e) For functional urethral obstruction: 1 mg/15 kg of body weight PO q8–24h (Lulich 2004)
f) To decrease urethral resistance: 1 mg per 15 kg of body weight PO q12–24h (Bartges 2006a), (Vernau 2006)

■ **CATS:**

To decrease urethral resistance:
a) 0.5 mg (total dose) PO q8h or 0.03 mg/kg IV (Lane 2000)
b) 0.03 mg/kg IV (Osborne, Kruger et al. 2000)
c) For functional urethral obstruction: 0.25–0.5 mg/cat (total dose) PO q12–24h (Lulich 2004), (Coates 2004), (Vernau 2006)

Monitoring

- Baseline thoracic radiographs
- Mucous membrane color; CRT
- If possible, arterial blood pressure and venous PO_2

Client Information

- Compliance with directions is necessary to maximize the benefits from this drug. If possible, give medication with food.
- Notify veterinarian if patient's condition deteriorates or if the animal becomes lethargic or depressed.

Chemistry/Synonyms

A quinazoline-derivative postsynaptic $alpha_1$-adrenergic blocker, prazosin HCl occurs as a white to tan powder. It is slightly soluble in water and very slightly soluble in alcohol.

Prazosin may also be known as: CP-12299-1, furazosin hydrochloride, prazosini hydrochloridum; many trade names are available.

Storage/Stability

Prazosin capsules should be stored in well-closed containers at room temperature.

Dosage Forms/Regulatory Status

VETERINARY-LABELED PRODUCTS: None

The ARCI (Racing Commissioners International) has designated this drug as a class 3 substance. See the appendix for more information.

HUMAN-LABELED PRODUCTS:

Prazosin Capsules: 1 mg, 2 mg & 5 mg (as base); *Minipress*® (Pfizer); generic (Rx)

PREDNISOLONE
PREDNISOLONE SODIUM SUCCINATE
PREDNISOLONE ACETATE
PREDNISONE

(pred-*niss*-oh-lone); (*pred*-ni-zone)

For more information refer to the monograph: Glucocorticoids, General Information or to the manufacturer's product information for veterinary labeled products.

Note: Although separate entities, prednisone and prednisolone are often considered bioequivalent; most species rapidly convert prednisone to prednisolone in the liver. **Horses, cats** and **patients in frank hepatic failure** do not appear to either absorb or convert prednisone to prednisolone efficiently. Use either prednisolone or an alternative glucocorticoid in these patients when possible.

Prescriber Highlights

- **Classic glucocorticoids used for many conditions in many species. Antiinflammatory activity is 4X more potent than hydrocortisone; has some mineralocorticoid activity**
- **Contraindications (relative): Systemic fungal infections**
- **Caution: Active bacterial infections, corneal ulcer, Cushingoid syndrome, diabetes, osteoporosis, chronic psychotic reactions, predisposition to thrombophlebitis, hypertension, CHF, renal insufficiency**
- **Goal of therapy is to use as much as is required & as little as possible for as short an amount of time as possible**
- **Prednisone poorly absorbed after oral use in horses; prednisone may not be readily converted to prednisolone in cats. Prednisolone is preferred in these two species.**
- **Primary adverse effects are "Cushingoid" in nature with sustained use**
- **Many potential drug & lab interactions**

Uses/Indications

Glucocorticoids have been used in an attempt to treat practically every malady that afflicts man or animal, but there are three broad uses and dosage ranges for use of these agents. 1) Replacement of glucocorticoid activity in patients with adrenal insufficiency, 2) as an antiinflammatory agent, and 3) as an immunosuppressive. Among some of the uses for glucocorticoids include treatment of: endocrine conditions (*e.g.*, adrenal insufficiency), rheumatic diseases (*e.g.*, rheumatoid arthritis), collagen diseases (*e.g.*, systemic lupus), allergic states, respiratory diseases (*e.g.*, asthma), dermatologic diseases (*e.g.*, pemphigus, allergic dermatoses), hematologic disorders (*e.g.*, thrombocytopenias, autoimmune hemolytic anemias), neoplasias, nervous system disorders (increased CSF pressure), GI diseases (*e.g.*, ulcerative colitis exacerbations), and renal diseases (*e.g.*, nephrotic syndrome). Some glucocorticoids are used topically in the eye and skin for various conditions or are injected intra-articularly or intra-lesionally. The above listing is certainly not complete.

In general, in using glucocorticoids, the following principles should be followed:

1. Glucocorticoids can mask disease! Try not to use them until you have a diagnosis.
2. Make a specific diagnosis!
3. Determine course from outset.
4. Determine endpoint before you starting treating.
5. Use the least potent form for the minimal time.
6. Know where glucocorticoids inappropriate. (Behrend 2007)

Pharmacology/Actions

Glucocorticoids have effects on virtually every cell type and system in mammals. An overview of the effects of these agents follows:

Cardiovascular System: Glucocorticoids can reduce capillary permeability and enhance vasoconstriction. A relatively clinically insignificant positive inotropic effect can occur after glucocorticoid administration. Increased blood pressure can result from both the drugs' vasoconstrictive properties and increased blood volume that may be produced.

Cells: Glucocorticoids inhibit fibroblast proliferation, macrophage response to migration inhibiting factor, sensitization of lymphocytes, and the cellular response to mediators of inflammation. Glucocorticoids stabilize lysosomal membranes.

CNS/Autonomic Nervous System: Glucocorticoids can lower seizure threshold, alter mood and behavior, diminish the response to pyrogens, stimulate appetite, and maintain alpha rhythm. Glucocorticoids are necessary for normal adrenergic receptor sensitivity.

Endocrine System: When animals are not stressed, glucocorticoids will suppress the release of ACTH from the anterior pituitary, thereby reducing or preventing the release of endogenous corticosteroids. Stress factors (*e.g.*, renal disease, liver disease, diabetes) may sometimes nullify the suppressing aspects of exogenously administered steroids. Release of thyroid-stimulating hormone (TSH), follicle-stimulating hormone (FSH), prolactin and luteinizing hormone (LH) may all be reduced when glucocorticoids are administered at pharmacological doses. Conversion of thyroxine (T_4) to triiodothyronine (T_3) may be reduced in glucocorticoids and plasma levels of parathyroid hormone increased. Glucocorticoids may inhibit osteoblast function. Vasopressin (ADH) activity is reduced at the renal tubules and diuresis may occur. Glucocorticoids inhibit insulin binding to insulin-receptors and the post-receptor effects of insulin.

Hematopoietic System: Glucocorticoids can increase the numbers of circulating platelets, neutrophils, and red blood cells, but platelet aggregation is inhibited. Decreased amounts of lymphocytes (peripheral), monocytes, and eosinophils are seen as glucocorticoids can sequester these cells into the lungs and spleen and prompt decreased release from the bone marrow. Removal of old red blood cells is diminished. Glucocorticoids can cause involution of lymphoid tissue.

GI Tract and **Hepatic System**: Glucocorticoids increase the secretion of gastric acid, pepsin, and trypsin. They alter the structure of mucin and decrease mucosal cell proliferation. Iron salts and calcium absorption are decreased while fat absorption increases. Hepatic changes can include increased fat and glycogen deposits within hepatocytes, increased serum levels of alanine aminotransferase (ALT), and gamma-glutamyl transpeptidase (GGT). Significant increases can be seen in serum alkaline phosphatase levels. Glucocorticoids can cause minor increases in BSP (bromosulfophthalein) retention time.

Immune System (also see Cells and Hematopoietic System): Glucocorticoids can decrease circulating levels of T-lymphocytes; inhibit lymphokines; inhibit neutrophil, macrophage, and monocyte migration; reduce production of interferon; inhibit phagocytosis and chemotaxis; antigen processing; and diminish intracellular killing. Specific acquired immunity is affected less than nonspecific immune responses. Glucocorticoids can also antagonize the complement cascade and mask the clinical signs of infection. Mast cells are decreased in number and histamine synthesis is suppressed. Many of these effects only occur at high or very high doses and there are species differences in response.

Metabolic effects: Glucocorticoids stimulate gluconeogenesis. Lipogenesis is enhanced in certain areas of the body (*e.g.*, abdomen) and adipose tissue can be redistributed away from the extremities to the trunk. Fatty acids are mobilized from tissues and their oxidation is increased. Plasma levels of triglycerides, cholesterol, and glycerol are increased. Protein is mobilized from most areas of the body (not the liver).

Musculoskeletal: Glucocorticoids may cause muscular weakness (also caused if there is a lack of glucocorticoids), atrophy, and osteoporosis. Bone growth can be inhibited via growth hormone and somatomedin inhibition, increased calcium excretion and inhibition of vitamin D activation. Resorption of bone can be enhanced. Fibrocartilage growth is also inhibited.

Ophthalmic: Prolonged corticosteroid use (both systemic or topically to the eye) can cause increased intraocular pressure and glaucoma, cataracts, and exophthalmos.

Reproductive Tract, Pregnancy, & **Lactation**: Glucocorticoids are probably necessary for normal fetal development. They may be required for adequate surfactant production, myelin, retinal, pancreas, and mammary development. Excessive dosages early in pregnancy may lead to teratogenic effects. In horses and ruminants, exogenous steroid administration may induce parturition when administered in the latter stages of pregnancy. Glucocorticoids unbound to plasma proteins will enter milk. High dosages or prolonged administration to mothers may potentially inhibit the growth of nursing newborns.

Renal, Fluid, & **Electrolytes**: Glucocorticoids can increase potassium and calcium excretion; sodium and chloride reabsorption and extracellular fluid volume. Hypokalemia and/or hypocalcemia occur rarely. Diuresis may occur following glucocorticoid administration.

Skin: Thinning of dermal tissue and skin atrophy can be seen with glucocorticoid therapy. Hair follicles can become distended and alopecia may occur.

Pharmacokinetics

Plasma half-life is not meaningful from a therapy standpoint when evaluating systemic corticosteroids. Prednisolone and prednisone are intermediate acting corticosteroids with a biologic "half-life" of 12–36 hours.

Contraindications/Precautions/Warnings

Systemic use of glucocorticoids is generally considered contraindicated in systemic fungal infections (unless used for replacement therapy in Addison's), when administered IM in patients with idiopathic thrombocytopenia, and those hypersensitive to a particular compound. Sustained-released injectable glucocorticoids are considered contraindicated for chronic corticosteroid therapy of systemic diseases.

Animals that have received glucocorticoids systemically, other than with "burst" therapy, should be tapered off the drugs. Patients who have received the drugs chronically should be tapered off slowly as endogenous ACTH and corticosteroid function may return slowly. Should the animal undergo a "stressor" (*e.g.*, surgery, trauma, illness, etc.) during the tapering process or until normal adrenal and pituitary function resume, additional glucocorticoids should be administered.

Adverse Effects

Adverse effects are generally associated with long-term administration of these drugs, especially if given at high dosages or not on an alternate day regimen. Effects generally are manifested as clinical signs of hyperadrenocorticism. When administered to young, growing animals, glucocorticoids can retard growth. Many of the potential effects, adverse and otherwise, are outlined above in the Pharmacology section.

In dogs, polydipsia (PD), polyphagia (PP), and polyuria (PU) may all be seen with short-term "burst" therapy as well as with alternate-day maintenance therapy on days when giving the drug. Adverse effects in dogs can include: dull, dry haircoat, weight gain, panting, vomiting, diarrhea, elevated liver enzymes, pancreatitis, GI ulceration, lipidemias, activation or worsening of diabetes mellitus, muscle wasting, and behavioral changes (depression, lethargy, viciousness). Discontinuation of the drug may be necessary; changing to an alternate steroid may also alleviate the problem. With the exception of PU/PD/PP, adverse effects associated with antiinflammatory therapy are relatively uncommon. Adverse effects associated with immunosuppressive doses are more common and potentially more severe.

Cats generally require higher dosages than dogs for clinical effect, but tend to develop fewer adverse effects. Occasionally, polydipsia, polyuria, polyphagia with weight gain, diarrhea, or depression can be seen. Long-term, high dose therapy can lead to "Cushingoid" effects, however.

Reproductive/Nursing Safety

Corticosteroid therapy may induce parturition in large animal species during the latter stages of pregnancy. In humans, the FDA categorizes this drug as category ***C*** for use during pregnancy (*Animal studies have shown an adverse effect on the fetus, but there are no adequate studies in humans; or there are no animal reproduction studies and no adequate studies in humans.*) In a separate system evaluating the safety of drugs in canine and feline pregnancy (Papich 1989), this drug is categorized as class: ***C*** (*These drugs may have potential risks. Studies in people or laboratory animals have uncovered risks, and these drugs should be used cautiously as a last resort when the benefit of therapy clearly outweighs the risks.*)

Use with caution in nursing dams. Glucocorticoids unbound to plasma proteins will enter milk. High dosages or prolonged administration to mothers may potentially inhibit growth, interfere with endogenous corticosteroid production or cause other unwanted effects in nursing offspring. In humans, however, several studies suggest that amounts excreted in breast milk are negligible when prednisone or prednisolone doses in the mother are less than or equal to 20 mg/day or methylprednisolone doses are less than or equal to 8 mg/day. Larger doses for short periods may not harm the infant.

Overdosage/Acute Toxicity

Glucocorticoids when given short-term are unlikely to cause harmful effects, even in massive dosages. One incidence of a dog developing acute CNS effects after accidental ingestion of glucocorticoids has been reported. Should clinical signs occur, use supportive treatment if required.

Chronic usage of glucocorticoids can lead to serious adverse effects. Refer to Adverse Effects above for more information.

Drug Interactions

The following drug interactions have either been reported or are theoretical in humans or animals receiving oral prednisolone/prednisone and may be of significance in veterinary patients:

- **AMPHOTERICIN B:** When administered concomitantly with glucocorticoids may cause hypokalemia
- **ANTICHOLINESTERASE AGENTS** (*e.g.*, **pyridostigmine, neostigmine,** etc.): In patients with myasthenia gravis, concomitant glucocorticoid with these agents may lead to profound muscle weakness. If possible, discontinue anticholinesterase medication at least 24 hours prior to corticosteroid administration.
- **ASPIRIN** (**salicylates**): Glucocorticoids may reduce salicylate blood levels
- **CYCLOPHOSPHAMIDE:** Glucocorticoids may also inhibit the hepatic metabolism of cyclophosphamide; dosage adjustments may be required.
- **CYCLOSPORINE:** Concomitant administration of may increase the blood levels of each, by mutually inhibiting the hepatic metabolism of each other; clinical significance of this interaction is not clear
- **DIGOXIN:** Secondary to hypokalemia, increased risk for arrhythmias
- **DIURETICS, POTASSIUM-DEPLETING** (**furosemide, thiazides**): When administered concomitantly with glucocorticoids may cause hypokalemia
- **EPHEDRINE:** May increase metabolism of glucocorticoids
- **ESTROGENS:** The effects of hydrocortisone, and possibly other glucocorticoids, may be potentiated by concomitant administration with estrogens
- **INSULIN:** Requirements may increase in patients receiving glucocorticoids
- **KETOCONAZOLE:** May decrease metabolism of glucocorticoids
- **MITOTANE:** May alter the metabolism of steroids; higher than usual doses of steroids may be necessary to treat mitotane-induced adrenal insufficiency
- **NSAIDS:** Administration of other ulcerogenic drugs with glucocorticoids may increase risk
- **PHENOBARBITAL:** May increase the metabolism of glucocorticoids
- **PHENYTOIN:** May increase the metabolism of glucocorticoids
- **RIFAMPIN:** May increase the metabolism of glucocorticoids
- **VACCINES:** Patients receiving corticosteroids at immunosuppressive dosages should generally not receive live attenuated-virus vaccines as virus replication may be augmented; a diminished immune response may occur after vaccine, toxoid, or bacterin administration in patients receiving glucocorticoids

Laboratory Considerations

- Glucocorticoids may increase serum **cholesterol** and **urine glucose** levels.
- Glucocorticoids may decrease serum **potassium**.
- Glucocorticoids can suppress the release of thyroid stimulating hormone (TSH) and reduce **T_3 & T_4** values. Thyroid gland atrophy has been reported after chronic glucocorticoid administration. Uptake of I^{131} by the thyroid may be decreased by glucocorticoids.
- Reactions to **skin tests** may be suppressed by glucocorticoids.
- False-negative results of the **nitroblue tetrazolium test for systemic bacterial infection**s may be induced by glucocorticoids.

Doses

- **DOGS:**

  For adjunctive treatment of neoplasms:

  For more information on using prednisone or prednisolone as part of chemotherapy protocols, refer to the protocols found in the appendix or other dosages/protocols found in numer-

ous references, including: *Withrow and MacEwen's Small Animal Clinical Oncology, 4th Ed.* (Withrow and Vail 2007); *Canine and Feline Geriatric Oncology* (Villalobos 2007); *Small Animal Internal Medicine, 3rd Edition* (Nelson and Couto 2003); *Textbook of Veterinary Internal Medicine: Diseases of the Dog and Cat 6th Edition* (Ettinger and Feldman 2005); and *The 5-Minute Veterinary Consult Canine & Feline, 3rd Ed.* (Tilley and Smith 2004).

a) Brain tumors (palliative therapy): Prednisone 0.5–1 mg/kg PO once a day to every other day. (Fenner 1988); Prednisone 0.5–1 mg/kg PO twice daily for several days, then decrease dosage over the next week or month, dependent on patient's needs (LeCouteur and Turrel 1986)

b) For adjunctive therapy in canine lymphomas:

COAP (cyclophosphamide, vincristine, cytosine arabinoside, prednisone) protocol: Prednisone: 50 mg/m2 PO every day for one week, then 25 mg/m2 every other day.

COP (no cytosine arabinoside) protocol: Prednisone 25 mg/m2 PO every other day.

CHOP (doxorubicin instead of cytosine arabinoside): Prednisone 25 mg/m2 PO every other day (Couto 1986)

c) For adjunctive therapy for multiple myeloma: Prednisone 0.5 mg/kg PO once daily. Used with melphalan: 0.1 mg/kg PO once daily for 10 days, then 0.05 mg/kg PO once daily or with cyclophosphamide: 1 mg/kg PO once daily (if resistance develops to melphalan). (Jenkins 1985)

d) For macroglobulinemia: Prednisone 0.5 mg/kg PO once daily. Used with chlorambucil: 0.2 mg/kg PO once daily for 10 days, then 0.1 mg/kg PO once daily or with cyclophosphamide: 1 mg/kg PO once daily (if resistance develops to chlorambucil) (Jenkins 1985)

For adjunctive treatment of respiratory disorders:

a) Chronic bronchitis: Prednisone 0.5–1 mg/kg PO once a day to every other day (Bauer 1988)

b) Allergic bronchitis: Prednisolone sodium succinate: 2–4 mg/kg IV or IM (do not give via rapid IV infusion). In chronically symptomatic patient: prednisone 0.5–1.5 mg/kg/day PO (Bauer 1988)

c) For adjunctive therapy of collapsing trachea:

Initially, prednisolone 0.25–0.5 mg/kg PO twice daily for 7–10 days (Prueter 1988b)

Prednisone: 0.5 mg/kg, PO once or twice a day. Discontinue if no improvement in one week. Corticosteroids must be used cautiously in this condition and rarely make a difference in the long-term outcome of therapy. (Fingland 1989)

d) For allergic (eosinophilic) bronchitis or pneumonitis: Prednisone 1–2 mg/kg/day divided two to three times a day. Every 7–10 days decrease total steroid dose by 1/4–1/2 as long as signs are controlled. After 3–4 weeks, every other day or every third day therapy may be attempted. (Noone 1986)

e) For adjunctive therapy of parasitic pulmonary hypersensitivities: To suppress inflammation prior to parasite elimination: Prednisolone 1–2 mg/kg PO divided into 2–3 doses (Noone 1986)

For adjunctive therapy in liver disorders: **Note:** Because prednisone requires conversion to the active compound prednisolone by the liver, some clinicians believe that only prednisolone should be used in patients with liver disease.

a) For cholangitis: Prednisolone 1–2 mg/kg PO once daily for at least 1 month. Then give every other day for another 2–3 months and consider discontinuing and monitoring for relapse. (Cornelius and Bjorling 1988)

b) For chronic lymphocytic-plasmacytic or autoimmune hepatitis: 2.2 mg/kg, PO once daily for several weeks and then tapered to 1.1 mg/kg every other day. If dogs cannot tolerate or fail prednisone may add azathioprine. (Twedt 1999)

c) Copper-induced hepatopathy: Prednisolone 0.5–1 mg/kg PO divided twice daily (used during acute stages). Used with chelation therapy and dietary copper restriction. (Cornelius and Bjorling 1988)

For adjunctive therapy of disorders of the gastrointestinal tract:

a) For eosinophilic colitis: Prednisolone 1–2 mg/kg PO for 7–10 days. Gradually decrease dose over following 3–4 weeks to a minimal dosage that will control clinical signs. Some cases will require additional alternate-day therapy for an additional 3–4 weeks. (DeNovo 1988)

b) For eosinophilic enteritis: Prednisolone 1–3 mg/kg PO once daily; gradually taper to every other day dosing for maintenance. May use injectable forms if dog is vomiting or malabsorption is severe. Therapy may be necessary for weeks to months. Do not use until intestinal biopsy sites are healed (usually 7–10 days). (Chiapella 1988);

Prednisone 0.5 mg/kg, PO once daily initially; reduce gradually to alternate day therapy (Hall and Twedt 1989);

Prednisolone: 0.5–1 mg/kg twice daily for 5–7 days, then decrease to 0.5 mg/kg/day for 5–7 days. Taper dose to alternate-day therapy as condition dictates. Additional therapy for 3–4 weeks is often necessary. Relapses can occur. (DeNovo 1986)

c) For eosinophilic colitis when dietary and parasitic infestations have been eliminated or when other appropriate therapy has been unsuccessful: Prednisolone 0.5–1 mg/kg two times a day; taper dose gradually over a 3–4 week period to the lowest effective dose. (Chiapella 1986)

d) For plasmacytic/lymphocytic enteritis: Prednisolone 2.2 mg/kg PO divided twice daily for 5–10 days, then 1.1 mg/kg/day for 5–10 days. Then taper by reducing steroid dosage by 1/2 every 10–14 days until alternate-day dosage is attained or symptoms recur. (Chiapella 1988)

e) For adjunctive therapy of chronic superficial gastritis (if predominance of lymphocyte and plasma cell infiltration seen on biopsy): Prednisone 0.5–1 mg/kg PO divided twice daily initially and reduced over a 3 month period to lowest, alternate-day effective dosage (Hall and Twedt 1989)

f) Ulcerative colitis: May cause some patients' condition to worsen. Use only after an unsuccessful trial of sulfasalazine. Use with caution. Prednisolone 1–2 mg/kg/day PO for 5–7 days; then 0.5 mg/kg/day for an additional 5–7 days; then 0.25–0.5 mg/kg PO every other day for 10–14 days. Continue sulfasalazine during steroid therapy. If significant improvement is not seen within the first 7 days of therapy, steroids are tapered and discontinued more rapidly. (DeNovo 1988)

g) For food allergy or intolerance: Prednisone 0.5 mg/kg PO once daily; taper dose weekly if clinical response dictates. Discontinue when clinical remission ensues. (Chiapella 1988)

h) For adjunctive therapy of endotoxemia secondary to GDV: Prednisolone sodium succinate: 11 mg/kg IV (Bellah 1988); Prednisolone sodium succinate 10 mg/kg (Orton 1986)

i) For eosinophilic gastritis: Prednisone 0.5 mg/kg once daily for 1–2 weeks; gradually taper to 0.12 mg/kg, PO every other day (Twedt and Magne 1986)

j) For adjunctive therapy of intestinal lymphangiectasia: prednisolone 2–3 mg/kg/day. Once remission is attained, may taper to a maintenance dosage. Not all cases respond. (Sherding 1986)

k) For adjunctive therapy of refractory wheat-sensitive enteropathy in Irish Setters: Prednisolone 0.5 mg/kg every 12 hours for one month. Then begin a reducing dosage schedule. (Batt 1986)

l) For dogs who respond poorly to conventional therapy (enzyme replacement, dietary modification, vitamin supplementation, and antibiotics) for exocrine pancreatic insufficiency: Predniso(lo)ne 1–2 mg/kg every 12 hours for 7–14 days. May reduce over 4–6 weeks as patient tolerates. (Williams 1989)

For adrenal diseases:

a) For adjunctive treatment of hypoadrenal crisis: Prednisolone sodium succinate: 4–20 mg/kg IV over 2–4 minutes, preferably after ACTH response test is completed. IV normal saline is usually sufficient therapy during the first hour until ACTH response test is completed. Prednisolone sodium succinate may be repeated in 2–6 hours or dexamethasone may be added to IV infusion at 0.05–0.2 mg/kg q12h. Prednisolone sodium succinate possesses some mineralocorticoid activity, while dexamethasone does not. (Feldman 1989)

b) For glucocorticoid supplementation in chronic or subacute adrenal insufficiency: Predniso(lo)ne 0.2–0.4 mg/kg PO per day (Feldman, Schrader, and Twedt 1988)

c) For glucocorticoid supplementation if azotemia or other symptoms of glucocorticoid deficiency result: Predniso(lo)ne 0.1–0.3 mg/kg PO per day (Schrader 1986)

d) For glucocorticoid "coverage" before and after adrenal tumor removal: Prednisolone sodium succinate 1–2 mg/kg IV either at 1 hour prior to surgery or at the time of anesthesia induction. May also add to IV fluids and administer IV during the procedure. Repeat dosage at end of procedure; may give IM or IV. Glucocorticoid supplementation must be maintained using an oral product (initially predniso(lo)ne 0.5 mg/kg twice daily, cortisone acetate 2.5 mg/kg twice daily, or dexamethasone 0.1 mg/kg once daily). Slowly taper to maintenance levels (predniso(lo)ne 0.2 mg/kg once a day, or cortisone acetate 0.5 mg/kg two times a day) over 7–10 days. Should complications develop during the taper, reinitiate doses at 5 times the maintenance dose. Most dogs can stop exogenous steroid therapy in about 2 months (based on an ACTH stimulation test). (Peterson 1986)

e) For glucocorticoid "coverage" in animals who have iatrogenic secondary adrenocortical insufficiency and/or HPA suppression: Animals exhibiting mild to moderate signs of glucocorticoid deficiency: Predniso(lo)ne 0.2 mg/kg PO every other day

For animals with HPA suppression undergoing a "stress" factor: Prednisolone sodium succinate 1–2 mg/kg just before and after stressful events (*e.g.*, major surgery). Continue with lower dosages until at least 3rd post-operative day. Access to a water-soluble form of glucocorticoid should be available should animal "collapse." (Kemppainen 1986)

f) For symptoms of glucocorticoid deficiency (anorexia, diarrhea, listlessness) or in well-controlled patients receiving mitotane (*Lysodren®*) therapy for hyperadrenocorticism undergoing a "stress": Prednisone 2.2 mg/kg PO for 2 days, then 1 mg/kg for 2 days, then 0.5 mg/kg for 3 days, then 0.5 mg/kg every other day for one week, then stop. Reintroduce therapy or readjust dosage should symptoms recur. (Feldman 1989)

For adjunctive or alternative medical management of hyperinsulinism:

a) Prednisone 0.5 mg/kg PO divided twice daily initially; increase dose as required, to maintain euglycemia (Kay, Kruth, and Twedt 1988)

b) Prednisolone 1 mg/kg divided twice-daily PO, then decrease to a minimally effective dosage (Lothrop 1989)

For adjunctive therapy of toxicoses:

a) For cholecalciferol toxicity: Prednisone 1–2 mg/kg PO two to three times daily (Grauer and Hjelle 1988a)

b) For adjunctive therapy of endotoxicosis secondary to garbage or carrion ingestion: Prednisolone sodium succinate 5–7 mg/kg IV every 4 hours (Coppock and Mostrom 1986)

For adjunctive therapy of reproductive disorders:

a) In bitches prone to relapse after initial therapy of eclampsia (puerperal tetany): Prednisone 0.25 mg/kg PO once daily during lactation and slowly withdrawn (Barton and Wolf 1988);

Prednisolone 0.5 mg/kg twice daily (Russo and Lees 1986)

For adjunctive therapy of heartworm disease (considered by some clinicians to be contraindicated during treatment for routine post-adulticide therapy as pulmonary thromboses may be promoted):

a) Prednisolone 1–2 mg/kg PO divided two times a day. Reduce dosage over next 7–14 days. (Knight 1988)

b) Dogs with severe cough, hemoptysis, or extensive parenchymal involvement: Prior to adulticide therapy, prednisolone 1–2 mg/kg PO divided twice daily and tapered over a 10–14 day period (Noone 1986)

c) For pneumonitis associated with occult heartworm disease: Prednisone 1–2 mg/kg daily for 3–5 days. After steroids are stopped, give adulticide therapy immediately. (Calvert and Rawlings 1986)

For CNS disorders:

a) For granulomatous meningoencephalitis: Prednisone: 1–2 mg/kg PO daily for the life of the patient. (Fenner 1988); prednisone 2–3 mg/kg PO divided twice daily for 2 weeks, then slowly reduce dosage over several weeks; long-term therapy is recommended. (Schunk 1988a)

b) For reticulosis: Prednisone: 1–2 mg/kg/day PO until symptoms begin to subside, then begin taper. Continue low-dose once a day or every other day therapy indefinitely. (Fenner 1988);

Prednisone 2–3 mg/kg PO divided twice daily for 2 weeks, then slowly reduce dosage over several weeks; long-term therapy is recommended. (Schunk 1988a)

Predniso(lo)ne: 2 mg/kg PO for 1 week, then 1 mg/kg/day for 1 week, then 0.5 mg/kg/day for 1 week, then 0.5 mg/kg every other day for 1 week, then 0.25 mg/kg every other day for 1 week, then 0.25 mg/kg every 3rd day (Riis 1986)

c) For adjunctive therapy of hydrocephalus: For long-term management, prednisone 0.5 mg/kg, PO every other day may be tried. (Fenner 1988)

Prednisone 0.25–0.5 mg/kg PO two times a day; continue if improvement is noted within one week and decrease dosage at weekly intervals to 0.1 mg/kg PO every other day eventually. Maintain dose for at least one month. (Shores 1989)

d) For adjunctive medical therapy of intervetebral disk disease (IVD):

Cervical IVD: Prednisolone 0.5 mg/kg PO twice daily for 3 days, then 0.5 mg/kg once daily for 3–5 days;

Thoracolumbar IVD: Prednisolone 0.5–1 mg/kg SC or PO twice daily for 2–3 days, then taper dosage over next 3–5 days (Schunk 1988a)

e) For adjunctive therapy of spondylopathy:
Cervical: For dogs with slowly progressive course and still ambulatory, use prednisone: 1–2 mg/kg PO divided twice daily initially. Gradually reduce dose every 2 weeks until reach 0.5 mg/kg PO every other day.
Lumbosacral: Prednisone: 1 mg/kg PO divided twice daily initially. Gradually reduce dose to 0.5 mg/kg, PO every other day (Schunk 1988a)

f) For adjunctive therapy of White Dog Shaker Syndrome: Prednisone 0.25 mg/kg PO twice daily for 10 days, then once a day for 10 days, then every other day for 10 days (Fenner 1988)

g) For adjunctive therapy of generalized tremor syndrome: Predniso(lo)ne 3 m/kg each AM for 5 days, then decreased to alternate mornings for 5 days, then begin a phased withdrawal of drug. May require long-term low-dose alternate day therapy. (Farrow 1986)

h) For nonbacterial suppurative meningitis: After cultures are confirmed negative, prednisone 2 mg/kg for 10 days, then taper slowly over 1 month (Fenner 1986b)

i) For adjunctive therapy of dogs diagnosed with canine wobbler syndrome with signs of mild to moderate paraparesis, tetraparesis, or ataxia: Prednisolone 1–2 mg/kg twice daily initially, decrease gradually over a 5 day period to 0.5–1 mg/kg on alternate days (Trotter 1986)

For hematologic disorders:

a) For autoimmune hemolytic anemia: Prednisolone 1–4 mg/kg PO daily divided two times a day. Add immunosuppressive agent (*e.g.*, cyclophosphamide, azathioprine) if PCV does not stabilize within 48–72 hours. May take several months to wean off drugs. (Maggio-Price 1988)

b) For adjunctive therapy of pure red blood cell aplasia (PRCA): Prednisolone 2 mg/kg divided two times a day. If no increases in reticulocyte count in 2-weeks, increase to 4 mg/kg, two times a day. If reticulocyte counts remain low after 4–6 weeks add cyclophosphamide (30–50 mg/m2 on 4 consecutive days each week). Continue prednisolone. Discontinue cyclophosphamide if neutropenia or thrombocytopenia occurs. If reticulocyte count increases, cyclophosphamide may be discontinued and prednisolone slowly tapered to alternate day therapy. (Weiss 1986)

c) For immune-mediated thrombocytopenia: Prednisolone 1–3 mg/kg PO divided two to three times a day. Do not give IM injections. If platelet-count increases, prednisolone dose may be tapered by 50% every 1–2 weeks. Reduction in dose should be done slowly over several months. (Johnessee and Hurvitz 1983)

For dermatologic or other immune-mediated disorders:

a) For adjunctive therapy of urticaria and angioedema: Prednisone 2 mg/kg PO or IM twice daily (Giger and Werner 1988)

b) For canine atopy: Predniso(lo)ne 0.5 mg/kg PO twice daily initially for 5–10 days, then taper to the minimum effective alternate-day dosage (Giger and Werner 1988)

c) For adjunctive flea allergy dermatitis: Prednisolone 1 mg/kg PO once a day for 1 week, the every other day at a minimally effective dose (Giger and Werner 1988)

d) As an immunosuppressant for auto-immune skin diseases: Predniso(lo)ne 2.2 mg/kg twice daily until remission; then taper to lowest effective every other day dosage (Giger and Werner 1988)

e) For type II (cytotoxic) hypersensitivity: Predniso(lo)ne 2 mg/kg two times a day. Once in remission, dosage may be reduced to a maintenance level. Other immunosuppressants may be required (Wilcke 1986)

f) For adjunctive therapy of urticaria, shock, and/or respiratory arrest secondary to contrast media hypersensitivity: Prednisolone sodium succinate 10 mg/kg IV (Walter, Feeney, and Johnston 1986)

g) For adjunctive therapy of surface pyodermas: Predniso(lo)ne 1 mg/kg/day for 5–7 days (Ihrke 1986)

h) For eosinophilic ulcer: Prednisolone 2–4.4 mg/kg PO once a day; for chronic cases use prednisolone 0.5–1 mg/kg PO every other day (DeNovo 1988)

Miscellaneous Indications:

a) For boxer cardiomyopathy: In patients not responding to antiarrhythmic agents: Prednisolone 1 mg/kg twice daily for 10 days (Ware and Bonagura 1986)

b) As an appetite stimulant: Prednisolone 0.25–0.5 mg/kg PO every day, every other day, or intermittently as needed. (Macy and Ralston 1989)

c) For adjunctive therapy of posterior uveitis: Prednisolone 2.2 mg/kg once daily; gradually reduce dose as inflammation is controlled (Swanson 1989)

d) For chronic, proliferative, pyogranulomatous laryngitis: Prednisolone 1 mg/kg twice daily PO; decrease dosage weekly (Prueter 1988a)

e) For adjunctive or alternate therapy for hypercalcemia: Prednisolone 1–1.5 mg/kg PO q12h. Has a delayed onset of action and a 4–8 day duration of response. (Kruger, Osborne, and Polzin 1986)

f) As an antiinflammatory in the adjunctive treatment of otitis interna: Prednisone 0.25 mg/kg/day for first 5–7 days of treatment (Neer 1988)

g) For adjunctive therapy of myasthenia gravis: Prednisone 0.5 mg/kg/day PO. Increase in 0.5 mg/kg/day increments every 2–4 days until total dose of 2 mg/kg/day is attained. After remission is achieved, gradually shift to every other day therapy. Should patient worsen during period when prednisone dose is increased, reduce dose and increase the intervals between dosage increases. May take several weeks to see a positive response. After signs are controlled, reduce dosage every 4 weeks until maintenance dose is determined. Cytotoxic drugs may be indicated should symptoms not be controlled or if dosage cannot be reduced. (LeCouteur 1988)

CATS:

Note: Use prednisolone in place of prednisone in this species whenever possible. Cats may not absorb or convert prednisone as well as dogs.

As an immunosuppressive agent:

a) Predniso(lo)ne: Initially 2–4 mg/kg daily in divided doses. Taper to alternate day, low-dose therapy as rapidly as patient allows. (Gorman and Werner 1989)

For adjunctive treatment of respiratory disorders:

a) Allergic bronchitis: Prednisolone sodium succinate: 1–3 mg/kg IV or IM (do not give via rapid IV infusion) (Bauer 1988)

b) For adjunctive therapy of feline asthma: Predniso(lo)ne: 1–2 mg/kg/day (Papich 1986);
c) For adjunctive emergency therapy: Prednisolone sodium succinate 50–100 mg IV. For non-emergency cases: Prednisone 5 mg PO three times daily initially, then rapidly decrease to alternate day use (or discontinue) (Noone 1986)

For adjunctive therapy of disorders of the gastrointestinal tract:
a) For plasmacytic/lymphocytic enteritis: Prednisolone 2.2 mg/kg PO divided twice daily for 5–10 days, then 1.1 mg/kg/day for 5–10 days, then taper by reducing steroid dosage by 1/2 every 10–14 days until alternate-day dosage is attained or symptoms recur (Chiapella 1988)
b) For small intestinal inflammatory bowel disease: Prednisone 1–2 mg/kg/day divided into 2 doses. Mild to moderate cases generally will respond to the lower dosage. If severe, use the higher dose and treat for 2–4 weeks or until symptoms resolve. In severe cases characterized by anorexia, weight loss, and chronic diarrhea, use an initial dose of 4 mg/kg/day for 2 weeks. If response is good, decrease dose by 1/2 after 2 weeks and again by 1/2 at 4 weeks. Eventually, alternate day therapy can be attained and should be maintained for 3 months. Some cats may have drugs discontinued in 3 months or long-term alternate day (or every 3rd day dosing) may be required. (Tams 1986)

For adjunctive therapy of feline plasma cell gingivitis-pharyngitis:
a) Prednisolone 1–2 mg/kg PO once daily (DeNovo, Potter, and Woolfson 1988)

For adjunctive therapy of feline heartworm disease:
a) For crisis due to embolization; Prednisolone 4.4 mg/kg three times daily with careful IV fluid therapy (Dillon 1986)

For dermatologic conditions:
a) For adjunctive treatment of flea allergy: Predniso(lo)ne 1–2 mg/kg PO q12h for 5 days, then gradually taper to alternate-day therapy (usually 1–2 mg/kg every other evening) (Kwochka 1986)
b) For idiopathic feline miliary dermatoses: Predniso(lo)ne 1–2 mg/kg PO q12h for 5–7 days, then reduce gradually to alternate-day therapy at 1–2 mg/kg. Rarely is effective for long-term use. (Kwochka 1986)
c) For linear granulomas: Prednisolone 0.5 mg/kg twice daily initially, with taper (Thoday 1986)
d) For eosinophilic ulcer: Prednisolone 2–4.4 mg/kg PO once a day; for chronic cases use prednisolone 0.5–1 mg/kg PO every other day (DeNovo, Potter, and Woolfson 1988)

As adjunctive therapy for feline neoplasias (lymphosarcoma, acute lymphoid leukemia, mast cell neoplasms):
a) 20–50 mg/m2 q24–48h PO, SC or IV (Couto 1989). See also the protocols noted in the canine dosage section.

■ **CATTLE:**

For adjunctive therapy of cerebral edema secondary to polioencephalomalacia:
a) Prednisolone 1–4 mg/kg intravenously (Dill 1986)

For adjunctive therapy of aseptic laminitis:
a) Prednisolone (assuming sodium succinate salt) 100–200 mg IM or IV; continue therapy for 2–3 days (Berg 1986)

For glucocorticoid activity:
a) Prednisolone sodium succinate: 0.2–1 mg/kg IV or IM (Howard 1986)

■ **RABBITS, RODENTS, SMALL MAMMALS:**

a) Rabbits: Rarely indicated. Use with caution; concurrent gastroprotectant is recommended. For spinal trauma: 0.25–0.5 mg/kg PO q12h for 3 days, then once daily for 3 days, then once every other day for 3 doses.

   As an antiinflammatory: 0.5–2 mg/kg PO (Ivey and Morrisey 2000)
b) Mice, Rats, Gerbils, Hamsters, Guinea pigs, Chinchillas: 0.5–2.2 mg/kg IM or SC (Adamcak and Otten 2000)

■ **FERRETS:**

As an antiinflammatory or for insulinoma (postsurgical or nonsurgical cases):
a) 0.5–2 mg/kg PO or IM (frequency not specified) (Williams 2000)

■ **HORSES:** (**Note:** ARCI UCGFS Class 4 Drug)

Note: Prednisone does not appear to be absorbed very well after oral dosing; use prednisolone or another oral steroid.

For adjunctive therapy of COPD:
a) Prednisolone: Initially, 600–800 mg IM or PO in a 450 kg horse. May be possible to decrease dose and go to alternate day dosing. Doses as low as 200 mg every other day may be effective. (Beech 1987a)

For glucocorticoid effects:
a) Prednisolone sodium succinate: 0.25–1 mg/kg IV, Predniso(lo)ne tablets 0.25–1 mg/kg PO; Prednisolone acetate: 0.25–1 mg/kg IM or 10–25 mg subconjunctivally (Robinson 1987)

■ **LLAMAS:**

For steroid-responsive pruritic dermatoses secondary to allergic origins:
a) Prednisone: 0.5–1 mg/kg PO initially, gradually reduce dosage to lowest effective dose given every other day (Rosychuk 1989)

■ **SWINE:**

For glucocorticoid activity:
a) Prednisolone sodium succinate: 0.2–1 mg/kg IV or IM (Howard 1986)

■ **BIRDS:**

As an antiinflammatory:
a) Prednisolone: 0.2 mg/30 gram body weight, or dissolve one 5 mg tablet in 2.5 mL of water and administer 2 drops orally. Give twice daily. Decrease dosage schedule if using long-term. (Clubb 1986)

For treatment of shock:
a) Prednisolone sodium succinate (10 mg/mL): 0.1–0.2 mL/100 grams body weight. Repeat every 15 minutes to effect. In large birds, dosage may be decreased by 1/2. (Clubb 1986)

■ **REPTILES:**

For shock in most species using prednisolone sodium succinate:
a) 5–10 mg/kg IV as needed (Gauvin 1993)

Monitoring

Monitoring of glucocorticoid therapy is dependent on its reason for use, dosage, agent used (amount of mineralocorticoid activity), dosage schedule (daily versus alternate day therapy), duration of therapy, and the animal's age and condition. The following list may not be appropriate or complete for all animals; use clinical assessment and judgment should adverse effects be noted:

■ Weight, appetite, signs of edema
■ Serum and/or urine electrolytes
■ Total plasma proteins, albumin

- Blood glucose
- Growth and development in young animals
- ACTH stimulation test if necessary

Client Information

- Clients should carefully follow the dosage instructions and not discontinue the drug abruptly without consulting with veterinarian beforehand.
- Clients should be briefed on the potential adverse effects that can be seen with these drugs and instructed to contact the veterinarian should these effects become severe or progress.

Chemistry/Synonyms

Prednisolone and prednisone are synthetic glucocorticoids. Prednisolone and prednisolone acetate occur as odorless, white to practically white, crystalline powders. Prednisolone is very slightly soluble in water and slightly soluble in alcohol. The acetate ester is practically insoluble in water and slightly soluble in alcohol. The sodium succinate ester is highly water-soluble.

Prednisone occurs as an odorless, white to practically white, crystalline powder. Prednisone is very slightly soluble in water and slightly soluble in alcohol.

Prednisolone is also known as deltahydrocortisone or metacortandralone.

Prednisone may also be known as: delta(1)-cortisone, 1,2-dehydrocortisone, deltacortisone, deltadehydrocortisone, metacortandracin, NSC-10023, prednisonum; many trade names are available.

Storage/Stability/Compatibility

Prednisolone and prednisone tablets should be stored in well-closed containers. All prednisone and prednisolone products should be stored at temperatures less than 40°, and preferably between 15–30°C; avoid freezing liquid products. Do not autoclave. Oral liquid preparations of prednisone should be stored in tight containers. Do not refrigerate prednisolone syrup.

Prednisolone sodium succinate should be stored at room temperature and protected from light (store in carton). After reconstitution, the product is recommended for immediate use and not to be stored for later use.

Little data appears to be available regarding the compatibility of prednisolone sodium succinate injection (*Solu-Delta Cortef*®—Upjohn) with other products. A related compound, prednisolone sodium phosphate is reportedly physically **compatible** with the following drugs/solutions: ascorbic acid injection, cephalothin sodium, cytarabine, erythromycin lactobionate, fluorouracil, heparin sodium, methicillin sodium, penicillin G potassium/sodium, tetracycline HCl, and vitamin B-Complex with C. It is reportedly physically **incompatible** with: calcium gluconate/gluceptate, dimenhydrinate, metaraminol bitartrate, methotrexate sodium, prochlorperazine edisylate, polymyxin B sulfate, promazine HCl, and promethazine. Compatibility is dependent upon factors such as pH, concentration, temperature, and diluent used; consult specialized references or a hospital pharmacist for more specific information.

Dosage Forms/Regulatory Status

VETERINARY-LABELED PRODUCTS:

A zero tolerance of residues in milk for these compounds have been established for dairy cattle. All these agents require a prescription (Rx). Known approved-veterinary products for systemic use are indicated below.

The ARCI (Racing Commissioners International) has designated this drug as a class 4 substance. See the appendix for more information.

Prednisolone Tablets: 5 mg, 20 mg: *Prednis-Tab*® (Vedco, Phoenix Pharmaceutical, Vet-A-Mix); generic; (Rx). Approved for use in dogs.

Prednisolone, Tetracycline, Novobiocin Tablets: each tablet contains 60 mg tetracycline, 60 mg novobiocin, 1.5 mg prednisolone. *Delta Albaplex*®; each tablet contains 180 mg tetracycline, 180 mg novobiocin, and 4.5 mg prednisolone *Delta Albaplex® 3X* (Pfizer); (Rx). Approved for use in dogs.

Prednisolone & Trimeprazine Tartrate Tablets: each tablet contains trimeprazine 5 mg and prednisolone 2 mg. *Temaril-P*® (Pfizer Animal Health); (Rx). Approved for use in dogs.

HUMAN-LABELED PRODUCTS:

Prednisolone Tablets: 5 mg generic; (Rx)

Prednisolone Sodium Phosphate Orally Disintegrating Tablets: 10 mg, 15 mg & 30 mg (as base); *Orapred ODT*® (Alliant Pharmaceuticals); (Rx)

Prednisolone Syrup/Oral Liquid or Solution: 1 mg/mL, 3 mg/mL; in 120 mL, 237 mL. 240 mL and 480 mL; *Prelone*® (Aero); *Pediapred*® (UCB Pharma); *Orapred*® (BioMarin); generic; (Rx)

Prednisone Tablets: 1 mg, 2.5 mg, 5 mg, 10 mg, 20 mg & 50 mg; *Meticorten*® (Schering); *Orasone*® (Solvay); *Panasol-S*® (Seatrace); *Deltasone*® (Upjohn); *Prednicen-M*® (Central); *Sterapred*® and *Sterapred DS*® (Merz); generic; (Rx)

Prednisone Oral Solution/Syrup: 1 mg/mL in 120 mL, 240 mL, 500 mL and UD 5 mL; 5 mg/mL in 30 mL; *Prednisone Intensol*® *Concentrate* (Roxane); *Liquid Pred*® (Muro); (Rx)

Ophthalmic solutions/suspensions are available.

PRIMAQUINE PHOSPHATE

(***prim***-ah-kwin)

ANTIPROTOZOAL

Prescriber Highlights

- **Antiprotozoal agent considered the drug of choice for treating *Babesia felis* in cats; does not apparently "cure" the infection; repeated courses of therapy may be necessary**
- **May also be useful in treating *Hepatazoon canis* in dogs or *Plasmodium* spp. in birds**
- **Most common adverse effect in cats is nausea; giving with food may help**
- **Very narrow therapeutic index (safety margin); must be careful in determining dosages**
- **Monitoring CBC mandatory**

Uses/Indications

Primaquine is considered the drug of choice for treating *Babesia felis* in cats. Primaquine does not apparently "cure" the infection; repeated courses of therapy may be necessary. It may be useful in treating *Hepatazoon canis* in dogs or *Plasmodium* spp. in birds. In humans, primaquine is used for treatment and prophylaxis for malaria and treating *Pneumocystis* pneumonia.