FRANCIS J. CURRY
NATIONAL
TUBERCULOSIS
CENTER

Tuberculosis Drug Information Guide

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STATE OF CALIFORNIA

S. Kimberly Belshé, *Secretary*
CALIFORNIA HEALTH &
HUMAN SERVICES AGENCY

Mark B Horton, MD, MSPH, *Director*
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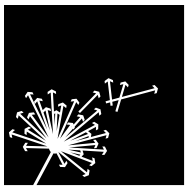

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Introduction

Tuberculosis (TB) is an ancient disease that has caused inestimable suffering and claimed millions of lives over the centuries. Pathologic evidence of TB has been found in Egyptian mummies, and Hippocrates described phthisis (consumption) as the most widespread disease of the times. Some of TB's more famous casualties include Anton Chekov, Frederick Chopin, Robert Louis Stevenson, George Orwell, and Charlotte and Emily Brontë.

It is little wonder that the discovery of effective anti-tuberculosis drugs in the 1940s was hailed as a medical milestone. When resistance to streptomycin was documented shortly after it was introduced as monotherapy for TB in the United States, multidrug regimens soon became the recommended treatment standard in order to prevent the selection of drug-resistant strains.

The World Health Organization (WHO) estimates that each year there are 9 million new TB cases. Approximately 2 billion people (1 in 3 individuals worldwide) are infected with *Mycobacterium tuberculosis*. Annually, TB kills approximately 1.5 million people, making it second only to HIV/AIDS as the leading cause of death from infectious disease. In 2008, 12,904 TB cases of TB (4.2 per 100,000) were reported in the United States.

The correct and effective use of chemotherapy for treating TB and latent tuberculosis infection (LTBI) is an essential component for controlling the disease and preventing the development of drug resistance.

Tuberculosis Drug Information Guide is derived from "Chapter 4: Medication Fact Sheets" in *Drug-Resistant Tuberculosis: A Survival Guide for Clinicians (2nd edition)* produced in 2008 by the Francis J. Curry National Tuberculosis Center (CNTC) and the State of California Department of Public Health, Tuberculosis Control Branch (CDPH). Two additional drugs, ofloxacin and clarithromycin, have been included in this *Guide*. The twenty fact sheets can assist any physician, nurse, or pharmacist who participates in the management of patients with TB or LTBI.

When considering the information presented in this *Guide*, users are advised to consult the policies and protocols of their local jurisdictions.

A word about treating drug-resistant tuberculosis

Hard data are often lacking to assist clinicians in the management of drug-resistant TB. Many of the drugs used to treat drug-resistant TB are not Food and Drug Administration (FDA)-licensed for these indications. Examples include amikacin, all of the fluoroquinolones, and rifabutin. Much-needed research is currently underway to more thoroughly document the clinical efficacies of various treatment regimens for drug-resistant TB and multidrug-resistant (MDR)-TB. Managing drug-resistant TB is extremely challenging, and national guidelines call for treatment of drug-resistant TB to be provided by or in close consultation with experts.

List of Acronyms and Abbreviations

AK	amikacin
ART	antiretroviral therapy
BID	twice a day
CM	capreomycin
CNS	central nervous system
CNTC	Francis J. Curry National Tuberculosis Center
CS	cycloserine
CSF	cerebrospinal fluid
EMB	ethambutol
ETA	ethionamide
FQN	fluoroquinolone
GI	gastrointestinal
HIV	human immunodeficiency virus
IM	intramuscular
INH	isoniazid
IV	intravenous
KM	kanamycin
LFT	liver function test
LFX	levofloxacin
LTBI	latent tuberculosis infection
M. tuberculosis ***M. tb***	*Mycobacterium tuberculosis*
MDR-TB	multidrug-resistant tuberculosis (resistant to at least isoniazid and rifampin)
NPO	nothing by mouth
NS	normal saline

PAS	para-aminosalicylate
PO	by mouth
PR	per rectum
PRN	as needed
PZA	pyrazinamide
qam	every morning
qd	once a day
qhs	every evening
qid	four times a day
QT	the interval from the beginning of the QRS complex to the end of the T wave on an electrocardiogram
QTc	heartrate corrected QT
RFB	rifabutin
RIF	rifampin
RIPE	rifampin, isoniazid, pyrazinamide, ethambutol
SIRE	streptomycin, isoniazid, rifampin, ethambutol
SJS	Stevens Johnson Syndrome
SM	streptomycin
TB	tuberculosis
TID	three times a day
TSH	thyroid-stimulating hormone

AMIKACIN (AK) [1 of 2]

Drug class	Aminoglycoside
Trade name	Amikacin/Amikin
Activity against TB	**Bactericidal;** has strong anti-TB activity. Cross-resistance with kanamycin and some data suggesting cross-resistance with capreomycin.
Dose (all once daily)	**Adults:** 15 mg/kg/day, 5–7 days per week (maximum dose is generally 1 gram, but a large, muscular person could receive more and should have concentrations monitored). 15 mg/kg/dose, 2–3 times per week after initial period of daily administration (some experts use up to 25 mg/kg/dose for intermittent therapy; monitor concentrations). **> 59 yrs of age:** 10 mg/kg/dose (max 750 mg) 5–7 times per week or 2–3 times per week after initial period. **Children:** 15–30 mg/kg/day (max 1 gram) 5–7 days per week. 15–30 mg/kg/day (max 1 gram) 2–3 days per week after initial period daily. **Renal failure/dialysis:** 12–15 mg/kg/dose 2–3 times weekly (not daily). **Markedly obese individuals** should have an adjusted dose due to the decreased distribution of extracellular fluids in adipose tissues. Dosing based on actual weight will give supratherapeutic concentrations. The suggested adjusted weight is ideal body weight plus 40% of the excess weight. Ideal body weight (men): 50 kg plus 2.3 kg/inch over 5 ft Ideal body weight (women): 45 kg plus 2.3 kg/inch over 5 ft *Concentrations should be followed closely.*
Route of administration	IV or IM (intraperitoneal and intrathecal have been reported—penetrates meninges only with inflammation). Some report that it is more painful than IM streptomycin. Not absorbed orally.
Preparation	Colorless solution; 250 mg/ml (2, 3, or 4 ml vials) and 50 mg/ml (2 ml vial). For intravenous solution, mix with D5W or other solutions (in at least 100 ml of fluid for adults or 5 mg/ml for children).
Storage	Solution is stable at room temperature; diluted solution is stable at room temperature at least 3 weeks or in the refrigerator at least 60 days.
Pharmacokinetics	For intravenous administration, infuse over 60 minutes for adults; 1–2 hours for children; intramuscular absorption is complete within 4 hours and peak concentrations are achieved at 1–2 hours. Obtaining a drug concentration 90–120 minutes after intravenous infusion allows for complete distribution of drug. An additional concentration collected 4 hours later will allow for a peak to be extrapolated. **Peak concentrations** for a 15 mg/kg dose are between 35 and 45 mcg/ml. **Peak concentrations** of 25–35 mcg/ml are acceptable if you anticipate using amikacin for more than 6 months. **Peak concentrations** of 65–80 mcg/ml are obtained after a 25 mg/kg dose. Trough concentrations are generally < 5 mcg/ml in patients with normal renal function.

AMIKACIN (AK) [2 of 2]

Oral absorption	There is no significant oral absorption. Intramuscular absorption might be delayed if the same site is used consistently.
CSF penetration	Variable penetration; appears to penetrate inflamed meninges better.
Special circumstances	**Use in pregnancy/breastfeeding:** Generally avoided in pregnancy due to congenital deafness seen with streptomycin and kanamycin. Can be used while breastfeeding. **Use in renal disease:** Use with caution. Concentrations should be monitored for patients with impaired renal function. Interval adjustment is recommended for renal impairment or dialysis. See "Dose – Renal Failure/Dialysis" (previous page). The drug is variably cleared by hemodialysis. **Use in hepatic disease:** Drug concentrations not affected by hepatic disease (except a larger volume of distribution for alcoholic cirrhotic patients with ascites). Presumed to be safe in severe liver disease; however, use with caution—some patients with severe liver disease may progress rapidly to hepato-renal syndrome. **Diuretic use:** Coadministration of loop diuretics and aminoglycoside antibiotics carries an increased risk of ototoxicity.
Adverse reactions	Nephrotoxicity: 9% for general population (may be lower for once-daily use, higher for prolonged use). Ototoxicity (hearing loss): Increased with advanced age and prolonged use. Local pain with IM injections. Vestibular toxicity. Electrolyte abnormalities, including hypokalemia and hypomagnesemia.
Contraindications	**Pregnancy** — relative contraindication (congenital deafness seen with streptomycin and kanamycin use in pregnancy). **Hypersensitivity to aminoglycosides.** **Caution with renal, hepatic, vestibular, or auditory impairment.**
Monitoring	Monitor renal function by documenting creatinine at least monthly (more frequently if renal or hepatic impairment); document creatinine clearance if there is baseline renal impairment or any concerns; document baseline and monthly audiology exam; follow monthly electrolytes, magnesium, and calcium. Question patient regularly about vestibular complaints and perform serial vestibular exams. Document peak and trough concentrations at baseline if there is any question about renal function. Some experts monitor aminoglycoside concentrations routinely, regardless of renal function. Monitor concentrations serially for patients with impaired renal function.
2007 wholesale cost 30-day supply, 75-kg person	$59 (TB clinic) $138 (community hospital)
Patient instructions	**Call your doctor right away if you have:** • Problems with hearing, dizziness, or balance • Rash or swelling of your face • Trouble breathing • Decreased urination • Swelling, pain, or redness at your IV site • Muscle twitching or weakness

AMOXICILLIN/CLAVULANATE [1 of 2]

Drug class	Penicillin/beta-lactam inhibitor
Trade name	Augmentin XR or Augmentin ES-600 suspension
Activity against TB	Conflicting and limited reports, but possible early bactericidal activity.
Dose	**Adults:** 2000 mg as amoxicillin/125 mg clavulanate twice daily. **Children:** 80 mg/kg/day divided twice daily of the amoxicillin component. **Renal failure/dialysis:** For creatinine clearance 10–30 ml/min dose 1000 mg as amoxicillin twice daily; for creatinine clearance < 10 ml/min dose 1000 mg as amoxicillin once daily. **Hemodialysis:** Single dose every 24 hours and after each dialysis session.
Route of administration	Oral. Imipenem/cilastatin should be used if a parenteral beta-lactam drug is desired.
Preparation	For adults: 1000 mg amoxicillin/62.5 mg clavulanate (Augmentin XR) tablets, 2 tablets twice daily; for pediatric dosing: 600 mg/5ml product (Augmentin ES-600). A less expensive equivalent can be achieved by prescribing generic amoxicillin/clavulanate and additional amoxicillin to achieve the same total daily dose of amoxicillin and clavulanate (for adults: 2000 mg amoxicillin and 250 mg clavulanate).
Storage	Tablets are stable at room temperature; reconstituted suspension should be stored in the refrigerator and discarded after 10 days.
Pharmacokinetics	Time to peak oral concentration is 60–90 minutes. **Serum concentrations** of 17 mcg/ml of amoxicillin were reported following a 2000 mg (as amoxicillin) dose.
Oral absorption	Good oral absorption, best tolerated and well absorbed when taken at the start of a standard meal.
CSF penetration	Approximately 5% of the plasma concentration reaches the CSF.
Special circumstances	**Use in pregnancy/breastfeeding:** Probably safe in pregnancy (no known risk); can be used while breastfeeding. **Use in renal disease:** Amoxicillin is renally excreted and the dose should be adjusted for renal failure. It is cleared by dialysis, so should be dosed after dialysis (see above). **Use in hepatic disease:** Clavulanate is cleared by the liver, so care should be used when using in patients with liver failure.
Adverse reactions	Diarrhea and abdominal discomfort are most common. Hypersensitivity. Nausea, vomiting, and rash are also common. Rare side effects have been reported in all other organ systems.
Contraindications	Penicillin allergy; use with caution with cephalosporin allergies.
Monitoring	No specific monitoring is required.

AMOXICILLIN/CLAVULANATE [2 of 2]

2007 wholesale cost 30-day supply, 75-kg person	$241 (TB clinic) $343 (community hospital)
Patient instructions	Take at the beginning of a meal. Store tablets at room temperature; store suspension in the refrigerator—throw away after 10 days and refill the prescription. **Call your doctor right away if you have:** • Rash or swelling • Trouble breathing • Severe diarrhea

CAPREOMYCIN (CM) [1 of 2]

Drug class	Cyclic polypeptide
Trade name	Capastat
Activity against TB	**Bactericidal;** has strong anti-TB activity; inhibits protein synthesis. Some data suggesting cross-resistance with amikacin and kanamycin.
Dose (all once daily)	**Adults:** 15 mg/kg/day, 5–7 days per week (maximum dose is generally 1 gram, but a large, muscular person could receive more and should have concentrations monitored). 15 mg/kg/dose, 2–3 times per week after initial period of daily administration (some experts use up to 25 mg/kg/dose for intermittent therapy; monitor concentrations). **> 59 yrs of age:** 10 mg/kg/dose (max 750 mg) 5–7 times per week or 2–3 times per week after initial period. **Children:** 15–30 mg/kg/day (max 1 gram) 5–7 days per week. 15–30 mg/kg/day (max 1 gram) 2–3 days per week after initial period daily. **Renal failure/dialysis:** 12–15 mg/kg/dose 2–3 times weekly (not daily). **Markedly obese individuals** should have an adjusted dose due to the decreased distribution of extracellular fluids in adipose tissues. Dosing based on actual weight will give supratherapeutic concentrations. The suggested adjusted weight is ideal body weight plus 40% of the excess weight. Ideal body weight (men): 50 kg plus 2.3 kg/inch over 5 ft Ideal body weight (women): 45 kg plus 2.3 kg/inch over 5 ft *Concentrations should be followed closely.*
Route of administration	IV or IM.
Preparation	Capreomycin is available in vials of 1 gram for either IM or IV administration. The contents of the vial should be reconstituted with 2 ml or more of NS or sterile water.
Storage	Package insert indicates that reconstituted capreomycin can be stored in the refrigerator up to 24 hours prior to use. Other data suggest that it may be held for 14 days in the refrigerator or 2 days at room temperature.
Pharmacokinetics	Intramuscular peak concentrations are achieved at 2 hours. Obtaining a drug concentration 90–120 minutes after intravenous infusion allows for complete distribution of drug. An additional concentration collected 4 hours later will allow for a peak to be extrapolated. **Peak concentrations** for a 15 mg/kg dose are between 35 and 45 mcg/ml. **Peak concentrations** of 25–35 mcg/ml are acceptable if you anticipate using capreomycin for more than 6 months. **Peak concentrations** of 65–80 mcg/ml are obtained after a 25 mg/kg dose. Trough concentrations should be < 5 mcg/ml in patients with normal renal function.
Oral absorption	There is no significant oral absorption. Intramuscular absorption might be delayed if the same site is used consistently.

CAPREOMYCIN (CM) [2 of 2]

CSF penetration	There is a paucity of data regarding capreomycin's penetration of the meninges.
Special circumstances	**Use in pregnancy/breastfeeding:** Generally avoided in pregnancy due to congenital deafness seen with streptomycin and kanamycin. There are case reports of its safe use in pregnancy (unaffected newborns). Can be used while breastfeeding. **Use in renal disease:** Use with caution. Concentrations should be monitored for patients with impaired renal function. Interval adjustment is recommended for renal impairment or dialysis. See "Dose – Renal Failure/Dialysis" (previous page). **Use in hepatic disease:** Drug concentrations not affected by hepatic disease (except a larger volume of distribution for alcoholic cirrhotic patients with ascites). Presumed to be safe in severe liver disease; however, use with caution—some patients with severe liver disease may progress rapidly to hepato-renal syndrome.
Adverse reactions	Similar to the aminoglycosides. Nephrotoxicity: 20%–25% including proteinuria, reduced creatinine clearance, and depletion of potassium and magnesium. Ototoxicity (hearing loss): Occurs more often in elderly persons or those with pre-existing renal impairment; vestibular toxicity. Local pain with IM injections. Electrolyte abnormalities, including hypokalemia, hypocalemia, and hypomagnesemia. Liver function test abnormalities when used with other TB drugs.
Contraindications	**Hypersensitivity to capreomycin.** Most experts would not use capreomycin if vestibular side effects resulted from aminoglycoside use. **Generally avoided in pregnancy** due to congenital deafness seen with aminoglycoses. There are case reports of its safe use in pregnancy (unaffected newborns).
Monitoring	Monitor renal function by documenting creatinine at least monthly (more frequently if renal or hepatic impairment); document creatinine clearance if there is baseline renal impairment or any concerns; document baseline and monthly audiology exam; follow monthly electrolytes, magnesium, and calcium. Question patient regularly about vestibular complaints and perform serial vestibular exams. Document peak and trough concentrations at baseline if there is any question about renal function. Some experts monitor capreomycin concentrations routinely, regardless of renal function. Monitor concentrations serially for patients with impaired renal function.
2007 wholesale cost 30-day supply, 75-kg person	$352 (TB clinic) $413 (community hospital)
Patient instructions	**Call your doctor right away if you have:** • Rash • Fever or chills • Bleeding or bruising • Problems with hearing, dizziness, or balance • Bleeding or a lump where the shot is given • Decreased urination • Trouble breathing • Muscle weakness

CLARITHROMYCIN [1 of 2]

Drug class	Macrolide
Trade name	Biaxin
Activity against TB	Much more active against atypical mycobacteria, especially MAC, but some isolates of TB are susceptible *in vitro*. Does not have proven value for the treatment of TB in humans, and *in vitro* data are not particularly encouraging. Inhibits protein synthesis by binding to the 50S ribosomal subunit.
Dose	**Adults:** 500 mg twice daily or 1 gram daily of extended release formulation **Children:** 7.5 mg/kg q 12 hours up to 500 mg **Renal failure/dialysis:** The drug is cleared both hepatically and renally. In severe renal impairment, the interval between doses should be increased, i.e., 500 mg daily.
Route of administration	Oral
Preparation	Oral tablets of 250 and 500 mg. Also available in Extended Release tablets for once daily use. Oral suspension 125 mg/5 ml and 250 mg/5 ml.
Storage	Store tablets and unmixed granules for suspension at room temperature in a well sealed container and protect from light. The mixed suspension should not be refrigerated and can be stored for 14 days.
Pharmacokinetics	**Peak oral absorption** occurs at 2–3 hours after the drug dose. **Peak concentrations** of 3–4 mcg/ml are expected after an oral dose of 500 mg in the nonfasting adult. Because of high intracellular concentrations, tissue levels are higher than in the serum.
Oral absorption	The drug is rapidly absorbed after oral administration and is about 50% bioavailable. It can be given without regard to food. Food slightly delays the peak serum level but also slightly increases the peak concentration achieved.
CSF penetration	There is no information available about CNS penetration
Special circumstances	**Pregnancy/Breastfeeding:** Pregnancy category C and generally should not be used in pregnancy unless no other alternative is available. It is not known if the drug is excreted in human breast milk. **Use in renal disease:** The interval between doses should be increased in severe renal disease. **Use in hepatic disease:** No adjustment is necessary.
Adverse reactions	Diarrhea, nausea, abnormal taste, dyspepsia, abdominal pain/discomfort, headache. **Rare** allergic skin reactions, liver toxicity, QT prolongation, C.diff colitis

CLARITHROMYCIN [2 of 2]

Contraindications	**Patients with known hypersensitivity to macrolide antibiotics.** **Should not be given with the any of the following drugs:** Cisapride, pimozide, astemizole, terfenadine, and ergotamine or dihydroergotamine.
Monitoring	No routine laboratory monitoring is indicated.
2009 wholesale cost 30-day supply, 75-kg person	$7.80 (TB clinic) $19.30 (community hospital)
Patient instructions	This medication may be taken with or without food. Be sure to tell your doctor what other medications you are taking. Do not take cisapride, pimozide, astemizole, terfenadine, and ergotamine or dihydroergotamine when taking clarithromycin. Stop the medication and call your doctor immediately if you develop severe diarrhea.

CLOFAZIMINE [1 of 2]

Drug class	Iminophenazine
Trade name	Lamprene
Activity against TB	*In vitro* activity against *M. tuberculosis* without much *in vivo* data. Generally reserved for cases with few other options.
Dose (all once daily)	**Adults:** 100 to 200 mg daily (oral) have been used. A regimen of 200 mg daily for 2 months, followed by 100 mg daily has been used. **Children:** Limited data, but doses of 1 mg/kg/day have been given. **Renal failure/dialysis:** No adjustment required.
Route of administration	Oral; not available parenterally.
Preparation	50 and 100 mg capsules.
Storage	Room temperature.
Pharmacokinetics	Tissue half-life estimated to be around 70 days. **Peak concentrations** 2–3 hours after a dose are expected to be 0.5–2.0 mcg/ml. **Peak concentrations** occur at 4–8 hours when given with food.
Oral absorption	70% absorption after an oral dose.
CSF penetration	Limited data are available regarding CNS penetration.
Special circumstances	**Use in pregnancy/breastfeeding:** Not recommended due to limited data (some reports of normal outcomes, some reports of neonatal deaths). Avoided with breastfeeding due to pigmentation of the infant. **Use in renal disease:** No dosage adjustment required. **Use in hepatic disease:** Metabolized by the liver; use caution and/or adjust the dose for severe hepatic insufficiency.
Adverse reactions	Pink or red discoloration of skin, conjunctiva, cornea, and body fluids. Gastrointestinal intolerance. Photosensitivity. Other side effects include retinopathy, dry skin, pruritus, rash, and severe abdominal symptoms, bleeding, and bowel obstruction.
Contraindications	**Allergy to clofazimine.**
Monitoring	Symptomatic monitoring.

CLOFAZIMINE [2 of 2]

2007 wholesale cost
30-day supply, 75-kg person

Clofazimine is not commercially available within the United States. Clinicians should contact the FDA's Office of Emergency Operations (301-443-1240) in order to apply for a single patient Investigational New Drug (IND).

Patient instructions

Take with food to avoid stomach upset and improve absorption.

This medicine may discolor your skin and body secretions pink, red, or brownish-black. This should go away after stopping the medicine, but may take a long time. Avoid the sun and use strong sunscreens.

Call your doctor right away if you have:

- Bloody or black stools or diarrhea
- Yellowing of your skin or eyes
- Severe nausea, vomiting, abdominal pain, cramps, or burning
- Depression or thoughts of hurting yourself

CYCLOSERINE (CS) [1 of 2]

Drug class	Analog of D-alanine
Trade name	Seromycin
Activity against TB	**Bacteriostatic;** inhibits cell wall synthesis.
Dose	**Adults:** 10–15 mg/kg/day usually; 250 mg PO twice a day; can increase to 250 mg PO 3 times a day or 250 mg qam and 500 mg PO qhs if peak concentrations are kept below 35 mcg/ml. **Children:** 10–20 mg/kg/day divided every 12 hours (daily maximum 1 gram). **Vitamin B6:** All patients should receive vitamin B6 while taking cycloserine. Adults need 100 mg or more (or 50 mg per 250 mg of cycloserine) and children should receive a dose proportionate to their weight. **Renal failure/dialysis:** 250 mg once daily or 500 mg 3 times per week; monitor drug concentrations to keep peak concentrations < 35 mcg/ml.
Route of administration	Oral; not available parenterally.
Preparation	250 mg capsule.
Storage	Room temperature in airtight containers.
Pharmacokinetics	**Peak oral absorption** usually occurs by 2 hours (may be up to 4 hours). **Peak concentration** should be drawn at 2 hours; if delayed absorption is suspected, a concentration at 6 hours will be helpful. A concentration at 10 hours will allow for calculation of the half-life. Allow 3–4 days of drug administration before drawing concentrations due to the long half-life. **Peak concentrations** are expected to be between 20 and 35 mcg/ml. CNS toxicity is associated with concentrations over 35 mcg/ml, but may occur even at lower concentrations.
Oral absorption	Modestly decreased by food (best to take on an empty stomach); not significantly affected by antacids or orange juice.
CSF penetration	Concentrations approach those in serum.
Special circumstances	**Use in pregnancy/breastfeeding:** Not well studied, but no teratogenicity documented. Use if there are not better choices. Can be used while breastfeeding (dose the infant with vitamin B6 if breastfed). **Use in renal disease:** Cycloserine is cleared by the kidney and requires dose adjustment for renal failure (see above). Use with caution. **Use in hepatic disease:** Not associated with hepatotoxicity. **Ethionamide use:** May have increased toxicity when ethionamide also used.

CYCLOSERINE (CS) [2 of 2]

Adverse reactions	CNS toxicity, including inability to concentrate and lethargy. More serious CNS side effects, including seizure, depression, psychosis, and suicidal ideation, *usually* occur at peak concentrations > 35 mcg/ml, but may be seen in the normal therapeutic range. Other side effects include peripheral neuropathy and skin changes. Skin problems include lichenoid eruptions and Stevens-Johnson syndrome.
Contraindications	**Significant CNS disease,** including seizure disorder, psychotic disease, or alcohol abuse.
Monitoring	Peak concentrations should be obtained within the first 1–2 weeks of therapy and monitored serially during therapy. The peak concentration should be kept below 35 mcg/ml. The dose is generally increased if the peak is less than 15 mcg/ml, and the dose is decreased if the peak is above 40 mcg/ml. If the dose is adjusted, repeat the peak concentration after at least 3–4 days.
2007 wholesale cost 30-day supply, 75-kg person	$375; cycloserine is available through the Chao Center at Purdue University (877-930-CHAO).
Patient instructions	Best taken on an empty stomach, with juice or antacids. If food is taken, avoid a large fatty meal. Avoid alcohol. You must also take a high-dose vitamin B6 supplement while on this drug. **Call your doctor right away if you have:** • Seizures • Shakiness or trouble talking • Depression or thoughts of hurting yourself • Anxiety, confusion, or loss of memory • Personality changes, such as aggressive behavior • Rash or hives • Headache

ETHAMBUTOL (EMB) [1 of 2]

Drug class	Unspecified
Trade name	Myambutol
Activity against TB	**Bacteriostatic** inhibitor of cell wall synthesis; bactericidal only at the high end of the dosing range. At doses used over long periods of time, ethambutol protects against further development of resistance.
Dose (all once daily)	**Adults:** 15–25 mg/kg/day. Higher doses should be used only during the initial months of therapy. For prolonged therapy, the dose should be closer to 15 mg/kg/day to avoid toxicity. **Children:** 15–25 mg/kg/day; doses closer to 15 mg/kg/day should be used if the drug is used for more than 2 months. **Renal failure/dialysis:** 15–25 mg/kg/dose 3 times weekly (not daily). **Obesity:** Ethambutol should be dosed on lean body weight. Ideal body weight (men): 50 kg plus 2.3 kg/inch over 5 ft Ideal body weight (women): 45 kg plus 2.3 kg/inch over 5 ft
Route of administration	Oral; not available parenterally.
Preparation	100 mg tablets; scored 400 mg tablets; coated 100 mg tablets; coated, scored 400 mg tablets.
Storage	Room temperature.
Pharmacokinetics	**Peak oral absorption** occurs 2–4 hours after the dose. Draw a peak serum concentration 2–3 hours after the dose; a second sample 6 hours post-dose could be obtained if there is concern about late absorption and in order to estimate the serum half-life. **Peak concentrations** of 2–6 mcg/ml are expected.
Oral absorption	80% bioavailability independent of food.
CSF penetration	Ethambutol penetrates meninges poorly.
Special circumstances	**Use in pregnancy/breastfeeding:** Safe in pregnancy; can be used while breastfeeding. **Use in renal disease:** Use with caution—cleared by the kidneys; dose adjustment required for renal failure. Increased risk of toxicity with renal failure. If needed for use in the regimen, consider therapeutic drug monitoring. **Use in hepatic disease:** Safe in liver disease.
Adverse reactions	Retrobulbar neuritis (dose-related—exacerbated during renal failure).
Contraindications	**Pre-existing optic neuritis; visual changes on ethambutol.**

ETHAMBUTOL (EMB) [2 of 2]

Monitoring	Patients should be counseled to report any changes in vision. Baseline and monthly visual acuity and color discrimination monitoring should be performed (particular attention should be given to individuals on higher doses or with renal impairment).
2007 wholesale cost 30-day supply, 75-kg person	$64 (TB clinic) $77 (community hospital)
Patient instructions	Can be taken with food or on an empty stomach. **Call your doctor right away if you have:** • Any problems with your eyes: vision changes, blurring, color blindness, trouble seeing, or eye pain • Swelling of face • Rash, hives, or trouble breathing • Numbness, pain, or tingling in hands or feet • Joint pain • Fever or chills • Nausea, vomiting, poor appetite, or abdominal pain • Headache or dizziness

ETHIONAMIDE (ETA) [1 of 2]

Drug class	Derivative of isonicotinic acid
Trade name	Trecator-SC
Activity against TB	Weakly bactericidal; blocks mycolic acid synthesis.
Dose	**Adults:** 15–20 mg/kg/day frequently divided (max dose 1 gram per day); usually 500–750 mg per day in 2 divided doses or a single daily dose. **Children:** 15–20 mg/kg/day usually divided into 2–3 doses (max dose 1 gram per day). A single daily dose can sometimes be given at bedtime or with the main meal. Many individuals require gradual ramping up of the dose and treatment for GI upset. **Vitamin B6:** All patients should receive vitamin B6 while taking ethionamide. Adults need 100 mg (more if also taking cycloserine) and children should receive a dose proportionate to their weight. **Renal failure/dialysis:** No change.
Route of administration	Oral; not available parenterally.
Preparation	Coated 250 mg tablet.
Storage	Store at room temperature.
Pharmacokinetics	**Peak oral absorption** is usually reached in 2–3 hours, but delayed absorption is common; peak concentrations should be drawn at 2 hours. **Peak concentrations** are typically 1–5 mcg/ml.
Oral absorption	Erratic absorption, possibly due to GI disturbances associated with the medication.
CSF penetration	Concentrations approach those in serum; one pediatric study evaluating drug concentrations in the CSF suggests that ethionamide should be dosed on the high end of the range for patients with meningitis.
Special circumstances	**Use in pregnancy/breastfeeding:** Generally avoided during pregnancy due to reports of teratogenicity; little data about use during breastfeeding—an estimated 20% of a usual therapeutic dose is thought be received (dose the infant with vitamin B6 if breastfed). **Use in renal disease:** No precautions are required for renal impairment. **Use in hepatic disease:** Can cause hepatotoxicity similar to that of INH—use with caution in liver disease.
Adverse reactions	Gastrointestinal upset and anorexia: Sometimes intolerable (symptoms are moderated by food or taking at bedtime). Metallic taste. Hepatotoxicity. Endocrine effects: Gynecomastia, hair loss, acne, impotence, menstrual irregularity, and reversible hypothyroidism—treat with thyroid replacement. Neurotoxicity (patients taking ethionamide should take high doses of vitamin B6). Side effects may be exaggerated in patients also taking cycloserine.

ETHIONAMIDE (ETA) [2 of 2]

Contraindications	**Sensitivity to ethionamide.**
Monitoring	Monitor TSH for evidence of hypothyroidism requiring replacement; therapeutic drug monitoring if malabsorption suspected. Monitor liver function tests.
2007 wholesale cost 30-day supply, 75-kg person	$188 (TB clinic) $264 (community hospital)
Patient instructions	Take this medicine with food. You must also take a high-dose vitamin B6 supplement while on this drug. **Call your doctor right away if you have:** • Any problems with your eyes: eye pain, blurred vision, color blindness, or trouble seeing • Numbness, tingling, or pain in your hands or feet • Unusual bruising or bleeding • Personality changes such as depression, confusion, or aggression • Yellowing of your skin or eyes • Dark-colored urine • Nausea and vomiting • Dizziness • Swollen breasts (in men)

IMIPENEM/CILASTATIN [1 of 2]

Drug class	Beta-lactam – carbapenem
Trade name	Primaxin
Activity against TB	*In vitro* activity—very limited clinical experience.
Dose	**Adults:** 1000 mg IV every 12 hours. **Children:** Meropenem preferred: 20–40 mg/kg/dose IV every 8 hours up to 2 grams per dose. **Renal failure/dialysis:** Adjustment in dose and interval based on severity of renal failure and body weight—for example, 500 mg every 8 hours for creatinine clearance 20–40 ml/min, 500 mg every 12 hours for creatinine clearance < 20 ml/min.
Route of administration	IV or IM (total IM doses are not recommended more than 1.5 gram/day and are therefore not very practical for treatment of drug-resistant TB). No oral preparation.
Preparation	Lypholized powder 1:1 ratio of imipenem and cilastatin. Vials are available 250, 500, 750 mg, or 1 gram.
Storage	Powder should be kept at room temperature; suspended product should be kept no more than 4 hours at room temperature or no more than 24 hours refrigerated.
Pharmacokinetics	**Peak concentrations** occur immediately after IV infusion and 1 hour after IM infusion. **Peak concentrations** of 35–60 mcg/ml occur after infusion of 1 gram.
Oral absorption	No oral absorption.
CSF penetration	Good CSF penetration, but children with meningitis treated with imipenem had high rates of seizures (meropenem preferred for meningitis and for children).
Special circumstances	**Use in pregnancy/breastfeeding:** Little information known regarding use in pregnancy; unknown safety during breastfeeding. **Use in renal disease:** Dose adjustment required (see above); dose after dialysis. **Use in hepatic disease:** Elevated liver function tests have been noted in up to 6% of patients, but no definite liver damage has been documented.
Adverse reactions	Diarrhea, nausea, or vomiting. Seizure (noted with CNS infection).
Contraindications	**Carbapenem intolerance; meningitis** (use meropenem rather than imipenem).
Monitoring	Symptomatic monitoring.
2007 wholesale cost 30-day supply, 75-kg person	$1655 (TB clinic) $3795 (community hospital)

IMIPENEM/CILASTATIN [2 of 2]

Patient instructions

Make sure your doctor knows if you are also taking ganciclovir or have allergy to penicillins or cephalosporins.

Call your doctor right away if you have:

- Fast or irregular heartbeat
- Seizures
- Severe diarrhea (watery or bloody)
- Skin rash, hives, or itching
- Swelling in the face, throat, or lips
- Wheezing or trouble breathing

ISONIAZID (INH) [1 of 2]

Drug class	Isonicotinic acid hydrazide
Trade name	INH/Isoniazid/Laniazid/Nydrazid
Activity against TB	**Bactericidal,** especially for rapidly dividing cells. Affects mycolic acid (cell wall) synthesis.
Dose (all once daily)	**Adults:** 5 mg/kg/day (PO or IV) usual adult dose 300 mg daily; high dose INH (900 to 1500 mg twice or thrice weekly) is sometimes used, especially for patients with low-level INH resistance. **Children:** 10–15 mg/kg/day up to 300 mg (PO or IV); 20–30 mg/kg/dose twice or thrice weekly. **Renal failure/dialysis:** 300 mg once daily or 900 mg thrice weekly. **Vitamin B6** should be used when high-dose INH employed and in patients with diabetes, uremia, HIV infection, alcohol abuse, malnutrition, or peripheral neuropathy. Additionally, pregnant and post-partum women and exclusively breastfeeding infants should receive vitamin B6 while taking INH.
Route of administration	Oral, intravenous, or intramuscular.
Preparation	50 mg, 100 mg, or 300 mg scored or unscored tablets; 50 mg/5 ml oral suspension in sorbitol; solution for injection 100 mg/ml.
Storage	Suspension must be kept at room temperature.
Pharmacokinetics	**Peak serum concentrations** are achieved at 1–2 hours after the oral dose. **Peak concentrations** should be drawn at 1 and 4 hours; if other drug concentrations are being submitted, collect blood for peak serum concentrations 2 hours after a dose (and if desired at 6 hours after a dose in order to calculate half-life). **Peak concentration** is expected to be 3–5 mcg/ml after daily dose and 9–15 mcg/ml after twice weekly dose.
Oral absorption	Well absorbed orally or intramuscularly; best absorbed on an empty stomach; up to 50% reduction in peak concentration with a fatty meal.
CSF penetration	Concentration equivalent to plasma in inflamed meninges. 20% of concentrations in plasma in non-inflamed meninges.
Special circumstances	**Use in pregnancy/breastfeeding:** Safe during pregnancy; safe during breastfeeding (both baby and mother should receive pyridoxine supplementation). Up to 20% of the infant therapeutic dose will be passed to the baby in the breast milk. **Use in renal disease:** No dose adjustment for renal failure, but pyridoxine supplementation should be used. **Use in hepatic disease:** May exacerbate liver failure. Use with caution. **Seizure medication:** Serum concentrations of phenytoin may be increased in persons taking INH. Inclusion of INH in the regimen of patients with strain W MDR-TB was also associated with improved outcomes.

ISONIAZID (INH) [2 of 2]

Adverse reactions	Hepatitis (age-related). Peripheral neuropathy. Hypersensitivity reactions. Other reactions, including optic neuritis, arthralgias, CNS changes, drug-induced lupus, diarrhea, and cramping with liquid product.
Contraindications	**Patients with high-level INH resistance** who have failed an INH-containing regimen should not receive INH.
Monitoring	**Clinical monitoring of all patients on INH is essential.** Routine laboratory monitoring is not recommended for patients receiving INH monotherapy. For patients receiving multiple TB drugs or other hepatotoxic drugs, or with underlying liver disease (including viral hepatitis), baseline liver function testing is recommended. Follow-up liver function testing is determined by baseline concerns and symptoms of hepatotoxicity. Therapeutic drug monitoring is recommended only for patients suspected of having malabsorption or treatment failure. Monitor concentrations of phenytoin or carbamazepine in patients receiving those drugs (increases phenytoin concentrations and risk of hepatotoxicity with carbamazepine), especially when undergoing INH monotherapy. Rifampin tends to lower concentrations of these drugs and balance effect of INH.
2007 wholesale cost 30-day supply, 75-kg person	$1 (TB clinic) $3 (community hospital)
Patient instructions	Do not take this medication with a large fatty meal. If you have an upset stomach, take the medicine with a snack. If you (or your child) are taking the liquid suspension—do not put it in the refrigerator. Avoid alcohol while taking this medicine. If you need an antacid, don't take it within an hour of this medicine. Make sure your doctor knows if you are also taking medicine for seizures. Let your doctor know if you get flushing, sweating, or headaches when eating certain cheeses or fish. Ask your doctor if you should be taking a vitamin B6 (pyridoxine supplement). **Call your doctor right away if you have any of these side effects:** • Loss of appetite for a few days that is not going away • Tiredness, weakness • Moderate stomach pain, nausea, or vomiting • Numbness or tingling of your fingers or toes • Blurred vision, eye pain • Yellow skin or eyes or dark-colored urine

KANAMYCIN (KM) [1 of 2]

Drug class	Aminoglycoside
Trade name	Kantrex
Activity against TB	**Bactericidal;** has strong anti-TB activity. Cross-resistance with amikacin and some data suggesting cross-resistance with capreomycin; inhibits protein synthesis.
Dose (all once daily)	**Adults:** 15 mg/kg/day, 5–7 days per week (maximum dose is generally 1 gram, but a large, muscular person could receive more and should have concentrations monitored). 15 mg/kg/dose, 2–3 times per week after initial period of daily administration (some experts use up to 25 mg/kg/dose for intermittent therapy; monitor concentrations). **> 59 yrs of age:** 10 mg/kg/dose (max 750 mg) 5–7 times per week or 2–3 times per week after initial period. **Children:** 15–30 mg/kg/day (max 1 gram) 5–7 days per week. 15–30 mg/kg/day (max 1 gram) 2–3 days per week after initial period daily. **Renal failure/dialysis:** 12–15 mg/kg/dose 2–3 times weekly (not daily). **Markedly obese individuals** should have an adjusted dose due to the decreased distribution of extracellular fluids in adipose tissues. Dosing based on actual weight will give supratherapeutic concentrations. The suggested adjusted weight is ideal body weight plus 40% of the excess weight. Ideal body weight (men): 50 kg plus 2.3 kg/inch over 5 ft Ideal body weight (women): 45 kg plus 2.3 kg/inch over 5 ft Concentrations should be followed closely.
Route of administration	Intravenous or intramuscular; not absorbed orally.
Preparation	Clear colorless solution stable at room temperature; 250 mg/ml in vials of 500 mg or 1 gram; 1 gram in 3 ml vial; or 75 mg/vial for infants. Can be mixed with D5W or normal saline for intravenous infusion. Adult doses should be mixed in at least 100 ml of fluid, and pediatric doses should be mixed to a concentration of at least 5 mg/ml.
Storage	Store in the refrigerator.
Pharmacokinetics	For intravenous administration, infuse over 60 minutes for adults; 1–2 hours for children; intramuscular absorption is complete within 4 hours and peak concentrations are achieved at 1–2 hours. Obtaining a drug concentration 90–120 minutes after intravenous infusion allows for complete distribution of drug. An additional concentration collected 4 hours later will allow for a peak to be extrapolated. **Peak concentrations** for a 15 mg/kg dose are between 35 and 45 mcg/ml. **Peak concentrations** of 25–35 mcg/ml are acceptable if you anticipate using kanamycin for more than 6 months. **Peak concentrations** of 65–80 mcg/ml are obtained after a 25 mg/kg dose. Trough concentrations should be undetectable after a 24-hour dose.
Oral absorption	Not absorbed orally; 40–80% of the dose is absorbed intramuscularly.

KANAMYCIN (KM) [2 of 2]

CSF penetration	Minimal and variable CSF penetration—slightly better with inflamed meninges.
Special circumstances	**Use in pregnancy/breastfeeding:** Generally avoided in pregnancy due to documented congenital deafness. Can be used while breastfeeding. **Use in renal disease:** Use with caution. Concentrations should be monitored for patients with impaired renal function. Interval adjustment is recommended for renal impairment or dialysis. See "Dose – Renal Failure/Dialysis" (previous page). The drug is variably cleared by hemodialysis. **Use in hepatic disease:** Drug concentrations not affected by hepatic disease (except a larger volume of distribution for alcoholic cirrhotic patients with ascites). Presumed to be safe in severe liver disease; however, use with caution—some patients with severe liver disease may progress rapidly to hepato-renal syndrome. **Diuretic use:** Coadministration of loop diuretics and aminoglycoside antibiotics carries an increased risk of ototoxicity.
Adverse reactions	Nephrotoxicity: Appears to be more nephrotoxic than streptomycin. Ototoxicity (hearing loss) and vestibular toxicity: Increased with advanced age and prolonged use; appears to occur slightly more commonly with kanamycin than with streptomycin and about the same frequency as amikacin. Kanamycin seems to have slightly less vestibular toxicity.
Contraindications	**Pregnancy** (congenital deafness seen with streptomycin and kanamycin use in pregnancy); **hypersensitivity to aminoglycosides;** caution with renal, vestibular, or auditory impairment; patients with intestinal obstructions.
Monitoring	Monitor renal function by documenting creatinine at least monthly (more frequently if renal or hepatic impairment); document creatinine clearance if there is baseline renal impairment or any concerns; document baseline and monthly audiology exam. Question patient regularly about vestibular complaints and perform serial vestibular exams. Document peak and trough concentrations at baseline if there is any question about renal function. Some experts monitor aminoglycoside concentrations routinely, regardless of renal function. Monitor concentrations serially for patients with impaired renal function.
2007 wholesale cost 30-day supply, 75-kg person	$129 (TB clinic) $151 (community hospital)
Patient instructions	**Call your doctor right away if you have:** • Problems with hearing, dizziness, or balance • Rash or swelling of your face • Trouble breathing • Decreased urination • Watery or bloody diarrhea • Swelling, pain, or redness at your IV site • Muscle twitching or weakness

LEVOFLOXACIN (LFX) [1 of 2]

Drug class	Fluoroquinolone (FQN)
Trade name	Levaquin
Activity against TB	**Bactericidal;** has strong anti-TB activity. Cross-resistance with other fluoroquinolones, but data suggests greater activity than ciprofloxacin or ofloxacin. Inhibits DNA gyrase.
Dose (all once daily)	**Adults:** For treatment of TB disease: 500–1000 mg/day (PO or IV). Usually at least 750 mg/day is used and the dose can be increased to 1000 mg if tolerated. For contacts to MDR-TB: 500 mg/day if ≤ 45.5 kg (100 lbs); 750 mg/day if > 45.5 kg (100 lbs). **Children:** 10 mg/kg/day for older children and 15–20 mg/kg/day divided bid for younger children (PO or IV) based on limited data and extrapolation from adult data. **Renal failure/dialysis:** 750–1000 mg/dose 3 times weekly (not daily).
Route of administration	Oral or intravenous.
Preparation	Coated tablets (250 mg, 500 mg, 750 mg); solution for injection 25 mg/ml; 250 mg in 50 ml container; 500 mg in 100 ml container; 750 mg in 150 ml container. Oral suspension is 25 mg/ml.
Storage	Oral forms, undiluted solution, and pre-mixed solutions are stored at room temperature. Once diluted, the solution can be kept at room temperature for 3 days, in the refrigerator for 2 weeks, or frozen for 6 months.
Pharmacokinetics	**Peak oral absorption** occurs at 1–2 hours. **Peak concentrations** should be drawn at 2 hours after the dose, and a trough 6–10 hours after the dose allows for calculation of the half-life. **Peak concentrations** of 8–12 mcg/ml are expected.
Oral absorption	Excellent oral absorption. Should not be administered within 2 hours of ingestion of milk-based products, antacids, or other medications containing divalent cations (iron, magnesium, calcium, zinc, vitamins, didanosine, sucralfate).
CSF penetration	Concentrations are 16–20% of that in the serum.
Special circumstances	**Use in pregnancy/breastfeeding:** Fluoroquinolones are generally avoided in pregnancy and breastfeeding due to observation of arthropathy in puppy models. However, there are a few case reports of fluoroquinolones being used safely in pregnancy. **Use in renal disease:** Dosage adjustment is recommended if creatinine clearance is < 50 ml/min. The drug is not cleared by hemodialysis; supplemental doses after dialysis are not necessary. **Use in hepatic disease:** Drug concentrations not affected by hepatic disease. Presumed to be safe in severe liver disease.

LEVOFLOXACIN (LFX) [2 of 2]

Adverse reactions	Nausea and bloating. Headache, dizziness, insomnia, or tremulousness. **Rare** tendon rupture, arthralgias (can usually be treated symptomatically). QTc prolongation.
Contraindications	**Fluoroquinolone intolerance, prolonged QTc, pregnancy (relative contraindication)**
Monitoring	Side effect monitoring, but no specific laboratory monitoring required.
2007 wholesale cost 30-day supply, 75-kg person	$144 (TB clinic) $598 (community hospital)
Patient instructions	Avoid caffeinated foods and beverages while taking this medicine; you can take levofloxacin with food. Drink plenty of beverages. Do not take milk-based products, antacids (especially aluminum-containing), or multivitamins within 2 hours of this medication. This medicine may cause sun sensitivity; use sunscreens. Do not undertake new strenuous activities. **Call your doctor and stop the medicine right away if you have:** • Pain, swelling or tearing of a tendon (such as the back of your ankle, elbow, etc.), or muscle or joint pain • Rashes, hives, bruising or blistering, trouble breathing, or tightness in your chest • Diarrhea • Yellow skin or eyes • Anxiety, confusion, or dizziness

LINEZOLID [1 of 2]

Drug class	Oxazolidinones
Trade name	Zyvox
Activity against TB	Has *in vitro* bactericidal activity—little clinical experience; inhibits protein synthesis.
Dose	**Adults:** 600 mg once daily. **Children:** 10 mg/kg/dose every 8 hours. **Vitamin B6:** All patients should receive vitamin B6 while receiving linezolid. **Renal failure/dialysis:** No dose adjustment required.
Route of administration	Oral or intravenous.
Preparation	Coated tablets: 400 and 600 mg; intravenous solution: 2 mg/ml: 100, 200, or 300 mg bags. Oral powder for suspension: 100 mg/5 ml 240 ml bottle.
Storage	Store tablet at room temperature. Reconstituted oral suspension may be stored at room temperature for 21 days. Parenteral preparation should be stored at room temperature (protect from light and do not freeze).
Pharmacokinetics	Intravenous doses are administered over 30–120 minutes. **Peak concentrations** are achieved 1–1.5 hours after an oral dose and ½ hour after an IV dose. **Peak concentrations** should be drawn 2 hours after an oral dose or after the end of an IV infusion. A 6-hour post dose concentration can be used to calculate half-life. **Peak concentrations** are expected to be 12–24 mcg/ml.
Oral absorption	Nearly complete oral absorption.
CSF penetration	CSF concentrations are about 1/3 of those in serum in animal models and has been used to treat meningitis in humans.
Special circumstances	**Use in pregnancy/breastfeeding:** Not recommended during pregnancy or breastfeeding due to limited data. **Use in renal disease:** No dose adjustment is recommended, but metabolites may accumulate. **Use in hepatic disease:** Rarely associated with increased transaminases.
Adverse reactions	Myelosuppression. Diarrhea and nausea. Optic and peripheral neuropathy.
Contraindications	**Hypersensitivity to oxazolidinones.** **Symptoms of neuropathy** (pain, numbness, tingling or weakness in the extremities).

LINEZOLID [2 of 2]

Monitoring	Monitor for peripheral neuropathy and optic neuritis. Monitor CBC weekly during the initial period, then monthly, and then as needed based on symptoms; there is little clinical experience with prolonged use.
2007 wholesale cost 30-day supply, 75-kg person	$1183 (TB clinic) $1909 (community hospital)
Patient instructions	This medicine may be taken with or without food. Try taking it with food if it bothers your stomach. Avoid food and drinks that contain tyramine: aged cheeses, dried meats, sauerkraut, soy sauce, tap beers, and red wines. Make sure your doctor knows if you're taking medicines for colds, congestion, or depression. **Call your doctor right away if you have any of these side effects:** • Pain, numbness, tingling or weakness in the extremities • Black, tarry stools or severe diarrhea • Unusual bleeding or bruising • Unusual tiredness or weakness • Headache, nausea, or vomiting

MOXIFLOXACIN [1 of 2]

Drug class	Fluoroquinolone (FQN)
Trade name	Avelox
Activity against TB	**Bactericidal;** inhibits DNA gyrase; cross-resistance with other fluoroquinolones, but may be more active based on *in vitro* data.
Dose (all once daily)	**Adults:** 400 mg daily (PO or IV). **Children:** No established dose. **Renal failure/dialysis:** No dose adjustment required.
Route of administration	Oral or IV.
Preparation	Tablets (400 mg); aqueous solution (400 mg/250 ml) for IV injection.
Storage	Store oral and IV products at room temperature (do not refrigerate).
Pharmacokinetics	**Peak absorption** after an oral dose is noted in 1–3 hours. **Peak concentrations** should be drawn at 2 hours. A 6-hour concentration can be drawn to calculate half-life. **Peak concentrations** are expected to be 3-4 mcg/ml after a 10-day course. Trough concentrations of 0.3–0.5 mcg/ml were noted.
Oral absorption	Good oral absorption (90% bioavailable). Should not be administered within 2 hours of ingestion of milk-based products, antacids, or other medications containing divalent cations (iron, magnesium, calcium, zinc, vitamins, didanosine, sucralfate).
CSF penetration	Good penetration in animal model studies.
Special circumstances	**Use in pregnancy/breastfeeding:** Fluoroquinolones are generally avoided in pregnancy and breastfeeding due to observation of arthropathy in puppy models. However, there are a few case reports of fluoroquinolones being used safely in pregnancy. **Use in renal disease:** Excretion unchanged in the face of renal failure; no data on effect of dialysis. **Use in hepatic disease:** Rarely associated with hepatotoxicity; use with caution. No dose adjustment required for mild or moderate liver disease.
Adverse reactions	Nausea and diarrhea. Headache and dizziness. **Rare** tendon rupture; arthralgias. Rare hepatotoxicity. QTc prolongation.
Contraindications	Fluoroquinolone intolerance, prolonged QTc, pregnancy (relative contraindication).

MOXIFLOXACIN [2 of 2]

Monitoring	Symptomatic monitoring.
2007 wholesale cost 30-day supply, 75-kg person	$127 (TB clinic) $76 (community hospital)
Patient instructions	Keep moxifloxacin at room temperature. Moxifloxacin can be taken with food, but do not take milk-based products, antacids (especially aluminum-coating), vitamin supplements, or sucralfate within 2 hours of this medication. Do not undertake new strenuous activities. **Call your doctor and stop the medicine right away if you have:** • Pain, swelling or tearing of a tendon (such as the back of your ankle, elbow, etc.), or muscle or joint pain • Rashes, hives, bruising or blistering, trouble breathing, or tightness in your chest • Diarrhea • Yellow skin or eyes • Anxiety, confusion, or dizziness

OFLOXACIN [1 of 2]

Drug class	Fluoroquinolone
Trade name	Floxin
Activity against TB	**Bactericidal;** Cross-resistance with other quinolones, but data suggests less activity and less favorable outcomes than levofloxacin or moxifloxacin. Should be used only if these agents are not available. Inhibits DNA gyrase.
Dose	**Adults:** 400 mg twice daily. Some series have used 600 mg once daily. **Children:** 10 mg/kg in 2 divided doses, up to 400 mg twice daily. **Renal failure/dialysis:** 400 mg daily or 600 mg three times weekly.
Route of administration	Oral
Preparation	Tablets (200 mg, 300 mg, 400 mg).
Storage	Store at room temperature. Protect from light.
Pharmacokinetics	**Peak oral absorption** occurs at 1–2 hours. **Peak concentrations** of 2.5–4 mcg/ml are expected
Oral absorption	Excellent
CSF penetration	Not well studied. Much lower than in serum.
Special circumstances	**Use in pregnancy/breastfeeding:** Fluoroquinolones are generally avoided in pregnancy and breastfeeding due to observation of arthropathy in puppy models. However, there are a few case reports of fluoroquinolones being used safely in pregnancy. **Use in renal disease:** Dosage adjustment is recommended if creatinine clearance is < 50ml/min. The drug is not cleared by hemodialysis: supplemental doses after dialysis are not necessary. **Use in hepatic disease:** Drug concentrations not affected by hepatic disease. Presumed to be safe in severe liver disease.
Adverse reactions	Nausea and bloating. Headache, dizziness, insomnia, or tremulousness. **Rare** tendon rupture, arthralgias (can usually be treated symptomatically). QTc prolongation.
Contraindications	Fluoroquinolone intolerance, prolonged QTc, pregnancy (relative contraindication).
Monitoring	No specific laboratory monitoring required.

OFLOXACIN [2 of 2]

2009 wholesale cost 30-day supply, 75-kg person	$52.20 (TB clinic) $145.20 (community hospital)

Patient instructions

Can be taken with food. Drink plenty of fluids. Do not take milk-based products, antacids, or multivitamins within 2 hours of this medication. May cause sun sensitivity; use sunscreens. Do not undertake new strenuous activities.

Call your doctor and stop the medicine right away if you have:

- Pain, swelling or tearing of a tendon (such as the back of your ankle, elbow, etc.), or muscle or joint pain
- Rashes, hives, bruising or blistering, trouble breathing, or tightness in your chest
- Diarrhea
- Yellow skin or eyes
- Anxiety, confusion, or dizziness

PARA-AMINOSALICYLATE (PAS) [1 of 2]

Drug class	Salicylic acid – anti-folate
Trade name	PASER
Activity against TB	**Bacteriostatic.**
Dose	**Adults:** 8–12 grams per day divided 2–3 times per day. **Children:** 200–300 mg/kg/day divided 2–4 times per day. **Renal failure/dialysis:** No change.
Route of administration	Oral; not available parenterally in the U.S.
Preparation	4 grams per packet.
Storage	Packets should be kept in the refrigerator or freezer.
Pharmacokinetics	Delayed peak concentration with the PASER formulation (the only product available in the United States) due to its enteric coating and sustained release (1–6 hours). **Peak concentrations** should be collected at 6 hours. **Peak concentrations** are expected to be 20–60 mcg/ml.
Oral absorption	Incomplete absorption—sometimes requires increased doses to achieve therapeutic concentrations.
CSF penetration	Poorly penetrates the meninges (somewhat better with inflammation).
Special circumstances	**Use in pregnancy/breastfeeding:** Not studied, but no teratogenicity known. There is little data regarding use during breastfeeding. In one patient, the milk concentration was 1 mcg/ml compared to a serum concentration of 70 mcg/ml. **Use in renal disease:** Inactive metabolite is cleared by the kidneys. The package insert says to avoid with severe renal failure. Other authorities believe it can be used with caution (no toxicity of metabolite known). **Use in hepatic disease:** Use with caution; 0.5% incidence of hepatotoxicity.
Adverse reactions	Gastrointestinal distress (less with the PASER formulation than with older preparations). Rare hepatotoxicity and coagulopathy. Reversible hypothyroidism (increased risk with concomitant use of ethionamide)—treat with thyroid replacement.
Contraindications	**Pregnancy (relative)**
Monitoring	Monitor TSH, electrolytes, blood counts, and liver function tests.

PARA-AMINOSALICYLATE (PAS) [2 of 2]

2007 wholesale cost 30-day supply, 75-kg person	$262 (TB clinic) $581 (community hospital)

Patient instructions

Keep the product in the refrigerator or freezer. Sprinkle granules over applesauce or yogurt or swirl in acidic juices (tomato, grape, grapefruit, cranberry, apple, or orange). Do not chew the granules. Take with food if desired. Do not use the packet if expanded or if the granules are discolored. Gastrointestinal discomfort and diarrhea usually improve over time. The shells of the granules may be seen in the stool—this is normal.

Call your doctor right away if you have any of these side effects:

- Skin rash, severe itching, or hives
- Severe abdominal pain, nausea, or vomiting
- Unusual tiredness or loss of appetite
- Black stools or bleeding

PYRAZINAMIDE (PZA) [1 of 2]

Drug class	Synthetic derivative of nicotinamide
Trade name	Pyrazinamide
Activity against TB	**Bactericidal** for semi-dormant *M. tuberculosis*. Mechanism unclear.
Dose (all once daily)	**Adults:** 25 mg/kg/day (max dose 2 grams). **Children:** 20–40 mg/kg/dose. **Renal failure/dialysis:** 25 mg/kg/dose 3 times per week (not daily). **Obesity:** Pyrazinamide should be dosed on lean body weight. Ideal body weight (men): 50 kg plus 2.3 kg/inch over 5 ft Ideal body weight (women): 45 kg plus 2.3 kg/inch over 5 ft
Route of administration	Oral; not available parenterally.
Preparation	500 mg scored or unscored tablet.
Storage	Store the tablets at room temperature.
Pharmacokinetics	**Peak concentration** is 1–4 hours after an oral dose. **Peak concentrations** should be drawn at 2 and 6 hours for therapeutic drug monitoring. **Peak concentrations** of 20–40 mcg/ml are expected after a daily dose. Pyrazinamide can be found in the urine all day long and can be an indication of adherence to therapy.
Oral absorption	Well absorbed from the GI tract.
CSF penetration	Concentrations equivalent to serum.
Special circumstances	**Use in pregnancy/breastfeeding:** In the United States, pyrazinamide is avoided in pregnancy for drug-susceptible disease due to lack of data regarding teratogenicity, but should be used for drug-resistant TB when the isolate is sensitive to pyrazinamide (no known teratogenicity). Can be used while breastfeeding. **Use in renal disease:** Cleared by the kidneys; dose 3 times a week and after dialysis. **Use in hepatic disease:** Use with caution; pyrazinamide is associated with hepatotoxicity in about 1% of patients. It can be quite severe and worsen off treatment.
Adverse reactions	Gout (hyperuricemia) and arthralgias. Hepatotoxicity. Rash. Photosensitivity. Gastrointestinal upset.
Contraindications	**Allergy to pyrazinamide; severe gout.**

PYRAZINAMIDE (PZA) [2 of 2]

Monitoring	Monitor transaminases; check uric acid if the patient develops arthralgias.
2007 wholesale cost 30-day supply, 75-kg person	$42 (TB clinic) $85 (community hospital)
Patient instructions	May be taken with or without food; this medicine may cause a rash after sun exposure: limit your sun exposure. **Call your doctor right away if you have any of these side effects:** • Skin rash, severe itching, or hives • Pain or swelling in the joints • Yellowing of the skin or eyes or dark urine • Nausea or vomiting • Unusual tiredness or loss of appetite

RIFABUTIN (RFB) [1 of 2]

Drug class	Rifamycin
Trade name	Mycobutin
Activity against TB	**Bactericidal;** same mechanism of activity as rifampin (inhibits RNA polymerase). Less than 20% of rifampin-resistant strains are susceptible to rifabutin.
Dose (all once daily)	**Adults:** 5 mg/kg/dose (max dose 300 mg, though doses up to 450 mg are sometimes used). Dose adjustments sometimes required when dosing with interacting drugs. **Children:** The pediatric dose is not established, but doses of 5–10 mg/kg/day have been used (higher doses have been recommended for children < 1 year of age). Caution should be used in very young children in whom visual changes might not be obvious. **Renal failure/dialysis:** Reduce dose by 50% for creatinine clearance less than 30 ml/minute and monitor concentrations to avoid under-dosing. **Concomitant medications:** Dosage adjustment may be required, particularly with anti-retroviral therapy use. See **www.cdc.gov/tb/publications/guidelines/TB_HIV_Drugs/default.htm.**
Route of administration	Oral; not available parenterally.
Preparation	150 mg capsule.
Storage	Capsules should be kept at room temperature.
Pharmacokinetics	**Peak concentration** is reached 3–4 hours after a dose. **Peak serum concentration** should be drawn 3 hours after the dose; a second sample 7 hours post-dose is desirable in order to estimate the serum half-life and assess absorption. **The peak concentration** should be between 0.3 and 0.9 mcg/ml. Dose adjustments should be considered for patients with concentrations < 0.3 or > 1.0 mcg/ml (low concentrations predict risk of emergence of drug resistance). Rifabutin concentrates in tissues: in lung tissues, concentrations reach 10–20 times that in serum.
Oral absorption	Well absorbed from the GI tract.
CSF penetration	Penetrates inflamed meninges.
Special circumstances	**Use in pregnancy/breastfeeding:** Insufficient data in pregnancy. Unknown effects from breastfeeding. **Use in renal disease:** Used without dose adjustment in mild renal insufficiency. Reduce dose by 50% for creatinine clearance less than 30 ml/minute and monitor concentrations to avoid under-dosing. **Use in hepatic disease:** Use with caution and additional monitoring in liver disease. Dose adjustments necessary for drug interactions—especially HIV drugs. See **www.cdc.gov/tb/publications/guidelines/TB_HIV_Drugs/default.htm.**

RIFABUTIN (RFB) [2 of 2]

Adverse reactions	Leukopenia (dose dependent); thrombocytopenia. Rashes and skin discoloration (bronzing or pseudojaundice). Anterior uveitis and other eye toxicities. Hepatotoxicity similar to that of rifampin. Drug interactions with many other drugs—but only 40% of that seen with rifampin. Rifabutin concentrations may be affected by other drugs. Arthralgias.
Contraindications	**Rifamycin hypersensitivity.** Data are lacking on cross-sensitivity to rifabutin in patients with hypersensitivity. If used, use with caution, with careful monitoring of patient for development of hypersensitivity. Should not be used for patients with MDR-TB unless susceptibility to rifabutin documented.
Monitoring	Increased liver function monitoring; monitor drug concentrations of interacting medications; blood counts and vision screening.
2007 wholesale cost 30-day supply, 75-kg person	$168 (TB clinic) $426 (community hospital)
Patient instructions	May be taken with or without food; if it bothers your stomach, try taking it with food. It is normal for your urine, tears, and other secretions to turn a brownish-orange color when taking this medicine. Sometimes skin becomes discolored. Soft contact lenses may become discolored while you are on this medicine. Make sure your doctor knows all the medicines you take, as there are many drugs that interfere with this one. Avoid the use of oral hormone-based birth control methods because rifabutin may decrease their effectiveness. **Call your doctor right away if you have any of these side effects:** • Any eye pain, change in vision, or sensitivity to light • Fever, chills, or sore throat • Pain or swelling in the joints • Yellowing of the skin or eyes or dark urine • Nausea or vomiting • Unusual tiredness or loss of appetite

RIFAMPIN (RIF) [1 of 2]

Drug class	Rifamycin
Trade name	Rifadin (also known as rifampicin)
Activity against TB	**Bactericidal;** inhibits protein synthesis; cross-resistance with other rifamycins.
Dose (all once daily)	**Adults:** 10 mg/kg/dose up to 600 mg (PO or IV). **Children:** 10–20 mg/kg/dose up to 600 mg (PO or IV). **Renal failure/dialysis:** No adjustment required. **Concomitant medications:** Dosage adjustment may be required, particularly with anti-retroviral therapy use. See **www.cdc.gov/tb/publications/guidelines/TB_HIV_Drugs/default.htm.**
Route of administration	Oral or intravenous.
Preparation	150 and 300 mg capsules; lyophilized powder for injection: 600 mg/vial; contents of capsules can be mixed with liquid or semi-soft vehicles. Extemporaneously prepared oral solutions have unproven homogeneity and shelf life. Immediate administration of the dose after mixing capsular contents in a vehicle is ideal.
Storage	Capsules and powder should be kept at room temperature; powder suspended in saline is stable for 24 hours; powder suspended in dextrose solutions is stable for 4 hours.
Pharmacokinetics	**Peak time to concentration** after an oral dose is 1–4 hours. **Peak concentrations** should be obtained 2 hours after a dose, and if delayed absorption is considered, a concentration at 6 hours should also be collected. **Peak concentrations** of 8 to 24 mcg/ml are expected. Dose increase should be strongly considered for low concentrations (but not for delayed absorption), as rifampin exhibits a dose response in treatment of TB.
Oral absorption	Usually rapid absorption, may be delayed or decreased by high-fat meals.
CSF penetration	Rifampin CSF penetration is variable and typically achieves only 10–20% of serum concentrations in CSF (may be better in the face of inflamed meninges), but this may still be an important contribution to the regimen.
Special circumstances	**Use in pregnancy/breastfeeding:** Recommended for use in pregnancy; can be used while breastfeeding. **Use in renal disease:** Can be used without dose adjustment. **Use in hepatic disease:** Use with caution, can be associated with hepatotoxicity. Dose adjustments necessary for drug interactions—especially HIV drugs. See **www.cdc.gov/tb/publications/guidelines/TB_HIV_Drugs/default.htm.**

RIFAMPIN (RIF) [2 of 2]

Adverse reactions	**Many drug interactions.** Orange staining of body fluids. Rash and pruritus. GI upset, flu-like syndrome (usually only with intermittent administration). Hepatotoxicity. Hematologic abnormalities (thrombocytopenia, hemolytic anemia).
Contraindications	**Rifamycin allergy;** due to **drug interactions**, may be contraindicated with concurrent use of certain drugs.
Monitoring	Liver function monitoring if appropriate (if given with other hepatotoxic medications or if there are symptoms of hepatotoxicity); monitor drug concentrations of interacting medications.
2007 wholesale cost 30-day supply, 75-kg person	$29 (TB clinic) $78 (community hospital)
Patient instructions	Best taken without food; if it bothers your stomach, try taking it with a small amount of food. It is normal for your urine, tears, and other secretions to turn an orange color when taking this medicine. Soft contact lenses may become discolored while you are on this medicine. Make sure your doctor knows all the medicines you take because many drugs can interfere with this one. Avoid the use of oral hormone-based birth control methods because rifampin may decrease their effectiveness. **Call your doctor right away if you have any of these side effects:** • Unusual tiredness or loss of appetite • Severe abdominal upset • Fever or chills

STREPTOMYCIN (SM) [1 of 2]

Drug class	Aminoglycoside
Trade name	Streptomycin sulfate
Activity against TB	**Bactericidal;** inhibits protein synthesis; no significant cross-resistance with other aminoglycosides.
Dose (all once daily)	**Adults:** 15 mg/kg/day, 5–7 days per week (maximum dose is generally 1 gram, but a large, muscular person could receive more and should have concentrations monitored). 15 mg/kg/dose, 2–3 times per week after initial period of daily administration (some experts use up to 25 mg/kg/dose for intermittent therapy; monitor concentrations). **> 59 yrs of age:** 10 mg/kg/dose (max 750 mg) 5–7 times per week or 2–3 times per week after initial period. **Children:** 20–40 mg/kg/day (max 1 gram) 5–7 days per week. 20–40 mg/kg/day (max 1 gram) 2–3 days per week after initial period daily. **Renal failure/dialysis:** 12–15 mg/kg/dose 2–3 times weekly (not daily). **Markedly obese individuals** should have an adjusted dose due to the decreased distribution of extracellular fluids in adipose tissues. Dosing based on actual weight will give supratherapeutic concentrations. The suggested adjusted weight is ideal body weight plus 40% of the excess weight. Ideal body weight (men): 50 kg plus 2.3 kg/inch over 5 ft Ideal body weight (women): 45 kg plus 2.3 kg/inch over 5 ft *Concentrations should be followed closely.*
Route of administration	Intravenous or intramuscular (has been used intrathecally and intraperitoneally). Not absorbed orally.
Preparation	1 gram vial for injection.
Storage	Store in the refrigerator.
Pharmacokinetics	For intravenous administration, infuse over 60 minutes for adults; 1–2 hours for children; intramuscular absorption is complete within 4 hours and peak concentrations are achieved at 1–2 hours. Obtaining a drug concentration 90–120 minutes after intravenous infusion allows for complete distribution of drug. An additional concentration collected 4 hours later will allow for a peak to be extrapolated. **Peak concentrations** for a 15 mg/kg dose are between 35 and 45 mcg/ml. **Peak concentrations** of 25–35 mcg/ml are acceptable if you anticipate using streptomycin for more than 6 months. **Peak concentrations** of 65–80 mcg/ml are obtained after a 25 mg/kg dose. Trough concentrations should be < 5 mcg/ml in patients with normal renal fucntion.
Oral absorption	There is no significant oral absorption. Intramuscular absorption might be delayed if the same site is used consistently.

STREPTOMYCIN (SM) [2 of 2]

CSF penetration	Variable penetration; appears to penetrate inflamed meninges better.
Special circumstances	**Use in pregnancy/breastfeeding:** Avoided in pregnancy due to documented cases of congenital deafness. Can be used while breastfeeding. **Use in renal disease:** Use with caution. Concentrations should be monitored for patients with impaired renal function. Interval adjustment is recommended for renal impairment or dialysis. See "Dose – Renal Failure/Dialysis" (previous page). The drug is variably cleared by hemodialysis. **Use in hepatic disease:** Drug concentrations not affected by hepatic disease (except a larger volume of distribution for alcoholic cirrhotic patients with ascites). Presumed to be safe in severe liver disease; however, use with caution—some patients with severe liver disease may progress rapidly to hepato-renal syndrome. **Diuretic use:** Coadministration of loop diuretics and aminoglycoside antibiotics carries an increased risk of ototoxicity.
Adverse reactions	Nephrotoxicity: Less nephrotoxic than amikacin. Ototoxicity (hearing loss): Increased with advanced age and prolonged use. Local pain with IM injections. Vestibular toxicity. Electrolyte abnormalities, including hypokalemia and hypomagnesemia.
Contraindications	**Pregnancy** (congenital deafness seen with streptomycin and kanamycin use in pregnancy); **hypersensitivity to aminoglycosides;** caution with renal, vestibular, or auditory impairment.
Monitoring	Monitor renal function by documenting creatinine at least monthly (more frequently if renal or hepatic impairment); document creatinine clearance if there is baseline renal impairment or any concerns; document baseline and monthly audiology exam. Question patient regularly about vestibular complaints and perform serial vestibular exams. Document peak and trough concentrations at baseline if there is any question about renal function. Some experts monitor aminoglycoside concentrations routinely, regardless of renal function. Monitor concentrations serially for patients with impaired renal function.
2007 wholesale cost 30-day supply, 75-kg person	$108 (TB clinic) $124 (community hospital)
Patient instructions	Store streptomycin in the refrigerator. **Call your doctor right away if you have:** • Problems with hearing, dizziness, or balance • Rash or swelling of your face • Trouble breathing • Decreased urination • Watery or bloody diarrhea • Swelling, pain, or redness at your IV site • Muscle twitching or weakness

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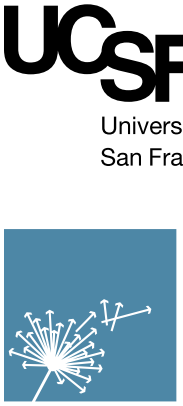

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