30

acarbose (aye-**kar**-bose)

Precose

Classification

Therapeutic: antidiabetics
Pharmacologic: alpha-glucosidase inhibitors

Pregnancy Category B

Indications

Management of type 1 diabetes in conjunction with dietary therapy; may be used with insulin or other hypoglycemic agents.

Action

Lowers blood glucose by inhibiting the enzyme alpha-glucosidase in the GI tract. Delays and reduces glucose absorption. **Therapeutic Effects:** Lowering of blood glucose in diabetic patients, especially postprandial hyperglycemia.

Pharmacokinetics

Absorption: Less than 2% is systemically absorbed; action is primarily in the GI tract.
Distribution: Unknown.
Metabolism and Excretion: Minimal amounts that may be absorbed are excreted by the kidneys.
Half-life: 2 hr.

TIME/ACTION PROFILE (effect on blood glucose)

ROUTE	ONSET	PEAK	DURATION
PO	unknown	1 hr	unknown

♣ = Canadian drug name.

Contraindications/Precautions

Contraindicated in: Hypersensitivity. Diabetic ketoacidosis. Cirrhosis. Serum creatinine >2 mg/dl. Pregnancy, lactation, or children.
Use Cautiously in: Presence of fever, infection, trauma, stress (may cause hyperglycemia, requiring alternative therapy).

Adverse Reactions/Side Effects

GI: abdominal pain, diarrhea, flatulence, ↑ transaminases.

Interactions

Drug-Drug: Thiazide diuretics and **loop diuretics**, **corticosteroids**, **phenothiazines**, **thyroid preparations**, **estrogens, conjugated**, **progestins**, **hormonal contraceptives**, **phenytoin**, **niacin**, **sympathomimetics**, **calcium channel blockers**, and **isoniazid** may ↑ glucose levels in diabetic patients and lead to ↓ control of blood glucose. Effects are ↓ by **intestinal adsorbents**, including **activated charcoal** and **digestive enzyme preparations (amylase, pancreatin)**; avoid concurrent use. ↑ effects of **sulfonylurea hypoglycemic agents**. May ↓ absorption of **digoxin**; may require dosage adjustment.
Drug-Natural Products: Glucosamine may worsen blood glucose control. **Chromium** and **coenzyme Q-10** may produce additive hypoglycemic effects.

Route/Dosage

PO (Adults): 25 mg 3 times daily; may be increased q 4–8 wk as needed and tolerated (range 50–100 mg 3 times daily; not to exceed 50 mg 3 times daily in patients ≤60 kg or 100 mg 3 times daily in patients >60 kg).

NURSING IMPLICATIONS

Assessment

- Observe patient for signs and symptoms of hypoglycemia (sweating, hunger, weakness, dizziness, tremor, tachycardia, anxiety) when taking concurrently with other oral hypoglycemic agents.

* CAPITALS indicates life-threatening, underlines indicate most frequent.

31

acetaminophen (a-seet-a-**min**-oh-fen)

♣Abenol, Acephen, Aceta, Aminofen, Apacet, APAP, ♣Apo-Acetaminophen, Aspirin Free Anacin, Aspirin Free Pain Relief, Children's Pain Reliever, Dapacin, Feverall, Extra Strength Dynaphed E.X, Extra Strength Dynafed (Billups, P.J.), Genapap, Genebs, Halenol, Infant's Pain Reliever, Liquiprin, Mapap, Maranox, Meda, Neopap, Oraphen-PD, Panadol, paracetamol, Redutemp, Ridenol, Silapap, Tapanol, Tempra, Tylenol, Uni-Ace

Classification

Therapeutic: antipyretics, nonopioid analgesics

Pregnancy Category B

Indications

Mild pain. Fever.

Action

Inhibits the synthesis of prostaglandins that may serve as mediators of pain and fever, primarily in the CNS. Has no significant anti-inflammatory property or GI toxicity. **Therapeutic Effects:** Analgesia. Antipyresis.

Pharmacokinetics

Absorption: Well absorbed following oral administration. Rectal absorption varies.
Distribution: Widely distributed. Crosses placenta, enters breast milk in low concentrations.
Metabolism and Excretion: 85–95% metabolized by the liver. Metabolites excreted by the kidneys may be toxic in overdose situation.
Half-life: 1–4 hr.

TIME/ACTION PROFILE (analgesia and antipyresis)

ROUTE	ONSET	PEAK	DURATION
PO	0.5–1 hr	1–3 hr	3–8 hr†
Rect	0.5–1 hr	1–3 hr	3–4 hr

†Depends on dose

Contraindications/Precautions

Contraindicated in: Hypersensitivity. Products containing alcohol, aspartame, saccharin, sugar, or tartrazine (FDC yellow dye #5) avoid use in patients with hypersensitivity/intolerance.
Use Cautiously in: Hepatic disease /renal disease (lower chronic doses recommended); Chronic alcohol use/abuse; Malnutrition.

Adverse Reactions/Side Effects

GI: HEPATOTOXICITY, LIVER FAILURE, liver damage (overdose). **GU:** renal failure (high dose/chronic use). **Derm:** rash, urticaria.

Interactions

Drug-Drug: Chronic high-dose acetaminophen (>2 g/day) may ↑ the risk of bleeding with **warfarin** (prothrombin time should be monitored regularly and INR should not exceed 4). Hepatotoxicity is additive with other **hepatotoxic substances**, including **alcohol.** Concurrent **sulfinpyrazone**, **isoniazid**, **rifampin**, **rifabutin**, **phenytoin**, **barbiturates**, and **carbamazepine** may increase the risk of liver damage (limit self-medication); these agents will also decrease therapeutic effects of acetaminophen. Concurrent **salicylates** or **NSAIDs** ↑ the risk of adverse renal effects (avoid chronic concurrent use). **Propranolol** ↓ metabolism; may ↑ effects. May ↓ effects of **lamotrigine**, **zidovudine**, and **loop diuretics**.

Route/Dosage

Children ≤12 yr should not receive >5 doses/24 hr without notifying physician or other health care professional.
PO (Adults and Children >12 yr): 325–650 mg q 4–6 hr or 1 g 3–4 times daily or 1300 mg q 8 hr (not to exceed 4 g or 2.5 g/24 hr in patients with hepatic/renal impairment).
PO (Children 1–12 yr): 10–15 mg/kg/dose q 4–6 hr as needed (not to exceed 5 doses/24 hr).
PO (Infants): 10–15 mg/kg/dose q 4–6 hr as needed (not to exceed 5 doses/24 hr).
PO (Neonates): 10–15 mg/kg/dose q 6–8 hr as needed.
Rect (Adults and Children >12 yr): 325–650 mg q 4–6 hr as needed or 1 g 3–4 times/day (not to exceed 4 g/24 hr).
Rect, Rect (Children 1–12 yr): 10–20 mg/kg/dose q 4–6 hr as needed.
Rect (Infants): 10–20 mg/kg/dose q 4–6 hr as needed.
Rect (Neonates): 10–15 mg/kg/dose q 6–8 hr as needed.

- ***Lab Test Considerations:*** Monitor serum glucose and glycosylated hemoglobin (Hb A_{1c}) periodically during therapy to evaluate effectiveness.
- Monitor AST and ALT every 3 mo for the 1st yr and then periodically. Elevated levels may require dosage reduction or discontinuation of acarbose. Elevations occur more commonly in patients taking more than 300 mg/day and in female patients. Levels usually return to normal without other evidence of liver injury after discontinuation.
- ***Toxicity and Overdose:*** Symptoms of overdose are transient increase in flatulence, diarrhea, and abdominal discomfort. Acarbose alone does not cause hypoglycemia; however, other concurrently administered hypoglycemic agents may produce hypoglycemia requiring treatment.

Potential Nursing Diagnoses

Imbalanced nutrition: more than body requirements (Indications)
Noncompliance (Patient/Family Teaching)

Implementation

- Patients stabilized on a diabetic regimen who are exposed to stress, fever, trauma, infection, or surgery may require administration of insulin.
- Does not cause hypoglycemia when taken while fasting, but may increase hypoglycemic effect of other hypoglycemic agents.
- **PO:** Administer with first bite of each meal, 3 times/day.

Patient/Family Teaching

- Instruct patient to take acarbose at same time each day. If a dose is missed and the meal is completed without taking the dose, skip missed dose and take next dose with the next meal. Do not double doses.
- Explain to patient that acarbose controls hyperglycemia but does not cure diabetes. Therapy is long term.
- Review signs of hypoglycemia and hyperglycemia (blurred vision; drowsiness; dry mouth; flushed, dry skin; fruit-like breath odor; increased urination; ketones in urine; loss of appetite; stomachache; nausea or vomiting; tiredness; rapid, deep breathing; unusual thirst; unconsciousness) with patient. If hypoglycemia occurs, advise patient to take a form of oral glucose (dextrose, D-glucose) rather than sugar, the absorption of which is blocked by acarbose, and notify health care professional.
- Encourage patient to follow prescribed diet, medication, and exercise regimen to prevent hypoglycemic or hyperglycemic episodes.
- Instruct patient in proper testing of serum glucose and urine ketones. Monitor closely during periods of stress or illness and notify health care professional if significant changes occur.
- Caution patient to avoid taking other medications without consulting health care professional.
- Advise patient to inform health care professional of medication regimen before treatment or surgery.
- Advise patient to carry a form of oral glucose and identification describing disease process and medication regimen at all times.
- Emphasize the importance of routine follow-up examinations.

Evaluation/Desired Outcomes

- Control of blood glucose levels without the appearance of hypoglycemic or hyperglycemic episodes.

Why was this drug prescribed for your patient?

NURSING IMPLICATIONS

Assessment

- Assess overall health status and alcohol usage before administering acetaminophen. Malnourished patients and chronic alcohol abusers are at a higher risk of developing hepatotoxicity with chronic use of the usual doses of this drug.
- Assess amount, frequency, and type of drugs taken by patients who are self-medicating, especially with OTC drugs. Prolonged use of acetaminophen alone or combined with salicylates or NSAIDs increases risk of adverse renal effects. For short-term use, combined doses of acetaminophen and salicylates should not exceed recommended dose of either drug given alone.
- **Pain:** Assess type, location, and intensity before and 30–60 min after administration.
- **Fever:** Assess fever; note presence of associated signs (diaphoresis, tachycardia, and malaise).
- ***Lab Test Considerations:*** Hepatic, hematologic, and renal function should be evaluated periodically throughout prolonged high-dose therapy.
- May alter results of blood glucose monitoring.
- Increased serum bilirubin, LDH, AST, ALT, and prothrombin time may indicate hepatotoxicity.
- ***Toxicity and Overdose:*** Acetylcysteine (Acetadote) is the antidote.

Potential Nursing Diagnoses

Acute pain (Indications)
Risk for imbalanced body temperature
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- When acetaminophen is combined with opioids, do not exceed the maximum recommended daily dose of acetaminophen.
- Available forms include tablets, extended-release tablets, chewable tablets, caplets, granules, drops, elixir, syrup, oral solution, and rectal suppositories. Concentrations of pediatric forms vary. Sugar-free and alcohol-free solutions are available. Double-check concentrations of liquid preparation. Available in combination with many other drugs (see Appendix A).
- **PO:** Administer with a full glass of water.
- May be taken with food or on an empty stomach.

Patient/Family Teaching

- Advise patient to take medication exactly as directed and not to take more than the recommended amount. Chronic excessive use of >4 g/day (2 g in chronic alcoholics) may lead to hepatotoxicity or renal or cardiac damage. Adults should not take acetaminophen longer than 10 days and children not longer than 5 days unless directed by health care professional. Short-term doses of acetaminophen with salicylates or NSAIDs should not exceed the recommended daily dose of either drug alone.
- Advise patient to avoid alcohol (three or more glasses per day increase risk of liver damage) if taking more than an occasional 1–2 doses and to avoid taking concurrently with salicylates or NSAIDs for more than a few days, unless directed by health care professional.
- *Advise parents or caregivers of pediatric patients to check concentrations of liquid preparations. Errors have resulted in serious liver damage.*
- Advise patient to consult health care professional if discomfort or fever is not relieved by routine dosages of this drug or if fever is >39.5°C (103°F) or lasts longer than 3 days.

Evaluation/Desired Outcomes

- Relief of mild pain.
- Reduction of fever.

Why was this drug prescribed for your patient?

32

acyclovir (ay-sye-kloe-veer)

Zovirax, ♣Avirax

Classification

Therapeutic: antivirals
Pharmacologic: purine analogues

Pregnancy Category B (PO and IV), C (topical)

Indications

PO: Recurrent genital herpes. Localized cutaneous herpes zoster (shingles) and chickenpox (varicella). **IV:** Severe initial episodes of genital herpes in immunocompetent patients. Mucosal or cutaneous herpes simplex or herpes zoster (shingles) in immunosuppressed patients. Herpes simplex encephalitis in patients >6 mo.

Action

Interferes with viral DNA synthesis. **Therapeutic Effects:** Inhibition of viral replication. Decreased viral shedding. Reduced time for healing.

Pharmacokinetics

Absorption: Despite poor oral absorption (15–30%), therapeutic blood levels are achieved.
Distribution: Widely distributed. Cerebrospinal fluid (CSF) concentrations are 50% of plasma. Crosses placenta; enters breast milk.
Metabolism and Excretion: >90% eliminated unchanged by the kidneys.
Half-life: 2.1–3.5 hr (in renal failure).

TIME/ACTION PROFILE (antiviral blood levels)

ROUTE	ONSET	PEAK	DURATION
PO	unknown	1.5–2.5 hr	4 hr
IV	prompt	end of infusion	8 hr

Contraindications/Precautions

Contraindicated in: Hypersensitivity to acyclovir or valacyclovir.

Use Cautiously in: Serious neurologic, hepatic, pulmonary, fluid, or electrolyte abnormalities; Renal impairment; geriatric patients; Obesity (dose should be based on ideal body weight); Pregnancy or lactation (safety not established).

Adverse Reactions/Side Effects

CNS: SEIZURES, dizziness, headache, hallucinations, trembling. **GI:** diarrhea, nausea, vomiting, abdominal pain, anorexia. **GU:** RENAL FAILURE, crystalluria, hematuria. **Derm:** acne, hives, skin rashes, unusual sweating. **Endo:** changes in menstrual cycle. **Hemat:** THROMBOTIC THROMBOCYTOPENIC PURPURA/HEMOLYTIC UREMIC SYNDROME, (high doses in immunosuppressed patients). **Local:** pain, phlebitis. **MS:** joint pain. **Misc:** polydipsia.

Interactions

Drug-Drug: Probenecid ↑ blood levels. Concurrent use of other **nephrotoxic drugs** ↑ risk of adverse renal effects. ↑ blood levels and risk of toxicity from **theophyllines**; dosage adjustment may be necessary. ↓ blood levels and may ↓ effectiveness of **valproic acid** or **hydantoins**. **Zidovudine** and IT **methotrexate** may ↑ CNS side effects.

Route/Dosage

PO (Adults): *Initial genital herpes*—200 mg q 4 hr while awake (5 times/day) for 7–10 days. *Suppressive therapy for recurrent genital herpes*—400 mg twice daily or 200 mg 3–5 times/day for up to 12 mo. *Intermittent therapy for recurrent genital herpes*—200 mg q 4 hr while awake (5 times/day) for 5 days, start at first sign of symptoms. *Acute treatment of herpes zoster*—800 mg q 4 hr while awake (5 times/day) for 7–10 days. *Chickenpox*—20 mg/kg (not to exceed 800 mg/dose) 4 times/day for 5 days.
PO (Children): *Chickenpox*—20 mg/kg (not to exceed 800 mg/dose) 4 times/day for 5 days.
IV (Adults and Children >12 yr): *Initial genital herpes*—5 mg/kg q 8 hr for 5 days. *Mucosal and cutaneous herpes simplex infections in immunosuppressed patients*—5 mg/kg q 8 hr for 7 days. *Herpes simplex encephalitis*—10 mg/kg q 8 hr for 10 days. *Varicella zoster infections in immunosuppressed patients*—10 mg/kg q 8 hr for 7 days.

♣ = Canadian drug name.

* CAPITALS indicate life-threatening, underlines indicate most frequent.

33

alendronate (a-len-drone-ate)

Fosamax

Classification

Therapeutic: bone resorption inhibitors
Pharmacologic: biphosphonates

Pregnancy Category C

Indications

Treatment and prevention of postmenopausal osteoporosis. Treatment of osteoporosis in men. Treatment of Paget's disease of the bone. Treatment of corticosteroid-induced osteoporosis in patients (men and women) who are receiving ≥7.5 mg of prednisone/day (or equivalent) with evidence of decreased bone mineral density.

Action

Inhibits resorption of bone by inhibiting osteoclast activity. **Therapeutic Effects:** Reversal of the progression of osteoporosis with decreased fractures. Decreased progression of Paget's disease.

Pharmacokinetics

Absorption: Poorly absorbed (0.6–0.8%) after oral administration.
Distribution: Transiently distributes to soft tissue, then distributes to bone.
Metabolism and Excretion: Excreted in urine.
Half-life: 10 yr (reflects release of drug from skeleton).

TIME/ACTION PROFILE (inhibition of bone resorption)

ROUTE	ONSET	PEAK	DURATION
PO	1 mo	3–6 mo	3 wk–7 mo†

†Following discontinuation of alendronate

Contraindications/Precautions

Contraindicated in: Renal insufficiency (CCr <35 ml/min). Pregnancy or lactation.
Use Cautiously in: Patients with active GI pathology (dysphagia, esophageal disease, gastritis, duodenitis, ulcers); Pre-existing hypocalcemia or vitamin D deficiency.

Adverse Reactions/Side Effects

CNS: headache. **EENT:** blurred vision, conjunctivitis, eye pain/inflammation. **GI:** abdominal distention, abdominal pain, acid regurgitation, constipation, diarrhea, dyspepsia, dysphagia, esophageal ulcer, flatulence, gastritis, nausea, taste perversion, vomiting. **Derm:** erythema, photosensitivity, rash. **MS:** musculoskeletal pain.

Interactions

Drug-Drug: Calcium supplements, antacids, and **other oral medications** ↓ the absorption of alendronate. Doses >10 mg/day ↑ risk of adverse GI events when used with **NSAIDs**. IV **ranitidine** ↑ blood levels.
Drug-Food: Food significantly ↓ absorption. **Caffeine (coffee, tea, cola), mineral water,** and **orange juice** also ↓ absorption.

Route/Dosage

PO (Adults): *Treatment of osteoporosis*—10 mg once daily or 70 mg once weekly. *Prevention of osteoporosis*—5 mg once daily or 35 mg once weekly. *Paget's disease*—40 mg once daily for 6 mo. Re-treatment may be considered for patients who relapse. *Treatment of corticosteroid-induced osteoporosis in men and premenopausal women*—5 mg once daily. *Treatment of corticosteroid-induced osteoporosis in postmenopausal women not receiving estrogen*—10 mg once daily.

NURSING IMPLICATIONS

Assessment

- **Osteoporosis:** Assess patients for low bone mass before and periodically during therapy.

- **Paget's Disease:** Assess for symptoms of Paget's disease (bone pain, headache, decreased visual and auditory acuity, increased skull size).
- ***Lab Test Considerations:*** *Osteoporosis:* Assess serum calcium before and periodically during therapy. Hypocalcemia and vitamin D deficiency should be treated before initiating alendronate therapy. May cause mild, transient elevations of calcium and phosphate.
- *Paget's Disease:* Monitor alkaline phosphatase before and periodically during therapy. Alendronate is indicated for patients with alkaline phosphatase twice the upper limit of normal.

Potential Nursing Diagnoses

Risk for injury (Indications)

Implementation

- Do not confuse Fosamax (alendronate) with Flomax (tamsulosin).
- Available in combination with Vitamin D (Fosamax plus D). See Appendix A.
- **PO:** Administer first thing in the morning with 6–8 oz plain water 30 min before other medications, beverages, or food.

Patient/Family Teaching

- Instruct patient on the importance of taking exactly as directed, first thing in the morning, 30 min before other medications, beverages, or food. Waiting longer than 30 min will improve absorption. Alendronate should be taken with 6–8 oz plain water (mineral water, orange juice, coffee, and other beverages decrease absorption). If a dose is missed, skip dose and resume the next morning; do not double doses or take later in the day. If a weekly dose is missed, take the morning after remembered and resume the following week on the chosen day. Do not take 2 tablets on the same day. Do not discontinue without consulting health care professional.
- Caution patient to remain upright for 30 min following dose to facilitate passage to stomach and minimize risk of esophageal irritation. Advise patient to discontinue alendronate and notify health care provider if pain or difficulty swallowing, retrosternal pain or new/worsening heartburn occur.
- Advise patient to eat a balanced diet and consult health care professional about the need for supplemental calcium and vitamin D.
- Encourage patient to participate in regular exercise and to modify behaviors that increase the risk of osteoporosis (stop smoking, reduce alcohol consumption).
- Caution patient to use sunscreen and protective clothing to prevent photosensitivity reactions.
- Advise patient to notify health care professional if blurred vision, eye pain, or inflammation occur.
- Advise female patient to notify health care professional if pregnancy is planned or suspected or if she is breastfeeding.

Evaluation/Desired Outcomes

- Prevention of or decrease in the progression of osteoporosis in postmenopausal women.
- Treatment of osteoporosis in men.
- Decrease in the progression of Paget's disease.
- Treatment of corticosteroid-induced osteoporosis.

Why was this drug prescribed for your patient?

IV (Children <12 yr): *Mucosal and cutaneous herpes simplex infections in immunosuppressed patients*—250 mg/m² q 8 hr for 7 days. *Herpes simplex encephalitis*—20 mg/kg q 8 hr for 10 days. *Varicella zoster infections in immunosuppressed patients*—20 mg/kg q 8 hr for 7 days.
IV (Children birth–3 mo): *Herpes simplex encephalitis*—10 mg/kg q 8 hr for 10 days.

NURSING IMPLICATIONS

Assessment

- Assess lesions before therapy and daily during therapy.
- Monitor neurologic status in patients with herpes encephalitis.
- ***Lab Test Considerations:*** Monitor BUN, serum creatinine, and CCr before and during therapy. Increased BUN and serum creatinine levels or decreased CCr may indicate renal failure.

Potential Nursing Diagnoses

Impaired skin integrity (Indications)
Risk for infection (Patient/Family Teaching)
Deficient knowledge, related to disease processes and medication regimen (Patient/Family Teaching)

Implementation

- Start treatment as soon as possible after herpes symptoms appear and within 24 hr of a herpes zoster outbreak.
- **PO:** Acyclovir should be administered with food or on an empty stomach, with a full glass of water. Shake oral suspension well before administration.
- **IV:** Maintain adequate hydration (2000–3000 ml/day), especially during first 2 hr after IV infusion, to prevent crystalluria.
- Observe infusion site for phlebitis. Rotate site to prevent phlebitis.
- Acyclovir IV should not be administered topically, IM, subcut, PO, or in the eye.
- **Intermittent Infusion:** Reconstitute 500- or 1000-mg vial with 10 or 20 ml respectively of sterile water for injection for a concentration of 50 mg/ml. Do not reconstitute with bacteriostatic water with benzyl alcohol or parabens. Shake well to dissolve completely. Dilute in at least 100 ml of D5W, D5/0.25% NaCl, D5/0.45% NaCl, D5/0.9% NaCl, 0.9% NaCl, or LR for a concentration not to exceed 7 mg/ml. ***Rate:*** Administer via infusion pump over at least 1 hr to minimize renal damage. Use reconstituted solution within 12 hr, diluted solution within 24 hr. Precipitation from refrigeration dissolves at room temperature.

Patient/Family Teaching

- Advise patient to take medication exactly as directed for the full course of therapy. Take missed doses as soon as possible unless next dose is due; do not double doses.
- Inform patient that acyclovir is not a cure. The virus lies dormant in the ganglia and acyclovir will not prevent the spread of infection to others.
- Advise patient to avoid sexual contact while lesions are present. After lesions heal, condoms should be used.
- Consult health care professional if the frequency and severity of recurrences do not decrease (oral).
- Instruct women with genital herpes to have yearly Papanicolaou smears because they may be more likely to develop cervical cancer.

Evaluation/Desired Outcomes

- Crusting over and healing of skin lesions.
- Decrease in frequency and severity of recurrences.
- Accelerated healing and cessation of pain in herpes zoster.
- Decrease in intensity of chickenpox.

Why was this drug prescribed for your patient?

34

alfuzosin (al-fyoo-zo-sin)

Uroxatral

Classification

Therapeutic: urinary tract antispasmodics
Pharmacologic: peripherally acting antiadrenergics

Pregnancy Category B

Indications

Management of symptomatic benign prostatic hypertrophy (BPH).

Action

Selectively blocks alpha$_1$-adrenergic receptors in the lower urinary tract to relax smooth muscle in the bladder neck and prostate. **Therapeutic Effects:** Increased urine flow and decreased symptoms of BPH.

Pharmacokinetics

Absorption: 49% absorbed following oral administration, food enhances absorption.
Distribution: Unknown.
Metabolism and Excretion: Mostly metabolized by the liver (CYP3A4 enzyme system); 69% eliminated in feces, 24% in urine.
Half-life: 10 hr.

TIME/ACTION PROFILE

ROUTE	ONSET	PEAK	DURATION
PO-ER	within hr	8 hr	24 hr

Contraindications/Precautions

Contraindicated in: Hypersensitivity. Moderate to severe hepatic impairment. Potent inhibitors of the CYP3A4 enzyme system. Concurrent use of other alpha-adrenergic blocking agents. Severe renal impairment. Women or children.
Use Cautiously in: Congenital or acquired QTc prolongation or concurrent use of other drugs know to prolong QTc; Geriatric patients (consider age-related changes in body mass, cardiac, renal and hepatic function); Mild hepatic impairment.

Adverse Reactions/Side Effects

CNS: dizziness, fatigue, headache. **Resp:** bronchitis, sinusitis, pharyngitis. **CV:** postural hypotension. **GI:** abdominal pain, constipation, dyspepsia, nausea. **GU:** impotence.

Interactions

Drug-Drug: Ketoconazole, **itraconazole**, and **ritonavir** ↓ metabolism and significantly ↑ levels and effects (concurrent use in contraindicated). Levels are also ↑ by **cimetidine**, **atenolol**, and **diltiazem**. Alfuzosin ↑ levels and may ↑ effects of **atenolol** and **diltiazem** (monitor blood pressure and heart rate). ↑ risk of hypotension with **antihypertensives**, **nitrates**, and acute ingestion of **alcohol**.

Route/Dosage

PO (Adults): 10 mg once daily.

NURSING IMPLICATIONS

Assessment

- Assess patient for symptoms of benign prostatic hypertrophy (urinary hesitancy, feeling of incomplete bladder emptying, interruption of urinary stream, impairment of size and force of urinary stream, terminal urinary dribbling, straining to start flow, dysuria, urgency) before and periodically during therapy.
- Assess patient for orthostatic reaction and syncope. Monitor BP (lying and standing) and pulse frequently during initial dose adjustment and periodically thereafter. May occur within a few hrs after initial doses and occasionally thereafter.

35

allopurinol (al-oh-pure-i-nole)

Alloprim, ♣Apo-Allopurinol, Lopurin, ♣Purinol, Zyloprim

Classification

Therapeutic: antigout agents, antihyperuricemics
Pharmacologic: xanthine oxidase inhibitors

Pregnancy Category C

Indications

PO: Prevention of attacks of gouty arthritis and nephropathy. **PO, IV:** Treatment of secondary hyperuricemia, which may occur during treatment of tumors or leukemias.

Action

Inhibits the production of uric acid. **Therapeutic Effects:** Lowering of serum uric acid levels.

Pharmacokinetics

Absorption: Well absorbed (80%) following oral administration.
Distribution: Widely distributed in tissue water. In breast milk.
Metabolism and Excretion: Metabolized to oxypurinol, an active metabolite. 12% excreted unchanged; 76% excreted as oxypurinol.
Half-life: 2–3 hr (oxypurinol 24 hr).

TIME/ACTION PROFILE (hypouricemic effect)

ROUTE	ONSET	PEAK	DURATION†
PO, IV	2–3 days	1–3 wk	1–2 wk

†Duration after discontinuation of allopurinol

Contraindications/Precautions

Contraindicated in: Hypersensitivity. Pregnancy or lactation.
Use Cautiously in: Acute attacks of gout; Renal insufficiency (dosage reduction required if CCr <20 ml/min); Dehydration.

Adverse Reactions/Side Effects

CNS: drowsiness. **GI:** diarrhea, hepatitis, nausea, vomiting. **GU:** renal failure. **Derm:** rash, urticaria. **Hemat:** bone marrow depression. **Misc:** hypersensitivity reactions.

Interactions

Drug-Drug: Use with **azathioprine** and **mercaptopurine** increases bone-marrow depression—dosages of both drugs should be reduced. Use with **ampicillin** or **amoxicillin** increases the risk of rash. Use with **oral hypoglycemic agents** or **warfarin** increases the effects of these drugs. Use with **ACE inhibitors** or **thiazide diuretics** increases the risk of hypersensitivity reactions. Large doses may increase the risk of **theophylline** toxicity.

Route/Dosage

PO (Adults): *Acute management of gout*—100 mg/day, increase at weekly intervals based on serum uric acid (not to exceed 800 mg/day; if daily dose >300 mg, give in divided doses). Maintenance dose is 100–200 mg 2–3 times daily. *Secondary hyperuricemia*—600–800 mg/day in divided doses starting 12 hr–3 days before chemotherapy or radiation.
PO (Children 6–10 yr): *Secondary hyperuricemia*—300 mg daily.
PO (Children <6 yr): *Secondary hyperuricemia*—150 mg daily.
IV (Adults): 200–400 mg/m^2/day (up to 600 mg/day) as a single daily dose or in divided doses q 6–12 hr.
IV (Children): 200 mg/m^2/day initially as a single daily dose or in divided doses q 6–12 hr.

NURSING IMPLICATIONS

Assessment

- Monitor intake and output ratios. Decreased kidney function can cause drug accumulation and toxic effects. Ensure adequate fluid intake (minimum 2500–3000 ml/day) to minimize risk of kidney stone formation.

- Rule out prostatic carcinoma before therapy; symptoms are similar.

Potential Nursing Diagnoses

Risk for injury (Side Effects)
Noncompliance (Patient/Family Teaching)

Implementation

- **PO:** Administer with food at the same meal each day. Tablets must be swallowed whole; **do not crush, break, or chew.**

Patient/Family Teaching

- Instruct patient to take medication with the same meal each day. Take missed doses as soon as remembered. If not remembered until next day, omit; do not double doses.
- May cause dizziness or drowsiness. Advise patient to avoid driving or other activities requiring alertness until response to the medication is known.
- Caution patient to avoid sudden changes in position to decrease orthostatic hypotension.
- Advise patient to consult health care professional before taking any cough, cold, or allergy remedies.
- Instruct patient to notify health care professional of medication regimen before any surgery.
- Advise patient to notify health care professional if frequent dizziness or fainting occurs.
- Emphasize the importance of follow-up exams to evaluate effectiveness of medication.

Evaluation/Desired Outcomes

- Decreased symptoms of benign prostatic hypertrophy.

Why was this drug prescribed for your patient?

- Assess patient for rash or more severe hypersensitivity reactions. Discontinue allopurinol immediately if rash occurs. Therapy should be discontinued permanently if reaction is severe. Therapy may be reinstated after a mild reaction has subsided, at a lower dose (50 mg/day with very gradual titration). If skin rash recurs, discontinue permanently.
- **Gout:** Monitor for joint pain and swelling. Addition of colchicine or NSAIDs may be necessary for acute attacks. Administer prophylactic doses of colchicine or an NSAID concurrently during first 3–6 mo of therapy due to an increased frequency of acute attacks of gouty arthritis during early therapy.
- ***Lab Test Considerations:*** Serum and urine uric acid levels usually begin to decrease 2–3 days after initiation of therapy.
- Monitor blood glucose in patients receiving oral hypoglycemic agents. May cause hypoglycemia.
- Monitor hematologic, renal, and liver function test results before and periodically during therapy, especially during first few months. May cause elevation of serum alkaline phosphatase, bilirubin, AST, and ALT levels. Decreased CBC and platelets may indicate bone marrow depression. Elevated BUN, serum creatinine, and creatinine clearance levels may indicate nephrotoxicity; usually reversed with discontinuation of therapy.

Potential Nursing Diagnoses

Acute pain (Indications)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- **PO:** May be administered with milk or meals to minimize gastric irritation. May be crushed and given with fluid or mixed with food.
- **Intermittent Infusion:** Reconstitute each 30-ml vial with 25 ml of sterile water for injection. Solution should be clear and almost colorless with slight opalescence. Dilute with 0.9% NaCL or D5W for a concentration of not >6 mg/ml. Administer within 10 hr of reconstitution; do not refrigerate. Do not administer solutions that are discolored or contain particulate matter. ***Rate:*** Infusion should be initiated 24–48 hr before start of chemotherapy known to cause tumor cell lysis. Rate of infusion depends on volume of infusate.

Patient/Family Teaching

- Instruct patient to take allopurinol as directed. Take missed doses as soon as remembered. If schedule is once daily, do not take if remembered the next day. If more than once daily, take up to 300 mg for the next dose.
- Instruct patient to continue taking allopurinol with an NSAID or colchicine during an acute attack of gout. Allopurinol helps prevent but does not relieve acute gout attacks.
- Alkaline diet may be ordered. Urinary acidification with large doses of vitamin C or other acids may increase kidney stone formation. Advise patient of need for increased fluid intake.
- May occasionally cause drowsiness. Caution patient to avoid driving or other activities requiring alertness until response to drug is known.
- Instruct patient to report rash or influenza symptoms (chills, fever, muscle aches, pains, nausea, or vomiting) occurring with or shortly after rash to health care professional immediately; may indicate hypersensitivity.
- Advise patient that large amounts of alcohol increase uric acid concentrations and may decrease the effectiveness of allopurinol.
- Emphasize the importance of follow-up examinations to monitor effectiveness and side effects.

Evaluation/Desired Outcomes

- Decreased serum and urinary uric acid levels. May take 2–6 wk to observe clinical improvement in patients treated for gout.

Why was this drug prescribed for your patient?

alprazolam (al-**pray**-zoe-lam)

🍁Apo-Alpraz, Niravam, 🍁Novo-Alprazol, 🍁Nu-Alpraz, Xanax, Xanax XR

Classification

Therapeutic: antianxiety agents
Pharmacologic: benzodiazepines

Schedule IV

Pregnancy Category D

Indications

Treatment of anxiety. Management of panic attacks. **Unlabeled uses:** Management of symptoms of premenstrual syndrome (PMS). Management of tremors (familial, senile, or essential action).

Action

Acts at many levels in the CNS to produce anxiolytic effect. May produce CNS depression. Effects may be mediated by gamma-aminobutyric acid, an inhibitory neurotransmitter. **Therapeutic Effects:** Relief of anxiety.

Pharmacokinetics

Absorption: Well absorbed (90%) from the GI tract; absorption is slower with extended-release tablets.
Distribution: Widely distributed, crosses blood-brain barrier. Probably crosses the placenta and enters breast milk. Accumulation is minimal.
Metabolism and Excretion: Metabolized by the liver (CYP3A4 enzyme system) to an active compound that is subsequently rapidly metabolized.
Half-life: 12–15 hr.

TIME/ACTION PROFILE (sedation)

ROUTE	ONSET	PEAK	DURATION
PO	1–2 hr	1–2 hr	Up to 24 hr

🍁 = Canadian drug name.

Contraindications/Precautions

Contraindicated in: Hypersensitivity. Cross-sensitivity with other benzodiazepines may exist. Patients with pre-existing CNS depression. Severe uncontrolled pain. Narrow-angle glaucoma. Pregnancy and lactation. Concurrent itraconazole or ketoconazole.
Use Cautiously in: Hepatic dysfunction (↓ dose required); Concurrent use of nefazodone, fluvoxamine, cimetidine (↓ dose recommended); Concurrent use with fluoxetine, hormonal contraceptives, propoxyphene, diltiazem, isoniazid, erythromycin, clarithromycin, grapefruit juice (↓ dose may be necessary); History of suicide attempt or drug dependence; Elderly or debilitated patients (↓ dose required).

Adverse Reactions/Side Effects

CNS: dizziness, drowsiness, lethargy, confusion, hangover, headache, mental depression, paradoxical excitation. **EENT:** blurred vision. **GI:** constipation, diarrhea, nausea, vomiting. **Derm:** rashes. **Misc:** physical dependence, psychological dependence, tolerance.

Interactions

Drug-Drug: Alcohol, antidepressants, other **benzodiazepines, antihistamines**, and **opioid analgesics**—concurrent use results in ↑ CNS depression. **Hormonal contraceptives, disulfiram, fluoxetine, isoniazid, metoprolol, propoxyphene, propranolol, valproic acid**, and **CYP3A4 inhibitors (erythromycin, ketoconazole, itraconazole, fluvoxamine, cimetidine, nefazodone)** ↓ metabolism of alprazolam, ↑ blood levels and ↑ its actions (dosage adjustments may be necessary). May ↓ efficacy of **levodopa**. **CYP3A4 inducers (rifampin, carbamazepine**, or **barbiturates)** ↑ metabolism and ↓ effects of alprazolam. Sedative effects may be ↓ by **theophylline**. **Cigarette smoking** ↓ blood levels and effects.
Drug-Natural Products: Kava, valerian, or **chamomile** can ↑ CNS depression.
Drug-Food: Concurrent ingestion of **grapefruit juice** ↑ blood levels.

* CAPITALS indicates life-threatening, underlines indicate most frequent.

AMINOGLYCOSIDES

amikacin

(am-i-**kay**-sin)
Amikin

gentamicin

(jen-ta-**mye**-sin)
🍁Cidomycin, Garamycin, G-Mycin, Jenamicin

streptomycin

(strep-toe-**mye**-sin)

tobramycin

(toe-bra-**mye**-sin)
Nebcin, TOBI

Classification

Therapeutic: anti-infectives
Pharmacologic: aminoglycosides

Pregnancy Category C (gentamicin), D (amikacin, kanamycin, streptomycin, tobramycin)

Indications

Amikacin, gentamicin, kanamycin, and tobramycin: Treatment of serious gram-negative bacillary infections and infections caused by staphylococci when penicillins or other less toxic drugs are contraindicated. **Streptomycin:** In combination with other agents in the management of active tuberculosis. **Tobramycin by inhalation:** Management of *Pseudomonas aeruginosa* in cystic fibrosis patients. **Gentamicin, streptomycin:** In combination with other agents in the management of serious enterococcal infections. **Gentamicin IM, IV:** Part of endocarditis prophylaxis. **Unlabeled uses: Amikacin:** In combination with other agents in the management of *Mycobacterium avium* complex infections.

Action

Inhibits protein synthesis in bacteria at level of 30S ribosome. **Therapeutic Effects:** Bactericidal action. **Spectrum:** Most aminoglycosides notable for activity against: *P. aeruginosa, Klebsiella pneumoniae, Escherichia coli, Proteus, Serratia, Acinetobacter, Staphylococcus aureus.* In treatment of enterococcal infections, synergy with a penicillin is required. Streptomycin and amikacin also active against *Mycobacterium.*

Pharmacokinetics

Absorption: Well absorbed after IM administration. IV administration results in complete bioavailability. Some absorption follows administration by other routes.
Distribution: Widely distributed throughout extracellular fluid; crosses the placenta; small amounts enter breast milk. Poor penetration into CSF.
Metabolism and Excretion: Excretion is >90% renal.
Half-life: 2–4 hr (increased in renal impairment).

TIME/ACTION PROFILE (blood levels†)

ROUTE	ONSET	PEAK	DURATION
IM	rapid	30–90 min	N/A
IV	rapid	15–30 min‡	N/A

†All parenterally administered aminoglycosides

‡Post-distribution peak occurs 30 min after the end of a 30-min infusion and 15 min after the end of a 1-hr infusion

Contraindications/Precautions

Contraindicated in: Hypersensitivity. Most parenteral products contain bisulfites and should be avoided in patients with known intolerance. Products containing benzyl alcohol should be avoided in neonates. Cross-sensitivity among aminoglycosides may occur.
Use Cautiously in: Renal impairment (dosage adjustments necessary; blood level monitoring useful in preventing ototoxicity and nephrotoxicity); Hearing impairment; Geriatric patients and premature infants (difficulty in assessing auditory and vestibular function; age-related renal impairment); Neuromuscular diseases such as myasthenia gravis; Obese patients (dosage should be based on ideal body weight); Pregnancy (tobramycin and strepto-

🍁 = Canadian drug name.

* CAPITALS indicates life-threatening, underlines indicate most frequent.

Route/Dosage

Anxiety

PO (Adults): 0.25–0.5 mg 2–3 times daily (not >4 mg/day; begin with 0.25 mg 2–3 times daily in geriatric/debilitated patients).

Panic Attacks

PO (Adults): 0.5 mg 3 times daily; may be increased as needed (not >10 mg/day). *Extended-release tablets (Xanax XR)*—0.5–1 mg once daily in the morning, may be increased every 3–4 days by not more than 1 mg/day; up to 10 mg/day (usual range 3–6 mg/day).

NURSING IMPLICATIONS

Assessment

- Assess degree and manifestations of anxiety and mental status before and periodically during therapy.
- Assess patient for drowsiness, light-headedness, and dizziness. These symptoms usually disappear as therapy progresses. Dose should be reduced if these symptoms persist.
- Prolonged high-dose therapy may lead to psychological or physical dependence. Risk is greater in patients taking >4 mg/day. Restrict the amount of drug available to patient.

Potential Nursing Diagnoses

Anxiety (Indications)
Risk for injury (Side Effects)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- **Do not confuse Xanax (alprazolam) with Zantac (ranitidine).**
- If early morning anxiety or anxiety between doses occurs, the same total daily dose should be divided into more frequent intervals.
- **PO:** May be administered with food if GI upset occurs.
- Tablets may be crushed and taken with food or fluids if patient has difficulty swallowing. **Do not crush, break, or chew extended-release tablets.**
- For *orally disintegrating tablets:* Remove tablet from bottle with dry hands just prior to taking medication. Place tablet on tongue. Tablet will dissolve with saliva; may also be taken with water. Remove cotton from bottle and reseal tightly to prevent moisture from entering bottle. If only ½ tablet taken, discard unused portion immediately; may not remain stable.

Patient/Family Teaching

- Instruct patient to take medication exactly as directed; do not skip or double up on missed doses. If a dose is missed, take within 1 hr; otherwise, skip the dose and return to regular schedule. If medication is less effective after a few weeks, check with health care professional; do not increase dose. Abrupt withdrawal may cause sweating, vomiting, muscle cramps, tremors, and seizures.
- May cause drowsiness or dizziness. Caution patient to avoid driving and other activities requiring alertness until response to the medication is known.
- Advise patient to avoid drinking grapefruit juice during therapy.
- Advise patient to avoid the use of alcohol or other CNS depressants concurrently with alprazolam. Instruct patient to consult health care professional before taking Rx, OTC, or herbal products concurrently with this medication.

Evaluation/Desired Outcomes

- Decreased sense of anxiety
- Increased ability to cope.
- Decreased frequency and severity of panic attacks. Treatment with this medication should not exceed 4 mo without re-evaluation of patient's need for the drug.
- Decreased symptoms of PMS.

Why was this drug prescribed for your patient?

mycin may cause congenital deafness); Neonates (increased risk of neuromuscular blockade; difficulty in assessing auditory and vestibular function; immature renal function); Lactation, infants, and neonates (safety not established).

Adverse Reactions/Side Effects

EENT: ototoxicity (vestibular and cochlear). **GU:** nephrotoxicity. **F and E:** hypomagnesemia. **MS:** muscle paralysis (high parenteral doses). **Misc:** hypersensitivity reactions.

Interactions

Drug-Drug: Inactivated by **penicillins** and **cephalosporins** when coadministered to patients with renal insufficiency. Possible respiratory paralysis after **inhalation anesthetics** or **neuromuscular blocking agents.** Increased incidence of ototoxicity with **loop diuretics.** Increased incidence of nephrotoxicity with other **nephrotoxic drugs.**

Route/Dosage

All maintenance doses depend on renal function.

Amikacin

IM, IV (Adults and Children and older infants): 5 mg/kg q 8 hr or 7.5 mg/kg q 12 hr. UTIs in adults: 250 mg q 12 hr.
IM, IV (Infants): 10 mg/kg initially, then 7.5 mg/kg q 12 hr.
IM, IV (Neonates): 10 mg/kg initially, 7.5 mg/kg every 12 hr; *premature neonates*—10 mg/kg initially, then 7.5 mg/kg q 18–24 hr.

Gentamicin

Many regimens are used; most involve dosing adjusted on the basis of blood level monitoring and assessment of renal function. For endocarditis prophylaxis regimen.
IM, IV (Adults): 1 mg/kg q 8 hr (up to 5 mg/kg/day in 3–4 divided doses); *Once-daily dosing (unlabeled)*—4–7 mg/kg q 24 hr.
IM, IV (Children): 2–2.5 mg/kg q 8 hr.
IM, IV (Infants and Neonates >1 wk): 2.5 mg/kg q 8 hr.
IM, IV (Infants and Premature Neonates ≤1 wk): 2.5 mg/kg q 12 hr.

Streptomycin

IM (Adults): *Tuberculosis*—1 g/day initially, decreased to 1 g 2–3 times weekly; *other infections*—250 mg–1 g q 6 hr *or* 500 mg–2 g q 12 hr.
IM (Children): *Tuberculosis*—20 mg/kg/day (not to exceed 1 g/day); *other infections*—5–10 mg/kg q 6 hr *or* 10–20 mg/kg q 12 hr.

Tobramycin

IM, IV (Adults): 0.75–1.25 mg/kg q 6 hr *or* 1–1.75 mg/kg q 8 hr (up to 8 mg/kg/day in cystic fibrosis patients).
IM, IV (Children and Older Infants): 1.5–1.9 mg/kg q 6 hr *or* 2–2.5 mg/kg q 8–16 hr, up to 8 mg/kg/day in cystic fibrosis patients.
IM, IV (Infants <1 wk): Up to 2 mg/kg q 12–24 hr.
Inhaln (Adults and Children ≥6 yr): 300 mg twice daily for 28 days, then off for 28 days, then repeat cycle.

NURSING IMPLICATIONS

Assessment

- Assess for infection (vital signs, wound appearance, sputum, urine, stool, WBC) at beginning of and throughout therapy.
- Obtain specimens for culture and sensitivity before initiating therapy. First dose may be given before receiving results.
- Evaluate eighth cranial nerve function by audiometry before and throughout therapy. Hearing loss is usually in the high-frequency range. Prompt recognition and intervention are essential in preventing permanent damage. Also monitor for vestibular dysfunction (vertigo, ataxia, nausea, vomiting). Eighth cranial nerve dysfunction is associated with persistently elevated peak aminoglycoside levels. Discontinue aminoglycosides if tinnitus or subjective hearing loss occurs.
- Monitor intake and output and daily weight to assess hydration status and renal function.

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AMINOGLYCOSIDES

- Assess for signs of superinfection (fever, upper respiratory infection, vaginal itching or discharge, increasing malaise, diarrhea). Report to physician or other health care professional.
- **Hepatic Encephalopathy:** Monitor neurologic status. Before administering oral medication, assess patient's ability to swallow.
- ***Lab Test Considerations:*** Monitor renal function by urinalysis, specific gravity, BUN, creatinine, and CCr before and during therapy.
- May cause ↑ BUN, AST, ALT, serum alkaline phosphatase, bilirubin, creatinine, and LDH concentrations.
- May cause ↓ serum calcium, magnesium, potassium, and sodium concentrations.
- ***Toxicity and Overdose:*** Monitor blood levels periodically during therapy. Timing of blood levels is important in interpreting results. Draw blood for peak levels 1 hr after IM injection and 30 min after a 30-min IV infusion is completed. Draw trough levels just before next dose. Peak level for **amikacin** and **kanamycin** should not exceed 35 mcg/ml; trough level should not exceed 5 mcg/ml. Peak level for **gentamicin** and **tobramycin** should not exceed 10 mcg/ml; trough level should not exceed 2 mcg/ml. Peak level for **streptomycin** should not exceed 25 mcg/ml.

Potential Nursing Diagnoses

Risk for infection (Indications)
Disturbed sensory perception (auditory) (Side Effects)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- Do not confuse Amikin (amikacin) with Amicar (aminocaproic acid).
- Keep patient well hydrated (1500–2000 ml/day) during therapy.
- **PO:** May be administered without regard to meals.
- **IM:** IM administration should be deep into a well-developed muscle. Alternate injection sites.

Amikacin

- **Intermittent Infusion:** Dilute 500 mg of amikacin in 100–200 ml of D5W, D10W, 0.9% NaCl, D5/0.9% NaCl, D5/0.45% NaCl, D5/0.25% NaCl, or LR. Solution may be pale yellow without decreased potency. Stable for 24 hr at room temperature. ***Rate:*** Infuse over 30–60 min (over 1–2 hr for infants).

Gentamicin

- **Intermittent Infusion:** Dilute each dose in 50–200 ml of D5W, 0.9% NaCl, or LR to provide a concentration not to exceed 1 mg/ml. Also available in commercially mixed piggyback injections. Do not use solutions that are discolored or that contain a precipitate. ***Rate:*** Infuse slowly over 30 min–2 hr. For pediatric patients, the volume of diluent may be reduced but should be sufficient to permit infusion over 30 min–2 hr.

Tobramycin

- **Intermittent Infusion:** Dilute each dose of tobramycin in 50–100 ml of D5W, D10W, D5/0.9% NaCl, 0.9%NaCl, Ringer's or LR to provide a concentration not >1 mg/ml. Pediatric doses may be diluted in proportionately smaller amounts. Stable for 24 hr at room temperature, 96 hr if refrigerated. Also available in commercially mixed piggyback injections. ***Rate:*** Infuse slowly over 30–60 min in both adult and pediatric patients.

Patient/Family Teaching

- Instruct patient to report signs of hypersensitivity, tinnitus, vertigo, hearing loss, rash, dizziness, or difficulty urinating.
- Advise patient of the importance of drinking plenty of liquids.

High Alert

amiodarone (am-ee-oh-da-rone)

Cordarone, Pacerone

Classification

Therapeutic: antiarrhythmics (class III)

Pregnancy Category D

Indications

Management and prophylaxis of life-threatening ventricular arrhythmias unresponsive to less toxic agents. **Unlabeled uses: PO:** Management of supraventricular tachyarrhythmias. **IV:** As part of the Advanced Cardiac Life Support (ACLS) and Pediatric Advanced Life Support (PALS) guidelines for the management of ventricular fibrillation/pulseless ventricular tachycardia after cardiopulmonary resuscitation and defibrillation have failed; also for other life-threatening tachyarrhythmias.

Action

Prolongs action potential and refractory period in myocardial tissue. Inhibits adrenergic stimulation. Slows sinus rate, increases P-R and Q-T intervals, and decreases peripheral vascular resistance. **Therapeutic Effects:** Suppression of arrhythmias.

Pharmacokinetics

Absorption: IV administration results in complete bioavailability. Slowly and variably absorbed from GI tract (35–65%).
Distribution: Accumulates slowly in many tissues. Concentrates in fat, muscle, liver, lungs, and spleen. Crosses placenta; enters breast milk.
Metabolism and Excretion: Metabolized by liver (one metabolite has antiarrhythmic activity), excreted in bile. Minimal renal excretion.
Half-life: 13–107 days.

TIME/ACTION PROFILE (suppression of ventricular arrhythmias)

ROUTE	ONSET	PEAK	DURATION
PO	2–3 days (up to 2–3 mo)	3–7 hr	wks–mos
IV	2 hr	3–7 hr	unknown

Contraindications/Precautions

Contraindicated in: Severe sinus node dysfunction. 2nd- and 3rd-degree AV block. Bradycardia (has caused syncope unless a pacemaker is in place). Products containing benzyl alcohol should not be used in neonates. Pregnancy and lactation.
Use Cautiously in: History of congestive heart failure (CHF); Thyroid disorders; Severe pulmonary or liver disease.

Adverse Reactions/Side Effects

CNS: confusional states, disorientation, hallucinations, dizziness, fatigue, malaise, headache, insomnia. **EENT:** corneal microdeposits, abnormal sense of smell, dry eyes, optic neuritis, optic neuropathy, photophobia. **Resp:** ADULT RESPIRATORY DISTRESS SYNDROME, PULMONARY FIBROSIS, PNEUMONITIS. **CV:** CHF, WORSENING OF ARRHYTHMIAS, bradycardia, hypotension. **GI:** LIVER FUNCTION ABNORMALITIES, anorexia, constipation, nausea, vomiting, abdominal pain, abnormal sense of taste. **GU:** decreased libido, epididymitis. **Derm:** TOXIC EPIDERMAL NECROLYSIS (rare), photosensitivity, blue discoloration. **Endo:** hypothyroidism, hyperthyroidism. **Neuro:** ataxia, involuntary movement, paresthesias, peripheral neuropathy, tremor.

Interactions

Drug-Drug: Increased risk of QT prolongations with **fluoroquinolones**, **macrolides**, and **azole antifungals** (undertake concurrent use with caution). ↑ Blood levels and may lead to toxicity from **digoxin** (↓ dose of digoxin by 50%). ↑ blood levels and may lead to toxicity from other **class I antiarrhythmics** (**quinidine**, **procainamide**, **mexiletine**, **lidocaine**, or **flecainide**— ↓ doses of other drugs by 30–50%). ↑ blood levels of

- Teach patients with a history of rheumatic heart disease or valve replacement the importance of using antimicrobial prophylaxis before invasive medical or dental procedures.
- **PO:** Instruct patient to take as directed for full course of therapy. Take missed doses as soon as possible if not almost time for next dose; do not double doses.
- Caution patient that medication may cause nausea, vomiting, or diarrhea.
- **Topical:** Instruct patient to wash affected skin gently and pat dry. Apply a thin film of ointment. Apply occlusive dressing only if directed by health care professional. Patient should assess skin and inform health care professional if skin irritation develops or infection worsens.
- **Inhaln:** Instruct patient to take inhalation twice daily as close to 12 hr apart as possible; not <6 hr apart. Administer over 10–15 min period using a hand-held PARI LC PLUS reusable nebulizer with a *DeVilbiss Pulmo-Aide* compressor. Do not mix with dornase alpha in nebulizer. Instruct patient on multiple therapies to take others first and use tobramycin last. Tobramycin-induced bronchospasm may be reduced if tobramycin is administered after bronchodilators. Instruct patient to sit or stand upright during inhalation and breathe normally through mouthpiece of nebulizer. Nose clips may help patient breath through mouth.

Evaluation/Desired Outcomes

- Resolution of the signs and symptoms of infection. If no response is seen within 3–5 days, new cultures should be taken.
- Prevention of infection in intestinal surgery.
- Improved neurologic status in hepatic encephalopathy.
- Endocarditis prophylaxis.

Why was this drug prescribed for your patient?

cyclosporine, **dextromethorphan**, **methotrexate**, **phenytoin**, and **theophylline**. **Phenytoin** ↓ amiodarone blood levels. ↑ activity of **warfarin** (↑ dose of warfarin by 33–50%). ↑ risk of bradyarrhythmias, sinus arrest, or AV heart block with **beta blockers** or **calcium channel blockers**. **Cholestyramine** may ↓ amiodarone blood levels. **Cimetidine** and **ritonavir** ↑ amiodarone blood levels. Risk of myocardial depression is ↑ by **volatile anesthetics**.

Route/Dosage

Ventricular arrhythmias

PO (Adults): 800–1600 mg/day in 1–2 doses for 1–3 wk, then 600–800 mg/day in 1–2 doses for 1 mo, then 400 mg/day maintenance dose.
PO (Children): 10 mg/kg/day (800 mg/1.72 m^2/day) for 10 days or until response or side effects occur, then 5 mg/kg/day (400 mg/1.72 m^2/day) for several weeks, then decreased to 2.5 mg/kg/day (200 mg/1.72 m^2/day) or lowest effective dose.
IV (Adults): 150 mg over 10 min, followed by 360 mg over the next 6 hr and then 540 mg over the next 18 hr. Continue infusion at 0.5 mg/min until oral therapy is initiated. If arrhythmia recurs, a small loading infusion of 150 mg over 10 min should be given; in addition, the rate of the maintenance infusion may be increased. *Conversion to initial oral therapy*—If duration of IV infusion was <1 wk, oral dose should be 800–1600 mg/day; if IV infusion was 1–3 wk, oral dose should be 600–800 mg/day; if IV infusion was >3 wk, oral dose should be 400 mg/day.

ACLS guidelines for VFib/Pulseless VTach

IV (Adults): 300 mg IV push, may repeat once after 3–5 min with 150 mg IV push (maximum cumulative dose 2.2 g/24 hr).

Supraventricular tachycardia

PO (Adults): 600–800 mg/day for 1 wk or until desired response occurs or side effects develop, then decrease to 400 mg/day for 3 wk, then maintenance dose of 200–400 mg/day.

PO (Children): 10 mg/kg/day (800 mg/1.72 m^2/day) for 10 days or until response or side effects occur, then 5 mg/kg/day (400 mg/1.72 m^2/day) for several weeks, then decreased to 2.5 mg/kg/day (200 mg/1.72 m^2/day) or lowest effective dose.

NURSING IMPLICATIONS

Assessment

- **Monitor ECG continuously** during IV therapy or initiation of oral therapy. Monitor heart rate and rhythm throughout therapy; PR prolongation, slight QRS widening, T-wave amplitude reduction with T-wave widening and bifurcation, and U waves may occur. QT prolongation may be associated with worsening of arrhythmias and should be monitored closely during IV therapy. Report bradycardia or increase in arrhythmias promptly; patients receiving IV therapy may require slowing rate, discontinuing infusion, or inserting a temporary pacemaker.
- **Assess for signs of pulmonary toxicity** (rales/crackles, decreased breath sounds, pleuritic friction rub, fatigue, dyspnea, cough, pleuritic pain, fever). Chest x-ray and pulmonary function tests are recommended before therapy. Monitor chest x-ray every 3–6 mo during therapy to detect diffuse interstitial changes or alveolar infiltrates. Bronchoscopy or gallium radionuclide scan may also be used for diagnosis. Usually reversible after withdrawal, but fatalities have occurred.
- **IV: Assess patient for signs and symptoms of ARDS** throughout therapy. Report dyspnea, tachypnea, or rales/crackles promptly. Bilateral, diffuse pulmonary infiltrates are seen on chest x-ray.
- Monitor blood pressure frequently. Hypotension usually occurs during first several hours of therapy and is related to rate of infusion. If hypotension occurs, slow rate.
- **PO:** Ophthalmic exams should be performed before and regularly during therapy and whenever visual changes (photophobia, halos around lights, decreased acuity) occur. May cause permanent loss of vision.
- Assess patient for signs of thyroid dysfunction, especially during initial therapy. Lethargy; weight gain; edema of the hands, feet, and periorbital

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CONTINUED

amiodarone

region; and cool, pale skin suggest hypothyroidism and may require decrease in dose or discontinuation of therapy and thyroid supplementation. Tachycardia; weight loss; nervousness; sensitivity to heat; insomnia; and warm, flushed, moist skin suggest hyperthyroidism and may require discontinuation of therapy and treatment with antithyroid agents.

- ***Lab Test Considerations:*** **Monitor liver and thyroid functions before and periodically throughout therapy**. Drug effects persist long after discontinuation. Thyroid function abnormalities are common, but clinical thyroid dysfunction is uncommon.
- **Monitor AST, ALT, and alkaline phosphatase at regular intervals during therapy, especially in patients receiving high maintenance dose. If liver function studies are 3 times normal or double in patients with elevated baseline levels or if hepatomegaly occurs, dose should be reduced.**
- May cause asymptomatic elevations in ANA titer concentrations.

Potential Nursing Diagnoses

Decreased cardiac output (Indications)
Impaired gas exchange (Side Effects)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- ***High Alert:*** IV vasoactive medications are inherently dangerous; fatalities have occurred from medication errors involving amiodarone. Before administering, have second practitioner check original order, dosage calculations and infusion pump settings. Patients should be hospitalized and monitored closely during IV therapy and initiation of oral therapy. IV therapy should be administered only by physicians experienced in treating life-threatening arrhythmias. Do not confuse amiodarone with amrinone, now called inamrinone.
- Hypokalemia and hypomagnesemia may decrease effectiveness or cause additional arrhythmias; correct before therapy.
- Assist patient during ambulation to prevent falls. Neurotoxicity (ataxia, proximal muscle weakness, tingling or numbness in fingers or toes, uncontrolled movements, tremors) is common during initial therapy, but may occur within 1 wk to several months of initiation of therapy and may persist for more than 1 yr after withdrawal. Dose reduction is recommended.
- Monitor closely when converting from IV to oral therapy, especially in geriatric patients.
- **PO:** May be administered with meals and in divided doses if GI intolerance occurs or if daily dose exceeds 1000 mg.
- **IV:** Administer via volumetric pump; drop size may be reduced, causing altered dosing with drop counter infusion sets.
- Infusions longer than 1 hr should not exceed 2 mg/ml unless administered through a central venous catheter.
- Administer through an in-line filter.
- Infusions exceeding 2 hr must be administered in glass or polyolefin bottles to prevent adsorption. However, polyvinyl chloride (PVC) tubing must be used during administration because concentrations and infusion rate recommendations have been based on PVC tubing.
- **Direct IV:** For cardiac arrest may administer 300 mg IV push. May repeat with 150 mg in 3–5 min
- **Intermittent Infusion:** Recommended starting dose of about 1000 mg over 24 hr is administered during loading and maintenance infusions.
- **Initial loading dose:** Add 3 ml (150 mg) of amiodarone to 100 ml D5W for a concentration of 1.5 mg/ml. ***Rate:*** Administer rapidly over 10 min.

amitriptyline (a-mee-**trip**-ti-leen)

♣Apo-Amitriptyline, Elavil, Endep, ♣Levate, ♣Novotriptyn

Classification

Therapeutic: antidepressants
Pharmacologic: tricyclic antidepressants

Pregnancy Category D

Indications

Treatment of various forms of depression, often in conjunction with psychotherapy. **Unlabeled uses:** Management of chronic pain syndromes.

Action

Potentiates the effect of serotonin and norepinephrine in the CNS. Also has significant anticholinergic properties. **Therapeutic Effects:** Antidepressant action.

Pharmacokinetics

Absorption: Well absorbed from the GI tract.
Distribution: Widely distributed. Crosses the placenta; enters breast milk in small amounts.
Metabolism and Excretion: Extensively metabolized by the liver; some metabolites have antidepressant activity. Undergoes enterohepatic recirculation and secretion into gastric juices.
Half-life: 10–50 hr.

TIME/ACTION PROFILE (antidepressant effect)

ROUTE	ONSET	PEAK	DURATION
PO	2–3 wk (up to 30 days)	2–6 wk	days–wks
IM	2–3 wk	2–6 wk	days–wks

Contraindications/Precautions

Contraindicated in: Narrow-angle glaucoma. Pregnancy and lactation.
Use Cautiously in: Geriatric patients (increased risk of adverse reactions); May ↑ risk of suicide attempt/ideation especially during dose early treatment or dose adjustment; risk may be greater in children or adolescents; Patients with pre-existing cardiovascular disease; Prostatic hypertrophy (increased risk of urinary retention); History of seizures (threshold may be ↓); Children <12 yr (safety not established).

Adverse Reactions/Side Effects

CNS: fatigue, sedation. **EENT:** blurred vision, dry eyes. **CV:** ARRHYTHMIAS, hypotension, ECG changes. **GI:** constipation, dry mouth, hepatitis, paralytic ileus. **GU:** urinary retention. **Derm:** photosensitivity. **Endo:** changes in blood glucose, gynecomastia. **Hemat:** blood dyscrasias. **Misc:** increased appetite, weight gain.

Interactions

Drug-Drug: Amitriptyline is metabolized in the liver by the cytochrome P450 2D6 enzyme, and its action may be affected by drugs that compete for metabolism by this enzyme, including other **antidepressants**, **phenothiazines**, **carbamazepine**, **class 1C antiarrhythmics** including **propafenone**, and **flecainide**; when these drugs are used concurrently with amitriptyline, dosage reduction of one or the other or both may be necessary. Concurrent use of other drugs that inhibit the activity of the enzyme, including **cimetidine**, **quinidine**, **amiodarone**, and **ritonavir**, may result in increased effects of amitriptyline. May cause hypotension, tachycardia, and potentially fatal reactions when used with **MAO inhibitors** (avoid concurrent use—discontinue 2 wk before starting amitriptyline). Concurrent use with **SSRI antidepressants** may result in ↑ toxicity and should be avoided (**fluoxetine** should be stopped 5 wk before starting amitriptyline). Concurrent use with **clonidine** may result in hypertensive crisis and should be avoided. Concurrent use with **levodopa** may result in delayed or ↓ absorption of levodopa or hypertension. Blood levels and effects may be ↓ by **rifamycins** (**rifampin**, **rifapentine**, and **rifabutin**). Concurrent use with

- **Loading Infusion:** Add 18 ml (900 mg) of amiodarone to 500 ml of D5W for a concentration of 1.8 mg/ml. ***Rate:*** Administer slowly, 360 mg over next 6 hr at a rate of 1 mg/min.
- **Maintenance Infusion:** Administer remainder of loading infusion. ***Rate:*** Administer 540 mg over the remaining 18 hr at a rate of 0.5 mg/min.
- **Continuous Infusion:** After initial 24 hr, infusion may continue using a concentration of 1–6 mg/ml. Administer concentrations of >2 mg/ml via central venous catheter. ***Rate:*** Administer at maintenance infusion rate of 0.5 mg/min (720 mg/24 hr). May be increased to achieve effective arrhythmia suppression but should not exceed 30 mg/min.
- **Supplemental Infusions:** If breakthrough episodes of ventricular fibrillation or hemodynamically unstable ventricular tachycardia occur, dilute 150 mg of amiodarone in 100 ml of D5W. ***Rate:*** Administer over 10 min to minimize hypotension.
- **Syringe Incompatibility:** heparin.
- **Y-Site Compatibility:** amikacin, amphotericin B, atracurium, atropine, calcium chloride, calcium gluconate, ceftizoxime, ceftriaxone, cefuroxime, ciprofloxacin, clindamycin, dexmedetomidine, dobutamine, dopamine, doxycycline, epinephrine, eptifibatide, erythromycin lactobionate, esmolol, famotidine, fenoldopam, fentanyl, fluconazole, gentamicin, insulin, isoproterenol, labetalol, lepirudin, lidocaine, lorazepam, metaraminol, methylprednisolone, metronidazole, midazolam, milrinone, morphine, nitroglycerin, norepinephrine, penicillin G potassium, phentolamine, phenylephrine, potassium chloride, procainamide, tirofiban, tobramycin, vancomycin, vasopressin, vecuronium.
- **Y-Site Incompatibility:** aminophylline, ceftazidime, digoxin, heparin, imipenem-cilastatin, piperacillin, piperacillin/tazobactam, potassium phosphates, sodium bicarbonate, sodium phosphates.
- **Additive Incompatibility:** aminophylline, heparin, sodium bicarbonate.

Patient/Family Teaching

- Instruct patient to take amiodarone as directed. Patient should read the *Medication Guide* prior to first dose and with each Rx refill. If a dose is missed, do not take at all. Consult health care professional if more than two doses are missed.
- Advise patient to avoid drinking grapefruit juice during therapy.
- Inform patient that side effects may not appear until several days, weeks, or years after initiation of therapy and may persist for several months after withdrawal.
- Teach patients to monitor pulse daily and report abnormalities.
- Advise patients that photosensitivity reactions may occur through window glass, thin clothing, and sunscreens. Protective clothing and sunblock are recommended during and for 4 months after therapy. If photosensitivity occurs, dosage reduction may be useful.
- Inform patients that bluish discoloration of the face, neck, and arms is a possible side effect of this drug after prolonged use. This is usually reversible and will fade over several months. Notify health care professional if this occurs.
- Instruct male patients to notify health care professional if signs of epididymitis (pain and swelling in scrotum) occur. May require reduction in dose.
- Instruct patient to notify health care professional of medication regimen before treatment or surgery.
- Emphasize the importance of follow-up exams, including chest x-ray and pulmonary function tests every 3–6 mo and ophthalmic exams after 6 mo of therapy, and then annually.

Evaluation/Desired Outcomes

- Cessation of life-threatening ventricular arrhythmias. Adverse effects may take up to 4 mo to resolve.

Why was this drug prescribed for your patient?

moxifloxaxin ↑ risk of adverse cardiovascular reactions. ↑ CNS depression with other **CNS depressants** including **alcohol, antihistamines, clonidine**, **opioids**, and **sedative/hypnotics. Barbiturates** may alter blood levels and effects. **Adrenergic** and **anticholinergic** side effects may ↑ with other **agents having anticholinergic properties. Phenothiazines** or **oral contraceptives** ↑ levels and may cause toxicity. **Cigarette smoking** may ↑ metabolism and alter effects.
Drug-Natural Products: St. John's wort may decrease serum concentrations and efficacy. Concomitant use of **kava, valerian,** or **chamomile** can increase CNS depression. Increased anticholinergic effects with **jimson weed** and **scopolia.**

Route/Dosage

PO (Adults): 75 mg/day in divided doses; may be increased up to 150 mg/day *or* 50–100 mg at bedtime, may increase by 25–50 mg up to 150 mg (total daily dose up to 300 mg has been used in hospitalized patients).
PO (Geriatric Patients and Adolescents): 10 mg tid and 20 mg at bedtime *or* 25 mg at bedtime initially, slowly increased to 100 mg/day as a single bedtime dose or divided doses.
IM (Adults): 20–30 mg 4 times daily.

NURSING IMPLICATIONS

Assessment

- Monitor blood pressure and pulse before and during therapy. Notify physician or other health care professional of decreases in blood pressure (10–20 mmHg) or sudden increase in pulse rate. Patients taking high doses or with a history of cardiovascular disease should have ECG monitored before and periodically throughout therapy.
- Geriatric patients may be at an increased risk for falls; start with low dose and monitor closely.
- **Depression:** Monitor mental status and affect. Assess for suicidal tendencies, especially during early therapy. Restrict amount of drug available.
- **Pain:** Assess intensity, quality, and location of pain periodically during therapy. May require several weeks for effects to be seen.
- ***Lab Test Considerations:*** Assess leukocyte and differential blood counts, liver function, and serum glucose before and periodically during therapy. May cause ↑ serum bilirubin and alkaline phosphatase. May cause bone marrow depression. May ↑ or ↓ serum glucose.

Potential Nursing Diagnoses

Ineffective coping (Indications)
Risk for injury (Side Effects)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- Do not confuse Elavil (amitriptyline) with Oruvail (ketoprofen).
- Dose increases should be made at bedtime because of sedation. Dose titration is a slow process; may take weeks to months. May give entire dose at bedtime. Sedative effect may be apparent before antidepressant effect is noted.
- **PO:** Administer medication with or immediately after a meal to minimize gastric upset. Tablet may be crushed and given with food or fluids.
- **IM:** For short-term IM administration only. Do not administer IV.

Patient/Family Teaching

- Instruct patient to take as directed. Drug effects may not be noticed for at least 2 wk. Abrupt discontinuation may cause nausea, headache, and malaise.
- May cause drowsiness and blurred vision. Caution patient to avoid driving and other activities requiring alertness until response to the drug is known.
- Orthostatic hypotension, sedation, and confusion are common during early therapy, especially in geriatric patients. Protect patient from falls and advise patient to change positions slowly.

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amitriptyline

- Advise patient to avoid alcohol and other CNS-depressant drugs during therapy and for 3–7 days after therapy has been discontinued.
- Instruct patient to notify health care professional if urinary retention occurs or if dry mouth or constipation persists. Sugarless hard candy or gum may diminish dry mouth. Increasing fluid intake or bulk may prevent constipation. Dosage reduction or discontinuation may be necessary. Consult health care professional if dry mouth persists for more than 2 wk.
- Caution patient to use sunscreen and protective clothing to prevent photosensitivity reactions.
- Inform patient of need to monitor dietary intake because increased appetite is possible and may lead to undesired weight gain.
- Advise patient to notify health care professional of medication regimen before treatment or surgery.
- Therapy for depression is usually prolonged. Emphasize the importance of follow-up exams to monitor effectiveness and side effects.

Evaluation/Desired Outcomes

- Increased sense of well-being.
- Renewed interest in surroundings.
- Increased appetite.
- Improved energy level.
- Improved sleep.
- Decrease in chronic pain symptoms.
- Full therapeutic effects may be seen 2–6 wk after initiating therapy.

Why was this drug prescribed for your patient?

amoxicillin (a-mox-i-**sil**-in)

Amoxil, ♣Apo-Amoxi, DisperMox, ♣Novamoxin, ♣Nu-Amoxi, Trimox, Wymox

Classification

Therapeutic: anti-infectives, antiulcer agents
Pharmacologic: aminopenicillins

Pregnancy Category B

Indications

Treatment of: Skin/skin structure infections, Otitis media, Sinusitis, Respiratory infections, Genitourinary infections, Septicemia. Endocarditis prophylaxis. Management of ulcer disease due to *Helicobacter pylori*.

Action

Binds to bacterial cell wall, causing cell death. **Therapeutic Effects:** Bactericidal action. **Spectrum:** Active against: Streptococci, Pneumococci, Enterococci, *Haemophilus influenzae*, *Escherichia coli*, *Proteus mirabilis*, *Neisseria meningitidis*, *Shigella*, *Chlamydia trachomatis*, *Salmonella*, *Borrelia burgdorferi*, *H. pylori*.

Pharmacokinetics

Absorption: Well absorbed from duodenum (75–90%). More resistant to acid inactivation than other penicillins.
Distribution: Diffuses readily into most body tissues and fluids. Cerebrospinal fluid (CSF) penetration ↑ when meninges are inflamed. Crosses placenta; enters breast milk in small amounts.
Metabolism and Excretion: 70% excreted unchanged in the urine, 30% metabolized by the liver.
Half-life: 1–1.3 hr.

TIME/ACTION PROFILE (blood levels)

	ONSET	PEAK	DURATION
PO	30 min	1–2 hr	8–12 hr

Contraindications/Precautions

Contraindicated in: Hypersensitivity to penicillins. Tablets for oral suspension (DisperMox) contain aspartame; avoid in patients with phenylketonuria.
Use Cautiously in: Severe renal insufficiency (↓ dose if CCr < 30 ml/min); Infectious mononucleosis (↑ risk of rash); Has been used safely during pregnancy and lactation.

Adverse Reactions/Side Effects

CNS: SEIZURES (high doses). **GI:** PSEUDOMEMBRANOUS COLITIS, diarrhea, nausea, vomiting. **Derm:** rashes, urticaria. **Hemat:** blood dyscrasias. **Misc:** allergic reactions including ANAPHYLAXIS/SERUM SICKNESS.

Interactions

Drug-Drug: Probenecid ↓ renal excretion and ↑ blood levels of amoxicillin—therapy may be combined for this purpose. May ↑ effect of **warfarin**. May ↓ effectiveness of **oral contraceptives**.

Route/Dosage

Most Infections

PO (Adults and Children > 20 kg): 250–500 mg q 8 hr *or* 500–875 mg q 12 hr.
PO (Children > 3 mo): 20–40 mg/kg/day in divided doses q 8 hr *or* 25–45 mg/kg q 12 hr.
PO (Infants ≤ 3 mo): up to 30 mg/kg q 12 hr.

H. Pylori

PO (Adults): *Triple therapy*—1000 mg amoxicillin twice daily (with lansoprazole and clarithromycin) 14 days *or* 1000 mg amoxicillin twice daily (with omeprazole and clarithromycin) for 14 days *or* amoxicillin 1000 mg twice daily with esomeprazole and clarithromycin. *Dual therapy*—1000 mg amoxicillin three times daily with lansoprazole for 14 days.

Endocarditis Prophylaxis

PO (Adults): 2 g 1 hr before procedure.
PO (Children): 50 mg/kg 1 hr before procedure.

NURSING IMPLICATIONS

Assessment

- Assess patient for infection (vital signs; appearance of wound, sputum, urine, and stool; WBC) at beginning of and throughout therapy.
- Obtain a history before initiating therapy to determine previous use of and reactions to penicillins or cephalosporins. Persons with a negative history of penicillin sensitivity may still have an allergic response.
- Observe for signs and symptoms of anaphylaxis (rash, pruritus, laryngeal edema, wheezing). Notify the physician or other health care professional immediately if these occur.
- Obtain specimens for culture and sensitivity before starting therapy. First dose may be given before receiving results.
- **Monitor bowel function. Diarrhea, abdominal cramping, fever, and bloody stools should be reported to health care professional promptly as a sign of pseudomembranous colitis. May begin up to several weeks after cessation of therapy.**
- ***Lab Test Considerations:*** May cause ↑ serum alkaline phosphatase, LDH, AST, and ALT concentrations.

Potential Nursing Diagnoses

Risk for infection (Indications, Side Effects)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)
Noncompliance (Patient/Family Teaching)

Implementation

- **PO:** Administer around the clock. May be given without regard to meals or with meals to decrease GI side effects. Capsule contents may be emptied and swallowed with liquids. Chewable tablets should be crushed or chewed before swallowing with liquids.
- Shake oral suspension before administering; suspension may be given straight or mixed in formula, milk, fruit juice, water, or ginger ale. Administer immediately after mixing. Discard refrigerated reconstituted suspension after 10 days.
- Mix each *tablet for oral suspension (DisperMox)* in 2 tsp of water. Patient should drink entire mixture, rinse container with a small amount of water and drink to make sure entire dose is taken. Do not chew or swallow tablet. Tablets will not dissolve in mouth. Use only water to dissolve tablets, other liquids are not recommended. Store tablets at room temperature.

Patient/Family Teaching

- Instruct patients to take medication around the clock and to finish the drug completely as directed, even if feeling better. Advise patients that sharing of this medication may be dangerous.
- Review use and preparation of *tablets for oral suspension (DisperMox)*.
- Instruct female patients taking oral contraceptives to use an alternate or additional nonhormonal method of contraception during therapy with amoxicillin and until next menstrual period.
- Advise patient to report signs of superinfection (furry overgrowth on tongue, vaginal itching or discharge, loose or foul-smelling stools) and allergy.
- **Instruct patient to notify health care professional immediately if diarrhea, abdominal cramping, fever, or bloody stools occur** and not to treat with antidiarrheals without consulting health care professional.
- Instruct the patient to notify health care professional if symptoms do not improve.
- Teach patients with a history of rheumatic heart disease or valve replacement the importance of using antimicrobial prophylaxis before invasive medical or dental procedures.

Evaluation/Desired Outcomes

- Resolution of the signs and symptoms of infection. Length of time for complete resolution depends on the organism and site of infection.
- Endocarditis prophylaxis.
- Eradication of *H. pylori* with resolution of ulcer symptoms.

Why was this drug prescribed for your patient?

amoxicillin/clavulanate (a-mox-i-**sill**-in/klav-yoo-**lan**-ate)

Augmentin, ♣Clavulin

Classification

Therapeutic: anti-infectives
Pharmacologic: aminopenicillins/beta lactamase inhibitors

Pregnancy Category B

Indications

Treatment of a variety of infections including: Skin and skin structure infections, Otitis media, Sinusitis, Respiratory tract infections, Genitourinary tract infections, Meningitis, Septicemia.

Action

Binds to bacterial cell wall, causing cell death; spectrum of amoxicillin is broader than penicillin. Clavulanate resists action of beta-lactamase, an enzyme produced by bacteria that is capable of inactivating some penicillins.
Therapeutic Effects: Bactericidal action against susceptible bacteria.
Spectrum: Active against: Streptococci, Pneumococci, Enterococci, *Haemophilus influenzae*, *Escherichia coli*, *Proteus mirabilis*, *Neisseria menigitidis*, *Shigella*, *Salmonella*, *Moraxella catarrhalis*.

Pharmacokinetics

Absorption: Well absorbed from the duodenum (75–90%). More resistant to acid inactivation than other penicillins.
Distribution: Diffuses readily into most body tissues and fluids. CSF penetration is increased in the presence of inflamed meninges. Crosses the placenta and enters breast milk in small amounts.
Metabolism and Excretion: 70% excreted unchanged in the urine; 30% metabolized by the liver.
Half-life: 1–1.3 hr.

TIME/ACTION PROFILE (peak blood levels)

ROUTE	ONSET	PEAK	DURATION
PO	30 min	1–2 hr	8–12 hr

Contraindications/Precautions

Contraindicated in: Hypersensitivity to penicillins. Hypersensitivity to clavulanate. Suspension and chewable tablets contain aspartame and should be avoided in phenylketonurics.
Use Cautiously in: Renal insufficiency (dosage reduction recommended if CCr <30 ml/min); Infectious mononucleosis (increased incidence of rash); Hepatic impairment (dose cautiously, monitor liver function).

Adverse Reactions/Side Effects

CNS: SEIZURES (high doses). **GI:** PSEUDOMEMBRANOUS COLITIS, diarrhea, hepatic dysfunction, nausea, vomiting. **Derm:** rashes, urticaria. **Hemat:** blood dyscrasias. **Misc:** allergic reactions including ANAPHYLAXIS and SERUM SICKNESS, superinfection.

Interactions

Drug-Drug: Probenecid ↓ renal excretion and ↑ blood levels of amoxicillin—therapy may be combined for this purpose. May potentiate the effect of **warfarin**. Concurrent **allopurinol** therapy ↑ risk of rash. May ↓ the effectiveness of **hormonal contraceptives**.
Drug-Food: Clavulanate absorption is ↓ by a **high fat** meal.

Route/Dosage

Most Infections

PO (Adults and Children >40 kg): Tablets: 1–500 mg tablet q 12 hr or 1–250 mg tablet q 8 hr. **Suspension:** 500 mg q 12 hr as 125 mg/5 ml or 250 mg/5 ml suspension.

Serious Infections and Respiratory Tract Infections

PO (Adults and Children >40 kg): 1–875 mg tablet every 12 hr *or* 1–500 mg tablet q 8 hr; *acute bacterial sinusitis*—2000 mg q 12 hr for 10

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amoxicillin/clavulanate

- Do not administer 250-mg chewable tablets to children <40 kg due to clavulanate content. Children <3 months should receive the 125-mg/5 ml oral solution.

Patient/Family Teaching

- Instruct patients to take medication around the clock and to finish the drug completely as directed, even if feeling better. Advise patients that sharing of this medication may be dangerous.
- Instruct female patients taking oral contraceptives to use an alternate or additional method of contraception during therapy and until next menstrual period.
- Advise patient to report the signs of superinfection (furry overgrowth on the tongue, vaginal itching or discharge, loose or foul-smelling stools) and allergy.
- **Instruct patient to notify health care professional immediately if diarrhea, abdominal cramping, fever, or bloody stools occur** and not to treat with antidiarrheals without consulting health care professionals.
- Instruct the patient to notify health care professional if symptoms do not improve or if nausea or diarrhea persists when drug is administered with food.
- Teach parents or caregivers to calculate and measure doses accurately. Reinforce importance of using measuring device supplied by pharmacy or with product, not household items.

Evaluation/Desired Outcomes

- Resolution of the signs and symptoms of infection. Length of time for complete resolution depends on the organism and site of infection.

Why was this drug prescribed for your patient?

days as extended release (XR) product; *community-acquired pneumonia*—2000 mg every 12 hr for 7–10 days as extended release (XR) product.

Recurrent/persistent acute otitis media due to *S. pneumonia*, *H. influenzae*, or *M. catarrhalis* in day-care children <2 yrs or in daycare.

PO (Children <2 yr or in daycare): 90 mg/kg/day in divided doses q 12 hr for 10 (as ES formulation only).

Renal Impairment

PO (Adults): *CCr 10–30 ml/min*—250–500 mg q 12 hr (do not use 875 mg tablet); *CCr <10 ml/min*—250–500 mg q 24 hr.

Otitis Media, Sinusitis, Lower Respiratory Tract Infections, Serious Infections

PO (Children ≥3 mo): *200 mg/5 ml or 400 mg/5 ml suspension*—22.5 mg/kg q 12 hr; *125 mg/5 ml or 250 mg/5 ml suspension*—13.3 mg/kg q 8 hr.

Less Serious Infections

PO (Children ≥3 mo): *200 mg/5 ml or 400 mg/5 ml suspension*—12.5 mg/kg q 12 hr *or* 6.6 mg/kg q 8 hr (as 125 mg/5 ml or 250 mg/5 ml suspension).

PO (Children <3 mo): 15 mg/kg q 12 hr (125 mg/ml suspension recommended).

NURSING IMPLICATIONS

Assessment

- Assess for infection (vital signs; appearance of wound, sputum, urine, and stool; WBC) at beginning of and throughout therapy.
- Obtain a history before initiating therapy to determine previous use of and reactions to penicillins or cephalosporins. Persons with a negative history of penicillin sensitivity may still have an allergic response.
- **Observe for signs and symptoms of anaphylaxis (rash, pruritus, laryngeal edema, wheezing). Notify the physician or other health care professional immediately if these occur.**
- Obtain specimens for culture and sensitivity prior to therapy. First dose may be given before receiving results.
- **Monitor bowel function. Diarrhea, abdominal cramping, fever, and bloody stools should be reported to health care professional promptly as a sign of pseudomembranous colitis. May begin up to several weeks following cessation of therapy.**
- ***Lab Test Considerations:*** May cause ↑ serum alkaline phosphatase, LDH, AST, and ALT concentrations. Elderly men and patients receiving prolonged treatment are at ↑ risk for hepatic dysfunction.
- May cause false-positive direct Coombs' test result.

Potential Nursing Diagnoses

Risk for infection (Indications, Side Effects)
Noncompliance (Patient/Family Teaching)

Implementation

- **PO:** Administer around the clock. Administer at the start of a meal to enhance absorption and to decrease GI side effects. Do not administer with high fat meals; clavulanate absorption is decreased. XR tablet is scored and can be broken for ease of administration. Capsule contents may be emptied and swallowed with liquids. Chewable tablets should be crushed or chewed before swallowing with liquids. Shake oral suspension before administering. Refrigerated reconstituted suspension should be discarded after 10 days.
- Two 250-mg tablets are not bioequivalent to one 500-mg tablet; 250-mg tablets and 250-mg chewable tablets are also not interchangeable. Two 500–mg tablets are not interchangeable with one 1000–mg XR tablet; amounts of clavulanic acid and durations of action are different. Augmentin ES 600 (600 mg/5 ml) does not contain the same amount of clavulanic acid as any of the other Augmentin suspensions. Suspensions are not interchangeable.

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amphotericin B deoxycholate (am-foe-**ter**-i-sin)
Fungizone

amphotericin B cholesteryl sulfate
Amphotec

amphotericin B lipid complex
Abelcet

amphotericin B liposome
AmBisome

Classification
Therapeutic: antifungals

Pregnancy Category B

Indications
IV: Treatment of active, progressive, potentially fatal fungal infections. **Amphotericin B liposome:** Management of suspected fungal infections in febrile neutropenic patients. Treatment of visceral leishmaniasis, Treatment of crytococcal meningitis in HIV patients. **PO:** Treatment of oral candidiasis. **Topical:** Treatment of superficial fungal infections.

Action
Binds to fungal cell membrane, allowing leakage of cellular contents. Toxicity (especially acute infusion reactions and nephrotoxicity) is less with lipid formulations. **Therapeutic Effects:** Fungistatic action. **Spectrum:** Active against: Aspergillosis, Blastomycosis, *Candida*, Coccidioidomycosis, Cryptococcosis, Histoplasmosis, Leishmaniasis, Mucormycosis.

Pharmacokinetics
Absorption: Not absorbed orally. Topical and oral preparations are not significantly absorbed.

Distribution: After administration, distributed to body tissues and fluids. Poor penetration into CSF. *Cholesteryl*—taken up by liver, spleen, and bone marrow, then slowly released.
Metabolism and Excretion: Elimination is very prolonged. Detectable in urine up to 7 wk after discontinuation.
Half-life: Biphasic—initial phase, 24–48 hr; terminal phase, 15 days. *Cholesteryl*—28 hr. *Liposomal*—174 hr.

TIME/ACTION PROFILE (blood levels)

ROUTE	ONSET	PEAK	DURATION
IV	rapid	end of infusion	24 hr

Contraindications/Precautions
Contraindicated in: Hypersensitivity. Lactation.
Use Cautiously in: Renal impairment or electrolyte abnormalities; Patients receiving concurrent leukocyte transfusions (increased risk of pulmonary toxicity with lipid complex formulation only); Pregnancy (has been used safely).

Adverse Reactions/Side Effects
CNS: headache, dizziness, tremor. **Resp:** dyspnea, hypoxia, wheezing. **CV:** hypotension, arrhythmias. **GI:** diarrhea, nausea, vomiting, abdominal pain, enlarged abdomen. **GU:** nephrotoxicity, hematuria. **F and E:** hypokalemia, hypocalcemia (cholesteryl only), hypomagnesemia. **Hemat:** anemia, dyscrasias. **Local:** phlebitis. **MS:** arthralgia, myalgia. **Neuro:** peripheral neuropathy. **Misc:** HYPERSENSITIVITY REACTIONS, chills, fever, acute infusion reactions.

Interactions
Drug-Drug: Increased risk of renal toxicity, bronchospasm, and hypotension with **antineoplastics**. Concurrent use with **corticosteroids** increases the risk of hypokalemia and cardiac dysfunction. Concurrent use with **zidovudine** may increase the risk of myelotoxicity and nephrotoxicity.

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amphotericin B deoxycholate

Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation
- Do not confuse amphotericin B cholesteryl sulfate (Amphotec) with amphotericin deoxycholate (Fungizone), amphotericin B lipid complex (Abelcet), or amphotericin B liposome (AmBisome); they are not interchangeable.
- Administer IV only to hospitalized patients or those under close supervision. Diagnosis should be confirmed before administration.

Amphotericin B Deoxycholate
- **IV:** Reconstitute 50-mg vial with 10 ml of sterile water for injection without bacteriostatic agent. Concentration equals 5 mg/ml. Shake until clear. Further dilute each 1 mg with at least 10 ml of D5W (pH >4.2) for a concentration of 100 mcg (0.1 mg)/ml. Do not use other diluents. Avoid use of precipitated solution. Use 20-gauge needle; change for each step of dilution. Wear gloves while handling. Store in dark area. Reconstituted solution is stable for 24 hr at room temperature and for 1 wk if refrigerated.
- **Test Dose:** Administer 1 mg in 20 ml of D5W over 10–30 min to determine patient tolerance. If medication is withheld for 7 days, restart at lowest dose level. In severe, life-threatening infections, test dose may be omitted.
- **Intermittent Infusion:** Administer preferably through central line. If peripheral site is used, change site with each dose to prevent phlebitis. If an in-line filter is used, the mean pore diameter should be no less than 1 micron. Short-term exposure to light (8 hr) does not alter potency. ***Rate:*** Administer slowly via infusion pump over 2–6 hr.
- **Syringe Compatibility:** heparin.
- **Y-Site Compatibility:** aldesleukin, diltiazem, tacrolimus, teniposide, thiotepa, zidovudine.
- **Y-Site Incompatibility:** allopurinol sodium, amifostine, aztreonam, cefepime, docetaxel, doxorubicin liposome, enalaprilat, etoposide, filgrastim, fluconazole, fludarabine, foscarnet, gemcitabine, granisetron, melphalan, meropenem, ondansetron, paclitaxel, piperacillin/tazobactam, propofol, vinorelbine.

Amphotericin B Cholesteryl Sulfate
- **IV:** Reconstitute 50-mg vial with 10 ml and 100-mg vial with 20 ml of sterile water for injection. Concentration equals 5 mg/ml. Shake gently until solids have dissolved. Solution may be opalescent. Further dilute with D5W for a concentration of 0.6 mg/ml. Do not use other diluents. Avoid use of precipitated solution. Use 20-gauge needle; change for each step of dilution. Wear gloves while handling.
- Refrigerate after reconstitution and further dilution; use within 24 hr.
- **Test Dose:** Administer 10 ml of the final preparation (containing 1.6–8.3 mg) over 15–30 min to determine patient tolerance. Observe patient closely for next 30 min. If medication is withheld for 7 days, restart at lowest dose level. In severe, life-threatening infections, test dose may be omitted. ***Rate:*** Administer at a rate of 1 mg/kg/hr via infusion pump. If patient tolerates infusion without adverse reactions, infusion time may be shortened to a minimum of 2 hr. If reactions occur or patient cannot tolerate volume, infusion time may be extended. Rapid infusions may cause hypotension, hypokalemia, arrhythmias, and shock.
- **Y-Site Compatibility:** acyclovir, aminophylline, ceftizoxime, clindamycin, fentanyl, furosemide, ganciclovir, granisetron, hydrocortisone, ifosfamide, lorazepam, mannitol, methotrexate, methylprednisolone, nitroglycerin, trimethoprim/sulfamethoxazole, vinblastine, vincristine, zidovudine.

Cyclosporine increases the risk of nephrotoxicity. Combined use with **flucytosine** increases antifungal activity but may increase the risk of toxicity from flucytosine. Combined use with **azole antifungals** may induce resistance. Increased risk of nephrotoxicity with other **nephrotoxic agents. Thiazide diuretics, corticosteroids** may potentiate hypokalemia. Hypokalemia from amphotericin increases the risk of **digoxin** toxicity. Hypokalemia may enhance the curariform effects of **neuromuscular blocking agents**.

Route/Dosage

Specific dosage and duration of therapy depend on nature of infection being treated.

Amphotericin Deoxycholate (Fungizone)

IV (Adults): Give test dose of 1 mg, then initial dose of 0.25 mg/kg; increase daily doses slowly to 0.5–0.7 mg/kg (some infections may require 1.5 mg/kg/day; alternate-day dosing may be used).
IV (Children): 0.25 mg/kg infused initially; increase by 0.25 mg/kg every other day to maximum of 1 mg/kg/day.
Topical (Adults and Children): Apply 2–4 times daily.
PO (Adults and Children): 1 ml 4 times daily.

Amphotericin B Cholesteryl Sulfate (Amphotec)

IV (Adults and Children): 3–4 mg/kg/day (up to 6 mg/kg/day).

Amphotericin B Lipid Complex (Abelcet)

IV (Adults and Children): 5 mg/kg/day.

Amphotericin B Liposome (AmBisome)

IV (Adults and Children): *Suspected fungal infections*—3 mg/kg q 24 hr; *documented fungal infections*—3–5 mg/kg q 24 hr; *visceral leishmaniasis (immunocompetent patients)*—3 mg/kg q 24 hr on days 1–5, then 3 mg/kg on days 14 and 21; *visceral leishmaniasis (immunosuppressed patients)*—4 mg/kg q 24 hr on days 1–5, then 4 mg/kg on days 10, 17, 24, 31, and 38; *cryptococcal meningitis in HIV patients*—6 mg/kg/day.

NURSING IMPLICATIONS

Assessment

- Monitor patient closely during test dose and the first 1–2 hr of each dose for fever, chills, headache, anorexia, nausea, or vomiting. Premedicating with antipyretics, corticosteroids, antihistamines, meperidine, and antiemetics and maintaining sodium balance may decrease these reactions. Febrile reaction usually subsides within 4 hr after the infusion is completed.
- Assess injection site frequently for thrombophlebitis or leakage. Drug is very irritating to tissues. Adding heparin to IV solution may decrease the likelihood of thrombophlebitis.
- Monitor vital signs every 15–30 min during test dose and every 30 min for 2–4 hr after administration Meperidine and dantrolene have been used to prevent and treat rigors. Assess respiratory status (lung sounds, dyspnea) daily. Notify physician of changes. If respiratory distress occurs, discontinue infusion immediately; anaphylaxis may occur. Equipment for cardiopulmonary resuscitation should be readily available.
- Monitor intake and output and weigh daily. Adequate hydration (2000–3000 ml/day) may minimize nephrotoxicity.
- ***Lab Test Considerations:*** Monitor CBC and platelet counts weekly, BUN and serum creatinine every other day while increasing dose and then twice weekly, and potassium and magnesium levels biweekly. Life-threatening hypokalemia may occur after each dose If BUN exceeds 40 mg/100 ml or serum creatinine exceeds 3 mg/100 ml, dosage should be decreased or discontinued until renal function improves. May cause decreased hemoglobin, hematocrit, and magnesium levels.

Potential Nursing Diagnoses

Risk for infection (Indications)

CONTINUED

Amphotericin B Lipid Complex

- **IV:** Prepare immediately before use. Shake vial gently until yellow sediment at bottom has dissolved. Withdraw dose from required number of vials with 18-gauge needle. Replace needle from syringe filled with amphotericin B lipid complex with 5-micron filter needle. Each filter needle may be used to filter the contents of no more than 4 vials. Insert filter needle of syringe into IV bag of D5W and empty contents of syringe into bag for a concentration of 1 mg/ml (2 mg/ml in pediatric patients or patients who cannot tolerate large volumes of fluid). Do not use admixtures containing foreign matter. Vials are for single use only; discard unused material. Refrigerate after dilution. May be stored in refrigerator for up to 48 hr and an additional 6 hr at room temperature.
- **Intermittent Infusion:** Do not use an in-line filter. ***Rate:*** Administer at a rate of 2.5 mg/kg/hr via infusion pump. If infusion exceeds 2 hr, mix contents by shaking infusion bag every 2 hr.
- **Y-Site Incompatibility:** Flush IV line with D5W before infusion or use a separate line.
- **Topical:** While wearing gloves, apply topical preparations liberally and rub in well. Shake lotion before applying. Do not use occlusive dressings. Discontinue if lesions worsen or signs of hypersensitivity develop.

Amphotericin B Liposome

- **Intermittent Infusion:** To reconstitute, add 12 ml of sterile water without bacteriostatic agent to 50-ml vial for a concentration of 4 mg/ml. Immediately shake vial vigorously for at least 30 seconds until all particulate matter is completely dispersed. Withdraw appropriate volume for dilution. Using 5-micron filter, dilute in D5W for a concentration of 1–2 mg/ml. Lower concentrations may be used for infants and small children to provide sufficient volume for infusion. Reconstituted solution is stable for 24 hr if refrigerated. Diluted solution should be used within 6 hr of dilution. ***Rate:*** Administer over 2 hr. May be increased to 1 hr in patients who tolerate infusion well. If discomfort occurs during infusion, duration of infusion may be increased. May be administered through an in-line filter with pore diameter of at least 1 micron.
- **Y-Site Incompatibility:** If administered through an existing line, flush line with D5W before infusion or use separate lines.

Patient/Family Teaching

- Explain need for long duration of IV or topical therapy.
- **PO:** Instruct patient to swish medication around in mouth as long as possible before swallowing.
- **IV:** Inform patient of potential side effects and discomfort at IV site. Advise patient to notify health care professional if side effects occur.
- **Home Care Issue:** Instruct family or caregiver on dilution, rate, and administration of drug and proper care of IV equipment.
- **Topical:** Advise patient that topical preparations may stain clothing. Cream or lotion may be removed with soap and warm water; ointment may be removed with cleaning fluid.

Evaluation/Desired Outcomes

- Resolution of signs and symptoms of infection. Several weeks to months of therapy may be required to prevent relapse.

Why was this drug prescribed for your patient?

ampicillin/sulbactam (am-pi-**sill**-in/sul-**bak**-tam)

Unasyn

Classification

Therapeutic: anti-infectives
Pharmacologic: aminopenicillins/beta lactamase inhibitors

Pregnancy Category B

Indications

Treatment of a variety of skin, skin structure, and soft-tissue infections including: Otitis media, Sinusitis, Respiratory tract infections, GU tract infections, Meningitis, Septicemia.

Action

Binds to bacterial cell wall, resulting in cell death; spectrum is broader than penicillin. Addition of sulbactam increases resistance to beta-lactamases, enzymes that may inactivate ampicillin. **Therapeutic Effects:** Bactericidal action. **Spectrum:** Active against: Streptococci, Pneumococci, Enterococci, *Haemophilus influenzae*, *Escherichia coli*, *Proteus mirabilis*, *Neisseria meningitidis*, *Neisseria gonorrhoeae*, *Shigella*, *Salmonella*, *Bacteroides fragilis*. Reserve for infections caused by beta-lactamase–producing strains.

Pharmacokinetics

Absorption: Well absorbed from IM sites.
Distribution: Diffuses readily into most body tissues and fluids. CSF penetration is increased in the presence of inflamed meninges. Crosses the placenta and enters breast milk in small amounts.
Metabolism and Excretion: Ampicillin is variably metabolized by the liver (12–50%); sulbactam is excreted unchanged in urine. Renal excretion is also variable.
Half-life: Ampicillin—1–1.5 hr; sulbactam—1–1.4 hr.

TIME/ACTION PROFILE (blood levels)

ROUTE	ONSET	PEAK	DURATION
IM	rapid	1 hr	6–8 hr
IV	immediate	end of infusion	6–8 hr

Contraindications/Precautions

Contraindicated in: Hypersensitivity to penicillins or sulbactam.
Use Cautiously in: Renal insufficiency (dosage reduction required if CCr <30 ml/min); Infectious mononucleosis (increased incidence of rash).

Adverse Reactions/Side Effects

CNS: SEIZURES (high doses). **GI:** PSEUDOMEMBRANOUS COLITIS, diarrhea, nausea, vomiting. **Derm:** rashes, urticaria. **Hemat:** blood dyscrasias. **Local:** pain at IM site, pain at IV site. **Misc:** allergic reactions including ANAPHYLAXIS and SERUM SICKNESS, superinfection.

Interactions

Drug-Drug: Probenecid increases blood levels of ampicillin; therapy may be combined for this purpose. May potentiate the effect of **warfarin**. Concurrent **allopurinol** increases the risk of rash. May decrease effectiveness of **hormonal contraceptive agents**.

Route/Dosage

IM, IV (Adults): 1.5–3 g (1 g ampicillin plus 0.5 g sulbactam or 2 g ampicillin plus 1 g sulbactam) q 6–8 hr (not to exceed 4 g sulbactam/day).
IV (Children ≥ 1 yr): 75 mg (50 mg ampicillin/25 mg sulbactam)/kg q 6 hr.

NURSING IMPLICATIONS

Assessment

- Assess patient for infection (vital signs; wound appearance, sputum, urine, stool, and WBC) at beginning and throughout course of therapy.

ANGIOTENSIN-CONVERTING ENZYME (ACE) INHIBITORS

benazepril
(ben-**aye**-ze-pril)
Lotensin

captopril
(**kap**-toe-pril)
Capoten

enalapril/enalaprilat
(e-**nal**-a-pril/e-**nal**-a-pril-at)
Vasotec, Vasotec IV

fosinopril
(foe-**sin**-oh-pril)
Monopril

lisinopril
(lyse-**in**-oh-pril)
Prinivil, Zestril

moexipril
(moe-**eks**-i-pril)
Univasc

perindopril
(per-**in**-doe-pril)
Aceon

quinapril
(**kwin**-a-pril)
Accupril

ramipril
(ra-**mi**-pril)
Altace

trandolapril
(tran-**doe**-la-pril)
Mavik

Classification

Therapeutic: antihypertensives
Pharmacologic: ACE inhibitors

Pregnancy Category C (first trimester), D (second and third trimesters)

Indications

Alone or with other agents in the management of hypertension. **Captopril, enalapril, fosinopril, lisinopril, perindopril, quinapril, ramipril, trandolapril:** Management of congestive heart failure (CHF). **Captopril, lisinopril, ramipril, trandolapril:** Reduction of risk of death or development of CHF following myocardial infarction (MI). Slowed progression of left ventricular dysfunction into overt heart failure (selected agents). **Ramipril:** Reduction of the risk of MI, stroke, and death from cardiovascular disease in patients at risk (>55 years old with a history of cardiovascular disease, stroke, peripheral vascular disease, or diabetes with another risk factor such as hypercholesterolemia or cigarette smoking). **Captopril:** Decreased progression of diabetic nephropathy. **Unlabeled uses: Lisinopril:** Prevention of migraine headaches.

Action

Angiotensin-converting enzyme (ACE) inhibitors block the conversion of angiotensin I to the vasoconstrictor angiotensin II. ACE also inactivates the vasodilator bradykinin and other vasodilatory prostaglandins. ACE inhibitors also increase plasma renin levels and reduce aldosterone levels. Net result is systemic vasodilation. **Therapeutic Effects:** Lowering of blood pressure in hypertensive patients. Decreased afterload in patients with CHF. Decreased development of overt heart failure. Increased survival after MI (selected agents only). Decreased progression of diabetic nephropathy (captopril only).

Pharmacokinetics

Absorption: *Benazepril*—at least 37% absorbed following oral administration. *Captopril*—at least 75% following oral administration (decreased to 30–55% by food). *Enalapril*—60% absorbed following oral administration. *Enalaprilat*—IV administration results in complete bioavailability. *Fosinopril*—36% absorbed following oral administration. *Lisinopril*—25% absorbed following oral administration (much variability). *Moexipril*—Converted to moexiprilat (the active form) following oral administration; absorption is variable (decreased by food), resulting in 13% bioavailability as moexiprilat. *Perindopril*—75% absorbed following oral administration; rapidly converted to perindoprilat (35% bioavailability for perindoprilat). *Quinapril*—60% absorbed following oral administration (high-fat meal

- Obtain a history before initiating therapy to determine previous use and reactions to penicillins or cephalosporins. Persons with a negative history of penicillin sensitivity may still have an allergic response.
- Obtain specimens for culture and sensitivity before initiating therapy. First dose may be given before receiving results.
- Observe patient for signs and symptoms of anaphylaxis (rash, pruritus, laryngeal edema, wheezing). Discontinue the drug and notify the physician or other health care professional immediately if these problems occur. Keep epinephrine, an antihistamine, and resuscitation equipment close by in case of an anaphylactic reaction.
- ***Lab Test Considerations:*** May cause increased AST, ALT, LDH, bilirubin, alkaline phosphatase, BUN, and creatinine levels.
- May cause decreased hemoglobin, hematocrit, RBC, WBC, neutrophil, and lymphocytes.

Potential Nursing Diagnoses

Risk for infection (Indications, Side Effects)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- **IM:** Reconstitute for IM use by adding 3.2 ml of sterile water or 0.5% or 2% lidocaine HCl to the 1.5-g vial or 6.4 ml to the 3-g vial. Administer within 1 hr of preparation, deep into well-developed muscle.
- **IV:** For IV use add 3.2 ml of sterile water for injection to each 1.5-g vial and 6.4 ml to each 3-g vial for a concentration of 250 mg ampicillin/ml and 125 mg sulbactam/ml. Foaming should dissipate on standing. Administer only clear solutions.
- **Direct IV:** May be administered over 10–15 min (1–2 g) within 1 hr of reconstitution. More rapid administration may cause seizures.
- **Intermittent Infusion:** Dilute immediately for infusion in 50 ml or more of 0.9% NaCl, D5W, D5/0.45% NaCl, or LR solution. Stability of solution varies from 2–8 hr at room temperature or 3–72 hr if refrigerated, depending on concentration and diluent.
- **Y-Site Incompatibility:** If aminoglycosides and penicillins must be given concurrently, administer in separate sites at least 1 hr apart.

Patient/Family Teaching

- Advise patient to report the signs of superinfection (furry overgrowth on the tongue, vaginal itching or discharge, loose or foul-smelling stools) and allergy.
- Advise patients taking oral contraceptives to use an alternative or additional nonhormonal method of contraception while taking ampicillin/sulbactam and until next menstrual period.
- **Caution patient to notify health care professional if fever and diarrhea occur, especially if stool contains blood, pus, or mucus. Advise patient not to treat diarrhea without consulting health care professional. May occur up to several weeks after discontinuation of medication.**
- Instruct patient to notify health care professional if symptoms do not improve.

Evaluation/Desired Outcomes

- Resolution of the signs and symptoms of infection. Length of time for complete resolution depends on the organism and site of infection.

Why was this drug prescribed for your patient?

may decrease absorption). *Ramipril*—50–60% absorbed following oral administration. *Trandolapril*—Converted to trandolaprilat (the active form) following oral administration; bioavailability 10%, 70% for trandolaprilat.

Distribution: All ACE inhibitors cross the placenta. *Benazepril, benazeprilat, captopril,* and *fosinoprilat*—Enter breast milk in small amounts. *Enalapril* and *enalaprilat*—Small amounts enter breast milk. *Lisinopril*—Minimal penetration of CNS. *Ramipril*—Probably does not enter breast milk. *Trandolapril*—Enters breast milk.

Protein Binding: *Benazepril*—96.7% (*benazeprilat*—95.3%), *fosinopril*—89–99.8%, *quinapril*—97%.

Metabolism and Excretion: *Benazepril*—Converted by the liver to benazeprilat, the active metabolite. 20% eliminated by the kidneys; 10–11% nonrenal (biliary) elimination. *Captopril*—50% metabolized by the liver to inactive compounds, 50% excreted unchanged by the kidneys. *Enalapril, enalaprilat*—Enalapril is converted by the liver to enalaprilat, the active metabolite; 60% eliminated by the kidneys (20% as enalapril and 60% as enalaprilat; 33% eliminated in feces (6% as enalapril and 27% as enalaprilat. *Fosinopril*—Converted by the liver and GI mucosa to fosinoprilat, the active metabolite; 50% eliminated by the kidneys; 50% fecal elimination. *Lisinopril*—100% eliminated by the kidneys. *Moexipril*—7% excreted in urine, 53% in feces. *Perindopril*—converted by the liver to perindoprilat, the active metabolite; perindoprilat and its metabolites are mostly eliminated by renal clearance. *Quinapril*—Converted by the liver, GI mucosa, and tissue to quinaprilat, the active metabolite; 61% eliminated by the kidneys; 37% fecal elimination. *Ramipril*—Metabolized by the liver to ramiprilat, the active metabolite; 60% eliminated by the kidneys; 40% fecal elimination. *Trandolapril*—Converted by liver to trandolaprilat; 33% excreted in urine as trandolaprilat, 66% in feces.

Half-life: *Benazeprilat*—10–11 hr. *Captopril*—<3 hr (increased in renal impairment). *Enalapril* and *enalaprilat*—11 hr (increased in renal impairment). *Fosinoprilat*—11.5 hr. *Lisinopril*—12 hr (increased in renal impairment). *Moexiprilat*—12 hr. *Perindoprilat*—10 hr, followed by a longer elimination half-life of 30–120 hr reflecting slow dissociation from plasma and tissue binding sites. *Quinaprilat*—2 hr. *Ramiprilat*—13–17 hr (increased in renal impairment). *Trandolaprilat*—10 hr.

TIME/ACTION PROFILE (effect on blood pressure—single dose*)

ROUTE	ONSET	PEAK	DURATION
Benazepril	within 1 hr	2–4 hr	24 hr
Captopril	15–60 min	60–90 min	6–12 hr
Enalapril PO	1 hr	4–6 hr	24 hr
Enalapril IV	15 min	1–4 hr	6 hr
Fosinopril	within 1 hr	2–6 hr	24 hr
Lisinopril	1 hr	6 hr	24 hr
Moexipril	within 1 hr	3–6 hr	up to 24 hr
Perindopril	unknown	3–7 hr	12–24 hr
Quinapril	within 1 hr	2–4 hr	up to 24 hr
Ramipril	within 1–2 hr	4–6.5 hr	24 hr
Trandolapril	within 1 hr	4–10 hr	up to 24 hr

*Full effects may not be noted for several weeks

Contraindications/Precautions

Contraindicated in: Hypersensitivity. Cross-sensitivity among ACE inhibitors may occur. Pregnancy. Angioedema (hereditary or idiopathic).

Use Cautiously in: Renal impairment, hepatic impairment, hypovolemia, hyponatremia, elderly patients, concurrent diuretic therapy (initial dosage reduction may be necessary); Black hypertensive patients (monotherapy less effective, may require additional therapy); Aortic stenosis/hypertrophic cardiomyopathy; Cerebrovascular or cardiac insufficiency; Surgery/anesthesia (hypotension may be exaggerated); Lactation or children (safety not established; most agents)

Exercise Extreme Caution in: Family history of angioedema.

Adverse Reactions/Side Effects

CNS: dizziness, fatigue, headache, insomnia, weakness. **Resp:** cough, eosinophilic pneumonitis. **CV:** hypotension, angina pectoris, tachycardia. **GI:**

CONTINUED

CONTINUED

ANGIOTENSIN-CONVERTING ENZYME (ACE) INHIBITORS

taste disturbances, anorexia, diarrhea, hepatotoxicity (rare), nausea. **GU:** proteinuria, impotence, renal failure. **Derm:** rashes. **F and E:** hyperkalemia. **Hemat:** AGRANULOCYTOSIS, NEUTROPENIA (captopril only). **Misc:** ANGIOEDEMA, fever.

Interactions

Drug-Drug: Excessive hypotension may occur with concurrent use of **diuretics** other **antihypertensives**, **nitrates**, **phenothiazines**, acute ingestion of **alcohol**, and during **surgery** or **general anesthesia**. Hyperkalemia may result from concurrent use of **potassium supplements**, **potassium-sparing diuretics**, **indomethacin**, **salt substitutes**, or **cyclosporine**. Antihypertensive response may be ↓ by **NSAIDs**. Absorption may be decreased by **antacids**. ↑ levels and may ↑ risk of **lithium** or **digoxin** toxicity. **Probenecid** ↓ elimination and ↑ levels of captopril. Risk of hypersensitivity reactions ↑ with **allopurinol**. **Capsaicin** may ↑ incidence of cough. **Rifampin** may ↓ effectiveness of enalapril. **Tetracycline** absorption is ↓ by quinapril (because of magnesium in tablets).
Drug-Food: Food ↓ conversion of perindopril to perindoprilat.

Route/Dosage

Benazepril

PO (Adults): 5–10 mg once daily, increased gradually to maintenance dose of 20–40 mg/day as single dose or 2 divided doses (begin with 5 mg/day in patients receiving diuretics or who have renal impairment).

Captopril

PO (Adults): *Hypertension*—12.5–25 mg 2–3 times daily, may be increased at 1–2 wk intervals up to 150 mg 3 times daily (usual dose 50 mg 3 times daily; begin with 6.25–12.5 mg 2–3 times daily in patients receiving diuretics or with renal impairment). *CHF*—12.5 mg 2–3 times daily, may be increased up to 50–100 mg 3 times daily (range 12.5–450 mg/day). *PostMI*—6.25-mg test dose, followed by 12.5 mg 3 times daily, may be increased up to 50 mg 3 times daily. *Diabetic nephropathy*—25 mg 3 times daily.

Enalapril/Enalaprilat

PO (Adults): *Hypertension*—5 mg/day (2.5 mg/day if CCr <30 ml/min), increased as required by response (usual range 10–40 mg/day in 1–2 divided doses; initiate therapy at 2.5 mg/day in patients receiving diuretics). *CHF*—2.5 mg 1–2 times daily, then 5 mg/day, increased as required by response (usual range 5–20 mg/day in 1–2 divided doses). *Asymptomatic left ventricular dysfunction*—2.5 mg twice daily, titrated upward to a target dose of 10 mg twice daily.
IV (Adults): 0.625–1.25 mg (0.625 mg if receiving diuretics) q 6 hr.

Fosinopril

PO (Adults): *Hypertension*—10 mg once daily, may be increased as required (range 20–40 mg once daily). *CHF*—10 mg once daily (5 mg in patients who have been vigorously diuresed), may be increased over several weeks up to 40 mg/day (usual range 20–40 mg/day).

Lisinopril

PO (Adults): *Hypertension*—10 mg once daily, can be increased up to 20–40 mg/day (initiate therapy at 5 mg/day in patients receiving diuretics or CCr <10 ml/min–30 ml/min). *CHF*—2.5–5 mg once daily, can be increased up to 50 mg/day. *Improved survival after MI*—5 mg once daily for 2 days, then 10 mg daily for 6 wk.

Moexipril

PO (Adults): 7.5 mg once daily, may be increased as needed (usual range is 7.5–30 mg/day in 1–2 divided doses; begin with 3.75 mg in patients receiving diuretics or CCr <40 ml/min).

CONTINUED

ANGIOTENSIN-CONVERTING ENZYME (ACE) INHIBITORS

Deficient knowledge, related to medication regimen (Patient/Family Teaching)
Noncompliance (Patient/Family Teaching)

Implementation

- **Do not confuse Lotensin (benazepril) with Loniten (minoxidil) or Lovastatin. Do not confuse enalapril with Eldepryl (seligiline). Do not confuse Monopril (fosinopril) with Accupril (quinapril), minoxidil, or Monoket (isosorbide mononitrate). Do not confuse Prinivil (lisinopril) with Plendil (felodipine) or Prilosec (omeprazole). Do not confuse Accupril (quinapril) with Accutane (isotretinoin). Do not confuse Altace (ramipril) with Artane (trihexyphenidyl).**
- Available in combinations: benazepril with amlodipine (Lotrel), benazepril with hydrocholrothiazide (Lotensin HCT), captopril with hydrochlorothiazide (Capozide), enalapril with diltiazem (Teczem), enalapril with felodopine (Lexxel), enalapril with hydrochlorothiazide (Vaseretic), lisinopril with hydrochlorothiazide (Prinzide, Zestoretic), moexipril with hydrochlorothiazide (Uniretic), quinapril with hydrochlorothiazide (Accuretic, Quinaretic), trandolapril with verapamil (Tarka) (see Appendix A).
- **PO:** Precipitous drop in blood pressure during first 1–3 hr following first dose may require volume expansion with normal saline but is not normally considered an indication for stopping therapy. Discontinuing diuretic therapy or increasing salt intake 1 wk before initiation may decrease risk of hypotension. Monitor closely for at least 1 hr after blood pressure has stabilized. Resume diuretics if blood pressure is not controlled.

Benazepril

- **PO:** For patients with difficulty swallowing tablets, pharmacist may compound suspension; stable for 30 days if refrigerated. Shake suspension before each use.

Captopril

- **PO:** Administer 1 hr before or 2 hr after meals. Tablets may be crushed if patient has difficulty swallowing. Tablets may have a sulfurous odor.

Enalaprilat

- **Direct IV:** May be administered undiluted. ***Rate:*** Administer over at least 5 min.
- **Intermittent Infusion:** Dilute in up to 50 ml of D5W, 0.9% NaCl, D5/0.9% NaCl, or D5/LR. Diluted solution is stable for 24 hr. ***Rate:*** Administer as a slow infusion.
- **Y-Site Compatibility:** allopurinol, amifostine, amikacin, aminophylline, ampicillin, ampicillin/sulbactam, aztreonam, bivalirudin, butorphanol, calcium gluconate, cefazolin, cefoperazone, ceftazidime, ceftizoxime, chloramphenicol, cimetidine, cisatracurium, cladribine, clindamycin, dexmedetomidine, dextran 40, dobutamine, docetaxel, dopamine, doxorubicin liposome, erythromycin lactobionate, esmolol, etoposide phosphate, famotidine, fenoldopam, fentanyl, filgrastim, ganciclovir, gatifloxacin, gemcitabine, gentamicin, granisetron, heparin, hetastarch, hydrocortisone sodium succinate, labetalol, lidocaine, linezolid, magnesium sulfate, melphalan, meropenem, methylprednisolone sodium succinate, metronidazole, morphine, nafcillin, nitroprusside, penicillin G potassium, phenobarbital, piperacillin, piperacillin/tazobactam, potassium chloride, potassium phosphate, propofol, ranitidine, remifentanil, sodium acetate, teniposide, thiotepa, tobramycin, trimethoprim/sulfamethoxazole, vancomycin, vinorelbine.

Perindopril

PO (Adults): 4 mg once daily; may be titrated upward to 16 mg/day as a single dose or 2 divided doses (begin with 2–4 mg/day inpatients receiving diuretics).

PO (Geriatric Patients): 4 mg once daily initially; may be titrated upward to 8 mg/day as a single dose or 2 divided doses.

Quinapril

PO (Adults): *Hypertension*—10–20 mg once daily initially, may be titrated no more often than every 2 wk up to 80 mg/day in single or two divided daily doses (initiate therapy at 10 mg/day in patients receiving diuretics or CCr >60 ml/min, 5 mg/day if CCr 30–60 ml/min, 2.5 mg/day if CCr <30 ml/min).

PO (Adults): *CHF*—5 mg twice daily initially, may be titrated up to 40 mg/day.

Ramipril

PO (Adults): *Hypertension*—2.5 mg once daily, may be increased slowly as needed up to 20 mg/day in 1–2 divided doses (initiate therapy at 1.25 mg/day in patients receiving diuretics or CCr <40 ml/min). *CHF following MI*—1.25–2.5 mg twice daily initially, may be increased up to 5 mg twice daily.

Trandolapril

PO (Adults): *Hypertension in non-black patients:*—1 mg once daily; initiate therapy with 0.5 mg once daily in patients with renal or hepatic impairment. *Hypertension in black patients:*—2 mg once daily. May be increased weekly up to 4 mg once daily; twice daily dosing may be necessary in some patients (begin with 0.5 mg/day in patients receiving diuretics). *Heart failure post-MI or left ventricular dysfunction post-MI*—Initiate therapy at 1 mg once daily, titrate up to 4 mg once daily if possible.

NURSING IMPLICATIONS

Assessment

- **Hypertension:** Monitor blood pressure and pulse frequently during initial dose adjustment and periodically during therapy. Notify health care professional of significant changes.
- Monitor frequency of prescription refills to determine adherence.
- **CHF:** Monitor weight and assess patient routinely for resolution of fluid overload (peripheral edema, rales/crackles, dyspnea, weight gain, jugular venous distention).
- ***Lab Test Considerations:*** Monitor BUN, creatinine, and electrolyte levels periodically. Serum potassium may be ↑ and BUN and creatinine transiently ↑, whereas sodium levels may be ↓. If ↑ BUN or serum creatinine concentrations occur, dose reduction or withdrawal may be required.
- Monitor CBC periodically during therapy. May rarely cause slight ↓ in hemoglobin and hematocrit.
- May cause ↑ AST, ALT, alkaline phosphatase, serum bilirubin, uric acid, and glucose.
- Assess urine protein prior to and periodically during therapy for up to 1 yr in patients with renal impairment or those receiving >150 mg/day of captopril. If excessive or ↑ proteinuria occurs, re-evaluate ACE inhibitor therapy.
- May cause positive ANA titer.
- *Captopril:* May cause false-positive test results for urine acetone.
- **Monitor WBC with differential prior to initiation of therapy, monthly for the first 3–6 mo, and periodically thereafter for up to 1 yr in patients at risk for neutropenia (patients with renal impairment, collagen-vascular disease, or those receiving high doses) or at first sign of infection. Discontinue therapy if neutrophil count is <1000/mm³.**

Potential Nursing Diagnoses

Decreased cardiac output (Indications, Side Effects)

CONTINUED

- **Y-Site Incompatibility:** amphotericin B, amphotericin B cholesteryl sulfate, cefepime, phenytoin.
- **Additive Compatibility:** dobutamine, dopamine, heparin, meropenem, nitroglycerin, nitroprusside, potassium chloride.

Moexipril

- **PO:** Administer moexipril on an empty stomach, 1 hr before a meal.

Ramipril

- **PO:** Capsules may be opened and sprinkled on apple sauce, added to apple juice, or dissolved in 4 oz water for patients with difficulty swallowing. Effectiveness is same as capsule. Preprepared mixtures can be stored for up to 24 hr at room temperature or up to 48 hr if refrigerated.

Patient/Family Teaching

- Instruct patient to take medication as directed at the same time each day, even if feeling well. Take missed doses as soon as possible but not if almost time for next dose. Do not double doses. Warn patient not to discontinue ACE inhibitor therapy unless directed by health care professional.
- Caution patient to avoid salt substitutes or foods containing high levels of potassium or sodium unless directed by health care professional.
- Caution patient to change positions slowly to minimize hypotension, particularly after initial dose. Patients should also be advised that exercising in hot weather may increase hypotensive effects.
- Advise patient to consult health care professional before taking any OTC medications, especially cold remedies.
- May cause dizziness. Caution patient to avoid driving and other activities requiring alertness until response to medication is known.
- Advise patient to inform health care professional of medication regimen prior to treatment or surgery.
- Advise patient that medication may cause impairment of taste that generally resolves within 8–12 wk, even with continued therapy.
- **Instruct patient to notify health care professional if rash; mouth sores; sore throat; fever; swelling of hands or feet; irregular heart beat; chest pain; dry cough; hoarseness; swelling of face, eyes, lips, or tongue; difficulty swallowing or breathing occur;** or if taste impairment or skin rash persists. Persistent dry cough may occur and may not subside until medication is discontinued. Consult health care professional if cough becomes bothersome. Also notify health care professional if nausea, vomiting, or diarrhea occurs and continues.
- Emphasize the importance of follow-up examinations to monitor progress.
- **Hypertension:** Encourage patient to comply with additional interventions for hypertension (weight reduction, discontinuation of smoking, moderation of alcohol consumption, regular exercise, and stress management). Medication controls but does not cure hypertension.
- Instruct patient and family on correct technique for monitoring blood pressure. Advise them to check blood pressure at least weekly and to report significant changes to health care professional.

Evaluation/Desired Outcomes

- Decrease in blood pressure without appearance of side effects.
- Decrease in signs and symptoms of CHF.
- Reduction of risk of death or development of CHF following MI.
- Decrease in progression of diabetic nephropathy (captopril).

Why was this drug prescribed for your patient?

ANGIOTENSIN II RECEPTOR ANTAGONISTS

candesartan*
(can-de-**sar**-tan)
Atacand

eprosartan*
(ep-roe-**sar**-tan)
Teveten

irbesartan*
(ir-be-**sar**-tan)
Avapro

losartan*
(loe-**sar**-tan)
Cozaar

telmisartan*
(tel-mi-**sar**-tan)
Micardis

valsartan*
(val-**sar**-tan)
Diovan

Classification
Therapeutic: antihypertensives
Pharmacologic: angiotensin II receptor antagonists

Pregnancy Category C (first trimester), D (second and third trimesters)

Indications

Management of hypertension. Treatment of type 2 diabetic nephropathy in patients with type 2 diabetes and hypertension (irbesartan and losartan). Management of CHF in patients who cannot tolerate ACE inhibitors (candesartan and valsartan only). Reduced risk of stroke in patients with CHF and left ventricular hypertrophy; effect may be less in black patients(losartan only).

Action

Blocks vasoconstrictor and aldosterone-producing effects of angiotensin II at receptor sites, including vascular smooth muscle and the adrenal glands.

Therapeutic Effects: Lowering of blood pressure. Slowed progression of diabetic nephropathy (irbesartan, losartan). Decreased hospitalizations in patients with CHF. Reduced risk of stroke.

Pharmacokinetics

Absorption: *Candesartan*—Candesartan cilexetil is converted to candesartan in the GI tract where 15% is absorbed; *eprosartan*—13% absorbed; *irbesartan*—60–80% absorbed; *losartan*—well absorbed; withextensive first-pass hepatic metabolism, resulting in 33% bioavailability; *olmesartan* –26% absorbed following oral administration; *telmisartan*—42–58% absorbed following oral administration (bioavailability ↑ hepatic impairment); *valsartan*—25% absorbed following oral administration.
Distribution: Unknown; *candesartan*—minimal penetration of the blood-brain barrier.
Protein Binding: *eprosartan*—98%; *olmesartan* –99%;.
Metabolism and Excretion: *Candesartan*—Excreted mostly unchanged in urine and feces (via bile); minor metabolism by the liver; *eprosartan*—90% eliminated unchanged in feces via biliary elimination, 7% excreted in urine; *irbesartan*—some hepatic metabolism, some biliary excretion, some elimination as unchanged drug in urine; *losartan*—extensive first-pass hepatic metabolism; 14% is converted to an active metabolite. 4% of losartan is excreted unchanged by the kidneys; 6% of active metabolite is excreted unchanged by the kidneys, some biliary elimination; *olmesartan* – 35–50% excreted unchanged in urine, remainder excretded in feces via bile; *telmisartan*—excreted mostly unchanged in feces via biliary excretion, 11% metabolized by the liver; *valsartan*—20% metabolized by the liver; mostly excreted in feces via bile.
Half-life: *Candesartan*—9 hr; eprosartan—5–9 hr; *irbesartan*—11–15 hr; *losartan*—2 hr (6–9 hr for metabolite); *olmesartan* –13 hr; *telmisartan*—24 hr; *valsartan*—6 hr.

CONTINUED

ANGIOTENSIN II RECEPTOR ANTAGONISTS

Valsartan

PO (Adults): *Hypertension* 80 mg/day as a single dose initially in patients who are not receiving diuretics or other antihypertensives; may be increased to 160–320 mg/day; *CHF*—40 mg twice daily initially, may be titrated to 160 mg twice daily; concurrent ACE inhibitor and beta-blocker therapy not recommended; consider reduction of diuretics.

NURSING IMPLICATIONS

Assessment

- Assess blood pressure (lying down, sitting, standing) and pulse periodically during therapy.
- Monitor frequency of prescription refills to determine adherence.
- Assess patient for signs of angioedema (dyspnea, facial swelling). May rarely cause angioedema; more common in patients who have had angioedema with ACE inhibitors.
- **CHF:** Monitor intake and output ratios and daily weight. Assess for peripheral edema and auscultate lungs for rales/crackles during therapy.
- ***Lab Test Considerations:*** Monitor serum creatinine and urinary protein in patients treated for diabetic nephropathy.
- May rarely cause ↑ in BUN and serum creatinine.
- May cause ↑ serum bilirubin.
- May occasionally cause hyperkalemia.
- *Losartan* may cause transient ↑ of ALT and AST, hemoglobin, and hematocrit and ↓ uric acid concentrations.

Potential Nursing Diagnoses

Risk for injury (Adverse Reactions)
Deficient knowledge, related to disease processes and medication regimen (Patient/Family Teaching)
Noncompliance (Patient/Family Teaching)

Implementation

- **Do not confuse Diovan (valsartan) with Zyban (buproprion). Do not confuse valsartan with losartan.**
- Correct volume depletion, if possible, prior to initiation of therapy.
- Available in combination with various drugs: candesartan with hydrochlorothiazide (Atacand); eprosartan with hydrochlorothiazide (Teveten); irbesartan with hydrochlorothiazide (Avalide); losartan with hydrochlorothiazide (Hyzaar); olmesartan with hydrochlorothiazide (Benicar; telmisartan with hydrochlorothiazide (Micardis); valsartan (Diovan).
- **PO:** May be administered without regard to meals.

Patient/Family Teaching

- Emphasize the importance of continuing to take as directed, even if feeling well. Take missed doses as soon as remembered if not almost time for next dose; do not double doses. Medication controls but does not cure hypertension. Instruct patient to take medication at the same time each day. Gradual reduction of dose prior to discontinuation is suggested.
- Encourage patient to comply with additional interventions for hypertension (weight reduction, low-sodium diet, discontinuation of smoking, moderation of alcohol consumption, regular exercise, stress management).
- Instruct patient and family on proper technique for monitoring blood pressure. Advise them to check blood pressure at least weekly and to report significant changes.
- Caution patient to avoid sudden changes in position to decrease orthostatic hypotension. Use of alcohol, standing for long periods, exercising, and hot weather may increase orthostatic hypotension.
- Advise women of childbearing age to use contraception and notify health care professional if pregnancy is suspected or planned.

TIME/ACTION PROFILE (antihypertensive effect*)

ROUTE	ONSET	PEAK	DURATION
Candesartan	2–4 hr	6–8 hr	24 hr
Eprosartan	1–2 hr	unk	12–24 hr
Irbesartan	within 2 hr	3–14 hr	24 h
Losartan	unknown	6 hr	24 hr
Olmesartan	within 1 wk	2 wk	24 hr
Telmisartan	within 3 hr	unknown	24 hr
Valsartan	within 2 hr	4–6 hr	24 hr

*Maximum response may take 2–4 weeks of treatment

Contraindications/Precautions

Contraindicated in: Hypersensitivity. Pregnancy or lactation.

Use Cautiously in: Congestive heart failure (CHF) (may result in azotemia, oliguria, acute renal failure and/or death); Volume- or salt-depleted patients or patients receiving high doses of diuretics (correct deficits before initiating therapy or initiate at lower doses); Black patients (monotherapy may not be effective); Impaired renal function due to primary renal disease or CHF (may worsen renal function); Obstructive biliary disorders or hepatic impairment (lower initial doses of losartan, temisartan, or valsartan recommended); Patients with childbearing potential; Children <18 yr (safety not established).

Adverse Reactions/Side Effects

CNS: dizziness, fatigue, headache. **CV:** hypotension. **GI:** diarrhea, drug-induced hepatitis. **GU:** RENAL FAILURE. **F and E:** hyperkalemia.

Interactions

Drug-Drug: NSAIDs may ↓ antihypertensive effects. ↑ antihypertensive effects with other **antihypertensives** and **diuretics**. Risk of hypotension ↑ by concurrent **diuretics** (use lower initial doses). Telmisartan ↑ serum **digoxin** levels. Concurrent use of **potassium-sparing diuretics** or **potassium supplements** may ↑ risk of hyperkalemia. Candesartan may ↑ serum **lithium** levels; monitoring is required.

Route/Dosage

Candesartan

PO (Adults): *As monotherapy*—16 mg once daily. *Patients receiving diuretics or who are volume depleted*—initiate therapy at a lower dose (range 2–32 mg/day as a single dose or divided into two daily doses). *CHF*—4 mg once daily initially, dose may be doubled at 2 wk intervals up to target dose of 32 mg once daily.

Renal Impairment

PO (Adults): Initiate therapy at a lower dose.

Eprosartan

PO (Adults): 600 mg once daily, may also be given in divided doses twice daily (usual range 400–800 mg/day).

Irbesartan

PO (Adults): *Hypertension*—150 mg once daily; may be increased to 300 mg once daily. *Patients receiving diuretics, who are volume depleted, or who are being hemodialyzed*—initiate with 75 mg/day. *Type 2 diabetic nephropathy*—300 mg once daily.

Losartan

PO (Adults): 50 mg/day initially (range 25–100 mg/day as a single daily dose or 2 divided doses). *Patients receiving diuretics or who are volume depleted*—25 mg/day initially; may be increased as tolerated.

Hepatic Impairment

PO (Adults): 25 mg/day initially; may be increased as tolerated.

Olmesartan

PO (Adults): 20 mg once daily; patients who are volume-depleted should be started on a lower dose.

Telmisartan

PO (Adults): 40 mg/day (up to 80 mg/day).

CONTINUED

- May cause dizziness. Caution patient to avoid driving or other activities requiring alertness until response to medication is known.
- Advise patient to consult health care professional before taking any OTC or herbal cough, cold, or allergy remedies or other medications.
- Instruct patient to notify health care professional of medication regimen prior to treatment or surgery.
- Emphasize the importance of follow-up exams to evaluate effectiveness of medication.

Evaluation/Desired Outcomes

- Decrease in blood pressure without appearance of excessive side effects.
- Slowed progression of diabetic nephropathy.
- Decreased hospitalizations in patients with CHF.
- Reduced risk of stroke.

Why was this drug prescribed for your patient?

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aprepitant (a-**prep**-i-tant)

Emend

Classification

Therapeutic: antiemetics
Pharmacologic: neurokinin antagonists

Pregnancy Category B

Indications

Prevention of acute and delayed nausea and vomiting caused by initial/repeat treatment with highly emetogenic chemotherapy (with other antiemetics).

Action

Acts as a selective antagonist at substance P/neurokinin 1 (NK_1) receptors in the brain. **Therapeutic Effects:** Decreased nausea and vomiting associated with chemotherapy. Augments the antiemetic effects of dexamethasone and 5–HT_3 antagonists (ondansetron).

Pharmacokinetics

Absorption: 60–65% absorbed following oral administration.
Distribution: Crosses the blood brain barrier; remainder of distribution unknown.
Metabolism and Excretion: Mostly metabolized by the liver (CYP3A4 enzyme system); not renally excreted.
Half-life: 9–13 hr.

TIME/ACTION PROFILE (antiemetic effect)

ROUTE	ONSET	PEAK	DURATION
PO	1 hr	4 hr*	24 hr

*Blood level

Contraindications/Precautions

Contraindicated in: Lactation. Hypersensitivity. Concurrent use with pimozide (risk of life-threatening adverse cardiovascular reactions).
Use Cautiously in: Concurrent use with any agents metabolized by CYP3A4 (see Drug-Drug Interactions); Pregnancy (use only if clearly needed); Children (safety not established).

Adverse Reactions/Side Effects

CV: dizziness, fatigue, weakness. **GI:** diarrhea. **Misc:** hiccups.

Interactions

Drug-Drug: Aprepitant inhibits, induces and is metabolized by the CYP3A4 enzyme system; it also induces the CYP2C9 system. Concurrent use with other medications that are metabolized by CYP3A4 may result in increased toxicity from these agents including **docetaxel**, **paclitaxel**, **etoposide**, **irinotecan**, **ifosfamide**, **imatinib**, **vinorelbine**, **vinblastine**, **vincristine**, **midazolam**, **triazolam**, and **alprazolam**; concurrent use should be undertaken with caution. Concurrent use with **drugs that significantly inhibit the CYP3A4 enzyme system** including (**ketoconazole**, **itraconazole**, **nefazodone**, **clarithromycin**, **ritonavir**, **nelfinavir**, and **diltiazem**) may ↑ blood levels and effects of aprepitant. Concurrent use with **drugs that induce the CYP3A4 enzyme system** including **rifampin**, **carbamazepine**, and **phenytoin** may ↓ blood levels and effects of aprepitant. ↑ blood levels and effects of **dexamethasone**, (regimen reflects a 50% dose reduction); a similar effect occurs with **methylprednisolone** (↓ IV dose by 25%, ↓ PO dose by 50% when used concurrently). May ↓ the effects of **warfarin** (careful monitoring for 2 wk recommended), **oral contraceptives** (use alternate method), **tolbutamide** and **phenytoin**.

Route/Dosage

PO (Adults): 125 mg 1 hr prior to chemotherapy, then 80 mg once daily for 2 days (with dexamethasone 12 mg PO 30 min prior to chemotherapy,

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atomoxetine (a-to-**mox**-e-teen)

Strattera

Classification

Therapeutic:
Pharmacologic:

Pregnancy Category C

Indications

Treatment of Attention-Deficit/Hyperactivity Disorder (ADHD).

Action

Selectively inhibits the presynaptic transporter of norepinephrine. **Therapeutic Effects:** Increased attention span.

Pharmacokinetics

Absorption: Well absorbed following oral administration.
Distribution: Unknown.
Protein Binding: 98%.
Metabolism and Excretion: Mostly metabolized by the liver (CYP2D6 enzyme pathway). A small percentage of the population are poor metabolizers and will have higher blood levels with increased effects).
Half-life: 5 hr.

TIME/ACTION PROFILE

	ONSET	PEAK	DURATION
PO	unknown	1–2 hr	12–24 hr

Contraindications/Precautions

Contraindicated in: Concurrent or within 2 wk therapy with MAO inhibitors. Narrow angle glaucoma.

Use Cautiously in: Hypertension, tachycardia, cardiovascular or cerebrovascular disease; May ↑ risk of suicide attempt/ideation especially during dose early treatment or dose adjustment; risk may be greater in children or adolescents; Concurrent albuterol or vasopressors (increases risk of adverse cardiovascular reactions); Pregnancy (use only if benefits outweigh risks to fetus); Lactation or children <6 yr (safety not established).

Adverse Reactions/Side Effects

CNS: dizziness, fatigue, mood swings; *Adults*— insomnia. **CV:** hypertension, orthostatic hypotension, tachycardia. **GI:** dyspepsia, severe liver injury (rare), nausea, vomiting; *Adults*—dry mouth, constipation. **Derm:** rash, urticaria. **GU:** *Adults*— dysmenorrhea, ejaculatory problems, ↓ libido, impotence, urinary hesitation, urinary retention. **Metab:** decreased appetite, weight/growth loss. **Misc:** allergic reactions including ANGIONEUROTIC EDEMA.

Interactions

Drug-Drug: Concurrent use with **MAO inhibitors** may result in serious, potentially fatal reactions (do not use within 2 wk of each other). Increased risk of cardiovascular effects with **albuterol** or **vasopressors** (use cautiously). **Drugs which inhibit the CYP2D6 enzyme pathway** (**quinidine**, **fluoxetine**, **paroxetine**) will increase blood levels and effects, dosage ↓ recommended.

Route/Dosage

PO (Children and adolescents <70 kg): 0.5 mg/kg/day initially, may be increased every 3 days to a daily target dose of 1.2 mg/kg, given as a single dose in the morning or evenly divided doses in the morning and late afternoon/early evening (not to exceed 1.4 mg/kg/day or 100 mg/day whichever is less). *If taking concurrent CYP2D6 inhibitor (quinidine, fluoxetine, paroxetine)*—0.5 mg/kg/day initially, may increase if needed to 1.2 mg/kg/day after 4 wk.
PO (Adults, adolescents and children >70 kg): 40 mg/day initially, may be increased every 3 days to a daily target dose of 80 mg/day given as a

then 8 mg once daily for 3 days and ondansetron 32 mg IV 30 min prior to chemotherapy).

NURSING IMPLICATIONS

Assessment

- Assess nausea, vomiting, appetite, bowel sounds, and abdominal pain prior to and following administration.
- Monitor hydration, nutritional status, and intake and output. Patients with severe nausea and vomiting may require IV fluids in addition to antiemetics.
- ***Lab Test Considerations:*** Monitor clotting status closely during the 2 wk period, especially at 7–10 days, following aprepitant therapy in patients on chronic warfarin therapy.
- May cause mild, transient ↑ in AST and ALT.

Potential Nursing Diagnoses

Risk for deficient fluid volume (Indications)
Imbalanced nutrition: less than body requirements (Indications)

Implementation

- Aprepitant is given as part of a regimen that includes a corticosteroid and a 5–HT_3 antagonist (see Route & Dosage).
- **PO:** Administer daily for 3 days. *Day 1*—administer 125 mg 1 hr prior to chemotherapy. *Days 2 and 3*—administer 80 mg once in the morning. May be administered without regard to food.

Patient/Family Teaching

- Instruct patient to take aprepitant exactly as directed. Direct patient to read the patient package insert before starting therapy and to reread it each time the prescription is renewed.
- Advise patient to notify health care professional prior to taking any other prescription, OTC, or herbal products.
- Caution patient that aprepitant may decrease the effectiveness of oral contraceptives. Advise patient to use alternate nonhormonal methods of contraception.
- Advise patient and family to use general measures to decrease nausea (begin with sips of liquids and small, nongreasy meals; provide oral hygiene; remove noxious stimuli from environment).

Evaluation/Desired Outcomes

- Decreased nausea and vomiting associated with chemotherapy.

Why was this drug prescribed for your patient?

single dose in the morning or evenly divided doses in the morning and late afternoon/early evening; may be further increased after 2–4 wk up to 100 mg/day. *If taking concurrent CYP2D6 inhibitor (quinidine, fluoxetine, paroxetine)*—40 mg/day initially, may increase if needed to 80 mg/day after 4 wk.

Hepatic Impairment

PO (Adults and Children): *Moderate hepatic impairment (Child-Pugh Class B)*—decrease initial and target dose by 50%; *Severe hepatic impairment (Child-Pugh Class C)*—decrease initial and target dose to 25% of normal.

NURSING IMPLICATIONS

Assessment

- Assess attention span, impulse control, and interactions with others.
- Monitor blood pressure and pulse periodically during therapy.
- Monitor growth, body height and weight in children.
- **Assess for signs of liver injury (pruritus, dark urine, jaundice, right upper quadrant tenderness, unexplained "flu-like" symptoms) during therapy. Monitor liver function tests at first sign of liver injury. Discontinue and do not restart atomoxetine in patients with jaundice of laboratory evidence of liver injury.**

Potential Nursing Diagnoses

Disturbed thought process (Indications)
Impaired social interaction (Indications)

Implementation

- **PO:** Administer without regard to food.

Patient/Family Teaching

- Instruct patient to take medication exactly as directed. Missed doses should be taken as soon as possible, but should not more than the total daily amount in any 24-hr period.
- **Advise patient to notify health care professional immediately if signs of liver injury occur.**
- Caution patient to consult health care professional prior to taking other prescription, OTC, dietary supplements, or herbal products.
- May cause dizziness. Caution patient to avoid driving or other activities requiring alertness until response to medication is known.
- Advise female patients to notify health care professional if pregnancy is planned or suspected or if they are breastfeeding.
- Advise parents to notify school nurse of medication regimen.

Evaluation/Desired Outcomes

- Improved attention span and social interactions in ADHD.

Why was this drug prescribed for your patient?

atropine (at-ro-peen)

Atro-Pen

Classification

Therapeutic: antiarrhythmics
Pharmacologic: anticholinergics, antimuscarinics

Pregnancy Category C

Indications

IM: Given preoperatively to decrease excessive oral and respiratory secretions. **IV:** Treatment of sinus bradycardia. **IV:** Reversal of muscarinic effects of anticholinesterase agents. **IM, IV:** Treatment of anticholinesterase (organophosphate pesticide) poisoning.

Action

Inhibits action of acetylcholine in smooth muscle, secretory glands, and CNS (antimuscarinic activity). Low doses decrease sweating, salivation, and respiratory secretions. Intermediate doses produce mydriasis, cycloplegia, and tachycardia. Larger doses decrease GI and GU tract motility. **Therapeutic Effects: IM:** Decreased GI and respiratory secretions. **IV:** Increased heart rate. **Ophth:** Mydriasis and cycloplegia. **IM, IV:** Reversal of muscarinic effects.

Pharmacokinetics

Absorption: Well absorbed following subcut and IM administration.
Distribution: Crosses the blood-brain barrier and placenta enters breast milk.
Metabolism and Excretion: Mostly metabolized by the liver; 30–50% excreted unchanged by the kidneys.
Half-life: 13–38 hr.

TIME/ACTION PROFILE (inhibition of salivation)

ROUTE	ONSET	PEAK	DURATION
IM, subcut	rapid	15–50 min	4–6 hr
IV	immediate	2–4 min	4–6 hr

Contraindications/Precautions

Contraindicated in: Hypersensitivity. Glaucoma. Hemorrhage. Tachycardia caused by cardiac insufficiency or thyrotoxicosis.
Use Cautiously in: Geriatric and very young patients (increased susceptibility to adverse reactions); Intra-abdominal infections; Prostatic hypertrophy; Renal, hepatic, pulmonary, or cardiac disease; Pregnancy or lactation (safety not established; IV administration may produce fetal tachycardia).

Adverse Reactions/Side Effects

CNS: drowsiness, confusion. **EENT:** blurred vision, cycloplegia, dry eyes, mydriasis. **CV:** tachycardia, palpitations. **GI:** dry mouth, constipation. **GU:** urinary hesitancy, retention. **Misc:** decreased sweating.

Interactions

Drug-Drug: ↑ anticholinergic effects with other **anticholinergics**, including **antihistamines**, **tricyclic antidepressants**, **quinidine**, and **disopyramide**. Anticholinergics may alter the absorption of other **orally administered drugs** by slowing motility of the GI tract. **Antacids** ↓ absorption of anticholinergics. May ↑ GI mucosal lesions in patients taking oral **potassium chloride** tablets.

Route/Dosage

Preanesthesia (to decrease salivation/secretions)

PO (Adults): 2 mg.
IM, IV, Subcut: (Adults and Children ≥20 kg): 0.4 mg (range 0.2–1 mg) 30–60 min preop.
IM, Subcut: (Children 12–16 kg): 0.3 mg 30–60 min preop.
IM, Subcut: (Children 7–9 kg): 0.2 mg 30–60 min preop.

azathioprine (ay-za-thye-oh-preen)

Azasan, Imuran

Classification

Therapeutic: immunosuppressants
Pharmacologic: purine antagonists

Pregnancy Category D

Indications

Prevention of renal transplant rejection (with corticosteroids, local radiation, or other cytotoxic agents). Severe, active, erosive rheumatoid arthritis unresponsive to other therapy.

Action

Antagonizes purine metabolism with subsequent inhibition of DNA and RNA synthesis. **Therapeutic Effects:** Suppression of cell-mediated immunity and altered antibody formation.

Pharmacokinetics

Absorption: Readily absorbed after oral administration.
Distribution: Crosses placenta; enters breast milk in low concentrations.
Metabolism and Excretion: Metabolized to mercaptopurine.
Half-life: 3 hr.

TIME/ACTION PROFILE

ROUTE	ONSET	PEAK	DURATION
PO (anti-inflammatory)	6–8 wk	12 wk	unknown
IV (immunosuppression)	days–wks	unknown	days–wks

Contraindications/Precautions

Contraindicated in: Hypersensitivity. Concurrent use of mycophenolate. Pregnancy or lactation.
Use Cautiously in: Infections; Malignancies; Decreased bone marrow reserve; Previous radiation therapy; Chronic debilitating illnesses; Severe renal impairment sensitivity; Childbearing potential.

Adverse Reactions/Side Effects

EENT: retinopathy. **Resp:** pulmonary edema. **GI:** anorexia, hepatotoxicity, nausea, vomiting, diarrhea, mucositis, pancreatitis. **Derm:** alopecia, rash. **Hemat:** anemia, leukopenia, pancytopenia, thrombocytopenia. **MS:** arthralgia. **Misc:** chills, fever, Raynaud's phenomenon, serum sickness.

Interactions

Drug-Drug: Additive myelosuppression with **antineoplastics**, **cyclosporine**, and **myelosuppressive agents**. **Allopurinol** increases toxicity—decrease dose of azathioprine by 25–33%. May decrease antibody response to **live-virus vaccines** and increase the risk of adverse reactions.
Drug-Natural Products: Concurrent use with **echinacea** and **melatonin** may interfere with immunosuppression.

Route/Dosage

Renal Allograft Rejection Prevention

PO, IV (Adults and Children): 3–5 mg/kg/day initially; maintenance dose 1–3 mg/kg/day.

Rheumatoid Arthritis

PO (Adults and Children): 1 mg/kg/day for 6–8 wk, increase by 0.5 mg/kg/day q 4 wk until response or up to 2.5 mg/kg/day, then decrease by 0.5 mg/kg/day q 4–8 wk to minimum effective dose.

NURSING IMPLICATIONS

Assessment

- Assess for infection (vital signs, sputum, urine, stool, WBC) during therapy.
- Monitor intake and output and daily weight. Decreased urine output may lead to toxicity with this medication.
- **Rheumatoid Arthritis:** Assess range of motion; degree of swelling, pain, and strength in affected joints; and ability to perform activities of daily living before and periodically during therapy.

IM, Subcut: (Children 3 kg): 0.1 mg 30–60 min preop.

Bradycardia

IV (Adults): 0.5–1.0 mg; may repeat as needed q 5 min (q 3–5 min in Advanced Cardiac Life Support guidelines) in or 0.4–1 mg q 1–2 hr to a total of 3 mg or 0.04 mg/kg (total vagolytic dose;).
IV (Children): 0.02 mg/kg (range is 0.1–0.5 mg in children or up to 1 mg in adolescents); may repeat q 5 min up to a total dose of 1 mg in children (2 mg in adolescents).

Reversal of Adverse Muscarinic Effects of Anticholinesterases

IV (Adults): 0.6–1.2 mg for each 0.5–2.5 mg of neostigmine methylsulfate or 10–20 mg of pyridostigmine bromide concurrently with anticholinesterase.

Organophosphate Poisoning

IM, IV (Adults): 1–2 mg initially, then 2 mg q 5–60 min as needed. *Severe cases*—2–6 mg initially and repeated every 5–60 min as needed. May be followed by oral therapy. Pralidoxime may be given concurrently.
IM, IV (Children): 0.05 mg/kg q 10–30 min as needed. Pralidoxime may be given concurrently.

Anticholinergic Effects

PO (Adults): 0.4–0.6 mg q 4–6 hr.
PO (Children): 0.01 mg/kg (not to exceed 0.4 mg or 0.3 mg/m²/dose) q 4–6 hr.

NURSING IMPLICATIONS

Assessment

- **IV:** Assess vital signs and ECG tracings frequently during the course of IV therapy. Report any significant changes in heart rate or blood pressure, increased ventricular ectopy, or angina to physician promptly.
- ***Toxicity and Overdose:*** Physostigmine is the antidote.

Potential Nursing Diagnoses

Decreased cardiac output (Indications)
Impaired oral mucous membrane (Side Effects)
Constipation (Side Effects)

Implementation

- **IM:** Intense flushing of the face and trunk, called "atropine flush," may occur in children 15–20 min after administration. This response is not harmful.
- **Direct IV:** Give IV undiluted or dilute in 10 ml of sterile water. ***Rate:*** Administer at a rate of 0.6 mg over 1 min. Do not add to IV solution. Inject through Y tubing or 3-way stopcock. When given IV in doses <0.4 mg or over longer than 1 min, atropine may cause paradoxical bradycardia; usually resolves in approximately 2 min.

Patient/Family Teaching

- Instruct patient that oral rinses, sugarless gum or candy, and frequent oral hygiene may help relieve dry mouth.

Evaluation/Desired Outcomes

- Increase in heart rate.
- Dryness of mouth.
- Reversal of muscarinic effects.

Why was this drug prescribed for your patient?

- ***Lab Test Considerations:*** Monitor renal, hepatic, and hematologic functions before beginning therapy, weekly during the first month, bimonthly for the next 2–3 mo, and monthly thereafter.
- Leukocyte count of <3000 or platelet count of <100,000/mm³ may require decreased dose or temporary discontinuation.
- A ↓ in hemoglobin may indicate bone marrow suppression.
- Hepatotoxicity (increased alkaline phosphatase, bilirubin, AST, ALT, amylase) usually occurs within 6 mo of transplant, rarely with rheumatoid arthritis, and is reversible on discontinuation of azathioprine.
- May ↓ serum and urine uric acid and plasma albumin.

Potential Nursing Diagnoses

Risk for infection (Indications)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- **Do not confuse Imuran (azathioprine) with IMDUR (isosorbide mononitrate).**
- Protect transplant patients from staff members and visitors who may carry infection. Maintain protective isolation as indicated.
- **PO:** May be administered with or after meals or in divided doses to minimize nausea.
- **IV:** Reconstitute 100 mg with 10 ml of sterile water for injection. Swirl vial gently until completely dissolved. Reconstituted solution may be administered up to 24 hr after preparation.
- Solution should be prepared in a biologic cabinet. Wear gloves, gown, and mask while handling medication. Discard equipment in specially designated containers.
- **Intermittent Infusion:** Solution may be further diluted in 50 ml of 0.9% NaCl, 0.45% NaCl, or D5W. Do not admix. ***Rate:*** Usually infused over 30–60 min; may range from 5 min–8 hr.

Patient/Family Teaching

- Instruct patient to take azathioprine as directed. If a dose is missed on a once-daily regimen, omit dose; if on several-times-a-day dosing, take as soon as possible or double next dose. Consult health care professional if more than 1 dose is missed or if vomiting occurs shortly after dose is taken. Do not discontinue without consulting health care professional.
- Advise patient to report unusual tiredness or weakness, cough or hoarseness, fever or chills, lower back or side pain, painful or difficult urination, severe diarrhea, black tarry stools, blood in urine, or transplant rejection to health care professional immediately.
- Reinforce the need for lifelong therapy to prevent transplant rejection.
- Instruct patient to consult health care professional before taking any OTC medications or natural/herbal products, or receiving any vaccinations while taking this medication.
- Advise patient to avoid contact with persons with contagious diseases. Consult health care provider before foreign travel.
- May have teratogenic properties. Advise patient to use contraception during and for at least 4 mo after therapy is completed.
- Emphasize the importance of follow-up exams and lab tests.
- **Rheumatoid Arthritis:** Concurrent therapy with salicylates, NSAIDs, or corticosteroids may be necessary. Patient should continue physical therapy and adequate rest. Explain that joint damage will not be reversed; goal is to slow or stop disease process.

Evaluation/Desired Outcomes

- Prevention of transplant rejection.
- For rheumatoid arthritis, decreased stiffness, pain, and swelling in affected joints in 6–8 wk. Discontinue if there is no improvement in 12 wk.

Why was this drug prescribed for your patient?

azithromycin (aye-zith-row-my-sin)

Zithromax, Zmax

Classification

Therapeutic: agents for atypical mycobacterium, anti-infectives
Pharmacologic: macrolides

Pregnancy Category B

Indications

Treatment of: Respiratory tract infections, Skin/skin structure infections, Nongonococcal urethritis, cervicitis, gonorrhea and chancroid, Pelvic inflammatory disease. Prevention of disseminated *Mycobacterium avium* complex (MAC) in advanced HIV infection. *Extended-release suspension (ZMax)* Acute bacterial sinusitis and community-acquired pneumonia in adults. **Unlabeled uses:** Prevention of bacterial endocarditis.

Action

Inhibits protein synthesis at the level of the 50S bacterial ribosome. **Therapeutic Effects:** Bacteriostatic action against susceptible bacteria. **Spectrum:** Active against these gram-positive: *Staphylococcus aureus*, *Streptococcus pneumoniae*, *S. pyogenes* (group A strep). Active against gram-negative bacteria: *Haemophilus influenzae*, *Moraxella catarrhalis*, *Neisseria gonorrhoeae*. Also active against: *Mycoplasma*, *Legionella*, *Chlamydia trachomatis*, *Ureaplasma urealyticum*, *Borrelia burgdorferi*, *Mycobacterium avium*.

Pharmacokinetics

Absorption: Rapidly absorbed (40%) following oral administration. IV administration results in complete bioavailability.
Distribution: Widely distributed; ↑ tissue levels; ↓ CSF levels.
Metabolism and Excretion: Mostly excreted unchanged in bile.
Half-life: 2–4 days.

TIME/ACTION PROFILE (serum levels)

ROUTE	ONSET	PEAK	DURATION
IV	rapid	end of infusion	24 hr
PO	rapid	2.5–3.2 hr	24 hr

Contraindications/Precautions

Contraindicated in: Hypersensitivity to azithromycin, or other macrolides.
Use Cautiously in: Severe liver disease; Severe renal impairment (CCr < 10 ml/min); Pregnancy, lactation, children <6 mo (safety not established).

Adverse Reactions/Side Effects

CNS: dizziness, drowsiness, fatigue, headache. **CV:** chest pain, palpitations. **GI:** PSEUDOMEMBRANOUS COLITIS, abdominal pain, diarrhea, nausea, cholestatic jaundice, dyspepsia, flatulence, melena. **GU:** nephritis, vaginitis. **Derm:** photosensitivity, rashes. **Endo:** hyperglycemia. **F and E:** hyperkalemia. **Misc:** ANGIOEDEMA.

Interactions

Drug-Drug: Nelfinavir increases serum levels (monitor carefully). Similar anti-infectives have been known to ↑ serum levels and effects of **digoxin**, **theophylline**, **ergotamine**, **dihydroergotamine**, **triazolam**, **carbamazepine**, **cyclosporine**, **phenytoin**, and **warfarin**; careful monitoring is recommended.

Route/Dosage

IV, PO (Adults): Most respiratory and skin infections: *PO*—500 mg on first day, then 250 mg/day for 4 more days; *acute bacterial exacerbations of chronic bronchitis*—500 mg daily for 3 days; *community-acquired pneumonia*—500 mg IV q 24 hr for 2 days, then 500 mg PO q 24 hr for a total of 7–10 days for more severe cases, for less severe cases 500 mg PO on 1st day then 250 mg PO for 4 more days or 2 g single dose as extended-release suspension (Zmax); *pelvic inflammatory disease*—500 mg IV q 24 hr for 1–2 days, then 250 mg PO q 24 hr for a total of 7 days; *nongonococcal urethritis, cervicitis, chancroid, chlamydia*—1 g (single dose);

Why was this drug prescribed for your patient?

CONTINUED

azithromycin

as soon as possible unless it is almost time for next dose; do not double doses. Advise patients that sharing of this medication may be dangerous.
- Instruct patient not to take azithromycin with food or antacids.
- May cause drowsiness and dizziness. Caution patient to avoid driving or other activities requiring alertness until response to medication is known.
- Advise patient to use sunscreen and protective clothing to prevent photosensitivity reactions.
- Advise patient to report signs of superinfection (black, furry overgrowth on tongue, vaginal itching or discharge, loose or foul-smelling stools).
- **Instruct patient to notify health care professional if fever and diarrhea develop, especially if stool contains blood, pus, or mucus. Advise patient not to treat diarrhea without advice of health care professional.**
- Advise patient to notify health care professional if pregnancy is planned or suspected.
- Advise patients being treated for nongonococcal urethritis or cervicitis that sexual partners should also be treated.
- Instruct patient to notify health care professional if symptoms do not improve.

Evaluation/Desired Outcomes

- Resolution of the signs and symptoms of infection. Length of time for complete resolution depends on the organism and site of infection.

Acute bacterial sinusitis—500 mg once daily for 3 days or single 2 g dose as extended-release suspension (Zmax); *gonorrhea*—2 g (single dose); **prevention of disseminated MAC infection:** *PO*—1.2 g once weekly; **endocarditis prophylaxis:** *PO*—500 mg 1 hr before procedure.

PO (Children 2-15 yr): *Most respiratory/skin infections*—10 mg/kg (not >500 mg/dose) on 1st day, then 5 mg/kg (not >250 mg/dose) for 4 more days; *pharyngitis/tonsilitis*—12 mg/kg once daily for 5 days; *endocarditis prophylaxis*– 15 mg/kg 1 hr before procedure.

PO (Children >6 mo): *Otitis media*—30 mg/kg single dose *or* 10 mg/kg/day as a single dose for 3 days *or* 10 mg/kg as a single dose on 1st day, then 5 mg/kg as a single dose daily for 4 more days.

NURSING IMPLICATIONS

Assessment

- Assess patient for infection (vital signs; appearance of wound, sputum, urine, and stool; WBC) at beginning of and throughout therapy.
- Obtain specimens for culture and sensitivity before initiating therapy. First dose may be given before receiving results.
- **Observe for signs of anaphylaxis (rash, pruritus, laryngeal edema, wheezing). Notify health care professional immediately if these occur.**
- ***Lab Test Considerations:*** May cause ↑ serum bilirubin, AST, ALT, GTT, LDH, and alkaline phosphatase concentrations.
- May cause ↑ creatine phosphokinase, potassium, prothrombin time, BUN, serum creatinine, and blood glucose concentrations.
- May occasionally cause ↓ WBC and platelet count.

Potential Nursing Diagnoses

Risk for infection (Indications, Side Effects)
Noncompliance (Patient/Family Teaching)

Implementation

- Do not confuse azithromycin with erythromycin.
- *Zmax extended release oral suspension* is not bioequivalent or interchangeable with azithromycin oral suspension.
- **PO:** Administer 1 hr before or 2 hr after meals.
- For administration of single 1–g packet, thoroughly mix entire contents of packet with 2 oz (60 ml) of water. Drink entire contents immediately; add an additional 2 oz of water, mix and drink to assure complete consumption of dose. Do not use the single packet to administer doses other than 1000 mg of azithromycin. 1–g packet is not for pediatric use.
- For *Zmax* shake suspension well and drink entire contents of bottle. Use within 12 hrs of reconstitution. If patient vomits within 1 hr of administration, contact prescriber for instructions. *Zmax* may be taken without regard to antacids containing magnesium or aluminum hydroxide.
- **Intermittent Infusion:** Reconstitute by adding 4.8 ml of sterile water for injection to the 500-mg vial and shake until dissolved, for a concentration of 100 mg/ml. Because azithromycin is supplied under vacuum, standard 5-ml syringe should be used to ensure the exact amount of 4.8 ml of sterile water is dispensed. Do not administer solution containing particulate matter. Dilute further by transferring 5 ml of the 100 mg/ml solution to 250 ml or 500 ml of 0.9% NaCl, 0.45% NaCl, D5W, LR, D5/0.45% NaCl, or D5/LR for a concentration of 2 mg/ml or 1 mg/ml, respectively. Solution is stable for 24 hr at room temperature or for 7 days if refrigerated. ***Rate:*** Administer the 1 mg/ml solution over 3 hr or the 2 mg/ml solution over 1 hr. Do not administer as a bolus.
- **Y-Site Compatibility:** bivalirudin, dexmedetomidine, diphenhydramine, dolasetron, droperidol.
- **Y-Site Incompatibility:** amikacin, aztreonam, cefotaxime, ceftazidime, ceftriaxone, cefuroxime, ciprofloxacin, clindamycin, famotidine, fentanyl, furosemide, gentamicin, imipenem-cilastatin, ketorolac, levofloxacin, morphine, ondansetron, piperacillin-tazobactam, potassium, ticarcillin-clavulanate, tobramycin.

Patient/Family Teaching

- Instruct patients to take medication as directed and to finish the drug completely, even if they are feeling better. Missed doses should be taken

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baclofen (bak-loe-fen)

Lioresal

Classification

Therapeutic: antispasticity agents, skeletal muscle relaxants (centrally acting)

Pregnancy Category C

Indications

PO: Treatment of reversible spasticity due to multiple sclerosis or spinal cord lesions. **IT:** Treatment of severe spasticity originating in the spinal cord. **Unlabeled uses:** Management of pain in trigeminal neuralgia.

Action

Inhibits reflexes at the spinal level. **Therapeutic Effects:** Relief of muscle spasticity. Bowel and bladder function may also be improved.

Pharmacokinetics

Absorption: Well absorbed following oral administration.
Distribution: Widely distributed. Crosses the placenta.
Metabolism and Excretion: 70–80% eliminated unchanged by the kidneys.
Half-life: 2.5–4 hr.

TIME/ACTION PROFILE (effects on spasticity)

ROUTE	ONSET	PEAK	DURATION
PO	hrs–wks	unknown	8 hr
IT	0.5–1 hr	4 hr	4–8 hr

Contraindications/Precautions

Contraindicated in: Hypersensitivity. Orally-disintegrating tablets (Kemstro) contain aspartame and should not be used in patients with phenylketonuria.
Use Cautiously in: Patients in whom spasticity maintains posture and balance; Patients with epilepsy (may ↓ seizure threshold); Geriatric patients (↑ risk of CNS side effects); Renal impairment (↓ dose may be required); Pregnancy, lactation, and children (safety not established).

Adverse Reactions/Side Effects

CNS: SEIZURES (IT), dizziness, drowsiness, fatigue, weakness, confusion, depression, headache, insomnia. **EENT:** nasal congestion, tinnitus. **CV:** edema, hypotension. **GI:** nausea, constipation. **GU:** frequency. **Derm:** pruritus, rash. **Metab:** hyperglycemia, weight gain. **Neuro:** ataxia. **Misc:** hypersensitivity reactions, sweating.

Interactions

Drug-Drug: ↑ CNS depression with other **CNS depressants** including **alcohol, antihistamines, opioid analgesics**, and **sedative/hypnotics.** Use with **MAO inhibitors** may lead to ↑ CNS depression or hypotension.
Drug-Natural Products: Concomitant use of **kava, valerian, chamomile,** or **hops** can ↑ CNS depression.

Route/Dosage

PO (Adults): 5 mg 3 times daily. May increase q 3 days by 5 mg/dose up to 80 mg/day (some patients may have a better response to 4 divided doses).
IT (Adults): 100–800 mcg/day infusion; dose is determined by response during screening phase.
IT (Children): 25–1200 mcg/day infusion (average 275 mcg/day); dose is determined by response during screening phase.

NURSING IMPLICATIONS

Assessment

- Assess muscle spasticity before and periodically during therapy.

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benztropine (benz-troe-peen)

♣Apo-Benztropine, Cogentin

Classification

Therapeutic: antiparkinson agents
Pharmacologic: anticholinergics

Pregnancy Category C

Indications

Adjunctive treatment of all forms of Parkinson's disease, including drug-induced extrapyramidal effects and acute dystonic reactions.

Action

Blocks cholinergic activity in the CNS, which is partially responsible for the symptoms of Parkinson's disease. Restores the natural balance of neurotransmitters in the CNS. **Therapeutic Effects:** Reduction of rigidity and tremors.

Pharmacokinetics

Absorption: Well absorbed following oral and IM administration.
Distribution: Unknown.
Metabolism and Excretion: Unknown.
Half-life: Unknown.

TIME/ACTION PROFILE (antidyskinetic activity)

ROUTE	ONSET	PEAK	DURATION
IM, IV	within min	unknown	24 hr
PO	1–2 hr	several days	24 hr

Contraindications/Precautions

Contraindicated in: Hypersensitivity. Children <3 yr. Narrow-angle glaucoma. Tardive dyskinesia.
Use Cautiously in: Geriatric patients (increased risk of adverse reactions); Pregnancy and lactation (safety not established).

Adverse Reactions/Side Effects

CNS: confusion, depression, dizziness, hallucinations, headache, sedation, weakness. **EENT:** blurred vision, dry eyes, mydriasis. **CV:** arrhythmias, hypotension, palpitations, tachycardia. **GI:** constipation, dry mouth, ileus, nausea. **GU:** hesitancy, urinary retention. **Misc:** decreased sweating.

Interactions

Drug-Drug: Additive anticholinergic effects with **drugs sharing anticholinergic properties** such as **antihistamines, phenothiazines, quinidine, disopyramide,** and **tricyclic antidepressants.** Counteracts the cholinergic effects of **bethanechol.** **Antacids** and **antidiarrheals** may decrease absorption.
Drug-Natural Products: Increased anticholinergic effect with **angel's trumpet, jimson weed,** and **scopolia.**

Route/Dosage

Parkinsonism

PO (Adults): 1–2 mg/day in 1–2 divided doses (range 0.5–6 mg/day).

Acute Dystonic Reactions

IM, IV (Adults): 1–2 mg, then 1–2 mg PO twice daily.

Drug-induced Extrapyramidal Reactions

PO, IM, IV (Adults): 1–4 mg given once or twice daily (1–2 mg 2–3 times daily may also be used PO).

NURSING IMPLICATIONS

Assessment

- Assess parkinsonian and extrapyramidal symptoms (restlessness or desire to keep moving, rigidity, tremors, pill-rolling, mask-like face, shuffling gait, muscle spasms, twisting motions, difficulty speaking or swallowing, loss of balance control) before and throughout therapy.

- Observe patient for drowsiness, dizziness, and ataxia. If these problems occur, notify physician. May be alleviated by a change in dose.
- **IT: Monitor patient closely during test dose and titration. Resuscitative equipment should be immediately available for life-threatening or intolerable side effects.**
- ***Lab Test Considerations:*** May cause increase in serum glucose, alkaline phosphatase, AST, and ALT levels.

Potential Nursing Diagnoses

Impaired wheelchair mobility (Indications)
Risk for injury (Adverse Reactions)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- **PO:** May be administered with milk or food to minimize gastric irritation.
- For *orally disintegrating tablets*, just prior to administration place tablet on tongue with dry hands. Tablet will disintegrate, then swallow with saliva or water. Administration with liquid is not necessary.
- **IT:** For *screening phase*, dilute for a concentration of 50 mcg/ml with sterile preservative-free NaCl for injection. Test dose should be administered over at least 1 min. Patient should be observed for a significant decrease in muscle tone or frequency or severity of spasm. If response is inadequate, 2 additional test doses, each 24 hr apart, 75 mcg/1.5 ml and 100 mcg/2 ml, respectively, may be administered. Patients with an inadequate response should not receive chronic IT therapy.
- Dose titration for implantable IT pumps is based on patient response. If no substantive response occurs after dose increase, check pump function and catheter patency.

Patient/Family Teaching

- Instruct patient to take baclofen as directed. Take a missed dose within 1 hr; do not double doses. Caution patient to avoid abrupt withdrawal of this medication because it may precipitate an acute withdrawal reaction (hallucinations, increased spasticity, seizures, mental changes, restlessness). Baclofen should be discontinued gradually over 2 wk or more.
- May cause dizziness and drowsiness. Advise patient to avoid driving or other activities requiring alertness until response to drug is known.
- Instruct patient to change position slowly to minimize orthostatic hypotension.
- Advise patient to avoid concurrent use of alcohol or other CNS depressants while taking this medication.
- Instruct patient to notify health care professional if frequent urge to urinate or painful urination, constipation, nausea, headache, insomnia, tinnitus, depression, or confusion persists. Advise patient to report signs and symptoms of hypersensitivity (rash, itching) promptly.
- **IT:** Caution patient and caregiver not discontinue IT therapy abruptly. May result in fever, mental status changes, exaggerated rebound spasticity, and muscle rigidity. Advise patient not to miss scheduled refill appointments and to notify health care professional promptly if signs of withdrawal occur.

Evaluation/Desired Outcomes

- Decrease in muscle spasticity and associated musculoskeletal pain with an increased ability to perform activities of daily living.
- Decreased pain in patients with trigeminal neuralgia. May take weeks to obtain optimal effects.

Why was this drug prescribed for your patient?

- Assess bowel function daily. Monitor for constipation, abdominal pain, distention, or the absence of bowel sounds.
- Monitor intake and output ratios and assess patient for urinary retention (dysuria, distended abdomen, infrequent voiding of small amounts, overflow incontinence).
- Patients with mental illness are at risk of developing exaggerated symptoms of their disorder during early therapy with benztropine. Withhold drug and notify physician or other health care professional if significant behavioral changes occur.
- **IM/IV:** Monitor pulse and blood pressure closely and maintain bedrest for 1 hr after administration. Advise patients to change positions slowly to minimize orthostatic hypotension.

Potential Nursing Diagnoses

Impaired physical mobility (Indications)
Risk for injury (Indications)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- **PO:** Administer with food or immediately after meals to minimize gastric irritation. May be crushed and administered with food if patient has difficulty swallowing.
- **IM:** Parenteral route is used only for dystonic reactions.
- **Direct IV:** IV route is rarely used because onset is same as with IM route. ***Rate:*** Administer at a rate of 1 mg over 1 min.
- **Syringe Compatibility:** metoclopramide.
- **Y-Site Compatibility:** fluconazole, tacrolimus.

Patient/Family Teaching

- Encourage patient to take benztropine as directed. Missed doses should be taken as soon as possible, up to 2 hr before the next dose. Taper gradually when discontinuing or a withdrawal reaction may occur (anxiety, tachycardia, insomnia, return of Parkinsonian or extrapyramidal symptoms).
- May cause drowsiness or dizziness. Advise patient to avoid driving or other activities that require alertness until response to the drug is known.
- Instruct patient that frequent rinsing of mouth, good oral hygiene, and sugarless gum or candy may decrease dry mouth. Patient should notify health care professional if dryness persists (saliva substitutes may be used). Also notify the dentist if dryness interferes with use of dentures.
- Caution patient to change position slowly to minimize orthostatic hypotension.
- Instruct patient to notify health care professional if difficulty with urination, constipation, abdominal discomfort, rapid or pounding heartbeat, confusion, eye pain, or rash occurs.
- Advise patient to confer with health care professional before taking OTC medications, especially cold remedies, or drinking alcoholic beverages.
- Caution patient that this medication decreases perspiration. Overheating may occur during hot weather. Patients should notify health care professional if they cannot remain indoors in an air-conditioned environment during hot weather.
- Advise patient to avoid taking antacids or antidiarrheals within 1–2 hr of this medication.
- Emphasize the importance of routine follow-up exams.

Evaluation/Desired Outcomes

- Decrease in tremors and rigidity and an improvement in gait and balance. Therapeutic effects are usually seen 2–3 days after the initiation of therapy.

Why was this drug prescribed for your patient?

BETA BLOCKERS (nonselective)

carteolol

(**kar**-tee-oh-lole)
Cartrol

carvedilol

(kar-**ve**-di-lole)
Coreg

labetalol

(la-**bet**-oh-lole)
Normodyne, Trandate

nadolol

(**nay**-doe-lole)
Corgard, ♣Syn-Nadolol

penbutolol

(pen-**byoo**-toe-lole)
Levatol

pindolol

(**pin**-doe-lole)
Visken, ♣Novo-Pindol, ♣Syn-Pindolol

propranolol

(proe-**pran**-oh-lole)
♣Apo-Propranolol, Inderal, ♣Detensol, Inderal LA, InnoPran XL, ♣Novopranol, ♣pms Propranolol

sotalol

(**soe**-ta-lole)
Betapace, ♣Sotacor

timolol

(**tim**-oh-lole)
♣Apo-Timol, Blocadren, ♣Novo-Timol

Classification

Therapeutic: antianginals, antiarrhythmics, antihypertensives
Pharmacologic: beta blockers (nonselective)

Pregnancy Category B (pindolol, sotalol), C (carteolol, carvedilol, labetalol, nadolol, penbutolol, propranolol, timolol)

Indications

Hypertension (not sotalol). **Carvedilol:** CHF (ischemic or cardiomyopathic) with other agents, Left ventricular dysfunction after MI. **Nadolol, propranolol:** Management of angina. **Propranolol, sotalol:** Management of arrhythmias. **Propranolol, timolol:** Prevention/management of myocardial infarction (MI). **Propranolol:** Prevention of vascular headaches, Manage thyrotoxicosis, Manage pheochromocytoma, Treat essential tremors, Manage hypertrophic cardiomyopathy. **Timolol:** Prevention vascular headaches.

Action

Block stimulation of $beta_1$-adrenergic (myocardial) and $beta_2$-adrenergic (pulmonary vascular and uterine) receptor sites. Labetalol and carvedilol have $alpha_1$-adrenergic blocking activity, which may result in more orthostatic hypotension. Carteolol, penbutolol, and pindolol have intrinsic sympathomimetic activity (ISA), which may produce less bradycardia. **Therapeutic Effects:** Decreased heart rate and blood pressure. Suppression of arrhythmias. Increased cardiac output, decreased risk of death from CHF, slowed progression of CHF (carvedilol only). Prevention of MI.

Pharmacokinetics

Absorption: *Carteolol*—85% absorbed after oral administration; *carvedilol*—well absorbed but rapidly undergoes extensive first-pass hepatic metabolism, resulting in 25–35% bioavailability; *nadolol*—variably (30%) absorbed after oral administration; *labetalol*—well absorbed but rapidly undergoes extensive first-pass hepatic metabolism, resulting in 25% bioavailability; *penbutolol, pindolol, sotalol,* and *timolol*—well absorbed after oral administration; *propranolol*—well absorbed but undergoes extensive first-pass hepatic metabolism.
Distribution: *Carvedilol*—unknown; *nadolol*—minimal penetration of the CNS; *labetalol*—some CNS penetration; *penbutolol*—moderate CNS penetration; *labetalol, nadolol, pindolol, propranolol, sotalol,* and *timolol*—known to enter breast milk; *labetalol, nadolol, pindolol, propranolol,* and *sotalol*—known to cross the placenta.

CONTINUED

BETA BLOCKERS (nonselective)

in blood pressure may accompany **insulin**-induced hypoglycemia. May ↓ effectiveness of **theophylline**. May ↓ beneficial $beta_1$ cardiovascular effects of **dopamine** or **dobutamine**. Use cautiously within 14 days of **MAO inhibitor** therapy (may result in hypertension). **Cimetidine** may ↑ toxicity from carvedilol, labetalol, timolol, or propranolol. Concurrent **NSAIDs** may ↓ antihypertensive action. Effectiveness of carvedilol may be ↓ by **rifampin**. Carvedilol may ↑ serum **digoxin** levels.

Route/Dosage

Carteolol

PO (Adults): 2.5 mg once daily; may be increased up to 10 mg/day.

Carvedilol

PO (Adults): *Hypertension*—6.25 mg twice daily, may be increased q 7–14 days up to 25 mg twice daily; *CHF*—3.125 mg twice daily for 2 wk; may be increased to 6.25 mg twice daily. Dose may be doubled q 2 wk as tolerated (not to exceed 25 mg twice daily in patients <85 kg or 50 mg twice daily in patients >85 kg); *Left ventricular dysfunction after MI*—6.25 mg twice daily, increase after 3–10 days to 12.5 twice daily then to target dose of 25 mg twice daily; some patients may require lower initial doses and slower titration.

Labetalol

PO (Adults): 100 mg twice daily, may be increased by 100 mg twice daily q 2–3 days as needed (usual range 400–800 mg/day in 2–3 divided doses; doses up to 1.2–2.4 g/day have been used).

IV (Adults): 20 mg; additional doses of 40–80 mg may be given q 10 min as needed (not to exceed 300-mg total dose) or 2 mg/min infusion (range 50–300-mg total dose required).

Nadolol

PO (Adults): 40 mg once daily initially, may increase by 40–80 mg/day q 3–7 days as needed (up to 240–320 mg/day).

Penbutolol

PO (Adults): 20 mg once daily.

Pindolol

PO (Adults): 5 mg twice daily initially, may be increased by 10 mg/day q 2–3 wk as needed (up to 45–60 mg/day).

Propranolol

PO (Adults): *Antianginal*—80–320 mg/day in 2–4 divided doses or once daily as extended/sustained-release capsules. *Antihypertensive*—40 mg twice daily initially; may be increased as needed (usual range 120–240 mg/day; doses up to 1 g/day have been used); *or* 80 mg once daily as extended/sustained-release capsules, increased as needed up to 120 mg. *InnoPran XL* dosing form is designed to be given once daily at bedtime. *Antiarrhythmic*—10–30 mg 3–4 times daily. *Prevention of MI*—180–240 mg/day in divided doses. *Hypertrophic cardiomyopathy*—20–40 mg 3–4 times daily. *Adjunct therapy of pheochromocytoma*—20 mg 3 times daily to 40 mg 3–4 times daily concurrently with alpha-blocking therapy, started 3 days before surgery is planned. *Vascular headache prevention*—20 mg 4 times daily *or* 80 mg/day as extended/sustained-release capsules; may be increased as needed up to 240 mg/day. *Management of tremor*—40 mg twice daily; may be increased up to 120 mg/day (up to 320 mg have been used).
PO (Children): *Antihypertensive/antiarrhythmic*—0.5–1 mg/kg/day in 2–4 divided doses, may be increased as needed (usual range for maintenance dose is 2–4 mg/kg/day in 2 divided doses).

Metabolism and Excretion: *Carteolol*—some metabolism by the liver, with conversion to at least one active compound; 5–70% excreted unchanged by the kidneys; *carvedilol*—extensively metabolized, excreted in feces via bile, <2% excreted unchanged in urine; *labetalol*—extensively metabolized by the liver; *nadolol*—70% excreted unchanged by the kidneys; *penbutolol*—mostly metabolized by the liver; *pindolol*—partially metabolized by the liver, 50% excreted unchanged by the kidneys; *propranolol and timolol*—extensively metabolized by the liver; *sotalol*—elimination is mostly renal.

Half-life: *Carteolol*—6–8 hr (8–12 hr for 8-hydroxycarteolol; both are increased in renal impairment); *carvedilol*—7–10 hr; *labetalol*—3–8 hr; *nadolol*—10–24 hr (increased in renal impairment); *penbutolol*—5 hr; *pindolol*—3–4 hr; *propranolol*—3.4–6 hr; *sotalol*—12 hr; *timolol*—3–4 hr.

TIME/ACTION PROFILE (cardiovascular effects)

ROUTE	ONSET	PEAK	DURATION
Carteolol—PO	unknown	1–3 hr	unknown
Carvedilol—PO	within 1 hr	1–2 hr	12 hr
Labetalol—PO	20 min–2 hr	1–4 hr	8–12 hr
Labetalol—IV	2–5 min	5–15 min	2–4 hr (up to 24 hr)
Nadolol—PO	up to 5 days	6–9 days	24 hr
Penbutolol—PO	unknown	1.5–3 hr*	up to 24 hr
Pindolol—PO	7 days	2 wk	8–24 hr
Propranolol—PO	30 min	60–90 min	6–12 hr
Propranolol—PO-ER	unknown	6 hr	24 hr
Propranolol—IV	immediate	1 min	4–6 hr
Sotalol—PO	hrs	2-3 days	unknown
Timolol—PO	unknown	1–2 hr*	12–24 hr

*After single dose, full effect not seen until several weeks of therapy.

Contraindications/Precautions

Contraindicated in: Uncompensated CHF. Pulmonary edema. Cardiogenic shock. Bradycardia or heart block. Severe hepatic impairment. bronchial asthma/bronchospasm.

Use Cautiously in: Renal impairment; Hepatic impairment; Geriatric patients (increased sensitivity to beta blockers; initial dosage reduction recommended); CHF (condition may deteriorate after initial therapy); Diabetes mellitus (may mask signs of hypoglycemia); Thyrotoxicosis (may mask symptoms); Peripheral vascular disease; Geriatric patients (may have increased sensitivity, use lower initial dose; consider age related decrease in body mass, renal/hepatic/cardiac function); Patients with a history of severe allergic reactions (intensity of reactions may be increased); Pregnancy, lactation, or children (safety not established; all agents cross the placenta and may cause fetal/neonatal bradycardia, hypotension, hypoglycemia, or respiratory depression).

Adverse Reactions/Side Effects

CNS: fatigue, weakness, anxiety, depression, dizziness, drowsiness, insomnia (increased with propranolol), memory loss, mental status changes, nightmares. **EENT:** blurred vision, dry eyes, nasal stuffiness. **Resp:** bronchospasm, wheezing. **CV:** ARRHYTHMIAS (INCREASED WITH SOTALOL), BRADYCARDIA, CHF, PULMONARY EDEMA, orthostatic hypotension (increased with labetalol), peripheral vasoconstriction. **GI:** constipation, diarrhea, nausea. **GU:** impotence, decreased libido. **Derm:** itching, rashes. **Endo:** hyperglycemia, hypoglycemia. **MS:** arthralgia, back pain, muscle cramps. **Neuro:** paresthesia. **Misc:** drug-induced lupus syndrome.

Interactions

Drug-Drug: General anesthetics, **IV phenytoin**, **diltiazem**, and **verapamil** may cause ↑ myocardial depression. ↑ bradycardia may occur with **digoxin**. ↑ hypotension may occur with **other antihypertensives**, acute ingestion of **alcohol**, or **nitrates**. Concurrent use with **amphetamines**, **cocaine**, **ephedrine**, **epinephrine**, **norepinephrine**, **phenylephrine**, or **pseudoephedrine** may result in unopposed alpha-adrenergic stimulation (excessive hypertension, bradycardia). Concurrent use with **clonidine** ↑ hypotension and bradycardia. Concurrent **thyroid** administration may ↓ effectiveness. May alter the effectiveness of **insulin** or **oral hypoglycemic agents** (dosage adjustments may be necessary). Acute ↑

CONTINUED

IV (Adults): *Antiarrhythmic*—1–3 mg, may be repeated after 2 min, and again in 4 hr if needed.

IV (Children): *Antiarrhythmic*—10–100 mcg (0.01–0.1 mg)/kg (up to 1 mg/dose), may be repeated q 6–8 hr if needed.

Sotalol

PO (Adults): 80 mg twice daily, may be gradually increased (usual maintenance dose is 160–320 mg/day in 2–3 divided doses; up to 480–640 mg/day).

Timolol

PO (Adults): *Antihypertensive*—10 mg twice daily, may be increased q 7 days (usual maintenance dose is 10–20 mg twice daily; up to 60 mg/day); *prevention of MI*—10 mg twice daily, starting 1–4 wk after MI; *prevention of vascular headache*—10 mg twice daily, may be given as a single daily dose; may be increased up to 10 mg in the morning and 20 mg in the evening.

NURSING IMPLICATIONS

Assessment

- **Monitor blood pressure and pulse frequently during dose adjustment and periodically during therapy.** Assess for orthostatic hypotension when assisting patient up from supine position.
- Patients receiving *labetalol IV* must be supine during and for 3 hr after administration. Monitor vital signs every 5–15 min during and for several hours after administration.
- Patients receiving *propranolol IV* must have continuous ECG monitoring and may have pulmonary capillary wedge pressure (PCWP) or central venous pressure (CVP) monitoring during and for several hours after administration.
- **Monitor intake and output ratios and daily weight. Assess patient routinely for evidence of fluid overload** (peripheral edema, dyspnea, rales/crackles, fatigue, weight gain, jugular venous distention).
- **Hypertension:** Check frequency of refills to determine compliance.
- **Angina:** Assess frequency and characteristics of angina periodically during therapy.
- **Vascular Headache Prophylaxis:** Assess frequency, severity, characteristics, and location of vascular headache periodically during therapy.
- ***Lab Test Considerations:*** May cause ↑ BUN, serum lipoprotein, potassium, triglyceride, and uric acid levels.
- May cause ↑ ANA titers.
- May cause ↑ in blood glucose levels.
- Labetalol may cause ↑ serum alkaline phosphatase, LDH, AST, and ALT levels. Discontinue if jaundice or laboratory signs of hepatic impairment occur.
- ***Toxicity and Overdose:*** Monitor patients receiving beta-adrenergic blocking agents for signs of overdose (bradycardia, severe dizziness or fainting, severe drowsiness, dyspnea, bluish fingernails or palms, seizures). Notify physician or other health care professional immediately if these signs occur.

Potential Nursing Diagnoses

Decreased cardiac output (Side Effects)
Noncompliance (Patient/Family Teaching)

Implementation

- **Do not confuse carteolol with carvedilol. Do not confuse carvedilol with captopril. Do not confuse pindolol with Parlodel (bromocriptine) or Plendil (felodipine). Do not confuse propranolol with Pravachol (pravastatin). Do not confuse Inderal (propranolol) with Adderall (amphetamine/dextroamphetamine).**
- Oral and parenteral doses of *propranolol* are not interchangeable. Check dose carefully. IV dose is 1/10 the oral dose and may be a temporary alternative if patient is NPO.
- Discontinuation of concurrent clonidine should be done gradually with beta blocker discontinued first. Then, after several days, discontinue clonidine.

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BETA BLOCKERS (nonselective)

- **PO:** Take apical pulse before administering. If <50 bpm or if arrhythmia occurs, withhold medication and notify physician.
- Most beta blockers may be administered with food or on an empty stomach. Administer *labetalol* and *propranolol* with meals or directly after eating to enhance absorption. Administer *sotalol* on an empty stomach, 1 hr before or 2 hr after meals. Administration with food, especially milk or milk products, reduces absorption.
- **Extended-release tablets should be swallowed whole; do not crush, break, or chew.** *Nadolol, pindolol, propranolol tablets,* and *timolol* may be crushed and mixed with food.
- Mix propranolol oral solution with liquid or semisolid food (water, juices, soda, applesauce, puddings). Rinse glass with more liquid to ensure that all medication is taken. Do not store after mixing.

Labetalol

- **Direct IV:** Administer undiluted. ***Rate:*** Administer slowly over 2 min.
- **Continuous Infusion:** Add 200 mg to 160 ml of diluent (1 mg/1 ml solution) or 200 mg to 250 ml of diluent (2 mg/3 ml solution). Compatible diluents include D5W, 0.9% NaCl, D5/0.25% NaCl, D5/0.9% NaCl, D5/Ringer's solution, D5/LR. ***Rate:*** Administer at a rate of 2 mg/min and titrate for desired response. Use infusion pump to ensure accurate dosage of medication.

Propranolol

- **Direct IV:** Administer undiluted or dilute each 1 mg in 10 ml of D5W. ***Rate:*** Administer at a rate not to exceed 1 mg/min.
- **Intermittent Infusion:** May also be diluted for infusion in 50 ml of 0.9% NaCl, D5W, D5/0.45% NaCl, D5/0.9%NaCl, or lactated Ringer's injection. ***Rate:*** Infuse over 10–15 min.

Patient/Family Teaching

- Instruct patient to take medication as directed, at the same time each day, even if feeling well; do not skip or double up on missed doses. Take missed doses as soon as possible up to 4 hr before next dose (8 hr with *labetalol, nadolol, penbutolol, sotalol, or extended-release propranolol). Abrupt withdrawal may precipitate life-threatening arrhythmias, hypertension, or myocardial ischemia.*.
- Advise patient to ensure that enough medication is available for weekends, holidays, and vacations. A written prescription may be kept in wallet for emergency.
- Teach patient and family how to check pulse and blood pressure. Instruct them to check pulse daily and blood pressure biweekly. Advise patient to hold dose and contact health care professional if pulse is <50 bpm or blood pressure changes significantly.
- May cause drowsiness or dizziness. Caution patients to avoid driving or other activities that require alertness until response to the drug is known. Caution patients receiving *labetalol IV* to call for assistance during ambulation or transfer.
- Advise patients to change positions slowly to minimize orthostatic hypotension, especially during initiation of therapy or when dose is increased. Patients taking oral labetalol should be especially cautious when drinking alcohol, standing for long periods, exercising, and during hot weather, as orthostatic hypotension is enhanced.
- Caution patient that this medication may increase sensitivity to cold.
- Instruct patient to consult health care professional before taking any OTC medications or herbal products, especially cold preparations, concurrently with this medication.
- Diabetics should closely monitor blood sugar, especially if weakness, malaise, irritability, or fatigue occurs. Medication may mask some signs

BETA BLOCKERS (selective)

acebutolol

(a-se-**byoo**-toe-lole)
♣Monitan, Sectral

atenolol

(a-**ten**-oh-lole)
♣Apo-Atenolol, ♣Novo-Atenol, Tenormin

betaxolol

(be-**tax**-oh-lol)
Kerlone

bisoprolol

(bis-**oh**-pro-lole)
Zebeta

metoprolol

(me-**toe**-proe-lole)
♣Betaloc, ♣Betaloc Durules, ♣Lopresor, ♣Lopresor SR, Lopressor, ♣Novometoprol, Toprol XL

Classification

Therapeutic: antianginals, antiarrhythmics, antihypertensives
Pharmacologic: beta blockers (selective)

Pregnancy Category B (acebutolol), C (betaxolol, bisoprolol, metoprolol), D (atenolol)

Indications

Management of hypertension. Management of angina pectoris (atenolol and metoprolol). Prevention of myocardial infarction (MI) (atenolol and metoprolol). Atenolol has been used to treat PVCs. Treatment of stable symptomatic congestive heart failure (CHF) due to ischemic heart disease, hypertension, or cardiomyopathy (Toprol XL only). **Unlabeled uses:** Prevention of migraine headaches. Management of tremors.

Action

Block stimulation of $beta_1$ (myocardial)-adrenergic receptors, usually without affecting $beta_2$ (pulmonary, vascular, uterine)-receptor sites. Acebutolol has mild intrinsic sympathomimetic activity (ISA), which may result in less bradycardia. **Therapeutic Effects:** Decreased blood pressure and heart rate. Decreased frequency of attacks of angina pectoris. Improved performance/survival in CHF.

Pharmacokinetics

Absorption: *Acebutolol, betaxolol,* and *metoprolol*—well absorbed after oral administration. *Atenolol*—50–60% absorbed after oral administration. *Bisoprolol*—well absorbed after oral administration, but 20% undergoes first-pass hepatic metabolism. IV administration of *atenolol* and *metoprolol* results in complete bioavailability.
Distribution: *Acebutolol* and *atenolol*—minimal penetration of CNS, cross the placenta, enter breast milk. *Betaxolol*—widely distributed. *Metoprolol*—crosses the blood-brain barrier, crosses the placenta, small amounts enter breast milk.
Metabolism and Excretion: *Acebutolol*—mostly converted by the liver to diacetolol, which is also a beta blocker. *Atenolol*—40–50% excreted unchanged by the kidneys; remainder excreted in feces as unabsorbed drug. *Betaxolol*—mostly metabolized by the liver; 20% excreted unchanged by the kidneys. *Bisoprolol*—50% excreted unchanged by the kidneys; remainder renally excreted as metabolites; 2% excreted in feces. *Metoprolol*—mostly metabolized by the liver.
Half-life: *Acebutolol*—3–4 hr (8–13 hr for diacetolol); *atenolol*—6–9 hr; *betaxolol*—15–20 hr; *bisoprolol*—9–12 hr; *metoprolol*—3–7 hr.

TIME/ACTION PROFILE (cardiovascular effects)

	ONSET	PEAK	DURATION
Acebutolol PO (antihypertensive effect)	1–1.5 hr	2–8 hr	12–24 hr
Acebutolol PO (antiarrhythmic effect)	1 hr	4–6 hr	Up to 10 hr
Atenolol PO	1 hr	2–4 hr	24 hr
Atenolol IV	rapid	5 min	unknown
Betaxolol PO	3–4 hr	7–14 days*	24 hr
Bisoprolol PO	unknown	1–4 hr	24 hr

of hypoglycemia, but dizziness and sweating may still occur. Acute hypertension may occur following insulin-induced hypoglycemia in patients receiving propranolol.
- Advise patient to notify health care professional if slow pulse, difficulty breathing, wheezing, cold hands and feet, dizziness, confusion, depression, rash, fever, sore throat, unusual bleeding, or bruising occurs.
- Instruct patient to inform health care professional of medication regimen before treatment or surgery.
- Advise patient to carry identification describing disease process and medication regimen at all times.
- **Hypertension:** Reinforce the need to continue additional therapies for hypertension (weight loss, sodium restriction, stress reduction, regular exercise, moderation of alcohol consumption, and smoking cessation). Medication controls but does not cure hypertension.
- **Angina:** Caution patient to avoid overexertion with decrease in chest pain.
- **Vascular Headache Prophylaxis:** Caution patient that sharing this medication may be dangerous.

Evaluation/Desired Outcomes

- Decrease in blood pressure. Maximum antihypertensive effects of *penbutolol* are usually seen by the end of the second week. Full effects of lower doses may not be seen for 4–6 wk. Hypotensive effects of *pindolol* may begin within 7 days, but maximum effect is reached in approximately 2 wk.
- Control of arrhythmias without appearance of detrimental side effects.
- Reduction in frequency of angina
- Increase in activity tolerance; *nadolol* may require up to 5 days before therapeutic effects are seen.
- Decreased progression of CHF.
- Prevention of MI.
- Prevention of vascular headaches.
- Management of thyrotoxicosis.
- Management of pheochromocytoma.
- Decrease in tremors.
- Management of hypertrophic cardiomyopathy.

Why was this drug prescribed for your patient?

Metoprolol PO†	15 min	unknown	6–12 hr
Metoprolol PO–ER	unknown	6–12 hr	24 hr
Metoprolol IV	immediate	20 min	5–8 hr

*With multiple dosing.

†Maximal effects on BP (chronic therapy) may not occur for 1 wk. Hypotensive effects may persist for up to 4 wk after discontinuation.

Contraindications/Precautions

Contraindicated in: Uncompensated CHF. Pulmonary edema. Cardiogenic shock. Bradycardia or heart block.

Use Cautiously in: Renal impairment (dosage reduction of *acebutolol* and *betaxolol* recommended; dosage reduction of *atenolol* recommended if CCr <35 ml/min; dosage reduction of *bisoprolol* recommended if CCr <40 ml/min); Hepatic impairment; dosage reduction recommended for *bisoprolol*; Geriatric patients (increased sensitivity to beta blockers; initial dosage reduction recommended); Pulmonary disease (including asthma; beta$_1$ selectivity may be lost at higher doses; avoid use if possible); Diabetes mellitus (may mask signs of hypoglycemia); Thyrotoxicosis (may mask symptoms); Patients with a history of severe allergic reactions (intensity of reactions may be increased); Pregnancy, lactation, or children (safety not established; all agents cross the placenta and may cause fetal/neonatal bradycardia, hypotension, hypoglycemia, or respiratory depression).

Adverse Reactions/Side Effects

CNS: fatigue, weakness, anxiety, depression, dizziness, drowsiness, insomnia, memory loss, mental status changes, nervousness, nightmares. **EENT:** blurred vision, stuffy nose. **Resp:** bronchospasm, wheezing. **CV:** BRADYCARDIA, CHF, PULMONARY EDEMA, hypotension, peripheral vasoconstriction. **GI:** constipation, diarrhea, liver function abnormalities (bisoprolol), nausea, vomiting. **GU:** impotence, decreased libido, urinary frequency. **Derm:** rashes. **Endo:** hyperglycemia, hypoglycemia. **Hemat:** thrombocytopenia (betaxolol). **MS:** arthralgia, back pain, joint pain. **Misc:** drug-induced lupus syndrome.

Interactions

Drug-Drug: General anesthesia, **IV phenytoin**, and **verapamil** may cause ↑ myocardial depression. ↑ bradycardia may occur with **digoxin**. ↑ hypotension may occur with other **antihypertensives**, acute ingestion of **alcohol** or **nitrates**. Concurrent use with **amphetamines**, **cocaine**, **ephedrine**, **epinephrine**, **norepinephrine**, **phenylephrine**, or **pseudoephedrine** may result in unopposed alpha-adrenergic stimulation (excessive hypertension, bradycardia). Concurrent **thyroid** administration may ↓ effectiveness. May alter the effectiveness of **insulin** or **oral hypoglycemic agents** (dosage adjustments may be necessary). Acute ↑ in blood pressure may accompany **insulin** -induced hypoglycemia. May ↓ the effectiveness of **theophylline**. May ↓ the beneficial beta$_1$-cardiovascular effects of **dopamine** or **dobutamine**. Use cautiously within 14 days of **monoamine oxidase (MAO) inhibitor** therapy (may result in hypertension).

Route/Dosage

Acebutolol

PO (Adults): *Antiarrhythmic*—200 mg twice daily; may be increased as needed (range 600–1200 mg/day). *Antihypertensive*—400 mg/day, as a single dose or 2 divided doses; may be increased as needed (range 400–800 mg/day).

Atenolol

PO (Adults): *Antianginal*—50 mg once daily initially, may be increased after 1 wk to 100 mg/day; may then be increased as needed (up to 200 mg/day). *Antihypertensive*—25–50 mg once daily initially, may be increased after 2 wk to 50–100 mg once daily. *MI*—50 mg (given 10 min after last IV dose), then 50 mg 12 hr later, then 100 mg /day as a single dose or in 2 divided doses for 6–9 days or until hospital discharge.

IV (Adults): *MI*—5 mg, followed by another 5 mg after 10 min; after 10 more minutes, follow with oral dosing.

Betaxolol

PO (Adults): 10 mg once daily, may be increased to 20 mg after 7 days; start with 5 mg in geriatric patients or patients with renal impairment.

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BETA BLOCKERS (selective)

Bisoprolol

PO (Adults): 5 mg once daily initially, may be increased to 10 mg once daily (range 2.5–20 mg/day); start with 2.5 mg/day in patients with bronchospasm.

Metoprolol

PO (Adults): *Antihypertensive/antianginal*—25–100 mg/day initially as a single dose or 2 divided doses, may be increased q 7 days as needed up to 450 mg/day (for angina, give in divided doses). Extended-release products are given once daily. *MI*—25–50 mg (starting 15 min after last IV dose) q 6 hr for 48 hr, then 100 mg twice daily for a minimum of 3 mo. *Migraine prevention*—50–100 mg 2–4 times daily (unlabeled). *CHF*—12.5–25 mg once daily, may be doubled every two weeks up to 200 mg/day (Toprol XL 25 mg only).

IV (Adults): *MI*—5 mg q 2 min for 3 doses, followed by oral dosing.

NURSING IMPLICATIONS

Assessment

- **Monitor blood pressure, ECG, and pulse frequently during dose adjustment and periodically throughout therapy.**
- **Monitor intake and output ratios and daily weights. Assess routinely for signs and symptoms of CHF** (dyspnea, rales/crackles, weight gain, peripheral edema, jugular venous distention).
- **Angina:** Assess frequency and characteristics of anginal attacks periodically during therapy.
- **Metoprolol or Atenolol:** Monitor vital signs and ECG every 5–15 min during and for several hours after parenteral administration. If heart rate <40 bpm, especially if cardiac output is also decreased, administer atropine 0.25–0.5 mg IV.
- ***Lab Test Considerations:*** May cause ↑ BUN, serum lipoprotein, potassium, triglyceride, and uric acid levels.
- May cause ↑ ANA titers.
- May cause ↑ in blood glucose levels.
- Acebutolol and metoprolol may cause ↑ serum alkaline phosphatase, LDH, AST, and ALT levels.
- ***Toxicity and Overdose:*** Monitor patients receiving beta-adrenergic blocking agents for signs of overdose (bradycardia, severe dizziness, or fainting, severe drowsiness, dyspnea, bluish fingernails or palms, seizures). Notify physician or other health care professional immediately if these signs occur.

Potential Nursing Diagnoses

Decreased cardiac output (Side Effects)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)
Noncompliance (Patient/Family Teaching)

Implementation

- Do not confuse Toprol-XL(metoprolol) with Topomax (topiramate) or Tegretol (carbamazepine). Do not confuse metoprolol with misoprostol.
- **PO:** Take apical pulse before administering. If <50 bpm or if arrhythmia occurs, withhold medication and notify physician or other health care professional.
- Most selective beta blockers may be administered with food or on an empty stomach. Administer metoprolol with meals or directly after eating.
- **Extended-release tablets should be swallowed whole; do not crush, break, or chew.**
- Atenolol is available in combination with chlorthalidone (Tenoretic). Bisoprolol is available in combination with hydrochlorothiazide (Ziac). Metoprolol is available in combination with hydrochlorothiazide (Lopressor HCT).

Atenolol

- **Direct IV:** IV therapy for acute MI should be initiated as soon as possible after patient arrives in the hospital.

bicalutamide (bye-ka-**loot**-a-mide)

Casodex

Classification

Therapeutic: antineoplastics
Pharmacologic: antiandrogens

Pregnancy Category X

Indications

Treatment of metastatic prostate carcinoma in conjunction with luteinizing hormone-releasing hormone (LHRH) analogues (goserelin, leuprolide), or following surgical castration.

Action

Antagonizes the effects of androgen at the cellular level. **Therapeutic Effects:** Decreased spread of prostate carcinoma.

Pharmacokinetics

Absorption: Well absorbed following oral administration.
Distribution: Unknown.
Protein Binding: 96%.
Metabolism and Excretion: Mostly metabolized by the liver.
Half-life: 5.8 days.

TIME/ACTION PROFILE (blood levels)

ROUTE	ONSET	PEAK	DURATION
PO	unknown	31.5 hr	unknown

Contraindications/Precautions

Contraindicated in: Hypersensitivity, Pregnancy.
Use Cautiously in: Moderate to severe liver impairment; Patients with childbearing potential; Lactation and children (safety not established).

Adverse Reactions/Side Effects

CNS: weakness, dizziness, headache, insomnia. **Resp:** dyspnea. **CV:** chest pain, hypertension, peripheral edema. **GI:** constipation, diarrhea, nausea, abdominal pain, increased liver enzymes, vomiting. **GU:** hematuria, impotence, incontinence, nocturia, urinary tract infections. **Derm:** alopecia, rashes, sweating. **Endo:** breast pain, gynecomastia. **Hemat:** anemia. **Metab:** hyperglycemia, weight loss. **MS:** back pain, pelvic pain, bone pain. **Neuro:** paresthesia. **Misc:** generalized pain, hot flashes, flu-like syndrome, infection.

Interactions

Drug-Drug: May increase the effect of **warfarin**.

Route/Dosage

PO (Adults): 50 mg once daily (given concurrently with LHRH analogue), or following surgical castration.

NURSING IMPLICATIONS

Assessment

- Assess patient for GI adverse effects. Diarrhea is the most common cause of discontinuation of therapy.
- ***Lab Test Considerations:*** Monitor serum prostate-specific antigen (PSA) periodically to determine response to therapy. If levels rise, assess patient for disease progression. May require periodic LHRH analogue administration without bicalutamide.
- Monitor liver function tests prior to and periodically during therapy. May cause elevated serum alkaline phosphatase, AST, ALT, and bilirubin concentrations. If transaminases increase >2 times normal, bicalutamide should be discontinued; levels usually return to normal after discontinuation.
- May cause increased BUN and serum creatinine, and decreased hemoglobin and WBCs.

- May be diluted in D5W, 0.9% NaCl, or D5/0.9% NaCl. Stable for 48 hr. ***Rate:*** Administer 5 mg over 5 min, followed by another 5 mg 10 min later.
- If patient tolerates 10-mg IV dose, administer 50 mg orally 10 min after last IV dose and give another 50-mg oral dose 12 hr later.
- **Y-Site Compatibility:** meperidine, meropenem, morphine.
- **Y-Site Incompatibility:** amphotericin B cholesteryl sulfate.

Metoprolol

- **Direct IV:** May be administered by injecting 5 mg rapidly at 2-min intervals for 3 doses. Oral therapy should begin 15 min after last IV dose.
- **Y-Site Compatibility:** abciximab, alteplase, argatroban, meperidine, morphine.
- **Y-Site Incompatibility:** amphotericin B cholesteryl sulfate.

Patient/Family Teaching

- Instruct patient to take medication as directed, at the same time each day, even if feeling well; do not skip or double up on missed doses. Take missed doses as soon as possible up to 4 hr before next dose (8 hr with atenolol, betaxolol, or metoprolol). Abrupt withdrawal may precipitate life-threatening arrhythmias, hypertension, or myocardial ischemia.
- Advise patient to ensure that enough medication is available for weekends, holidays, and vacations. A written prescription may be kept in the wallet for emergencies.
- Teach patient and family how to check pulse and blood pressure. Instruct them to check pulse daily and blood pressure biweekly and to report significant changes to health care professional.
- May cause drowsiness. Caution patients to avoid driving or other activities that require alertness until response to the drug is known.
- Advise patients to change positions slowly to minimize orthostatic hypotension.
- Caution patient that this medication may increase sensitivity to cold.
- Instruct patient to consult health care professional before taking any Rx, OTC, or herbal products, especially cold preparations, concurrently with this medication. Patients on antihypertensive therapy should also avoid excessive amounts of coffee, tea, and cola.
- Diabetics should closely monitor blood sugar, especially if weakness, malaise, irritability, or fatigue occurs. Medication does not block dizziness or sweating as signs of hypoglycemia.
- Advise patient to notify health care professional if slow pulse, difficulty breathing, wheezing, cold hands and feet, dizziness, light-headedness, confusion, depression, rash, fever, sore throat, unusual bleeding, or bruising occurs.
- Instruct patient to inform health care professional of medication regimen before treatment or surgery.
- Advise patient to carry identification describing disease process and medication regimen at all times.
- **Hypertension:** Reinforce the need to continue additional therapies for hypertension (weight loss, sodium restriction, stress reduction, regular exercise, moderation of alcohol consumption, and smoking cessation). Medication controls but does not cure hypertension.

Evaluation/Desired Outcomes

- Decrease in blood pressure.
- Control of arrhythmias without appearance of detrimental side effects.
- Reduction in frequency of anginal attacks
- Increase in activity tolerance.
- Prevention of MI.
- Managment of stable, symptomatic heart failure (Toprol XL 25 mg only).

Why was this drug prescribed for your patient?

Potential Nursing Diagnoses

Diarrhea (Adverse Reactions)

Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- Start treatment with bicalutamide at the same time as LHRH analogue.
- **PO:** May be administered in the morning or evening, without regard to food.

Patient/Family Teaching

- Instruct patient to take bicalutamide exactly as directed at the same time each day. Do not discontinue without consulting health care professional.
- Advise patient not to take other medications without consulting health care professional.
- Instruct patient to report diarrhea that is severe or persistent.
- Discuss with patient the possibility of hair loss. Explore methods of coping.
- Emphasize the importance of regular follow-up exams and blood tests to determine progress, and monitor for side effects.

Evaluation/Desired Outcomes

- Decreased spread of prostate carcinoma.

Why was this drug prescribed for your patient?

bisacodyl (bis-a-**koe**-dill)

Bisac-Evac, ♣Bisaco-Lax, ♣Bisacolax, Caroid, Carter's Little Pills, Dacodyl, Deficol, Dulcagen, Dulcolax, Feen-a-Mint, Fleet Laxative, ♣Laxit, Modane, Reliable Gentle Laxative, Theralax, Women's Gentle Laxative

Classification
Therapeutic: laxatives
Pharmacologic: stimulant laxatives

Pregnancy Category UK

Indications
Treatment of constipation, particularly when associated with: Prolonged bedrest, Constipating drugs, Slow transit time, Irritable bowel syndrome. Evacuation of the bowel before radiologic studies or surgery. Used as part of a bowel regimen in patients with spinal cord injury.

Action
Stimulates peristalsis (alters fluid and electrolyte transport, producing fluid accumulation in the colon). **Therapeutic Effects:** Evacuation of the colon.

Pharmacokinetics
Absorption: Variable absorption follows oral administration; rectal absorption is minimal. Action is local in the colon.
Distribution: Small amounts of metabolites excreted in breast milk.
Metabolism and Excretion: Metabolized by the liver.
Half-life: Unknown.

TIME/ACTION PROFILE (evacuation of bowel)

ROUTE	ONSET	PEAK	DURATION
PO	6–12 hr	unknown	unknown
Rectal	15–60 min	unknown	unknown

Contraindications/Precautions
Contraindicated in: Hypersensitivity. Abdominal pain. Obstruction. Nausea or vomiting, especially when associated with fever or other signs of acute abdomen.
Use Cautiously in: Severe cardiovascular disease; Anal or rectal fissures; Excess or prolonged use may result in dependence; Products containing tannic acid (Clysodrast) should not be used as multiple enemas (increased risk of hepatotoxicity); Has been used during pregnancy and lactation.

Adverse Reactions/Side Effects
GI: abdominal cramps, nausea, diarrhea, rectal burning. **F and E:** hypokalemia (chronic use). **MS:** muscle weakness (chronic use). **Misc:** protein-losing enteropathy, tetany (chronic use).

Interactions
Drug-Drug: Antacids, histamine H_2-receptor antagonists, and **gastric acid–pump inhibitors** may remove enteric coating of tablets resulting in gastric irritation/dyspepsia. May decrease the absorption of other **orally administered drugs** because of increased motility and decreased transit time.
Drug-Food: Milk may remove enteric coating of tablets, resulting in gastric irritation/dyspepsia.

Route/Dosage
PO (Adults and Children ≥12 yr): 5–15 mg (up to 30 mg/day) as a single dose.
PO (Children >3 yr): 5–10 mg (0.3 mg/kg) as a single dose.
Rect (Adults and Children ≥12 yr): 10 mg single dose.
Rect (Children 2–11 yr): 5–10 mg single dose.
Rect (Children <2 yr): 5 mg single dose.

NURSING IMPLICATIONS

Assessment
- Assess patient for abdominal distention, presence of bowel sounds, and usual pattern of bowel function.

BRONCHODILATORS (ADRENERGIC)

albuterol
(al-**byoo**-ter-ole)
Accu-Neb, Airet, ♣Gen-Salbutamol, ♣Novo-Salmol, Proventil, Proventil HFA, Salbutamol, Ventodisk, Ventolin, Volmax

formoterol
(for-**mo**-te-role)
Foradil

levalbuterol
(le-val-**byoo**-te-role)
Xopenex

metaproterenol
(met-a-proe-**ter**-e-nole)
Alupent, Metaprel

pirbuterol
(peer-**byoo**-te-role)
Maxair

salmeterol
(sal-**me**-te-role)
Serevent

terbutaline
(ter-**byoo**-ta-leen)
Brethaire, Bricanyl

Classification
Therapeutic: bronchodilators
Pharmacologic: adrenergics

Pregnancy Category B (terbutaline), C (albuterol, formoterol, levalbuterol, pirbuterol, salmetrol)

Indications
Reversible airway disease due to asthma or chronic obstructive pulmonary disease (formoterol and salmeterol can only be used for prevention, not for acute treatment). **Inhalation:** All except formoterol and salmeterol are used as quick-relief agents in the management of asthma. **PO:** Sustained-release preparations are used for long-term control of asthma in patients with chronic/persistent bronchospasm. **Unlabeled uses:** *Terbutaline*—management of pre-term labor (tocolytic).

Action
Result in the accumulation of cyclic adenosine monophosphate (cAMP) at beta-adrenergic receptors. Produce bronchodilation. Inhibit the release of mediators of immediate hypersensitivity reactions from mast cells. Relatively selective for $beta_2$-adrenergic (pulmonary) receptor sites with less effect on $beta_1$ (cardiac)-adrenergic receptors. **Therapeutic Effects:** Bronchodilation.

Pharmacokinetics
Absorption: *Albuterol* and *metaproterenol*—well absorbed following oral administration, but rapidly undergo extensive metabolism. *Levalbuterol*—some absorption occurs following inhalation. *Pirbuterol* and *salmeterol*—minimal systemic absorption. *Formoterol*—inhaled drug is swallowed and then rapidly metabolized. *Terbutaline*—35–50% absorbed following oral administration, but rapidly undergoes first-pass metabolism. Well absorbed following subcut administration. Minimal absorption occurs following inhalation.
Distribution: *Albuterol*—small amounts appear in breast milk. *Metaproterenol, pirbuterol*—Unknown. *Salmeterol*—action is primarily local. *Terbutaline*—enters breast milk.
Metabolism and Excretion: *Albuterol* and *metaproterenol*—extensively metabolized by the liver and other tissues. *Formoterol*—absorbed drug is mostly metabolized by the liver (P450 enzymes). *Pirbuterol*—metabolized by the liver. *Terbutaline*—partially metabolized by the liver, 60% excreted unchanged by the kidneys following subcut administration.
Half-life: *Albuterol*—3.8 hr; *formoterol*—10 hr; *salmeterol*—5.5 hr; *pirbuterol*—2 hr.

- Assess color, consistency, and amount of stool produced.

Potential Nursing Diagnoses

Constipation (Indications)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- May be administered at bedtime for morning results.
- **PO:** Taking on an empty stomach will produce more rapid results.
- **Do not crush or chew enteric-coated tablets** Take with a full glass of water or juice.
- Do not administer within 1 hr of milk or antacids; this may lead to premature dissolution of tablet and subsequent gastric or duodenal irritation.
- **Rect:** Suppository or enema can be given when a bowel movement is desired. Lubricate suppositories with water or water-soluble lubricant before inserting. Encourage patient to retain 15–30 min before expelling.

Patient/Family Teaching

- Advise patients, other than those with spinal cord injuries, that laxatives should be used only for short-term therapy. Long-term therapy may cause dependence and electrolyte imbalance.
- Advise patient to increase fluid intake to a minimum of 1500–2000 ml/day during therapy to prevent dehydration.
- Encourage patient to utilize other forms of bowel regulation, such as increasing bulk in the diet, increasing fluid intake, and increasing mobility. Normal bowel habits are individualized—frequency of bowel movement may vary from 3 times/day to 3 times/wk.
- Instruct patient with cardiac disease to avoid straining during bowel movements (Valsalva maneuver).
- Advise patient that bisacodyl should not be used when constipation is accompanied by abdominal pain, fever, nausea, or vomiting.

Evaluation/Desired Outcomes

- Patient having a soft, formed bowel movement when used for constipation.
- Evacuation of the colon when used before surgery or radiologic studies or for patients with spinal cord injury.

Why was this drug prescribed for your patient?

TIME/ACTION PROFILE (bronchodilation)

ROUTE	ONSET	PEAK	DURATION
Albuterol PO	30 min	2–3 hr	≥6 ερ
Albuterol PO-ER	30 min	2–3 hr	12 hr
Albuterol inhaln	5–15 min	60–90 min	4–6 hr
Formoterol inhaln	15 min	1–3 hr	12 hr
Levalbuterol	rapid	30 min	6–8 hr
Metaproterenol PO	within 30 min	within 1 hr	up to 4 hr
Metaproterenol aerosol	within 1 min	1 hr	1–5 hr
Metaproterenol IPPB	5–30 min	unknown	2–6 hr
Pirbuterol inhaln	within 5 min	1.5 hr	6–8 hr
Salmeterol inhaln	within 30 min	4 hr	12 hr
Terbutaline PO	within 120 min	within 2–3 hr	4–8 hr
Terbutaline inhaln	5–30 min	1–2 hr	3–6 hr
Terbutaline subcut	within 15 min	within 0.5–1 hr	1.5–4 hr

Contraindications/Precautions

Contraindicated in: Hypersensitivity to adrenergic amines. Some products may contain bisulfites, alcohol, or fluorocarbons and should be avoided in patients with known hypersensitivity or intolerance. Acute bronchospasm (salmeterol and formoterol).

Use Cautiously in: Cardiovascular disorders; Hyperthyroidism; Diabetes; Glaucoma; Elderly patients (more susceptible to adverse reactions); Excessive use of inhalers may lead to tolerance and paradoxical bronchospasm; Pregnancy (near term; avoid use of salmeterol during labor as it may inhibit contractions), lactation, and children <2 yr (safety not established).

Adverse Reactions/Side Effects

CNS: nervousness, restlessness, tremor, headache, insomnia. **Resp:** PARADOXICAL BRONCHOSPASM (excessive use of inhalers), PULMONARY EDEMA (tocolytic use of terbutaline only). **CV:** palpitations, tachycardia, angina, arrhythmias, ECG changes, hypertension. **GI:** nausea, vomiting. **Endo:** hyperglycemia (maternal), hypoglycemia (fetaltocolytic use of terbutaline only). **F and E:** hypokalemia. **Misc:** allergic reactions.

Interactions

Drug-Drug: Concurrent use with other **adrenergic agents** will cause ↑ adrenergic effects. ↑ risk of hypokalemia with thiazide and loop **diuretics** and **corticosteroids**. **Beta blockers** may ↓ effects. Concurrent use with **MAO inhibitors**, **tricyclic antidepressants**, or other **agents that may prolong the QTc interval** may cause serious arrhythmias or hypertension and should be undertaken with extreme caution.

Drug-Natural Products: Use with caffeine-containing herbs (*cola nut*, *guarana*, *mate*, **tea, coffee**) ↑ stimulant effect.

Route/Dosage

Albuterol

PO (Adults and Children ≥12 yr): 2–4 mg 3–4 times daily (not to exceed 32 mg/day) or 4–8 mg of extended-release tablets twice daily.

PO (Geriatric Patients): Initial dose should not exceed 2 mg 3–4 times daily; may be increased carefully (up to 32 mg/day).

PO (Children 6–12 yr): 2 mg 3–4 times daily or 4 mg as extended-release tablets twice daily; may be carefully increased as needed (not to exceed 24 mg/day).

PO (Children 2–6 yr): 0.1 mg/kg 3 times daily (not to exceed 2 mg 3 times daily initially); may be carefully increased to 0.2 mg/kg 3 times daily (not to exceed 4 mg 3 times daily).

Inhaln (Adults and Children ≥4 yr): *Via metered-dose inhaler*—2 inhalations q 4–6 hr or 2 inhalations 15 min before exercise (90 mcg/spray); some patients may respond to 1 inhalation.

Inhaln (Adults and Children >12 yr): *Via nebulization or IPPB*—2.5 mg 3–4 times daily.

Inhaln (Children 2–12 yr): *Via nebulization or IPPB*—0.1–0.15 mg/kg/dose 3–4 times daily *or* 1.25 mg 3–4 times daily for children 10–15 kg *or* 2.5 mg 3–4 times daily for children >15 kg.

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BRONCHODILATORS (ADRENERGIC)

Inhaln (Adults and Children ≥4 yr): *Via Rotahaler inhalation device*—200 mcg (as Ventolin Rotacaps) q 4–6 hr (up to 400 mcg q 4–6 hr). May also be given 15 min before exercise.

Formoterol

Inhaln (Adults and Children ≥5 yr): *Maintenance treatment of asthma*—1 capsule (12 mcg) q 12 hr using Aerolizer inhaler. *Prevention of exercise induced bronchospasm*—1 capsule (12 mcg) at least 15 min before exercise (for patients ≥12 yrs only).

Levalbuterol

Inhaln (Adults): 0.63 via nebulization three times daily (every 6–8 hr); may be increased to 1.25 mg three times daily.
Inhaln (Children 6–11 yr): 0.31 mg three times daily (not exceed 0.63 mg three times daily).

Metaproterenol

Inhaln (Adults and Children >12 yr): *Metered-dose inhaler*—2–3 inhalations q 3–4 hr (not to exceed 12 inhalations/day). *IPPB*—0.2–0.3 ml of 5% solution or 2.5 ml of 0.4–0.6% solution for nebulization 3–4 times daily (not to exceed q 4 hr use).

Pirbuterol

Inhaln (Adults): 1–2 inhalations (0.2 mg/inhalation) q 4–6 hr (not to exceed 12 inhalations/day).

Salmeterol

Inhaln (Adults and Children ≥12 yr): 50 mcg (one inhaltion as dry powder) twice daily (approximately 12 hr apart); *exercise-induced bronchospasm*—50 mcg (one inhalation as dry powder) 30–60 min before exercise.
Inhaln (Children 4–12 yr): 50 mcg (as dry powder) twice daily (approximately 12 hr apart); *exercise-induced bronchospasm*—50 mcg (as dry powder) 30–60 min before exercise.

Terbutaline

PO (Adults and Children >15 yr): *Bronchodilation*—2.5–5 mg 3 times daily, given q 6 hr (not to exceed 15 mg/24 hr). *Tocolysis*—2.5 mg q 4–6 hr until delivery (unlabeled).
PO (Children 12–15 yr): 2.5 mg 3 times daily (given q 6 hr).
Subcut: (Adults): *Bronchodilation*—250 mcg, may repeat in 15–30 min (not to exceed 500 mcg/4 hr). *Tocolysis*—250 mcg q hr until contractions stop (unlabeled).
IV (Adults): *Tocolysis*—10 mcg/min infusion, increase by 5 mcg/min q 10 min until contractions stop (not to exceed 80 mcg/min). After contractions have stopped for 30 min, decrease infusion rate to lowest effective amount and maintain for 4–8 hr (unlabeled).

NURSING IMPLICATIONS

Assessment

- **Bronchodilator:** Assess lung sounds, respiratory pattern, pulse, and BP before administration and during peak of medication. Note amount, color, and character of sputum produced. Report abnormal findings.
- Monitor pulmonary function tests before initiating therapy and periodically during course to determine effectiveness.
- **Observe for paradoxical bronchospasm (wheezing). If condition occurs, withhold medication and notify physician or other health care professional immediately.**
- Observe patient for drug tolerance and rebound bronchospasm. Patients requiring more than 3 inhalation treatments in 24 hr should be under close supervision. If minimal or no relief is seen after 3–5 inhalation

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BRONCHODILATORS (ADRENERGIC)

fore use. Store inhaler in a level, horizontal position. Aerolizer Inhaler should never be washed and should be kept dry.

- Do not use a spacer with fomoterol. **Inhaln:** To use, pull off the Aerolizer cover. Hold the base of the inhaler firmly, and twist mouthoiece in the direction of the arrow to open. Push the buttons in to make sure four pins are visible in the capsule well on each side. Remove capsule from blister pack immediately before use. Separate one blistered capsule by tearing at perforations. With foil-side up, fold back along performation and flatten. Starting at slit, tear off corner; separate and peel foil from paper backing and remove capsule. Place capsule in the capsule chamber in the base of the Aerolizer Inhaler. Never place a capsule directly into the mouthpiece. Twist the mouthpiece back to the closed position. With the mouthpiece upright, simultaneously press both buttons only once. A click should be heard as the capsule is being pierced. Release buttons; if buttons stick in depressed position grasp wings on buttons and retract before inhalation. With patient sitting or standing in a comfortable upright position, exhale fully. Do not exhale into the device. Tilt head back slightly and breathe in rapidly but steadily. A sweet taste will be experienced and a whirring noise heard. If no whirring is heard, the capsule may be stuck. Open inhaler and loosen capsule allowing it to spin freely. Do not repeatedly press buttons to loosen capsule. Hold breath for as long as comfortably possible after removing inhaler from mouth. Open inhaler to see if any powder is still in capsule. If powder is found, repeat inhalation steps. After use, open, remove and discard empty capsule.

Levalbuterol

- Open foil pouch by tearing one edge on serrated seam and remove one unit-dose vial. If vial is not used immediately, protect from light and use within 1 week. Use opened vials immediately or discard. Discard vial if solution is not colorless. Keep unused vials in foil pouch to protect from light. Twist top of unit-dose vial and squeeze entire contents into nebulizer reservoir. Do not mix other drugs in nebulizer with levalbuterol. Connect nebulizer to mouthpiece or face mask and to compressor.
- Solution should not be injected or administered orally.
- **Inhaln:** With patient sitting in a comfortable upright position, place mouthpiece in mouth (or put on face mask) and turn on compressor. Instruct patient to breathe as calmly, deeply, and evenly as possible until no more mist is formed in nebulizer reservoir, 5–15 minutes.

Metaproterenol

- **Inhaln:** For IPPB administration, dilute each dose in 2.5 ml of 0.9% NaCl. Do not use if solution is brown or darker than slightly yellow or pinkish, or if it contains a precipitate.

Salmeterol

- **Inhaln:** Salmeterol metered-dose inhaler should be primed or tested before first use.

Terbutaline

- **Subcut:** Administer subcut injections in lateral deltoid area. Do not use solution if discolored.
- **Continuous Infusion:** May be diluted in D5W, 0.9% NaCl, or 0.45% NaCl. ***Rate:*** Use infusion pump to ensure accurate dosage. Begin infusion at 10 mcg/min. Increase dosage by 5 mcg every 10 min until contractions cease. Maximum dose is 80 mcg/min. Begin to taper dose in 5-mcg decrements after a 30–60 min contraction-free period is attained. Switch to oral dosage form after patient is contraction-free 4–8 hr on the lowest effective dose.

treatments within 6–12 hr, further treatment with aerosol alone is not recommended.
- Assess for hypersensitivity reaction (rash, urticaria, swelling of the face, lips, or eyelids). If condition occurs, withhold medication and notify physician or other health care professional immediately.
- **Preterm Labor:** Monitor maternal pulse and BP, frequency and duration of contractions, and fetal heart rate. Notify physician or other health care professional if contractions persist or if increase in frequency or duration or if symptoms of maternal or fetal distress occur. Maternal side effects include tachycardia, palpitations, tremor, anxiety, and headache.
- **Assess maternal respiratory status for symptoms of pulmonary edema (increased rate, dyspnea, rales/crackles, frothy sputum).**
- Monitor mother for symptoms of hyperglycemia (drowsiness, flushed dry skin, fruit-like breath odor, frequent urination, loss of appetite, tiredness, unusual thirst) and hypokalemia (weakness, fatigue, U wave on ECG, arrhythmias). Assess neonate for symptoms of hypoglycemia (chills, cold sweats, cool pale skin, drowsiness, excessive hunger, irritability, rapid pulse, shakiness, weakness).
- **Formoterol:** Monitor ECG periodically during therapy. May cause prolonged QTc interval.
- ***Lab Test Considerations:*** May cause transient ↓ in serum potassium levels with nebulization or with higher than recommended doses.
- *Salmeterol* may cause ↑ serum glucose and ↓ serum potassium concentrations, usually transient and dose-related; occur rarely with recommended doses and are more pronounced with frequent use of high doses.
- Monitor maternal serum glucose and electrolytes in patients receiving *terbutaline*. May cause maternal hypokalemia and hyperglycemia. Monitor neonate's serum glucose, as hypoglycemia may occur in neonate.
- ***Lab Test Considerations:*** Formoterol may cause ↑ serum glucose and ↓ serum potassium.

Potential Nursing Diagnoses

Ineffective airway clearance (Indications)
Ineffective tissue perfusion (Indications)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- **Do not confuse Ventolin (albuterol) with Vantin (cefpodoxime). Do not confuse Alupent (metaproterenol) with Atrovent (ipratopium). Do not confuse salmeterol with Salbutamol (albuterol). Do not confuse Maxair (pirbuterol) with Maxalt (rizatriptan).**
- **PO:** Administer oral medication with meals to minimize gastric irritation.
- Terbutaline tablet may be crushed and mixed with food or fluids for patients with difficulty swallowing.
- **Extended-release tablets should be swallowed whole; do not break, crush, or chew.**

Albuterol

- **Inhaln:** For nebulization or intermittent positive pressure breathing (IPPB), the 0.5-, 0.83-, 1-, and 2-mg/ml solutions do not require dilution prior to administration. The 5-mg/ml solution must be diluted with 2.5 ml of 0.9% NaCl for inhalation. Diluted solutions are stable for 24 hr at room temperature or 48 hr if refrigerated.
- For nebulizer, compressed air or oxygen flow should be 6–10 L/min; a single treatment of 3 ml lasts about 10 min.
- For IPPB, the inspiratory pressure is usually 5–20 cm H_2O and lasts 5–20 min.

Formoterol

- Place capsule in the well of the Aerolizer Inhaler with dry hands; do not expose to moisture. The capsule is pierced by pressing and releasing the buttons on the side of the device. Medication is dispersed into the air stream when patient inhales rapidly and deeply through mouthpiece. Capsules are only to be used with Aerolizer Inhaler and should not be taken orally. Store capsules in the blister and only remove immediately be-

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Patient/Family Teaching

- Instruct patient to take medication as directed. If on a scheduled dosing regimen, take a missed dose as soon as remembered, spacing remaining doses at regular intervals. Do not double doses or increase the dose or frequency of doses. Caution patient not to exceed recommended dose; may cause adverse effects, paradoxical bronchospasm, or loss of effectiveness of medication. Advise patient that not all agents should be used for acute attacks.
- Instruct patient to contact health care professional immediately if shortness of breath is not relieved by medication or is accompanied by diaphoresis, dizziness, palpitations, or chest pain.
- Advise patient to consult health care professional before taking any OTC medications or alcoholic beverages concurrently with this therapy. Caution patient also to avoid smoking and other respiratory irritants.
- Inform patient that albuterol may cause an unusual or bad taste.
- **Inhaln:** Review correct administration technique (aerosolization, IPPB, metered-dose inhaler, Rotahaler) with patient. Wait 1–5 min before administering next dose. Mouthpiece should be washed after each use.
- Do not spray inhaler near eyes.
- Instruct patient to save inhaler; refill canisters may be available.
- Advise patients to use bronchodilator first if using other inhalation medications, and allow 5 min (15 min for terbutaline) to elapse before administering other inhalant medications, unless otherwise directed.
- Advise patient to rinse mouth with water after each inhalation dose to minimize dry mouth.
- Advise patient to maintain adequate fluid intake (2000–3000 ml/day) to help liquefy tenacious secretions.
- Advise patient to consult health care professional if respiratory symptoms are not relieved or worsen after treatment, or if chest pain, headache, severe dizziness, palpitations, nervousness, or weakness occur.
- **Advise patient that paradoxical bronchospasm is more likely to occur with use of a new canister or vial.**
- Instruct patient to notify health care professional if contents of one canister are used up in less than 2 wk.
- *Albuterol:* Instruct patient to prime unit with 4 sprays before using and to discard canister after 200 sprays.
- *Salmeterol:* Instruct patient that inhalation powder device is not reusable, discard after every blister has been used or 6 wk after removing from moisture-protective foil overwrap pouch.
- Instruct patient not to use a spacer with the inhalation powder (diskus).
- If symptoms occur before next dose is due, use a rapid-acting inhaled bronchodilator. Caution patient not to use salmeterol to treat acute symptoms. A rapid-acting inhaled beta-adrenergic bronchodilator should be used for relief of acute asthma attacks.
- Advise patients on chronic therapy not to use additional salmeterol to prevent exercise-induced bronchospasm. Patients using salmeterol for prevention of exercise-induced bronchospasm should not use additional doses of salmeterol for 12 hr after prophylactic administration.
- **Advise patient to notify health care professional immediately if difficulty in breathing persists after use of salmeterol, if condition worsens, if more inhalations of rapid-acting bronchodilator than usual are needed to relieve an acute attack, or if using 4 or more inhalations of a rapid-acting bronchodilator for 2 or more consecutive days or more than 1 canister in an 8-wk period.**
- Instruct patient on correct technique for use of Aerolizer Inhaler. Advise patient always to use new Aerolizer Inhaler that comes with each refill. Take sticker with 'use by' date written by pharmacist from the outside of the box and place it on the Aerolizer Inhaler cover. If the date is blank, count 4 months from the date of purchase and write date on sticker. Use new inhaler and blister pack following the "use by" date.
- Inform patient that in rare cases capsule might break into small pieces. These pieces should be retained by the screen in the inhaler, however in rare instances tiny pieces may reach mouth or throat after inhalation. Shattering of capsule is less likely to happen if storage conditions are

CONTINUED

Why was this drug prescribed for your patient?

CONTINUED

BRONCHODILATORS (ADRENERGIC)

strictly followed, capsules removed from blister immediately before use, and capsules are only pierced once.
- Advise patient to have a rapid-acting bronchodilator available for use at all times for symptomatic relief of acute asthma attacks.
- Instruct patient to contact health care professional immediately if shortness of breath is not relieved by medication or nausea, vomiting, shakiness, headache, fast or irregular heartbeat, or sleeplessness occur.
- **Instruct patient to notify health care professional if there is no response to the usual dose of fomoterol. Asthma and treatment regimen should be re-evaluated and corticosteroids should be considered. Need for increased use to treat symptoms indicates decrease in asthma control and need to reevaluate patient's therapy.**
- Advise patient to consult health care professional before taking any OTC medications, herbal/alternative products or alcohol concurrently with this therapy. Caution patient also to avoid smoking and other respiratory irritants.
- Advise patient to notify health care professional if pregnancy is planned or suspected, or if nursing.
- **Preterm Labor:** Health care professional should be notified immediately if labor resumes or significant side effects occur.

Evaluation/Desired Outcomes

Effectiveness of therapy can be demonstrated by:
- Prevention or relief of bronchospasm
- Increase in ease of breathing.
- Control of preterm labor in a fetus of 20–36 wk gestational age.

BRONCHODILATORS (XANTHINES)

aminophylline (am-in-**off**-i-lin)
Phyllocontin, Truphylline

theophylline (thee-**off**-i-lin)
Accurbron, ♣Apo-Theo LA, Asmalix, Bronkodyl, Elixomin, Elixophyllin, Lanophyllin, Quibron-T, Respbid, Sustaire, Theobid, Theochron, Theoclear, Theo–Dur, Theospan, Theostat, Theo-Time, Theo-24, Theovent, Theo-X, T-Phyl, Uniphyl

Classification
Therapeutic: bronchodilators
Pharmacologic: phosphodiesterase inhibitors, xanthines

Pregnancy Category C

Indications

Long-term control of reversible airway obstruction caused by asthma or chronic obstructive pulmonary disease. **Unlabeled uses:** Respiratory and myocardial stimulant in apnea of infancy.

Action

Inhibits phosphodiesterase, producing increased tissue concentrations of cyclic adenosine monophosphate (cAMP). Increased levels of cAMP result in: Bronchodilation, CNS stimulation, Positive inotropic and chronotropic effects, Diuresis, Gastric acid secretion. **Therapeutic Effects:** Bronchodilation.

Pharmacokinetics

Absorption: Aminophylline releases theophylline after administration. *Aminophylline*—well absorbed from PO dosing; absorption from extended-release dosage forms is slow but complete; absorption from suppositories is unreliable. *Theophylline*—well absorbed from PO dosage forms; absorption from extended-release dosage forms is slow but complete.

Distribution: widely distributed; crosses the placenta; enter breast milk in high concentrations; do not distribute into adipose tissue.
Metabolism and Excretion: *Aminophylline* and *theophylline*—aminophylline is converted to theophylline; theophylline is metabolized by the liver (90%) to caffeine, which may accumulate in neonates; 10% excreted unchanged by the kidneys.
Half-life: *Theophylline*—3–13 hr (increased in patients >60 yr, neonates, patients with congestive heart failure (CHF) or liver disease; decreased in cigarette smokers and children.

TIME/ACTION PROFILE (bronchodilation)

ROUTE	ONSET*	PEAK	DURATION
Aminophylline PO	15–60 min	1–2 hr	6–8 hr
Aminophylline PO-ER	unknown	+–7 hr	8–12 hr
Aminophylline IV	rapid	end of infusion	6–8 hr
Theophylline PO	rapid	1–2 hr	6 hr
Theophylline PO–ER	delayed	+–8 hr	8–24 hr
Theophylline IV	rapid	end of infusion	6–8 hr

*Provided that a loading dose has been given and steady-state blood levels exist

Contraindications/Precautions

Contraindicated in: Uncontrolled arrhythmias. Hyperthyroidism.
Use Cautiously in: Geriatric patients (>60 yr), CHF, or liver disease (dosage reduction required); Obese patients (dose should be based on lean body weight); Has been used safely in pregnancy.

Adverse Reactions/Side Effects

CNS: SEIZURES, anxiety, headache, insomnia. **CV:** ARRHYTHMIAS, tachycardia, angina, palpitations. **GI:** nausea, vomiting, anorexia, cramps. **Neuro:** tremor.

Interactions

Drug-Drug: Additive CV and CNS side effects with **adrenergic (sympathomimetic) agents**. May decrease the therapeutic effect of **lithium**. **Ad-**

renergic agents, **barbiturates**, **ketoconazole**, **nicotine** (cigarettes, gum, transdermal patches) **phenytoin**, and **rifampin** may decrease effectiveness. **Beta blockers**, **cimetidine**, **clarithromycin**, **disulfiram**, **erythromycin**, some **fluoroquinolones**, **fluvoxamine**, **corticosteroids**, **influenza vaccine**, **interferon**, **mexiletine**, **hormonal contraceptives**, **thiabendazole**, and large doses of **allopurinol** may lead to toxicity. **Carbamazepine**, **isoniazid**, and loop **diuretics** may alter theophylline levels.

Route/Dosage

Dose should be determined by serum-level monitoring. Loading dose should be decreased or eliminated if theophylline has been used in previous 24 hr. Aminophylline is 79–86% theophylline. Extended- or sustained-release products may be given q 8–24 hr.

Aminophylline/Theophylline

Doses are expressed in theophylline equivalents.

PO (Adults): *Loading dose*—6 mg/kg then 3 mg/kg q 6 hr for 2 doses, then 3 mg/kg q 8 hr maintenance dose (up to 13 mg/kg or 900 mg/day).

PO (Adults with CHF or Liver Disease): *Loading dose*—6 mg/kg, then 2 mg/kg q 8 hr for 2 doses, then 1–2 mg/kg q 12 hr maintenance dose.

PO (Geriatric Patients and Patients with Cor Pulmonale): 6 mg/kg loading dose, then 2 mg/kg q 6 hr for 2 doses, then 2 mg/kg q 8 hr maintenance dose.

PO (Children 9–16 yr or Young Adult Smokers): *Loading dose*—6 mg/kg, then 3 mg/kg q 4 hr for 3 doses, then 3 mg/kg q 6 hr maintenance dose (up to 20 mg/kg/day in children 9–12 yr or 18 mg/kg/day in children 12–16 yr).

PO (Children 6 mo–9 yr): *Loading dose*—4 mg/kg q 4 hr for 3 doses, then 4 mg/kg q 6 hr maintenance dose (up to 24 mg/kg/day).

PO, IV (Neonates—Premature and up to 40 wk Postconception Age): 1 mg/kg q 12 hr.

PO, IV (Neonates at Birth or 40 wk Postconception): *Up to 4 wk postnatal age*—1–2 mg/kg q 12 hr; *4–8 wk postnatal age*—1–2 mg/kg q 8 hr; *over 8 wk postnatal age*—1–3 mg/kg q 6 hr.

IV (Adults): *Loading dose*—4.7 mg/kg, then 0.55 mg/kg/hr for 12 hr, then 0.36 mg/kg/hr maintenance infusion.

IV (Adults with CHF or Liver Disease): *Loading dose*—4.7 mg/kg, then 0.39 mg/kg/hr for 12 hr, then 0.08–0.16 mg/kg/hr maintenance infusion.

IV (Geriatric Patients and Patients with Cor Pulmonale): *Loading dose*—4.7 mg/kg, then 0.47 mg/kg/hr for 12 hr, then 0.24 mg/kg/hr maintenance infusion.

IV (Children 9–16 yr or Young Adult Smokers): 4.7 mg/kg, then 0.79 mg/kg/hr for 12 hr, then 0.63 mg/kg/hr maintenance infusion.

IV (Children 6 mo–9 yr): 4.7 mg/kg, then 0.95 mg/kg/hr for 12 hr, then 0.79 mg/kg/hr maintenance infusion.

NURSING IMPLICATIONS

Assessment

- Assess blood pressure, pulse, respiratory status (rate, lung sounds, use of accessory muscles) before and throughout therapy. Ensure that oxygen therapy is correctly instituted during acute asthma attacks.
- Monitor intake and output for an increase in diuresis or fluid overload.
- Monitor patients with a history of cardiovascular problems for chest pain and ECG changes (PACs, supraventricular tachycardia, PVCs, ventricular tachycardia). Resuscitative equipment should be readily available.
- Monitor pulmonary function tests before and periodically during therapy to determine efficacy in patients with chronic bronchitis or emphysema.
- ***Lab Test Considerations:*** Monitor ABGs, acid-base, and fluid and electrolyte balance in patients receiving parenteral therapy or whenever required by patient's condition.
- ***Toxicity and Overdose:*** Monitor drug levels routinely, especially in patients requiring high doses or during prolonged intensive therapy. Obtain serum samples at time of peak absorption; 15–30 min after IV loading dose, 1–2 hr after rapid-acting forms, and 4–12 hr after exten-

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BRONCHODILATORS (XANTHINES)

ded-release forms. Therapeutic plasma levels range from 5–15 mcg/ml. Levels >20 mcg/ml are associated with toxicity. Caffeine ingestion may falsely elevate levels: Observe patient for symptoms of drug toxicity (anorexia, nausea, vomiting, stomach cramps, diarrhea, confusion, headache, restlessness, flushing, increased urination, insomnia, tachycardia, arrhythmias, seizures). Notify physician or other health care professional immediately if these occur. Tachycardia, ventricular arrhythmias, or seizures may be the first sign of toxicity.

Potential Nursing Diagnoses

Ineffective airway clearance (Indications)
Activity intolerance (Indications)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- Administer around the clock to maintain therapeutic plasma levels. Once-a-day doses should be administered in the morning.
- Do not refrigerate elixirs, solutions, or syrups; crystals may form. Crystals should dissolve when liquid is warmed to room temperature.
- Wait at least 4–6 hr after stopping IV therapy to begin immediate-release oral dosage; for extended-release oral dosage form, give first oral dose at time of IV discontinuation.
- **PO:** Administer oral preparations with food or a full glass of water to minimize GI irritation. Food slows but does not reduce the extent of absorption. May be administered 1 hr before or 2 hr after meals for more rapid absorption. Use calibrated measuring device to ensure accurate dose of liquid preparations. **Swallow tablets whole; do not crush, break, or chew enteric-coated or extended-release tablets (extended-release tablets may be broken if scored).**
- Patients receiving once-daily doses of >13 mg/kg or ≥900 mg (whichever is less) should avoid eating a high-fat-content morning meal or should take medication at least 1 hr before eating. Patients unable to comply with this regimen should be placed on alternative therapy.
- **IM:** Do not use if precipitate is present. May be caused by exposure to cold.
- Inject slowly; avoid IV administration.

Aminophylline

- **IV:** May be diluted in D5W, D10W, D20W, 0.9% NaCl, 0.45% NaCl, D5/0.9% NaCl, D5/0.45% NaCl, D5/0.25% NaCl, or LR. Mixture is stable for 24 hr if refrigerated. Do not administer discolored or precipitated solution. Flush main IV line before administration.
- If extravasation occurs, local injection of 1% procaine and application of heat may relieve pain and promote vasodilation.
- **Loading Dose:** Administer over 20–30 min. ***Rate:*** Do not exceed 20–25 mg/min. Administer via infusion pump to ensure accurate dosage. Rapid administration may cause chest pain, dizziness, hypotension, tachypnea, flushing, arrhythmias, or a reaction to the solution or administration technique (chills; fever; redness, pain, or swelling at injection site).
- **Continuous Infusion:** Usually given as a loading dose in a small volume followed by continuous infusion in larger volume. ***Rate:*** See Route and Dosage section for rates.
- **Y-Site Compatibility:** allopurinol, amifostine, amphotericin B cholesteryl sulfate, ceftazidime, cimetidine, cladribine, docetaxel, doxorubicin liposome, enalaprilat, esmolol, etoposide, famotidine, filgrastim, fluconazole, fludarabine, foscarnet, gemcitabine, granisetron, inamrinone, labetalol, melphalan, meropenem, morphine, paclitaxel, pancuronium, piperacillin/tazobactam, potassium chloride, ranitidine, remifentanil,

bupropion (byoo-**proe**-pee-on)

Wellbutrin, Wellbutrin SR, Wellbutrin XL, Zyban

Classification

Therapeutic: antidepressants, smoking deterrants
Pharmacologic: aminoketones

Pregnancy Category B

Indications

Treatment of depression (with psychotherapy). Smoking cessation (Zyban).

Action

Decreases neuronal reuptake of dopamine in the CNS. Diminished neuronal uptake of serotonin and norepinephrine. **Therapeutic Effects:** Decreased depression. Decreased nicotine craving.

Pharmacokinetics

Absorption: Although well absorbed, rapidly and extensively metabolized by the liver.
Distribution: Unknown.
Metabolism and Excretion: Extensively metabolized by the liver. Some conversion to active metabolites.
Half-life: 14 hr (active metabolites may have longer half-lives).

TIME/ACTION PROFILE (antidepressant effect)

ROUTE	ONSET	PEAK	DURATION
PO	1–3 wk	unknown	unknown

Contraindications/Precautions

Contraindicated in: Hypersensitivity. History of bulimia, and anorexia nervosa. Concurrent MAO inhibitor or ritonavir therapy.

Use Cautiously in: Renal/hepatic impairment (↓ dose recommended); Recent history of MI; Geriatric patients (increased risk of drug accumulation; increased sensitivity to effects); History of suicide attempt; May ↑ risk of suicide attempt/ideation especially during early treatment or dosage adjustment; this risk may be greater in adolescents or children; Unstable cardiovascular status; Pregnancy, lactation, or children <18 yr (safety not established)

Exercise Extreme Caution in: History of seizures, head trauma or concurrent medications that ↓ seizure threshold (theophylline, antipsychotics, antidepressants, systemic corticosteroids); Severe hepatic chirrhosis (↓ dose required).

Adverse Reactions/Side Effects

CNS: SEIZURES, agitation, headache, insomnia, mania, psychoses. **GI:** dry mouth, nausea, vomiting, change in appetite, weight gain, weight loss. **Derm:** photosensitivity. **Endo:** hyperglycemia, hypoglycemia, syndrome of inappropriate ADH secretion. **Neuro:** tremor.

Interactions

Drug-Drug: ↑ risk of adverse reactions when used with **amantadine, levodopa** or **MAO inhibitors** (concurrent use of MAO inhibitors is contraindicated). ↑ risk of seizures with **phenothiazines, antidepressants, theophylline, corticosteroids, OTC stimulants/anorectics**, or cessation of **alcohol** or **benzodiazepines** (avoid or minimize alcohol use). Blood levels ↑ by **ritonavir** (avoid concurrent use). **Carbamazepine** may decrease ↓ blood levels and effectiveness. Concurrent use with **nicotine** replacement may cause hypertension. ↑ risk of bleeding with **warfarin**. Bupropion and one of its metabolites inhibit the CYP 2D6 enzyme system and may ↑ levels and risk of toxicity from **antidepressants** (SSRIs and tricyclic), some **beta blockers, antiarrhythmics**, and **antipsychotics**.

sargramostim, tacrolimus, teniposide, thiotepa, tolazoline, vecuronium, vitamin B complex vitamin C.
- **Y-Site Incompatibility:** amiodarone, ciprofloxacin, dobutamine, hydralazine, ondansetron, vinorelbine, warfarin.
- **Additive Incompatibility:** Admixing is not recommended.

Theophylline
- **Continuous Infusion:** IV theophylline and 5% dextrose are packed in a moisture-barrier overwrap. Remove immediately before administration and squeeze bag to check for leaks. Discard if solution is not clear.
- **Loading Dose:** Administer over 20–30 min. If patient has had another form of theophylline before loading dose, serum theophylline level should be obtained and loading dose proportionately reduced. ***Rate:*** Do not exceed 20–25 mg/min. Rapid administration may cause chest pain, dizziness, hypotension, tachypnea, flushing, arrhythmias, or a reaction to the solution or administration technique (chills; fever; redness, pain, or swelling at injection site). Infusion rate may be increased after 12 hr. Administer via infusion pump to ensure accurate dosage. Monitor ECG continuously; tachyarrhythmias may occur.
- **Y-Site Compatibility:** acyclovir, ampicillin, ampicillin/sulbactam, aztreonam, cefazolin, cefotetan, ceftazidime, ceftriaxone, cimetidine, cisatracurium, clindamycin, diltiazem, dobutamine, dopamine, doxycycline, erythromycin, famotidine, fluconazole, gentamicin, haloperidol, heparin, hydrocortisone, lidocaine, methyldopate, methylprednisolone, metronidazole, midazolam, milrinone, nafcillin, nitroglycerin, penicillin G potassium, piperacillin, potassium chloride, ranitidine, remifentanil, ticarcillin, ticarcillin/clavulanate, tobramycin, vancomycin.
- **Y-Site Incompatibility:** hetastarch, phenytoin.
- **Additive Incompatibility:** Admixing is not recommended because of dose titration and incompatibilities.

Patient/Family Teaching
- Emphasize the importance of taking only the prescribed dose at the prescribed time intervals. Missed doses should be taken as soon as possible or omitted if close to next dose.
- Encourage the patient to drink adequate liquids (2000 ml/day minimum) to decrease the viscosity of the airway secretions.
- Advise patient to avoid OTC cough, cold, or breathing preparations without consulting health care professional. These medications may increase side effects and cause arrhythmias.
- Encourage patients not to smoke. A change in smoking habits may necessitate a change in dosage.
- Advise patient to minimize intake of xanthine-containing foods or beverages (colas, coffee, chocolate) and not to eat charcoal-broiled foods daily.
- Instruct patient not to change brands or dosage forms without consulting health care professional.
- Advise patient to contact health care professional promptly if the usual dose fails to produce the desired results, symptoms worsen after treatment, or toxic effects occur.
- Emphasize the importance of having serum levels routinely tested every 6–12 mo during long-term therapy.

Evaluation/Desired Outcomes
- Increased ease in breathing
- Clearing of lung fields on auscultation.

Why was this drug prescribed for your patient?

Route/Dosage
PO (Adults): *Depression*—100 mg twice daily initially; after 3 days may increase to 100 mg 3 times daily; after at leaast 4 wk of therapy, may increase up to 450 mg/day in divided doses (not to exceed 150 mg/dose; wait at least 6 hr between doses at the 300 mg/day dose or at least 4 hr between doses at the 450 mg/day dose). *Sustained release tablets*—150 mg once daily in the morning; increase after 3 days to 150 mg twice daily; if necessary may increase to 200 mg twice daily after at least 4 wk (at least 8 hr between doses). *Extended release tablets*—150 mg once daily in the morning; increase after 4 days to 300 mg once daily; some patients may require 450 mg/day/. *Smoking cessation (Zyban)*—150 mg once daily for 3 days, then 150 mg twice daily for 7–12 wk (doses should be at least 8 hr apart).

NURSING IMPLICATIONS

Assessment
- Monitor mood changes. Inform physician or other health care professional if patient demonstrates significant increase in anxiety, nervousness, or insomnia.
- Assess for suicidal tendencies, especially during early therapy. Restrict amount of drug available to patient.
- ***Lab Test Considerations:*** Monitor hepatic and renal function closely in patients with kidney or liver impairment to prevent elevated serum and tissue bupropion concentrations.

Potential Nursing Diagnoses
Ineffective coping (Indications)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation
- **Do not confuse bupropion with buspirone. Do not confuse Zyban (bupropion) with Zagam (Sparfloxacin).**
- **Administer doses in equally spaced time increments throughout day to minimize the risk of seizures. Risk of seizures increases four fold in dosages greater than 450 mg per day. Do not administer bupropion (Wellbutrin) with Zyban, contain same ingredients.**
- May be initially administered concurrently with sedatives to minimize agitation. This is not usually required after the 1st wk of therapy.
- Insomnia may be decreased by avoiding bedtime doses. May require treatment during first week of therapy.
- May be administered with food to lessen GI irritation.
- Nicotine patches, gum, inhalers, and spray may be used concurrently with bupropion.
- **PO: Sustained-release (SR or XL) tablets should be swallowed whole; do not break, crush, or chew.**

Patient/Family Teaching
- Instruct patient to take bupropion exactly as directed. If a dose taken for depression is missed, take as soon as possible and space day's remaining doses evenly at not less than 4-hr intervals. Missed doses for smoking cessation should be omitted. Do not double doses or take more than prescribed. May require 4 wk or longer for full effects. Do not discontinue without consulting health care professional. May require gradual reduction prior to discontinuation.
- Bupropion may impair judgment or motor and cognitive skills. Caution patient to avoid driving and other activities requiring alertness until response to medication is known.
- Advise patient to avoid alcohol during therapy and to consult with health care professional before taking other medications with bupropion.
- Inform patient that frequent mouth rinses, good oral hygiene, and sugarless gum or candy may minimize dry mouth. If dry mouth persists for more than 2 wk, consult health care professional regarding use of saliva substitute.
- Advise patient to notify health care professional if rash or other troublesome side effects occur.

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bupropion

- Inform patient that unused shell of XL tablets may appear in stool; this is normal.
- Advise patient to use sunscreen and protective clothing to prevent photosensitivity reactions.
- Instruct female patients to inform health care professional if pregnancy is planned or suspected.
- Advise patient to notify health care professional of medication regimen prior to treatment or surgery.
- Emphasize the importance of follow-up exams to monitor progress. Encourage patient participation in psychotherapy.
- **Smoking Cessation:** Smoking should be stopped during the 2nd week of therapy to allow for the onset of bupropion and to maximize the chances of quitting.

Evaluation/Desired Outcomes

- Increased sense of well-being
- Renewed interest in surroundings. Acute episodes of depression may require several months of treatment.
- Cessation of smoking.

Why was this drug prescribed for your patient?

buspirone (byoo-**spye**-rone)

BuSpar

Classification

Therapeutic: antianxiety agents

Pregnancy Category B

Indications

Management of anxiety.

Action

Binds to serotonin and dopamine receptors in the brain. Increases norepinephrine metabolism in the brain. **Therapeutic Effects:** Relief of anxiety.

Pharmacokinetics

Absorption: Rapidly absorbed.
Distribution: Unknown.
Protein Binding: 95% bound to plasma proteins.
Metabolism and Excretion: Extensively metabolized by the liver; 20–40% excreted in feces.
Half-life: 2–3 hr.

TIME/ACTION PROFILE (relief of anxiety)

ROUTE	ONSET	PEAK	DURATION
PO	7–10 days	3–4 wk	unknown

Contraindications/Precautions

Contraindicated in: Hypersensitivity. Severe hepatic or renal impairment. Concurrent use of MAO inhibitors. Ingestion of large amounts of grapefruit juice.

Use Cautiously in: Patients receiving other antianxiety agents (other agents should be slowly withdrawn to prevent withdrawal or rebound phenomenon); Patients receiving other psychoactive drugs; Pregnancy, lactation, and children (safety not established).

Adverse Reactions/Side Effects

CNS: dizziness, drowsiness, excitement, fatigue, headache, insomnia, nervousness, weakness, personality changes. **EENT:** blurred vision, nasal congestion, sore throat, tinnitus, altered taste or smell, conjunctivitis. **Resp:** chest congestion, hyperventilation, shortness of breath. **CV:** chest pain, palpitations, tachycardia, hypertension, hypotension, syncope. **GI:** nausea, abdominal pain, constipation, diarrhea, dry mouth, vomiting. **GU:** changes in libido, dysuria, urinary frequency, urinary hesitancy. **Derm:** rashes, alopecia, blisters, dry skin, easy bruising, edema, flushing, pruritus. **Endo:** irregular menses. **MS:** myalgia. **Neuro:** incoordination, numbness, paresthesia, tremor. **Misc:** clamminess, sweating, fever.

Interactions

Drug-Drug: Use with **MAO inhibitors** may result in hypertension and is not recommended. **Erythromycin**, **nefazodone**, **ketoconazole**, **itraconazole**, **ritonavir**, and other **inhibitors of CYP 3A4** ↑ blood levels and effects of buspirone; dose reduction is recommended (decrease to 2.5 mg twice daily with erythromycin, decrease to 2.5 mg once daily with nefazodone). **Rifampin**, **dexamethasone**, **phenytoin**, **phenobarbital**, **carbamazepine**, and other **inducers of CYP 3A4** ↓ blood levels and effects of buspirone; dose adjustment may be necessary. Avoid concurrent use with **alcohol**.

Drug-Natural Products: Concomitant use of **kava, valerian,** or **chamomile** can increase CNS depression.

Drug-Food: Grapefruit juice ↑ serum levels and effect; ingestion of large amounts not recommended.

Route/Dosage

PO (Adults): 5 mg 3 times daily; increase by 5 mg/day q 2–3 days as needed (not to exceed 60 mg/day). Usual dose is 20–30 mg/day.

NURSING IMPLICATIONS

Assessment

- Assess degree and manifestations of anxiety before and during throughout therapy.
- Buspirone does not appear to cause physical or psychological dependence or tolerance. However, patients with a history of drug abuse should be assessed for tolerance and dependence. Restrict amount of drug available to these patients.

Potential Nursing Diagnoses

Anxiety (Indications)
Risk for injury (Side Effects)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- **Do not confuse buspirone with bupropion.**
- Patients changing from other antianxiety agents should receive gradually decreasing doses. Buspirone will not prevent withdrawal symptoms.
- **PO:** May be administered with food to minimize gastric irritation. Food slows but does not alter extent of absorption.

Patient/Family Teaching

- Instruct patient to take buspirone exactly as directed. Take missed doses as soon as possible if not just before next dose; do not double doses. Do not take more than amount prescribed.
- May cause dizziness or drowsiness. Caution patient to avoid driving or other activities requiring alertness until response to the medication is known.
- Advise patient to avoid concurrent use of alcohol or other CNS depressants.
- Advise patient to consult health care professional before taking OTC medications or herbal products with this drug.
- Instruct patient to notify health care professional if any chronic abnormal movements (dystonia, motor restlessness, involuntary movements of facial or cervical muscles) occur or if pregnancy is suspected.
- Emphasize the importance of follow-up exams to determine effectiveness of medication.

Evaluation/Desired Outcomes

- Increased sense of well-being.
- Decrease in subjective feelings of anxiety. Some improvement may be seen in 7–10 days. Optimal results take 3–4 wk of therapy. Buspirone is usually used for short-term therapy (3–4 wk). If prescribed for long-term therapy, efficacy should be periodically assessed.

Why was this drug prescribed for your patient?

BUTALBITAL COMPOUND (byoo-**tal**-bi-tal)

butalbital, acetaminophen†
Axocet, Bucet, Bupap, Butex Forte, Dolgic, Marten-Tab, Phrenilin, Phrenilin Forte, Repap CF, Sedapap, Tencon, Triaprin

butalbital, acetaminophen, caffeine†
Endolor, Esgic, Esgic-Plus, Fioricet, Margesic, Medigesic, Repan, Triad

butalbital, aspirin, caffeine‡
Fiorinal, Fiortal, ♣Tecnal

Classification
Therapeutic: nonopioid analgesics (combination with barbiturate)
Pharmacologic: barbiturates

Schedule III (products with aspirin only)

Pregnancy Category D

†For information on acetaminophen component in formulation, see acetaminophen monograph

‡For information on aspirin component in formulation, see salicylates monograph

Indications
Management of mild to moderate pain.

Action
Contains aspirin or acetaminophen for pain relief, butalbital for its sedative effect, and may contain caffeine, which may be of benefit in vascular headaches. **Therapeutic Effects:** Decreased severity of pain with some sedation.

Pharmacokinetics
Absorption: Well absorbed.
Distribution: Widely distributed, crosses the placenta, and enters breast milk.

Metabolism and Excretion: Mostly metabolized by the liver.
Half-life: 35 hr.

TIME/ACTION PROFILE

ROUTE	ONSET	PEAK	DURATION
PO	15–30 min	1–2 hr	2–6 hr

Contraindications/Precautions
Contraindicated in: Hypersensitivity to individual components. Cross-sensitivity may occur. Comatose patients or those with pre-existing CNS depression. Uncontrolled severe pain. Pregnancy or lactation. Aspirin should be avoided in patients with bleeding disorders or thrombocytopenia. Acetaminophen should be avoided in patients with severe hepatic or renal disease. Caffeine should be avoided in patients with severe cardiovascular disease. Porphyria.
Use Cautiously in: History of suicide attempt or drug addiction; Chronic alcohol use/abuse (for aspirin and acetaminophen content); Geriatric patients (dosage reduction required); Use should be short-term only; Children (safety not established).

Adverse Reactions/Side Effects
CNS: drowsiness, hangover, delirium, depression, excitation, headache (with chronic use), lethargy, vertigo; *caffeine*— insomnia, irritability, nervousness. **Resp:** respiratory depression. **CV:** *caffeine*— palpitations, tachycardia. **GI:** constipation, diarrhea, nausea, vomiting; *caffeine*—epigastric distress, heartburn. **Derm:** dermatitis, rash. **Misc:** hypersensitivity reactions including ANGIOEDEMA and SERUM SICKNESS, physical dependence, psychological dependence, tolerance.

Interactions
Drug-Drug: Additive CNS depression with **antidepressants**, **antihistamines**, **other CNS depressants**, including **alcohol**, **opioid analgesics**, and **sedative/hypnotics**. May increase the liver metabolism and decrease the effectiveness of other drugs including **acebutolol**, **chloramphenicol**, **doxycycline**, **corticosteroids**, **metoprolol**, **hormonal contraceptives**, **phenothiazines**, **phenylbutazone**, **propranolol**, **quinidine**, **ti-**

♣ = Canadian drug name.

* CAPITALS indicates life-threatening, underlines indicate most frequent.

CALCIUM CHANNEL BLOCKERS

amlodipine
(am-**loe**-di-peen)
Norvasc

diltiazem
(dil-**tye**-a-zem)
♣Apo-Diltiaz, Cardizem, ♣Novo-Diltazem, Nu-Diltiaz, ♣Syn-Diltiazem, Tiamate, Tiazac

felodipine
(fe-**loe**-di-peen)
Plendil, ♣Renedil

isradipine
(is-**ra**-di-peen)
DynaCirc, DynaCirc R

nicardipine
(nye-**kar**-di-peen)
Cardene

nifedipine
(nye-**fed**-i-peen)
Adalat, ♣Apo-Nifed, ♣Novo-Nifedin, ♣Nu-Nifed, Nifedical XL, Procardia

nimodipine
(nye-**moe**-di-peen)
Nimotop

nisoldipine
(nye-**sole**-di-peen)
Sular

verapamil
(ver-**ap**-a-mil)
Apo-Verap, Calan, Isoptin, ♣Novo-Veramil, ♣Nu-Verap, Verelan

Classification
Therapeutic: antianginals, antiarrhythmics, antihypertensives

Pregnancy Category C

Indications
Management of hypertension, angina pectoris, and vasospastic (Prinzmetal's) angina.

Action
Inhibits the transport of calcium into myocardial and vascular smooth muscle cells, resulting in inhibition of excitation-contraction coupling and subsequent contraction. **Diltiazem, verapamil:** Decrease SA and AV conduction and prolong AV node refractory period in conduction tissue. **Therapeutic Effects:** Systemic vasodilation resulting in decreased blood pressure. Coronary vasodilation resulting in decreased frequency and severity of attacks of angina. **Nimodipine:** Prevention of vascular spasm after subarachnoid hemorrhage, resulting in decreased neurologic impairment. **Diltiazem, verapamil:** Suppression of ventricular tachyarrhythmias.

Pharmacokinetics
Absorption: *Amlodipine*—well absorbed after oral administration (64–90%); *Diltiazem* and *verapamil*—well absorbed after oral administration, but rapidly metabolized; *felodipine*, *isradipine*, *nicardipine*, *nimodipine*, and *nisoldipine*—well absorbed after oral administration, but extensively metabolized, resulting in decreased bioavailability; *Nifedipine*—well absorbed after oral administration, but rapidly metabolized, resulting in decreased bioavailability (45–70%); bioavailability is increased (80%) with long-acting (CC, XL, PA) forms.
Distribution: *Amlodipine*—probably crosses the placenta; *nimodipine*—crosses the blood-brain barrier; remainder of distribution; *verapamil*—small amounts enter breast milk.
Metabolism and Excretion: All agents are mostly metabolized by the liver; ≤10% excreted unchanged by kidneys.
Half-life: *Amlodipine*—30–50 hr; *diltiazem*—3.5–9 hr; *felodipine*—11–16 hr; *isradipine*—8 hr;—2–4 hr; *nifedipine*—2–5 hr; *nimodipine*—1–2 hr; *verapamil*—4.5–12 hr.

TIME/ACTION PROFILE (cardiovascular effects)

ROUTE	ONSET	PEAK	DURATION
Amlodipine PO	unknown	6–9	24 hr
Diltiazem PO	30 min	2–3 hr	6–8 hr

♣ = Canadian drug name.

* CAPITALS indicates life-threatening, underlines indicate most frequent.

molol, and **tricyclic antidepressants. MAO inhibitors, primidone**, and **valproic acid** may prevent metabolism and increase the effectiveness of butalbital. May enhance the hematologic toxicity of **cyclophosphamide**. **Drug-Natural Products: St. John's wort** may decrease barbiturate effect. Concurrent use of **kava, valerian, skullcap, chamomile**, or **hops** can increase CNS depression.

Route/Dosage

PO (Adults): 1–2 capsules or tablets (50–100 mg butalbital) every 4 hr as needed for pain (not to exceed 4 g acetaminophen or aspirin/24 hr).

NURSING IMPLICATIONS

Assessment

- Assess type, location, and intensity of pain before and 60 min after administration.
- Prolonged use may lead to physical and psychological dependence and tolerance. This should not prevent patient from receiving adequate analgesia. Most patients who receive butalbital compound for pain do not develop psychological dependence.

Potential Nursing Diagnoses

Acute pain (Indications)
Risk for injury (Side Effects)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- Explain therapeutic value of the medication before administering to enhance the analgesic effect.
- Regularly administered doses may be more effective than prn administration. Analgesic is more effective if given before pain becomes severe.
- Medication should be discontinued gradually after long-term use to prevent withdrawal symptoms.
- Available in combination with acetaminophen, aspirin, and codeine (see Appendix A).
- **PO:** May be administered with food or milk to minimize GI irritation.

Patient/Family Teaching

- Instruct patient to take medication exactly as directed. Do not increase dose because of the habit-forming potential of butalbital. If medication appears less effective after a few weeks, consult health care professional. Doses of acetaminophen or aspirin should not exceed the recommended daily dose. Chronic excessive use of >4 g/day (2 g in chronic alcoholism) may lead to hepatotoxicity, renal or cardiac damage.
- Advise patients with vascular headaches to take medication at first sign of headache. Lying down in a quiet, dark room may also be helpful. Medications taken for prophylaxis should be continued.
- Instruct patient on how and when to ask for pain medication.
- May cause drowsiness or dizziness. Advise patient to avoid driving and other activities requiring alertness until response to medication is known.
- Caution patient to avoid concurrent use of alcohol or other CNS depressants.
- Advise patient to use an additional nonhormonal method of contraception while taking butalbital compound.

Evaluation/Desired Outcomes

- Decrease in severity of pain without significant alteration in level of consciousness.

Why was this drug prescribed for your patient?

Diltiazem PO-SR	unknown	unknown	12 hr
Diltiazem PO-CD	unknown	14 days†	24 hr
Diltiazem PO-XR	unknown	14 days†	24 hr
Diltiazem IV	2–5 min	unknown	unknown
Felodipine PO	1 hr	2–4 hr	up to 24 hr
Isradipine PO	<2 hr	2–3 hr	12 hr
Nicardipine PO	20 min	1–2 hr	8 hr
Nicardipine IV	within min	45 min	50 hr‡
Nifedipine PO	20 min	unknown	6–8 hr
Nifedipine PO-XL, GC, PA	unknown	unknown	24 hr
Nimodipine PO	unknown	1 hr	unknown
Nisoldipine	unknown	6–12 hr	24 hr
Verapamil PO	1–2 hr	30–90 min§	3–7 hr
Verapamil PO-ER	unknown	5–7 hr	24 hr
Verapamil IV	1–5 min¶	3–5 min	2 hr¶

†Maximum antihypertensive effect with chronic therapy.

‡After discontinuation.

§Single dose; effects from multiple doses may not be evident for 24–48 hr.

¶Antiarrhythmic effects; hemodynamic effects begin 3–5 min after injection and persist for 10–20 min.

Contraindications/Precautions

Contraindicated in: Hypersensitivity (cross-sensitivity may occur). Sick sinus syndrome. Second- or third-degree AV block (unless an artificial pacemaker is in place). Blood pressure <90 mmHg (especially with diltiazem and verapamil). Recent MI or pulmonary congestion (diltiazem only). CHF, severe ventricular dysfunction or cardiogenic shock, unless associated with supraventricular tachyarrhythmias (diltiazem and verapamil only). Concurrent IV beta-blocker therapy (IV diltiazem and verapamil only). Advanced aortic stenosis (nicardipine only). Coadministration with grapefruit juice (nifedipine only).

Use Cautiously in: Severe hepatic impairment (dose reduction recommended for most agents); Geriatric patients (dose reduction/slower IV infusion rates recommended for most agents; increased risk of hypotension; consider age-related decrease in body mass, decreased hepatic/renal/cardiac function, concurrent drug therapy and other disease states); Severe renal impairment (dose reduction of nicardipine may be necessary); History of serious ventricular arrhythmias or CHF; Pregnancy, lactation, or children (safety not established; verapamil is approved for use in children); History of porphyria (nifedipine).

Adverse Reactions/Side Effects

CNS: abnormal dreams, anxiety, confusion, dizziness, drowsiness, headache (increased with nifedipine, isradipine, felodipine; decreased with verapamil, nimodipine), nervousness, psychiatric disturbances, weakness. **EENT:** blurred vision, disturbed equilibrium, epistaxis, tinnitus. **Resp:** cough, dyspnea. **CV:** ARRHYTHMIAS, CHF, peripheral edema (increased with amlodipine, felodipine, nifedipine; decreased with nimodipine, verapamil), bradycardia, chest pain, hypotension, palpitations, syncope, tachycardia. **GI:** abnormal liver function studies, anorexia, constipation, diarrhea, dry mouth, dysgeusia, dyspepsia, nausea, vomiting. **GU:** dysuria, nocturia, polyuria, sexual dysfunction, urinary frequency. **Derm:** dermatitis, erythema multiforme, flushing (increased with nifedipine, nicardipine; decreased with verapamil, nimodipine, isradipine), increased sweating, photosensitivity, pruritus/urticaria, rash. **Endo:** gynecomastia, hyperglycemia. **Hemat:** anemia, leukopenia, thrombocytopenia. **Metab:** weight gain. **MS:** joint stiffness, muscle cramps. **Neuro:** paresthesia, tremor. **Misc:** STEVENS-JOHNSON SYNDROME, gingival hyperplasia.

Interactions

Drug-Drug: Additive hypotension may occur when used concurrently with acute ingestion of **alcohol** or **quinidine, fentanyl, nitrates**, or other **antihypertensives**. Antihypertensive effects may be decreased by concurrent use of **nonsteroidal anti-inflammatory agents**. Serum **digoxin** levels may be increased by diltiazem, nifedipine, or verapamil. Concurrent use of diltiazem, felodipine, isradipine, nicardipine, nifedipine, nimodipine, or verapamil with **beta blockers, digoxin, disopyramide**, or **phenytoin** may result in bradycardia, conduction defects, or CHF. Concurrent use with **some HMG-CoA reductase inhibitors** may increase the risk of rhabdomyolysis (concurrent use with **lovastatin** or **simvastatin** is contraindicated; concurrent use with **atorvastatin** should be avoided). **Phenobarbital**

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CALCIUM CHANNEL BLOCKERS

and **phenytoin** may increase the metabolism and decrease the effectiveness of diltiazem. **Cimetidine** and **propranolol** may decrease metabolism and increase the risk of toxicity from diltiazem, felodipine, nicardipine, or nifedipine. Diltiazem, nicardipine, and verapamil may decrease the metabolism of and increase the risk of toxicity from **carbamazepine**, **cyclosporine**, **prazosin**, or **quinidine**. Verapamil may decrease the effectiveness of **rifampin**. Verapamil increases the muscle-paralyzing effects of **nondepolarizing neuromuscular blocking agents**. Effectiveness of verapamil may be decreased by coadministration with **vitamin D** and calcium. Verapamil may alter serum **lithium** levels.

Drug-Natural Products: Verapamil increases caffeine levels with caffeine-containing herbs (cola nut, guarana, mate, tea, coffee).

Drug-Food: Concurrent ingestion of **grapefruit juice** increases blood levels and effects of **felodipine**, **nifedipine**, **nimodipine**, **nicardipine**, **nisoldipine**, and **verapamil**; coadministration with nifedipine should be avoided.

Route/Dosage

Amlodipine

PO (Adults): 5–10 mg as a single dose (range 2.5–10 mg). Initiate therapy with 2.5 mg/day in geriatric or small patients or patients with hepatic insufficiency.

Diltiazem

PO (Adults): 30–120 mg 3–4 times daily or 60–120 mg twice daily as SR capsules or 120–240 mg once daily as ER, CD or XR capsules (up to 360 mg/day).

IV (Adults): 0.25 mg/kg, may repeat in 15 min with a dose of 0.35 mg/kg. May follow with continuous infusion at 10 mg/hr (range 5–15 mg/hr) for up to 24 hr.

Felodipine

PO (Adults): 5 mg/day initially (2.5 mg/day in geriatric patients). May increase q 2 wk. Usual daily dose is 5–10 mg (not to exceed 20 mg/day).

Isradipine

PO (Adults): 2.5 mg twice daily, may be increased q 2–4 wk by 5 mg/day (not to exceed 20 mg/day).

Nicardipine

PO (Adults): 20 mg 3 times daily, may increase q 3 days (range 20–40 mg 3 times daily) or 30 mg twice daily as sustained-release form (up to 60 mg twice daily).

IV (Adults): *Substitute for PO nicardipine*—if PO dose is 20 mg q 8 hr, then infusion rate is 0.5 mg/hr; if PO dose is 30 mg q 8 hr, then infusion rate is 1.2 mg/hr; if PO dose is 40 mg q 8 hr, then infusion rate is 2.2 mg/hr. *Initial therapy in previously untreated patients*—initiate therapy at 5 mg/hr, may be increased by 2.5 mg 15 min until desired effect is obtained, then decrease to 3 mg/hr. Additional adjustments may be required.

Nifedipine

PO (Adults): 10–30 mg 3 times daily (not to exceed 180 mg/day) or 30–90 mg once daily as sustained-release (CC, PA, XL) form (not to exceed 90–120 mg/day).

Nimodipine

PO (Adults): 60 mg q 4 hr for 21 days; therapy should be started within 96 hr of subarachnoid hemorrhage.

Nisoldipine

PO (Adults): 20 mg/day (single dose), may increase by 10 mg/day q 7 days (range 20–40 mg/day; not to exceed 60 mg/day).

Verapamil

PO (Adults): 80–120 mg 3 times daily, increased as needed. *Patients with poor ventricular function or hepatic impairment, or geriatric pa-*

CONTINUED

CALCIUM CHANNEL BLOCKERS

- **Continuous Infusion:** Dilute 125 mg in 100 ml, 250 mg in 250 ml, or 250 mg in 500 ml of 0.9% NaCl, D5W, or D5/0.45% NaCl for concentrations of 1 mg/ml, 0.83 mg/ml, or 0.45 mg/ml, respectively. Stable for 24 hr at room temperature. ***Rate:*** Initial infusion should be administered at a rate of 10 mg/hr. May increase in increments of 5 mg/hr, up to 15 mg/hr if further reduction in heart rate is required. Some patients may respond to a rate of 5 mg/hr. Infusion may be continued up to 24 hr.

Nicardipine

- To transfer from IV nicardipine infusion to oral therapy with other antihypertensive, start oral therapy simultaneously with discontinuation of nicardipine infusion. If transferring to oral nicardipine therapy, administer first dose of a 3-times-a-day regimen 1 hr before discontinuation of infusion.
- Dose adjustments of nicardipine should be made no more frequently than every 3 days.
- **Continuous Infusion:** Dilute each 25-mg ampule with 240 ml of D5W, D5/0.45% NaCl, D5/0.9% NaCl, D5/potassium chloride 40 mEq, 0.45% NaCl, or 0.9% NaCl for a concentration of 0.1 mg/ml. Stable for 24 hr at room temperature. ***Rate:*** Administer via slow infusion. Titrate rate according to blood pressure response. Continuous infusions of 0.5 mg/hr, 1.2 mg/hr, and 2.2 mg/hr produce average plasma concentrations equal to a 20-mg, 30-mg, and 40-mg oral dose, respectively, given every 8 hr at steady state.

Verapamil

- **IV:** Patients should remain recumbent for at least 1 hr after IV administration to minimize hypotensive effects.
- **Direct IV:** Administer IV undiluted over 2 min for each single dose. Administer over 3 min in geriatric patients.

Patient/Family Teaching

- Advise patient to take medication exactly as directed, even if feeling well. If a dose is missed, take as soon as possible unless almost time for next dose; do not double doses. May need to be discontinued gradually.
- Instruct patient on technique for monitoring pulse. Instruct patient to contact health care professional if heart rate is <50 bpm.
- Caution patient to change positions slowly to minimize orthostatic hypotension.
- May cause drowsiness or dizziness. Advise patient to avoid driving or other activities requiring alertness until response to the medication is known.
- Instruct patient on importance of maintaining good dental hygiene and seeing dentist frequently for teeth cleaning to prevent tenderness, bleeding, and gingival hyperplasia (gum enlargement).
- Instruct patient to avoid concurrent use of alcohol or OTC medications and herbal products, especially cold preparations, without consulting health care professional.
- Advise patient to notify health care professional if irregular heartbeat, dyspnea, swelling of hands and feet, pronounced dizziness, nausea, constipation, or hypotension occurs or if headache is severe or persistent.
- Caution patient to wear protective clothing and use sunscreen to prevent photosensitivity reactions.
- **Angina:** Instruct patient on concurrent nitrate or beta-blocker therapy to continue taking both medications as directed and use SL nitroglycerin as needed for anginal attacks.
- Inform patient taking isradipine or nifedipine that anginal attacks may occur 30 min after administration as a result of reflex tachycardia. This is usually temporary and is not an indication for discontinuation.
- Advise patient to contact health care professional if chest pain does not improve, worsens after therapy, or occurs with diaphoresis; or if shortness of breath or persistent headache occurs.

tients—40 mg 3 times daily initially. *Extended-release preparations*—120–240 mg/day as a single dose, may be increased as needed (range 240–480 mg/day).
PO (Geriatric Patients): 40 mg 3 times daily initially.
PO (Children <15 yr): 4–8 mg/kg/day in divided doses.
IV (Adults): 5–10 mg (75–150 mcg/kg); may repeat with 10 mg after 30 min.
IV (Children 1–15 yr): 100–300 mcg/kg; may repeat after 30 min (initial dose not to exceed 5 mg; repeat dose not to exceed 10 mg).
IV (Children <1 yr): 100–200 mcg/kg.

NURSING IMPLICATIONS

Assessment

- Monitor blood pressure and pulse before therapy, during dose titration, and periodically during therapy. Monitor ECG periodically during prolonged therapy.
- Monitor intake and output ratios and daily weight. Assess for signs of CHF (peripheral edema, rales/crackles, dyspnea, weight gain, jugular venous distention).
- Patients receiving digoxin concurrently with diltiazem, nifedipine, or verapamil should have routine serum digoxin level and be monitored for signs and symptoms of digoxin toxicity.
- **Angina:** Assess location, duration, intensity, and precipitating factors of patient's anginal pain.
- **Arrhythmias:** Monitor ECG continuously during administration. Report bradycardia or prolonged hypotension promptly. Emergency equipment and medication should be available.
- **Nimodipine:** Assess patient's neurologic status (level of consciousness, movement) before and periodically after administration.
- ***Lab Test Considerations:*** Total serum calcium concentrations are not affected by calcium channel blockers.
- Monitor serum potassium periodically. Hypokalemia increases risk of arrhythmias; should be corrected.
- Monitor renal and hepatic functions periodically during long-term therapy. Several days of therapy may cause ↑ in hepatic enzymes, which return to normal on discontinuation of therapy.
- Nifedipine may cause positive antinuclear antibody (ANA) and direct Coombs' test results.
- Nimodipine may occasionally cause ↓ platelet count.

Potential Nursing Diagnoses

Decreased cardiac output (Indications)
Acute pain (Indications)

Implementation

- **Do not confuse Tiazac (diltiazem) with Ziac (bisprolol/hydrochlorothiazide).**
- **PO:** May be administered without regard to meals. Administer with meals if GI irritation becomes a problem. Administer verapamil with meals or milk to minimize gastric irritation. Felodipine should be taken on empty stomach or with a light meal.
- **Do not open, crush, break, or chew sustained-release capsules or tablets.** Empty tablets that appear in stool are not significant.
- Crush and mix diltiazem with food or fluids for patients having difficulty swallowing.

Nifedipine

- Sublingual use is not recommended due to serious adverse drug reactions.

Nimodipine

- Begin administration within 96 hr of subarachnoid hemorrhage and continue every 4 hr for 21 consecutive days.
- **PO:** If patient is unable to swallow capsule, make a hole in both ends of the capsule with a sterile 18-gauge needle and extract the contents into a syringe. Empty contents into water or nasogastric tube and flush with 30 ml normal saline.

Diltiazem

- **Direct IV:** May be administered undiluted. ***Rate:*** Administer each dose as a bolus over 2 min.

CONTINUED

- Caution patient to discuss exercise restrictions with health care professional before exertion.
- **Hypertension:** Encourage patient to comply with other interventions for hypertension (weight reduction, low-sodium diet, smoking cessation, moderation of alcohol consumption, regular exercise, and stress management). Medication controls but does not cure hypertension.
- Instruct patient and family in proper technique for monitoring BP. Advise patient to take BP weekly and to report significant changes to health care professional.

Evaluation/Desired Outcomes

- Decrease in blood pressure.
- Decrease in frequency and severity of anginal attacks.
- Decrease in need for nitrate therapy.
- Increase in activity tolerance and sense of well-being.
- Suppression and prevention of atrial tachyarrhythmias.
- Improvement in neurologic deficits caused by vasospasm after subarachnoid hemorrhage.

Why was this drug prescribed for your patient?

High Alert

CALCIUM SALTS

calcium acetate (25% Ca or 12.6 mEq/g)

(**kal**-see-um**ass**-e-tate)

Calphron, PhosLo

calcium carbonate (40% Ca or 20 mEq/g)

(**kal**-see-um**kar**-bo-nate)

Alka-Mints, Amitone, ♣Apo-Cal, BioCal, Calcarb, Calci-Chew, Calciday, Calcilac, Calci-Mix, ♣Calcite, ♣Calglycine, Cal-Plus, ♣Calsan, Caltrate, Chooz, Dicarbosil, Equilet, Gencalc, Liqui-Cal, Liquid Cal-600, Maalox Antacid Caplets, Mallamint, ♣Mylanta Lozenges, Nephro-Calci, ♣Nu-Cal, Os-Cal, Oysco, Oyst-Cal, Oystercal, Rolaids Calcium Rich, Surpass, Surpass Extra Strength, Titralac, Tums, Tums E-X

calcium chloride (27% Ca or 13.6 mEq/g)

(**kal**-see-um**kloh**-ride)

calcium citrate (21% Ca or 12 mEq/g)

(**kal**-see-um**si**-trate)

Cal-Citrate 250, Citrical, Citrical Liquitab

calcium gluconate (9% Ca or 4.5 mEq/g)

(**kal**-see-um**gloo**-koh-nate)

Kalcinate

calcium lactate (13% Ca or 6.5 mEq/g)

(**kal**-see-um**lak**-tate)

Cal-Lac

tricalcium phosphate (39% Ca or 19.5 mEq/g)

Posture

Classification

Therapeutic: mineral and electrolyte replacements/supplements

Pregnancy Category C (calcium acetate, calcium chloride, calcium gluconate injections), UK (calcium carbonate, calcium citrate, calcium lactate, tricalcium phosphate)

Indications

PO, IV: Treatment and prevention of hypocalcemia. **PO:** Adjunct in the prevention of postmenopausal osteoporosis. **Calcium carbonate:** Used as an antacid (oral). **Calcium acetate:** Control of hyperphosphatemia in end-stage renal disease.

Action

Essential for nervous, muscular, and skeletal systems. Maintains cell membrane and capillary permeability. Acts as an activator in the transmission of nerve impulses and in the contraction of cardiac, skeletal, and smooth muscle. Essential for bone formation and blood coagulation. **Therapeutic Effects:** Replacement of calcium in deficiency states. Control of hyperphosphatemia in end-stage renal disease without promoting aluminum absorption (calcium acetate).

Pharmacokinetics

Absorption: Absorption from the GI tract requires vitamin D. IV administration results in complete bioavailability.
Distribution: Readily enter extracellular fluid. Cross the placenta and enter breast milk.
Metabolism and Excretion: Excreted mostly in the feces; 20% eliminated by the kidneys.
Half-life: Unknown.

TIME/ACTION PROFILE (effects on serum calcium)

ROUTE	ONSET	PEAK	DURATION
PO	unknown	unknown	unknown
IV	immediate	immediate	0.5–2 hr

♣ = Canadian drug name.

* CAPITALS indicates life-threatening, underlines indicate most frequent.

CONTINUED

CALCIUM SALTS

- May cause decreased serum phosphate concentrations with excessive and prolonged use. When used to treat hyperphosphatemia in renal failure patients, monitor phosphate levels.
- ***Toxicity and Overdose:*** Assess patient for nausea, vomiting, anorexia, thirst, severe constipation, paralytic ileus, and bradycardia. Contact physician or other health care professional immediately if these signs of hypercalcemia occur.

Potential Nursing Diagnoses

Imbalanced nutrition: less than body requirements (Indications)
Risk for injury, related to osteoporosis or electrolyte imbalance (Indications)

Implementation

- ***High Alert:*** Errors with IV calcium gluconate and chloride have occurred secondary to confusion over which salt is ordered. Clarify incomplete orders. Confusion has occurred with milligram doses of calcium chloride and calcium gluconate, which are not equal. Chloride and gluconate forms are routinely available on most hospital crash carts; physician should specify form of calcium desired. Doses should be expressed in mEq.
- Do not confuse Os-Cal (calcium carbonate) with Asacol (mesalamine).
- In arrest situations, the use of calcium chloride is now limited to patients with hyperkalemia, hypocalcemia, and calcium channel blocker toxicity.
- **PO:** Administer calcium carbonate or phosphate 1–1.5 hr after meals and at bedtime. Chewable tablets should be well chewed before swallowing. Dissolve effervescent tablets in glass of water. Follow oral doses with a full glass of water, except when using calcium carbonate as a phosphate binder in renal dialysis. Administer with meals for patients with hyperphosphatemia.
- **IM:** IM administration of calcium gluconate may be tolerated in an emergency if IV administration is not feasible. For child, administer only in thigh. For adult, administer only in gluteal region. Do not administer calcium chloride IM.
- **IV:** IV solution should be warmed to body temperature and given through a small-bore needle in a large vein to minimize phlebitis. Do not administer through a scalp vein. May cause cutaneous burning sensation, peripheral vasodilation, and drop in blood pressure. Patient should remain recumbent for 30–60 min after IV administration.
- If infiltration occurs, discontinue IV. May be treated with application of heat, elevation, and local infiltration of normal saline, 1% procaine HCl, or hyaluronidase.
- ***High Alert:*** Administer slowly. High concentrations may cause cardiac arrest. Rapid administration may cause tingling, sensation of warmth, and a metallic taste. Halt infusion if these symptoms occur, and resume infusion at a slower rate when they subside.
- Do not administer solutions that are not clear or that contain a precipitate.

Calcium Chloride

- **Direct IV:** May be administered undiluted by IV push.
- **Intermittent/Continuous Infusion:** May be diluted with D5W, D10W, 0.9% NaCl, D5/0.25% NaCl, D5/0.45% NaCl, D5/0.9% NaCl, or D5/LR. ***Rate:*** Maximum rate for adults is 0.7–1.4 mEq/min (0.5–1 ml of 10% solution); for children, 0.5 ml/min.
- **Syringe Compatibility:** milrinone.
- **Y-Site Compatibility:** amiodarone, dobutamine, doxapram, epinephrine, esmolol, gatifloxacin, inamrinone, milrinone, morphine, nitroprusside, paclitaxel.

♣ = Canadian drug name.

* CAPITALS indicates life-threatening, underlines indicate most frequent.

Contraindications/Precautions

Contraindicated in: Hypercalcemia. Renal calculi. Ventricular fibrillation. Some products contain aspartame and should be avoided in patients with phenylketonuria.

Use Cautiously in: Patients receiving digitalis glycosides; Severe respiratory insufficiency; Renal disease; Cardiac disease.

Adverse Reactions/Side Effects

CNS: syncope (IV only), tingling. **CV:** CARDIAC ARREST (IV only), arrhythmias, bradycardia. **GI:** constipation, nausea, vomiting. **GU:** calculi, hypercalciuria. **Local:** phlebitis (IV only).

Interactions

Drug-Drug: Hypercalcemia increases the risk of **digoxin** toxicity. Chronic use with **antacids** in renal insufficiency may lead to milk-alkali syndrome. Ingestion by mouth decreases the absorption of orally administered **fluoroquinolones**, **iron salts**, **phenytoin**, and **tetracycline**. Excessive amounts may decrease the effects of **calcium channel blocking agents**. Decreases absorption of **etidronate** or **risedronate** (do not take within 2 hr of calcium supplements. May decrease the effectiveness of **atenolol**. Concurrent use with **thiazide diuretics** may result in hypercalcemia. May decrease the ability of **sodium polystyrene sulfonate** to decrease serum potassium. **Calcium acetate** should not be given concurrently with other **calcium supplements**.

Drug-Food: Cereals, spinach, or **rhubarb** may decrease the absorption of calcium supplements.

Route/Dosage

Doses are expressed in mg, g, or mEq of calcium.

PO (Adults): *Prevention of hypocalcemia, treatment of depletion, osteoporosis*—1–2 g/day. *Antacid*—0.5–1.5 g as needed (calcium carbonate only). *Hyperphosphatemia in end-stage renal disease (calcium acetate only)*—amount necessary to control serum phosphate and calcium.

PO (Children): *Supplementation*—45–65 mg/kg/day.

PO (Infants): *Neonatal hypocalcemia*—50–150 mg/kg (not to exceed 1 g).

IV (Adults): *Emergency treatment of hypocalcemia, cardiac standstill*—7–14 mEq. *Hypocalcemic tetany*—4.5–16 mEq, repeat until symptoms are controlled. *Hyperkalemia with cardiac toxicity*—2.25–14 mEq, may repeat in 1–2 min. *Hypermagnesemia*—7 mEq.

IV (Children): *Emergency treatment of hypocalcemia*—1–7 mEq. *Hypocalcemic tetany*—0.5–0.7 mEq/kg 3–4 times daily.

IV (Infants): *Emergency treatment of hypocalcemia*—<1 mEq. *Hypocalcemic tetany*—2.4 mEq/kg/day in divided doses.

NURSING IMPLICATIONS

Assessment

- **Calcium Supplement/Replacement:** Observe patient closely for symptoms of hypocalcemia (paresthesia, muscle twitching, laryngospasm, colic, cardiac arrhythmias, Chvostek's or Trousseau's sign). Notify physician or other health care professional if these occur. Protect symptomatic patients by elevating and padding siderails and keeping bed in low position.
- Monitor blood pressure, pulse, and ECG frequently throughout parenteral therapy. May cause vasodilation with resulting hypotension, bradycardia, arrhythmias, and cardiac arrest. Transient increases in blood pressure may occur during IV administration, especially in geriatric patients or in patients with hypertension.
- Assess IV site for patency. Extravasation may cause cellulitis, necrosis, and sloughing.
- Monitor patient on digitalis glycosides for signs of toxicity.
- **Antacid:** When used as an antacid, assess for heartburn, indigestion, and abdominal pain. Inspect abdomen; auscultate bowel sounds.
- ***Lab Test Considerations:*** Monitor serum calcium or ionized calcium, chloride, sodium, potassium, magnesium, albumin, and parathyroid hormone (PTH) concentrations before and periodically during therapy for treatment of hypocalcemia.

CONTINUED

- **Y-Site Incompatibility:** amphotericin B cholesteryl sulfate, propofol, sodium bicarbonate.

Calcium Gluconate

- **Direct IV:** Administer slowly by direct IV push. ***Rate:*** Maximum administration rate for adults is 1.5–2 ml/min.
- **Continuous Infusion:** May be further diluted in 1000 ml of D5W, D10W, D20W, D5/0.9% NaCl, 0.9% NaCl, D5/LR, or LR. ***Rate:*** Administer at a rate not to exceed 200 mg/min over 12–24 hr.
- **Syringe Incompatibility:** metoclopramide.
- **Y-Site Compatibility:** aldesleukin, allopurinol, amifostine, amiodarone, aztreonam, bivalirudin, cefazolin, cefepime, ciprofloxacin, cisatracurium, cladribine, dexmedetomidate, dobutamine, docetaxel, doxapram, doxorubicin liposome, enalaprilat, epinephrine, etoposide, famotidine, fenoldopam, filgrastim, gatifloxacin, gemcitabine, granisetron, labetalol, linezolid, melphalan, midazolam, milrinone, piperacillin/tazobactam, potassium chloride, prochlorperazine edisylate, propofol, remifentanil, sargramostim, tacrolimus, teniposide, thiotepa, tolazoline, vinorelbine, vitamin B complex with C.
- **Y-Site Incompatibility:** amphotericin B cholesteryl sulfate, fluconazole, indomethacin.

Patient/Family Teaching

- Instruct patient not to take enteric-coated tablets within 1 hr of calcium carbonate; this will result in premature dissolution of the tablets.
- Do not administer concurrently with foods containing large amounts of oxalic acid (spinach, rhubarb), phytic acid (brans, cereals), or phosphorus (milk or dairy products). Administration with milk products may lead to milk-alkali syndrome (nausea, vomiting, confusion, headache). Do not take within 1–2 hr of other medications if possible.
- Instruct patients on a regular schedule to take missed doses as soon as possible, then go back to regular schedule.
- Advise patient that calcium carbonate may cause constipation. Review methods of preventing constipation (increasing bulk in diet, increasing fluid intake, increasing mobility) and using laxatives. Severe constipation may indicate toxicity.
- Advise patient to avoid excessive use of tobacco or beverages containing alcohol or caffeine.
- **Calcium Supplement:** Encourage patients to maintain a diet adequate in vitamin D.
- **Osteoporosis:** Advise patients that exercise has been found to arrest and reverse bone loss. Patient should discuss any exercise limitations with health care professional before beginning program.

Evaluation/Desired Outcomes

- Increase in serum calcium levels.
- Decrease in the signs and symptoms of hypocalcemia.
- Resolution of indigestion.
- Control of hyperphosphatemia in patients with renal failure (calcium acetate only).

Why was this drug prescribed for your patient?

carbamazepine (kar-ba-**maz**-e-peen)

♣Apo-Carbamazepine, Atretol, Carbatrol, Epitol, Equetro, ♣Novo-Carbamaz, Tegretol, ♣Tegretol CR, Tegretol-XR, Teril

Classification

Therapeutic: anticonvulsants

Pregnancy Category C

Indications

Prophylaxis of tonic-clonic, mixed, and complex-partial seizures. **Equetro only:** Acute manic and mixed episodes due to Bipolar I Disorder. Management of pain in trigeminal neuralgia. **Unlabeled uses:** Other forms of neurogenic pain.

Action

Decreases synaptic transmission in the CNS by affecting sodium channels in neurons. **Therapeutic Effects:** Prevention of seizures. Relief of pain in trigeminal neuralgia. Decreased mania in Bipolar I disorder.

Pharmacokinetics

Absorption: Absorption is slow but complete. Suspension produces earlier, higher peak and lower trough levels.
Distribution: Widely distributed. Crosses the blood-brain barrier. Crosses the placenta rapidly and enters breast milk.
Metabolism and Excretion: Extensively metabolized by the liver. One metabolite has anticonvulsant activity.
Half-life: 8–29 hr (during chronic therapy).

TIME/ACTION PROFILE (anticonvulsant activity)

	ONSET	PEAK	DURATION
PO	up to one month†	4–5 hr‡	6–12 hr
PO-ER	up to one month†	2–3–12 hr‡	12 hr

†Onset of antineuralgic activity is 8–72 hr

‡Listed for tablets; peak level occurs 1.5 hr after a chronic dose of suspension

Contraindications/Precautions

Contraindicated in: Hypersensitivity. Bone marrow depression. Pregnancy (use only if potential benefits outweigh risks to the fetus).
Use Cautiously in: Cardiac or hepatic disease; Prostatic hypertrophy; Glaucoma.

Adverse Reactions/Side Effects

CNS: ataxia, drowsiness, fatigue, psychosis, vertigo. **EENT:** blurred vision, corneal opacities. **Resp:** pneumonitis. **CV:** CHF, hypertension, hypotension, syncope. **GI:** hepatitis. **GU:** hesitancy, urinary retention. **Derm:** photosensitivity, rashes, urticaria. **Endo:** inappropriate secretion of antidiuretic hormone (SIADH). **Hemat:** AGRANULOCYTOSIS, APLASTIC ANEMIA, THROMBOCYTOPENIA, eosinophilia, leukopenia. **Misc:** chills, fever, lymphadenopathy.

Interactions

Drug-Drug: ↓ levels/may ↓ effectiveness of **corticosteroids**, **doxycycline**, **felbamate**, **quinidine**, **warfarin**, **estrogen-containing contraceptives**, **barbiturates**, **cyclosporine**, **benzodiazepines**, **theophylline**, **lamotrigine**, **valproic acid**, **bupropion**, and **haloperidol**. **Danazol** ↑ blood levels (avoid concurrent use if possible). Concurrent use (within 2 wk) of **MAO inhibitors** may result in hyperpyrexia, hypertension, seizures, and death. **Verapamil**, **diltiazem**, **propoxyphene**, **erythromycin**, **clarithromycin**, **SSRIs**, **antidepressants**, or **cimetidine** ↑ levels; may cause toxicity. May ↑ risk of hepatotoxicity from **isoniazid**. **Felbamate** ↓ carbamazepine levels but ↑ levels of active metabolite. May ↓ effectiveness and ↑ risk of toxicity from **acetaminophen**. May ↑ risk of CNS toxicity from **lithium**. May ↓ duration of action of **nondepolarizing neuromuscular blocking agents.**
Drug-Food: Grapefruit juice ↑ serum levels and effect.

Route/Dosage

PO (Adults): *Anticonvulsant*—200 mg twice daily or 100 mg 4 times daily (suspension); increase by 200 mg/day q 7 days until therapeutic levels are achieved (range is 600–1200 mg/day in divided doses q 6–8 hr; not to exceed 1 g/day in 12–15-yr-olds. Extended-release products are given twice daily (XR, CR). *Antineuralgic*—100 mg twice daily (tablets) or 50 mg 4 times daily (suspension), increase by up to 200 mg/day until pain is relieved, then maintenance dose of 200–1200 mg/day in divided doses (usual range 400–800 mg/day).

♣ = Canadian drug name.

* CAPITALS indicates life-threatening, underlines indicate most frequent.

CONTINUED

carbamazepine

- **Seizures:** Advise patients to carry identification describing disease and medication regimen at all times.

Evaluation/Desired Outcomes

- Absence or reduction of seizure activity.
- Decrease in trigeminal neuralgia pain. Patients with trigeminal neuralgia who are pain-free should be re-evaluated every 3 mo to determine minimum effective dose.
- Decreased mania and depressive symptoms in Bipolar I disorder.

Why was this drug prescribed for your patient?

♣ = Canadian drug name.

* CAPITALS indicates life-threatening, underlines indicate most frequent.

PO (Children 6–12 yr): 100 mg twice daily (tablets) or 50 mg 4 times daily (suspension) increased by 100 mg weekly until therapeutic levels are obtained (usual range 400–800 mg/day; not to exceed 1 g/day). Extended-release products (XR, CR) are given twice daily.
PO (Children <6 yr): 10–20 mg/kg/day in 2–3 divided doses, may be increased by 100 mg/day at weekly intervals. Usual maintenance dose is 250–350 mg/day (not to exceed 400 mg/day).

NURSING IMPLICATIONS

Assessment

- **Seizures:** Assess frequency, location, duration, and characteristics of seizure activity.
- **Trigeminal Neuralgia:** Assess for facial pain (location, intensity, duration). Ask patient to identify stimuli that may precipitate facial pain (hot or cold foods, bedclothes, touching face).
- **Bipolar Disorder:** Assess mood, ideation, and behaviors frequently.
- ***Lab Test Considerations:*** Monitor CBC, including platelet count, reticulocyte count, and serum iron, weekly during the first 2 mo and yearly thereafter for evidence of potentially fatal blood cell abnormalities. Medication should be discontinued if bone marrow depression occurs.
- Liver function tests, urinalysis, and BUN should be routinely performed. May cause ↑ AST, ALT, serum alkaline phosphatase, bilirubin, BUN, urine protein, and urine glucose levels.
- Monitor serum ionized calcium levels every 6 mo or if seizure frequency increases. Thyroid function tests and ionized serum calcium concentrations may be ↓; hypocalcemia decreases seizure threshold.
- Monitor ECG and serum electrolytes before and periodically during therapy. May cause hyponatremia.
- May occasionally cause ↑ serum cholesterol, high-density lipoprotein, and triglyceride concentrations.
- May cause false-negative pregnancy test results with tests that determine human chorionic gonadotropin.
- ***Toxicity and Overdose:*** Serum blood levels should be routinely monitored during therapy. Therapeutic levels range from 6–12 mcg/ml.

Potential Nursing Diagnoses

Risk for injury (Indications, Side Effects)
Chronic pain (Indications)

Implementation

- Implement seizure precautions as indicated.
- **PO:** Administer medication with food to minimize gastric irritation. Tablets may be crushed if patient has difficulty swallowing. **Do not crush or chew extended-release tablets.** Extended-release capsules may be opened and the contents sprinkled on applesauce or other similar foods.
- Do not administer suspension simultaneously with other liquid medications or diluents; mixture produces an orange rubbery mass.

Patient/Family Teaching

- Instruct patient to take carbamazepine around the clock, as directed. Take missed doses as soon as possible but not just before next dose; do not double doses. Notify health care professional if more than one dose is missed. Medication should be gradually discontinued to prevent seizures.
- May cause dizziness or drowsiness. Advise patients to avoid driving or other activities requiring alertness until response to medication is known.
- Instruct patients that fever, sore throat, mouth ulcers, easy bruising, petechiae, unusual bleeding, abdominal pain, chills, rash, pale stools, dark urine, or jaundice should be reported to health care professional immediately.
- Inform patient that coating of *Tegretol XR* is not absorbed but is excreted in feces and may be visible in stool.
- Advise patient not to take alcohol or other CNS depressants concurrently with this medication.
- Caution patients to use sunscreen and protective clothing to prevent photosensitivity reactions.
- Inform patient that frequent mouth rinses, good oral hygiene, and sugarless gum or candy may help reduce dry mouth. Saliva substitute may be used. Consult dentist if dry mouth persists >2 wk.
- Advise female patients to use a nonhormonal form of contraception while taking carbamazepine.
- Instruct patient to notify health care professional of medication regimen before treatment or surgery.
- Emphasize the importance of follow-up lab tests and eye exams to monitor for side effects.

CONTINUED

High Alert

carboplatin (kar-boe-**pla**-tin)

Paraplatin, ♣Paraplatin-AQ

Classification

Therapeutic: antineoplastics
Pharmacologic: alkylating agents

Pregnancy Category D

Indications

Advanced ovarian carcinoma (with other agents). Palliative treatment of ovarian carcinoma unresponsive to other modalities.

Action

Inhibits DNA synthesis by producing cross-linking of parent DNA strands (cell-cycle phase—nonspecific). **Therapeutic Effects:** Death of rapidly replicating cells, particularly malignant cells.

Pharmacokinetics

Absorption: IV administration results in complete bioavailability.
Distribution: Unknown.
Metabolism and Excretion: Excreted mostly by the kidneys.
Half-life: *Carboplatin*—2.6–5.9 hr (increased in renal impairment); *platinum*—5 days.

TIME/ACTION PROFILE (effects on blood counts)

ROUTE	ONSET	PEAK	DURATION
IV	unknown	21 days	28 days

Contraindications/Precautions

Contraindicated in: Hypersensitivity to carboplatin, cisplatin, or mannitol. Pregnancy or lactation.

Use Cautiously in: Hearing loss; Electrolyte abnormalities; Renal impairment (dose reduction required if CCr <60 ml/min); Active infections; Diminished bone marrow reserve (dosage reduction recommended); Other chronic debilitating illnesses; Patients with childbearing potential.

Adverse Reactions/Side Effects

CNS: weakness. **EENT:** ototoxicity. **GI:** abdominal pain, nausea, vomiting, constipation, diarrhea, hepatitis, stomatitis. **GU:** gonadal suppression, nephrotoxicity. **Derm:** alopecia, rash. **F and E:** hypocalcemia, hypokalemia, hypomagnesemia, hyponatremia. **Hemat:** ANEMIA, LEUKOPENIA, THROMBOCYTOPENIA. **Metab:** hyperuricemia. **Neuro:** peripheral neuropathy. **Misc:** hypersensitivity reactions including ANAPHYLACTIC-LIKE REACTIONS.

Interactions

Drug-Drug: ↑ nephrotoxicity and ototoxicity with other **nephrotoxic** and **ototoxic drugs (aminoglycosides, loop diuretics).** ↑ bone marrow depression with other **bone marrow–depressing drugs** or **radiation therapy.** May ↓ antibody response to **live-virus vaccines** and ↑ risk of adverse reactions.

Route/Dosage

Other dosing formulas are used.
IV (Adults): *Initial treatment*—300 mg/m² with cyclophosphamide at 4-wk intervals. *Treatment of refractory tumors*—360 mg/m² as a single dose; may be repeated at 4-wk intervals depending on response.

NURSING IMPLICATIONS

Assessment

- Assess for nausea and vomiting; often occur 6–12 hr after therapy (1–4 hr for aqueous solution) and may persist for 24 hr. Prophylactic antiemetics may be used. Adjust diet as tolerated to maintain fluid and electrolyte balance and ensure adequate nutritional intake. May require discontinuation of therapy.

♣ = Canadian drug name.

* CAPITALS indicates life-threatening, underlines indicate most frequent.

CONTINUED

carboplatin

Paraplatin

- **Intermittent Infusion:** Reconstitute to a concentration of 10 mg/ml with sterile water for injection, D5W, or 0.9% NaCl for injection. May be further diluted in D5W or 0.9% NaCl to a concentration of 0.5 mg/ml. Stable for 8 hr at room temperature.
- May also be administered over 24 hr or by dividing total dose into 5 consecutive pulse doses; may decrease nausea and vomiting but does not decrease nephrotoxicity or ototoxicity. ***Rate:*** Administer over 15–60 min.
- **Y-Site Compatibility:** allopurinol, amifostine, aztreonam, cefepime, cladribine, doxorubicin liposome, etoposide phosphate, filgrastim, fludarabine, gatifloxacin, gemcitabine, granisetron, linezolid, melphalan, ondansetron, paclitaxel, piperacillin/tazobactam, propofol, sargramostim, teniposide, thiotepa, topotecan, vinorelbine.
- **Y-Site Incompatibility:** amphotericin B cholesteryl sulfate complex.

Paraplatin-AQ

- Hydrate patient with 1–2 liters of fluid infused over 8–12 hr prior to therapy.
- **Intermittent Infusion:** Adequate hydration and urinary output must be maintained for 24 hr following infusion.
- **Intermittent Infusion:** Dilute Paraplatin-AQ with 2 liters of D5/0.45% NaCl containing 37.5 g of mannitol. Do not dilute with D5W. If diluted solution is not to be used within 6 hrs, protect solution from light. Do not refrigerate.

Patient/Family Teaching

- Instruct patient to notify health care professional promptly if fever; chills; sore throat; signs of infection; lower back or side pain; difficult or painful urination; bleeding gums; bruising; pinpoint red spots on skin; blood in stools, urine, or emesis; increased fatigue, dyspnea, or orthostatic hypotension occurs.
- Caution patient to avoid crowds and persons with known infections. Instruct patient to use soft toothbrush and electric razor and to avoid falls. Caution patients not to drink alcoholic beverages or take medication containing aspirin or NSAIDs because they may precipitate gastric bleeding.
- Instruct patient to promptly report any numbness or tingling in extremities or face, decreased coordination, difficulty with hearing or ringing in the ears, unusual swelling, or weight gain to health care professional.
- Instruct patient not to receive any vaccinations without advice of health care professional and to avoid contact with persons who have received oral polio vaccine within the past several months.
- Advise patient of the need for contraception (if patient is not infertile as a result of surgical or radiation therapy).
- Instruct patient to inspect oral mucosa for erythema and ulceration. If ulceration occurs, advise patient to notify health care professional, rinse mouth with water after eating, and use sponge brush. Mouth pain may require treatment with opioids.
- Discuss with patient the possibility of hair loss. Explore methods of coping.
- Emphasize the need for periodic lab tests to monitor for side effects.

Evaluation/Desired Outcomes

- Decrease in size or spread of ovarian carcinoma.

Why was this drug prescribed for your patient?

♣ = Canadian drug name.

* CAPITALS indicates life-threatening, underlines indicate most frequent.

- Assess patients receiving *Paraplatin-AQ* for neurotoxicity (paresthesias in a stocking—glove distribution, areflexia, loss of proprioception and vibratory sensations). Discontinue therapy when symptoms are first observed. May progress further even after stopping therapy. May be irreversible.
- Monitor for bone marrow depression Assess for bleeding (bleeding gums, bruising, petechiae, guaiac stools, urine, and emesis) and avoid IM injections and rectal temperatures if platelet count is low. Apply pressure to venipuncture sites for 10 min. Assess for signs of infection during neutropenia. Anemia may occur and may be cumulative; transfusions are frequently required. Monitor for increased fatigue, dyspnea, and orthostatic hypotension.
- Monitor for signs of anaphylaxis (rash, urticaria, pruritus, facial swelling, wheezing, tachycardia, hypotension). Discontinue medication immediately and notify physician if these occur. Epinephrine and resuscitation equipment should be readily available.
- Audiometry is recommended before initiation of therapy and subsequent doses. Ototoxicity manifests as tinnitus and unilateral or bilateral hearing loss in high frequencies and becomes more frequent and severe with repeated doses. Ototoxicity is more pronounced in children.
- ***Lab Test Considerations:*** Monitor CBC, differential, and clotting studies before and weekly during therapy For *Paraplatin:* The nadirs of thrombocytopenia and leukopenia occur after 21 days and recover by 30 days after a dose. Nadir of granulocyte counts usually occurs after 21–28 days and recovers by day 35. Withhold subsequent doses until neutrophil count is >2000/mm^3 and platelet count is >100,000/mm^3. For *Paraplatin-AQ:* The nadirs of thrombocytopenia and leukopenia occur between days 18 and 23 and recover by day 39. Anemia also occurs with the same frequency and timing as thrombocytopenia and leukopenia.
- Monitor renal function and serum electrolytes before initiation of therapy and before each course of carboplatin. Nephrotoxicity with *Paraplatin-AQ* is cumulative and is potentiated by aminoglycoside antibiotics. Monitor serum creatinine, BUN, creatinine clearance, and magnesium, sodium, potassium, and calcium levels prior to initiating therapy and before each subsequent dose. May cause ↑ BUN and serum creatinine concentrations and ↓ CCr. May cause ↓ serum potassium, calcium, magnesium, and sodium concentrations. Renal function must return to normal before each dose of *Paraplatin-AQ* is given.
- Monitor hepatic function before and periodically during therapy. May cause ↑ serum bilirubin, alkaline phosphatase, and AST concentrations.
- *Paraplatin-AQ* may cause hyperuricemia, usually occurring 3–5 days after therapy. Allopurinol may be used to ↓ uric acid levels.
- *Paraplatin-AQ* may cause ↑ serum amylase levels.

Potential Nursing Diagnoses

Risk for infection (Adverse Reactions)
Risk for injury (Side Effects)

Implementation

- ***High Alert:*** Fatalities have occurred with chemotherapeutic agents. Before administering, clarify all ambiguous orders; double check single, daily, and course-of-therapy dose limits; have second practitioner independently double check original order, calculations and infusion pump settings.
- ***High Alert:*** Do not confuse carboplatin with cisplatin. Do not confuse Paraplatin (carboplatin) with Platinol (cisplatin).
- ***High Alert:*** Carboplatin should be administered in a monitored setting under the supervision of a physician experienced in cancer chemotherapy.
- Solution should be prepared in a biologic cabinet. Wear gloves, gown, and mask while handling medication. Discard equipment in specially designated containers.
- Do not use aluminum needles or equipment during preparation or administration; aluminum reacts with the drug.

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carisoprodol (kar-i-**sop**-roe-dole)

Soma, Vanadom

Classification

Therapeutic: skeletal muscle relaxants (centrally acting)

Pregnancy Category UK

Indications

Adjunct to rest and physical therapy in the treatment of muscle spasm associated with acute, painful musculoskeletal conditions.

Action

Skeletal muscle relaxation, probably due to CNS depression. **Therapeutic Effects:** Skeletal muscle relaxation.

Pharmacokinetics

Absorption: Well absorbed following oral administration.
Distribution: Crosses the placenta; high concentrations in breast milk.
Metabolism and Excretion: Mostly metabolized by the liver.
Half-life: 8 hr.

TIME/ACTION PROFILE (skeletal muscle relaxation)

	ONSET	PEAK	DURATION
PO	30 min	unknown	4–6 hr

Contraindications/Precautions

Contraindicated in: Hypersensitivity to carisoprodol or to meprobamate. Porphyria or suspected porphyria.
Use Cautiously in: Severe liver or kidney disease; Pregnancy, lactation, or children <12 yr (safety not established).

Adverse Reactions/Side Effects

CNS: dizziness, drowsiness, agitation, ataxia, depression, headache, insomnia, irritability, syncope. **Resp:** asthmatic attacks. **CV:** hypotension, tachycardia. **GI:** epigastric distress, hiccups, nausea, vomiting. **Derm:** flushing, rashes. **Hemat:** eosinophilia, leukopenia. **Misc:** ANAPHYLACTIC SHOCK, fever, psychological dependence, severe idiosyncratic reaction.

Interactions

Drug-Drug: Additive CNS depression with other **CNS depressants** including **alcohol**, **antihistamines**, **opioid analgesics**, and **sedative/hypnotics.**
Drug-Natural Products: Concomitant use of **kava, valerian, skullcap, chamomile,** or **hops** can increase CNS depression.

Route/Dosage

PO (Adults): 350 mg 4 times daily.
PO (Children 5–12 yr): 6.25 mg/kg 4 times daily.

NURSING IMPLICATIONS

Assessment

- Assess patient for pain, muscle stiffness, and range of motion prior to and periodically throughout therapy.
- Observe patient for idiosyncratic symptoms that may appear within minutes or hours of administration during the first dose. Symptoms include extreme weakness, quadriplegia, dizziness, ataxia, dysarthria, visual disturbances, agitation, euphoria, confusion, and disorientation. Usually subsides over several hours.

Potential Nursing Diagnoses

Acute pain (Indications)
Impaired bed mobility (Indications)
Risk for injury (Side Effects)

Implementation

- **Do not confuse Soma with Soma Compound.**

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celecoxib (sel-e-**kox**-ib)

Celebrex

Classification

Therapeutic: antirheumatics, nonsteroidal anti-inflammatory agents
Pharmacologic: COX-2 inhibitors

Pregnancy Category C

Indications

Relief of signs and symptoms of osteoarthritis, rheumtoid arthritis and ankylosing spondylitis. Reduction of the number of adenomatous colorectal polyps in familial adenomatous polyposis (FAP), as an adjunct to usual care (endoscopic surveillance, surgery). Management of acute pain including primary dysmenorrhea.

Action

Inhibits the enzyme COX-2. This enzyme is required for the synthesis of prostaglandins. Has analgesic, anti-inflammatory, and antipyretic properties. **Therapeutic Effects:** Decreased pain and inflammation due to arthritis or spondylitis. Reduction in number of adenomatous colorectal polyps. Decreased acute pain, including dysmenorrhea.

Pharmacokinetics

Absorption: Bioavailability unknown.
Distribution: 97% bound to plasma proteins; extensive tissue distribution.
Metabolism and Excretion: Mostly metabolized by the liver; <3% excreted unchanged in urine and feces.
Half-life: 11 hr.

TIME/ACTION PROFILE (pain reduction)

ROUTE	ONSET	PEAK	DURATION
PO	24–48 hr	unknown	12–24 hr†

†After discontinuation

Contraindications/Precautions

Contraindicated in: Hypersensitivity. Cross-sensitivity may exist with other NSAIDs, including aspirin. History of allergic-type reactions to sulfonamides. History of asthma, urticaria, or allergic-type reactions to aspirin or other NSAIDs, including the aspirin triad (asthma, nasal polyps, and severe hypersensitivity reactions to aspirin). Advanced renal disease. Peri-operative pain from coronary artery bypass graft (CABG) surgery. Should not be used in late pregnancy (may cause premature closure of the ductus arteriosus).
Use Cautiously in: Cardiovascular disease or risk factors for cardiovascular disease (may ↑ risk of serious cardiovascular thrombotic events, myocardial infarction, and stroke, especially with prolonged use); Concurrent therapy with corticosteroids or anticoagulants, long duration of NSAID therapy, history of smoking, alcoholism, geriatric patients, or poor general health status (increased risk of GI bleeding); Pre-existing renal disease, heart failure, liver dysfunction, concurrent diuretic or ACE inhibitor therapy (increased risk of renal impairment); Hypertension or fluid retention; Serious dehydration (correct deficits before administering); Pre-existing asthma; Pregnancy or children <18 yr (safety not established, use not recommended during late pregnancy)
Exercise Extreme Caution in: History of ulcer disease or GI bleeding.

Adverse Reactions/Side Effects

CNS: dizziness, headache, insomnia. **CV:** edema. **GI:** GI BLEEDING, abdominal pain, diarrhea, dyspepsia, flatulence, nausea. **Derm:** EXFOLIATIVE DERMATITIS, STEVENS-JOHNSON SYNDROME, TOXIC EPIDERMAL NECROLYSIS, rash.

Interactions

Drug-Drug: Significant interactions may occur when celexicob is coadministered with other drugs that inhibit the CYP450 2C9 enzyme system. May decrease the effectiveness of **ACE inhibitors, thiazide diuretics**, and **furosemide**. **Fluconazole** increases celecoxib blood levels (dosage reduction recommended). May increase the risk of bleeding with **warfarin**. May increase serum **lithium** levels. Does not inhibit the cardioprotective effect of low-dose **aspirin**.

- Provide safety measures as indicated. Supervise ambulation and transfer of patients.
- **PO:** Administer with food to minimize GI irritation. Give dose at bedtime.

Patient/Family Teaching

- Instruct patient to take medication exactly as directed. Missed doses should be taken within 1 hr; if not, omit and return to regular dosing schedule. Do not double doses.
- Encourage patient to comply with additional therapies prescribed for muscle spasm (rest, physical therapy, heat, etc.).
- May cause dizziness or drowsiness. Advise patient to avoid driving or other activities requiring alertness until response to drug is known.
- Instruct patient to change positions slowly to minimize orthostatic hypotension.
- Advise patient to avoid concurrent use of alcohol and other CNS depressants while taking this medication.
- Instruct patient to notify health care professional if signs of allergy (rash, hives, swelling of tongue or lips, dyspnea) or idiosyncratic reaction occur.

Evaluation/Desired Outcomes

- Decreased musculoskeletal pain and muscle spasticity.
- Increased range of motion.

Why was this drug prescribed for your patient?

Route/Dosage

PO (Adults): *Osteoarthritis*—200 mg/day as a single dose *or* 100 mg twice daily. *Rheumatoid arthritis*—100–200 mg twice daily. *Ankylosing spondyltitis*— 200 mg once daily *or* 100 mg twice daily; dose may be increased after 6 wk to 400 mg daily. *Familial adenomatous polyosis*—400 mg twice daily. *Acute pain, including dysmenorrhea*— 400 mg initially, then a 200 mg dose if needed on the first day; then 200 mg twice daily as needed.

NURSING IMPLICATIONS

Assessment

- Assess patient's range of motion, degree of swelling, and pain in affected joints before and periodically throughout therapy.
- Assess patient for allergy to sulfonamides, aspirin, or NSAIDs. Patients with these allergies should not receive celecoxib.
- ***Lab Test Considerations:*** May cause ↑ AST and ALT levels.
- May cause hypophosphatemia and ↑ BUN.

Potential Nursing Diagnoses

Impaired physical mobility (Indications)
Acute pain (Indications)
Deficient knowledge, related to medication regimen, related to medication regimen (Patient/Family Teaching)

Implementation

- *Do not confuse with Celexa (citalopram) or Cerebyx (fosphenytoin).*
- **PO:** May be administered without regard to meals.

Patient/Family Teaching

- Instruct patient to take celecoxib exactly as directed. Do not take more than prescribed dose. Increasing doses does not appear to increase effectiveness. Use lowest effective dose for shortest period of time.
- Advise patient to notify health care professional promptly if signs or symptoms of GI toxicity (abdominal pain, black stools), skin rash, unexplained weight gain, or edema occur. Patients should discontinue celecoxib and notify health care professional if signs and symptoms of hepatotoxicity (nausea, fatigue, lethargy, pruritus, jaundice, upper right quadrant tenderness, flulike symptoms) occur.
- Advise patient to notify health care professional if pregnancy is planned or suspected.
- **Familial adenomatous polyposis:** Advise patient that prophylactic surveillance of polyps should be continued during celecoxib therapy.

Evaluation/Desired Outcomes

- Reduction in joint pain in patients with osteoarthritis.
- Reduction in joint tenderness, pain, and joint swelling in patients with rheumatoid arthritis.

Why was this drug prescribed for your patient?

CEPHALOSPORINS–FIRST GENERATION

cefadroxil

(sef-a-**drox**-ill)
Duricef

cefazolin

(sef-**a**-zoe-lin)
Ancef

cephalexin

(sef-a-**lex**-in)
Apo-Cephalex, Keflex, Novo-Lexin, Nu-Cephalex

cephradine

(**sef**-re-deen)
Velosef

Classification
Therapeutic: anti-infectives
Pharmacologic: first-generation cephalosporins

Pregnancy Category B

Indications

Treatment of: Skin and skin structure infections (including burn wounds), Pneumonia, Otitis media, Urinary tract infections, Bone and joint infections, Septicemia (including endocarditis) caused by susceptible organisms. **Cephazolin:** Perioperative prophylaxis. Not suitable for the treatment of meningitis.

Action

Binds to bacterial cell wall membrane, causing cell death. **Therapeutic Effects:** Bactericidal action against susceptible bacteria. **Spectrum:** Active against many gram-positive cocci including: *Streptococcus pneumoniae*, Group A beta-hemolytic streptococci, Penicillinase-producing staphylococci. Not active against: Methicillin-resistant staphylococci, *Bacteroides fragilis*, Enterococci. Limited activity against some gram-negative rods including: *Klebsiella pneumoniae*, *Proteus mirabilis*, *Escherichia coli*.

Pharmacokinetics

Absorption: *Cefadroxil, cephalexin,* and *cephradine* are well absorbed following oral administration. *Cefazolin* is well absorbed following IM administration.
Distribution: Widely distributed. All cross the placenta and enter breast milk in low concentrations. Minimal CSF penetration.
Metabolism and Excretion: Excreted almost entirely unchanged by the kidneys.
Half-life: *Cefadroxil*—60–120 min; *cefazolin*—90–120 min; *cephalexin*—50–80 min; *cephradine*—60-120 min (all are increased in renal impairment).

TIME/ACTION PROFILE (blood levels)

ROUTE	ONSET	PEAK	DURATION
Cefadroxil PO	rapid	1.5–2 hr	12–24 hr
Cefazolin IM	rapid	1–2 hr	6–12 hr
Cefazolin IV	rapid	end of infusion	6–12 hr
Cephalexin PO	rapid	1 hr	+–6 hr
Cephradine PO	rapid	1–2 hr	+–6 hr

Contraindications/Precautions

Contraindicated in: Hypersensitivity to cephalosporins. Serious hypersensitivity to penicillins.
Use Cautiously in: Renal impairment (dosage reduction and/increased dosing interval recommended for: *cefadroxil* if CCr ≤50 ml/min and *cephradine* if CCr ≤50 ml/min; History of GI disease, especially colitis; Geriatric patients (consider age-related decrease in body mass, renal/hepatic/cardiac function, concurrent medications and chronic disease states); Pregnancy or lactation (half-life is shorter and blood levels lower during pregnancy; have been used safely) *cefazolin* if CCr <55 ml/min).

Adverse Reactions/Side Effects

CNS: SEIZURES (high doses). **GI:** PSEUDOMEMBRANOUS COLITIS, diarrhea, nausea, vomiting, cramps. **Derm:** rashes, pruritis, urticaria. **Hemat:** blood

= Canadian drug name.

* CAPITALS indicates life-threatening, underlines indicate most frequent.

CONTINUED

CEPHALOSPORINS—FIRST GENERATION

- ***Lab Test Considerations:*** May cause positive results for Coombs' test with high doses or in neonates whose mothers were given cephalosporins prior to delivery.
- May cause ↑ serum AST, ALT, alkaline phosphatase, bilirubin, LDH, BUN, and creatinine.
- May rarely cause leukopenia, neutropenia, agranulocytosis, thrombocytopenia, eosinophilia, lymphocytosis, and thrombocytosis.

Potential Nursing Diagnoses

Risk for infection (Indications, Side Effects)
Diarrhea (Adverse Reactions)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- **PO:** Administer around the clock. May be administered on full or empty stomach. Administration with food may minimize GI irritation. Shake oral suspension well before administering. Refrigerate oral suspensions.
- Mix each *Panixine Disperdose tablet for oral suspension* with 2 teaspoons of water. Patients should drink entire mixture, rinse container with a small amount of water and drink to make sure entire dose is taken. Tablets will not dissolve in mouth. Use only water to dissolve tablets, other liquids are not recommended. Store tablets at room temperature.

Cefazolin

- **Intermittent Infusion:** Reconstituted 500-mg or 1-g solution may be diluted in 50–100 ml of 0.9% NaCl, D5W, D10W, D5/0.25% NaCl, D5/0.45% NaCl, D5/09% NaCl, D5/LR. Solution is stable for 24 hr at room temperature and 10 days if refrigerated. ***Rate:*** Administer over 30–60 min.
- **Y-Site Compatibility:** acyclovir, allopurinol, amifostine, amphotericin B cholesteryl sulfate, atracurium, aztreonam, calcium gluconate, cyclophosphamide, diltiazem, docetaxel, doxorubicin liposome, enalaprilat, esmolol, etoposide, famotidine, filgrastim, fluconazole, fludarabine, foscarnet, gemcitabine, granisetron, heparin, insulin, labetalol, lidocaine, magnesium sulfate, melphalan, meperidine, midazolam, morphine, multivitamins, ondansetron, pancuronium, perphenazine, propofol, remifentanil, sargramostim, tacrolimus, teniposide, theophylline, thiotepa, vecuronium, vitamin B complex with C, warfarin.
- **Y-Site Incompatibility:** amphotericin B cholesteryl sulfate complex, idarubicin, pentamidine, vinorelbine.

Patient/Family Teaching

- Instruct patient to take medication around the clock at evenly spaced times and to finish the medication completely as directed, even if feeling better. Missed doses should be taken as soon as possible unless almost time for next dose; do not double doses. Instruct patient to use calibrated measuring device with liquid preparations. Advise patient that sharing this medication may be dangerous.
- Review use and preparation of tablets for oral suspension (Panixine DisperDose).
- Advise patient to report signs of superinfection (furry overgrowth on the tongue, vaginal itching or discharge, loose or foul-smelling stools) and allergy.
- **Instruct patient to notify health care professional if fever and diarrhea develop, especially if diarrhea contains blood, mucus, or pus. Advise patient not to treat diarrhea without consulting health care professional.**

= Canadian drug name.

* CAPITALS indicates life-threatening, underlines indicate most frequent.

dyscrasias, hemolytic anemia. **Local:** pain at IM site, phlebitis at IV site. **Misc:** allergic reactions including ANAPHYLAXIS and SERUM SICKNESS, superinfection.

Interactions

Drug-Drug: Probenecid ↓ excretion and ↑ blood levels of renally excreted cephalosporins. Concurrent use of **loop diuretics** or **aminoglycosides** may ↑ risk of renal toxicity.

Route/Dosage

Cefadroxil

PO (Adults): Pharyngitis and tonsilitis—500 mg q 12 hr or 1 g q 24 hr for 10 days. *Skin and soft-tissue infections*—500 mg q 12 hr or 1 g q 24 hr. *Urinary tract infections*—500 mg–1 g q 12 hr or 1–2 g q 24 hr.
PO (Children): *Pharyngitis, tonsillitis, or impetigo*—15 mg/kg q 12 hr or 30 mg/kg q 24 hr for 10 days. *Skin and soft-tissue infections*—15 mg/kg q 12 hr. *Urinary tract infections*—15 mg/kg q 12 hr.

Renal Impairment

PO (Adults): *CCr 25–50 ml/min*—500 mg q 12 hr; *CCr 10–25 ml/min*—500 mg q 24 hr; *CCr 0–10 ml/min*—500 mg q 36 hr.

Cefazolin

IM, IV (Adults): *Moderate to severe infections*—500 mg-1 g q 6-8 hr. *Mild infections with gram-positive cocci*—250-500 mg q 8 hr. *Uncomplicated urinary tract infections*—1 g q 12 hr. *Pneumococcal pneumonia*—500 mg q 12 hr. *Endocarditis or septicemia*—1-1.5 g q 6 hr. *Perioperative prophylaxis*—1 g given 30-60 min prior to incision. Additional 500 mg-1 g should be given for surgeries ≥2 hr. 500 mg-1 g should then be given for all surgeries q 6-8 hr for 24 hr postoperatively.
IM, IV (Children and Infants >1 mo): 6.25–25 mg/kg q 6 hr or 8.3–33.3 mg/kg q 8 hr.

Renal Impairment

IM, IV (Adults): *CCr 35–54 ml/min*—full dose q 8 hr; *CCr 11–34 ml/min*—½ full dose q 12 hr; *CCr ≤10 ml/min*—½ full dose q 18–24 hr.

Cephalexin

PO (Adults): *Most infections*—250–500 mg q 6 hr. *Uncomplicated cystitis, skin and soft-tissue infections, streptococcal pharyngitis*—500 mg q 12 hr.
PO (Children): *Most infections*—25–50 mg/kg/day divided q 6–8 hr. *Skin and soft-tissue infections, streptococcal pharyngitis*—12.5–25 mg/kg q 12 hr. *Otitis media*—18.75-25 mg/kg q 6 hr.

Cephradine

PO (Adults): *Most infections*—250–500 mg q 6–12 hr.
PO (Children ≥9 mo): *Most infections*—6.25–12.5 mg/kg q 6 hr.

Renal Impairment

PO (Adults): *CCr 10–50 ml/min*—Decrease dose by 50%; *CCr <10 ml/min*—Decrease dose by 75%.

NURSING IMPLICATIONS

Assessment

- Assess for infection (vital signs; appearance of wound, sputum, urine, and stool; WBC) at beginning and during therapy.
- Before initiating therapy, obtain a history to determine previous use of and reactions to penicillins or cephalosporins. Persons with a negative history of penicillin sensitivity may still have an allergic response.
- Obtain specimens for culture and sensitivity before initiating therapy. First dose may be given before receiving results.
- **Observe patient for signs and symptoms of anaphylaxis (rash, pruritus, laryngeal edema, wheezing). Discontinue drug and notify physician or other health care provider immediately if these problems occur. Keep epinephrine, an antihistamine, and resuscitation equipment close by in case of an anaphylactic reaction.**

CONTINUED

Evaluation/Desired Outcomes

- Resolution of signs and symptoms of infection. Length of time for complete resolution depends on the organism and site of infection.
- Decreased incidence of infection when used for prophylaxis.

Why was this drug prescribed for your patient?

CEPHALOSPORINS–SECOND GENERATION

cefaclor

(**sef**-a-klor)
Ceclor, Ceclor CD, Raniclor

cefprozil

(sef-**proe**-zil)
Cefzil

cefotetan

(sef-oh-**tee**-tan)
Cefotan

cefuroxime

(se-fyoor-**ox**-eem)
Ceftin, Zinacef

cefoxitin

(se-**fox**-i-tin)
Mefoxin

loracarbef

(lore-a-**kar**-beff)
Lorabid

Classification
Therapeutic: anti-infectives
Pharmacologic: second-generation cephalosporins

Pregnancy Category B

Indications

Treatment of: Respiratory tract infections, Skin and skin structure infections, Bone and joint infections (not cefprozil, or loracarbef), Urinary tract and gynecologic infections (not cefprozil), Septicemia (not cefprozil, or loracarbef). **Cefotetan:** Intra-abdominal, gynecological, and biliary tract infections. **Cefuroxime:** Meningitis. **Cefaclor, cefprozil, cefuroxime:** Otitis media. **Cefoxitin, cefuroxime, cefotetan:** Perioperative prophylaxis.

Action

Binds to bacterial cell wall membrane, causing cell death. **Therapeutic Effects:** Bactericidal action against susceptible bacteria. **Spectrum:** Similar to first-generation cephalosporins but increased activity against several other gram-negative pathogens including: *Haemophilus influenzae, Escherichia coli, Klebsiella pneumoniae, Moraxella catarrhalis, Neisseria gonorrhoeae* (including penicillinase-producing strains), *Proteus*. Cefotetan, and cefoxitin have activity against *Bacteroides fragilis*. Not active against methicillin-resistant staphylococci or enterococci.

Pharmacokinetics

Absorption: Well absorbed following IM administration. *Cefaclor, cefprozil, cefuroxime,* and *loracarbef*—well absorbed following PO administration.
Distribution: Widely distributed. Penetration into CSF is poor, but adequate for cefuroxime to be used in treating meningitis. All cross the placenta and enter breast milk in low concentrations.
Metabolism and Excretion: Excreted primarily unchanged by the kidneys.
Half-life: *Cefaclor*—35–54 min; *cefotetan*—3–4.6 hr; *cefoxitin*—40–60 min; *cefprozil*—90 min; *cefuroxime*—80 min; *loracarbef*—1 hr (all are ↑ in renal impairment).

TIME/ACTION PROFILE

ROUTE	ONSET	PEAK	DURATION
Cefaclor PO	rapid	30–60 min	6–12 hr
Cefaclor PO-CD	unknown	unknown	12 hr
Cefotetan IM	rapid	1–3 hr	12 hr
Cefotetan IV	rapid	end of infusion	12 hr
Cefoxitin IM	rapid	30 min	4–8 hr
Cefoxitin IV	rapid	end of infusion	4–8 hr
Cefprozil PO	unknown	1–2 hr	12–24 hr
Cefuroxime PO	unknown	2 hr	8–12 hr
Cefuroxime IM	rapid	15–60 min	6–12 hr
Cefuroxime IV	rapid	end of infusion	6–12 hr
Loracarbef PO	rapid	0.5–1.2 hr	12 hr

Contraindications/Precautions

Contraindicated in: Hypersensitivity to cephalosporins. Serious hypersensitivity to penicillins. Some oral dose forms contain aspartame and should be avoided in patients with phenylketonuria
Use Cautiously in: Renal impairment (↓ dose/↑ dosing interval recommended for: *cefotetan* if CCr ≤30 ml/min, *cefoxitin* if CCr ≤50 ml/min.

CONTINUED

CEPHALOSPORINS—SECOND GENERATION

- Before initiating therapy, obtain a history to determine previous use of and reactions to penicillins or cephalosporins. Persons with a negative history of penicillin sensitivity may still have an allergic response.
- Obtain specimens for culture and sensitivity before initiating therapy. First dose may be given before receiving results.
- Observe patient for signs and symptoms of anaphylaxis (rash, pruritus, laryngeal edema, wheezing). Discontinue the drug and notify the physician or other health care professional immediately if these occur. Keep epinephrine, an antihistamine, and resuscitation equipment close by in the event of an anaphylactic reaction.
- Assess patient for renal dysfunction and adjust dose accordingly. Monitor for dose-related adverse CNS events (including seizures, myoclonus, encephalopathy) and nephrotoxicity.
- ***Lab Test Considerations:*** May cause positive results for Coombs' test with high doses or in neonates whose mothers were given cephalosporins prior to delivery.
- Monitor prothrombin time and assess patient for bleeding (guaiac stools; check for hematuria, bleeding gums, ecchymosis) daily in high-risk patients or those receiving *cefotetan* because these agents may cause hypoprothrombinemia.
- *Cefuroxime* may also cause false-negative blood glucose results with ferricyanide tests. Use glucose enzymatic or hexokinase tests to determine blood glucose.
- May cause ↑ AST, ALT, serum alkaline phosphatase, bilirubin, LDH, BUN, and creatinine.
- *Cefotetan, cephalothin,* and *cefoxitin* may cause falsely elevated test results for serum and urine creatinine; do not obtain serum samples within 2 hr of administration.

Potential Nursing Diagnoses

Risk for infection (Indications, Side Effects)
Diarrhea (Adverse Reactions)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- **PO:** Administer around the clock. May be administered on full or empty stomach. Administration with food may minimize GI irritation. Shake oral suspension well before administering.
- Administer cefaclor extended-release tablets with food; **do not crush, break, or chew.**
- *Cefuroxime* tablets should be swallowed whole, not crushed; crushed tablets have a strong, persistent bitter taste. Tablets may be taken without regard to meals. Suspension must be taken with food. Shake well each time before using. Tablets and suspension are not interchangeable.
- **IM:** Reconstitute IM doses with sterile or bacteriostatic water for injection or 0.9% NaCl for injection. May be diluted with lidocaine to minimize injection discomfort.
- Inject deep into a well-developed muscle mass; massage well.
- When administering 2-g dose of *cefonicid*, divide in half and inject into two large muscle mass sites.
- **IV:** Change sites every 48–72 hr to prevent phlebitis. Monitor site frequently for thrombophlebitis (pain, redness, swelling).
- If aminoglycosides are administered concurrently, administer in separate sites if possible, at least 1 hr apart. If second site is unavailable, flush line between medications.
- **Direct IV:** Dilute in at least 1 g/10 ml. Do not use preparations containing benzyl alcohol for neonates. ***Rate:*** Administer slowly over 3–5 min.

Cefotetan

- **Intermittent Infusion:** Reconstituted solution may be further diluted in 50–100 ml of D5W or 0.9% NaCl. Solution may be colorless or yellow. Solution is stable for 24 hr at room temperature or 96 hr if refrigerated. ***Rate:*** Administer over 20–30 min.
- **Y-Site Compatibility:** allopurinol, amifostine, aztreonam, bivalirudin, dexmedetomidate, diltiazem, docetaxel, etoposide phosphate, famotidine, fenoldopam, filgrastim, fluconazole, fludarabine, gatifloxacin, gem-

cefprozil if CCr <30 ml/min, *cefuroxime* if CCr ≤20 ml/min, *loracarbef* if CCr <50 ml/min); Geriatric, debilitated, or emaciated patients (may need supplemental vitamin K to prevent bleeding); History of GI disease, especially colitis; Geriatric patients (consider age-related decrease in body mass, renal/hepatic/cardiac function, concurrent medications and chronic disease states); Pregnancy and lactation (have been used safely in obstetrical surgery).

Adverse Reactions/Side Effects

CNS: SEIZURES (high doses). **GI:** PSEUDOMEMBRANOUS COLITIS, diarrhea, jaundice (ceftazidime), nausea, vomiting, cramps. **Derm:** rashes, urticaria. **Hemat:** bleeding (↑ with cefotetan), blood dyscrasias, hemolytic anemia. **Local:** phlebitis at IV site. **Misc:** allergic reactions including ANAPHYLAXIS and SERUM SICKNESS, superinfection.

Interactions

Drug-Drug: Probenecid ↓ excretion and ↑ blood levels. If **alcohol** is ingested within 48–72 hr of cefotetan, a disulfiram-like reaction may occur. Cefotetan may ↑ the effects of **anticoagulants** and ↑ the risk of bleeding with **antiplatelet agents, NSAIDS, , thrombolytic agents**, or **valproic acid**.

Drug-Natural Products: Risk of bleeding with **cefotetan** may be ↑ by **arnica, chamomile, clove, feverfew, garlic, ginger, ginkgo, Panax ginseng, willow**, and others.

Route/Dosage

Cefaclor

PO (Adults): 250–500 mg q 8 hr or 375–500 mg q 12 hr as extended-release tablets.

PO (Children >1 mo): 6.7–13.4 mg/kg q 8 hr or 10–20 mg/kg q 12 hr (up to 60 mg/kg/day or 1.5 g/day have been used).

Cefotetan

IM, IV (Adults): *Most infections*—1–2 g q 12 hr. *Severe/life-threatening infections*—2–3 g q 12 hr. *Urinary tract infections*—500 mg–1 g q 12 hr or 1–2 g q 24 hr.

Cefoxitin

IM, IV (Adults): *Most infections*—1 g q 6–8 hr. *Severe infections*—1 g q 4 hr or 2 g q 6–8 hr. *Life-threatening infections*—2 g q 4 hr or 3 g q 6 hr. *Perioperative prophylaxis*—1–2 g IV within 60 min of incision, then q 6 hr for up to 24 hr.

IM, IV (Children and Infants >3 mo): *Most infections*—13.3–26.7 mg/kg q 4 hr or 20–40 mg/kg q 6 hr.

Cefprozil

PO (Adults): *Most infections*—250–500 mg q 12 hr or 500 mg q 24 hr.

PO (Children 6 mo–12 yr): *Otitis media*—15 mg/kg q 12 hr.

PO (Children 2–12 yr): *Pharyngitis/tonsillitis*—7.5 mg/kg q 12 hr.

Cefuroxime

PO (Adults and Children >12 yr): *Most infections*—250–500 mg q 12 hr. *Urinary tract infections*—125–250 mg q 12 hr.

PO (Children <12 yr): *Most infections*—125 mg q 12 hr as tablets. *Otitis media*—250 mg q 12 hr as tablets.

PO (Children 3 mo–12 yr): *Otitis media, impetigo*—15 mg/kg q 12 hr as oral suspension. *Pharyngitis/tonsillitis*—10 mg/kg q 12 hr as oral suspension.

IM, IV (Adults): *Most infections*—750 mg–1.5 g q 8 hr. *Bacterial meningitis*—up to 3 g q 8 hr.

IM, IV (Children and Infants >3 mo): *Most infections*—16.7–33.3 mg/kg q 8 hr or 15–50 mg/kg q 12 hr. *Bone infections*—50 mg/kg q 8 hr. *Bacterial meningitis*—50–60 mg/kg q 6 hr or 66.7–80 mg/kg q 8 hr.

IM, IV (Neonates): *Most infections*—10–33.3 mg/kg q 8 hr or 15–50 mg/kg q 12 hr. *Bacterial meningitis*—33.3 mg/kg q 8 hr or 50 mg/kg q 12 hr.

Loracarbef

PO (Adults): *Most infections*—200–400 mg q 12 hr. *Cystitis*—200 mg q 24 hr.

PO (Children 6 mo–12 yr): *Pharyngitis/skin and soft-tissue infections*—7.5 mg q 12 hr. *Otitis media*—15 mg/kg q 12 hr.

NURSING IMPLICATIONS

Assessment

- Assess patient for infection (vital signs; appearance of wound, sputum, urine, and stool; WBC) at beginning and during therapy.

CONTINUED

citabine, granisetron, heparin, insulin, linezolid, melphalan, meperidine, morphine, paclitaxel, propofol, remifentanil, sargramostim, tacrolimus, teniposide, theophylline, thiotepa.

- **Y-Site Incompatibility:** promethazine, vinorelbine.

Cefoxitin

- **Intermittent Infusion:** Reconstituted solution may be further diluted in 50–100 ml of D5W, D10W, 0.9% NaCl, D5/0.45% NaCl, D5/0.25% NaCl, D5/0.9% NaCl, D5/LR, Ringer's or LR. Stable for 24 hr at room temperature and 1 wk if refrigerated. Darkening of powder does not alter potency. ***Rate:*** Administer over 15–30 min.
- **Continuous Infusion:** May be diluted in 500–1000 ml for continuous infusion.
- **Syringe Compatibility:** heparin.
- **Y-Site Compatibility:** acyclovir, amifostine, amphotericin B cholesteryl sulfate, aztreonam, bivalirudin, cyclophosphamide, dexmedetomidate, diltiazem, docetaxel, doxorubicin liposome, etoposide phosphate, famotidine, fluconazole, foscarnet, gemcitabine, granisetron, hydromorphone, linezolid, magnesium sulfate, meperidine, morphine, ondansetrol, perphenazine, propofol, ranitidine, remifentanil, teniposide, thiotepa.
- **Y-Site Incompatibility:** Manufacturer recommends stopping other medications during infusion, fenoldopam, filgrastim, gatifloxacin, pentamidine.

Cefuroxime

- **Intermittent Infusion:** Solution may be further diluted in 100 ml of 0.9% NaCl, D5W, D10W, D5/0.45% NaCl, or D5/0.9% NaCl. Stable for 24 hr at room temperature and 1 wk if refrigerated. ***Rate:*** Administer over 15–60 min.
- **Continuous Infusion:** May also be diluted in 500–1000 ml for continuous infusion.
- **Y-Site Compatibility:** acyclovir, allopurinol, amifostine, amiodarone, atracurium, aztreonam, bivalirudin, cyclophosphamide, dexmedetomidate, diltiazem, docetaxel, etoposide phosphate, famotidine, fenoldopam, fludarabine, foscarnet, gemcitabine, granisetron, hydromorphone, linezolid, melphalan, meperidine, milrinone, morphine, ondansetron, pancuronium, perphenazine, propofol, remifentanil, sargramostim, tacrolimus, teniposide, thiotepa, vecuronium.
- **Y-Site Incompatibility:** Manufacturer recommends temporarily discontinuing primary solution when administering cefuroxime via Y-site, azithromycin, filgrastim, fluconazole, midazolam, vinorelbine.

Patient/Family Teaching

- Instruct patient to take medication around the clock at evenly spaced times and to finish the medication completely, even if feeling better. Missed doses should be taken as soon as possible unless it is almost time for next dose; do not double doses. Advise patient that sharing of this medication may be dangerous.
- Advise patient to report signs of superinfection (furry overgrowth on the tongue, vaginal itching or discharge, loose or foul-smelling stools) and allergy.
- Caution patients that concurrent use of alcohol with *cefotetan* may cause a disulfiram-like reaction (abdominal cramps, nausea, vomiting, headache, hypotension, palpitations, dyspnea, tachycardia, sweating, flushing). Alcohol and alcohol-containing medications should be avoided during and for several days after therapy.
- Instruct patient to notify health care professional if fever and diarrhea develop, especially if stool contains blood, pus, or mucus. Advise patient not to treat diarrhea without consulting health care professional.

Evaluation/Desired Outcomes

- Resolution of signs and symptoms of infection. Length of time for complete resolution depends on the organism and site of infection.
- Decreased incidence of infection when used for prophylaxis.

Why was this drug prescribed for your patient?

CEPHALOSPORINS–THIRD GENERATION

cefdinir
(**sef**-di-nir)
Omnicef

cefditoren
(sef-tye-**dor**-en)
Spectracef

cefepime
(**seff**-e-peem)
Maxipime

cefixime
(sef-**ik**-seem)
Suprax

cefoperazone
(sef-oh-**per**-a-zone)
Cefobid

cefotaxime
(sef-oh-**taks**-eem)
Claforan

cefpodoxime
(sef-poe-**dox**-eem)
Vantin

ceftazidime
(sef-**tay**-zi-deem)
Ceptaz, Fortaz, Tazicef, Tazidime

ceftibuten
(sef-tye-**byoo**-ten)
Cedax

ceftizoxime
(sef-ti-**zox**-eem)
Cefizox

ceftriaxone
(sef-try-**ax**-one)
Rocephin

Classification
Therapeutic: anti-infectives
Pharmacologic: third-generation cephalosporins
Pregnancy Category B

Indications

Treatment of: Skin and skin structure infections (not cefixime), Bone and joint infections (not cefixime), Urinary and gynecologic infections including gonorrhea (ceftriaxone) or respiratory tract infections, Intra-abdominal infections (not cefixime), Septicemia, Otitis media (cefdinir, cefixime). **Cefotaxime, ceftazidime, ceftizoxime, ceftriaxone:** Meningitis. **Ceftriaxone:** Perioperative prophylaxis. **Cefepime:** Empiric treatment of febrile neutropenic patients. **Ceftriaxone:** Single-dose treatment of acute bacterial otitis media. **Cefotaxime, ceftriaxone:** Lyme disease. **Cefdinir, cefditoren:** Acute exacerbations of chronic bronchitis.

Action

Bind to the bacterial cell wall membrane, causing cell death. **Therapeutic Effects:** Bactericidal action against susceptible bacteria. **Spectrum:** Similar to that of second-generation cephalosporins, but activity against staphylococci is less, whereas activity against gram-negative pathogens is greater, even for organisms resistant to first- and second-generation agents. Notable is increased action against: *Enterobacter, Haemophilus influenzae, Escherichia coli, Klebsiella pneumoniae, Neisseria, Proteus, Providencia, Serratia, Moraxella catarrhalis, Borrelia burgdorferi*. Some agents have enhanced activity against: *Pseudomonas aeruginosa* (ceftazidime, cefoperazone), and *Moraxella catarrhalis* (cefdinir). Some have activity against anaerobes, including *Bacteroides fragilis*.

Pharmacokinetics

Absorption: Well absorbed after IM administration. *Ceftibuten* and *cefpodoxime* are well absorbed after oral administration; *cefixime* 40–50% absorbed after oral administration (oral suspension); *cefdinir* 16–25% absorbed after oral administration. Cefditoren is a prodrug and is broken down prior to absorption (14% absorbed).
Distribution: Widely distributed. Cross the placenta; enter breast milk in low concentrations. CSF penetration better than with first- and second-generation agents.
Protein Binding: *Cefoperazone* and *ceftriaxone* ≥90%.

CONTINUED

CEPHALOSPORINS—THIRD GENERATION

Route/Dosage

Cefdinir
PO (Adults ≥13 yr): 300 mg q 12 hr or 600 mg q 24 hr.
PO (Children 6 mo–12 yr): 7 mg/kg q 12 hr or 14 mg/kg q 24 hr.

Cefepime
IM (Adults and Children): 0.5–1 g q 12 hr.
IV (Adults and Children): 0.5–2 g q 12 hr.
IM, IV (Children up to 40 kg): 50 mg/kg q 12 hr (50 mg/kg q 8 hr in febrile neutropenic patients).

Cefixime
PO (Adults and Children >12 hr or >50 kg): 400 mg once daily; *gonorrhea*— 400 mg single dose.
PO (Children >6 mo): 8 mg/kg/day as a single daily dose or in divided doses every 12 hr.

Cefoperazone
IM, IV (Adults): *Mild to moderate infections*—1–2 g q 12 hr. *Severe infections*—2–4 g q 8 hr or 3–6 g q 12 hr.

Cefotaxime
IM, IV (Adults): *Most infections*—1 g q 12 hr. *Moderate to severe infections*—1–2 g q 6–8 hr. *Life-threatening infections*—2 g q 4 hr.
IM, IV (Children >1 mo): 8.3–30 mg/kg q 4 hr or 12.5–45 mg/kg q 6 hr.
IV (Neonates 1–4 wk): 50 mg/kg q 8 hr.
IV (Neonates ≤1 wk): 50 mg/kg q 12 hr.

Cefpodoxime
PO (Adults): *Most infections*—200 mg q 12 hr. *Skin and soft tissue infections*—400 mg q 12 hr. *Urinary tract infections/pharyngitis*—100 mg q 12 hr. *Gonorrhea*—200 mg single dose.
PO (Children 6 mo–12 yr): *Pharyngitis/tonsillitis/otitis media*—5 mg/kg q 12 hr; may be given as 10 mg/kg once daily for otitis media (not to exceed 200 mg/day for pharyngitis/tonsillitis or 400 mg/day for otitis media).

Ceftazidime
IM, IV (Adults): *Most infections*—500 mg–2 g q 8–12 hr. *Pneumonia/skin structure infections*—0.5–1 g q 8–12 hr. *Bone and joint infections*—2 g q 12 hr. *Severe/life-threatening infections*—2 g q 8 hr. *Complicated urinary tract infections*—500 mg q 8–12 hr. *Uncomplicated urinary tract infections*—250 mg q 12 hr.
IM, IV (Children 1 mo–12 yr): 30–50 mg/kg q 8 hr.
IV (Neonates ≤4 wk): 30 mg/kg q 12 hr.

Ceftibuten
PO (Adults and Children ≥12 yr): 400 mg q 24 hr for 10 days.
PO (Children 6 mo–12 yr): 9 mg/kg/day for 10 days (up to 400 mg/day).

Cefditoren
PO (Adults): *Acute bacterial exacerbation of chronic bronchitis*—400 mg twice daily for 10 days; *pharyngitis/tonsilitis*—200 mg twice daily for 10 days.

Ceftizoxime
IM, IV (Adults): *Severe infections*—1–2 g q 8–12 hr. *Life-threatening infections*—3–4 g q 8 hr or 2 g q 6 hr. *Mild/moderate infections*—1 g q 8–12 hr. *Uncomplicated urinary tract infections*—500 mg q 12 hr.
IM, IV (Children >6 mo): 50 mg/kg q 6–8 hr (not to exceed 200 mg/kg/day).

Ceftriaxone
IM, IV (Adults): *Most infections*—0.5–1 g q 12 hr or 1–2 g q 24 hr. *Meningitis*—2 g q 12 hr.

Metabolism and Excretion: *Cefdinir, cefepime, ceftazidime, cefpodoxime, cefditoren,* and *ceftizoxime*—>85% excreted in urine. *Cefoperazone*—excreted in the bile. *Ceftibuten, ceftriaxone,* and *cefotaxime*—partly metabolized and partly excreted in the urine. *cefixime*—50% excreted unchanged in urine, 10% in bile.

Half-life: *Cefdinir*—102 min; *cefditoren*—100 min; *cefepime*—120 min; *cefixime*—180–240 min; *cefoperazone*—102–156 min; *cefotaxime*—60 min; *cefpodoxime*—120–180 min; *ceftazidime*—114–120 min; *ceftibuten*—120–144 min; *ceftizoxime*—84–114 min; *ceftriaxone*—348–522 min (all except *cefoperazone* and *ceftriaxone* are increased in renal impairment).

TIME/ACTION PROFILE

ROUTE	ONSET	PEAK	DURATION
Cefdinir PO	rapid	2–4 hr	12–24 hr
Cefditoren PO	rapid	1.5–3 hr	12 hr
Cefepime IM	rapid	1–2 hr	12 hr
Cefepime IV	rapid	end of infusion	12 hr
Cefixime PO	rapid	4 hr	12—24 hrhr
Cefoperazone IM	rapid	1–2 hr	12 hr
Cefoperazone IV	rapid	end of infusion	12 hr
Cefotaxime IM	rapid	0.5 hr	4–12 hr
Cefotaxime IV	rapid	end of infusion	4–12 hr
Cefpodoxime PO	unknown	2–3 hr	12 hr
Ceftazidime IM	rapid	1 hr	6–12 hr
Ceftazidime IV	rapid	end of infusion	6–12 hr
Ceftizoxime IM	rapid	0.5–1.5 hr	6–12 hr
Ceftizoxime IV	rapid	end of infusion	6–12 hr
Ceftriaxone IM	rapid	1–2 hr	12–24 hr
Ceftriaxone IV	rapid	end of infusion	12–24 hr

Contraindications/Precautions

Contraindicated in: Hypersensitivity to cephalosporins. Serious hypersensitivity to penicillins. Hypersensitivity to L -arginine (Ceptaz formulation only). Carnitine deficiency or errors in carnitine metabolism (cefditoren). Milk protein hypersensitivity (cefditoren).

Use Cautiously in: Renal impairment (decreased dosing/increased dosing interval recommended for: *Cefdinir* if CCr <30 ml/min, *cefepime* if CCr ≤60 ml/min, *cefotaxime* if CCr <20 ml/min, *cefpodoxime* if CCr <30 ml/min, *ceftazidime, cefditoren* if CCr ≤50 ml/min, *ceftizoxime* if CCr ≤80 ml/min); Severe hepatic/biliary impairment (dosage reduction/increased dosing interval recommended for *cefoperazone*); Combined severe hepatic and renal impairment (dosage reduction/increased dosing interval recommended for *cefoperazone* and *ceftriaxone*); Diabetes (*ceftibuten* and *cefdinir* suspension contain sucrose; History of GI disease, especially colitis; Geriatric patients (consider age-related decrease in body mass, renal/hepatic/cardiac function, concurrent medications and chronic disease states); Geriatric patients (consider age-related decrease in body mass, renal/hepatic/cardiac function, concurrent medications and chronic disease states); Pregnancy and lactation (have been used safely).

Adverse Reactions/Side Effects

CNS: SEIZURES (high doses). **GI:** PSEUDOMEMBRANOUS COLITIS, diarrhea, nausea, vomiting, cramps, jaundice (ceftazidime), pseudolithiasis (ceftriaxone). **Derm:** rashes, urticaria. **Hemat:** bleeding (increased with cefoperazone), blood dyscrasias, hemolytic anemia. **Local:** pain at IM site, phlebitis at IV site. **Misc:** allergic reactions including ANAPHYLAXIS and SERUM SICKNESS, superinfection.

Interactions

Drug-Drug: Probenecid decreases excretion and increases serum levels *cefotaxime, cefpodoxime, ceftizoxime)*. Ingestion of **alcohol** within 48–72 hr of *cefoperazone* may result in a disulfiram-like reaction. *Cefoperazone* may potentiate the effects of **anticoagulants** and increase the risk of bleeding with **antiplatelet agents**, **NSAIDs**, **thrombolytic agents**, or **valproic acid**. **Antacids** and **iron supplements** decrease absorption of cefdinir (administer 2 hr before or 2 hr after). **Antacids** and **histamine H_2-receptor antagonists** ↓ absorption of cefditoren (avoid concurrent use). Cefixime may ↑ **carbamazepine** levels.

Drug-Natural Products: Risk of bleeding with **cefoperazone** may be ↑ by **arnica, chamomile, clove, feverfew, garlic, ginger, ginkgo, Panax ginseng, willow,** and others.

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IM, IV (Children): *Most infections*—25–37.5 mg/kg q 12 hr. *Meningitis*—100 mg/kg q 24 hr or 50 mg/kg q 12 hr. *Skin/soft tissue infections*—50–75 mg/kg q 24 hr. *Single-dose treatment of acute otitis media*—50 mg/kg IM.

NURSING IMPLICATIONS

Assessment

- Assess patient for infection (vital signs; appearance of wound, sputum, urine, and stool; WBC) at beginning and throughout therapy.
- Before initiating therapy, obtain a history to determine previous use of and reactions to penicillins or cephalosporins. Persons with a negative history of penicillin sensitivity may still have an allergic response.
- Obtain specimens for culture and sensitivity before initiating therapy. First dose may be given before receiving results.
- Observe patient for signs and symptoms of anaphylaxis (rash, pruritus, laryngeal edema, wheezing). Discontinue the drug and notify the physician or other health care professional immediately if these occur. Keep epinephrine, an antihistamine, and resuscitation equipment close by in the event of an anaphylactic reaction.
- ***Lab Test Considerations:*** May cause positive results for Coombs' test if receiving high doses or in neonates whose mothers were given cephalosporins before delivery.
- Monitor prothrombin time and assess patient for bleeding (guaiac stools; check for hematuria, bleeding gums, ecchymosis) daily if receiving *cefoperazone*; this agent may cause hypoprothrombinemia.
- May cause ↑ serum AST, ALT, alkaline phosphatase, bilirubin, LDH, BUN, and creatinine.

Potential Nursing Diagnoses

Risk for infection (Indications, Side Effects)
Diarrhea (Adverse Reactions)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- Cefditoren is not recommended for prolonged use since other piralate-containing compounds have caused clinical manifestations of carnitine deficiency when used over a period of months.
- **PO:** Administer around the clock. May be administered on full or empty stomach. Administration with food may minimize GI irritation. Shake oral suspension well before administering. *Cefditoren* should be administered with meals to enhance absorption.
- Do not administer cefdinir or cefpodoxime within 2 hr before or after an antacid or cefdinir within 2 hr before or after iron supplements; may decrease absorption. Do not administer cefditoren concomitantly with antacids or other drugs taken to reduce stomach acid.
- **IM:** Reconstitute IM doses with sterile or bacteriostatic water for injection or 0.9% NaCl for injection. May be diluted with lidocaine to minimize injection discomfort.
- Inject deep into a well-developed muscle mass; massage well.
- **IV:** Monitor injection site frequently for phlebitis (pain, redness, swelling). Change sites every 48–72 hr to prevent phlebitis.
- If aminoglycosides are administered concurrently, administer in separate sites, if possible, at least 1 hr apart. If second site is unavailable, flush lines between medications.
- **Direct IV:** Dilute in at least 1 g/10 ml. Avoid direct IV administration of *cefoperazone* and *ceftriaxone*. Do not use preparations containing benzyl alcohol for neonates. ***Rate:*** Administer slowly over 3–5 min.

Cefepime

- **Intermittent Infusion:** Dilute in 50–100 ml for a concentration of 1–40 mg/ml with D5W, 0.9% NaCl, D10W, M/6 sodium lactate injection, D5/0.9% NaCl, D5/LR, D5/Normosol-R, or D5/Normosol-M injection.
- Solution is stable for 24 hr at room temperature and 7 days if refrigerated. ***Rate:*** Administer over 30 min.
- **Y-Site Compatibility:** ampicillin-sulbactam, aztreonam, bivalirudin, bleomycin, bumetanide, buprenorphine, butorphanol, calcium gluconate, carboplatin, carmustine, cyclophosphamide, cytarabine, dactinomycin, dexamethasone sodium phosphate, dexmedetomidate, docetaxel,

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CEPHALOSPORINS—THIRD GENERATION

doxorubicin liposome, fenoldopam, fluconazole, fludarabine, fluorouracil, furosemide, granisetron, hydrocortisone sodium phosphate, hydrocortisone sodium succinate, hydromorphone, imipenem-cilastatin, leucovorin, lorazepam, melphalan, mesna, methotrexate, methylprednisolone sodium succinate, metronidazole, milrinone, paclitaxel, piperacillin-tazobactam, propofol, ranitidine, sargramostim, sodium bicarbonate, thiotepa, ticarcillin-clavulanate, trimethoprim-sulfamethoxazole, zidovudine.

- **Y-Site Incompatibility:** acyclovir, amphotericin B, amphotericin B cholesteryl sulfate, chlordiazepoxide, chlorpromazine, cimetidine, ciprofloxacin, cisplatin, dacarbazine, daunorubicin, diazepam, diphenhydramine, dobutamine, dopamine, doxorubicin, droperidol, enalaprilat, etoposide, etoposide phosphate, famotidine, filgrastim, floxuridine, ganciclovir, haloperidol, idarubicin, ifosfamide, magnesium sulfate, mannitol, mechlorethamine, meperidine, metoclopramide, mitomycin, mitoxantrone, morphine, nalbuphine, ofloxacin, ondansetron, prochlorperazine, promethazine, streptozocin, vancomycin, vinblastine, vincristine.

Cefoperazone

- **Intermittent Infusion:** Reconstitute each gram with at least 2.8 ml of sterile or bacteriostatic water for injection or 0.9% NaCl. Shake vigorously and allow to stand for visualization and clarity. Solution may be colorless to straw colored. Each gram in solution should be further diluted in 20–40 ml of 0.9% NaCl, D5W, D10W, D5/0.25% NaCl, D5/0.9% NaCl, D5/LR, or LR. Solution is stable for 24 hr at room temperature and 5 days if refrigerated. ***Rate:*** Administer over 15–30 min.
- **Continuous Infusion:** For continuous infusion, concentration should be 2–25 mg/ml.
- **Syringe Compatibility:** heparin.
- **Y-Site Compatibility:** acyclovir, allopurinol, aztreonam, cyclophosphamide, docetaxel, enalaprilat, esmolol, etoposide, famotidine, fludarabine, foscarnet, granisetron, hydromorphone, linezolid, magnesium sulfate, melphalan, morphine, propofol, ranitidine, teniposide, thiotepa.
- **Y-Site Incompatibility:** amifostine, amphotericin B cholesteryl sulfate, cisatracurium, doxorubicin liposome, filgrastim, gatifloxacin, gemcitabine, labetalol, meperidine, ondansetron, pentamidine, perphenazine, promethazine, sargramostim, vinorelbine.

Cefotaxime

- **Intermittent Infusion:** Reconstituted solution may be further diluted in 50–100 ml of D5W, D10W, LR, D5/0.25% NaCl, D5/0.45% NaCl, D5/0.9% NaCl, or 0.9% NaCl. Solution may appear light yellow to amber. Solution is stable for 24 hr at room temperature and 5 days if refrigerated. ***Rate:*** Administer over 20–30 min.
- **Syringe Compatibility:** heparin, ofloxacin.
- **Y-Site Compatibility:** acyclovir, amifostine, aztreonam, bivalirudin, cyclophosphamide, dexmedetomidine, diltiazem, docetaxel, etoposide phosphate, famotidine, fenoldopam, fludarabine, granisetron, hydromorphone, levofloxacin, lorazepam, magnesium sulfate, melphalan, meperidine, midazolam, milrinone, morphine, ondansetron, perphenazine, propofol, remifentanil, sargramostim, teniposide, thiotepa, tolazoline, vinorelbine.
- **Y-Site Incompatibility:** allopurinol, azithromycin, filgrastim, fluconazole, gemcitabine, pentamidine.

Ceftazidime

- **Intermittent Infusion:** Reconstituted solution may be further diluted in at least 1 g/10 ml of 0.9% NaCl, D5W, D10W, D5/0.25% NaCl, D5/0.45% NaCl, D5/0.9% NaCl, or LR. Dilution causes CO_2 to form inside vial, resulting in positive pressure; vial may require venting after dissolution to preserve sterility of vial. Not required with L-arginine formulation (Ceptaz). Solution may appear yellow to amber; darkening does not alter potency.

High Alert

cisplatin (sis-pla-tin)

♣Platinol, Platinol-AQ

Classification

Therapeutic: antineoplastics
Pharmacologic: alkylating agents

Pregnancy Category D

Indications

Metastatic testicular and ovarian carcinoma. Advanced bladder cancer. Head and neck cancer. Cervical cancer. Lung cancer. Other tumors.

Action

Inhibits DNA synthesis by producing cross-linking of parent DNA strands (cell-cycle phase—nonspecific). **Therapeutic Effects:** Death of rapidly replicating cells, particularly malignant ones.

Pharmacokinetics

Absorption: IV administration results on complete bioavailability.
Distribution: Widely distributed; accumulates for months; enters breast milk.
Metabolism and Excretion: Excreted mainly by the kidneys.
Half-life: 30–100 hr.

TIME/ACTION PROFILE (effects on blood counts)

ROUTE	ONSET	PEAK	DURATION
IV	unknown	18–23 days	39 days

Contraindications/Precautions

Contraindicated in: Hypersensitivity. Pregnancy or lactation.
Use Cautiously in: Hearing loss; Renal impairment (dosage ↓ recommended); CHF; Electrolyte abnormalities; Active infections; Bone marrow depression; Geriatric patients (↑ risk of nephrotoxicity, peripheral neuropathy); Chronic debilitating illnesses; Patients with childbearing potential.

Adverse Reactions/Side Effects

CNS: SEIZURES, malaise, weakness. **EENT:** ototoxicity, tinnitus. **GI:** severe nausea, vomiting, diarrhea, hepatotoxicity. **GU:** nephrotoxicity, sterility. **Derm:** alopecia. **F and E:** hypocalcemia, hypokalemia, hypomagnesemia. **Hemat:** LEUKOPENIA, THROMBOCYTOPENIA, anemia. **Local:** phlebitis at IV site. **Metab:** hyperuricemia. **Neuro:** peripheral neuropathy. **Misc:** anaphylactoid reactions.

Interactions

Drug-Drug: ↑ nephrotoxicity and ototoxicity with other **nephrotoxic** and **ototoxic drugs (aminoglycosides, loop diuretics)**. ↑ risk of hypokalemia and hypomagnesemia with **loop diuretics** and **amphotericin B**. May ↓ **phenytoin** levels. ↑ bone marrow depression with other **antineoplastics** or **radiation therapy.** May ↓ antibody response to **live-virus vaccines** and ↑ adverse reactions.

Route/Dosage

Other regimens are used.
IV (Adults): *Metastatic testicular tumors*—20 mg/m² daily for 5 days repeated q 3–4 wk. *Metastatic ovarian cancer*—75–100 mg/m², repeat q 4 wk in combination cyclophosphamide *or* 100 mg/m² q 3 wk if used as a single agent. *Advanced bladder cancer*—50–70 mg/m² q 3–4 wk as a single agent.

NURSING IMPLICATIONS

Assessment

- Monitor blood pressure, pulse, respiratory rate, and temperature frequently during administration. Report significant changes.
- Monitor intake and output and specific gravity frequently throughout therapy. Report discrepancies immediately. To reduce the risk of nephro-

Solution is stable for 18 hr at room temperature and 7 days if refrigerated. ***Rate:*** Administer over 15–30 min.

- **Syringe Compatibility:** hydromorphone.
- **Y-Site Compatibility:** acyclovir, allopurinol, amifostine, aminophylline, aztreonam, ciprofloxacin, dexmedetomidine, diltiazem, docetaxel, enalaprilat, esmolol, etoposide phosphate, famotidine, fenoldopam, filgrastim, fludarabine, foscarnet, furosemide, gatifloxacin, gemcitabine, granisetron, heparin, hydromorphone, ketamine, labetalol, linezolid, melphalan, meperidine, milrinone, morphine, ondansetron, paclitaxel, ranitidine, remifentanil, sufentanil, tacrolimus, teniposide, theophylline, thiotepa, tobramycin, vinorelbine, zidovudine.
- **Y-Site Incompatibility:** amiodarone, amphotericin B cholesteryl sulfate, azithromycin, doxorubicin liposome, erythromycin, fluconazole, idarubicin, midazolam, pentamidine, warfarin.

Ceftizoxime

- **Intermittent Infusion:** Reconstituted solution may be further diluted in 50–100 ml of D5W, D10W, 0.9% NaCl, D5/0.25% NaCl, D5/0.45% NaCl, D5/0.9% NaCl, or LR. Solution is stable for 8 hr at room temperature and 48 hr if refrigerated. ***Rate:*** Administer over 15–30 min.
- **Y-Site Compatibility:** acyclovir, allopurinol, amifostine, amiodarone, amphotericin B cholesteryl sulfate, aztreonam, bivalirudin, dexmedetomidine, docetaxel, doxorubicin liposome, enalaprilat, esmolol, etoposide phosphate, famotidine, fenoldopam, fludarabine, foscarnet, gatifloxacin, gemcitabine, granisetron, hydromorphone, labetalol, linezolid, melphalan, meperidine, morphine, nicardipine, ondansetron, propofol, ranitidine, remifentanil, sargramostim, teniposide, thiotepa, vinorelbine.
- **Y-Site Incompatibility:** filgrastim.

Ceftriaxone

- **Intermittent Infusion:** Reconstitute each 250-mg vial with 2.4 ml, each 500-mg vial with 4.8 ml, each 1-g vial with 9.6 ml, and each 2-g vial with 19.2 ml of sterile water for injection, 0.9% NaCl, or D5W for a concentration of 100 mg/ml. Solution may be further diluted in 50–100 ml of 0.9% NaCl, D5W, D10W, D5/0.45% NaCl, or LR. Solution may appear light yellow to amber. Solution is stable for 3 days at room temperature. ***Rate:*** Administer over 15–30 min in adults and 10–30 min in newborns or children.
- **Y-Site Compatibility:** acyclovir, allopurinol, amifostine, amiodarone, aztreonam, bivalirudin, cisatracurium, dexmedetomidine, diltiazem, docetaxel, doxorubicin liposome, etoposide phosphate, famotidine, fenoldopam, fludarabine, foscarnet, gatifloxacin, gemcitabine, granisetron, heparin, linezolid, melphalan, meperidine, methotrexate, morphine, paclitaxel, propofol, remifentanil, sargramostim, sodium bicarbonate, tacrolimus, teniposide, theophylline, thiotepa, warfarin, zidovudine.
- **Y-Site Incompatibility:** amphotericin B cholesteryl sulfate, azithromycin, filgrastim, fluconazole, labetalol, pentamidine, vinorelbine.

Patient/Family Teaching

- Instruct patient to take medication at evenly spaced times and to finish the medication completely, even if feeling better. Missed doses should be taken as soon as possible unless it is almost time for next dose; do not double doses. Advise patient that sharing of this medication may be dangerous.
- Advise patient to report signs of superinfection (furry overgrowth on the tongue, vaginal itching or discharge, loose or foul-smelling stools) and allergy.
- Caution patients that concurrent use of alcohol with *cefoperazone* may cause a disulfiram-like reaction (abdominal cramps, nausea, vomiting, headache, hypotension, palpitations, dyspnea, tachycardia, sweating, flushing). Alcohol and alcohol-containing medications should be avoided during and for several days after therapy.
- Instruct patient to notify health care professional if fever and diarrhea develop, especially if stool contains blood, pus, or mucus. Advise patient not to treat diarrhea without consulting health care professional.

Evaluation/Desired Outcomes

- Resolution of the signs and symptoms of infection. Length of time for complete resolution depends on the organism and site of infection.
- Decreased incidence of infection when used for prophylaxis.

Why was this drug prescribed for your patient?

toxicity, a urinary output of at least 100 ml/hr should be maintained for 4 hr before initiating and for at least 24 hr after administration.

- Encourage patient to drink 2000–3000 ml/day to promote excretion of uric acid. Allopurinol and alkalinization of the urine may be used to help prevent uric acid nephropathy.
- Assess patency of IV site frequently during therapy. Cisplatin may cause severe irritation and necrosis of tissue if extravasation occurs. If a large amount of highly concentrated cisplatin solution extravasates, mix 4 ml of 10% sodium thiosulfate with 6 ml of sterile water or 1.6 ml of 25% sodium thiosulfate with 8.4 ml of sterile water and inject 1–4 ml (1 ml for each ml extravasated) through existing line or cannula. Inject subcut if needle has been removed. Sodium thiosulfate inactivates cisplatin.
- Severe and protracted nausea and vomiting usually occur 1–4 hr after a dose; vomiting may last for 24 hr. Parenteral antiemetic agents should be administered 30–45 min before therapy and routinely around the clock for the next 24 hr. Monitor amount of emesis and notify physician or other health care professional if emesis exceeds guidelines to prevent dehydration. Nausea and anorexia may persist for up to 1 wk.
- Monitor for bone marrow depression. Assess for bleeding (bleeding gums, bruising, petechiae, stools, urine, and emesis) and avoid IM injections and taking rectal temperatures if platelet count is low. Apply pressure to venipuncture sites for 10 min. Assess for signs of infection during neutropenia. Anemia may occur. Monitor for increased fatigue, dyspnea, and orthostatic hypotension.
- Monitor for signs of anaphylaxis (facial edema, wheezing, dizziness, fainting, tachycardia, hypotension). Discontinue medication immediately and report symptoms. Epinephrine and resuscitation equipment should be readily available.
- Medication may cause ototoxicity and neurotoxicity. Assess patient frequently for dizziness, tinnitus, hearing loss, loss of coordination, loss of taste, or numbness and tingling of extremities; may be irreversible. Notify physician or other health care professional promptly if these occur. Audiometry should be performed before initiation of therapy and before subsequent doses. Hearing loss is more frequent with children and usually occurs first with high frequencies and may be unilateral or bilateral.
- Monitor inadvertent cisplatin overdose. Doses >100 mg/m^2/cycle once every 3–4 wk are rarely used. Differentiate daily doses from total dose/cycle. Symptoms of high cumulative doses include muscle cramps (localized, painful involuntary skeletal muscle contractions of sudden onset and short duration) and are usually associated with advanced stages of peripheral neuropathy.
- ***Lab Test Considerations:*** Monitor CBC with differential and platelet count before and routinely throughout course of therapy. The nadir of leukopenia, thrombocytopenia, and anemia occurs within 18–23 days and recovery 39 days after a dose. Withhold further doses until WBC is >4000/mm^3 and platelet count is >100,000/mm^3.
- Monitor BUN, serum creatinine, and CCr before initiation of therapy and before each course of cisplatin to detect nephrotoxicity. May cause increased BUN and creatinine and decreased calcium, magnesium, phosphate, sodium, and potassium levels that usually occur the 2nd wk after a dose. Do not administer additional doses until BUN is <25 mg/100 ml and serum creatinine is <1.5 mg/100 ml. May cause increased uric acid level, which usually peaks 3–5 days after a dose.
- May cause transiently increased serum bilirubin and AST concentrations.
- May cause positive Coombs' test result.

Potential Nursing Diagnoses

Risk for infection (Adverse Reactions)
Risk for injury (Side Effects)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)

Implementation

- ***High Alert:*** Fatalities have occurred with chemotherapeutic agents. Before administering, clarify all ambiguous orders; double check single, daily, and course-of-therapy dose limits; have second practitioner independently double check original order, calculations and infusion pump

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cisplatin

settings. Do not confuse with carboplatin. To prevent confusion, orders should include generic and brand names. Administer under the supervision of a physician experienced in the use of cancer chemotherapeutic agents.

- Solution should be prepared in a biologic cabinet. Wear gloves, gown, and mask while handling medication. If powder or solution comes in contact with skin or mucosa, wash thoroughly with soap and water. Discard equipment in specially designated containers.
- Administer under the supervision of a physician experienced in the use of cancer chemotherapeutic agents.
- Hydrate patient with at least 1–2 L of IV fluid 8–12 hr before initiating therapy with cisplatin. Amifostine may be administered to minimize nephrotoxicity.
- Do not use aluminum needles or equipment during preparation or administration. Aluminum reacts with this drug, forms a black or brown precipitate, and renders the drug ineffective.
- Unopened vials of powder and constituted solution must not be refrigerated.
- **Intermittent Infusion:** Reconstitute 10-mg vials with 10 ml of sterile water for injection and 50-mg vial with 50 ml. Stable for 20 hr if reconstituted with sterile water, for 72 hr with bacteriostatic water. Do not refrigerate, because crystals will form. Solution should be clear and colorless; discard if turbid or if it contains precipitates.
- Dilution in 2 L of 5% dextrose in 0.3% or 0.45% NaCl containing 37.5 g of mannitol is recommended. ***Rate:*** Infuse over 6–8 hr.
- **Continuous Infusion:** Has been administered as continuous infusion over 24 hr to 5 days with resultant decrease in nausea and vomiting.
- ***High Alert:*** Clarify dose to ensure cumulative dosage is not confused with daily dose; errors may be fatal.
- **Syringe Compatibility:** bleomycin, cyclophosphamide, doxapram, doxorubicin, droperidol, fluorouracil, furosemide, heparin, leucovorin calcium, methotrexate, metoclopramide, mitomycin, vinblastine, vincristine.
- **Y-Site Compatibility:** allopurinol, aztreonam, bleomycin, chlorpromazine, cimetidine, cladribine, cyclophosphamide, dexamethasone, diphenhydramine, doxorubicin, doxorubicin liposome, droperidol, etoposide, famotidine, filgrastim, fludarabine, fluorouracil, furosemide, gatifloxacin, ganciclovir, gemcitabine, granisetron, granisetron, heparin, hydromorphone, leucovorin calcium, linezolid, lorazepam, melphalan, methotrexate, methylprednisolone, metoclopramide, mitomycin, morphine, ondansetron, paclitaxel, prochlorperazine edisylate, promethazine, propofol, ranitidine, sargramostim, teniposide, topotecan, vinblastine, vincristine, vinorelbine.
- **Y-Site Incompatibility:** amifostine, amphotericin B cholesteryl sulfate, cefepime, piperacillin/tazobactam, thiotepa.
- **Additive Compatibility:** etoposide, floxuridine, ifosfamide, leucovorin calcium, magnesium sulfate, mannitol, ondansetron, 0.9% NaCl, D5/0.9% NaCl.
- **Additive Incompatibility:** fluorouracil, mesna, sodium bicarbonate, thiotepa.

Patient/Family Teaching

- Instruct patient to report pain at injection site immediately.
- Instruct patient to notify health care professional if fever; chills; cough; hoarseness; sore throat; signs of infection; lower back/side pain; painful urination; bleeding gums; bruising; petechiae; blood in stools, urine, or emesis; increased fatigue; dyspnea; or orthostatic hypotension occurs. Caution patient to avoid crowds and persons with infections. Instruct

clarithromycin (kla-rith-roe-mye-sin)

Biaxin, Biaxin XL

Classification

Therapeutic: agents for atypical mycobacterium, anti-infectives, antiulcer agents

Pharmacologic: macrolides

Pregnancy Category C

Indications

Treatment of respiratory tract infections including streptococcal pharyngitis, sinusitis, bronchitis and pneumonia. Treatment (with ethambutol) and prevention of disseminated *Mycobacterium avium* complex (MAC). Treatment of following pediatric infections: Otitis media, Sinusitis, Pharyngitis, Skin/skin structure infections. Part of a combination regimen for ulcer disease due to *Helicobacter pylori*. Endocarditis prophylaxis.

Action

Inhibits protein synthesis at the level of the 50S bacterial ribosome. **Therapeutic Effects:** Bacteriostatic action. **Spectrum:** Active against: *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Streptococcus pyogenes* (group A strep). Also active against: *Haemophilus influenzae*, *Moraxella catarrhalis*. Additional activity against: *Mycoplasma*, *Legionella*, *H. pylori*, *Mycobacterium avium*.

Pharmacokinetics

Absorption: Well absorbed (50%) after PO use.
Distribution: Widely distributed with tissue levels that may exceed serum levels.
Metabolism and Excretion: 10–15% converted by the liver to 14-hydroxyclarithromycin, which has anti-infective activity; 20–30% excreted unchanged in urine.
Half-life: 250-mg dose—3–4 hr; 500-mg dose—5–7 hr.

TIME/ACTION PROFILE (serum levels)

	ONSET	PEAK	DURATION
PO	unknown	2 hr	12 hr
PO-XL	unknown	4 hr	24 hr

Contraindications/Precautions

Contraindicated in: Hypersensitivity to clarithromycin, erythromycin, or other macrolides. Pregnancy (avoid use during pregnancy unless no alternatives are available). Concurrent pimozide.
Use Cautiously in: Severe hepatic or renal impairment (dosage adjustment required if CCr <30 ml/min).

Adverse Reactions/Side Effects

CNS: headache. **CV:** VENTRICULAR ARRHYTHMIAS. **GI:** PSEUDOMEMBRANOUS COLITIS, abdominal pain/discomfort, abnormal taste, diarrhea, dyspepsia, nausea.

Interactions

Drug-Drug: Clarithromycin is an inhibitor of the CYP3A enzyme system. Concurrent use with other agents metabolized by this system can ↑ levels and risk of toxicity. May ↑ risk of arrhythmias with **pimozide**; concurrent use is contraindicated. Similar effects may occur with antiarrhythmics; ECG should be monitored for QTc prolongation and serum levels monitored. May ↑ serum levels and the risk of toxicity from **carbamazepine**, some **benzodiazepines (midazolam, triazolam, alprazolam)**, **cyclosporine**, **buspirone**, **disopyramide**, **ergot alkaloids**, **felodipine**, **omeprazole**, **tacrolimus**, **digoxin**, or **theophylline**. **Ritonavir** ↑ blood levels (↓ clarithromycin dose in patients with CC <60 ml/min). ↑ levels of **HMG-CoA reductase inhibitors** and may ↑ risk of rhabdomyolysis. May ↑ effect of **warfarin** and **sildenafil** (dosage reduction may be warranted). May ↑ or ↓ effects of **zidovudine**. Blood levels are ↑ by **delavirdine** and **fluconazole**. Blood levels may be ↓ by **rifampin** and **rifabutin**.

patient to use soft toothbrush and electric razor and to avoid falls. Caution patient to avoid alcoholic beverages, aspirin, or NSAIDs.
- Patients should avoid vaccinations without advice of health care professional.
- Advise patient to use contraception, although cisplatin may cause infertility.
- Emphasize the need for periodic lab tests to monitor for side effects.

Evaluation/Desired Outcomes
- Decreased size or spread of malignancies. Therapy should not be administered more frequently than every 3–4 wk, and only if lab values are within acceptable parameters and patient is not exhibiting signs of ototoxicity or other serious adverse effects.

Why was this drug prescribed for your patient?

Route/Dosage
PO (Adults): *Pharyngitis/tonsillitis*—250 mg q 12 hr for 10 days; *Acute maxillary sinusitis*—500 mg q 12 hr for 14 days or 1000 mg once daily for 14 days as XL tablets; *Acute exacerbation of chronic bronchitis*—250–500 mg q 12 hr for 7–14 days or 1000 mg once daily for 7 days as XL tablets; *Community-Acquired pneumonia*—250 q 12 hr for 7–14 days or 1000 mg once daily for 7 days as XL tablets; *skin/skin structure infections*—250 mg q 12 hr for 7–14 days; *H.pylori*—500 mg 2–3 times daily with a proton pump inhibitor (lansoprazole or omeprazole) or ranitadine with or without amoxicillin for 10–14 days; *Endocarditis prophylaxis*—500 mg 1 hr before procedure; *MAC prophylaxis/treatment*—500 mg twice daily, for active infection another antimycobacterial is required.
PO (Children): *Most infections*—7.5 mg/kg q 12 hr for 10 days (up to 500 mg/dose for MAC). *Endocarditis prophylaxis*—15 mg/kg 1 hr before procedure.

NURSING IMPLICATIONS

Assessment
- **Infections:** Assess patient for infection (vital signs; appearance of wound, sputum, urine, and stool; WBC) at beginning of and during therapy.
- Obtain specimens for culture and sensitivity before initiating therapy. First dose may be given before receiving results.
- **Ulcers:** Assess patient for epigastric or abdominal pain and frank or occult blood in the stool, emesis, or gastric aspirate.
- ***Lab Test Considerations:*** May rarely cause ↑ serum AST, ALT, and alkaline phosphatase concentrations.
- May occasionally cause ↑ BUN.

Potential Nursing Diagnoses
Risk for infection (Indications, Side Effects)
Deficient knowledge, related to medication regimen (Patient/Family Teaching)
Noncompliance (Patient/Family Teaching)

Implementation
- **PO:** Administer around the clock, without regard to meals. Food slows but does not decrease the extent of absorption.
- Administer XL tablets with food; **do not crush, break, or chew.**
- Shake suspension well before administration. Store suspension at room temperature; do not refrigerate.
- Do not administer within 4 hr of zidovudine.

Patient/Family Teaching
- Instruct patient to take medication around the clock and to finish the drug completely as directed, even if feeling better. Take missed doses as soon as possible, unless it is almost time for next dose. Do not double doses. Advise patient that sharing of this medication may be dangerous.
- Advise patient to report the signs of superinfection (black, furry overgrowth on the tongue, vaginal itching or discharge, loose or foul-smelling stools).
- Instruct patient to notify health care professional if fever and diarrhea develop, especially if stool contains blood, pus, or mucus. Advise patient not to treat diarrhea without consulting health care professional.
- Caution patient taking zidovudine that clarithromycin and zidovudine must be taken at least 4 hr apart.
- Advise patient to notify health care professional if pregnancy is planned or suspected.
- Instruct the patient to notify health care professional if symptoms do not improve within a few days.

Evaluation/Desired Outcomes
- Resolution of the signs and symptoms of infection. Length of time for complete resolution depends on the organism and site of infection.
- Treatment of ulcers.
- Endocarditis prophylaxis.

Why was this drug prescribed for your patient?