Doses

■ **DOGS, CATS:**

a) For Neosporosis or Toxoplasmosis: 7.5–15 mg/kg PO once daily for 28 days. Dose extrapolated between doses for horses and mice. (Greene, Hartmannn et al. 2006)

b) For coccidiosis: Anecdotally, 15–30 mg/kg PO once or repeated after 7–10 days. (Hurley 2007)

■ **HORSES:**

For EPM:

a) 5 mg/kg, PO once daily for 28 days. See the package insert for specific dosing instructions. (Package insert; *Marquis*®—Bayer)

Monitoring

■ Clinical efficacy

Client Information

■ For this drug to be effective it must be given as prescribed.

■ Contact veterinarian if rashes, hives, blisters, or GI signs develop.

■ Clients should be forewarned of the considerable expense associated with this drug and that clinical improvement may be marginal or not occur at all in some horses treated.

Chemistry/Synonyms

Related to other antiprotozoals such as toltrazuril, ponazuril is a triazine antiprotozoal (anticoccidial) agent. The commercially available oral paste is white to off-white in color and odorless; pH is 5.7–6.

Ponazuril may also be known as: ICI-128436, *Marquis*®, and *Ponalrestat*®.

Storage/Stability

Store the paste at room temperature (15–30°C).

Dosage Forms/Regulatory Status

VETERINARY-LABELED PRODUCTS:

Ponazuril Oral Paste (15% w/w): 127-gram tubes; each gram of paste contains 150 mg of ponazuril; each syringe is enough to treat a 1200 lb. horse for 7 days. *Marquis*® (Bayer); (Rx). Not for use in horses intended for food.

HUMAN-LABELED PRODUCTS: None

Potassium Bromide – see Bromides
Potassium Iodide – see Iodide, Potassium

POTASSIUM CHLORIDE
POTASSIUM GLUCONATE

(po-*tass*-ee-um) Cal-Dextro® K, Tumil-K®

ELECTROLYTE

Prescriber Highlights

- Used for treatment or prevention of hypokalemia
- Contraindications: Hyperkalemia, renal failure or severe renal impairment, severe hemolytic reactions, untreated Addison's disease, acute dehydration, GI motility impairment (solid oral dosage forms)
- Caution: Patients on digoxin
- Adverse Effects: Hyperkalemia. Oral therapy: GI distress; IV therapy may be irritating to veins
- Intravenous potassium salts must be diluted before administering & drug must be given slowly
- Acid/base, hydration status important
- Drug Interactions

Uses/Indications

Potassium supplementation is used to prevent or treat potassium deficits. When feasible and appropriate, because it is generally safer, oral or nutritional therapy is generally preferred over parenteral potassium administration.

Pharmacology/Actions

Potassium is the principal intracellular cation in the body. It is essential in maintaining cellular tonicity; nerve impulse transmission; smooth, skeletal and cardiac muscle contraction; and maintenance of normal renal function. Potassium is also used in carbohydrate utilization and protein synthesis.

Pharmacokinetics

Potassium is primarily (80–90%) excreted via the kidneys with the majority of the remainder excreted in the feces. Very small amounts may be excreted in perspiration (animals with sweat glands).

Contraindications/Precautions/Warnings

Potassium salts are contraindicated in patients with hyperkalemia, renal failure or severe renal impairment, severe hemolytic reactions, untreated Addison's disease, and acute dehydration. Solid oral dosage forms should not be used in patients where GI motility is impaired. Use cautiously in digitalized patients (see Drug Interactions).

Because potassium is primarily an intracellular electrolyte, serum levels may not adequately reflect the total body stores of potassium. Acid-base balance may also mask the actual potassium picture. Patients with systemic acidosis conditions may appear to have hyperkalemia when, in fact, they may be significantly low in total body potassium. Conversely, alkalosis may cause a falsely low serum potassium value. Assess renal and cardiac function prior to therapy and closely monitor serum potassium levels. Supplementation should generally occur over 3–5 days to allow equilibration to occur between extracellular and intracellular fluids. Some clinicians feel that if acidosis is present or a concern, use potassium acetate, citrate or bicarbonate; if alkalosis is present, use potassium chloride.

Adverse Effects

The major problem associated with potassium supplementation is the development of hyperkalemia. Clinical signs associated with hyperkalemia can range from muscular weakness and/or GI disturbances to cardiac conduction disturbances. Clinical signs can be exacerbated by concomitant hypocalcemia, hyponatremia, or acidosis. Intravenous potassium salts must be diluted before administering and given slowly (see Doses).

Oral therapy can cause GI distress and IV therapy may be irritating to veins.

Reproductive/Nursing Safety

Monitored potassium supplementation is unlikely to have negative effects during pregnancy or lactation.

Overdosage/Acute Toxicity

Fatal hyperkalemia may develop if potassium salts are administered too rapidly IV or if potassium renal excretory mechanisms are impaired. Clinical signs associated with hyperkalemia are noted in the Adverse Effects section above. Treatment of hyperkalemia is dependent upon the cause and/or severity of the condition and can consist of: discontinuation of the drug with ECG, acid/base and electrolyte monitoring, glucose/insulin infusions, sodium bicarbonate, calcium therapy, and polystyrene sulfonate resin. It is suggested to refer to other references appropriate for the species being treated for specific protocols for the treatment of hyperkalemia.

Drug Interactions

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

- **ACE INHIBITORS** (*e.g.*, **enalapril**): Potassium retention may occur; increased risk for hyperkalemia
- **DIGOXIN**: In patients with severe or complete heart block who are receiving digitalis therapy, it is often recommended not to use potassium salts
- **NSAIDS**: Oral potassium given with non-steroidal antiinflammatory agents may increase the risk of gastrointestinal adverse effects
- **POTASSIUM-SPARING DIURETICS** (*e.g.*, **spironolactone**): Potassium retention may occur; increased risk for hyperkalemia

Doses

- **DOGS & CATS:**

For hypokalemia:

a) Intravenous replacement: If animal has normal renal function, IV KCl not to exceed 0.5 mEq/kg/hr. Use IV replacement very cautiously in animals with impaired renal function or in those receiving potassium-sparing diuretics.

Subcutaneous replacement: If IV use is unfeasible or rapid correction is unnecessary, may add KCl to SC fluids; do not exceed 30 mEq of potassium per liter.

Oral replacement: Potassium gluconate PO at a rate of 2.2 mEq per 100 calories of required energy intake or potassium gluconate elixir (20 mEq/mL) for dogs at 5 mL q8–12h PO (Bell and Osborne 1986)

b) Oral using *Tumil-K*® (Virbac): 1/4 teaspoonful (2 mEq) per 4.5 kg body weight PO in food twice daily. Adjust dose as necessary. (Package insert; *Tumil-K*®—Virbac).

c) Intravenous replacement: potassium chloride IV at a rate not to exceed 0.5 mEq/hour. Concentration of replacement fluid should exceed 60 mEq/L. Begin oral supplementation as soon as possible using potassium gluconate for dogs at a dose of 2–44 mEq/day depending on body size; cats get 2–4 mEq/day. (Peres 2000)

d) Potassium administration should be considered on the basis of how much potassium to administer to the patient, not how much to add to a bag of fluid. Dosages usually range from maintenance (0.05–0.1 mEq/kg/hour) to 0.5 mEq/kg/hour. (Hansen 2007c)

- **RUMINANTS:**

For hypokalemia:

a) In "downer" cows: 80 g sodium chloride and 20 g potassium chloride in 10 liters of water PO via stomach tube. Provide a bucket containing similar solution for cow to drink and another containing fresh water. (Caple 1986)

b) 50 grams PO daily; 1 mEq/kg/hr IV drip (Howard 1986)

c) For severe hypokalemia (<2.3 mEq/L) with severe muscle weakness or recumbency: Isotonic potassium chloride (11.5 grams of potassium chloride per 1 liter of sterile water) at a rate of 4 mL/kg/hour. Combined with large doses of oral potassium salts (*i.e.*, 200 grams of KCl per day. (Smith 2006)

Monitoring

Level and frequency of monitoring associated with potassium therapy is dependent upon the cause and/or severity of hypokalemia, acid/base abnormalities, renal function, concomitant drugs administered, or disease states and can include:

- Serum potassium
- Other electrolytes
- Acid/base status
- Glucose
- ECG
- CBC
- Urinalyses

Chemistry/Synonyms

Potassium chloride occurs as either white, granular powder or as colorless, elongated, prismatic, or cubical crystals. It is odorless and has a saline taste. One gram is soluble in about 3 mL of water and is insoluble in alcohol. The pH of the injection ranges from 4–8. One gram of potassium chloride contains 13.4 mEq of potassium. A 2 mEq/mL solution has an osmolarity of 4000 mOsm/L. Potassium chloride may also be known as KCl.

Potassium gluconate occurs as white to yellowish white, crystalline powder or granules. It is odorless, has a slightly bitter taste, and is freely soluble in water. One gram of potassium gluconate contains 4.3 mEq of potassium.

Potassium Chloride may also be known as: KCl, cloreto de potassio, E508, kalii chloridum, or kalium chloratum.

Potassium Gluconate may also be known as: E577, *K-G Elixir*®, *Kaon*®, *Kaylixir*®, *Potasoral*®, *Potassiject*®, *Potassium-Rougier*®, *Renakare*®, *Sopa-K*®, *Tumil-K*®, and *Ultra-K*®.

Storage/Stability/Compatibility

Potassium gluconate oral products should be stored in tight, light resistant containers at room temperature (15–30°C), unless otherwise instructed by the manufacturer.

Unless otherwise directed by the manufacturer, potassium chloride products should be stored in tight, containers at room temperature (15–30°C); protect from freezing.

Potassium chloride for injection is reportedly physically **compatible** with the following intravenous solutions and drugs (as an additive): all commonly used intravenous replacement fluids (not 10% fat emulsion), aminophylline, amiodarone HCl, bretylium tosylate, calcium gluconate, carbenicillin disodium, cephalothin sodium,

cephapirin sodium, chloramphenicol sodium succinate, cimetidine HCl, clindamycin phosphate, corticotropin (ACTH), cytarabine, dimenhydrinate, dopamine HCl, erythromycin gluceptate/lactobionate, heparin sodium, hydrocortisone sodium succinate, isoproterenol HCl, lidocaine HCl, metaraminol bitartrate, methicillin sodium, methyldopate HCl, metoclopramide HCl, nafcillin sodium, norepinephrine bitartrate, oxacillin sodium, oxytetracycline HCl, penicillin G potassium, phenylephrine HCl, piperacillin sodium, sodium bicarbonate, tetracycline HCl, thiopental sodium, vancomycin HCl, verapamil HCl, and vitamin B-complex with C.

Potassium chloride for injection **compatibility information conflicts** or is dependent on diluent or concentration factors with the following drugs or solutions: fat emulsion 10%, amikacin sulfate, dobutamine HCl, methylprednisolone sodium succinate (at Y-site), penicillin G sodium, and promethazine HCl (at Y-site). Compatibility is dependent upon factors such as pH, concentration, temperature, and diluent used; consult specialized references or a hospital pharmacist for more specific information.

Potassium chloride for injection is reportedly physically **incompatible** with the following solutions or drugs: amphotericin B, diazepam (at Y-site), and phenytoin sodium (at Y-site).

Dosage Forms/Regulatory Status

VETERINARY-LABELED PRODUCTS:

There are several products for parenteral use that contain potassium; refer to the tables in the appendix or individual proprietary veterinary products (*e.g.*, *Cal-Dextro® K*—Fort Dodge) for additional information.

Potassium Chloride IV Solution: 2 mEq (149 mg) in 10 mL vials; *Potassiject®* (Butler); generic; (Rx)

Oral Products:

Potassium Gluconate Tablets: 2 mEq (468 mg). Labeled for use in cats and dogs; *Tumil-K®* (Virbac), *Renakare®* (Neogen); (Rx)

Potassium Gluconate Oral Powder: Each 0.65 gram 4 oz (1/4 teaspoonful) contains 2 mEq of potassium in 4 oz. Containers; *Renakare®* (Neogen); *Tumil-K®* (Virbac) (Rx). Labeled for use in dogs and cats.

Potassium Gluconate Gel: Each 2.34 gm (1/2 teaspoonful) contains 2 mEq of potassium in 5 oz tubes; *Tumil-K® Gel* (Virbac), *Renakare®* (Neogen) (Rx). Labeled for use in dogs and cats.

HUMAN-LABELED PRODUCTS: Not a complete list.

Parenteral Products:

Potassium Chloride for Injection Concentrate (**Must be diluted before administering**): 2 mEq/mL in 250 mL and 500 mL; 10 mEq in 5 mL, 10 mL, 50 mL and 100 mL vials & 5 mL additive syringes; 20 mEq in 10 mL and 20 mL vials, 10 mL additive syringes and amps; 30 mEq in 15 mL, 20 mL, 30 mL and 100 mL vials and 20 mL additive syringes; 40 mEq in 20 mL, 30 mL, 50 mL and 100 mL vials, 20 mL amps and additive syringes; 60 mEq and 90 mEq in 30 mL vials; generic; (Rx)

Potassium acetate for injection and potassium phosphate for injection (see Phosphate monograph) are also available. There are a multitude of human-labeled potassium salts for oral use available in several dosage forms; refer to human drug references for more information on these products. Tablets, controlled/sustained release tablets and capsules, effervescent tablets, liquids, and powder in varying strengths available; (OTC and Rx)

Potassium Citrate—see Citrate Salts

PRALIDOXIME CHLORIDE
2-PAM CHLORIDE

(pra-li-***dox***-eem) Protopam Chloride®

ANTIDOTE; CHOLINESTERASE REACTIVATOR

Prescriber Highlights

- Cholinesterase reactivator used for adjunctive treatment of organophosphate poisoning
- Contraindications: Hypersensitivity; generally not recommended for carbamate poisoning
- Caution: Renal impairment, patients receiving anticholinesterase agents for the treatment of myasthenia gravis
- Adverse Effects: Rapid IV injection may cause tachycardia, muscle rigidity, transient neuromuscular blockade, or laryngospasm
- Most-effective if given within 24 hours of exposure

Uses/Indications

Pralidoxime is used in the treatment of organophosphate poisoning, often in conjunction with atropine and supportive therapy.

Pharmacology/Actions

Pralidoxime reactivates cholinesterase that has been inactivated by phosphorylation secondary to certain organophosphates. Via nucleophilic attack, the drug removes and binds the offending phosphoryl group attached to the enzyme, which is then excreted.

Pharmacokinetics

Pralidoxime is only marginally absorbed after oral dosing; oral dosage forms are no longer available in the United States. It is distributed primarily throughout the extracellular water. Because of its quaternary ammonium structure, it is not believed to enter the CNS in significant quantities, but recent studies and clinical responses have led some to question this belief.

Pralidoxime is thought to be metabolized by the liver and excreted as both metabolite(s) and unchanged drug in the urine.

Contraindications/Precautions/Warnings

Pralidoxime is contraindicated in patients hypersensitive to it. Pralidoxime is generally not recommended for use in instances of carbamate poisoning because inhibition is rapidly reversible, but there is some controversy regarding this issue.

Pralidoxime should be used with caution in patients receiving anticholinesterase agents for the treatment of myasthenia gravis as it may precipitate a myasthenic crisis. It should also be used cautiously and at a reduced dosage rate in patients with renal impairment.

Adverse Effects

At usual doses, pralidoxime generally is safe and free of significant adverse effects. Rapid IV injection may cause tachycardia, muscle rigidity, transient neuromuscular blockade, and laryngospasm.

Pralidoxime must generally be given within 24 hours of exposure to be effective, but some benefits may occur, particularly in large exposures, if given within 36–48 hours.