APPENDIX 3

Reptile Formulary and Laboratory Normals*

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TABLE 1

Antimicrobial, Antiviral, and Antifungal Agents[a]

Drug dosages are first listed by "most species," followed by dosages in snakes, lizards, chelonians, and crocodilians; feed and water dosages are generally listed last.

Agent	Dosage	Species/Comments
Acyclovir	≥80 mg/kg PO q24h[1]	Tortoises/PD; herpesvirus; poor oral absorption
	80 mg/kg PO q8h or 240 mg/kg/day PO[2]	Tortoises/herpesvirus; uncertain efficacy
Amikacin	—	Potentially nephrotoxic. Often used in combination with penicillins, cephalosporins or metronidazole
	3.48 mg/kg IM once[3]	Pythons/PD
	5 mg/kg IM then 2.5 mg/kg q72h[4]	Gopher snakes/PD; house at high end of optimum temperature range during treatment
	5 mg/kg IM then 2.5 mg/kg q72h[5,6]	Lizards
	2.5-3 mg/kg IM q72h × 5 treatments[7]	Sea turtles
	5 mg/kg IM q48h[8]	Gopher tortoises/PD; 30°C (86°F)
	2.25 mg/kg IM q72h[9]	Alligators/PD
Amoxicillin	22 mg/kg PO q12-24h[10,11]	Most species
Amphotericin B	0.5 mg/kg IV q48-72h[12]	Most species/nephrotoxic; can use in combination with ketoconazole; administer slowly
	0.5-1 mg/kg IV, ICe q24-72h × 14-28 days[10]	Most species/aspergillosis
	1 mg/kg IT q24h × 14-28 days[13]	Most species/respiratory infection; dilute with water or saline
	0.1 mg/kg intrapulmonary q24h × 28 days[14]	Greek tortoises/pneumonia
	1 mg/kg q24h ICe × 2-4 wk[15]	Crocodilians
	5 mg/150 mL saline × 1 h nebulization q12h × 7 days[16]	Most species/pneumonia
Ampicillin	3-6 mg/kg PO, SC, IM q12-24h[11,17]	Most species
	10-20 mg/kg SC, IM q12h[18]	Most species
	20 mg/kg IM q24h[19]	Chelonians
	50 mg/kg IM q12h[20,21]	Tortoises
Azithromycin	10 mg/kg PO q2-7d[22]	Ball pythons/PD; single-dose study; may cause nonregenerative anemia; *Mycoplasma, Cryptosporidium,* Giardia; location dictates dosage frequency: skin q3d; respiratory tract q5d; liver/kidneys, q7d
Carbenicillin	200 mg/kg IM q24h[23]	Carpet pythons/PD
	400 mg/kg IM q24h[24]	Snakes/PD; 30°C (86°F)
	400 mg/kg SC, IM q24h[5]	Lizards
	200-400 mg/kg IM q48h[19]	Chelonians: may cause skin sloughing in desert tortoises
	400 mg/kg IM q48h[25]	Chelonians/PD
Cefoperazone	100 mg/kg IM q96h[20]	Snakes/PD (24°C [75°F])
	125 mg/kg IM q24h[20]	Lizards/PD (24°C [75°F])

*All reptile formulary information has been modified from J. Carpenter. Exotic animal formulary. 4th ed. St Louis: Saunders, 2013, by permission.

TABLE 1—cont'd

Antimicrobial, Antiviral, and Antifungal Agents[a]

Agent	Dosage	Species/Comments
Cefotaxime	20-40 mg/kg IM q24h[17,19]	Most species
Ceftazidime	20-40 mg/kg SC, IM, q48-72h[6,20,26]	Most species/in chameleons use q24h
	20 mg/kg SC, IM, IV q72h[5,27]	Snakes/PD; 30°C (86°F)
	22 mg/kg IM, IV q72h[28]	Sea turtles
Ceftiofur sodium	2.2 mg/kg IM q48h[10]	Snakes
	5 mg/kg SC, IM q24h[29]	Lizards/PD
	2.2 mg/kg IM q24h[10]	Turtles
	4 mg/kg IM q24h[10,17]	Tortoises
Cefuroxime	100 mg/kg IM q24h[10,17]	Most species, snakes/30°C (86°F)
Cephalexin	20-40 mg/kg PO q12h[20]	Most species/unknown absorption
Cephalothin	20-40 mg/kg IM q12h[17,20,30]	Most species
Chloramphenicol	—	Most species/public health concern
	40 mg/kg PO, SC, IM q24h, or 20 mg/kg PO, SC, IM q12h[19,20,31]	Most species/20 mg/kg may be given q24h in larger crocodilians
	40 mg/kg SC q24h[32]	Snakes/PD (29°C [84°F])
	50 mg/kg SC q12-72h[20,33]	Snakes/PD; q12h in indigo, rat, king snakes; q24h in boids, moccasin snakes; q48h in rattlesnakes; q72h in red-bellied water snakes
Chlortetracycline	200 mg/kg PO q24h[20,30]	Most species
Ciprofloxacin	10 mg/kg PO q48h[10]	Most species
	11 mg/kg PO q48-72h[34]	Pythons/PD
Clarithromycin	15 mg/kg PO q48-72h[35,36]	Tortoises/PD (mycoplasmosis)
Clindamycin	5 mg/kg PO q12h[30]	Most species
Danofloxacin	6 mg/kg SC, IM[37]	Loggerhead sea turtles
	6 mg/kg SC q48h × 30d[38]	Tortoises/mycoplasmosis
Doxycycline	5-10 mg/kg PO q24h × 10-45 days[30,31]	Most species/mycoplasmosis
	50 mg/kg IM, then 25 mg/kg q72h[21,39]	Tortoises 27°C (81°F)
Enrofloxacin	5-10 mg/kg q24h PO, SC, IM, ICe[30]	Most species/IM is painful and may result in tissue necrosis/sterile abscesses; SC may cause skin discoloration/tissue necrosis
	6.6 mg/kg IM q24h, or 11 mg/kg IM q48h[34]	Pythons/PD
	10 mg/kg IM q48h[40]	Snakes/PD
	5 mg/kg PO, IM q24h[41]	Lizards/PD; marked pharmacokinetic variability with PO route
	10 mg/kg IM q5d[42]	Monitors/PD
	5 mg/kg IM q24-48h[43]	Chelonians, most species/PD; neurologic signs and diarrhea reported in a Galapagos tortoise[44]
	5 mg/kg IM q12-24h[45]	Chelonians/PD; q12h for *Pseudomonas* and *Citrobacter*; q24h for other bacteria
	5 mg/kg IM q48h[7]	Sea turtles
	10 mg/kg IM q24h[21]	Chelonians/PD
	5 mg/kg IV q36-72h[46,47]	Crocodilians/PD; mycoplasmosis
	Nasal flush 50 mg/250 mL sterile water; 1-3 mL/naris q24-48h[31]	Tortoises/URT syndrome; use until no more discharge (5-10 days); may use concurrently with parenteral antibiotics
Fluconazole	5 mg/kg PO q24h[48]	Lizards/dermatophytosis
	21 mg/kg SC once, then 10 mg/kg SC 5 days later[49,50]	Loggerhead sea turtles/PD
Gentamicin	—	Nephrotoxic, [51] especially in snakes
	2.5 mg/kg IM q72h[32,52]	Snakes/PD
	2.5-3 mg/kg IM, then 1.5 mg/kg q96h[53]	Snakes/PD
	3 mg/kg IM q>96h[54]	Turtles/PD (29°C [84°F]); lower dose may be more appropriate
	6 mg/kg IM q72-96h[55]	Turtles/PD (24°C,[75°F])
	1.75-2.25 mg/kg IM q72-96h[9]	Crocodilians/PD; respiratory infection
Griseofulvin	20-40 mg/kg PO q72h × five treatments[56]	Most species/dermatitis; limited success
	15 mg/kg PO q72h[57-59]	Most species

Continued

TABLE 1—cont'd

Antimicrobial, Antiviral, and Antifungal Agents[a]

Agent	Dosage	Species/Comments
Itraconazole	5 mg/kg PO q24h[60]	Most species/some hepatotoxicity noted when used for *Chrysosporium* anamorph of *Nannizziopsis vriesii*
	10 mg/kg PO q24h[61]	Snakes
	5 mg/kg PO q24h[62]	Panther chameleons
	10 mg/kg PO q48h × 60 days[63]	Chameleons (Parson's)/osteomyelitis
	23.5 mg/kg PO q24h[64]	Lizards/PD; after 3-day treatment, therapeutic plasma concentration persists for 6 days beyond peak concentration; treatment interval not determined
	5 mg/kg PO q24h or 15 mg/kg PO q72h[65]	Kemp's Ridley sea turtles
Kanamycin	10-15 mg/kg IM, IV q24h (or divided doses)[10,11]	Most species/24°C (75°F); nephrotoxic
Ketoconazole	—	May use antibiotics concomitantly to prevent bacterial overgrowth; may use concurrently with thiabendazole
	15-30 mg/kg PO q24h × 14-28 days[17]	Most species
	25 mg/kg PO q24h × 21 days[66]	Snakes, turtles
	15 mg/kg q72h PO[57-59]	Most species
	15-30 mg/kg PO q24h × 14-28 days[67,68]	Chelonians/PD; systemic infection
	50 mg/kg PO q24h × 14-28 days[30]	Crocodilians
Lincomycin	5 mg/kg IM q12-24h[10]	Most species; nephrotoxic
	10 mg/kg PO q24h[10]	Most species
Marbofloxacin	10 mg/kg PO q48h[69]	Ball pythons/PD
Metronidazole	20 mg/kg PO q48h × ≥7 days[70]	Most species
	50 mg/kg PO q24h × 7-14 days[34]	Most species; potential side effects at this dose; lower dose may be prudent
	20 mg/kg PO q48h[71,72]	Snakes/PD
	20 mg/kg PO q24-48h[73]	Iguanas/PD
Oxytetracycline	6-10 mg/kg PO, IM, IV q24h[10,11]	Most species/may produce inflammation at injection site
	5-10 mg/kg IM q24h[35]	Tortoises/mycoplasmosis
	10 mg/kg IM, IV q5d[74]	Crocodilians/PD (27°C [81°F]); mycoplasmosis
Penicillin, benzathine	10,000-20,000 U/kg IM q48-96h[20]	Most species
Penicillin G	10,000-20,000 U/kg SC, IM, IV, ICe q8-12h[11]	Most species/infrequently used
Piperacillin	50-100 mg/kg IM q24h[10,11]	Most species/nephrotoxic
	50 mg/kg IM, then 25 mg/kg q24h[10,30]	Snakes
	100 mg/kg IM q48h[75]	Snakes/PD
	100-200 mg/kg SC, IM q24-48h[18]	Chameleons
	100 mg/10 mL saline × 30 min nebulization q12h[76]	Most species/pneumonia
Streptomycin	10 mg/kg IM q12-24h[11]	Most species/nephrotoxic; avoid with hepatic dysfunction
Sulfadiazine	25 mg/kg PO q24h[30]	Most species/nephrotoxic
Sulfadimethoxine	90 mg/kg IM, then 45 mg/kg q24h[11]	Most species/nephrotoxic
Thiabendazole	50 mg/kg PO q24h × 14 days[77]	Chelonians/pneumonia; dermatitis
Ticarcillin	50-100 mg/kg IM q24h[11]	Most species/nephrotoxic
	50-100 mg/kg IM, IV q24-48h[78]	Loggerhead sea turtles/PD
Tobramycin	—	Nephrotoxic
	2.5 mg/kg IM q24-72h[10,17]	Most species
	10 mg/kg IM q24-48h[10]	Chelonians/can be given q48h in tortoises
Trimethoprim/sulfadiazine	—	Avoid in renal dysfunction; compound parenteral form
	15-25 mg/kg PO q24h[30]	Most species
	20-30 mg/kg IM q24-48h[34]	Most species
	30 mg/kg IM q24h × 2 days, then q48h[10,11,20]	Most species/can administer PO, SC
Trimethoprim/sulfamethoxazole	10-30 mg/kg PO q24h[11]	Most species/ Avoid in renal dysfunction
Tylosin	5 mg/kg IM q24h × 10-60 days[10,17]	Most species/mycoplasmosis
Voriconazole	10 mg/kg PO[79]	Bearded dragons/no hepatotoxicity noted when used for *Chrysosporium* anamorph of *Nannizziopsis vriesii*
	5 mg/kg SC[80]	Red-eared sliders/exceeded MIC only until 4 h after injection; 26°C (78°F)

ICe, Intracoelomic; *IM,* intramuscular; *IT,* intrathecal; *IV,* intravenous; *MIC,* minimum inhibitory concentration; *PD,* pharmacodynamic; *PO,* by mouth; *SC,* subcutaneous; *URT,* upper respiratory tract.

[a]Because reptiles are ectothermic, pharmacokinetics of drugs are influenced by ambient temperature. Antimicrobial therapy should be conducted at the upper end of the patient's preferred (selected) optimum temperature zone.

TABLE 2

Antiparasitic Agents

Agent	Dosage	Species/Comments
Albendazole	50 mg/kg PO[30]	Most species/ascarids
Carbaryl powder (5%)	Lightly dust animal and environment; rinse after 1 h; repeat in 7 days[20,81]	Lizards; snakes/mites
Chloroquine	125 mg/kg PO q48h × 3 treatments[30]	Tortoises/hemoprotozoa
Emodepside (1.98%) + praziquantel (7.94%)	1.12 mL/kg[82,83]	Many species/PD; nematodes; cestodes; aquatic turtles must be kept dry 48 h after application; appears safe, but need more safety and efficacy data
Fenbendazole	—	May have antiprotozoan effect; may cause leukopenia, avoid with septicemia[84]
	25-100 mg/kg PO q14d × 1-4 treatments[16,39,85]	All species/nematodes
	50 mg/kg PO q24h × 3-5 days[20,86,87]	All species/nematodes (× 3 days); flagellates and giardia in chameleons (× 5 days)
	100 mg/kg once[88]	Tortoises/nematodes; ova still sheds for 30 days
Fipronil	Spray or wipe on then wash off in 5 min q7-10d prn[20,81]	Most species/mites, ticks; beware of reactions to alcohol carrier; needs safety evaluation[89]
Imidacloprid and moxidectin	0.2 mg/kg topical q14d × 3 treatments[90]	Lizards/eliminated hookworms and pinworms; needs safety and pharmacokinetic evaluation
Ivermectin	—	Do not use in chelonians,[91] crocodilians, indigo snakes, or skinks[30,39,87]
	0.2 mg/kg PO, SC, IM repeat in 14 days[5,92 93]	Snakes (except indigos), lizards (except skinks)[39]/nematodes,[94] mites; dilute with propylene glycol for oral use; colored animals may have skin discoloration at injection site; rare adverse effects reported in chameleons[5]; do not use within 10 days of diazepam or tiletamine/zolazepam; rare death and occasional nervous system signs, lethargy, or inappetence;[87] pentastomids in monitors (with dexamethasone)[92]
	5-10 mg/L water topical spray q3-5d up to 28 days[87]	Snakes (except indigos), lizards (except skinks)/mites; less effective than fipronil; spray on skin and in newly cleaned cage, then allow to dry before replacing water dish
Metronidazole	—	Protozoan (i.e., flagellates, amoebae) overgrowth; may stimulate appetite; may cause severe neurologic signs at doses >200 mg/kg[95]; death occurred in indigo and mountain king snakes at 100 mg/kg[16]; for small patients, injectable form can be administered PO; oral liquid not available in the United States but can be compounded
	40-100 mg/kg PO, repeat in 10-14 days[11]	Most species/flagellate overgrowth
	20 mg/kg PO q48h[71]	Corn snakes/PD; 28°C (82°F); protozoa
	40 mg/kg PO, repeat in 14 days[16,20]	Uracoan rattler, milk, tricolor king, and indigo snakes/flagellates
	40-60 mg/kg PO q7d × 2-3 doses[96]	Chameleons/flagellates; amoebae
	40-200 mg/kg PO, repeat in 14 days[97]	Geckos/ocular lesions (40 mg/kg) and SC lesions (200 mg/kg) caused by *Trichomonas*
	50 mg/kg PO q24h × 2-5 days[86]	Chameleons/when accompanied by increased gastrointestinal symptoms
	20 mg/kg ICe q48h[98]	Red-eared sliders/PD; ICe administration not recommended; needs further safety evaluation
	25 mg/kg PO q24h × 5 days or 50 mg/kg PO q14 days prn[99]	Chelonians (tortoises)/amoebae; use 25 mg/kg dosage for clinically ill cases
Paromomycin	35-100 mg/kg PO q24h × ≤28 days[11,16,93]	Most species/amoebae
	100 mg/kg PO q24h × 7 days, then 2 ×/wk × 3 mo[100]	Snakes/cryptosporidia; reduced clinical signs and oocyte shedding; does not eliminate the organism
	300-360 mg/kg PO q48h × 14 days[101]	Lizards (gila monsters)/cryptosporidia
	300-800 mg/kg PO q24h prn[102]	Geckos/cryptosporidia; reduced clinical signs; does not eliminate the organism
Permethrin	Environmental treatment, 1 s of spray/ft^2; wait until dry before returning animal to enclosure[81]	Lizards, snakes/mites; ticks; FDA approved; safe and effective; wash immediately if accidentally applied to skin
	Topical[81]	Tortoises/ticks

Continued

TABLE 2—cont'd

Antiparasitic Agents

Agent	Dosage	Species/Comments
Ponazuril	30 mg/kg PO q48h × 2 treatments[103,104]	Bearded dragons/coccidiosis
Praziquantel (also see Emodepside)	8 mg/kg PO, SC, IM, repeat in 14 days[5,18,30]	Most species/cestodes, trematodes; higher dosages have been administered[20]
	5-10 mg/kg PO q14d[86]	Chameleons/flukes may best be left untreated if not causing a problem
	25-50 mg/kg PO q3h × 3 treatments[105,106]	Sea turtles (green, loggerhead)/PD; spirorchidiasis
Pyrantel pamoate	5 mg/kg PO, repeat in 14 days[87]	Most species/nematodes
	25 mg/kg PO q24h × 3 days; repeat in 3 wk[20,107]	Most species/ascarids, hookworms, pinworms
Pyrethrin spray (0.09%)	Topical q7d × 2-3 treatments[81]	Most species/use water-based labeled for kittens and puppies; apply with cloth; can also spray cage, wash out after 30 min; use sparingly and with caution; pyrethroids are safer
Quinacrine	19-100 mg/kg PO q48h × 14-21 days[108]	Most species/some hematozoa
Quinine sulfate	75 mg/kg PO q48h × 14-28 days[108]	Most species/some hematozoa; toxic at >100 mg/kg q24h; ineffective against exoerythrocytic forms
Resmethrin spray/shampoo	Topical, repeat q≥10d prn[81]	Most species/mites; pyrethroid; safer than pyrethrins; use with care; spray (0.35%) or shampoo entire animal, rinse off immediately in running, tepid water; protect eyes (other than snakes) with 1 drop of mineral oil; lightly spray environment, wipe off in 5-10 min
Spiramycin	160 mg/kg PO q24h × 10 days, then 2×/wk for 3 mo[100]	Snakes/cryptosporidia; may reduce clinical signs and oocyte shedding; does not eliminate
Sulfadiazine, sulfamerazine	—	Most species/coccidia; watch renal dysfunction[95]
	75 mg/kg PO, then 45 mg/kg q24h × 5 days[11,86,108]	Most species/coccidia
	25 mg/kg PO q24h × 21 days[5,77,108]	Snakes, lizards/coccidian
Sulfadimethoxine	50 mg/kg PO q24h × 3-5 days, then q48h prn[87]	Most species/coccidia; watch renal dysfunction
	90 mg/kg PO, IM, IV, then 45 mg/kg q24h × 5-7 days[11,16,108]	Most species/coccidia
Sulfamethazine	50 mg/kg PO q24h × 3 days, off 3 days, on 3 days[108]	Most species/coccidia
	25 mg/kg PO, IM q24h × 21 days[109]	Most species/coccidia
	75 mg/kg PO, IM, IV, then 40 mg/kg q24h × 5-7 days[16,17]	Most species/coccidia; ensure adequate hydration and renal function
Toltrazuril 5%	5-15 mg/kg q24h × 3 days[110]	Bearded dragons/coccidia
	15 mg/kg q48h × 10 days; discontinue for 2 wk; repeat q48h × 10 days prn[111]	Tortoises/intranuclear coccidiosis; needs safety, efficacy, and pharmacokinetic study
Trimethoprim/sulfa	—	Most species/coccidia; avoid potentiated sulfa drugs in cases of dehydration or renal dysfunction[95]
	30 mg/kg PO q24h × 2 days, then q48h × 21 days[5,108]	Most species/coccidia
	30 mg/kg IM q24h × 2 days, then 15 mg/kg IM q48h × 10-28 days[108]	Most species/coccidia

FDA, U.S. Food and Drug Administration; *ICe,* intracoelomic; *IM,* intramuscular; *IV,* intravenous; *PD,* pharmacodynamic; *PO,* by mouth; *prn,* as required; *SC,* subcutaneous.

TABLE 3

Chemical Restraint/Anesthetic and Analgesic Agents

Agent	Dosage	Species/Comments
Acepromazine	0.05-0.25 mg/kg IM[31]	Most species/preanesthetic with ketamine
	0.1-0.5 mg/kg IM[112,113]	Most species/preanesthetic; reduce by 50% if used with barbiturates
Alphaxalone	—	Not available in the United States
	6-9 mg/kg IV, or 9-15 mg/kg IM[114]	Most species/good muscle relaxation; variable results; needs more evaluation; possible violent recovery;[115] avoid within 10 days of DMSO
	6-15 mg/kg IM, IV[116]	Most species
	9 mg/kg IV[117]	Snakes, lizards/induction; not effective for blotched blue-tongued skinks
	15 mg/kg IM[112]	Lizards, chelonians/induction,35-40 min; duration 15-35 min; good muscle relaxation
	24 mg/kg ICe[118]	Chelonians (red-eared sliders)/surgical anesthesia with good relaxation
Atipamezole	Same volume SC, IV, IP as medetomidine or dexmedetomidine[a,119,120]	Most species/medetomidine and dexmedetomidine reversal; severe hypotension in gopher tortoises IV[121]
Atropine	0.01-0.04 mg/kg SC, IM,[122] IV,[12] ICe[123]	Most species/preanesthetic; rarely indicated; for profound bradycardia[123]; may help prevent intracardiac shunting[57]; ineffective dose in green iguanas[124]
	0.5 mg/kg IM, IV, IT, IO[95]	Most species/bradycardia, decrease secretions, CPR
Bupivacaine	1-2 mg/kg local q4-12h prn[116]	Most species; 4 mg/kg max dose
Buprenorphine	0.005-0.02 mg/kg IM q24-48h[125]	Most species/analgesia
	0.1-1 mg/kg IM[126]	Most species/analgesia
Butorphanol	—	Combinations (see ketamine) follow; recent studies call into question use in providing analgesia in reptiles, including red-eared sliders, ball pythons, bearded dragons, and green iguanas; respiratory depression at high doses[127-129]
	0.4-1 mg/kg SC, IM[123]	Most species/analgesia; sedation; preanesthetic
	0.5-2 mg/kg IM or 0.2-0.5 mg/kg IV, IO[126]	Most species/preanesthetic
	1-1.5 mg/kg SC, IM[123]	Lizards/administer 30 min before isoflurane for smooth, shorter induction
	0.2 mg/kg IM[125,130]	Chelonians/tranquilizer
	20 mg/kg IM[131]	Cornsnakes/potential analgesia
Butorphanol (B)/midazolam (M)	(B) 0.4 mg/kg + (M) 2 mg/kg IM[132]	Most species/preanesthetic; administer 20 min before induction
Carprofen	1-4 mg/kg PO, SC, IM, IV q24h,[133] follow with half the dose q24-72h[134]	Most species/analgesia; nonsteroidal antiinflammatory
Dexmedetomidine[a]	—	α_2 agonist that has replaced medetomidine[a]
Diazepam	—	Combinations follow; muscle relaxation; give 20 min before anesthesia; potentially reversible with flumazenil; interaction with ivermectin
	0.5 mg/kg IM, IV[95]	All species/seizures
	0.2-0.8 mg/kg IM[123]	Snakes/use with ketamine for anesthesia with muscle relaxation
	0.2-2 mg/kg IM, IV[116]	Snakes, lizards
	2.5 mg/kg PO[123]	Iguanas/reduce anxiety that often leads to aggression
	0.2-1 mg/kg IM[116,123]	Chelonians/use with ketamine for anesthesia with muscle relaxation
Doxapram	5 mg/kg IM, IV[132] q10min prn	Most species/respiratory stimulant; reduces recovery time; reported to partially "reverse" effects of dissociatives[133]
	4-12 mg/kg IM, IV[123]	Most species/respiratory stimulant
	20 mg/kg IM, IV, IO[95]	Most species/respiratory stimulant
Epinephrine (1:1000)	0.5-1 mg/kg IV, IO, IT[95]	Most species/CPR, cardiac arrest
Fentanyl	2.5 μg/h patch to caudodorsal lumbar skin[135]	Prehensile-tailed skinks/no side effects reported after 24 h when skink blood levels reached human therapeutic levels; environmental temperature can significantly affect absorption

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TABLE 3—cont'd

Chemical Restraint/Anesthetic and Analgesic Agents

Agent	Dosage	Species/Comments
Flunixin meglumine	0.1-0.5 mg/kg IM q12-24h[133]	Most species/analgesia; use max of 3 days
	1-2 mg/kg IM q24h × 2 treatments[136,137]	Lizards/nonsteroidal antiinflammatory; postsurgical analgesia
	0.5-2 mg/kg IM q12-24h[116]	Most species/nonsteroidal antiinflammatory; analgesia
Glycopyrrolate	0.01 mg/kg SC,[122] IM, IV[132]	Most species/preanesthetic; excess mucus; use with prolonged bradycardia; dose does not work in green iguanas[124]
Haloperidol	0.5-10 mg/kg IM q7-14d[138]	Boids/aggression management
Isoflurane	3%-5% induction[13] 1%-3% maintenance[39]	Most species/inhalation anesthetic of choice in reptiles
Ketamine	—	Muscle relaxation and analgesia may be marginal; prolonged recovery with higher doses; larger reptiles require lower dose; painful at injection site; safety questionable in debilitated patients; avoid with renal dysfunction; snakes may be permanently aggressive after ketamine anesthesia[115]; recommend only as preanesthetic before isoflurane for surgical anesthesia
	20-60 mg/kg IM, or 5-15 mg/kg IV[31]	Most species/muscle relaxation improved with midazolam or diazepam
	22-44 mg/kg SC, IM[115,139]	Most species/sedation
	55-88 mg/kg SC, IM[139]	Most species/surgical anesthesia; induction, 10-30 min; recovery, 24-96 h
	20-60 mg/kg SC, IM[122,140]	Snakes/sedation; induction, 30 min; recovery, 2-48 h
	60-80 mg/kg IM[39]	Snakes/light anesthesia; IPPV may be needed at higher doses
	30-50 mg/kg SC, IM[122,140]	Lizards/sedation; variable results
	20-60 mg/kg IM[113,140,141]	Chelonians/sedation; induction, 30 min; recovery, ≥24 h; potentially dangerous in dehydrated and debilitated tortoises
	25 mg/kg IM, IV[7]	Sea turtles/sedation
	38-71 mg/kg ICe[142]	Green sea turtles/anesthesia; induction, 2-10 min; duration, 2-10 min; recovery, <30 min
	60-90 mg/kg IM[112,140]	Chelonians/light anesthesia; induction, <30 min; recovery, hours to days; require higher doses than most other reptiles
	20-40 mg/kg SC, IM, ICe (sedation), to 40-80 mg/kg (anesthesia)[143]	Crocodilians/induction, <30-60 min; recovery, hours to days; in larger animals, 12-15 mg/kg may permit tracheal intubation[123]; not recommended alone in Nile crocodiles[144]
Ketamine (K)/butorphanol (B)	See (K) dosages + (B) ≤1.5 mg/kg IM[123]	Snakes/anesthesia with improved muscle relaxation
	(K) 10-30 mg/kg + (B) 0.5-1.5 mg/kg IM[123]	Chelonians/minor surgical procedures (i.e., shell repair)
Ketamine (K)/diazepam (D)	See (K) dosages + (D) 0.2-0.8 mg/kg IM[123]	Snakes/anesthesia with improved muscle relaxation
	(K) 60-80 mg/kg[112]+ (D) 0.2-1 mg/kg IM[123]	Chelonians/anesthesia; muscle relaxation
Ketamine (K)/medetomidine (M)[a]	—	Medetomidine no longer commercially available, can be compounded[a]; reverse with atipamezole
	(K) 10 mg/kg + (M) 0.1-0.3 mg/kg IM[145]	Most species
	(K) 3-8 mg/kg + (M) 0.025-0.08 mg/kg IV[146]	Giant tortoises (Aldabra)
	(K) 4 mg/kg + (M) 0.04 mg/kg IM[147]	Green sea turtles
	(K) 4-10 mg/kg + (M) 0.04-0.14 mg/kg IM[148]	Chelonians/sedation and muscle relaxation for shell repair
	(K) 5 mg/kg + (M) 0.05 mg/kg IV[149]	Loggerhead sea turtles/induction of anesthesia for intubation
	(K) 5-10 mg/kg IM + (M) 0.1-0.15 mg/kg IM, IV[150]	Tortoises (small-medium)
	(K) 10-20 mg/kg IM + (M) 0.15-0.3 mg/kg IM, IV[150]	Turtles (fresh water)
	(K) 5-10 mg/kg + (M) 0.1-0.15 mg/kg IM[151]	Alligators/adults
	(K) 10-15 mg/kg + (M) 0.15-0.25 mg/kg IM[151]	Alligators/juveniles

TABLE 3—cont'd

Chemical Restraint/Anesthetic and Analgesic Agents

Agent	Dosage	Species/Comments
Ketamine (K)/midazolam (M)	(K) 20-40 mg/kg + (M) ≤2 mg/kg IM[152]	Chelonians/sedation; muscle relaxation
	(K) 60-80 mg/kg[112] + (M) ≤2 mg/kg IM[123]	Chelonians/anesthesia; muscle relaxation
Ketoprofen	2 mg/kg SC, IM q24h[133]	Most species/analgesia; in green iguanas, IM, IV q24h; administration at this dose may be too frequent based on PK study[153]
Lidocaine (0.5%-2%)	2-5 mg/kg; local or topical[116,123]	Most species/local analgesia; infiltrate to effect, often used in conjunction with chemical; 10 mg/kg maximum dosage immobilization
Medetomidine[a]	—	Medetomidine is no longer commercially available but can be compounded[a]; poor immobilization alone, see combinations
Meloxicam	0.1-0.5 mg/kg PO, SC q24-48h[57-59]	Most species
	0.5 mg/kg PO, IM or 0.22 mg/kg IV[154]	Red-eared sliders/PK; found better absorption IM vs. PO;[154] after IV administration, plasma levels decreased rapidly
	0.2 mg/kg PO, IV q24h[155]	Green iguanas/PD
	0.1-0.2 mg/kg PO, IM q24h × 4-10 days[148]	Chelonians
Meperidine/Pethidine	5-10 mg/kg IM q12-24h[125]	Most species/analgesia; no noticeable effect in snakes, even at 200 mg/kg
	20 mg/kg IM q12-24h[133]	Most species/analgesia
	2-4 mg/kg ICe q6-8h[57]	Lizards
	2-4 mg/kg ICe[156]	Nile crocodiles/analgesia
Methohexital	5-20 mg/kg SC,[139] IV[12]	Most species/induction, 5-30 min; recovery, 1-5 h; use at 0.125%-0.5% concentration; much species variability; decrease dose 20%-30% for young\animals; avoid use in debilitated animals
	9-10 mg/kg SC,[157] ICe	Colubrids/induction, ≥22 min; recovery, 2-5 h; does not produce soft tissue irritation seen with other barbiturates; may need to adjust dosage in obese snakes
Metomidate	10 mg/kg IM[145,158]	Snakes/profound sedation; not available in the United States
Midazolam	—	See butorphanol, ketamine for combinations; can be reversed by flumazenil
	2 mg/kg IM[115,139]	Most species/preanesthetic; increases efficacy of ketamine; effective in snapping turtles; not in painted turtles[139]
	0.5-2 mg/kg[159]	Lizards
	1.5 mg/kg IM[160]	Turtles (red-eared sliders)/sedation; onset, 5.5 min; duration, 82 min; recovery, 40 min; much individual variability
Morphine	—	No effective analgesic dose in cornsnakes[129]
	1.5-6.5 mg/kg IM[128,129,131,148]	Red-eared sliders (long-lasting respiratory depression), freshwater crocodiles, *Anolis* lizards/may be effective thermal analgesia in bearded dragons
	10 mg/kg IM[129]	Crocodilians/analgesia
Oxymorphone	0.025-0.1 mg/kg IV[12]	Some species/analgesia; avoid in cases with hepatic or renal dysfunction; no noticeable effect in snakes, even at 1.5 mg/kg[115]
	0.05-0.2 mg/kg SC, IM q12-48h[125]	See previous dosage comments within Oxymorphone
Pentazocine	2-5 mg/kg IM q6-24h[125]	Analgesia

Continued

TABLE 3—cont'd

Chemical Restraint/Anesthetic and Analgesic Agents

Agent	Dosage	Species/Comments
Propofol	—	If administered in supravertebral sinus, be aware of potential submeningeal delivery[161]; anesthesia; rapid, smooth induction; 15-25 min anesthesia and restraint in most species; rapid, excitement-free recovery; administered IV/IO slowly; reduce dosages by as much as 50% in premedicated animals; apnea and bradycardia; intubation and IPPV generally required
	0.3-0.5 mg/kg/min IV, IO constant rate infusion or 0.5-1 mg/kg IV, IO periodic bolus[116]	Most species/maintenance anesthesia; must provide respiratory and thermal support
	5-10 mg/kg IV, IC[158,162]	Snakes
	3-5 mg/kg IV, IO[150,163]	Lizards/intubation and minor diagnostic procedures; may need additional dose in 3-5 min; less cardiopulmonary depression
	5-10 mg/kg IV, IO[164]	Iguanas/higher dose is recommended for induction for short duration procedures or intubation
	2 mg/kg IV[132]	Giant tortoises
	3-5 mg/kg IV[148]	Chelonians/sedation (i.e., shell repair)
	10 mg/kg IV[165]	Red-eared sliders/40-85 min anesthesia
	20 mg/kg IV[165]	Red-eared sliders/60-120 min anesthesia
	10-15 mg/kg IV[143]	Crocodilians/duration, 0.5-1.5 h; maintain with gas anesthetics; experimental IM with hyaluronidase
Sevoflurane	To effect[5,166]	Most species/anesthesia; rapid induction and recovery when intubated
Tiletamine/zolazepam	—	Sedation, anesthesia; severe respiratory depression possible—IPPV;[39] variable results; prolonged recovery; lower dose in heavier species; good for muscle relaxation before intubation[130,167]
	4-5 mg/kg SC, IM[139]	Most species/sedation; induction, 9-15 min; recovery, 1-12 h; adequate for most noninvasive procedures
	5-10 mg/kg IM[132]	Most species
	3 mg/kg IM[150]	Snakes/facilitates handling and intubation of large snakes; induction, 30-45 min; prolongs recovery
	10-30 mg/kg IM[112] to 20-40 mg/kg IM[13,168]	Snakes, lizards/induction, 8-20 min; recovery, 2-10 h; variable results; longer sedation and recovery times at 22°C (72°F) than at 30°C (86°F);[169] good sedation in boa constrictors at 25 mg/kg IM[169]; generally need to supplement with inhalational agents for surgical anesthesia; some snakes died at 55 mg/kg
	5-10 mg/kg IM, IV[123]	Large tortoises/facilitates intubation; if light, mask with isoflurane rather than redosing
	1-2 mg/kg IM[15]	Crocodilians/recovery takes several hours
	2-10 mg/kg IM[123]	Large crocodilians/may permit intubation
	10-40 mg/kg SC, IM, ICe[143]	Crocodilians, anesthesia
	15 mg/kg IM[170]	Alligators/induction, >20 min; minor procedures
Tramadol	11 mg/kg PO[171]	Bearded dragons
	5-10 mg/kg PO[172]	Red-eared sliders/thermal analgesia, higher doses may affect ventilation
Xylazine	—	Infrequently used; variable effects; potentially reversible with yohimbine
	0.1-1.25 mg/kg IM, IV[12]	Most species
	0.1-1 mg/kg IM[15]	Crocodilians/atipamezole better reversal
	1-2 mg/kg IM[113,143]	Nile crocodiles

CPR, Cardiopulmonary resuscitation; *IC,* intracardiac; *ICe,* intracoelomic; *IM,* intramuscular; *IO,* intraosseous; *IP,* intraperitoneal; *IPPV,* intermittent positive pressure ventilation; *IT,* intrathecal; *IV,* intravenous; *PD,* pharmacodynamic; *PK,* pharmacokinetic; *PO,* by mouth; *prn,* as required; *SC,* subcutaneous.
[a]Medetomidine is no longer commercially available, although it can be obtained from select compounding services. Dosages listed here are a guide for possible use with dexmedetomidine, an α_2 agonist that is the active optical enantiomer of the racemic compound medetomidine. It is used at half the dose of medetomidine but the same volume because of higher concentration. Although the same effects would be expected as with medetomidine, there are limited data on the efficacy and safety of dexmedetomidine in reptiles, and, to date, it appears to have been seldom used clinically in reptiles. The effects of the volume-to-volume use of the two drugs may not be equivalent, so the dose of dexmedetomidine may need to be adjusted based on clinical response.

TABLE 4

Hormones and Steroids

Agent	Dosage	Species/Comments
Arginine vasotocin	0.01-1 μg/kg IV, ICe[173] q12-24h × 2-3 treatments	Most species/dystocias; give 30-60 min after parenteral Ca; available for research; higher doses reported; 0.5 μg/kg commonly recommended
Calcitonin	1.5 U/kg SC q8h × 14-21 days prn[12] 50 U/kg IM repeat in 14 days[30,174] 50 U/kg q7d × 2-3 doses[175,176]	Most species (e.g., iguanas)/severe NSHP; administer after Ca; avoid if hypocalcemic Green iguanas/salmon calcitonin; do not give if hypocalcemic
Dexamethasone	0.6-1.25 mg/kg IM, IV[12] 2-4 mg/kg IM, IV q24h × 3 days[177] 0.3-1.5 mg/kg IM, IV, IO[59]	Most species/shock (septic/traumatic) Most species/inflammatory, noninfectious respiratory disease Chelonians/hyperthermia
Dexamethasone sodium phosphate	0.1-0.25 mg/kg SC, IM, IV[17]	Most species/shock (septic/traumatic)
Insulin	1-5 U/kg IM, ICe q24-72h[178] 5-10 U/kg IM, ICe q24-72h[178]	Snakes, chelonians/doses adjusted based on response to therapy and serial blood glucose; ICe may take 24-48 h before response Lizards, crocodilians/see previous dosage comments within Insulin
Leuprolide acetate	0.4 mg/kg IM[179]	Iguanas/did not suppress testosterone levels in males
Levothyroxine	0.02 mg/kg PO q48h[180] 0.025 mg/kg q24h in morning[181]	Tortoises/hypothyroidism; stimulates feeding in debilitated tortoises Tortoises/monitor T_4 levels
Methylprednisolone	1 mg/kg IV q24h[59]	Chelonians/ivermectin toxicity
Nandrolone	0.5-5 mg/kg IM q7-28d[182] 1 mg/kg IM q7-28d[183]	Most species/hepatic lipidosis Lizards/anabolic steroid; reduces protein catabolism; may stimulate erythropoiesis
Oxytocin	— 1-10 U/kg IM[31,184] 2 U/kg IM q4-6h × 1-3 treatments[185] 1-5 U/kg IM,[186] repeat in 1 h 1-2,[187] 2-20,[17,67] or 10-20[188] U/kg IM	Dystocias; results variable; works well in chelonians, less in snakes and lizards; give 1 h after Ca administration Most species/higher dose is commonly used; may be repeated up to three treatments at 90 min intervals, increasing dosage Most species Lizards/alternatively, 5 U/kg by slow IV or IO over 4-8 h[186] Chelonians
Prednisolone	2-5 mg/kg PO, IM[133] 0.5 mg/kg q24h × 14 days, then q48h until PCV stable[57]	Most species/analgesia (chronic pain) Lizards/autoimmune hemolytic anemia
Prednisolone sodium succinate	5-10 mg/kg IM, IV,[119] IO[183]	Most species/shock; hyperthermia; may help reduce nephrocalcinosis
Prednisone	0.5-1 mg/kg PO, SC, IM, IV[189] 0.8 mg/kg q48h[190]	Most species/lymphoma, leukemia, myeloproliferative disease Most species/chronic T-lymphocytic leukemia; combine with chlorambucil, but monitor uric acid levels
Stanozolol	5 mg/kg IM q7d prn[17]	Most species/anabolic steroid; management of catabolic disease states

Ca, Calcium; *ICe,* intracoelomic; *IM,* intramuscular; *IO,* intraosseous; *IV,* intravenous; *NSHPT,* nutritional secondary hyperparathyroidism; *PCV,* packed cell volume; *PO,* by mouth; *prn,* as required; *SC,* subcutaneous; T_4, thyroxine.

TABLE 5

Nutritional/Mineral/Fluid Support*

Agent	Dosage	Species/Comments
Calcium glubionate	10 mg/kg PO q12-24h prn[70]	All species/NSHPT
	360 mg/kg (1 mL/kg) PO q12-24h prn[39,174]	Most species/NSHPT; hypocalcemia; dystocia; ensure adequate UVB exposure and proper nutrition
Calcium gluconate	100 mg/kg SC, IM, ICe[191,192] q6-24h[39,174]	Most species/hypocalcemia (low ionized Ca); when patient is stable switch to oral Ca
Calcium gluconate/borogluconate	10-50 mg/kg SC, IM[70]	Most species/hypocalcemia; hypocalcemic dystocia
Calcium glycerophosphate/Calcium lactate	1-5 mg/kg SC, IM[70]	Most species/hypocalcemia; hypocalcemic dystocia
	10-25 mg/kg SC, IM[17]	Most species/hypocalcemia; dystocia
	10 mg/kg SC, IM, ICe q24h × 1-7 days[5,174]	Lizards (iguanas)/hypocalcemia
Electrolyte solutions	Voluntary drinking (whole body soak)[193]	All species/oral fluid therapy; early treatment of anorexia; dilute 1:1 with water; caution against drowning
	10-20 mL/kg via gavage or esophagostomy tube q24h[193]	All species/rehydration; when stable; first stage in supplemental nutrition
Hydroxyethyl starch	3-5 mL/kg slow IV or IO bolus prn[193,194]	All species/hypoalbuminemia; hypovolemic perfusion deficits; increased capillary permeability; use with crystalloids; reduce crystalloid volume 40%-60%; max volume 20 mL/kg[195]
Iodine	2-4 mg/kg PO q24h × 14-21 days, then q7d[17]	Herbivorous species/iodine deficiency (goiter); suggested daily dietary iodine 0.03 mg/kg BW[196]
Iron dextran	12 mg/kg IM 1-2 ×/wk × 45 days[197]	Crocodilians/iron deficiency; in other species for anemia[99]
Lactated Ringer's solution (LRS)	15-40 mL/kg SC, IV, IO prn[194]	Land turtles/fluid replacement; use extracoelomically after warming the patient; avoid lactate if hepatic insufficiency
Metronidazole	12.5-50 mg/kg PO[11]	Most species/appetite stimulant
	50-100 mg/kg PO[18]	Chameleons/appetite stimulant
Polymerized bovine hemoglobin	3-5 mL/kg slow IV or IO bolus prn[193,194]	All species/hemoglobin polymer; hypoalbuminemia; hemorrhage; severe anemia; hypovolemic perfusion deficits; increased capillary permeability; use with crystalloids; reduce crystalloid volume 40%-60%; max volume 20 mL/kg[195]
Replacement crystalloid solutions	10-30 mL/kg q24h or divided into 2-3 boluses several hours apart[198]	All species/ongoing regurgitation or severe diarrhea
	15-25 mL/kg/day PO, SC, IV, IO, ICe, EpiCe prn[136]	All species/replacement fluid therapy; warm to 29°C (84°F)[194]
Ringer's solution for reptiles:	10-20 mL/kg q24h[199]	All species/hypertonic dehydration or to prevent aminoglycoside nephrotoxicity
1 part Normosol-R + 2 parts 2.5% dextrose in 0.45% saline[197] or	15 (large reptiles) to 25 (small reptiles) mL/kg q24h or divided into 2 doses per day[136]	All species/hypertonic dehydration; warm fluids to 28°C (82°F)
1 part Normosol-R + 1 part 5% dextrose + 1 part 0.9% saline	20 mL/kg q12h[39]	Chelonians/severe dehydration
Selenium	0.028 mg/kg IM[5]	Lizards/deficiency; myopathy
Vitamin A	—	Overdose causes epidermal sloughing; greater risk with aqueous parenteral formulation[196,200,201]; may help infectious stomatitis
	1000-5000 U/kg IM q7-10d × 4 treatments[17]	Most species/hypovitaminosis A
	2000 U/30 g BW PO once, repeat in 7 days[201,202]	Chameleons/eye swelling, respiratory disease, hemipenile plugs, dysecdysis
	200-300 U/kg[196] SC, IM	Turtles/hypovitaminosis A; give in conjunction with PO vitamin A (2-8 U/g feed DM)

TABLE 5—cont'd

Nutritional/Mineral/Fluid Support*

Agent	Dosage	Species/Comments
Vitamins A, D_3, E	0.15 mL/kg IM, repeat in 21 days[31]	Most species/hypovitaminosis A, D_3, or E; contains alcohol and may sting when given; alcohol-free product can be compounded commercially
	0.3 mL/kg PO, then 0.06 mL/kg q7d × 3-4 treatments[188]	Box turtles/hypovitaminosis A; parenteral use may result in hypervitaminosis A and D; given PO may enhance Ca uptake
Vitamin B complex	0.3 mL/kg SC, IM q24h[99]	Most species/anorexia; hypovitaminosis B
	25 mg thiamine/kg PO q24h × 3-7 days[185]	Most species/appetite stimulant; hypovitaminosis B
Vitamin B_1 (thiamine)	50-100 mg/kg PO, SC, IM q24h[203]	Piscivores/thiamine deficiency from thawed fish
	30 g/kg feed fish PO[17]	Crocodilians/treat or prevent deficiency
Vitamin B_{12} (cyanocobalamin)	0.05 mg/kg SC, IM[17]	Snakes, lizards/appetite stimulant
Vitamin C	10-20 mg/kg SC, IM q24h[204,205]	All species/hypovitaminosis C; stomatitis; skin slough in snakes; supportive therapy for bacterial infections
Vitamin D_3	—	NSHPT; hypocalcemia; deficiency and excess may lead to soft tissue calcification
	1000 U/kg IM, repeat in 1 wk[39]	Most species/deficiency; use with oral calcium glubionate and carbonate, general dietary management, and UVB irradiation
	200 U/kg PO, IM q7d[5,174]	Lizards/PO safer than IM
	400 U/kg IM q7d × 3 treatments[175]	Green iguanas/NSHPT; use with calcitonin after normocalcemic; also give PO calcium
Vitamin E/selenium	1 U vitamin E/kg[196] IM 50 U vit E/kg + 0.025 mg selenium/kg IM[206]	Piscivores/hypovitaminosis E; myopathy, anorexia, swollen subcutaneous nodules Lizards/hypovitaminosis E (vitamin E/selenium)
Vitamin K_1	0.25-0.5 mg/kg IM[31]	Most species/hypovitaminosis K_1; coagulopathies

BW, Body weight; *Ca,* calcium; *DM,* dry matter; *ICe,* intracoelomic; *IM,* intramuscular; *IO,* intraosseous; *IV,* intravenous; *NSHPT,* nutritional secondary hyperparathyroidism; *PO,* by mouth; *prn,* as required; *SC,* subcutaneous; *UVB,* ultraviolet B.
*See also Table 10.

TABLE 6

Miscellaneous Agents

Agent	Dosage	Species/Comments
Allopurinol	10-20 mg/kg PO q24h[67,183,207]	Most species/gout; decreases production of uric acid;[208] long-term therapy; tortoises may respond best
	25 mg/kg PO q24h[209]	Green iguanas
	50 mg/kg PO q24h × 30 days, then q72h[210]	Chelonians/hyperuricemia
Aluminum hydroxide	100 mg/kg PO q12-24h[208]	Most species/hyperphosphatemia; decreases intestinal absorption of phosphorus; use cautiously in patients with gastric outlet obstruction
Amidotrizoate	7.5 mL/kg PO[211]	Tortoises/gastrointestinal contrast agent; give via gavage; mean transit times: 2.6 h at 30.6°C (87°F); 6.6 h at 21.5°C (71°F)
Aminophylline	2-4 mg/kg IM[12]	Most species/bronchodilator
Atropine	0.01-0.04 mg/kg IM, IV q8-24h[212]	Most species/dries up excess mucous secretions with infectious stomatitis
	0.1-0.2 mg/kg IM prn[31]	Most species/organophosphate toxicity prn
	0.2 mg/kg SC, IM[213]	Most species/respiratory distress associated with excessive secretions
Barium sulfate	5-20 mL/kg PO[214]	Most species/gastrointestinal contrast studies

Continued

TABLE 6—cont'd

Miscellaneous Agents

Agent	Dosage	Species/Comments
Calcium EDTA	10-40 mg/kg IM q12h[191]	Most species/heavy metal chelation; ensure hydration
Carboplatin	2.5-5 mg/kg IV, IC[189]	Most species/chemotherapy
Chlorambucil	0.1-0.2 mg/kg PO[189]	Most species/chemotherapy
Cimetidine	4 mg/kg PO, IM q8-12h[17]	Most species/gastric and duodenal ulceration; esophagitis; gastroesophageal reflux; may use in renal failure to increase phosphate loss
Cisapride	0.5-2 mg/kg PO q24h[30]	Most species/motility modifier; GI stasis; may be compounded in the United States; ineffective in desert tortoises at 1 mg/kg[215]
Cisplatin	0.5-1 mg/kg IV (prehydrate), IC, intralesional (in oil)[189]	Most species/chemotherapy
Cyclophosphamide	10 mg/kg SC, IM, IV, IC[189]	Most species/chemotherapy
Dioctyl sodium sulfosuccinate	1-5 mg/kg PO[216]	Most species/constipation; use 1:20 dilution
Doxorubicin	1 mg/kg IV q7d × 2 treatments, then q14d × 2 treatments, then q21d × 2 treatments[217]	Snakes/chemotherapy
Furosemide	2-5 mg/kg PO, IM, IV q12-24h[17,31,57-59]	Most species/diuretic for edema and pulmonary congestion, while lacking loop of Henle, may effect via other mechanisms
Hydrochlorothiazide	1 mg/kg q24-72h[183]	Lizards/promotes diuresis; monitor hydration status
Iodine compound	500 mg/kg IV, IO[183]	Lizards/IV urography; take radiographs 0, 5, 15, 30, and 60 min postinjection
Iohexol	5-20 mL/kg PO[89]	Most species/gastrointestinal contrast studies, nonionic, organic iodine solution; good alternative to barium;[214] faster transit time than barium; can be diluted 1:1 with water
Lactulose	0.5 mL/kg PO q24h[57,59,218]	Lizards, chelonians/hepatic lipidosis
L-Asparaginase	400 U/kg SC, IM, IC[187]	Most species/chemotherapy
Melphalan	0.05-0.1 mg/kg PO[187]	Most species/chemotherapy
Methimazole	2 mg/kg q24h × 30 days[200]	Snakes/excessive shedding from hyperthyroidism; limited effectiveness
Methotrexate	0.25 mg/kg IV, SC, PO[187]	Most species/chemotherapy
Metoclopramide	0.06 mg/kg PO q24h × 7 day[30,219]	Most species/stimulates gastric motility
	1-10 mg/kg PO q24h[220]	Tortoises/stimulates gastric motility; ineffective in desert tortoises at 1 mg/kg[215]
Milk thistle (*Silybum marianum*)	4-15 mg/kg PO q8-12h[57,59]	Lizards, chelonians/ hepatoprotectant
Pentobarbital	60-100 mg/kg IV, ICe[221,222]	Euthanasia
Pimobendan	0.2 mg/kg PO q24h[57]	Lizards
Potassium chloride	2 mEq/kg IV, ICe[174]	Most species/euthanasia; cardioplegic; administer after a euthanasia solution
Probenecid	250 mg/kg PO q12h[223]	Most species/gout; increases uric acid excretion; can be increased prn
S-Adenosylmethionine	30 mg/kg PO q24h[224]	Savannah monitors/liver disease
Sodium bicarbonate	0.5-1 mg/kg IV[30]	Most species/hypoxic acidosis postanesthesia
Sucralfate	500-1000 mg/kg PO q6-8h[12]	Most species/oral, esophageal, gastric, and duodenal ulcers
Tamoxifen 60-day time-release pellets	Pellets containing 5 mg tamoxifen implants, ICe[225]	Leopard geckos/inhibition of follicular development for 60 days if implanted before vitellogenesis
Vincristine	0.025 mg/kg IV[189]	Most species/chemotherapy

GI, Gastrointestinal; *IC,* intracavitary; *ICe,* intracoelomic; *IM,* intramuscular; *IV,* intravenous; *PO,* by mouth; *prn,* as required; *SC,* subcutaneous.

TABLE 7

Hematologic and Serum Biochemical Values[a]

Measurement	Boa constrictor (Boa constrictor)[226-228]	Emerald tree boa (Corallus caninus)[228]	Rainbow boa (Epicrates cenchria)[228]	Blood python (Python curtus)[228]	South Asian pythons (Python molurus ssp)[228]	Ball python (Python regius)[228,229]	Green tree python (Chondropython viridis)[228]	Jungle carpet python (Morelia spilota cheynei)[228,230]	Reticulated python (Python reticulatus)[228]
HEMATOLOGY									
PCV (%)	29 (10-45)	22.6 (6-57)	28 (11-40)	25 (15-49)	28 (18-36)	22 (10-30)	17 (8-27)	25 (10-46)	24 (18-30)
RBC ($10^6/\mu L$)	0.73 (0.16-2.1)	2.16 (0.54-5.05)	0.92 (0.34-1.74)	0.65	1.44 (0.65-6.9)	0.82 (0.12-1.31)	0.85 (0.4-1.3)	0.92 (0.54-1.3)	0.72 (0.41-1.25)
Hgb (g/dL)	9 (2.6-15.3)	8.2 (6.1-11.4)	10.6 (8-13.1)	—	9.4 (7-11)	8.0 (5.5-9.6)	5.9 (4-7)	9.3 (4-15.5)	10.7 (5.2-30)
MCV (fL)	393 (159-625)	237 (37-360)	292 (175-534)	340	275 (52-384)	381 (211-917)	229 (208-250)	282 (178-414)	343 (176-429)
MCH (pg)	132 (84-208)	120 (113-128)	160	—	93 (16-127)	82-139	100	114 (67-159)	138 (60-186)
MCHC (g/dL)	32 (22-42)	34 (30-36)	36 (33-40)	—	32 (29-35)	31 (25-40)	36 (33-40)	40 (24-53)	37 (29-45)
WBC ($10^3/\mu L$)	8.54 (0.88-22.6)	4.35 (0.48-10.6)	7.99 (1-35.2)	11.7 (1.13-42.5)	9.94 (2-19.8)	9.74 (1-26)	11.3 (3.5-22.1)	11.93 (1.72-34.1)	7.6 (1.8-17.7)
Heterophils ($10^3/\mu L$)	2.46 (0.21-12.3)	1.61 (0.18-5.36)	2.85 (0.03-10)	1.82 (0.31-3.99)	2.36 (0.42-6.84)	2.86 (0.37-10.80)	3.89 (0.86-6.63)	2.78 (0.29-11.3)	2.03 (0.5-4.02)
Lymphocytes ($10^3/\mu L$)	4.01 (0.16-18.5)	2.48 (0.14-8.27)	3.91 (0.1-32.4)	6.71 (0.34-33.6)	5.78 (0.34-18.6)	4.18 (0.13-14.10)	3.44 (0.21-11.2)	6.11 (0.6-19.7)	3.77 (0.42-11.9)
Monocytes ($10^3/\mu L$)	0.68 (0.02-6.55)	0.45 (0.06-2.12)	0.9 (0.03-3.06)	0.62 (0.13-2.12)	1.016 (0.06-5.01)	1.00 (0.01-3.20)	0.74 (0.04-2.35)	2.21 (0.06-8.79)	1.72 (0.11-6.76)
Azurophils ($10^3/\mu L$)	1.75 (0-5.76)	0.71 (0.1-1.84)	1.08 (0.11-4.44)	2.82 (0.27-6.8)	1.81 (0.26-4.8)	3.4 (0.3-13.26)	5.42 (0.97-13.9)	3.46 (0.09-18.04)	3.73 (1.07-6.88)
Eosinophils ($10^3/\mu L$)	0.26 (0.03-1.22)	0.07 (0.06-0.08)	0.11 (0.04-0.22)	0.08	0.45 (0.1-1.4)	0.25 (0.12-0.37)	0.16 (0.1-0.22)	0.19 (0.08-0.34)	0.68 (0.04-1.95)
Basophils ($10^3/\mu L$)	0.46 (0.03-2.77)	0.07 (0.03-0.14)	0.1 (0.02-0.27)	0.93 (0.32-1.83)	0.25 (0.08-1.08)	0.38 (0.05-1.12)	0.55 (0.07-1.8)	0.26 (0.05-1.76)	0.06 (0.06-0.7)
CHEMISTRIES									
ALP (U/L)	287 (43-1342)	128 (61-323)	27 (14-37)	44 (8-56)	105 (7-728)	61 (13-153)	209 (112-349)	40 (13-60)	64 (4-144)
ALT (U/L)	14 (0-37)	5 (1-10)	4 (1-6)	10 (3-17)	19 (0-40)	14 (5-26)	43 (8-132)	17 (6-38)	8 (0-29)
Amylase (U/L)	22 (5-67)	293 (160-470)	—	—	3255	2490 (1611-3368)	902 (564-1240)	—	1690 (416-2963)
AST (U/L)	35 (3-331)	30 (5-92)	43 (9-136)	56 (6-209)	22 (1-205)	55 (2-118)	27 (11-75)	16 (5-46)	34 (7-105)
Bilirubin, total (mg/dL)	0.2 (0-0.6)	0.2 (0.2-0.3)	0.4 (0-0.8)	0.3 (0.2-0.5)	0.6 (0-2)	0.4 (0-2.1)	0.2	0.5	0.3
BUN (mg/dL)	5 (0-34)	2 (0-4)	2 (1-3)	1 (0-2)	4 (1-14)	1 (0-3)	2 (0-2)	3 (2-3)	4 (0-12)
Calcium (mg/dL)	15.9 (9-27)	12.7 (10.3-17.4)	13.4 (11.3-18.9)	14.7 (13.5-16.2)	19 (9.9-34)	15.3 (10.8-22.2)	23.4 (10.3-80.1)	14.4 (12.8-16.5)	23.5 (8.6-78)
Chloride (mEq/L)	125 (108-139)	130 (119-138)	115 (94-128)	131 (123-138)	118 (101-135)	120 (109-130)	125 (119-130)	115 (109-123)	118 (104-129)
Cholesterol (mg/dL)	131 (34-314)	206 (116-343)	206 (140-314)	214 (76-445)	289 (146-445)	182 (23-302)	204 (116-360)	315 (264-386)	309 (257-356)
Creatine kinase (U/L)	526 (53-1728)	592 (157-985)	154 (31-745)	668 (327-1009)	494 (42-3093)	1318 (93-3108)	614	398 (27-1350)	1818 (356-8342)
Creatinine (mg/dL)	0.4 (0.1-1.6)	0.6 (0.4-0.9)	0.4 (0.1-0.7)	0.9 (0.5-1.3)	1.4 (0.1-16.9)	0.2 (0-0.5)	0.2 (0.2-0.5)	1.3 (0.3-3.7)	0.2 (0.1-0.4)
GGT (U/L)	4 (0-10)	2 (1-2)	5	8 (0-16)	9 (0-26)	5	78 (5-223)	31 (16-71)	38 (14-64)
Glucose (mg/dL)	37 (9-85)	27 (5-56)	17 (2-46)	30 (13-74)	24 (1-83)	23 (2-43)	—	32 (9-55)	22
Iron (μg/dL)	113 (103-122)	—	—	207 (49-364)	456 (20-5525)	371 (77-782)	206	306 ± 160	313 (43-1048)
LDH (U/L)	235 (16-877)	632 (76-1680)	401 (141-661)	4.9	—	—	—	330 (48-547)	—
Lipase (U/L)	2730	—	—	3.7 (3.1-4.5)	4.7 (2.9-9.1)	3.8 (0.9-7.2)	11.8 (4-26.3)	3.4 (2.1-6.1)	7.2 (2.5-14.58)
Magnesium (mEq/L)	2.95 (2.9-3)	—	—	6.3 (3.3-11.2)	4.8 (3.8-6.3)	7.1 (4.3-10.5)	5.3 (5.2-5.3)	6.1 (4.9-9)	6.6 (4.4-10.2)
Osmolarity (mOsm/L)	306	—	—	6.2 (3.6-8.1)	7.3 (4.2-10.5)	6.7 (3.2-10.5)	5.4 (3.9-6.9)	7.6 (5.9-10.9)	7.5 (6.1-9.8)
Phosphorus (mg/dL)	4.7 (2.6-11.7)	4.1 (1.8-8)	5.4 (3.8-7.7)	2.3 (1.6-2.8)	2.7 (1.7-3.9)	2.5 (1-8.4)	2 (1.3-2.7)	3.1 (2.8-3.3)	3.9 (1.9-7.2)
Potassium (mEq/L)	5.4 (3-10)	5 (3-8.7)	3.2 (1.2-5)	4.1 (3.1-4.9)	4.9 (2.4-6.7)	4.6 (2.1-9)	4.4 (3.4-5)	4.9 (4.2-5.5)	5.4 (3.7-8)
Protein, total (g/dL)	7 (4.3-10.8)	4.5 (2.6-7.2)	6.2 (3.7-8)	160 (155-164)	158 (151-165)	159 (146-173)	158 (157-159)	153 (150-158)	157 (142-169)
Albumin (g/dL)[b]	3.1 (1.9-5.3)	2.6 (2-3.6)	2.6 (1.8-3.6)	16 (13-22)	114 (16-532)	31	—	30	45
Globulin (g/dL)[b]	4 (2.2-6.9)	2.8 (1.8-3.6)	4.1 (2.8-5.8)	4.3 (2.1-7.1)	4.3 (1.3-18)	7.6 (1.1-23)	7.7 (1.6-20.4)	6.5 (1.9-23.7)	7.8 (3.5-17.4)
Sodium (mEq/L)	158 (130-171)	157 (148-167)	155 (137-163)						
Triglyceride (mg/dL)	103 (3-457)	24 (10-49)	72 (64-90)						
Uric acid (mg/dL)	4.7 (0-11.9)	4.7 (1.4-19.2)	7.2 (2.1-27.5)						

Continued

TABLE 7—cont'd

Hematologic and Serum Biochemical Values[a]

Measurement	Gopher snake (Pituophis catenifer)[228,231]	Cornsnake (Elaphe guttata)[228]	Yellow rat snake (Elaphe obsoleta quadrivitatta)[228,232]	Common kingsnake (Lampropeltis getula)[228]	Milk snake (Lampropeltis triangulum)[228]	Indigo snake (Drymarchon corais)[228,233]	Panther chameleon (Furcifer pardalis)[228]	Spiny-tailed lizard (Uromastyx spp)[228,234]	Blue-tongued skink (Tiliqua scincoides)[228]
HEMATOLOGY									
PCV (%)	25 (15-38)	32 (21-52)	24 (9-46)	29 (12-45)	26 (8-38)	24 (15-34)	27 (16-35)	29 (4.9-44.5)	31 (22-46)
RBC (10^6/μL)	0.67 (0.14-1.4)	1.21 (0.62-1.85)	0.77 (0.21-1.34)	3.11 (0.35-14)	0.89 (0.49-2)	0.62 (0.43-0.76)	0.83 (0.42-1.6)	0.78 (0.33-4.1)	1.1 (0.73-1.36)
Hgb (g/dL)	9.7 (4.3-12.3)	11.5 (9.7-13.5)	8.3 (2.8-15.2)	—	10.4 (6.9-11.9)	9.2 (7.3-11.1)	—	9.9 (3.3-17.4)	10.4 (6-13)
MCV (fL)	578 (246-1571)	315 (171-404)	361 (198-765)	304 (27.9-500)	377 (135-615)	369 (221-558)	330 (200-418)	415 (119-614)	299 (266-354)
MCH (pg)	111 (81-132)	127 (110-143)	121 (90-175)	—	119 (89-164)	258	—	133 (1.2-203)	98 (44-173)
MCHC (g/dL)	33 (27.5-36)	35 (32-40)	32 (26-54)	—	34 (29-45)	40 (33-46)	—	33 (22-41)	33 (16-57)
WBC (10^3/μL)	6.36 (1.56-11.5)	11.3 (1.02-31.4)	9.32 (0.37-25)	12.7 (1.46-42.2)	9.17 (1.25-24.7)	10.8 (2-26.9)	—	958 (290-2290)	—
Heterophils (10^3/μL)	1.62 (0.18-9.43)	2.7 (0.21-8.35)	1.93 (0.06-10.5)	1.63 (0.19-4.8)	1.14 (0.05-4.46)	1.96 (0.35-8.1)	6.18 (0.47-18.6)	3.1 (1-8.1)	7.3 (2.2-19.6)
Lymphocytes (10^3/μL)	3.39 (0.24-8.03)	5.61 (0.41-22.9)	4.05 (0.14-14.4)	7.5 (0.13-33.3)	5.92 (0.47-19.2)	6.26 (0.28-16.7)	1.57 (0.09-4.17)	2 (0.59-5.36)	2.45 (0.54-6.24)
Monocytes (10^3/μL)	0.88 (0.05-3.07)	0.93 (0.04-1.75)	1.5 (0.01-9.72)	0.8 (0.05-5.83)	1.15 (0.07-3.6)	1.5 (0.04-4.84)	2.96 (0.21-9.67)	0.99 (0.27-4.05)	2.75 (0.32-10.9)
Azurophils (10^3/μL)	0.94 (0.45-1.67)	2 (0.15-5.34)	3.05 (0.06-8.33)	3.26 (0.21-8.87)	1.58 (0.03-5.93)	1.58 (0.5-4.69)	—	0.04 (0-0.5)	0.84 (0.35-1.49)
Eosinophils (10^3/μL)	0.08 (0.05-0.12)	0.1 (0.08-0.12)	0.1 (0.01-0.22)	0.11 (0.02-0.22)	0.1 (0.01-0.25)	0.23 (0.13-0.43)	1.25 (0.08-3.74)	—	0.34 (0-1.08)
Basophils (10^3/vL)	0.15 (0.02-0.51)	0.55 (0.07-1.44)	0.26 (0.05-0.66)	0.42 (0.1-1.3)	0.33 (0.04-1.82)	0.4 (0.08-0.74)	—	0.04 (0-0.2)	1.5 (0.03-2.96)
							0.1 (0.07-0.13)	0.03 (0-0.33)	0.98 (0.11-2.24)
CHEMISTRIES									
ALP (U/L)	58 (9-170)	54 (23-75)	142 (37-858)	88 (23-152)	108 (70-168)	123 (80-161)	—	31 (5.9-139)	71 (39-101)
ALT (U/L)	22 (11-65)	34 (4-62)	13 (2-72)	18 (8-25)	8 (3-17)	10 (3-16)	—	11 (2.4-35)	20 (5-34)
Amylase (U/L)	344 (214-473)	458 (366-574)	1337 (630-2626)	848	665	—	—	134	—
AST (U/L)	53 (16-127)	43 (10-224)	29 (2-142)	54 (5-249)	46 (0-178)	46 (6-163)	10 (0-31)	73 (29-172)	50 (7-106)
Bilirubin, total (mg/dL)	0.4 (0.3-0.6)	0.7 (0.1-1)	0.2 (0.1-0.8)	0.4 (0.1-0.7)	0.4 (0.1-0.9)	2.1 (0.6-3.5)	—	0.3 (0.1-0.7)	—
BUN (mg/dL)	2.2 (1-5)	2 (0-6)	5 (0-20)	2 (0-4)	5 (2-14)	7 (0-22)	—	0.56 (0-3)	1 (0-2)
Calcium (mg/dL)	14.5 (11.1-17.6)	16.1 (13.5-19.6)	15.9 (11.3-73.2)	26.4 (12.3-60)	14.6 (12.4-17.6)	33 (12-59)[c,297]	10.3 (8.9-11.7)	9.9 (7.2-13.2)	14.2 (10.4-20.6)
Chloride (mEq/L)	134 (109-148)	124 (109-137)	118 (68-140)	115 (88-136)	127 (111-134)	119 (100-129)	—	126 (111-135)	113 (111-115)
Cholesterol (mg/dL)	265 (152-493)	433 (314-572)	377 (101-745)	409 (117-1083)	357 (154-563)	278 (116-397)	—	161 (64-295)	183 (72-429)
Creatine kinase (U/L)	669 (175-1763)	699 (91-2460)	221 (73-646)	500 (108-1112)	202 (92-332)	644 (68-1923)	—	1780 (141-10k)	2517 (73-5832)
Creatinine (mg/dL)	0.3 (0.1-0.6)	0.6 (0.2-2)	0.5 (0.2-1.3)	0.6 (0-1.6)	0.5 (0.3-1.1)	0.3 (0.2-0.3)	—	0.4 (0.1-3)	0.3 (0.1-0.6)
GGT (U/L)	10 (0-34)	5 (0-13)	9 (1-35)	9	8 (3-13)	15	—	8	8
Glucose (mg/dL)	88 (24-129)	56 (32-88)	66 (26-117)	46 (8-82)	54 (15-76)	46 (28-89)	294 (219-341)	200 (68-356)	127 (63-160)
Iron (μg/dL)	98	—	—	190 (30-488)	816 (18-2807)	313 (13-1055)	—	209 (22-899)	735 (364-1106)
LDH (U/L)	76 (20-191)	182 (48-444)	419 (4-5665)	6.2 (0.7-15.2)	8.6 (2.9-25)	7.4 (5.3-9)[c,297]	—	3.48 (2.1-10.2)	364
Lipase (U/L)	8 (5-17)	—	4 (3-4)	5.3 (2.8-9.2)	5.5 (3.3-9.7)	6.5 (3.8-14.3)	8.2 (5.5-9.8)	4.5 (1.3-10)	5.7 (2.8-7.7)
Magnesium (mg/dL)	3.2	—	2.5	7.5 (3.6-12)	6.8 (3.8-11.6)	8.6 (4.6-12.3)	—	3.7 (3-4.6)	5.7 (4.3-8.6)
Phosphorus (mg/dL)	4.1 (2.5-5.7)	4.5 (2.8-5.7)	3.7 (1.7-14.7)	2.9 (1.6-6.8)	2.3 (1.8-3)	2.5 (1.7-4.6)	5.8 (4.7-7.8)	4 (2.6-7.4)	6.2 (5.3-7.6)
Potassium (mEq/L)	4.7 (3.3-6.5)	6.7 (3.3-16.6)	4.7 (1.6-8.5)	4 (1.8-5.8)	5.3 (3.3-9)	3.8 (3.3-4.4)	2.5 (1.8-3.2)	2 (1.2-3.1)	2.2 (1.3-2.9)
Protein, total (g/dL)	5.3 (3.2-7.4)	6.8 (4.6-10.8)	6.4 (3.3-8.9)	163 (132-184)	167 (157-178)	157 (143-170)	3.5 (2.9-4.6)	2.9 (2.2-4.6)	4 (3.3-5.2)
Albumin (g/dL)[b]	2.4 (1.6-3.2)	3.6 (2.5-7.6)	2.3 (1.6-3.8)	149 (66-278)	428 (68-1620)	92 (76-118)	—	173 ± 4	149 (142-158)
Globulin (g/dL)[b]	3.1 (1.9-3.2)	3.9 (3.2-4.8)	4.1 (2.6-6.4)	5.7 (2.4-14.7)	6.3 (2.1-35.6)	8.6 (2.2-17.1)	—	175 (111-238)	—
Sodium (mEq/L)	171 (155-187)	165 (154-174)	164 (151-177)				9.4 (4-16.1)	2.94 (0.3-7.3)	3.8 (0.7-8.5)
Triglyceride (mg/dL)	27 (16-37)	331 (47-1118)	195 (21-1017)						
Uric acid (mg/dL)	6.7 (2-17.6)	7.2 (2.8-19.9)	7.6 (1.6-47)						

Measurement	Bearded dragon (Pogona vitticeps)[228,235]	Chinese (Asian) water dragon (Physignathus cocincinus)[236]	Green iguana (Iguana iguana)[228,237-242]	Green iguana (Iguana iguana) male[e,243,244]	Green iguana (Iguana iguana) female[e,243,244]	Green iguana (Iguana iguana) juvenile[e,243]	Prehensile-tailed skink (Corucia zebrata)[228,245]	Tegu lizard (Tupinambis spp)[f,228,246]	Green basilisk (Basiliscus plumifrons)[228]
HEMATOLOGY									
PCV (%)	30 (19-40)	35 (32-40)	25-38	34 (29-39)	38 (33-44)	38 (30-47)	35 (24-60)	25 ± 2.6	36 (29-41)
RBC (10^6/μL)	0.97 (0.68-1.21)	—	1-1.9	1.3 (1-1.7)	1.4 (1.2-1.8)	1.4 (1.3-1.6)	1.5 (0.66-3.28)	0.96 ± 0.14	—
Hgb (g/dL)	9.5 (6.7-12)	—	8-12	8.6 (6.7-10.2)	10.6 (9.1-12.2)	9.6 (9.2-10.1)	9.6 (7.4-11.6)	11.4 ± 1.6	8.9 (8.6-9.1)
MCV (fL)	311 (236-397)	—	165-305	266 (228-303)	270 (235-331)	—	263 (152-600)	261 ± 23	—
MCH (pg)	108 (81-140)	—	65-105	25 (23-28)	28 (25-31)	—	69 (42-111)	119 ± 12.5	—
MCHC (g/dL)	34 (24-45)	—	20-38	15 (11-25)	15 (8-25)	16 (8-22)	28 (17-56)	45.6 ± 3.4	26 (22-29)
WBC (10^3/μL)	8.14 (1.99-23)	13.5 (11.7-18.2)	3-10	3.6 (1-5.4)	3.2 (0.6-6.4)	2.2 (1-3.8)	12.4 (3.9-22.4)	16.8 ± 2.5	16.8 (6.1-31)
Heterophils (10^3/μL)	2.17 (0.35-4.99)	5.1 (3.9-6.9)	0.35-5.2	9.7 (5-16.5)	9.9 (5.2-14.4)	12.9 (6.2-17.2)	4.4 (1.02-6.4)	2.2 ± 0.45	8.9 (2.8-17.7)
Lymphocytes (10^3/μL)	4.68 (0.57-17)	7.2 (5.6-9.5)	0.5-5.5	1.3 (0.2-2.7)	1.2 (0.4-2.3)	0.4 (0.3-0.6)	2.7 (0.3-4.7)	7.5 ± 0.58	6.4 (1.8-10.7)
Monocytes (10^3/μL)	0.7 (0.03-2.72)	1.1 (0.4-1.9)	0-0.1	0.1- (0-0.3)	0.1 (0-0.2)	0.3 (0-0.4)	0.1 (0.0-1)	1 ± 0.41	1.5 (0.12-4)
Azurophils (10^3/μL)	0.53 (0.04-1.84)	0 (0-0.6)	0-1.7	0.4 (0.1-1)	0.5 (0.2-1.2)	0.5 (0.1-0.7)	2.8 (0.4-4.8)	1.8 ± 0.56	—
Eosinophils (10^3/μL)	0.15 (0.06-0.27)	0.2 (0.1-0.3)	0-1	100 (100-200)	100 (100-300)	100 (100-300)	0.6 (0-3)	4.1 ± 0.11	—
Basophils (10^3/μL)	0.39 (0.05-1.01)	0.5 (0.2-0.8)	0-0.5				1.9 (0.1-4.3)	0.4 ± 0.01	1.5
Fibrinogen (mg/dL)	180 (0-300)	—	0-300				—	133 (0-200)	—
CHEMISTRIES									
ALP (U/L)	151 (15-447)	—	40 (4-170)	39 (14-65)	59 (22-90)	—	154 (44-334)	160 ± 85	137 (77-230)
ALT (U/L)	12 (5-20)	—	21 (0-97)	32 (4-76)	45 (5-96)	—	9 (2-23)	33 ± 24	13 (5-21)
Amylase (U/L)	497	—	1815 (996-2988)	22 (12-30)	29 (19-41)	—	19 (0-76)	18 ± 14	60 (14-136)
AST (U/L)	27 (0-77)	16.5 (8-52)	52 (2-100)	33 (19-65)	40 (7-102)	41 (13-72)	0.2 (0-0.9)	0.3 ± 0.2	0.6 (0.5-0.8)
Bile acids (rest; μmol/L)	—	—	7.5 (2.6-30.3)	0.8 (0.1-1.4)	1.5 (0.3-3.1)	—	1 (0-2)	1 ± 1	5 (1-20)
Bile acids (7.5h; μmol/L)	—	—	32.5 (15.2-44.1)	11.3 (8.6-14.1)	12.5 (10.8-14)	14.3 (12.1-23.2)	13 (11-21)	12.2 ± 0.8	10.5 (9.8-11.2)
Bilirubin, total (mg/dL)	0.5 (0-3.7)	—	0.3 (0-4.9)	119 (115-124)	121 (113-129)	—	124 (123-129)	121 ± 7	127 (125-129)
BUN (mg/dL)	3 (1-7)	—	2 (0-10)	161 (82-214)	255 (204-347)	—	144 (11-252)	206 ± 67	957 (550-1393)
Calcium (mg/dL)	11.8 (8.6-27)	12.4 (11.6-13.3)	12 (6-18)[d]	19.9 (15.2-24.7)	19 (16-23)	—	210 (27-940)	641 ± 568	5355 (2691-9436)
Ionized Ca^{++} (mmol/L)	—	—	1.01-1.62	79 (36-162)	270 (81-512)	—	0.2 (0-0.7)	0.3 ± 0.1	0.4 (0.2-0.8)
Chloride (mEq/L)	130 (104-160)	—	117 (102-130)	166 (70-244)	170 (105-258)	273 (131-335)	0 (0-1)	7	—
Cholesterol (mg/dL)	513 (230-900)	—	104-333[d]	5.3 (3.2-7.6)	6.3 (2.8-9.3)	7.7 (4.3-9)	100 (70-122)	128 ± 30	174 (60-280)
Creatine kinase (U/L)	1211 (59-7000)	1747 (19-6630)	1876(174-8768)[d]	4 (2.8-6.1)	3.6 (2-5.8)	—	236 (42-1139)	540 ± 537	—
Creatinine (mg/dL)	0.3 (0.0-0.6)	—	0.5 (0.2-1.3)	5.4 (4.4-6.5)	6.1 (4.9-7.6)	5 (4.2-6.1)	361 (335-373)	—	—
GGT (U/L)	2 (1-2)	—	3 (0-10)	2 (1.3-3)	2.4 (1.5-3)	2.3 (2-2.8)	—	—	—
Glucose (mg/dL)	210 (139-291)	157 (112-243)	169-288	3.5 (2.5-4.4)	3.8 (2.8-5.2)	2.7 (2.2-3)	3.7 (2.8-6.7)	5.6 ± 2.1	9.5 (6.2-11.6)
Iron (μg/dL)	—	—	88-133	0.6 (0.4-0.9)	0.7 (0.3-1)	0.8 (0.7-0.9)	3.6 (1.4-5)	2.4 ± 1.4	2.9 (2.4-3.5)
LDH (U/L)	304 (35-628)	—	617 (36-7424)[d]	157 (152-162)	163 (156-172)	—	5.9 (3.8-9)	6.6 ± 1.3	5.7 (4-8.3)
Lipase (U/L)	—	—	21 (17-24)	10.2 (2.2-15.7)	0.26 (0.07-0.35)	—	2.4 (1.3-3.6)	3.6 ± 0.7	3.1 (2.6-3.5)
Magnesium (mEq/L)	—	—	2.4-4	2.7 (1.5-5.8)	3.6 (0.9-6.7)	3.3 (0.7-5.7)	4.8 (3.5-8)	—	—
Phosphorus (mg/dL)	5.7 (2.7-15.1)	5.7 (3.4-8.2)	5 (2.5-21)[d]				3.1 (1.9-5.4)	2.9 ± 1.2	2.9 (2.1-4.9)
Potassium (mEq/L)	3.6 (1-6.5)	4.2 (3.8-4.5)	1.3-3				158 (145-167)	159 ± 4	163 (145-172)
Protein, total (g/dL)	5 (3.6-6.4)	7 (6.6-7.5)	5.4 (4.1-7.4)[d]				93 (28-319)	31	285 (9-712)
Albumin (g/dL)[b]	2.6 (1.3-4.6)	2.2 (2.1-2.3)	2.1-2.8				1.6 (<0.3-3.1)	3.2 ± 2	10.9 (1-96.6)
Albumin (PEP; g/dL)[b]	—	—	1.8 (1.4-3.1)						
Globulin (g/dL)[b]	2.3 (1-4.4)	4.7 (4.5-5.3)	2.5-4.3[d]						
α (PEP; g/dL)[b]	—	—	0.9 (0.4-1.2)						
β (PEP; g/dL)[b]	—	—	2.2 (1.6-3.8)[d]						
γ (PEP; g/dL)[b]	—	—	0.3 (0.1-0.4)						
A/G Ratio	—	—	0.5 (0.41-0.78)						
Sodium (mEq/L)	153 (137-190)	150 (147-153)	158-183						
Triglyceride (mg/dL)	261 (93-437)	—	383 (7-1323)[d]						
Uric acid (mg/dL)	5.2 (1.6-11.4)	2.3 (1.9-2.7)	2.6 (0-8.2)[d]						
Vit D_3 (25-OH; nmol/L)	—	—	51-393[d]						

Continued

TABLE 7—cont'd

Hematologic and Serum Biochemical Values[a]

Measurement	Savannah monitor (Varanus exanthematicus)[228]	Water monitor (Varanus salvator)[228]	American alligator (Alligator mississippiensis)[228]	Dwarf caiman (Paleosuchus palpebrosus)[228]	Eastern box turtle (Terrapene carolina)[228,247,248]	Ornate box turtle (Terrapene ornata)[228]	Radiated tortoise (Astrochelys radiata)[228,249,250]	Red-footed tortoise (Chelonoidis carbonaria)[228]	Indian star tortoise (Geochelone elegans)[228]
HEMATOLOGY									
PCV (%)	31.2 (21-51)	33.2 (20-44)	24.7 (12-38)	22 (16-28)	26 (21-32)	26 (18-37)	10-51	29 (18-47)	21 (12-31)
RBC (10^6/μL)	1.23 (0.63-1.58)	0.98 (0.42-1.42)	0.57 (0.38-1.2)	0.66 (0.43-0.89)	0.49 (0.09-0.89)	0.62 (0.46-0.8)	0.3-1.1	2.1 (0.47-6.3)	0.37 (0.24-0.55)
Hgb (g/dL)	10.5 (6.2-13.2)	10.5 (9.8-11.5)	7.7 (5.7-11.3)	7.7 (6.2-8.8)	5.1	7.2 (6-9)	5.6 (4-8)	7.5 (7-7.9)	7.9 (6.9-8.5)
MCV (fL)	284 (229-382)	335 (227-595)	453 (230-762)	362 (180-535)	420 (229-1000)	408 (350-463)	454 (319-571)	347 (71-468)	—
MCH (pg)	94 (89-99)	140 (104-177)	146 (105-202)	98	102	122 (108-136)	108 (82-133)	136 (123-149)	—
MCHC (g/dL)	32 (26-38)	33 (30-40)	32 (23-44)	33 (23-38)	28 (26-29)	33 (31-33)	28 (26-33)	31 (29-32)	27 (26-28)
WBC (10^3/μL)	5.07 (1.2-11.3)	11.1 (2.9-26)	8.33 (1.75-20.8)	6 (2.7-13.5)	10.8 (8-13)	5.8 (2-11.1)	2.5-14	7.1 (2.2-13.4)	11.02 (0.75-31)
Heterophils (10^3/μL)	1.95 (0.38-4.06)	5.58 (2.09-11.1)	3.85 (0.65-16.7)	3 (1.4-6.2)	4.8 (1.7-9)[f]	1.8 (0.1-4.5)	0.7-8	1.8 (0.09-6.4)	4.09 (0.17-14.9)
Lymphocytes (10^3/μL)	2.12 (0.43-5.25)	3.43 (0.3-10.1)	3.18 (0.36-12.1)	2.57 (0.18-10.1)	4.9 (2.6-8.2)[f]	2.9 (1.5-5.6)	0.4-5.8	3.3 (0.23-6.1)	5.14 (0.16-17.6)
Monocytes (10^3/μL)	1.64 (0.06-6.67)	0.81 (0.06-3.38)	0.37 (0.04-0.84)	0.13 (0.03-0.23)	0.11 (0-0.4)[f]	0.06 (0.04-0.07)	0.02-0.5	0.18 (0.04-0.67)	0.38 (0.02-1.35)
Azurophils (10^3/μL)	0.11	2.26 (0.42-5.98)	0.64 (0.04-3.54)	0.52 (0-1.3)	—	0.25 (0.06-0.67)	0-0.82	0.98 (0.29-2.5)	0.72 (0.08-1.73)
Eosinophils (10^3/μL)	—	0.1	0.29 (0.04-1.02)	0.1 (0.05-0.18)	0.02 (0-0.1)[f]	0.96 (0.07-4.4)	0.03-0.82	0.5 (0.02-2.3)	0.96 (0.08-2.24)
Basophils (10^3/μL)	0.15 (0.07-0.28)	0.11 (0.06-0.14)	0.71 (0.04-3.23)	0.16 (0.05-0.48)	0.21 (0-0.4)[f]	0.42 (0.07-0.94)	0.1-2.5	1.4 (0.05-5.5)	0.76 (0.04-3)
Fibrinogen (mg/dL)	156 (100-300)	500 (200-700)	267 ± 115	100 (0-200)	—	—	117 (100-200)	—	—
CHEMISTRIES									
ALP (U/L)	89 (5-675)	187 (35-410)	46 ± 29	11 (6-16)	62 (29-102)	26 (15-37)	72-392	84 (39-173)	174 (38-379)
ALT (U/L)	70 (7-374)	36 (4-138)	49 ± 42	45 (24-71)	7 (2-14)	30 (25-33)	0-17	18 (4-63)	5 (0-15) 1235
Amylase (U/L)	—	1021 (265-1868)	471 ± 335	533	160	—	—	—	87 (12-296)
AST (U/L)	22 (1-78)	38 (5-239)	314 ± 158	78 (17-139)	124 (2-620)	62 (33-201)	25-348	238 (97-616)	—
Bilirubin, total (mg/dL)	0.1 (0-0.3)	0.1 (0-0.3)	0.2 ± 0.2	0.2 (0-0.6)	0.5 (0.1-1)	0.3 (0.1-0.4)	0.3-31.3	—	0.2 (0-0.4)
BUN (mg/dL)	1 (0-5)	3 (0-6)	3 ± 3	1 (0-2)	49 (20-102)	47 (4-65)	0-0.5	0.5 (0.1-1.1)	4 (0-11)
Calcium (mg/dL)	14.6 (11.9-17.5)	14.4 (8.5-22)	11.2 ± 2.2	10.7 (9.7-11.4)	13.6 (6.5-26.4)	11.1 (8-13.6)	2-34	17 (4-53)	12 (9.3-17.6)
Chloride (mEq/L)	116 (105-124)	110 (100-128)	109 ± 21	113 (99-126)	106 (101-112)	108 (96-115)	8.6-18	12.7 (9.5-15.8)	104 (90-112)
Cholesterol (mg/dL)	116 (49-231)	94 (22-291)	128 ± 73	147 (68-344)	240 (65-496)	155 (125-185)	91-112	100 (89-119)	128 (77-252)
Creatine kinase (U/L)	764 (150-3048)	772 (176-1818)	2663 ± 2493	1984 (37-9890)	463 (37-898)	918 (88-3100)	56-154	146 (47-284)	1496 (144-8518)
Creatinine (mg/dL)	8.7 (0-67)	0.5 (0-1)	0.4 ± 0.2	0.3 (0-0.4)	0.4	1 (0.2-2.4)	33-5666	360 (43-996)	0.3 (0.2-0.5)
GGT (U/L)	7 (1-11)	24 (7-48)	6 ± 7	84 (29-187)	84 (33-153)	71 (8-113)	0.1-0.5	0.4 (0.2-1.3)	4 (0-5)
Glucose (mg/dL)	118 (90-159)	115 (42-215)	92 ± 42	221 (80-485)	206 (111-313)	362 (300-424)	5 (0-11)	28 (7-130)	109 (39-199)
Iron (μg/dL)	—	242 (111-429)	—	—	3.5	—	21-93	94 (17-171)	—
LDH (U/L)	427 (29-3699)	693 (34-3588)	522 ± 541	303 (301-304)	—	—	60	107	438 (12-863)
Lipase (U/L)	—	—	12	3.8 (3.2-5.1)	4 (1.6-8.2)	3.6 (2.7-4.8)	213-6444	401 (242-534)	5
Magnesium (mEq/L)	3.1	2.5 (2.2-2.7)	—	4.1 (3.7-4.5)	5.6 (3-9.7)	7.2 (6-8.8)	5-50	—	4.1 (2.7-5.7)
Osmolarity (mOsmol/L)	332 (319-345)	—	—	5.1 (3.6-6.9)	5.6 (2.7-7.5)	4.9 (2.8-7.6)	2.5-7	3.8 (1.8-5.8)	5.2 (3.9-5.9)
Phosphorus (mg/dL)	4.6 (3.1-7.5)	5.8 (3-10)	4.3 ± 1.6	1.4 (1.1-1.7)	2.2 (1.2-3.2)	2.3 (1.6-3.4)	3.1-5.8	5.4 (3.7-6.8)	4.7 (3.9-5.9)
Potassium (mEq/L)	4.2 (3.2-5.7)	4.6 (3.5-6.5)	4.1 ± 0.9	2.2 (1.8-2.5)	—	—	3-6.6	5.2 (3.3-7.4)	2.1 (1.5-3.1)
Protein, total (g/dL)	6.7 (4.2-8.6)	7.6 (5.2-11.9)	5.4 ± 1.2	4.1 (3.5-5.2)	3.4 (2.5-4.7)	2.7 (1.2-4.2)	0.6-2.4	1.9 (1.3-3.4)	—
Albumin (g/dL)[b]	2.1 (1.5-3.5)	2.4 (1.2-3.4)	1.7 ± 0.3	147 (140-153)	144 (138-149)	140 (132-160)	0.9-2.4	—	2.7 (2.3-3.1)
Albumin (PEP; g/dL)[b]	3.2 (3.1-3.3)	3.1 (3-3.2)	—	92 (9-174)	—	—	1.4-3.2	3.1 (2-5.3)	—
Globulin (g/dL)[b]	4.9 (3.4-6.6)	4.9 (3.2-7.3)	3.7 ± 0.9	2.4 (0.7-4.5)	1.6 (0.5-3.1)	2.2 (0.6-5.6)	0.1-0.5	—	—
α-1 (PEP; g/dL)[b]	—	0.1	—				0.6-1.9	—	—
α-2 (PEP; g/dL)[b]	—	0.9 (0.8-1)	—				0.6-1.5	—	—
β (PEP; g/dL)[b]	—	0.9	—				0.4-0.9	—	128 (122-133)
γ (PEP; g/dL)[b]	—	4.7 (2.6-6.8)	—				121-146	131 (116-155)	60 (27-110)
Sodium (mEq/L)	156 (149-165)	156 (142-176)	144 ± 26				26-303	246 (28-480)	3.3 (1-8.1)
Triglyceride (mg/dL)	135 (17-476)	35 (6-78)	241 ± 360				0.3 (0-0.6)	0.8 (0.3-1.3)	
Uric acid (mg/dL)	6.7 (1.2-18)	5.8 (1-16.6)	1.7 ± 1.1						

Measurement	Desert tortoise (Gopherus agassizii)[228, 251-254]	Gopher tortoise (Gopherus polyphemus)[255]	Russian tortoise (Testudo horsfieldii)[256,257]	African spurred tortoise (Centrochelys sulcata)[228]	Leopard tortoise (Stigmochelys pardalis)[228]	Galapagos tortoise (Chelonoidis nigra)[228]	Sliders (Trachemys scripta ssp)[228, 258-260]	Painted turtle (Chrysemys picta)[228,259,260]	Green sea turtle (Chelonia mydas)[228,261]
HEMATOLOGY									
PCV (%)	15-39	23 (15-30)	23 (22-34)	28 (9-48)	22 (7-60)	19 (11-27)	29 (25-33)	28 (24-30)	37 (27-49)
RBC (10^6/μL)	0.28-1.34	0.54 (0.24-0.91)	—	0.9 (0.43-1.28)	0.82 (0.58-1.06)	0.39 (0.28-0.6)	0.84 (0.33-2.21)	0.57 (0.41-0.68)	1.94
Hgb (g/dL)	3.6-10.3	6.4 (4.2-8.6)	—	10.2 (6.4-15.7)	16.1 (8.8-28)	6 (4.1-9.9)	11.1 (10-12.2)	11.2 (10.7-11.7)	10.7
MCV (fL)	197-688	—	—	386 (201-575)	279 (179-379)	528 (280-667)	409 (179-697)	271 (183-365)	155
MCH (pg)	39-189	—	—	133 (91-165)	83	169 (111-222)	108	—	55
MCHC (g/dL)	19-35	—	—-	35 (24-62)	44 (42-46)	31 (25-37)	30	—	36
WBC (10^3/μL)	0.97-10.9	15.7 (10-22)	8.5 (5-12.5)	7.97 (1.2-25.6)	10.23 (1.3-23)	7.72 (0.3-33.1)	13.7 (1.2-25.5)	6.7 (1.2-12.9)	11.7 (2.9-18)
Heterophils (10^3/μL)	0.49-7.3	4.7 (1-12.5)[g]	3.7 (1.3-4.6)	3.44 (0.32-9.62)	4.25 (0.21-12.8)	2.82 (0.27-20.4)	5 (0.95-14)	2.2 (0.17-4.26)	3.5 (0.9-6.6)
Lymphocytes (10^3/μL)	0-3.8	8.9 (3.2-17.4)[g]	4.7 (3.6-7.6)	3.68 (0.19-13.7)	2.7 (0.72-6.6)	4.24 (0.09-25.5)	3.3 (0.25-7.88)	1.6 (0.23-3.46)	6.7 (1.2-10.1)
Monocytes (10^3/μL)	0-0.57	1.1 (0.3-2.9)[g]	0.01 (0-0.02)	0.64 (0.06-2.25)	0.38	0.16 (0.01-0.58)	0.24 (0.14-0.38)	0.26	0.62 (0.11-1.3)
Azurophils (10^3/μL)	0-0.9	—	0.05 (0.03-0.12)	0.25 (0.02-0.54)	—	0.36 (0.03-1.97)	0.58 (0.23-1.33)	0.51 (0.25-0.77)	1.2 (0.17-2.7)
Eosinophils (10^3/μL)	0-0.95	—	0.05 (0.02-0.06)	0.35 (0.03-1.41)	0.1 (0.09-0.12)	0.42 (0.02-5.18)	1.53 (0.17-5.9)	0.55 (0.09-1.03)	0.42 (0.08-1.08)
Basophils (10^3/μL)	0-4.3	0.94 (0.2-2.4)[g]	0.05 (0.02-0.08)	0.3 (0.02-0.54)	0.21 (0.18-0.24)	0.54 (0.01-2.72)	3.8 (0.31-8)	2.17 (0.04-4.86)	0.18 (0.08-0.34)
CHEMISTRIES									
ALP (U/L)	43-176	39 (11-71)	498 (181-1188)	36 (12-59)	121 (54-173)	96 (30-302)	395 (201-677)	208	6-67
ALT (U/L)	21 (0-66)	15 (2-57)	1 (0-2)	13 (1-71)	8	7 (0-28)	14 (1-66)	—	31 (5-82)
AST (U/L)	41-106	136 (57-392)	20 (12-32)	—	—	167 (20-523)	493 (411-535)	152	534
Bile acids (μmol/L)	0-5.4	—	—	108 (34-401)	110 (41-344)	56 (19-187)	183 (108-350)	0.1	74-245
Bilirubin, total (mg/dL)	0-0.9	0.02 (0-0.1)	0.015 (0-0.09)	0.4 (0-2.6)	0.1	0.3 (0-1)	0.2 (0.1-0.5)	37	0.03-0.2
BUN (mg/dL)	0-4	30 (1-130)	12 (4-17)	3 (0-6)	41 (6-72)	14 (2-42)	25 (4-54)	10 (8.8-11.4)	93 (54-154)
Calcium (total; mg/dL)	9.3-14.7	12 (10-14)	13.2 (9.9-19.5)	12.1 (6.6-20)	12.2 (9.1-20.4)	12.6 (4.8-41)	13.4 (10-18)	85	8-8.8
Ionized calcium (mmol/L)	—	—	1.28 (1-1.6)	106 (93-123)	—	96 (83-119)	102 (81-107)	—	101-121
Chloride (mEq/L)	94-112	102 (35-128)	—	160 (69-394)	189 (164-237)	225 (78-506)	162 (106-227)	—	221 (142-354)
Cholesterol (mg/dL)	56-233	76 (19-150)	109 (25-210)	1518 (291-6205)	359 (223-704)	1262 (216-8090)	3095 (392-4856)	—	326-2729
Creatine kinase (U/L)	2262 (944-3880)	160 (32-628)	123 (6-344)	0.3 (0.1-0.4)	0.6	0.2 (0.1-0.5)	0.3 (0.2-0.5)	76 (76-84)	0.1 (0-0.4)
Creatinine (mg/dL)	0.11-0.37	0.3 (0.1-0.4)	—	14 (3-19)	—	6 (0-10)	7 (0-21)	—	6 (0-21)
GLDH (U/L)	—	—	1 (0.6-1.5)	142 (54-277)	91 (48-132)	144 (38-445)	84 (52-138)	412	67-178
Glucose (mg/dL)	92-165	75 (55-128)	59 (40-86)	81 (80-82)	—	73 (8-593)	—	—	362 (117-600)
LDH (U/L)	25-250	273 (18-909)	—	1315 (258-1980)	446 (346-546)	719 (197-1884)	1713 (371-5763)	4.8	75-477
Magnesium (mEq/L)	2.1 (1.8-2.4)	4.1 (3.3-4.8)	—	3.9 (1.5-7.8)	4 (2.5-6.6)	4.6 (2-10.3)	6 (1-15)	3.1 (2.8-3.1)	—
Phosphorus (mg/dL)	1-6.3	2.1 (1-3.1)	2.6 (1.3-3.9)	5 (3.6-8.5)	6.7 (5.4-7.4)	5.3 (3.2-8.1)	2.2	2.9 (2.6-3.2)	4.8-12.2
Potassium (mEq/L)	3.5-4.7	5 (2.9-7.)	5.3 (1.9-7.2)	3.9 (1.6-7)	3.2 (1.6-5.9)	4.8 (2.4-8.3)	5.2 (3.7-7.5)	2.4 (2.4-4.4)	4.9-11.1
Protein, total (g/dL)	3-4.6	3.1 (1.3-4.6)	3 (2.5-4.6)	1.5 (0.6-2)	1.1 (0.5-1.5)	1.8 (0.8-3.1)	4.1 (3.5-4.7)	1.2	3-7.1
Albumin (g/dL)[b]	1.2-2.2	1.5 (0.5-2.6)	1.6 (1.2-2.3)	2 (1.0-2.9)	1.5 (1.1-1.8)	3.2 (1.2-5.7)	4.6 (2.8-6.1)	1.2	2.1-6.2
Albumin (PEP; g/dL)[b]	—	—	—	138 (121-155)	141 (135-149)	128 (114-141)	2 (1.6-2.5)	143	0.7-1.8

Continued

TABLE 7—cont'd

Hematologic and Serum Biochemical Values[a]

Measurement	Desert tortoise (Gopherus agassizii)[228,251-254]	Gopher tortoise (Gopherus polyphemus)[255]	Russian tortoise (Testudo horsfieldii)[256,257]	African spurred tortoise (Centrochelys sulcata)[228]	Leopard tortoise (Stigmochelys pardalis)[228]	Galapagos tortoise (Chelonoidis nigra)[228]	Sliders (Trachemys scripta ssp)[228,258-260]	Painted turtle (Chrysemys picta)[228,259,260]	Green sea turtle (Chelonia mydas)[228,261]
CHEMISTRIES—cont'd									
Globulin (g/dL)[b]	1.2-2.6	—	1.4 (1.3-2.3)	—	—	2 (1-2)	2.6 (1.2-3.7)	—	1.5-4.7
α-1 Glob (PEP; g/dL)[b]	1	—	—	163 (53-388)	—	271 (29-1345)	137 (124-144)	2 (1.2-2)	139-158
α-2 Glob (PEP; g/dL)[b]	1	—	—	—	—	29	304 (30-664)		492 (124-932)
β Glob (PEP; g/dL)[b]	0.6	—	—	5.2 (2.1-10.5)	3.2 (0.5-15.3)	2.3 (0.5-7.4)	1.2 (0.6-3.2)		1 (0.2-1.5)
γ Glob (PEP; g/dL)[b]	—	—	—						
Sodium (mEq/L)	122-139	138 (127-148)	138 (131-149)						
Triglyceride (mg/dL)	0-425	—	—						
Uric acid (mg/dL)	2.7-7.2	3.5 (0.9-8.5)	1.2 (0.8-3.9)						
Vitamin A (μg/mL)	0.2-0.6	—	—						
Zinc (ppm)	0.4-3.7	—	—						

A/G ratio, Albumin/globulin ratio; *ALP,* alkaline phosphatase; *ALT,* alanine aminotransferase; *AST,* aspartate aminotransferase; *BUN,* blood urea nitrogen; *GGT,* gamma-glutamyl transpeptidase; *Hgb,* hemoglobin; *LDH,* lactate dehydrogenase; *MCH,* mean corpuscular hemoglobin; *MCHC,* mean corpuscular hemoglobin concentration; *MCV,* mean corpuscular volume; *PCV,* packed cell volume; *PEP,* protein electrophoresis; *RBC,* red blood cell; *WBC,* white blood cell.

[a]Listed values are mean (min-max), unless a single value indicates n = 1 or a range that is not enclosed in parentheses indicates a reported reference range.

[b]Albumin is measured by colorimetry (e.g., bromocresol green), and globulin value is calculated unless otherwise indicated.

[c]Remarkably high reference ranges for Ca (mean, 159 mg/dL; range, 30-337 mg/dL) and P (mean, 35 mg/dL; range, 8-69) have also been reported.[233]

[d]Can be elevated in gravid females; vitamin D_3 is higher in female green iguanas.[242]

[e]These data were obtained from iguanas housed outdoors with unfiltered sunlight.

[f]Adults.

[g]Calculated from data.

TABLE 8

Environmental, Dietary, and Reproductive Characteristics of Reptiles[137,199,262-267]

Species	Environmental Preference		Diet[d]	Method of Reproduction[e]	Gestation/ Incubation Period (Days)[f]
	Temperature[a-c]	RH (%)			
SNAKES					
Ball (Royal) python *(Python regius)*	25-30°C (77-86°F)	70-80 (use humidity box)[g]	C	Ov	90
Boa constrictor *(Boa constrictor)*	28-34°C (82-93°F)	50-70 (use humidity box)[g]	C	V	120-240
Garter snake *(Thamnophis sirtalis)*	22-30°C (72-86°F)	60-80 (use humidity box)[g]	C	V	90-110
King snake *(Lampropeltis getula)*	23-30°C (73-86°F)	50-70 (use humidity box)[g]	Op/c	Ov	50-60
Sand boa (*Eryx* sp)	25-30°C (77-86°F)	20-30	C	V	120-180
LIZARDS					
Bearded dragon *(Pogona vitticeps)*	27-30°C (80-85°F)	— (use humidity box)[g]	I: young; H: adult	Ov	65-90
Green anole *(Anolis carolinensis)*	23-29°C (73-84°F)	70-80	I/c	Ov	60-90
Green iguana *(Iguana iguana)*	29-38°C (84-100°F)	60-80	H	Ov	73
Jackson's chameleon *(Chamaeleo jacksonii)*	21-27°C (70-81°F)	50-70	I	V	90-180
Leopard ground gecko *(Eublepharis macularius)*	25-30°C (77-86°F)	20-30 (use humidity box)[g]	I	Ov	55-60
Australian Water dragon *(Physignathus lesueurii)*	25-34°C (77-93°F)	80-90; Need water with filter[h]	I/om	Ov	90
CHELONIANS					
Common box turtle *(Terrapene carolina)*	24-29°C (75-84°F)	60-80 (use humidity box)[g]	C/f	Ov	50-90
Desert tortoise *(Gopherus agassizii)*	25-30°C (77-86°F)	— (use humidity box)[g]	H	Ov	84-120
Greek tortoise *(Testudo graeca)*	20-27°C (68-81°F)	30-50 (use humidity box)[g]	H/om	Ov	60
Painted turtle *(Chrysemys picta)*	23-28°C (73-82°F)	80-90; Need water with filter[h]	H/I/o	Ov	47-99
Red-eared slider *(Trachemys scripta elegans)*	22-30°C (72-86°F)	80-90; Need water with filter[h]	C	Ov	59-93
Russian tortoise *(Testudo horsfieldii)*	21-32°C (70-90°F)	— (use humidity box)[g]	H	Ov	56-84
CROCODILIAN					
American alligator *(Alligator mississippiensis)*	30-35°C (86-95°F)	80-90; Need water with filter[h]	C/p	Ov	62-65

C, Carnivorous; *F,* frugivorous; *H,* herbivorous; *I,* insectivorous; *O,* molluscavorous; *Om,* omnivorous; *Op,* ophiophagus; *Ov,* oviparous; *P,* piscivorous; *RH,* relative humidity; *V,* viviparous.

[a]Temperatures shown are ideal ambient daytime temperature gradients. These should be allowed to fall by approximately 5°C (9°F) during the night. "Hot-spot" temperatures should generally be 5°C (9°F) greater than the highest temperature shown.

[b]Preferred daytime temperature range for other commonly housed captive snakes are rosy boa *(Lichanura trivirgata),* 27-29.5°C (81-85°F); green tree python *(Morelia viridis),* 24-28°C (75-82°F); carpet python *(Morelia spilota),* 27-29.5°C (81-85°F); cornsnake *(Elaphe guttata),* 25-30°C (77-86°F); black rat snake *(Elaphe obsoleta),* 25-29°C (77-84°F); gopher/bullsnake *(Pituophis melanoleucus),* 25-29°C (77-84°F).

[c]Preferred daytime temperature range for other commonly housed captive lizards are day gecko (*Phelsuma* sp), 29.5°C (85°F); chameleons (montane) (*Chamaeleo* spp), 21-27°C (70-81°F); chameleons (lowland) (*Chamaeleo* spp), 27-29°C (81-84°F); blue-tongued skink (*Tiliqua* sp), 27-29.5°C (81-85°F); monitor lizards (*Varanus* spp), 29-31°C (84-88°F); tegus (*Tupinambis* spp), 27-30°C (81-86°F).

[d]Uppercase letters denote principal dietary requirements. Lowercase denotes secondary preference.

[e]Temperature-dependent.

[f]Can have long hatch times dependent on incubation parameters.

[g]This simulates humid underground burrow. Use dark colored plastic container with cut entrance, moistened paper towels, or sphagnum moss.

[h]Need to set up water component like fish tank with proper filter (use one for koi or turtles), pump, water quality testing, dechlorinator.

TABLE 9

Urinalysis Values of Chelonians[267-270]

Measurement	Normal Values	Abnormal Values
Specific gravity	1.003-1.014 (mean, 1.008)	Up to 1.034
pH	Herbivores: alkaline Omnivores: 5-8	Acidic[a]
Color	Colorless to pale yellow with white urates	Dark yellow, yellow-brown, yellow-green
Turbidity	Clear	Cloudy
Protein	Trace proteinuria	Increased proteinuria
Glucose	Glucosuria up to 30 mg/dL	Glucosuria can be higher than 50 mg/dL with anorexia
Renal casts	None	Various types present
Calcium, phosphorus, ammonia, urea, creatinine	Detectable in urine	Significantly increased in urine of *Testudo* spp. with renal disease
AST, CK, LDH	Detectable in urine	Significantly increased in urine of *Testudo* spp. with renal disease
Crystals	Amorphous urates/ammonium biurates	Many other crystals found in renal failure; uric acid crystals in gout; bilirubin and tyrosine crystals in liver disease

AST, Aspartate aminotransferase; *CK,* creatine kinase; *LDH,* lactate dehydrogenase.
[a]May be associated with hibernation, anorexia, and improper diet.

TABLE 10

Selected Products and Guidelines Used in Force-Feeding Anorectic or Debilitated Reptiles[a,b]

Agent	Guidelines	Species/Comments
Alfalfa pellets (e.g., iguana or rabbit pellets) or powder (Alfalfa Powder, NOW Foods)	Blend (1:4) with electrolyte solution or water; 20 mL/kg PO q48h (lizards) to q84h (chelonians)[29,271]	Herbivorous reptiles/administer via gavage; may clog feeding tube; for iguanas, may gavage equal volume of water on alternate days until patient is stable and eating[271]; soaked pellets can also be hand-fed (especially by owner)
Baby foods	Vegetable; blend in with other food sources	Herbivorous reptiles/administer via gavage; for some species, some fruit baby food can be added
	Meat (small amount); blend in with other food sources	Omnivorous species/administer via gavage
Dog/cat food, canned (a/d, Hill's; Maximum-Calorie Iams; Nutritional Recovery Formula, Eukanuba)	30 mL/kg PO q7-14d[38,159]	Carnivorous species/administer via gavage; although low protein (8.5%), some concern over high purine and vitamin A levels (probably OK unless concurrent renal disease); in dehydrated animals, dilute 1:1 with physiologic solution, oral human electrolyte solutions (pediatric: Pedialyte, Ross; Gatorade); once stabilized, small whole animals (lubricated with egg white) can be force-fed
Electrolyte solutions (Pedialyte, Ross; Gatorade)	15-25 mL/kg PO q24h	Most species
High protein powders (Carnivore Care, Oxbow Pet Products; Emeraid Carnivore, Lafeber)	Mix as labeled, generally to pancake batter consistency; feed small amount to start (see bag suggestion) once daily	Insectivorous and carnivorous species/once reconstituted, can be mixed 1:1 with an alfalfa or timothy product for true omnivorous reptiles; administer via gavage
Timothy hay-based powder (Herbivore Critical Care Fine Grind, Oxbow Pet Products; Emeraid Herbivore, Lafeber)	Mix as labeled, generally to pancake batter consistency; feed small amount to start (see bag suggestion) once daily	Herbivorous species/once reconstituted, can be mixed 1:1 with an alfalfa or timothy product for true omnivorous reptiles; administer via gavage

[a]General guidelines for force-feeding: generally provide nutrition after rehydration of patient; needs may vary with specific disease (e.g., low protein with renal disease); force-feeding volumes are frequently started at a low/modest level and gradually brought up to the desired level (for patients with severe disease/cachexia, transition should be very gradual); concurrent to force-feeding and hydrating a patient, highly palatable food items should be provided for voluntary food intake.
[b]Dietary fiber supplements (alfalfa pellets or powder; barley powder; purified cellulose) should be an integral part of enteral therapy for herbivorous reptiles.

TABLE 11

Selected Sources of Diets and Other Commercial Products for Reptiles[a,b]

FOODS AND SUPPLEMENTS			
Fluker Farms	800-735-8537	www.flukerfarms.com	
Drs Foster & Smith	800-381-7179	www.drsfostersmith.com	
Kaytee	800-529-8331	www.kaytee.com	
Mazuri	800-227-8941	www.mazuri.com	
Oxbow Animal Health	800-249-0366	www.oxbowanimalhealth.com	
Pretty Pets	800-356-5020	www.prettybird.com	
Reliable Protein Products	480-361-3940	www.zoofood.com	
Repashy Superfoods	855-737-2749	www.store.repashy.com	
Rep-Cal	800-406-6446	www.repcal.com	
San Francisco Bay Brand	510-792-7200	http://sfbb.com	
Sticky Tongue Farms	951-244-3434	www.stickytonguefarms.com	
Tetra Fauna	800-423-6458	www.tetra-fish.com	
T-Rex Products	800-991-8739	www.t-rexproducts.com	
Zoo Med Laboratories	888-496-6633	www.zoomed.com	
ZuPreem	800-345-4767	www.zupreem.com	
LIVE/FROZEN FOODS FOR CARNIVORES			
American Rodent Supply	317-899-1599	www.americanrodent.com	Frozen mice, rats
Big Cheese Rodents	800-887-0921	www.bigcheeserodents.com	Frozen mice, rats
Carolina Mouse Farm	864-944-6192	—	Frozen mice, rats
The Gourmet Rodent	352-472-9189	www.gourmetrodent.com	Frozen mice, rats, rabbits, chicks
Hoosier Mouse Supply	317-831-1219	www.hoosiermousesupply.com	Live (local) and frozen mice, rats
Komodo Reptiles	914-788-8722	www.komodoreptiles.com	Live (local) and frozen mice, rats
Mouse Factory	800-720-0076	—	Live and frozen mice, rats
Perfect Pets Inc	800-366-8794	www.perfectpet.net	Frozen mice, rats, hamsters, gerbils, guinea pigs, rabbits, chicks
Rodent Pro	812-867-7598	www.rodentpro.com	Frozen mice, rats, rabbits, guinea pigs, chicks, quail
LIVE FOODS FOR INSECTIVORES			
Arbico Organics	800-827-2847	www.arbico-organics.com	Crickets, fly pupae, mealworms, waxworms, superworms
Bassett's Cricket Ranch	800-634-2445	www.bcrcricket.com	Crickets, mealworms
The Drosophila Co	954-227-3966	http://www.jtresser.com/flypaper.html	Fruit flies
Fluker Farms	800-735-8537	www.flukerfarms.com	Crickets, mealworms, fruit flies, hissing cockroaches
Ghann's Cricket Farm	800-476-2248	www.ghann.com	Crickets, soldier fly larvae
Grubco	800-222-3563	www.grubco.com	Crickets, superworms, mealworms, fly larvae
Knutson's	800-248-9318	www.knutsonlivebait.com	Night crawlers, crickets, mealworms
Komodo Reptiles	914-788-8722	www.komodoreptiles.com	Crickets, superworms, goliath worms, fruit flies, mealworms, nightcrawlers
Millbrook Cricket Farm	800-654-3506	www.millbrookcrickets.com	Crickets, mealworms, superworms
Mulberry Farms	760-731-6088	www.mulberryfarms.com	Silkworm larvae
The Phoenix Worm Store	—	www.phoenixworm.com	Soldier fly larvae
Rainbow Mealworms	800-777-9676	www.rainbowmealworms.net	Crickets, mealworms, cockroaches
Russell's Cricket Farm	234-738-3663	www.livecrickets.com	Crickets, mealworms, superworms
Sunshine Mealworms	800-322-1100	—	Mealworms, crickets, superworms
Top Hat Cricket Farm	800-638-2555	www.tophatcrickets.com	Crickets, mealworms, superworms, hornworms, waxworms
Topline Whlse Dist Co.	888-922-0464	—	Nightcrawlers, redworms, hissing cockroaches
LIGHTS			
Duro-Test Lighting	800-289-3876	—	Vita-Lite fluorescent
Fluker Farms	800-735-8537	www.flukerfarms.com	Incandescent, heat
General Electric	800-435-4448	www.gelighting.com	Incandescent, heat
Hikari Sales USA	800-621-5619	www.hikariusa.com	UVB fluorescent
Mac Industries, Inc	252-241-4584	www.reptileuv.com	Mega-ray UVB
Philips	800-555-0050	www.lighting.philips.com	Incandescent, heat
Sylvania	978-777-1900	www.sylvania.com	350BL blacklights
T-Rex Products	800-991-8739	www.t-rexproducts.com	Mercury vapor UVB, incandescent, heat

Continued

TABLE 11—cont'd

Selected Sources of Diets and Other Commercial Products for Reptiles[a,b]

Zilla	888-255-4527	www.zilla-rules.com	Incandescent, heat, UVB fluorescent
Zoo Med Laboratories	888-496-6633	www.zoomed.com	Incandescent, heat, mercury vapor UVB, fluorescent UVB
HEATING DEVICES			
Avitec	800-646-2473	www.avitec.com	Conical ceramic heat emitters, thermostats
The Bean Farm	877-708-5882	www.beanfarm.com	Heat tape, heat pads
Big Apple Pet Supply	800-922-7753	www.bigappleherp.com	Thermostats
Fluker Farms	800-735-8537	www.flukerfarms.com	Under-cage heat pads
Helix Controls	760-726-4464	www.helixcontrols.com	Thermostats, heat tape, heat panels
LLL Reptile	888-547-3784	http://lllreptile.com	Pearlco conical ceramic heat emitters
Zilla	888-255-4527	www.zilla-rules.com	Conical ceramic heat emitters, thermostats
Zoo Med Laboratories	888-496-6633	www.zoomed.com	Thermostats, rheostats, heat pads, tape, cables
HUMIDITY DEVICES			
Exo Terra (Hagen)	800-724-2436	www.exo-terra.com	Ultrasonic fogger, Monsoon rainfall
Humidifirst	561-752-1936	www.humidifirst.com	Mist Pac ultrasonic humidifiers
Zoo Med Laboratories	888-496-6633	www.zoomed.com	Ultrasonic fogger, Repti fogger, Habba mist, Hygro-Therm humidity controller
ENVIRONMENTAL SENSING AND MONITORING DEVICES			
Exo Terra (Hagen)	800-724-2436	www.exo-terra.com	Remote digital thermometers, hygrometers
FLIR	866-477-3687	www.flir.com	Infrared thermography
Onset Computer Corp.	800-564-4377	www.onsetcomp.com	HOBO data loggers
Raytek	800-227-8074	www.raytek.com	Digital infrared thermometer
Solartech	800-798-3311	www.solarmeter.com	Solarmeter 6.2 UVB meter
Zilla	888-255-4527	www.zilla-rules.com	Digital infrared thermometer
Zoo Med Laboratories	888-496-6633	www.zoomed.com	Hygro-Therm humidity/heat monitor and controller

[a]Many pet stores sell live and frozen food for reptiles, as well as many of the products listed.
[b]Numerous sources of information were used to compile this table, particularly Internet sources.

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