LINCOSAMIDES Veterinary—Systemic

This monograph includes information on the following: Clindamycin; Lincomycin.

Some commonly used *brand names* are:

For veterinary-labeled products—

AmTech Clindamycin Hydrochloride Capsules [Clindamycin]
AmTech Clindamycin Hydrochloride Oral Liquid [Clindamycin]
Antirobe [Clindamycin]
Antirobe Aquadrops [Clindamycin]
Clincaps [Clindamycin]
ClindaCure [Clindamycin]
Clinda-Guard [Clindamycin]
Clindrops [Clindamycin]
Lincocin [Lincomycin]
Lincocin Aquadrops [Lincomycin]
Lincocin Injectable [Lincomycin]
Lincocin Sterile Solution [Lincomycin]
Lincomix 20 Feed Medication [Lincomycin]
Lincomix 50 Feed Medication [Lincomycin]
Lincomix Injectable [Lincomycin]
Lincomix Injectable Solution [Lincomycin]
Lincomix 44 Premix [Lincomycin]
Lincomix 110 Premix [Lincomycin]
Lincomix Soluble Powder [Lincomycin]
Lincomycin 44 Premix [Lincomycin]
Lincomycin 44G Premix [Lincomycin]
Lincomycin 110 Premix [Lincomycin]
Lincomycin 110G Premix [Lincomycin]
Lincomycin Soluble [Lincomycin]
Moorman's LN 10 [Lincomycin]
nvClindamycin Capsules [Clindamycin]

Note: For a listing of dosage forms and brand names by country availability, see the *Dosage Forms* section(s).

Category: Antibacterial (systemic).

Indications

Note: Bracketed information in the *Indications* section refers to uses that either are not included in U.S. product labeling or are for products not commercially available in the U.S.

General considerations

The lincosamides have activity against many gram-positive bacteria and many anaerobic bacteria, but are not effective against most gram-negative organisms.

Lincomycin has been shown to have efficacy against *Staphylococcus* species, *Streptococcus* species (except *Streptococcus faecalis*), *Erysipelothrix insidiosa*, *Leptospira pomona*, and *Mycoplasma* species. **{R-3; 4}** The activity of lincomycin against obligate anaerobes is seldom addressed in published literature. According to the National Committee for Clinical Laboratory Standards in the United States, clindamycin is the class antibiotic for the lincosamide family and the clindamycin disk is used in *in vitro* testing to assess susceptibility to both clindamycin and lincomycin **{R-31}**. Therefore, it is presumed that most anaerobes susceptible to clindamycin would likewise be susceptible to lincomycin, provided compensations for potency and kinetic disposition are made **{R-39}**.

Clindamycin has a spectrum of activity that includes *Staphylococcus* species, *Streptococcus* species (except *Streptococcus faecalis*), and *Mycoplasma* species, as well as anaerobic organisms, such as *Bacteroides* species, *Fusobacterium* species, *Clostridium perfringens* (but not necessarily other clostridia), *Actinomyces* species, *Peptostreptococcus* species, and many *Propionibacterium* species.

{R-1}

Accepted

Dysentery, swine (treatment)—*Pigs:* Lincomycin hydrochloride for medicated feed and soluble powder are indicated in the treatment and control of swine dysentery caused by susceptible organisms. **{R-21; 28; 38; 41; 63}**

Enteritis, necrotic (treatment)—*Chickens:* Lincomycin hydrochloride for medicated feed[1] and soluble powder are indicated in the control of necrotic enteritis in chickens caused by susceptible organisms, such as *Clostridium perfringens*. **{R-22; 28; 38; 41; 42; 56}**

Growth promotion and feed efficiency, increased—*Chickens* and *pigs*[1]: Lincomycin hydrochloride for medicated feed is indicated for increased weight gain in growing-finishing pigs and for increased weight gain and feed efficiency in broiler chickens. **{R-38; 63}**

Joint infections (treatment)—*Pigs:* Lincomycin injection is indicated in the treatment of infectious arthritis caused by susceptible organisms, including susceptible *Staphylococcus* species, *Streptococcus* species, *Erysipelothrix rhusiopathiae*, and *Mycoplasma* species. **{R-4; 5}**

Metritis (treatment)[1]—*Dogs:* Lincomycin injection, syrup, and tablets are indicated in the treatment of metritis caused by susceptible organisms. **{R-3}**

Osteomyelitis (treatment)—*Dogs:* Clindamycin capsules and oral solution are indicated in the treatment of osteomyelitis caused by susceptible organisms, **{R-1; 2}** such as *Staphylococcus aureus*.**{R-35; 36; 62}**

Periodontal infections (treatment)—

Cats: Clindamycin oral solution is indicated in the treatment of periodontal infections caused by susceptible bacteria **{R-2; 30; 62}**.

Dogs: Clindamycin capsules and oral solution are indicated in the treatment of periodontal infections caused by susceptible bacteria. **{R-1; 2; 62}**

Porcine proliferative enteropathies (treatment)[1]—*Pigs:* Lincomycin hydrochloride for medicated feed is indicated in the control of porcine proliferative enteropathies (ileitis) caused by *Lawsonia intracellularis***{R-38}**.

Pneumonia, bacterial (treatment)—*Pigs:* Lincomycin injection[1] and lincomycin hydrochloride for medicated feed are indicated in the treatment of pneumonia caused by susceptible *Mycoplasma* species. **{R-4; 5; 63}**

Respiratory tract infections (treatment)[1]—

Cats: Lincomycin injection, syrup, and tablets are indicated in the treatment of respiratory tract infections caused by susceptible organisms. **{R-3}**

Dogs: Lincomycin injection, syrup, and tablets are indicated in the treatment of respiratory tract infections caused by susceptible organisms. **{R-3}**

Skin infections (treatment)[1]—*Dogs:* Lincomycin injection, syrup, and tablets are indicated and [clindamycin] **{R-20}** is effective in the treatment of skin infections, such as pustular dermatitis, caused by susceptible organisms. **{R-3}** To assure efficacy in the treatment of skin infections, underlying primary disorders, such as allergic inhalant dermatitis, should be identified and controlled **{R-1; 30}**.

Soft tissue infections (treatment)—

Cats: Clindamycin oral solution and lincomycin injection[1], syrup[1], and tablets[1] are indicated in the treatment of soft tissue infections, including abscesses, caused by susceptible organisms. **{R-2; 3; 30; 62}**

Dogs: Clindamycin capsules and oral solution, and lincomycin injection[1], syrup[1], and tablets[1] are indicated in the treatment of soft tissue infections, including abscesses and infected wounds, caused by susceptible organisms. **{R-1-3; 62}**

Acceptance not established

Metritis (treatment)—*Dogs:* There are insufficient data to confirm specifically the efficacy of [clindamycin][1] in the treatment of metritis in dogs; however, because lincomycin is indicated for this use, clindamycin can be expected to be at least equally effective **{R-15}**.

Osteomyelitis (treatment)—[*Cats*][1]: There are insufficient data to confirm specifically the efficacy of clindamycin in the treatment of

osteomyelitis in cats; however, the safety and predicted antimicrobial efficacy are supported by research. **{R-24; 53; 54; 57}**

Respiratory tract infections (treatment)—*Cats* and *dogs:* There are insufficient data to confirm specifically the efficacy of [clindamycin][1] in the treatment of respiratory infections in cats and dogs; however, because lincomycin is indicated for this use, clindamycin can be expected to be at least equally effective **{R-15}**.

[Abscesses, laryngeal (treatment)][1]—*Cattle:* There are insufficient data to confirm the efficacy and safety of lincomycin injection in the treatment of laryngeal abscesses in cattle. Reports of three cases showed a good response in laryngeal abscesses treated **{R-44}**.

[Arthritis, septic (treatment)][1]—*Cattle* and *sheep:* There are insufficient data to confirm the efficacy and safety of lincomycin injection in the treatment of septic arthritis in cattle and sheep. Case reports of a dozen cases show a resolution of clinical signs in approximately one-half of refractory joint infections treated (mixed infections of streptococci, staphylococci, and *Corynebacterium pyogenes*). **{R-44}**

[Mastitis (treatment)][1]—*Cattle:* There are insufficient data to confirm the efficacy and safety of parenteral lincomycin in the treatment of mastitis in cattle; however, there is evidence of distribution into milk in ruminants in concentrations sufficient to treat susceptible infections that are refractory to other antimicrobials. **{R-14; 58}** Although no studies have been performed to demonstrate the efficacy of lincomycin against gram-positive mastitis pathogens such as *Staphylococcus* or *Corynebacterium*, given lincomycin's distribution and the susceptibility patterns of these organisms, lincomycin therapy may be a legitimate choice when other conventional treatments are deemed unlikely to be effective.

[Toxoplasmosis (treatment)][1]—*Cats:* There are insufficient data to establish the efficacy of clindamycin in the treatment of *Toxoplasma gondii* infection in cats; however, it is considered to have fewer side effects and perhaps to be more effective in treating some aspects of the disease than is pyrimethamine **{R-17-19; 34; 59}**. Clindamycin may not effectively clear organisms from areas such as the central nervous system in chronically infected animals **{R-18}** and, in some cases, may be ineffective in resolving clinical signs involving the eye. **{R-17}**

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[1]Not included in Canadian product labeling or product not commercially available in Canada.

Regulatory Considerations

U.S.—

Withdrawal times have been established for the use of lincomycin in chickens and pigs (see the *Dosage Forms* section). Lincomycin is not labeled for use in chickens producing eggs for human consumption. **{R-4; 38; 42}**

Canada—

Withdrawal times have been established for the use of lincomycin in chickens and pigs (see the *Dosage Forms* section). Lincomycin is not labeled for use in chickens producing eggs for human consumption. **{R-6; 41}**

Chemistry

Source:

Clindamycin hydrochloride—7(*S*)-Chloro derivative of lincomycin. **{R-27}**

Lincomycin hydrochloride—Produced by the growth of a member of the *lincolnensis* group of *Streptomyces lincolnensis* (family *Streptomycetaceae*). **{R-3}**

Chemical name:

Clindamycin hydrochloride—L-*threo*-alpha-D-*galacto*-Octopyranoside, methyl 7-chloro-6,7,8-trideoxy-6-[[(1-methyl-4-propyl-2-pyrrolidinyl)carbonyl]amino]-1-thio-, (2*S*-*trans*)-, monohydrochloride. **{R-25}**

Lincomycin hydrochloride—D-*erythro*-alpha-D-*galacto*-Octopyranoside, methyl 6,8-dideoxy-6-[[(1-methyl-4-propyl-2-pyrrolidinyl)carbonyl]amino]-1-thio-, monohydrochloride, monohydrate, (2*S*-*trans*)-. **{R-25}**

Molecular formula:
Clindamycin hydrochloride—$C_{18}H_{33}ClN_2O_5S \cdot HCl$. **{R-25}**
Lincomycin hydrochloride—$C_{18}H_{34}N_2O_6S \cdot HCl \cdot H_2O$. **{R-25}**

Molecular weight:
Clindamycin hydrochloride—461.44. **{R-25}**
Lincomycin hydrochloride—461.01. **{R-25}**

Description:
Clindamycin Hydrochloride USP—White or practically white, crystalline powder. Is odorless or has a faint mercaptan-like odor. Is stable in the presence of air and light. Its solutions are acidic and are dextrorotatory. **{R-26}**
Lincomycin Hydrochloride USP—White or practically white, crystalline powder. Is odorless or has a faint odor. Is stable in the presence of air and light. Its solutions are acid and are dextrorotatory. **{R-26}**
Lincomycin Hydrochloride Injection USP—Clear, colorless to slightly yellow solution, having a slight odor. **{R-26}**

pKa:
Clindamycin—7.7. **{R-14}**
Lincomycin—7.6. **{R-14}**

Solubility:
Clindamycin Hydrochloride USP—Freely soluble in water, in dimethylformamide, and in methanol; soluble in alcohol; practically insoluble in acetone. **{R-26}**
Lincomycin Hydrochloride USP—Freely soluble in water; soluble in dimethylformamide; very slightly soluble in acetone. **{R-26}**

Pharmacology/Pharmacokinetics

Mechanism of action/Effect: The lincosamides inhibit protein synthesis in susceptible bacteria by binding to the 50 S ribosomal subunits of bacterial ribosomes and preventing peptide bond formation. **{R-43}** The lincosamides are usually considered bacteriostatic **{R-43}**; however, when clindamycin is present at sufficient concentrations, it may act as a bactericidal antibiotic against sensitive organisms. **{R-43}**

Other actions/effects: Clindamycin may interfere with the attachment and entry of *Toxoplasma gondii* tachyzoites into host cells. **{R-33}**

Absorption: Oral absorption of the lincosamides is rapid, but orally administered lincomycin is less well absorbed than clindamycin.
Clindamycin—Oral absorption of clindamycin is high **{R-1}** and is unaffected by food.
Lincomycin—Oral absorption of lincomycin may be greatly reduced by the presence of food in the stomach. **{R-48}**
Oral absorption:
Pigs—20 to 50%. **{R-49}**
Rats—45 to 60%. **{R-49}**
Intramuscular absorption: Lincomycin hydrochloride is rapidly absorbed after intramuscular administration. **{R-3}**

Distribution: Clindamycin and lincomycin are widely distributed into most tissues, including respiratory tissue, soft tissue, bones, and joints **{R-13; 23; 24}**. The lincosamides are weak bases (commercial preparations are acidic) and are very lipid soluble at physiologic pH (7.4). Tissue concentrations may be higher than serum concentrations. **{R-48}** Small amounts are distributed into pancreatic and prostatic secretions. **{R-48}** There is evidence that clindamycin hydrochloride accumulates in polymorphonuclear granulocytes. **{R-20}** The lincosamides do not penetrate cerebrospinal fluid (CSF) well; **{R-24}** however, in healthy cats, concentrations of clindamycin in brain tissue after 10 days of therapy were 10 to 20% of serum concentration and were consistently higher than CSF concentrations. **{R-24}**
Volume of distribution (area)—Intravenous administration:
Clindamycin phosphate—*Dogs:* 1.4 L per kg (L/kg). **{R-16}**
Lincomycin—*Calves:*
6 weeks of age—1 to 1.2 L/kg (healthy calves or calves with induced *Pasteurella haemolytica* pneumonia). **{R-46; 47}**
9 months of age—1.3 L/kg. **{R-47}**

Protein binding:
Clindamycin—*Sheep:* Moderate (40 to 50%). **{R-14; 51}**
Lincomycin—
Cows—Low to moderate (26 to 46%). **{R-52}**
Sheep—Low (30 to 40%). **{R-14; 51}**
Note: Human protein binding of lincomycin decreases with increased plasma concentrations; the range of protein binding varies from low to high.

Biotransformation:
Clindamycin—Active metabolites of clindamycin measured in urine along with parent compound include *N*-demethylclindamycin and clindamycin sulfoxide. **{R-1}**
Lincomycin—The percentage of administered lincosamide metabolized by the liver is unknown. **{R-49}**

Half-life: Elimination—Intravenous administration:
Clindamycin phosphate—*Dogs:* 3.2 hours. **{R-16}**
Lincomycin:
Calves, newborn to 2 weeks of age—3 hours. **{R-47}**
Calves, 4 weeks to 9 months of age—2 to 2.5 hours. **{R-46; 47}**

Time to peak concentration:
Clindamycin hydrochloride—
Dogs: Oral—1.3 hours (single dose of 5.5 to 11 mg per kg of body weight [mg/kg]). **{R-1}**
Sheep: Intramuscular—1 hour (dose of 20 mg/kg). **{R-14}**
Clindamycin phosphate—*Dogs:* Intramuscular—1 hour (dose of 11 mg/kg). **{R-16}**
Lincomycin hydrochloride—
Dogs:
Intramuscular—10 minutes to 2 hours (dose of 22 mg/kg). **{R-3}**
Oral—2 to 4 hours (dose of 22 mg/kg). **{R-3}**
Sheep: Intramuscular—1 hour (dose of 20 mg/kg). **{R-14}**

Serum concentrations:
Peak serum concentration—
Clindamycin hydrochloride: *Sheep*—Intramuscular: 13.8 mcg/mL (single dose of 20 mg/kg). **{R-14}**
Clindamycin phosphate: *Dogs*—Intramuscular: 5.3 mcg/mL (dose of 11 mg/kg) **{R-16}**.
Lincomycin: *Sheep*—Intramuscular: 12.6 mcg/mL (dose of 20 mg/kg). **{R-14}**
Serum concentration after multiple dosing—Clindamycin hydrochloride (sample 12 hours after the last dose of an every-twelve-hour oral dose for 10 days): *Cats*— **{R-53}**
3.5 mcg/mL (dose of 5.5 mg/kg).
5.4 mcg/mL (dose of 11 mg/kg).
6.5 mcg/mL (dose of 22 mg/kg).

Duration of action:
Clindamycin—*Cats* and *dogs:* **{R-15}**
12 hours, with an oral dose of 11 mg/kg.
24 hours, with an oral dose of 22 mg/kg.
Lincomycin—*Dogs:* Oral—For gram-positive organisms: 6 to 8 hours (22 mg/kg dose). **{R-3}**
Note: Efficacy studies based on a 22 mg/kg dose every 12 hours for 3 weeks in dogs show that duration of action for lincomycin is sufficient for it to be effective when administered every twelve hours **{R-20}**.

Elimination:
Parent drug and metabolites are primarily excreted in the urine and the bile. **{R-1; 3; 24; 48; 49}** Small amounts are excreted in intestinal contents and pancreatic and prostatic fluids. **{R-48}**
When lincomycin is administered orally to dogs, 77% of the dose is excreted in the feces and 14% of the dose is excreted in the urine. When administered intramuscularly , 38% of the dose is excreted

in the feces and 49% is excreted in the urine. **{R-3}**

Less clindamycin than lincomycin is excreted in the urine. **{R-50}**

Clearance—Intravenous administration:

Clindamycin phosphate—*Dogs:* 5.3 mL per minute per kg (mL/min/kg). **{R-16}**

Lincomycin—*Calves:*

6 weeks of age—3.9 to 8.1 mL/min/kg. **{R-46}**

9 months of age—4.4 mL/min/kg. **{R-46}**

Precautions to Consider

Cross-sensitivity and related problems

Animals sensitive to clindamycin may be sensitive to lincomycin and the reverse may also be true.

Species sensitivity

Chinchillas, guinea pigs, hamsters, horses, ponies, and *rabbits:* **{R-7-9; 11}** The use of oral clindamycin or lincomycin is generally contraindicated in these species because of the risk of altering the gastrointestinal microflora and causing serious or fatal enterocolitis and diarrhea. Overgrowth of organisms such as *Clostridium* or *Salmonella* species has been suspected as the cause in many species. Cecal *Escherichia coli*, but not *Clostridium* species, have been cultured from rabbits showing adverse effects after lincomycin exposure. **{R-9}** Contamination of feed with lincomycin at or below feed additive concentrations used for pigs has caused severe or fatal diarrhea in rabbits, ponies, and horses. **{R-7-9}**

Ruminants: Ruminants exposed to oral lincomycin have also been reported to have side effects such as anorexia, ketosis, and sometimes severe diarrhea, **{R-10; 12; 55}** possibly caused by overgrowth of nonsusceptible bacteria; however, case reports and research studies using parenteral lincomycin have reported that only a small percentage of treated animals developed diarrhea and/or decreased milk production. **{R-44-47}**

Feeds contaminated with 3 to 24 parts per million (ppm) of lincomycin have caused ketosis and diarrhea in dairy cows **{R-12}**.

After treatment with oral lincomycin for *Campylobacter*, two thirds of a range flock of sheep died; however, the flock had a history of *Salmonella* infections and grazed in an area with some oxalate-containing range plants, both of which were believed to play a role in the losses. **{R-10}**

Pregnancy/Reproduction

The safety of clindamycin in pregnant or breeding animals has not been established. **{R-1; 2; 13}**

When lincomycin was given to pregnant dogs at 50 mg per kg of body weight (mg/kg) per day, no evidence of teratogenic effects on the embryos was seen. **{R-3}** Also, 75 mg of lincomycin per kg a day administered to breeding male and female rats during a breeding cycle had no observed effect on breeding or teratogenic effects on offspring. **{R-3}**

Lactation

Clindamycin and lincomycin are distributed into milk **{R-14}** in therapeutic concentrations. **{R-40}** With constant serum lincomycin concentrations, milk concentrations range from 2.5 to 6.2 times the serum concentration, depending on the pH of the milk. **{R-14}**

Pediatrics

No evidence of side effects was noted in newborn puppies and rats given lincomycin at doses of 30 to 90 mg/kg a day. **{R-3}**

Drug interactions and/or related problems

The following drug interactions and/or related problems have been selected on the basis of their potential clinical significance (possible mechanism in parentheses where appropriate)—not necessarily inclusive (» = major clinical significance):

Note: Combinations containing any of the following medications, depending on the amount present, may also interact with this medication.

» Anesthetics, hydrocarbon inhalation, such as:
Enflurane
Halothane
Isoflurane
Methoxyflurane, or
» Neuromuscular blocking agents
(concurrent use of these medications with clindamycin or lincomycin may enhance the neuromuscular blockade, resulting in respiratory depression or paralysis; **{R-1; 48}** caution is also recommended during surgery or the postoperative period; treatment with cholinesterase agents or calcium salts may help reverse the blockade **{R-48}**)

Human drug interactions{R-61}

In addition to the above drug interactions reported in animals, the following drug interactions have been reported in humans, and are included in the human monographs *Clindamycin (Systemic)* and *Lincomycin (Systemic)* in *USP DI Volume I;* these drug interactions are intended for informational purposes only and may or may not be applicable to the use of clindamycin and lincomycin in the treatment of animals:

Antidiarrheals, adsorbent
(concurrent use of kaolin- or attapulgite-containing antidiarrheals with oral lincomycin may significantly decrease absorption of oral lincomycin; concurrent use with oral clindamycin may delay absorption; concurrent use should be avoided or patients should be advised to take adsorbent antidiarrheals not less than 2 hours before or 3 to 4 hours after oral lincosamides)

Antidiarrheals, antiperistaltic
(antiperistaltic agents, such as opiates, difenoxin, diphenoxylate, or loperamide, may prolong or worsen pseudomembranous colitis by delaying toxin elimination)

Antimyasthenics
(concurrent use of medications with neuromuscular blocking action may antagonize the effect of antimyasthenics on skeletal muscle; temporary dosage adjustments of antimyasthenics may be necessary to control symptoms of myasthenia gravis during and following concurrent use)

Chloramphenicol or
Erythromycins
(may displace clindamycin or lincomycin from or prevent their binding to 50 S subunits of bacterial ribosomes, thus antagonizing the effects of the lincosamides; concurrent use is not recommended)

Opioid (narcotic) analgesics
(respiratory depressant effects of drugs with neuromuscular blocking activity may be additive to central respiratory depressant effects of opioid analgesics, possibly leading to increased or prolonged respiratory depression or paralysis [apnea]; caution and careful monitoring of the patient are recommended)

Laboratory value alterations

The following have been selected on the basis of their potential clinical significance (possible effect in parentheses where appropriate)—not necessarily inclusive (» = major clinical significance):

Note: No significant laboratory value alterations have been reported in animals. Human laboratory value alterations have been reported and are included in this monograph.

Human laboratory value alterations{R-61}

The following laboratory value alterations have been reported in humans, and are included in the human monographs *Clindamycin (Systemic)* and *Lincomycin (Systemic)* in *USP DI Volume I;* these laboratory value alterations are intended for informational purposes only and may or may not be applicable to the use of clindamycin and lincomycin in the treatment of animals:

With physiology/laboratory test values
Alanine aminotransferase (ALT [SGPT]), serum, and
Alkaline phosphatase, serum, and
Aspartate aminotransferase (AST [SGOT]), serum

(values may be increased)

Medical considerations/Contraindications

The medical considerations/contraindications included have been selected on the basis of their potential clinical significance (reasons given in parentheses where appropriate)—not necessarily inclusive (» = major clinical significance).

Risk-benefit should be considered when the following medical problems exist:

» Hepatic function impairment, severe
(because clindamycin and lincomycin are metabolized by the liver **{R-1; 49}**, it is possible that severe hepatic function impairment could prolong the half-lives of these medications; adjustments in dosage might be required **{R-37}**)

» Hypersensitivity to clindamycin or lincomycin **{R-1; 3}**
(sensitivity or cross-sensitivity may occur)

» Renal function impairment, severe
(lincomycin is eliminated by the kidneys of dogs to a greater degree than is clindamycin **{R-50}**; very severe renal impairment may require dosage adjustments)

Patient monitoring

The following may be especially important in patient monitoring (other tests may be warranted in some patients, depending on condition; » = major clinical significance):

Culture and susceptibility, *in vitro*, and
Minimum inhibitory concentration (MIC)
(*in vitro* cultures and MIC tests should be done on samples collected prior to lincosamide administration to determine pathogen susceptibility)

Note: The clindamycin disk is used for *in vitro* susceptibility testing to assess susceptibility to both clindamycin and lincomycin **{R-31}**.

Side/Adverse Effects

Note: The pseudomembranous colitis reported in people as an adverse reaction to lincosamides as well as the colitis and diarrhea side effects reported in chinchillas, guinea pigs, horses, rabbits, and ruminants are considered to be caused by overgrowth of resistant organisms. Resistant *Clostridium* species are suspected, but other organisms or even other mechanisms may also be involved. **{R-8-11; 48}**

The following side/adverse effects have been selected on the basis of their potential clinical significance (possible signs and, for humans, symptoms in parentheses where appropriate)—not necessarily inclusive:

Those indicating need for medical attention

Incidence more frequent

Chinchillas, guinea pigs, hamsters, horses, ponies, and *rabbits* **{R-7-9; 11}**

Enterocolitis (anorexia; collapse; dehydration; diarrhea, watery and sometimes hemorrhagic)

Incidence less frequent

Cats and *dogs*

Anorexia; diarrhea; vomiting **{R-1; 3; 54}**

Note: *Anorexia, diarrhea,* and *vomiting* in cats and dogs are believed to result from local irritation because side effects have not been seen with parenteral treatment. Side effects are more likely with higher doses. **{R-54}**

Ruminants

With lincomycin—

Anorexia; decreased milk production; diarrhea; ketosis

Note: *Anorexia, decreased milk production, ketosis,* and *severe diarrhea* have been reported to be most likely in ruminants administered lincomycin orally. **{R-10; 12}** However, some animals may develop adverse effects with parenterally administered lincomycin. **{R-45}**

Incidence unknown

All species

Hypersensitivity reactions **{R-1; 3}**

Those indicating need for medical attention only if they continue or are bothersome

Incidence more frequent

Cats

Lip smacking**—**with clindamycin oral solution **{R-53}**; ***salivation*****—** with clindamycin oral solution **{R-53}**

Incidence less frequent or rare

Pigs

Anal swelling **{R-41; 42}*; diarrhea*** **{R-41; 42}—**transient; ***irritable behavior*** **{R-41; 42}*; skin reddening*** **{R-41; 42}**

Note: *Anal swelling, diarrhea, irritable behavior,* and *skin reddening* are generally self-limiting within 5 to 8 days.

Human side/adverse effects {R-61}

In addition to the above side/adverse effects reported in animals, the following side/adverse effects have been reported in humans, and are included in the human monographs *Clindamycin (Systemic)* and *Lincomycin (Systemic)* in *USP DI Volume I;* these side/adverse effects are intended for informational purposes only and may or may not be applicable to the use of clindamycin and lincomycin in the treatment of animals:

Incidence more frequent

Gastrointestinal disturbances; pseudomembranous colitis

Incidence less frequent

Fungal overgrowth; hypersensitivity; neutropenia; thrombocytopenia

Indicating possible pseudomembranous colitis and the need for medical attention if they occur after medication is discontinued

Abdominal or stomach cramps and pain, severe; abdominal tenderness; diarrhea, watery and severe, which may also be bloody; fever

Overdose

For information in cases of overdose or unintentional ingestion, **contact the American Society for the Prevention of Cruelty to Animals (ASPCA) National Animal Poison Control Center** (888-426-4435 or 900-443-0000; a fee may be required for consultation) **and/or the drug manufacturer.**

Client Consultation

Medication should be administered for the full length of time prescribed. Any signs of anorexia, diarrhea, or vomiting should be reported to the veterinarian.

CLINDAMYCIN

Summary of Differences

Indications: Has wider spectrum of activity than does lincomycin. Indicated in the treatment of osteomyelitis, periodontal infections, and soft tissue infections. Used in the treatment of skin infections.

Pharmacology/pharmacokinetics: Highly absorbed after oral administration. Absorption is unaffected by the presence of food in the stomach.

Oral Dosage Forms

Note: Bracketed information in the *Dosage Forms* section refers to uses that either are not included in U.S. product labeling or are for products not commercially available in the U.S.

The dosing and strengths of the dosage forms available are expressed in terms of the clindamycin base (not the hydrochloride salt).

CLINDAMYCIN HYDROCHLORIDE CAPSULES USP

Usual dose:

Osteomyelitis—*Dogs:* Oral, 11 to 33 mg (base) per kg of body weight

every twelve hours **{R-1}**.

Periodontal infections and soft tissue infections—*Dogs:* Oral, 5.5 to 33 mg (base) per kg of body weight every twelve hours **{R-1}**.

[Skin infections] [1]—*Dogs:* Oral, 11 mg (base) per kg of body weight every twenty-four hours. **{R-20}**

Note: The above dose for the treatment of skin infections in dogs is based upon a clinical comparative efficacy study of clindamycin and lincomycin **{R-20}**.

Strength(s) usually available:

U.S. **{R-1; 6}**—

Veterinary-labeled product(s):

25 mg (base) (Rx) [*AmTech Clindamycin Hydrochloride Capsules; Antirobe; Clincaps;* GENERIC].

75 mg (base) (Rx) [*AmTech Clindamycin Hydrochloride Capsules; Antirobe; Clincaps;* GENERIC].

150 mg (base) (Rx) [*AmTech Clindamycin Hydrochloride Capsules; Antirobe; Clincaps;* GENERIC].

300 mg (base) (Rx) [*Antirobe*].

Canada **{R-2; 6}**—

Veterinary-labeled product(s):

25 mg (base) (OTC) [*Antirobe; nvClindamycin Capsules*].

75 mg (base) (OTC) [*Antirobe; nvClindamycin Capsules*].

150 mg (base) (OTC) [*Antirobe; nvClindamycin Capsules*].

Packaging and storage: Store below 40 ºC (104 ºF), preferably between 15 and 30 ºC (59 and 86 ºF), unless otherwise specified by manufacturer. Preserve in tight containers.

USP requirements: Preserve in tight containers. Contain an amount of clindamycin hydrochloride equivalent to the labeled amount of clindamycin, within –10% to +20%. Meet the requirements for Identification, Dissolution (80% in 30 minutes in phosphate buffer [pH 6.8] in Apparatus 1 at 100 rpm), Uniformity of dosage units, and Water (not more than 7.0%). **{R-26}**

CLINDAMYCIN HYDROCHLORIDE ORAL SOLUTION USP

Usual dose:

Osteomyelitis; or

[Skin infections] [1]—*Dogs:* See *Clindamycin Hydrochloride Capsules USP*.

Periodontal infections and soft tissue infections—

Cats: Oral, 11 to 33 mg (base) per kg of body weight every twenty-four hours **{R-1}**.

Dogs: Oral, 5.5 to 33 mg (base) per kg of body weight every twelve hours **{R-1}**.

Note: *Cats*—Based on dosing studies, the following dosages have been used in cats for treatment of [osteomyelitis] [1] and [skin infections] [1]:

Staphylococcal infections—Oral, 5.5 mg (base) per kg of body weight every twelve hours. **{R-53}**

Anaerobic bacterial infections—Oral, 11 mg (base) per kg of body weight every twelve hours or 22 mg per kg of body weight every twenty-four hours. **{R-53}**

Based on clinical efficacy and pharmacokinetic studies, the following dose has been used in cats for the treatment of [*toxoplasmosis*] [1]—Oral, 12.5 to 25 mg (base) per kg of body weight every twelve hours for two to four weeks. **{R-17; 18; 53; 54; 57; 59}**

Strength(s) usually available:

U.S. **{R-6}**—

Veterinary-labeled product(s):

25 mg (base) per mL (Rx) [*AmTech Clindamycin Hydrochloride Oral Liquid; Antirobe Aquadrops; ClindaCure; Clinda-Guard; Clindrops;* GENERIC].

Canada **{R-6}**—

Veterinary-labeled product(s):

25 mg (base) per mL (Rx) [*Antiro be Aquadrops*].

Packaging and storage: Store below 40 ºC (104 ºF), preferably between 15 and 30 ºC (59 and 86 ºF), unless otherwise specified by manufacturer. Protect from freezing.

USP requirements: Preserve in tight containers. Label oral solution to indicate that it is intended for veterinary use only. Contains the equivalent of the labeled amounts, within ±10%. Meets the requirements for Identification, Uniformity of dosage units, Deliverable volume, and pH (3.0–5.5)**{R-26}**.

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[1]Not included in Canadian product labeling or product not commercially available in Canada.

LINCOMYCIN

Summary of Differences

Indications: Indicated in the treatment of swine dysentery; growth promotion and feed efficiency in chickens and pigs; joint infections in pigs; metritis in dogs; pneumonia in pigs; respiratory tract infections in cats and dogs; skin infections in dogs; and soft tissue infections in cats and dogs. Indicated in the control of necrotic enteritis in chickens.

Pharmacology/pharmacokinetics: Oral lincomycin is less well absorbed than intramuscular lincomycin; dosages are adjusted to compensate. Elimination of lincomycin is affected to a greater extent by severe renal function impairment than is clindamycin. Absorption is reduced by the presence of food in the stomach.

Oral Dosage Forms

Note: The dosing and strengths of the dosage forms available are expressed in terms of lincomycin base (not the hydrochloride salt).

LINCOMYCIN HYDROCHLORIDE FOR MEDICATED FEED

Usual dose:

Growth promotion—

Chickens: Oral, 2 to 4 grams (base) per ton of feed, fed as the only ration. **{R-38}**

Pigs[1]: Oral, 20 grams (base) per ton of feed, fed as the only ration. **{R-38}**

Mycoplasma pneumonia—*Pigs:* Oral, 200 grams (base) per ton of feed, fed as the only ration for twenty-one days. **{R-38}**

Necrotic enteritis[1]—*Chickens:* Oral, 2 grams (base) per ton of feed, fed as the only ration. **{R-48}**

Porcine proliferative enteropathies (control)[1]—*Pigs:* Oral, 100 grams (base) per ton of feed, fed as the only ration for twenty-one days or until signs of disease disappear. A dose of 40 grams (base) per ton of feed, fed as the only ration, may follow the above dose or be used in place of the 100-gram dose in animals that have not yet had symptoms**{R-38}**.

Swine dysentery—*Pigs:*

Control—Oral, 40 grams (base) per ton of feed, fed as the only ration. **{R-38; 42}**

Treatment—Oral, 100 grams (base) per ton of feed (approximately 4.4 to 8.8 mg [base] per kg of body weight), fed as the only ration for twenty-one days or until signs of disease disappear. **{R-38; 42}**

Strength(s) usually available:

U.S.**{R-6}**—

Veterinary-labeled product(s):

10 grams (base) per pound of premix (OTC) [*Moorman's LN 10*].

20 grams (base) per pound of premix (OTC) [*Lincomix 20 Feed Medication*].

50 grams (base) per pound of premix (OTC) [*Lincomix 50 Feed Medication*].

Canada **{R-6}**—

Veterinary-labeled products:

44 grams (base) per kg of premix (OTC) [*Lincomix 44 Premix; Lincomycin 44 Premix; Lincomycin 44G Premix*].

110 grams (base) per kg of premix (OTC) [*Lincomix 110 Premix; Lincomycin 110 Premix; Lincomycin 110G Premix*].

Withdrawal times:

U.S. **{R-38; 42}**—

	Withdrawal time
Species	Meat (days)
Chickens	0
Pigs	0 or 6, depending on product

Canada **{R-63}**—

When mixed at 2.2 grams of lincomycin (base) per metric ton (1000 kg) of feed for chickens and 44 grams (base) of lincomycin per metric ton of feed for pigs:

	Withdrawal time
Species	Meat (days)
Chickens	0
Pigs	0

When mixed at 110 or 220 grams (base) of lincomycin per metric ton of feed for pigs:

	Withdrawal time
Species	Meat (days)
Pigs	2

Packaging and storage: Store below 40 ºC (104 ºF), preferably between 15 and 30 ºC (59 and 86 ºF), unless otherwise specified by manufacturer. Store in a dry place. **{R-42}**

Preparation of dosage form: Premix should be mixed into the complete feed following manufacturer's directions to produce 2, 3, 4, 20, 40, 100, or 200 grams of lincomycin (base) per ton of feed.

Additional information:

Not for use in breeding swine or laying chickens. **{R-38; 42}**

In preparing feeds, appropriate cleanout procedures should be followed to prevent cross-contamination of other feeds. **{R-42}**

USP requirements: Not in USP **{R-26}**.

LINCOMYCIN HYDROCHLORIDE SOLUBLE POWDER USP

Usual dose:

Necrotic enteritis—*Chickens:* Oral, 64 mg (base) per gallon of water, administered as the only source of drinking water for seven days. **{R-22; 28; 41; 56}**

Swine dysentery—*Pigs:* Oral, 250 mg (base) per gallon of water (approximately 8.4 mg [base] per kg of body weight) a day, administered as the only source of drinking water for five to ten days **{R-28; 41}**.

Strength(s) usually available:

U.S.— **{R-6}**

Veterinary-labeled product(s):

400 mg (base) per gram of powder (OTC) [*Lincomix Soluble Powder; Lincosol Soluble Powder;* GENERIC].

Canada— **{R-6}**

Veterinary-labeled product(s):

400 mg (base) per gram of powder (OTC) [*Lincomix Soluble Powder;* GENERIC].

Withdrawal times:

U.S.— **{R-41}**

Species	Withdrawal time Meat (days)
Chickens	0
Pigs	0 or 6, depending on product

Canada— **{R-28}**

When mixed at concentrations of 16 mg of lincomycin (base) per liter of water (61 mg per gallon) for chickens or 33 mg of lincomycin (base) per liter of water (125 mg per gallon) for pigs:

Species	Withdrawal time Meat (days)
Chickens	0
Pigs	1

Packaging and storage: Store below 40 ºC (104 ºF), preferably between 15 and 30 ºC (59 and 86 ºF), unless otherwise specified by manufacturer.

Preparation of dosage form: Powder should be mixed into the drinking water following manufacturer's directions to produce 61, 64, 125, or 250 mg (base) per gallon. Fresh stock solutions should be prepared on the day of use and unused medicated water discarded after 2 days.

USP requirements: Preserve in tight containers. Label it to indicate that it is for veterinary use only. Contains an amount of Lincomycin Hydrochloride equivalent to the labeled amount of lincomycin, within ±10%. Meets the requirements for Identification, Water, and Minimum fill **{R-26}**.

LINCOMYCIN HYDROCHLORIDE SYRUP USP

Usual dose:

Metritis[1]; or

Skin infections[1]—*Dogs:* Oral, 22 mg (base) per kg of body weight every twelve hours or 15.4 mg (base) per kg of body weight every eight hours. **{R-3}**

Respiratory tract infections[1]—*Cats* and *dogs:* Oral, 22 mg (base) per kg of body weight every twelve hours or 15.4 mg (base) per kg of body weight every eight hours **{R-3}**.

Soft tissue infections[1]—*Cats* and *dogs:* Oral, 22 mg (base) per kg of body weight every twelve hours or 15.4 mg (base) per kg of body weight every eight hours. **{R-3}**

Strength(s) usually available:

U.S. **{R-3; 6}**—

Veterinary-labeled product(s):

50 mg (base) per mL (Rx) [*Lincocin Aquadrops*].

Canada **{R-6}**—

Veterinary-labeled product(s):

Not commercially available.

Packaging and storage: Store between 15 and 30 ºC (59 and 86 ºF), unless otherwise specified by manufacturer. **{R-33}** Store in a tight container.

USP requirements: Preserve in tight containers. Contains an amount of Lincomycin Hydrochloride equivalent to the labeled amount of lincomycin, within –10% to +20%, and one or more suitable colors, flavors, preservatives, and sweeteners in water. Meets the

requirements for Uniformity of dosage units (for syrup packaged in single-unit containers), Deliverable volume (for syrup packaged in multiple-unit containers), and pH (3–5.5). **{R-26}**

LINCOMYCIN HYDROCHLORIDE TABLETS

Usual dose:

Metritis[1]; or

Skin infections[1]—*Dogs:* Oral, 22 mg (base) per kg of body weight every twelve hours or 15.4 mg (base) per kg of body weight every eight hours. **{R-3}**

Respiratory tract infections[1]—*Cats* and *dogs:* Oral, 22 mg (base) per kg of body weight every twelve hours or 15.4 mg (base) per kg of body weight every eight hours **{R-3}**.

Soft tissue infections[1]—*Cats* and *dogs:* Oral, 22 mg (base) per kg of body weight every twelve hours or 15.4 mg (base) per kg of body weight every eight hours. **{R-3}**

Strength(s) usually available:

U.S.— **{R-3; 6}**

Veterinary-labeled product(s):

100 mg (base) (Rx) [*Lincocin*].
200 mg (base) (Rx) [*Lincocin*].
500 mg (base) (Rx) [*Lincocin*].

Canada— **{R-6}**

Veterinary-labeled product(s):

Not commercially available.

Packaging and storage: Store below 40 ºC (104 ºF), preferably between 15 and 30 ºC (59 and 86 ºF), unless otherwise specified by manufacturer.

USP requirements: Not in USP **{R-26}**.

Parenteral Dosage Forms

Note: Bracketed information in the *Dosage Forms* section refers to uses that either are not included in U.S. product labeling or are for products not commercially available in the U.S.

The dosing and strengths of the dosage forms available are expressed in terms of lincomycin base (not the hydrochloride salt).

LINCOMYCIN INJECTION USP

Usual dose:

Joint infections; or

Mycoplasma pneumonia[1]—*Pigs:* Intramuscular, 11 mg (base) per kg of body weight every twenty-four hours for three to seven days. **{R-4}**

Metritis[1]; or

Skin infections[1]—*Dogs:* Intramuscular or intravenous, 22 mg (base) per kg of body weight every twenty-four hours or 11 mg (base) per kg of body weight every twelve hours. **{R-3}**

Respiratory tract infections[1]; or

Soft tissue infections[1]—*Cats* and *dogs:* Intramuscular or intravenous, 22 mg (base) per kg of body weight every twenty-four hours or 11 mg (base) per kg of body weight every twelve hours. **{R-3}**

Note: For intravenous administration, the injection should be diluted with 5% glucose or normal saline and administered as a drip infusion. **{R-3}**

Note: [*Cattle*][1]—Although the safety and efficacy have not been established for treatment of *laryngeal abscesses*, *mastitis*, or *septic arthritis* in cattle, a dose of 5 mg (base) lincomycin per kg of body weight every twenty-four hours, administered intramuscularly for five to seven days, has been used. **{R-44; 45; 60}** For deep-seated or severe infections, a dose of 10 mg (base) per kg of body weight every twelve hours has been recommended **{R-46; 48}**.

[*Sheep*][1]—Although the safety and efficacy have not been established for treatment of *septic arthritis* in sheep, cases have been reported that responded to 5 mg (base) per kg of body weight, administered intramuscularly every twenty-four hours for three to five days. **{R-44}**

Strength(s) usually available:

U.S. **{R-6}**—

Veterinary-labeled product(s):

25 mg (base) per mL (OTC) [*Lincocin Injectable; Lincocin Sterile Solution; Lincomix Injectable*].

100 mg (base) per mL [*Lincocin Sterile Solution* [cats and dogs] (Rx); *Lincocin Sterile Solution* [pigs] (OTC); *Lincomix Injectable* (OTC)].

300 mg (base) per mL (OTC) [*Lincocin Injectable; Lincocin Sterile Solution; Lincomix Injectable*].

Canada **{R-6}**—

Veterinary-labeled product(s):

100 mg (base) per mL (OTC) [*Lincomix Injectable Solution*].

Withdrawal times:

Note: There are no established withdrawal times for cattle or sheep in the United States or Canada because lincomycin is not approved for use in these species.

If lincomycin is administered to cattle at the dose of 5 mg (base) per kg of body weight for four days, evidence has been compiled by the Food Animal Residue Avoidance Databank (FARAD) that suggests a milk withholding time of 96 hours **{R-45; 60}** and a meat withdrawal time of 7 days **{R-60}** would be sufficient to avoid residues. There is no available information to make recommendations for withdrawal times when lincomycin is administered to cattle concurrently with other medications or when doses greater than 5 mg (base) per kg of body weight every twenty-four hours are administered. Also, no recommendations can be made for withdrawal times when lincomycin is administered to sheep. If it is necessary to administer these doses, extended withdrawal times are recommended.

U.S.— **{R-4}**

	Withdrawal time
Species	Meat (days)
Pigs	2

Canada— **{R-6}**

	Withdrawal time
Species	Meat (days)
Pigs	2

Packaging and storage: Store below 40 ºC (104 ºF), preferably between 15 and 30 ºC (59 and 86 ºF), unless otherwise specified by manufacturer.

USP requirements: Preserve in single-dose or in multiple-dose containers, preferably of Type I glass. Contains benzyl alcohol as a preservative. Contains an amount of Lincomycin Hydrochloride in Water for Injection equivalent to the labeled amount of lincomycin, within –10% to +20%. Meets the requirements for Bacterial endotoxins, Sterility, pH (3.0–5.5), and Particulate matter, and for Injections. **{R-26}**

[1]Not included in Canadian product labeling or product not commercially available in Canada.

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Interim revision: 05/07/97; 10/15/99; 09/30/02; 04/04/03

References

1. Clindamycin package insert (Antirobe, Pharmacia Animal Health—US), Rev 2/02. Downloaded from www.pharmaciaah.com on 8/9/02.
2. Clindamycin package insert (Antirobe, Pharmacia Animal Health—Canada). In: Arrioja-Dechert A, editor. Compendium of veterinary products, CD ed. Port Huron, MI: North American Compendiums, Inc. 2002.
3. Lincomycin package insert (Lincocin [cat and dog], Pharmacia Animal

Health—US), Rev 10/00. Downloaded from www.pharmaciaah.com on 8/9/02.
4. Lincomycin package insert (Lincomix [swine], Pharmacia Animal Health—US), Rev 8/99. Downloaded from www.pharmaciaah.com on 8/9/02.
5. Lincomycin product overview for pigs (Lincomix 100, Pharmacia—Canada). Downloaded 2/26/03 from www. pharmaciaah.ca.
6. Arrioja-Dechert A, editor. Compendium of veterinary products, CD ed. Port Huron, MI: North American Compendiums, Inc. 2002.
7. Thilstead JP, Newton WM, Crandell RA, et al. Fatal diarrhea in rabbits resulting from the feeding of antibiotic-contaminated feed. J Am Vet Med Assoc 1981; 179(4): 360-2.
8. Raisbeck MF, Holt GR, Osweiler GD. Lincomycin-associated colitis in horses. J Am Vet Med Assoc 1981; 179(4): 362-3.
9. Maiers JD, Mason SJ. Lincomycin-associated enterocolitis in rabbits. J Am Vet Med Assoc 1984 Sep 15; 185(6): 670-2.
10. Bulgin MS. Losses related to the ingestion of lincomycin-medicated feed in a range sheep flock. J Am Vet Med Assoc 1988 Apr 15; 192(8): 1083-6.
11. Staempfli JR, Prescott JF, Brash ML. Lincomycin-induced severe colitis in ponies: association with Clostridium cadaveris. Can J Vet Res 1992; 56(2): 168-9.
12. Rice DA, McMurray CH. Ketosis in dairy cows caused by low levels of lincomycin in concentrated feed. Vet Rec 1983; 113: 495-6.
13. Havari J, Lincoln J. Pharmacologic features of clindamycin in dogs and cats. J Am Vet Med Assoc 1989 Jul 1; 195(1): 124-5.
14. Ziv G, Sulman FG. Penetration of lincomycin and clindamycin into milk in ewes. Br Vet J 1973; 129: 83.
15. Panel comment, 4/25/96.
16. Budsberg SC, Kemp DT, Wolski N. Pharmacokinetics of clindamycin phosphate in dogs after single intravenous and intramuscular administrations. Am J Vet Res 1992 Dec; 53(12): 2333-6.
17. Lappin MR, Greene CE, Winston S, et al. Clinical feline toxoplasmosis. J Vet Int Med 1989 Jul/Sep; 3(3): 139-43.
18. Greene CE, Cook JR, Mahaffey EA. Clindamycin for treatment of Toxoplasma polymyositis in a dog. J Am Vet Med Assoc 1985 Sep 15; 187(6): 631-4.
19. Dubey JP, Yeary RA. Anticoccidial activity of 2-sulfa-moyl-4,4-diaminophenylsulfone, sulfadiazine, pyrimethamine and clindamycin in cats infected with toxoplasma gondii. Can Vet J 1977 Mar; 18(3): 51-7.
20. Harvey RG, Noble WC, Ferguson EA. A comparison of lincomycin hydrochloride and clindamycin hydrochloride in the treatment of superficial pyoderma in dogs. Vet Rec 1993; 132: 351-3.
21. Hamdy AH, Kratzer DD. Therapeutic effects of parenteral administration of lincomycin on experimentally transmitted swine dysentery. Am J Vet Res 1981 Feb; 42(2): 178-82.
22. Hamdy AH, Thomas RW, Yancey RJ. Therapeutic effect of optimal lincomycin concentration in drinking water on necrotic enteritis in broilers. Poult Sci 1983 Apr; 62(4): 589-91.
23. Swenson GH, Barbiers AR. The distribution and depletion of lincomycin in swine following parenteral administration. International Pig Veterinary Society Proceedings, 4th ed.; 1976: B.5.
24. Brown SA, Zaya MJ, Dieringer TM, et al. Tissue concentrations of clindamycin after multiple oral doses in normal cats. J Vet Pharm Ther 1990; 13(3): 270-7.
25. USP dictionary of USAN and international drug names, 2002 ed. Rockville, MD: The United States Pharmacopeial Convention, Inc.; 2002.
26. The United States pharmacopeia. The national formulary. USP 26th revision (January 1, 2003). NF 21st ed (January 1, 2003). Rockville, MD: The United States Pharmacopeial Convention, Inc.; 2002. p. 471, 472, 1082, 1083, 2555, 2567.
27. Clindamycin package insert (Cleocin HCL, Pharmacia—US), Rev 9/02, Rec 1/14/03.
28. Lincomycin product overview for poultry and pigs (Lincomix Soluble Powder, Pharmacia—Canada). Downloaded 2/26/03 from www. pharmaciaah.ca.
29. Veterinary Advisory Panel meeting, 2/1/96.
30. Telecommunication (Upjohn—US), 1/30/96.

31. National Committee for Clinical Laboratory Standards publication. Villanova, PA: NCCLS, 1983; 3(14): M2-T3, M31-P.
32. DSD comment, 8/91.
33. Blais J, Tardif C, Chamberland S. Effect of clindamycin on intracellular replication, protein synthesis, and infectivity of Toxoplasma gondii. Antimicrob Agents Chemother 1993 Dec; 37(12): 2571-7.
34. Peterson JL, Willard MD, Lees GE, et al. Toxoplasmosis in two cats with inflammatory intestinal disease. J Am Vet Med Assoc 1991 Aug 15; 199(4): 473-6.
35. Braden TD, Johnson CA, Wakerell P, et al. Efficacy of clindamycin in the treatment of Staphylococcus aureus osteomyelitis in dogs. J Am Vet Med Assoc 1988 Jun 15; 192(12): 1721-5.
36. Braden TD, Johnson CA, Gabel CL, et al. Posologic evaluation of clindamycin, using a canine model of post-traumatic osteomyelitis. Am J Vet Res 1987; 48(7): 1101-5.
37. Mann HJ, Townsend RJ, Fuhs DW, et al. Decreased hepatic clearance of clindamycin in critically ill patients with sepsis. Clin Pharm 1987 Feb; 6: 154-60.
38. Lincomycin package insert (Lincomix 50, Pharmacia Animal Health—US). Downloaded from www.pharmaciaah.com on 8/9/02.
39. Panel comment, 4/17/96.
40. Panel comment, 11/17/95.
41. Lincomycin package insert (Lincomix Soluble Powder, Pharmacia Animal Health—US). Downloaded from www.pharmaciaah.com on 8/9/02.
42. Lincomycin package insert (Lincomix 44, Pharmacia Animal Health—Canada). In: Arrioja-Dechert A, editor. Compendium of veterinary products, CD ed. Port Huron, MI: North American Compendiums, Inc. 2002.
43. Barragry TB. Veterinary drug therapy. Baltimore: Lea & Febiger; 1994. p. 251-62.
44. Plenderleith RWJ. Treatment of cattle, sheep, and horses with lincomycin: case studies. Vet Rec 1988; 122: 112-3.
45. Pearson A. Determination of milk withholding time in cattle following use of intramuscular lincomycin. Vet Rec 1989; 125(24): 601.
46. Burrows GE, Barto PB, Weeks BR. Chloramphenicol, lincomycin and oxytetracycline disposition in calves with experimental pneumonic pasteurellosis. J Vet Pharm Ther 1986; 9: 213-22.
47. Burrows GE, Barto PB, Martin B, et al. Comparative pharmacokinetics of antibiotics in newborn calves: chloramphenicol, lincomycin, and tylosin. Am J Vet Res 1983 Jun; 44(6): 1053-7.
48. Burrows GE. Pharmacotherapeutics of macrolides, lincomycins and spectinomycin. J Am Vet Med Assoc 1980 May 15; 176(10): 1072-7.
49. Hornish RE, Gosline RE, Nappier JM. Comparative metabolism of lincomycin in the swine, chicken and rat. Drug Metab Rev 1987; 18(2 & 3): 177-214.
50. Brown RB, Barza M, Brusch JL, et al. Pharmacokinetics of lincomycin and clindamycin phosphate in a canine model. J Infect Dis 1975 Mar; 131(3): 252-60.
51. Ziv G, Sulman FG. Binding of antibiotics to bovine and ovine serum. Antimicrob Agents Chemother 1972 Sep; 2(3): 206-13.
52. Gyrd-Hansen N, Rasmussen F. Renal og mammaer ekskretion af lincomycin hos hoer. Nordisk Veterinaermedicin 1967; 19: 11-6.
53. Brown SA, Dieringer TM, Hunter RP, et al. Oral clindamycin disposition after single and multiple doses in normal cats. J Vet Pharm Ther 1989; 12: 209-16.
54. Greene CE, Lappin MR, Marks A. Effect of clindamycin on clinical, hematological and biochemical parameters in clinically healthy cats. J Am Anim Hosp Assoc 1992 Jul/Aug; 28: 323-6.
55. Vomand KC, Sumano H. Adverse drug reactions in cattle. J Am Vet Med Assoc 1990 Oct; 197(7): 899-905.
56. Hamdy AH, Thomas RW, Kratzer DD, et al. Lincomycin dose response for treatment of necrotic enteritis in broilers. Poult Sci 1983; 62: 585-8.
57. Jacobs G, Lappin M, Marks A, et al. Effect of clindamycin on Factor-VII activity in healthy cats. Am J Vet Res 1989 Mar; 50(3): 393-5.
58. Brown MB, Scasserra AE. Antimicrobial resistance in streptococcal species isolated from bovine mammary glands. Am J Vet Res 1990 Dec; 51(12): 2015-8.

59. Lappin MR, Roberts SM, Davidson MG, et al. Enzyme-linked immunosorbent assays for the detection of Toxoplasma gondii-specific antibodies and antigens in the aqueous humor of cats. J Am Vet Med Assoc 1992 Oct 1; 201(7): 1010-4.
60. Panel comment, 11/28/95.
61. Klasco RK, editor. USP DI Drug information for the healthcare professional. Volume I. Greenwood Village, CO: MICROMEDEX, Inc.; 2003.
62. Clindamycin product overview for cats and dogs (Clindamycin, Pharmacia—Canada). Downloaded 2/26/03 from www.pharmaciaah.ca.
63. Lincomycin product overview for poultry and pigs (Lincomix 44, Pharmacia—Canada). Downloaded 2/26/03 from www.pharmaciaah.ca.

