■ **HORSES:**

For susceptible infections:

a) 20 mg/kg, IM three times daily (Robinson 1987)

b) For pneumonia: 20 mg/kg IM q8h; may cause local myositis. Insufficient data to comment on use. (Beech 1987b)

■ **SWINE:**

For susceptible enteric infections:

a) 10 mg/kg, PO q12h (Howard 1986)

b) For bacterial enteritis (white scours) in baby pigs associated with E. coli susceptible to spectinomycin: 50 mg/10 lbs of body weight PO twice daily for 3–5 days (Label directions; *Spectam Scour-Halt®*—Ceva)

c) 10 mg/kg, IM q12h (Baggot 1983)

■ **BIRDS:**

a) For airsacculitis associated with *M. meleagridis* or chronic respiratory disease associated with *E. coli* in turkey poults (1–3 days old): Inject 0.1 mL (10 mg) SC in the base of the neck.

For control and to lessen mortality due to infections from *M. synoviae, S. typhimurium, S. infantis,* and *E. coli* in newly hatched chicks: Dilute injection with normal saline to a concentration of 2.5–5 mg/0.2 mL and inject SC. (Label directions; *Spectam® Injectable*—Ceva)

b) For prevention and control of chronic respiratory disease associated with *Mycoplasma gallisepticum* in broilers: Add sufficient amount to drinking water to attain a final concentration of 2 g/gallon.

For infectious synovitis associated with *Mycoplasma synoviae* in broilers: Add sufficient amount to drinking water to attain a final concentration of 1 g/gallon.

For improved weight gain/feed efficiency in floor-raised broilers: Add sufficient amount to drinking water to attain a final concentration of 0.5 g/gallon. (Label directions; *Spectam® Water-Soluble*—Ceva)

Monitoring

■ Clinical efficacy

Chemistry/Synonyms

An aminocyclitol antibiotic obtained from *Streptomyces spectabilis*, spectinomycin is available as the dihydrochloride pentahydrate and hexahydrate sulfate salts. It occurs as a white to pale buff, crystalline powder with pK_as of 7 and 8.7. It is freely soluble in water and practically insoluble in alcohol.

Spectinomycin may also be known as: M-141, actinospectacin, spectinomycini, U-18409AE, *Adspec®, Amtech Spectam®, Kempi®, Kirin®, Spectoguard Scour-Chek®, Stanilo®, Togamycin®, Trobicin®, Trobicine®,* or *Vabicin®*.

Storage/Stability

Unless otherwise instructed by the manufacturer, spectinomycin products should be stored at room temperature (15–30°C). Protect from freezing.

Dosage Forms/Regulatory Status

VETERINARY-LABELED PRODUCTS:

Spectinomycin Sulfate Injection: 100 mg/mL in 500 mL vials; *Adspec®*; (Pharmacia & Upjohn); (Rx). When used as labeled, slaughter withdrawal in cattle = 11 days; not to be used in veal calves or in dairy cattle 20 months of age or older.

Spectinomycin Injection: 100 mg/mL in 500 mL vials; *Amtech Spectam® Injectable* (IVX); (OTC). Approved for use in 1–3 days old turkey poults and newly hatched chicks.

Spectinomycin Water Soluble Concentrate: 0.5 g of spectinomycin per gram *Spectam® Water Soluble* (Bimeda); (OTC). Approved for use in chickens (not layers). Slaughter withdrawal (at labeled doses) = 5 days.

Spectinomycin Oral Solution: 50 mg/mL in 240 mL pump bottle and 500 and 1000 mL without pump; *Amtech Spectam Scour-Halt®*, (IVX), *Spectoguard Scour-Chek®* (Bimeda), *Spectam Scour-Halt®*, (AgriPharm); (OTC). Approved for use in swine (Weighing less than 15 lbs and not older than 4 weeks of age). Slaughter withdrawal (at labeled doses) = 21 days.

Spectinomycin/Lincomycin in a 2:1 ratio

LS 50 Water Soluble Powder® (Pharmacia & Upjohn); *Sepclinx-50®* (Bimeda); generic (IVX, AgriLabs); in 2.65 oz packets. Each packet contains lincomycin 16.7 g and spectinomycin 33.3 g. Approved for use in chickens up to 7 days of age.

Lincomycin 50 mg/Spectinomycin 100 mg per mL in 20 mL vials; *Linco-Spectin® Sterile Solution* (Pharmacia & Upjohn); (OTC). Approved for use in semen extenders only.

HUMAN-LABELED PRODUCTS:

Spectinomycin Powder for Injection: 400 mg (as the HCl) per mL after reconstitution in 2 g vial with 3.2 mL diluent; *Trobicin®* (Upjohn); (Rx)

SPIRONOLACTONE

(speer-on-oh-*lak*-tone) Aldactone®

ALDOSTERONE ANTAGONIST

Prescriber Highlights

- **Aldosterone antagonist used as a potassium sparing diuretic or for adjunctive treatment for heart failure (use is somewhat controversial for CHF in dogs); should not be substituted for furosemide in CHF**
- **Contraindications: Hyperkalemia, Addison's disease, anuria, acute renal failure or significant renal impairment**
- **Caution: Any renal impairment or hepatic disease**
- **Adverse Effects: Hyperkalemia, hyponatremia, & dehydration; increased BUN & mild acidosis in patients with renal impairment. GI distress (vomiting, anorexia, etc.), CNS effects (lethargy, ataxia, headache, etc.), & endocrine changes possible**

Uses/Indications

Spironolactone may be used in patients with congestive heart failure who do not adequately respond to furosemide and ACE inhibitors, who develop hypokalemia on other diuretics, and are unwilling or unable to supplement with exogenous potassium sources. It may also be effective in treating ascites as it has less potential to increase ammonia levels than other diuretics.

Pharmacology/Actions

Aldosterone is competitively inhibited by spironolactone in the distal renal tubules with resultant increased excretion of sodium, chloride, and water, and decreased excretion of potassium, ammonium, phosphate, and titratable acid. Spironolactone has no effect on carbonic anhydrase or renal transport mechanisms and has its greatest effect in patients with hyperaldosteronism. When used alone in

healthy dogs, spironolactone does not appear to cause significant diuresis (Jeunesse, Wohrle et al. 2004).

Spironolactone is not commonly used alone as most sodium is reabsorbed at the proximal tubules. Combining it with a thiazide or loop diuretic will yield maximum diuretic effect.

After cats received 2.7 mg/kg spironolactone twice daily for 7–9 days, the following serum values increased (on average) significantly: potassium 0.39 mEq/L, calcium 0.48 mg/dL, creatinine 0.22 mg/dL, phosphorus 0.63 mg/dL and total protein 0.51 mg/dL. (Abbott and Saker 2006)

In humans, spironolactone can have antifibrotic effects on cardiac muscle.

Pharmacokinetics

No information was found regarding the pharmacokinetics of spironolactone in veterinary species. In humans, spironolactone is >90% bioavailable and peak levels are reached within 1–2 hours. The diuretic action of spironolactone (when used alone) is gradually attained and generally reaches its maximal effect on the third day of therapy.

Spironolactone and its active metabolite, canrenone, are both about 98% bound to plasma proteins. Both spironolactone and its metabolites may cross the placenta. Canrenone has been detected in breast milk. Spironolactone is rapidly metabolized (half-life of 1–2 hours) to several metabolites, including canrenone, which has diuretic activity. Canrenone is more slowly eliminated, with an average half-life of around 20 hours.

Contraindications/Precautions/Warnings

Spironolactone is contraindicated in patients with hyperkalemia, Addison's disease, anuria, acute renal failure or significant renal impairment. It should be used cautiously in patients with any renal impairment or hepatic disease.

Adverse Effects

Adverse effects are usually considered mild and reversible upon discontinuation of the drug. Electrolyte (hyperkalemia, hyponatremia) and water balance (dehydration) abnormalities are the most likely effects with spironolactone therapy, but electrolytes in dogs do not appear to be significantly affected.

Transient increases in BUN and mild acidosis may occur in patients with renal impairment. GI distress (vomiting, anorexia, etc.), CNS effects (lethargy, ataxia, headache, etc.), and endocrine changes (gynecomastia in human males) are all possible.

Use of spironolactone in patients with renal impairment may lead to hyperkalemia. Spironolactone reportedly inhibits the synthesis of testosterone and may increase the peripheral conversion of testosterone to estradiol. Long-term toxicity studies in rats have demonstrated that spironolactone is tumorigenic in that species.

Reproductive/Nursing Safety

Spironolactone or its metabolites may cross the placental barrier. Feminization occurs in male rat fetuses. In humans, the FDA categorizes this drug as category ***D*** for use during pregnancy (*There is evidence of human fetal risk, but the potential benefits from the use of the drug in pregnant women may be acceptable despite its potential risks.*)

Canrenone, a metabolite of spironolactone, appears in maternal milk. In humans, the estimated maximum dose to the infant is approximately 0.2% of the mother's daily dose. Use with caution in nursing patients, but it is unlikely of clinical significance in veterinary patients.

Overdosage/Acute Toxicity

Information on overdosage of spironolactone is apparently unavailable. Should an acute overdose occur, it is suggested to follow the guidelines outlined in the chlorothiazide and furosemide monographs. Contact an animal poison control center for further guidance.

Drug Interactions

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

- **DIGOXIN**: Spironolactone may increase the half-life of digoxin; enhanced monitoring of digoxin serum levels and effects are warranted when spironolactone is used with these agents
- **MITOTANE**: Spironolactone may mute the effects of mitotane if given concurrently, but very limited information is available on this potential interaction; monitor carefully.
- **NEUROMUSCULAR BLOCKERS, NON-DEPOLARIZING**: Increase in neuromuscular blockade effects possible
- **POTASSIUM-SPARING DIURETICS, OTHER** (*e.g.,* **triamterene**): Hyperkalemia possible
- **POTASSIUM SUPPLEMENTS**: Hyperkalemia possible
- **SALICYLATES**: Spironolactone's diuretic effects may be decreased if **aspirin** or other salicylates are administered concomitantly

Laboratory Considerations

- Spironolactone may give falsely elevated **digoxin** values, if using a radioimmune assay (RIA) method.
- Fluorometric methods of determining plasma and urinary **17-hydroxycorticosteroids** (cortisol) may be interfered with by spironolactone.

Doses

- **DOGS:**

  As a diuretic in CHF:

  a) When furosemide and ACE inhibitors alone do not control fluid accumulation in refractory CHF: 1–2 mg/kg PO q12h (Ware and Keene 2000)

  b) With other diuretics when hypokalemia is an issue: 2–4 mg/kg PO once daily (Kittleson 2000)

  c) To allow further reduction of furosemide dose (target dose for furosemide during maintenance phase: 1–2 mg/kg PO q24–48h): Spironolactone dose varies between 0.5 mg/kg PO once daily (aldosterone blockage, weak diuretic effect) to 2 mg/kg twice daily (stronger diuretic effect). (de Madron 2004)

  For treating ascites:

  a) 1–2 mg/kg PO twice daily; if no response in 4–5 days, double dose for an additional 4–5 days; if no response, may double again (4–8 mg/kg twice daily). Monitor (weigh) patients daily and do not allow patient to become dehydrated or to lose more than 0.25–0.5 kg/day. (Hardy 1985)

  b) Attempt at treating underlying abnormality. When ascites is caused by right-sided heart failure: Be sure owner is administering medication properly and the prescription is correct. Increase furosemide to 4–6 mg/kg PO q8h (generally speaking dose should be increased until all the abnormal accumulated fluid is eliminated or unacceptable azotemia develops). Optimize ACE inhibitor dose. Restrict dietary sodium. Add spironolactone at 1–2 mg/kg PO q12h. Initially (3 times weekly) substitute one of the oral furosemide doses with a SC dose. Consider adding hydrochlorothiazide initially at 2 mg/kg PO every other day. (Connolly 2006)

For adjunctive treatment of hypertension:
a) 1–2 mg/kg PO q12h (Stepian 2006b)

■ **CATS:**

As a diuretic in CHF:
a) When furosemide and ACE inhibitors alone do not control fluid accumulation in refractory CHF: 1–2 mg/kg PO q12h (Ware and Keene 2000)
b) 1 mg/kg q12h PO when serum potassium is low (Bonagura 1989)

For adjunctive treatment of hypertension:
a) 1–2 mg/kg PO q12h (Stepian 2006b)

Monitoring

- Serum electrolytes, BUN, creatinine
- Hydration status
- Blood pressure, if indicated
- Clinical signs of edema/ascites; patient weight, if indicated

Client Information

- Notify veterinarian if GI symptoms (*e.g.*, vomiting, diarrhea, anorexia), lethargy, or other CNS effects are severe or persist

Chemistry/Synonyms

A synthetically produced aldosterone antagonist, spironolactone occurs as a cream-colored to light tan, crystalline powder with a faint mercaptan-like odor. It has a melting range of 198°–207°, with decomposition. Spironolactone is practically insoluble in water and soluble in alcohol.

Spironolactone may also be known as: espironolactona, SC-9420, spirolactone, spironolactonum; many trade names are available.

Storage/Stability

Spironolactone tablets should be stored at room temperature in tight, light-resistant containers. An extemporaneously prepared oral suspension can be prepared by pulverizing commercially available tablets and adding cherry syrup. This preparation is reportedly stable for at least one month when refrigerated.

Dosage Forms/Regulatory Status

VETERINARY-LABELED PRODUCTS: None

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

HUMAN-LABELED PRODUCTS:

Spironolactone Tablets: 25 mg, 50 mg & 100 mg; *Aldactone*® (Searle); generic; (Rx)

Also available in combination with hydrochlorothiazide.

STANOZOLOL

(stah-***no***-zo-lahl) Winstrol®-V

ANABOLIC STEROID

Prescriber Highlights

- **Anabolic steroid; veterinary labeled products no longer marketed in USA**
- **Contraindications: Pregnant animals, breeding stallions, food animals. Extreme Caution: Cats, hepatic dysfunction, hypercalcemia, history of myocardial infarction, pituitary insufficiency, prostate carcinoma, mammary carcinoma, benign prostatic hypertrophy, & during the nephrotic stage of nephritis. Caution: Cardiac & renal dysfunction with enhanced fluid & electrolyte monitoring.**
- **Adverse Effects: Potentially high incidence of hepatotoxicity in cats. Other possible effects: sodium, calcium, potassium, water, chloride, & phosphate retention; hepatotoxicity, behavioral (androgenic) changes, & reproductive abnormalities (oligospermia, estrus suppression)**
- **Category "*X*" for pregnancy; teratogenicity outweighs any possible benefit**
- **Controlled substance in the USA**
- **Drug Interactions; lab interactions**

Uses/Indications

Labeled indications for the previously marketed veterinary stanozolol product *Winstrol®-V* (Winthrop/Upjohn) included "…to improve appetite, promote weight gain, and increase strength and vitality…" in dogs, cats and horses. The manufacturer also stated that: "Anabolic therapy is intended primarily as an adjunct to other specific and supportive therapy, including nutritional therapy."

Like nandrolone, stanozolol has been used to treat anemia of chronic disease. Because stanozolol has been demonstrated to enhance fibrinolysis after parenteral injection, it may be efficacious in the treatment of feline aortic thromboembolism or thrombosis in nephrotic syndrome; however, clinical studies and/or experience are apparently lacking for this indication at present.

Pharmacology/Actions

Stanozolol possesses the actions of other anabolic agents but it may be less androgenic than other anabolics that are used in veterinary medicine. Refer to the discussion in the boldenone monograph for more information.

Pharmacokinetics

No specific information was located for this agent. It is generally recommended that the injectable suspension be dosed on a weekly basis in both small animals and horses.

Contraindications/Precautions/Warnings

Stanozolol is contraindicated in pregnant animals and in breeding stallions and should not be administered to horses intended for food purposes. Because of reported hepatotoxicity associated with this drug in cats, it should only be used in this species with extreme caution.

The manufacturer recommends using stanozolol cautiously in patients with cardiac and renal dysfunction with enhanced fluid and electrolyte monitoring.