhalant anesthetics via a transparent anesthetic chamber: carbon dioxide at 10-20%, 3-5 minutes; halothane 4-8% for 5-10 minutes, methoxyflurane 4% for 10-30 minutes, isoflurane 3-4% for 10-15 minutes.
- Induction time varies depending on a number of factors including ambient temperature.
- Nitrous oxide may be added to reduce the amount of anesthetic agent needed.
- When the tarantula is immobile, and does not attempt to right itself (absence of righting reflex), consider it sufficiently anesthetized. Remove it from the anesthetic chamber.
- Anesthesia will last from 5-20 minutes.
- If the tarantula has not recovered by 20-25 minutes, replace it in the chamber and expose it to 100% oxygen for 15 minutes, with optimal ambient temperature.
- If it shows no signs of recovery after six hours, it may be presumed dead.

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APPENDIX

The following selected resources are provided only for the convenience of the avian and exotic animal practitioner and are not considered recommendations or endorsements.

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APPENDIX I — MEDICAL SUPPORT

(See page 4 for addresses of facilities.)

Diagnostic and Consultation Services

Adrenal antigen assay
University of Tennessee

Aleutian disease serology (indirect immunofluorescence antibody assay)
Research Animal Diag. Lab - MIT

Aleutian disease (counter electrophoresis test)
United Vaccines

Aspergillosis serology
Consolidated Veterinary Diag. Lab
Univ. of Minnesota Raptor Center

Bacteriology/microbiology
Avian & Exotic Animal Clin Path Lab
Avian and Wildlife Laboratory - University of Miami
California Avian Laboratory
Clinipath Laboratories, Inc
Consolidated Veterinary Diag. Lab
Maryland Dept Agric Animal Health Diagnostic Lab
Phoenix Central Lab
Private labs (local)
State Diagnostic Laboratories
Univ. of Nebraska Vet Diag. Center

Bile acid levels
Avian & Exotic Animal Clin Path Lab
Avian and Wildlife Laboratory - University of Miami
California Avian Laboratory
Phoenix Central Laboratory
Veterinary Research Associates

Blood lead levels
Cenvet
Louisiana Veterinary Med. Diag. Lab
Smith Kline Laboratories
State Diagnostic Laboratories
Veterinary Research Associates

Boid inclusion body virus diagnosis
Univ. of Arizona Vet. Diag. Lab
Northwest Zoo Path

Chemistries
Avian & Exotic Animal Clin Path Lab
Avian and Wildlife Laboratory - University of Miami
California Avian Laboratory
Cenvet
Clinipath Laboratories, Inc.
Consolidated Veterinary Diag. Lab
Phoenix Central Lab
Southwest Veterinary Diagnostics
UC Davis Vet Med Teaching Hosp.
Veterinary Research Associates

Chlamydia diagnosis
Avian & Exotic Animal Clin Path Lab
California Avian Laboratory
Clinipath Laboratories, Inc (ELISA)
Consolidated Veterinary Diag. Lab (antigen capture)
Research Associates Lab
Texas Vet Med Diagnostic Lab (serology, antigen detection)
Univ. of Arizona Vet Diagnostic Lab
University of Georgia (experimental nuclei acid probe)
University of Miami (serology, antigen detection)
National Center of Avian Clinical Services

Cytology
Avian & Exotic Animal Clin Path Lab
Avian and Wildlife Laboratory - University of Miami
California Avian Laboratory
Clinipath Laboratories, Inc.
Consolidated Veterinary Diag. Lab
Northwest Zoo Path
University of Georgia
Univ. of Nebraska Vet Diag. Center
Zoo and Exotic Pathology

Electrophoresis
Avian & Exotic Animal Clin Path Lab
Avian and Wildlife Laboratory - University of Miami
Consolidated Veterinary Diag. Lab

Electrocardiograms
Cardiopet

Electron microscopy
University of Georgia (W.L Steffens)

Endocrinology
Consolidated Veterinary Diag. Lab
Phoenix Central Lab (ferrets)
University of Tennessee Clinical Endocrinology Lab

Exotic case consultation
Jeffrey R. Jenkins, DVM
Branson W. Ritchie, DVM, PhD, University of Georgia
Greg J. Harrison, DVM (avian)

Feed analysis
Midwest Laboratories Inc
Waters Agricultural Labs Inc

Hematology
Avian & Exotic Animal Clin Path Lab
Avian and Wildlife Laboratory - University of Miami
California Avian Laboratory
Cenvet
Clinipath Laboratories, Inc.
Consolidated Veterinary Diag. Lab
Phoenix Central Lab
Southwest Veterinary Diagnostics
Univ. of Georgia - Exotic/Zoo Path.

Histopathology
AccuPath
California State Vet Diag. Lab
Consolidated Veterinary Diag. Lab
Maryland Dept Agric Animal Health Diagnostic Lab
Northwest Zoo Path
Oklahoma Animal Diag. Lab
PetPath
Phoenix Central Lab
Schubot Exotic Bird Health Ctr.
UC Davis Vet Med Teaching Hosp.
Univ. of Arizona Vet Diagnostic Lab
University of Florida (Elliott Jacobson - reptiles)
Univ. of Nebraska Vet Diag. Center
Univ. of Georgia Exotic/Zoo Path
University of Michigan Animal Health Diagnostic Lab
Zoo and Exotic Pathology

Lymphosarcoma research
Dr. Susan Erdman - MIT (ferret)

Mycobacteria diagnosis
Institut für Geflügelkrankeiten
National Vet Services Lab (NVSL)
Virus Reference Lab

Necropsy
Consolidated Veterinary Diag. Lab
Maryland Dept Agric Animal Health Diagnostic Lab
Northwest Zoo Path
Oklahoma Animal Diag. Lab
Schubot Exotic Bird Health Ctr.
University of Florida (Elliott Jacobson - reptiles)
University of Nebraska
Zoo & Exotic Pathology Service

OPMV diagnosis
Univ. of Florida (Elliot Jacobson)
Univ. of Arizona Vet Diagnostic Lab

Pacheco's disease virus antibody assay
Texas Vet Med Diagnostic Lab

PBFD DNA probe testing
Research Associates Lab, Inc.
VetGen, Europe

Polyomavirus DNA probe testing
Research Associates Lab, Inc.
VetGen, Europe

Polyomavirus serology
University of Georgia

Rabbit disease serology
Sound Diagnostics

Radiograph consultation
Marjorie McMillan, DVM
Veterinary Telerad

Salmonella typing
National Veterinary Services Lab

Serology (various assays)
Maryland Dept Agric Animal Health Diagnostic Lab
Microbiological Associates (rodent, rabbit, primate)
Univ. of Florida Dept of Infectious Diseases
Univ. of Florida (Elliott Jacobson)
Virus Reference Lab (primates)

Sexing (avian)
Avian Genetic Sexing Lab
Research Associates Lab, Inc.
VetGen (Europe)
Zoogen, Inc

Surgical pathology service
PetPath
Northwest Zoo Path
Zoo & Exotic Pathology

Toxicology
Louisiana Vet Medical Diag. Labs
Smith Kline Labs

Urolith analysis (ferrets)
Minnesota Urolith Center

Viral serology
Microbiological Associates (rodent/rabbit)
Virus Reference Lab (primates)

Virology
University Florida Dept of Infectious Disease
Schubot Exotic Bird Health Ctr.
Maryland Dept Agric Animal Health Diagnostic Lab
Microbiological Associates
University of Georgia
Virus Reference Lab

Virus isolation
National Veterinary Services Lab
Univ. of Nebraska Vet Diag. Center
Microbiological Associates
University of Florida (Elliott Jacobson - reptiles)
University of Georgia
Virus Reference Lab

Directory of Diagnostic Facilities

AccuPath
Bruce H. Williams, DVM, Dipl ACVP
7605-F Airpark Road
Gaithersburg, MD 20879
301-299-8041

Animal Health Diagnostic Lab
PO Box 629 West Fee Hall
MSU, E. Lansing, MI 48824-1316
517-353-1683 517-355-0281

APL Veterinary Laboratories
4230 S. Burnbow Ave. #250
Las Vegas, NV 89119, 800-433-2750

Avian BioTech
4500 Shannon Lakes Plaza
Unit 1 Suite 138
Tallahassee, FL 32308
904-386-1145

Avian Genetic Sexing Lab
6551 Stage Oaks Drive, Suite 3
Bartlett, TN 38134

Avian & Exotic Animal Clin Path Lab
3701 Inglewood Ave, Suite 106
Redondo Beach, CA 90278
1-800-350-1122 or 310-542-6556

Avian and Wildlife Laboratory - University of Miami
Division of Comparative Pathology
1550 NW 10th avenue
Pap Building, Room 105
Miami, FL 33136
800-596-7390 305-243-5829
fax 305-243-5662

California Avian Laboratory
6114 Greenback Lane
Citrus Heights, CA 95621-4716
1-800-783-BIRD 916-722-8428

California State Vet Diag. Lab
105 W Central Ave
San Bernardino, CA 92412
714-383-4287

Cardiopet
51 Atlantic Ave
Floral Park, NY 11002-0208
1-800-726-1212

Center Laboratories
35 Hannel Drive
Port Washington, NY 11050

Cenvet
32-50 57th St, Woodside, NY 11377
1-800-4CENVET

Clinipath Laboratories, Inc
PO Box 826, Hebron, IN 46341
219-464-1336

Consolidated Veterinary Diagnostics, Inc.
2825 KOVR Drive
West Sacramento, CA 95605
800-444-4210 Fax 916-372-4938

Greg J. Harrison, DVM
The Bird Hospital
5770 Lake Worth Road
Lake Worth, FL 33463
407-964-2121 fax 407-433-3521
bird doc@aol.com

Harlan Sprague Dawley, Inc.
United Vaccines, P.O. Box 44220
Madison, WI 53744
800-283-6465

Institut für Geflügelkrankheiten
Prof. Dr. J. Kösters
Veterinar Str. 3
D-8042 Oberschleißheim
GERMANY 011-49-89-315-4029

Jeffrey R. Jenkins, DVM
Avian & Exotic Animal Med &
Surgery Consulting & Ref. Service
2317 Hotel Circle South, Suite C
San Diego, CA 92108
800-379-6842 Fax 619-260-1499

Louisiana Vet Med Diag. Lab
School of Med, LSU, PO Box 25070
Baton Rouge, LA 70894
504-346-3193

Marjorie McMillan, DVM
Windhover Veterinary Center
944-A Main St, Walpole, MA 02081
508-668-4520

Maryland Dept of Agriculture
Animal Health Diagnostic Lab
3740 Metzerott Rd
College Park, MD 20740
301-935-6074

Massachusetts Institute of Tech.
Susan Erdman, DVM
Div. of Comp. Med. Bldg 45
37 Vassar St., Cambridge MA 02139
617-253-1772

Microbiological Associates, Inc.
9900 Blackwell Road
Rockville, MD 20850
800-756-5688 Fax 301-738-1605

Midwest Laboratories Inc
13611 13th Street
Omaha, NE 68144-3693

Minnesota Urolith Center
Dr. Carl Osborne
Dept. Small Animal Clinical Sciences
College of Veterinary Medicine
University of Minnesota
St. Paul MN 55108
612-625-4221

National Center of Avian Clinical Services
1920 Fitch Ave, St Paul, MN 55108
612-624-3013

National Vet. Services Labs
USDA/APHIS/VS, PO Box 844
1800 Dayton Rd, Ames, IA 50010
515-239-8266 Fax 515-239-8397

Northwest Zoo Path
Michael Garner, DVM, ACVP
15326 Broadway Ave SE
Snohomish WA 98290-7042
360-668-6003 fax 360-668-6003

Oklahoma Animal Diag. Lab
Oklahoma State University
Stillwater, OK 74078
405-744-4407; 405-744-4454

Pet Path
Dr Richard Montali
7605-F Airpark Rd
Gaithersburg, MD 20879
301-330-1200 or 301-601-4393

Phoenix Central Lab
11620 Airport Rd. #100
Everett, WA 98204-3742
800-347-0043 Fax 206-355-3676

Research Associates Lab, Inc.
100 TechneCenter Dr. Suite 101
Milford, OH 45150
513-248-4700

Schubot Exotic Bird Health Ctr.
Dr. David Graham, Texas Vet Med Ctr
Texas A&M, College Station, TX 77843
409-845-3414

SmithKline Labs
818-989-2520

Sound Diagnostics
1222 NE 145th Street
Seattle, WA 98155-7134
206-363-0787, Fax 206-363-0948

Southwest Veterinary Diagnostics
13633 N Cave Creek Rd
Phoenix, AZ 85022
602-352-0705

Texas Vet Med Diagnostic Lab
Dr. J. E. Grimes, 1 Sissel Rd
College Station, TX 77841-3040
409-845-3414

United Vaccines
see Harlan Sprague Dawley, Inc.

University of Arizona Vet Diagnostic Lab
Bldg. 90, Rm 202, Tucson, AZ 85721
520-621-4731

University of California Davis
Vet Med Teaching Hospital
Dr. Linda Lowenstine
UC Davis, Dept of Pathology
Davis, CA 95616
916-752-7380

University of Florida
Dr. Jack Gaskin
CVM, Dept of Infectious Disease
PO Box J137, Gainesville, FL 32610
352-392-9415 352-392-1841

University of Florida
Dr. Elliott Jacobson
PO Box 100126 HSC, CVM
Gainesville, FL 32610
352-392-4751

University of Georgia
Dr. Branson W. Ritchie
CVM, Carlton St., Athens, GA 30602
706-542-6316;
Avian case consult: 900-228-4267

University of Georgia
Dr. Kenneth Latimer, Dr. WL Steffens
Dept. of Pathology, Carlton St
Athens, GA 30602
706-542-5844

University of Nebraska Vet Diagnostic Center
Dr. Eva Wallner-Pendleton
Vet Science Dept, Lincoln, NE 68583

University of Tennessee
Clinical Endocrinology Lab
Dept of Environmental Practice
Vet Teaching Hospital A105
Knoxville, TN 37916
423-974-5638

VetGen Europe
P.O. Box 60, Winchester, Hampshire
SO23 9XN, United Kingdom
44-962-880-376 Fax 44-962-881-790

Veterinary Telerad
Dr. Sam Silverman
45 San Clemente Dr Suite B230
Corte Madera, CA 94925
414-668-0387; 800-762-0125

Veterinary Research Associates
333 West Merrick Rd
Valley Stream, NY 11580
1-800-872-1001

Virus Reference Lab, Inc.
Dr. S.S. Kalter
7540 Louis Pasteur Suite 205
San Antonio, TX 78229
210-614-7350 Fax 210-614-7355

Waters Agricultural Labs Inc
Newton Hwy, Camilla, GA 31730
912-336-7216

Zoo and Exotic Pathology Service
Dr. Robert Schmidt
2825 KOVR Drive
West Sacramento, CA 95605
800-457-7981 fax 916-756-9079

Zoogen, Inc
1756 Picasso Ave., Davis, CA 95616
916-756-8089 Fax 916-756-5143
800-995-BIRD

APPENDIX II — VETERINARY INFORMATION SOURCES

Veterinary Hotlines

Veterinary product failure and adverse reaction reporting
800-4-USPPRN

FDA/CVM (drugs, devices, animal feeds)
301-594-1751

USDA (biologics and diagnostics)
800-752-6255

National Animal Poison Control Center Hotlines
800-548-2423, 900-680-000

USDA (shipping regulations)
800-545-873

Animal Blood Bank Hotline
800-243-5759

HEMOPET (blood bank)
714-252-8455

Pet Loss Support Hotlines
916-752-4200
University of California
352-392-4700 - then dial 1, 4080
University of Florida
517-432-2696
Michigan State University
708-603-3994
Chicago VMA veterinarians

Internet Information

For an up-to-date list of veterinary resources on the internet, we suggest you use one of the following internet search engines.

Name/URL	Description
Yahoo! **http://www.yahoo.com**	Yahoo! is probably the most well-known of all the search engines. It is easily browsable or searchable by keywords.
Lycos **http://www.lycos.com**	Lycos is easily searchable by keywords, and provides rated matches to each word - listing sites that match all keywords, then sites with one or more keywords.
InfoSeek **http://www2.infoseek.com**	InfoSeek offers a paid service where you get an extensive search for a fee.
InfoSeek Guide **http://guide.infoseek.com**	Same as InfoSeek but it is free and searches are limited to the top 100 hits.
WebCrawler **http://webcrawler.com**	WebCrawler lets you type in your keywords, choose whether you want the engine to find sites with "any" or "all" of the key-words mentioned, and specify how many of the results you'd like displayed.
WWWWorm **http://www.cs.colorado.edu/home/mcbryan/WWWW.html**	WWWWorm has a simple interface. Search by URL or title, match all or any keywords, and choose how many matches you wish.

APPENDIX III — SELECTED PRODUCTS FOR USE WITH EXOTIC COMPANION SPECIES

(See Appendix V for distributors' addresses.)

Hospital Equipment and Supplies

avian collars
- Ejay International
- Veterinary Specialty Products

band removal
- Donna G Corp.
- K. Miller Tool Co.
- L & M Bird Leg Bands

cautery unit
- Phoenix Unlimited

client communication
- Barx Bros, Inc.
- Karjojon Kards
- Message Art
- The Harbor Works

fluid replacement
- Deva Labs, Inc.
- Sanofi Animal Health

gavage, feeding tubes
- Corners Limited
- E-Jay International
- IAW Research Inst.
- Lafeber Company
- Popper & Sons
- Professional Specialties

gram scales
- Henry Schein, Inc.
- Lafeber Company
- Northgate Veterinary Supply
- Ohaus Corp.
- Veterinary Specialty Products

hemostatic supplies
- Graham-Field, Inc.
- Mallinckrodt, Inc

identification systems
- AVID

incubators/temperature controlled environments
- Avian Engineering
- AvTech Systems
- D & M Bird Farm
- Dean's Animal Supply, Inc.
- Lyon Electric Company
- Snyder Mfg. Co.
- Thermocare, Inc.

magnification loupes
- Aseptico
- Carl Zeiss, Inc.
- General Scientific Corp.
- Medical Diagnostic Services, Inc.

mouth speculums
- Lafeber Co.

nebulizers
- DeVilbiss
- Thermocare, Inc.

oxygen generator
- Airsep Corporation

restraint straps
- Veterinary Specialty Products

syringes, low-dose/microliter
- Monoject
- MPL, Inc.
- Terumo Medical Corp.

temperature probes
- Veterinary Specialty Products

Laboratory Supplies

biochemistry analyzers
- Boehringer-Mannheim
- CellDyne
- Dupont
- Eastman Kodak
- IDEXX
- IIM Diagnostics
- Miles
- Schiaparelli Biosystems
- Southeast Vetlab Supply
- Stat Medical Services

biochemistry supplies
- Miles Laboratories, Inc

Laboratory Supplies *(continued)*

blood collection supplies
- Becton-Dickinson
- Monoject
- Sarstedt
- Statspin Technologies
- Terumo

cytologic stains
- AJP Scientific
- Miles Laboratories, Inc
- Baxter Diagnostics

cryptosporidium kit
- AJP Scientific

Gram's stain kit & supplies
- Difco Laboratories
- Fisher Scientific
- Harleco
- Mid-Atlantic Biomedical
- Scott Laboratories

microbiology/chlamydia testing
- Becton Dickinson (Culturette)
- BBL Microbiology Systems (Port-a-Cul)
- Eastman Kodak (Surecell chlamydia)
- Inolex Laboratories (calcium alginate swabs)
- Marion Scientific Corp. (sample submission supplies)
- Medical Media Laboratory (Culture-Eze)
- Medical Wire (Transwab)
- Spectrum (Calgiswab)
- Texas A & M University

microscopes
- Prescott's, Inc

miscellaneous supplies
- Hematocytometer - Henry Schein
- Permount - Fisher Scientific
- Refractometer - Leica # 10436
- Sedi-Cal calibrated tubes - Chase
- Unopette #5877 (Eosinophil kit) Becton-Dickinson

shipping containers
- Horizon Micro-Environments, Inc

Imaging Supplies

radiographic positioners
- Henry Schein, Inc.
- Silverdust Bird Positioner
- Veterinary Specialty Products

rare earth cassettes, X-ray film
- A-1 X-ray, Inc., multiple suppliers

ultra detail film
- A-1 X-ray, Inc., multiple suppliers

ultrasound
- Classic Medical Supply
- Corometrics

x-ray processors
- Fischer Industries

Surgical Equipment and Supplies

anesthesia equipment & supplies
- A.M. Bickford, Inc
- Anaquest
- Exotic Animal Medical Products
- Matrix Medical (Isotec Mark III)
- Ohmeda (Tech 4)
- Parks Medical Electronics
- Solvay Animal Health
- Summit Hill Laboratories

anesthesia monitors
- Dynax
- Medical Engineering & Development, Inc.
- Silogic Design Ltd.

anesthesia scavenger system
- Summit Hill Laboratories

bandaging material
- 3M Animal Care Products

beak repair materials
- Ellman International Mfg

casting material
- Hexcel Medical

Surgical Equipment and Supplies *(continued)*

electrosurgical units
- Cameron-Miller
- Ellman Intl Mfg
- Summit Hill Laboratories

endoscopes and accessories
- Dyonics, Inc
- Endoscopy Support Services, Inc.
- Karl Storz Veterinary Endoscopy America
- MDS, Inc.
- Richard Wolf Med. Inst. Corp
- Schott Fiberoptics

endotracheal tubes, non-rebreathing systems
- Bivona
- Matryx Med Inc.
- Summit Hill Labs

microsurgery scopes and instruments
- General Scientific Corp.
- Prescott's, Inc
- Solvay Animal Health, Inc.

orthopedic supplies
- 3M Animal Care Products
- Fitz Enterprises
- Hexcel Medical Products
- IMEX Veterinary
- Kirschner Medical Corp.

surgical instruments and supplies
- 3M Animal Care Products
- Arista Surgical Supply Co.
- S. Jackson
- Solvay Animal Health
- Sontec Instruments
- Universal Medical Distributors

tissue glue
- 3M Animal Care Products
- Ellman Intl Mfg Inc
- Tri-Point Medical (CRX)
- Veterinary Products Lab

wound management
- 3M Animal Care Products
- Sherwood Medical

Animal Husbandry and Handling

air purifier
- National Safety Association

avian housing
- Animal Environments
- Bird Depot
- Corners Ltd.
- Expandable Habitats
- Inglebrook Cages
- Kings Aviary
- Papagallo Enterprises
- Penn-Plax Inc
- Phoenix Cage Co
- Prevue Metal Products

blowguns
- Addison Biological Labs
- Animal Management, Inc.

brooders
- Thermocare, Inc.

cage netting
- J.A. Cissel

capture nets
- Aviary West
- Beckman Net Co.
- circulating water blankets
- Gorman-Rupp Industries Div.

dart guns
- Palmer Chemical Equip. Co.
- Zulu Arms of Omaha

egg incubators
- Grumbach (Swan Creek Supply)
- Humidaire Inc
- Lyon Electric Company

exercise wheel for hedgehogs
- Balanced Innovations

flex heat
- ASI Sales
- Safe & Warm

gloves
- Ketch-All Co.
- One of a Kind

handling equipment
- Animal Care Equip. & Services
- Animal Management, Inc.
- Furman Diversified
- NASCO

Animal Husbandry and Handling *(continued)*

heated sleeping platforms
Bob Clark
Animal Technology
Veterinary Specialty Products

heated water blankets
Gorman-Rupp Industries Div.

heating pads
ASI Sales
Safe & Warm
Valentine Equip. Co.

heating panels & elements
RAM Network

infra-red heaters
Animal Spectrum Inc.

intensive care units
Animal Care Products
D & M Bird Farm
Thermocare

lighting supplies
Duro-Test Corporation
Fluker Laboratories

live traps
Safe-N-Sound Live Traps
Tomahawk Live Trap Co.

pole syringes
Animal Management, Inc.
Kay Research Products
Zulu Arms of Omaha

reptile housing
The Reptile News Press
The Andersons

squeeze cages
Animal Technology
Research Equipment Co, Inc.

Compounding and Customized Rx
Home Care Pharmacy
Island Pharmacy Services, Inc
Mortar and Pestle
VetCo Laboratories

Sources of Companion Avian Vaccines
Biomune, Inc.
Maine Biological Labs, Inc.

Client Education
Assoc. of Avian Veterinarians
ASPCA Education Dept.
AVLS, Inc.
Canaviax Publications
HBD, Inc.
Kaytee
Lafeber Company
Mosby Year Book
Wingers Publishing

APPENDIX IV — DIETS FOR COMPANION EXOTIC ANIMALS

(See Appendix V for manufacturer's addresses.)

Formulated Diets for Birds

(including hand-feeding diets for psittacine chicks)

AviSci Inc.
Harrison's Bird Diets
Kaytee Products
Kellogg's Inc.
Lafeber Company
Lake's Minnesota Macaws, Inc.
L/M Animal Farms
Loriidae Production Network
Marion Zoological Inc.
Nekton USA
Pretty Bird Int'l, Inc.
Rolf C. Hagen Inc.
Roudybush Diets
Topper Bird Ranch
Zeigler Bros, Inc.

Formulated Diets for Ferrets

8 in 1
Kaytee Products, Inc.
L'Avian Pet Products
Marshall Pet Products, Inc.
Mazuri Zoo Feeding Resource
Performance Foods, Inc.
"Totally Ferret"
PMI (Purina Mills Inc) Feeds

Formulated Diets for Other Small Exotic Mammals

(rabbits, guinea pigs, hamsters, gerbils, and opossums)

Kaytee Products Inc.
Mazuri Zoo Feeding Resource
National Complete Fox Food Pellet

Formulated Diets for Reptiles and Amphibians

iguana diets

San Francisco Bay Brand, Inc.
Zoo-Med Laboratories Inc.
ZuPreem Diets
Reliable Protein Products

turtle and tortoise diets

Zeigler Bros, Inc
Mazuri Feeds, Inc.
Reptile Fare

Miscellaneous Sources of Food

Zoo diets

ZuPreem Diets
Mazuri Feeds, Inc.
Animal Spectrum Inc.

Bird of prey diet

Animal Spectrum Inc.
Mazuri Feeds, Inc.
Central Nebraska Packing , Inc.

Insectivore diet

Reliable Protein Products
Zupreem Diets
Mazuri Foods, Inc.

Omnivore diet

Animal Spectrum, Inc.
Milk replacers
Pet-Ag, Inc.
Foremost McKesson (doe)

Crickets

Fluker Farms
Rainbow Mealworms
Top Hat Cricket Farm

Grubs, worms, fly larvae

Grubco, Inc.

Mink or fox feed

National Milk Specialties Co.

Mealworms

Grubco, Inc.
Rainbow Mealworms, Inc.
Fluker Farms

Rabbit chow

PMI
Mazuri
L/Avian Pet Products
Rabbit/rodent treat feeds
L/M Animal Farms

Spirulina

Earthrise Animal Feeds

Rodent chow

PMI, Inc.
Mazuri Feeds, Inc.
L'Avian

Frozen mice & rats

Perfect Pets, Inc.
Ocean Nutrition Corporation
Rio Bravo Lab Farms

Hays *(timothy, alfalfa, orchard grass hay, wheat straw)*

Oxbow Hay Co.
Oasis Division of Noralek, Inc.
Kaytee Products

Woodland Park Zoo Hedgehog Diet

(feeds several adults - can be mixed and frozen or refrigerated)

1 Tbs Insectivore diet, 1 Tbs Fruit mix, 1 slice cooked carrot, 5 crickets, 30 small mealworms, 1 slice cooked yams, 1 pinch chopped romaine or leaf lettuce

Insectivore diet:

1 cup chopped non-domestic feline diet (frozen Nebraska brand), 1 cup chopped hard-boiled egg, 1 Tbs wheat germ flakes, 1 tsp powdered milk, 1/2 tsp Vionate vitamin mineral powder, 2 tsp wheat germ oil

Fruit mix (dice and mix together):

2 medium sized apples (peeled), 1 orange, 1 small tomato, 1/2 melon, 1/2 papaya, 1/2 cup carrots, 1/2 cup yams, 1/2 cup blueberries, 1/2 cup raisins, 1/2 cup sunflower seeds (shelled, non salted)

Selected Foods Containing High Levels of Vitamin A*

Beet greens	Endive	Sweet potato
Dandelion greens	Collard greens	Peas (fresh)
Kale	Carrot	Leaf lettuce (dark green)
Broccoli leaves	Apricot	Squash (summer)
Chard	Broccoli florets	Broccoli stem
Mustard greens	Yam	Watercress
Spinach	Pumpkin	Tomatoes
Turnip greens	Cabbage	Peaches
Parsley	Squash (hubbard)	

* *In decreasing amounts per 1 cup portion.*

Selected Foods Containing High Levels of Calcium

Turnip greens	Chard	Beet greens
Chinese cabbage	Collards (cooked)	Parsley
Mustard greens	Kale	Spinach
Watercress	Dandelion greens	Papaya