PRODUCT MONOGRAPH

PrRAN™-CLARITHROMYCIN
Clarithromycin Tablets

250 mg and 500 mg

USP

Antibiotic

NOTE: WHEN USED IN COMBINATION WITH ACID ANTISECRETORY DRUGS AND OTHER ANTIMICROBIALS FOR THE ERADICATION OF *HELICOBACTER PYLORI*, THE PRODUCT MONOGRAPH FOR THOSE AGENTS SHOULD BE CONSULTED.

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PART I: HEALTH PROFESSIONAL INFORMATION

SUMMARY PRODUCT INFORMATION

Route of Administration	Dosage Form / Strength	All Non-medicinal Ingredients
oral	film-coated tablets / 250 mg & 500 mg	croscarmellose sodium, D&C yellow #10 aluminum lake, hydroxypropyl cellulose, hypromellose, magnesium stearate, microcrystalline cellulose, povidone, propylene glycol, purified talc, silica, colloidal anhydrous; stearic acid and titanium dioxide.

INDICATIONS AND CLINICAL USE

RAN-CLARITHROMYCIN (clarithromycin tablets, USP) may be indicated in the treatment of mild to moderate infections caused by susceptible strains of the designated microorganisms in the diseases listed below:

Upper Respiratory Tract

Pharyngitis/tonsillitis, caused by Streptococcus pyogenes (Group A beta-hemolytic streptococci).

Acute maxillary sinusitis caused by *Streptococcus pneumoniae (S. pneumoniae)*, *Haemophilus influenzae (H. influenzae)*, and *Moraxella (Branhamella) catarrhalis* [*M. (Branhamella) catarrhalis*]

Lower Respiratory Tract

Acute bacterial exacerbation of chronic bronchitis caused by *S. pneumoniae*, *H. influenzae* (including beta-lactamase producing strains), *M. (Branhamella) catarrhalis* (including beta-lactamase producing strains).

Pneumonia caused by *S. pneumoniae* and *Mycoplasma. pneumoniae (M. pneumoniae)*.

Uncomplicated Skin and Skin Structure Infections

Uncomplicated Skin and Skin Structure Infections caused by *Streptococcus pyogenes* (*S. pyogenes*), *Staphylococcus aureus (S. aureus).*

Mycobacterial Infections

RAN-CLARITHROMYCIN (clarithromycin tablets, USP) is indicated for the prevention of disseminated *Mycobacterium avium* complex (MAC) disease in patients with advanced HIV infection (see **CLINICAL TRIALS, Mycobacterial Infections**), and for the treatment of disseminated mycobacterial infections due to *Mycobacterium avium* (*M. avium*) and *Mycobacterium intracellulare* (*M. intracellulare*).

Eradication of *Helicobacter pylori*

RAN-CLARITHROMYCIN (clarithromycin tablets, USP) in the presence of acid suppression (with omeprazole) with another antibiotic (amoxicillin) is indicated for the eradication of *Helicobacter pylori (H. pylori)* that may result in decreased recurrence of duodenal ulcer in patients with active duodenal ulcers and who are *H. pylori positive.* See (**CLINICAL TRIALS, Eradication of *Helicobacter pylori*, Triple Therapy: clarithromycin/omeprazole/amoxicillin)** and (**CLINICAL TRIALS, Eradication of *Helicobacter pylori*, Dual Therapy: clarithromycin/omeprazole**).

(For additional information on the use of clarithromycin in triple therapy for the treatment of *H. pylori* infection and active duodenal ulcer recurrence, refer to the Hp-PAC® Product Monograph.)

Pediatrics:	Not for use in children < 12 years of age. See **DOSAGE AND ADMINISTRATION**, For a brief discussion see **WARNINGS AND PRECAUTIONS**, **Special Populations**, **Pediatrics**.
Geriatrics (> 65 years of age):	Dosage adjustment should be considered in elderly patients with severe renal impairment. For a brief discussion see **WARNINGS AND PRECAUTIONS**, **Special Populations**, **Geriatrics**.

CONTRAINDICATIONS

RAN-CLARITHROMYCIN (clarithromycin tablets, USP) is contraindicated in patients with a known hypersensitivity to clarithromycin, erythromycin, other macrolide antibacterial agents or

to any ingredient in the formulation or component of the container. See (**DOSAGE FORMS**, **COMPOSITION AND PACKAGING)**.

Clarithromycin is contraindicated in patients with a history of cholestatic jaundice/hepatic dysfunction associated with prior use of clarithromycin.

Clarithromycin is contraindicated in patients with history of QT prolongation or ventricular cardiac arrhythmia, including torsades de pointes. See (**WARNINGS AND PRECAUTIONS**) and (**DRUG INTERACTIONS, Drug-Drug Interactions**).

Clarithromycin is contraindicated as concurrent therapy with astemizole, terfenadine, cisapride, pimozide. There have been post-marketing reports of drug interactions when clarithromycin and/or erythromycin are co-administered with astemizole, terfenadine, cisapride or pimozide resulting in cardiac arrhythmias (QT prolongation, ventricular tachycardia, ventricular fibrillation, and torsades de pointes) most likely due to inhibition of hepatic metabolism of these drugs by erythromycin and clarithromycin. Fatalities have been reported. See (**DRUG INTERACTIONS, Drug-Drug Interactions, Table 11).**

Clarithromycin is contraindicated with HMG-CoA reductase inhibitors (statins) that are extensively metabolized by CYP3A4 (lovastatin or simvastatin), due to an increased risk of myopathy, including rhabdomyolysis. See (**DRUG INTERACTIONS, Drug-Drug Interactions, Table 11).**

Clarithromycin is contraindicated as concurrent therapy with ergotamine or dihydroergotamine as may result in ergot toxicity. See **(DRUG INTERACTIONS, Drug-Drug Interactions, Table 11).**

Clarithromycin is contraindicated as concurrent therapy with colchicine in patients with renal or hepatic impairment due to the risk of life threatening and fatal colchicine toxicity. This risk may be further increased with concomitant medications metabolized by P-glycoprotein or strong CYP3A inhibitors. See (**WARNINGS AND PRECAUTIONS,** Colchicine) and (**DRUG INTERACTIONS, Drug-Drug Interactions, Table 11)**.

WARNINGS AND PRECAUTIONS

Serious Warnings and Precautions

- Clarithromycin should not be used in **pregnancy** except where no alternative therapy is appropriate, particularly during the first 3 months of pregnancy. If pregnancy occurs while taking the drug, the patient should be apprised of the potential hazard to the fetus (see **WARNINGS AND PRECAUTIONS, Special Populations, Pregnant Women**).
- The concomitant administration of clarithromycin and drugs metabolized by CYP3A and/or transported by P-gp may result in significant safety concerns. See (**WARNINGS AND PRECAUTIONS**) and (**DRUG INTERACTIONS, Overview**).

General

Clarithromycin should be administered with caution to any patient who has demonstrated some form of drug allergy, particularly to structurally related-drugs. If an allergic reaction to clarithromycin occurs, administration of the drug should be discontinued. Serious hypersensitivity reactions may require epinephrine, antihistamines, or corticosteroids. See (**WARNINGS AND PRECAUTIONS, Immune, Hypersensitivity**).

Long-term use may, as with other antibiotics, result in colonization with increased numbers of non-susceptible bacteria and fungi. If superinfections occur, appropriate therapy should be instituted.

Patients Infected with Human Immunodeficiency Virus

Several studies of Human Immunodeficiency Virus (HIV)-positive patients receiving clarithromycin for treatment of MAC infection have shown poorer survival in those patients randomized to receive doses higher than 500 mg twice daily. The explanation for the poorer survival associated with doses higher than 500 mg twice daily has not been determined. Treatment or prophylaxis of MAC infection with clarithromycin should not exceed the approved dose of 500 mg twice daily.

Myasthenia Gravis

Exacerbation of symptoms of myasthenia gravis and new onset of symptoms of myasthenic syndrome has been reported in patients receiving clarithromycin therapy.

Use of Clarithromycin with Other Drugs

Use of clarithromycin with other drugs may lead to drug-drug interactions.

Colchicine

Life-threatening and fatal drug interactions have been reported in patients treated with clarithromycin and colchicine. Clarithromycin is a strong CYP3A4 inhibitor and this interaction may occur while using both drugs at their recommended doses. If co-administration of clarithromycin and colchicine is necessary in patients with normal renal and hepatic function, the dose of colchicine should be reduced. Patients should be monitored for clinical symptoms of colchicine toxicity. See (**CONTRAINDICATIONS**).

There have been post-marketing reports of colchicine toxicity with concurrent use of clarithromycin and colchicine. In patients with impaired renal and/or hepatic function and/or who are elderly, colchicine and clarithromycin should not be used concurrently due to the risk of colchicine toxicity. Deaths have been reported in some patients. See (**DRUG INTERACTIONS, Drug-Drug Interactions**, **Table 11)** and (**ADVERSE REACTIONS, Post-Market Adverse Drug Reactions**, **Colchicine**).

Oral Hypoglycemic Agents/Insulin

The concomitant use of clarithromycin and oral hypoglycaemic agents and/or insulin can result in significant hypoglycaemia. With certain hypoglycaemic drugs such as nateglinide, pioglitazone, repaglinide and rosiglitazone, inhibition of CYP3A enzyme by clarithromycin may be involved and could cause hypoglycaemia when used concomitantly. Careful monitoring of glucose is recommended. See (**DRUG INTERACTIONS, Drug-Drug Interactions, Table 11**).

Oral Anticoagulants

There is a risk of serious hemorrhage and significant elevations in International Normalized Ratio (INR) and prothrombin time when clarithromycin is co-administered with warfarin. INR and prothrombin times should be frequently monitored while patients are receiving clarithromycin and oral anticoagulants concurrently. See (**DRUG INTERACTIONS, Drug-Drug Interactions, Table 11**).

HMG-CoA Reductase Inhibitors

Concomitant use of clarithromycin with lovastatin or simvastatin is contraindicated. See (**CONTRAINDICATIONS**) as these statins are extensively metabolized by CYP3A4 and concomitant treatment with clarithromycin increases their plasma concentration, which increases the risk of myopathy, including rhabdomyolysis. Reports of rhabdomyolysis have been received for patients taking clarithromycin concomitantly with these statins. If treatment with clarithromycin cannot be avoided, therapy with lovastatin or simvastatin must be suspended during the course of treatment.

Caution should be exercised when prescribing clarithromycin with statins. In situations where the concomitant use of clarithromycin with atorvastatin or pravastatin cannot be avoided, atorvastatin dose should not exceed 20 mg daily and pravastatin dose should not exceed 40 mg daily. Use of a statin that is not dependent on CYP3A metabolism (e.g., fluvastatin) can be considered. It is recommended to prescribe the lowest registered dose of statin if concomitant use cannot be avoided. See (**DRUG INTERACTIONS, Drug-Drug Interactions, Table 11**).

Triazolobenzodiazepines and Related Benzodiazepines

Caution is advised regarding the concomitant administration of clarithromycin with triazolobenzodiazepines (such as triazolam and alprazolam), or with other benzodiazepines (such as midazolam) due to the serious risk of central nervous system (CNS) effects (e.g., somnolence and confusion). See (**DRUG INTERACTIONS, Drug-Drug Interactions, Table 11**).

Calcium Channel Blockers

Caution is advised regarding the concomitant administration of clarithromycin and calcium channel blockers metabolized by CYP3A4 (e.g., verapamil, amlodipine, diltiazem) due to the risk of hypotension. See (**DRUG INTERACTIONS, Drug-Drug Interactions, Table 11**).

Hypotension, bradyarrhythmias, and lactic acidosis have been observed in patients receiving concurrent verapamil, belonging to the calcium channel blockers drug class. See (**DRUG INTERACTIONS, Drug-Drug Interactions, Table 11**).

Other Drugs

For other established or potential drug-drug interactions and their mechanisms, see **(CONTRAINDICATIONS)** and (**DRUG INTERACTIONS**, **Drug-Drug Interactions)**.

Carcinogenesis and Mutagenesis

Long-term studies in animals have not been performed to evaluate the carcinogenic potential of clarithromycin.

The following *in vitro* mutagenicity tests have been conducted with clarithromycin: Salmonella/mammalian microsome test, bacterial induced mutation frequency test, *in vitro* chromosome aberration test, rat hepatocyte DNA synthesis assay, mouse lymphoma assay, mouse dominant lethal study, mouse micronucleus test. All tests had negative results except the *in vitro* chromosome aberration test which was weakly positive in one test and negative in another. In addition, a Bacterial Reverse-Mutation Test (Ames Test) has been performed on clarithromycin metabolites with negative results.

Cardiovascular

Clarithromycin should be used with caution in patients with a medical condition associated with a potential risk of QT prolongation and torsades de pointes. See (**CONTRAINDICATIONS**) and (**DRUG INTERACTIONS, Drug-Drug Interactions**).

Gastrointestinal

Clostridium difficile-Associated Disease

Clostridium difficile-associated disease (CDAD) has been reported with use of many antibacterial agents, including clarithromycin. CDAD may range in severity from mild diarrhea to fatal colitis. It is important to consider this diagnosis in patients who present with diarrhea, or symptoms of colitis, pseudomembranous colitis, toxic megacolon, or perforation of colon subsequent to the administration of any antibacterial agent. CDAD has been reported to occur over 2 months after the administration of antibacterial agents.

Treatment with antibacterial agents may alter the normal flora of the colon and may permit overgrowth of *Clostridium difficile. Clostridium difficile* produces toxins A and B, which contribute to the development of CDAD. CDAD may cause significant morbidity and mortality. CDAD can be refractory to antimicrobial therapy.

If the diagnosis of CDAD is suspected or confirmed, appropriate therapeutic measures should be initiated. Mild cases of CDAD usually respond to discontinuation of antibacterial agents not directed against *Clostridium difficile*. In moderate to severe cases, consideration should be given

to management with fluids and electrolytes, protein supplementation, and treatment with an antibacterial drug clinically effective against *Clostridium difficile*. Surgical evaluation should be instituted as clinically indicated, as surgical intervention may be required in certain severe cases. See (**ADVERSE REACTIONS**).

Hepatic/Biliary/Pancreatic

Clarithromycin is principally excreted by the liver and kidney. In patients with both hepatic and renal impairments or in the presence of severe renal impairment, decreased dosage of clarithromycin or prolonged dosing intervals might be appropriate. See (**DOSAGE AND ADMINISTRATION, Recommended Dose and Dosage Adjustment)**.

Hepatic dysfunction, including increased liver enzymes, and hepatocellular and/or cholestatic hepatitis, with or without jaundice, has been reported with clarithromycin. This hepatic dysfunction may be severe and is usually reversible. In some instances, hepatic failure with fatal outcomes has been reported and generally has been associated with serious underlying diseases and/or concomitant medications. Discontinue clarithromycin immediately if signs and symptoms of hepatitis occur, such as anorexia, jaundice, dark urine, pruritus, or tender abdomen.

Immune

Hypersensitivity Reactions

Severe acute hypersensitivity reactions, such as anaphylaxis, Stevens - Johnson syndrome, toxic epidermal necrolysis, DRESS, and Henoch-Schonlein purpura have been reported. In the event of severe acute hypersensitivity reactions, clarithromycin therapy should be discontinued immediately and appropriate treatment should be urgently initiated.

Renal

Caution is advised in patients with severe renal insufficiency.

Clarithromycin is principally excreted by the liver and kidney. In patients with both hepatic and renal impairments or in the presence of severe renal impairment, decreased dosage of clarithromycin or prolonged dosing intervals might be appropriate. See (**DOSAGE AND ADMINISTRATION, Recommended Dose and Dosage Adjustment)**.

For the eradication of *H. pylori*, amoxicillin and clarithromycin should not be administered to patients with renal impairment since the appropriate dosage in this patient population has not yet been established.

Sensitivity/Resistance

The development of resistance (11 out of 19 breakthrough isolates in 1 study) has been seen in HIV positive patients receiving clarithromycin for prophylaxis and treatment of MAC infection.

In view of the emerging resistance of *Streptococcus pneumoniae*, *Staphylococcus aureus* and *Streptococcus pyogenes* to macrolides, it is important that sensitivity testing be performed when prescribing clarithromycin for community-acquired pneumonia and uncomplicated skin and skin structure infections.

To avoid failure of the eradication treatment with a potential for developing antimicrobial resistance and a risk of failure with subsequent therapy, patients should be instructed to follow closely the prescribed regimen.

Antibiotic Resistance in Relation to *Helicobacter pylori* Eradication

Use of any antimicrobial therapy, such as clarithromycin, to treat *H. pylori* infection may select for drug-resistant organisms.

Triple and Dual Therapy with Omeprazole

Among the 113 triple therapy recipients with pretreatment *H. pylori* isolates susceptible to clarithromycin, 2/102 patients (2%) developed resistance after treatment with omeprazole, clarithromycin, and amoxicillin. Among patients who received triple therapy, 6/108 (5.6%) patients had pretreatment *H. pylori* isolates resistant to clarithromycin. Of these 6 patients, 3 (50%) had *H. pylori* eradicated at follow-up, and 3 (50%) remained positive after treatment. In 5/113 (4.4%) patients, no susceptibility data for clarithromycin pretreatment were available. Twenty-six of 104 patients (25%) with pretreatment isolates susceptible to clarithromycin developed resistance after treatment with omeprazole and clarithromycin. Development of clarithromycin resistance should be considered as a possible risk especially when less efficient treatment regimens are used.

Special Populations

Pregnant Women

There are no adequate and well-controlled studies in pregnant women. The benefits against risk, particularly during the first 3 months of pregnancy should be carefully weighed by a physician. See (**WARNINGS AND PRECAUTIONS, Serious Warnings and Precautions**).

Four teratogenicity studies in rats (3 with oral doses and 1 with intravenous doses up to 160 mg/kg/day administered during the period of major organogenesis) and 2 in rabbits (at oral doses up to 125 mg/kg/day or intravenous doses of 30 mg/kg/day administered during gestation days 6 to 18) failed to demonstrate any teratogenicity from clarithromycin. Two additional oral studies in a different rat strain at similar doses and similar conditions demonstrated a low incidence of cardiovascular anomalies at doses of 150 mg/kg/day administered during gestation days 6 to 15. Plasma levels after 150 mg/kg/day were 2 times the human serum levels.

Four studies in mice revealed a variable incidence of cleft palate following oral doses of 1000 mg/kg/day during gestation days 6 to 15. Cleft palate was also seen at 500 mg/kg/day. The 1000 mg/kg/day exposure resulted in plasma levels 17 times the human serum levels. In monkeys, an

oral dose of 70 mg/kg/day produced fetal growth retardation at plasma levels that were 2 times the human serum levels.

Embryonic loss has been seen in monkeys and rabbits. See (**TOXICOLOGY**, **Reproduction and Teratology**).

Nursing Women

The safety of clarithromycin for use during breast-feeding of infants has not been established. Clarithromycin is excreted in human milk.

Preweaned rats, exposed indirectly via consumption of milk from dams treated with 150 mg/kg/day for 3 weeks, were not adversely affected, despite data indicating higher drug levels in milk than in plasma.

Pediatrics (≥ 12 years of age): Not for use in children less than 12 years of age.

Use of clarithromycin tablets in children under 12 years of age has not been studied.

Neonatal and juvenile animals tolerated clarithromycin in a manner similar to adult animals. Young animals were slightly more intolerant to acute overdosage and to subtle reductions in erythrocytes, platelets and leukocytes, but were less sensitive to toxicity in the liver, kidney, thymus and genitalia.

Increased valproate and phenobarbital concentrations and extreme sedation were noted in a 3-year old patient coincident with clarithromycin therapy. Cause and effect relationship cannot be established. However, monitoring of valproate and phenobarbital concentrations may be considered.

Geriatrics (> 65 years of age)

Dosage adjustment should be considered in elderly patients with severe renal impairment. In a steady-state study in which healthy elderly subjects (age 65 to 81 years old) were given 500 mg every 12 hours, the maximum concentrations of clarithromycin and 14-OH-clarithromycin were increased. The AUC was also increased. These changes in pharmacokinetics parallel known age-related decreases in renal function. In clinical trials, elderly patients did not have an increased incidence of adverse events when compared to younger patients.

ADVERSE REACTIONS

Adverse Drug Reaction Overview

The majority of side effects observed in clinical trials involving 3563 patients treated with clarithromycin were of a mild and transient nature. Fewer than 3% of adult patients without mycobacterial infections discontinued therapy because of drug-related side-effects. The most common drug-related adverse reactions in adults taking clarithromycin were nausea, diarrhea, abdominal pain, dyspepsia, headache, taste perversion and vomiting.

Clinical Trial Adverse Drug Reactions

Because clinical trials are conducted under very specific conditions, the adverse reaction rates observed in the clinical trials may not reflect the rates observed in practice and should not be compared to the rates in the clinical trials of another drug. Adverse drug reaction information from clinical trials is useful for identifying drug-related adverse events and for approximating rates.

Patients with Respiratory Tract or Skin Infections

Table 1 provides a listing of adverse reactions from clinical trials or post-marketing surveillance as well as adverse events reported during post-marketing surveillance. Adverse events reported during post-marketing surveillance may include patients treated for various infections and are not limited to patients with respiratory tract or skin infections.

Table 1
Adverse Events/Adverse Drug Reactions in Patients with Respiratory Tract or Skin Infections or Other Infections Treated with Clarithromycin

System Organ Class	Adverse Reaction/Adverse Event
General disorders and administration site conditions	Asthenia Pain Chest pain
Infections and infestations	Infection Colitis pseudomembranous Candidiasis Rhinitis Pharyngitis Vaginal candidiasis Vaginal infection
Musculoskeletal and connective tissue disorders	Back pain Myalgia
Investigations	Increased liver enzymes
Cardiac disorders*	Electrocardiogram QT prolonged Ventricular tachycardia Torsades de pointes
Gastrointestinal disorders	Constipation Flatulence Dry mouth Glossitis Stomatitis Gastrointestinal disorder Tongue discolouration Tooth discolouration Pancreatitis
Metabolism and nutrition disorders	Anorexia Hypoglycemia**
Hepatobiliary disorders	Hepatomegaly Hepatic function abnormal Hepatitis Hepatitis cholestatic Jaundice (cholestatic and hepatocellular) Hepatic failure ***

Nervous system disorders	Dizziness Somnolence Convulsion Parosmia Dysgeusia Ageusia
Ear and labyrinth disorders	Vertigo Tinnitus Ear disorder Deafness****
Psychiatric disorders	Nervousness Anxiety Insomnia Nightmare Depression Confusional state Disorientation Depersonalisation Hallucination Psychotic disorder
Respiratory, thoracic and mediastinal disorders	Cough Dyspnea Asthma
Skin and subcutaneous tissue disorders	Pruritus Rash Hyperhidrosis Urticaria Stevens-Johnson syndrome Toxic epidermal necrosis
Immune system disorders	Anaphylactic reaction Myasthenia gravis
Eye disorders	Visual disturbance Conjunctivitis
Renal and urinary disorders	Hematuria Nephritis interstitial
Reproductive system and breast disorders	Dysmenorrhea
Blood and lymphatic system disorders	Eosinophilia Anemia Leukopenia Thrombocythemia Thrombocytopenia

* As with other macrolides, QT prolongation, ventricular tachycardia, and torsades de pointes have been reported with clarithromycin.
** There have been reports of hypoglycemia, some of which have occurred in patients on concomitant oral hypoglycemic agents or insulin.
*** Hepatic dysfunction may be severe and is usually reversible. Hepatic failure with fatal outcome has been reported and generally has been associated with serious underlying diseases and/or concomitant medications.
**** There have been reports of hearing loss with clarithromycin which is usually reversible upon withdrawal of therapy.

In studies of adults with pneumonia comparing clarithromycin to erythromycin base or erythromycin stearate, there were significantly fewer adverse events involving the digestive system in patients treated with clarithromycin.

Abnormal Laboratory Values

Changes in laboratory values with possible clinical significance reported during clinical studies or during post-marketing surveillance are displayed in **Table 2**.

Table 2 Abnormal Hematologic and Clinical Chemistry Findings in Patients with Respiratory Tract or Skin Infections Treated with Clarithromycin		
System Organ Class	**Laboratory Values**	**Frequency**
Investigations	Alanine aminotransferase increased Aspartate aminotransferase increased Gamma-glutamyltransferase increased Blood alkaline phosphatase increased Blood lactate dehydrogenase increased Blood bilirubin increased Blood creatinine increased White blood cell count decreased	Uncommon (Less than 1%)
	Prothrombin time prolonged Blood urea increased	1% 4%

Patients with Mycobacterial Infections

In patients with acquired immune deficiency syndrome (AIDS) and other immunocompromised patients treated with the higher doses of clarithromycin over long periods of time for prevention or treatment of mycobacterial infections, it was often difficult to distinguish adverse events possibly associated with clarithromycin administration from underlying signs of HIV disease or intercurrent illness.

Prophylaxis

Discontinuation due to adverse events was required in 18% of AIDS patients receiving clarithromycin 500 mg twice daily, compared to 17% of patients receiving placebo in a randomized, double-blind study. Primary reasons for discontinuation in the clarithromycin-treated patients include headache, nausea, vomiting, depression and taste perversion. The most frequently reported adverse events with an incidence of 2% or greater, excluding those due to the patient's concurrent condition, are listed in **Table 3**. Among these events, taste perversion was the only event that had significantly higher incidence in the clarithromycin-treated compared to the placebo-treated group.

Table 3 Percentage of Adverse Events* in Immunocompromised Adult Patients Receiving Prophylaxis Against *M. avium* Complex			
System Organ Class‡	**Adverse Reaction**	**Clarithromycin (n=339) %**	**Placebo (n = 339) %**
Gastrointestinal disorders	Abdominal pain	5.0%	3.5%
	Nausea	11.2%	7.1%
	Diarrhea	7.7%	4.1%
	Vomiting	5.9%	3.2%
	Dyspepsia	3.8%	2.7%
	Flatulence	2.4%	0.9%
Nervous system disorders	Dysgeusia	8.0%	0.3%
	Headache	2.7%	0.9%
Skin and subcutaneous tissue disorders	Rash	3.2%	3.5%
* Includes those events possibly or probably related to study drug and excludes concurrent conditions. ‡ ≥ 2% Adverse Event Incidence Rates for either treatment group.			

Abnormal Laboratory Values

In immunocompromised patients receiving prophylaxis against *M. avium*, those laboratory values outside the extreme high or low limit for the specified test were analyzed (**Table 4**).

Table 4
Percentage of Patients* Exceeding Extreme Laboratory Value in Immunocompromised Patients Receiving Prophylaxis Against *M. avium* Complex

System Organ Class	Laboratory Values	Clarithromycin 500 mg b.i.d.		Placebo	
Investigations	Hemoglobin decreased < 8 g/dL	4/118	3%	5/103	5%
	Platelet count decreased < 50×10^9/L	11/249	4%	12/250	5%
	White blood cell count decreased < 1×10^9/L	2/103	4%	0/95	0%
	Aspartate aminotransferase increased > 5 × ULN	7/196	4%	5/208	2%
	Alanine aminotransferase increased > 5 × ULN	6/217	3%	4/232	2%
	Blood alkaline phosphatase increased > 5 × ULN	5/220	2%	5/218	2%

* Includes only patients with baseline values within the normal range or borderline high (hematology variables) and within the normal range or borderline low (chemistry variables).

Legend: b.i.d. = twice daily; ULN = Upper Limit of Normal

Treatment of Patients with Mycobacterial Infections

Excluding those patients who discontinued therapy due to complications of their underlying non-mycobacterial diseases (including death), approximately 14% of the patients discontinued therapy due to drug-related adverse events.

In adult patients, the most frequently reported adverse events with an incidence of 3% or greater, excluding those due to the patient's concurrent condition, are listed in **Table 5** by the total daily dose the patient was receiving at the time of the event. A total of 867 patients were treated with clarithromycin for mycobacterial infections. Of these, 43% reported one or more adverse events. Most of these events were described as mild to moderate in severity, although 14% were described as severe.

Incidence of adverse events was higher in patients taking 4000 mg total daily doses compared to lower doses (**Table 5**).

Table 5 Percentage of Adverse Events* in Immunocompromised Adult Patients Treated with Clarithromycin for Mycobacterial Infections				
Presented by Total Daily Dose at Time of the Event				
System Organ Class	**Adverse Reaction**	**1000 mg (n=463)**	**2000 mg (n=516)**	**4000 mg (n=87)**
Gastrointestinal disorders	Nausea	11%	16%	40%
	Vomiting	7%	9%	24%
	Abdominal Pain	5%	7%	20%
	Diarrhea	4%	6%	17%
	Flatulence	1%	2%	7%
	Constipation	1%	< 1%	5%
	Dry Mouth	< 1%	0%	5%
Nervous system disorders	Dysgeusia	6%	7%	29%
	Headache	2%	2%	7%
Skin and subcutaneous tissue disorders	Rash	4%	3%	2%
Investigations	Aspartate aminotransferase increased	2%	2%	11%
	Alanine aminotransferase increased	1%	1%	9%
Respiratory, thoracic and mediastinal disorders	Dyspnea	< 1%	< 1%	7%
Psychiatric disorders	Insomnia	< 1%	< 1%	6%
Ear and labyrinth disorders	Hearing impaired**	3%	2%	5%

* Related adverse events considered to be definitely, probably, possibly or remotely related to study events.
** Sum of patients with deafness, ear disorder, partial transitory deafness, and/or tinnitus.
n = Number of adverse events.

Abnormal Laboratory Values

In immunocompromised patients treated with clarithromycin for mycobacterial infections, evaluations of laboratory values were made by analysing those values outside the seriously abnormal level (i.e., the extreme high or low limit) for the specified test (**Table 6**).

Table 6
Percentage of Immunocompromised Adult Patients Treated with Clarithromycin for Mycobacterial Infections who had On-Treatment Laboratory Values that Were Outside the Seriously Abnormal Level

Presented by Total Daily Dose					
System Organ Class	**Laboratory Values**	**Seriously Abnormal Level**	**1000 mg**	**2000 mg**	**4000 mg**
Investigations	Aspartate aminotransferase increased	> 5 × ULN	3%	2%	4%
	Alanine aminotransferase increased	> 5 × ULN	2%	2%	7%
	Platelet count decreased	< 50 × 109/L	2%	2%	4%
	White blood cell count decreased	< 1 × 109/L	0%	2%	0%
	Blood urea increased	> 50 mg/dL	< 1%	< 1%	4%

Legend: ULN = Upper Limit of Normal.

Patients with *Helicobacter pylori* Infection

Triple Therapy: clarithromycin/omeprazole/amoxicillin

A summary of drug-related adverse event incidence rates is presented in **Table 7**.

Table 7
Summary of Drug-Related Adverse Event Incidence Rates by System Organ Class

	Patients With Drug-Related Adverse Events (% of Patients Treated)*	
System Organ Class	**Omeprazole + Clarithromycin + Amoxicillin (n=137)**	**Omeprazole + Clarithromycin (n=130)**
Gastrointestinal disorders	24 (18%)	21 (16%)
General disorders and administration site conditions	5 (4%)	0 (0%)
Nervous system disorders	15 (11%)	30 (23%)
Cardiac disorders	0 (0%)	1 (1%)
Investigations	9 (7%)	0 (0%)
Infections and infestations	1 (1%)	1(1%)
Hepatobiliary disorders	2(1%)	0 (0%)
Psychiatric disorders	1(1%)	1(1%)
Ear and labyrinth disorders	1(1%)	2 (2%)
Respiratory, thoracic and mediastinal disorders	1(1%)	0 (0%)
Skin and subcutaneous tissue disorders	3 (2%)	1 (1%)
Eye disorders	0 (0%)	1 (1%)
Reproductive system and breast disorders	1 (1%)	0 (0%)

* Patients with more than 1 event within a system organ class are counted only once in the total for that system organ class
Note: There is a statistical difference (Fisher's exact two-sided, p-value = 0.009) between omeprazole + clarithromycin + amoxicillin (11%) versus omeprazole + clarithromycin (23%) in regard to nervous system disorders.

Dual Therapy: clarithromycin/omeprazole

Of 346 patients, 156 (45%) reported at least 1 adverse event. Adverse events associated with the Gastrointestinal disorders, Nervous system disorders, and Infections and infestations system

organ class (SOC) were the most commonly reported adverse events among clarithromycin/omeprazole-treated patients. One hundred and two patients (29%) reported gastrointestinal disorder events. The most common adverse events reported in the Gastrointestinal disorder SOC were nausea (5%) diarrhea (4%), vomiting (3%), and abdominal pain (3%). Eighty-three patients (24%) reported adverse events in the Nervous system disorders SOC. Dysgeusia (15%), headache (5%), and dizziness (2%) were the most frequently reported events in the Nervous system disorders SOC. Twenty-nine patients (8%) reported adverse events in the Infections and infestations SOC. Infection (3%) was the most frequently reported adverse event in the Infections and infestations SOC.

Adverse events by system organ class for all patients treated with clarithromycin and omeprazole are presented in **Table 8**.

Table 8

Summary of Adverse Event Incidence by System Organ Class all Patients Treated with Clarithromycin/Omeprazole

System Organ Class*	***Number (%) of Patients (N=346)***
Infections and infestations	29 (8%)
Neoplasma benign, malignant and unspecified	2 (< 1%)
Metabolism and nutrition disorders	1 (< 1%)
Psychiatric disorders	12 (3%)
Nervous system disorders	83 (24%)
Eye disorders	2 (< 1%)
Ear and labyrinth disorders	1 (< 1%)
Cardiac disorders	6 (2%)
Vascular disorders	1 (< 1%)
Respiratory, thoracic and mediastinal disorders	5 (1%)
Gastrointestinal disorders	102 (29%)
Hepatobiliary disorders	1 (< 1%)
Skin and subcutaneous tissue disorders	11 (3%)
Musculoskeletal and connective tissue disorders	12 (3%)
Renal and urinary disorders	2 (< 1%)
General disorders and administration site conditions	24 (7%)
Investigations	8 (2%)
Injury, poisoning and procedural complications	3 (1%)
TOTAL**	156 (45%)

* Patients with more than one event within a system organ class are counted only once in the total for that system organ class.
** Patients with event in more than one system organ class are counted only once in the total.

The most commonly reported adverse events for the 346 patients who received clarithromycin and omeprazole were: taste perversion (15%), nausea (5%), headache (5%), diarrhea (4%), vomiting (3%), abdominal pain (3%), and infection (3%).

Table 9 presents adverse events reported by 1% or more of clarithromycin/omeprazole-treated patients.

Table 9 Rank-Order of Adverse Events for Patients who Received Clarithromycin and Omeprazole		
System Organ Class	**Adverse Event***	**Number (%) of Patients**
Nervous system disorders	Dysgeusia	53 (15%)
	Headache	16 (5%)
	Dizziness	7 (2%)
Gastrointestinal disorders	Nausea.	18 (5%)
	Diarrhea	15 (4%)
	Vomiting	12 (3%)
	Abdominal Pain	11 (3%)
	Tongue Discoloration	8 (2%)
	Constipation	5 (1%)
	Dry Mouth	4 (1%)
Infections and infestations	Infection	9 (3%)
	Rhinitis	7 (2%)
	Pharyngitis	5 (1%)
General disorders and administration site conditions	Pain	6 (2%)
	Asthenia	4 (1%)
	Chills	4 (1%)
	Influenza	4 (1%)
Musculoskeletal and connective tissue disorders	Back Pain	5 (1%)
Skin and subcutaneous tissue disorders	Rash	4 (1%)
* Events reported in at least 1% of the clarithromycin/omeprazole population.		

Twelve (4%) of the clarithromycin/omeprazole-treated patients prematurely discontinued from study drug therapy due to adverse events. The most frequently reported adverse events leading to withdrawal included taste perversion, nausea, and headache. Three patients treated with clarithromycin and omeprazole died during follow-up periods; none of the deaths were considered by the investigator to be related to study drug administration.

Few laboratory abnormalities were observed among clarithromycin/omeprazole-treated patients. The incidence of possibly clinically significant hematology and serum chemistry variables was < 1% for any variable evaluated.

Less Common Clinical Trial Adverse Drug Reactions (<1%) for Clarithromycin

The following adverse drug reactions are applicable to all indications approved for this formulation.

Blood and Lymphatic System Disorders:	eosinophilia and neutropenia
Gastrointestinal Disorders:	abdominal distension
General Disorders and Administration Site Conditions:	chest pain, chills, fatigue and malaise
Hepatobiliary Disorders:	cholestasis, gamma-glutamyltransferase increased and hepatitis

Investigations:	blood alkaline phosphatase increased and blood lactate dehydrogenase increased

***Other adverse reactions have been observed in different patient populations and during post-marketing surveillance. See* ADVERSE REACTIONS, Clinical Trial Adverse Drug Reactions, Table 1.**

Post-Market Adverse Drug Reactions

The following list of adverse events is a compilation of adverse reactions from Post-marketing Surveillance and Post-marketing Clinical Studies for all clarithromycin formulations.

Table 10
Post-Market Adverse Drug Reactions

System Organ Class	Adverse Event
Blood and lymphatic system disorders	Leukopenia
	Thrombocytopenia
	Agranulocytosis
Cardiac disorders[1]	Atrial fibrillation
	Cardiac arrest
	Extrasystoles
	Electrocardiogram QT prolonged
	Ventricular tachycardia
	Torsades de pointes
	Palpitations
Gastrointestinal disorders	Abdominal pain
	Constipation
	Dyspepsia
	Dry mouth
	Eructation
	Esophagitis
	Flatulence
	Vomiting
	Glossitis
	Gastritis
	Stomatitis
	Tongue discolouration
	Tooth discolouration
	Pancreatitis
General disorders and administration site conditions	Asthenia
Infections and infestations	Candidiasis
	Cellulitis
	Pseudomembranous colitis
	Vaginal infection
Hepatobiliary disorders	Hepatitis
	Hepatitis cholestatic
	Hepatic failure[2]
	Jaundice (cholestatic and hepatocellular)
Investigations	Albumin globulin ratio abnormal
	Alanine aminotransferase increased
	Aspartate aminotransferase increased

	Liver function test abnormal
	Increased liver enzymes
	Blood creatinine increased
	Blood urea increased
	International normalized ration (INR) increased[6]
	Prothrombin time prolonged[6]
	Urine color abnormal[7]
Metabolism and nutrition disorders	Hypoglycemia[3]
	Anorexia
	Decreased appetite
Musculoskeletal and connective tissue disorders	Myalgia
	Myopathy
	Rhabdomyolysis[4]
	Musculoskeletal stiffness
Nervous system disorders	Dizziness
	Tremor
	Alteration of sense of smell
	Convulsions
	Ageusia
	Anosmia
	Loss of consciousness
	Parosmia
	Somnolence
	Dysgeusia
	Dyskinesia
	Headache
	Paraesthesia
Psychiatric disorders	Anxiety
	Insomnia
	Bad dreams
	Confusion
	Disorientation
	Hallucination
	Psychosis
	Depersonalization
	Depression
Respiratory, thoracic and mediastinal disorders	Asthma
	Pulmonary embolism
Skin and subcutaneous tissue disorders	Acne
	Dermatitis bullous
	Pruritus
	Hyperhidrosis
	Urticaria
	Rash
	Stevens Johnson syndrome
	Toxic epidermal necrosis
	Drug rash with eosinophilia and systemic symptoms (DRESS)
	Henoch-Schonlein purpura
Immune system disorders	Anaphylaxis
	Anaphylactic reaction
	Anaphylactoid reaction

	Hypersensitivity
	Myasthenia gravis
Ear and labyrinth disorders	Tinnitus
	Hearing loss[5]
	Deafness
	Hearing impaired
	Vertigo
Renal and urinary disorders	Interstitial nephritis
	Renal failure
Vascular disorders	Hemorrhage[6]
	Vasodilation

1 As with other macrolides, QT prolongation, ventricular tachycardia, and torsades de pointes have been reported with clarithromycin.
2 Hepatic dysfunction may be severe and is usually reversible. Hepatic failure with fatal outcome has been reported and generally has been associated with serious underlying diseases and/or concomitant medications.
3 There have been reports of hypoglycemia, some of which have occurred in patients on concomitant oral hypoglycemic agents or insulin.
4 In some of the reports of rhabdomyolysis, clarithromycin was administered concomitantly with other drugs known to be associated with rhabdomyolysis (such as statins, fibrates, colchicine or allopurinol).
5 There have been reports of hearing loss with clarithromycin which is usually reversible upon withdrawal of therapy
6 When clarithromycin is co-administered with warfarin.
7 Symptom of hepatic failure.

Colchicine

There have been post-marketing reports of colchicine toxicity with concomitant use of clarithromycin and colchicine, especially in the elderly, some of which occurred in patients with renal insufficiency. Deaths have been reported in some patients. See (**CONTRAINDICATIONS**), (**WARNINGS AND PRECAUTIONS, General**) and (**DRUG INTERACTIONS**, **Drug-Drug Interactions**).

DRUG INTERACTIONS

Serious Drug Interactions

- Concomitant administration of clarithromycin with astemizole, cisapride, pimozide, terfenadine, lovastatin, simvastatin, ergotamine, or dihydroergotamine is contraindicated. See **CONTRAINDICATIONS)** and (**DRUG INTERACTIONS, Drug-Drug Interactions**).
- Clarithromycin is an inhibitor of the cytochrome P450 3A isoform subfamily (CYP3A) and the P-glycoprotein transporter (P-gp). The concomitant administration of clarithromycin and drugs metabolized by CYP3A and/or transported by P-gp may lead to an increase in the plasma concentrations of the co-administered drug which could result in clinically significant safety concerns.

Overview

Many categories of drugs are metabolized by CYP3A and/or transported by P-gp located in the liver and in the intestine. Some drugs may inhibit or induce the activities of CYP3A and/or P-gp. Administration of such inhibitors or inducers may impact upon the metabolism. In some cases serum concentrations may be increased and in others decreased. Care must therefore be exercised

when co-administering such drugs.

Effects of clarithromycin on Other Drugs

Clarithromycin is an inhibitor of CYP3A and P-gp. This inhibition may lead to increased or prolonged serum levels of those drugs also metabolized by CYP3A or transported by P-gp when co-administered with clarithromycin. For such drugs the monitoring of their serum concentrations may be necessary.

Clarithromycin should be used with caution in patients receiving treatment with other drugs known to be CYP3A and/or P-gp substrates, especially if the CYP3A/P-gp substrate has a narrow safety margin (e.g., carbamazepine) and/or the substrate is extensively metabolized by CYP3A or transported by P-gp. Dosage adjustments may be considered, and when possible, serum concentrations of these drugs should be monitored closely in patients concurrently receiving clarithromycin.

With certain drugs, co-administration of clarithromycin is contraindicated or should be avoided (**Table 11**).

Effects of Other Drugs on Clarithromycin

Clarithromycin is a substrate of CYP3A. Co-administration of strong inducers of the cytochrome P450 metabolism system may accelerate the metabolism of clarithromycin and thus lower exposure to clarithromycin while increasing exposure to its metabolite 14-OH-clarithromycin which could impair the intended therapeutic effect. Furthermore, it might be necessary to monitor the plasma levels of the CYP3A inducer, which could be increased owing to the inhibition of CYP3A by clarithromycin (see also the relevant product information for the CYP3A4 inhibitor administered). Co-administration of potent CYP3A inhibitors may lead to increased exposure to clarithromycin and decreased exposure to its metabolite 14-OH-clarithromycin. Clarithromycin dosage adjustment or consideration of alternative treatments may be required.

Bi-Directional Drug Interactions

Bi-directional drug interactions are complex and may occur if both of the interacting drugs are substrates and inhibitors/inducers of CYP3A.

Additional Mechanisms

Interactions with clarithromycin have been reported with drugs metabolized by cytochrome P450 isoforms other than CYP3A system. Additional mechanisms, such as effects upon absorption, may also be responsible for interaction between drugs, including zidovudine and clarithromycin.

Drug-Drug Interactions

Some of the drug-drug interactions which have been reported between clarithromycin-macrolides and other drugs or drug categories are listed in **Table 11**. The drugs listed in this table are based on drug interactions case reports, clinical trials, or potential interactions due to the expected mechanism of the interaction.

Table 11 Established or Potential Drug-Drug Interactions with Clarithromycin			
Concomitant Medication	**Ref**	**Effect**	**Clinical Comments**
Astemizole* / Terfenadine	CT	terfenadine-acid metabolite concentrations increase ↑ QT interval	Macrolides have been reported to alter the metabolism of terfenadine resulting in increased serum levels of terfenadine which has occasionally been associated with cardiac arrhythmias such as QT prolongation, ventricular tachycardia, ventricular fibrillation and torsade de pointes. See (**CONTRAINDICATIONS**). In a study involving 14 healthy volunteers, the concomitant administration of clarithromycin tablets and terfenadine resulted in a 2- to 3-fold increase in the serum levels of the acid metabolite of terfenadine, MDL 16, 455, and in prolongation of the QT interval. Similar effects have been observed with concomitant administration of astemizole and other macrolides.
Atazanavir	CT	↑ clarithromycin levels ↑ atazanavir AUC	Both clarithromycin and atazanavir are substrates and inhibitors of CYP3A, and there is evidence of a bi-directional drug interaction. Co-administration of clarithromycin (500 mg twice daily) with atazanavir (400 mg once daily) resulted in a 2-fold increase in exposure to clarithromycin and a 70% decrease in exposure to 14-OH-clarithromycin, with a 28% increase in the AUC of atazanavir. Because of the large therapeutic window for clarithromycin, no dosage reduction should be necessary in patients with normal renal function. For patients with moderate renal function (creatinine clearance 30 to 60 mL/min), the dose of clarithromycin should be decreased by 50%. For patients with creatinine clearance < 30 mL/min, the dose of clarithromycin should be decreased by 75% using an appropriate clarithromycin formulation. Doses of clarithromycin greater than 1000 mg per day should not be co-administered with protease inhibitors.
Carbamazepine	C	↑ levels of carbamazepine	Clarithromycin administration in patients receiving carbamazepine has been reported to cause increased levels of carbamazepine. Blood level monitoring of carbamazepine should be considered.
Cisapride* / Pimozide	C	↑ levels of cisapride ↑ levels of pimozide	Elevated cisapride levels have been reported in patients receiving clarithromycin and cisapride concomitantly. This may result in QT prolongation and cardiac arrhythmias including ventricular tachycardia, ventricular fibrillation and torsade de pointes. Similar effects have been observed in patients taking clarithromycin and pimozide concomitantly. See (**CONTRAINDICATIONS**).
Colchicine	C	Potential colchicine toxicity	Colchicine is a substrate for both CYP3A and the efflux transporter, P-gp. Clarithromycin and other macrolides are known to inhibit CYP3A and P-gp. When clarithromycin and colchicine are administered together, inhibition of P-gp and/or CYP3A by clarithromycin may lead to increased exposure to colchicine. Patients should be monitored for clinical symptoms of colchicine toxicity. See (CONTRAINDICATIONS), (**WARNINGS AND PRECAUTIONS, General**) and (**ADVERSE REACTIONS, Post-Market Adverse Drug Reactions**).

Cyclosporine	C	↑ levels of cyclosporine	There have been reports of elevated cyclosporine serum concentrations when clarithromycin and cyclosporine are used concurrently. Cyclosporine levels should be monitored and the dosage should be adjusted as necessary. Patients should also be monitored for increased cyclosporine toxicity.
Didanosine	CT	No change in didanosine pharmacokinetics in HIV-infected patients (n=12)	Simultaneous administration of clarithromycin tablets and didanosine to 12 HIV-infected adult patients resulted in no statistically significant change in didanosine pharmacokinetics.
Digoxin	C	↑ levels of digoxin	Digoxin is thought to be a substrate for the efflux transporter, P-gp. Clarithromycin is known to inhibit P-gp. When clarithromycin and digoxin are administered together, inhibition of P-gp by clarithromycin may lead to increased exposure to digoxin. Elevated digoxin serum concentrations have been reported in patients receiving clarithromycin tablets and digoxin concomitantly. In post-marketing surveillance some patients have shown clinical signs consistent with digoxin toxicity, including potentially fatal arrhythmias. Serum digoxin levels should be carefully monitored while patients are receiving digoxin and clarithromycin simultaneously.
Disopyramide / Quinidine	C	↑ levels of disopyramide, resulting in ventricular fibrillation & QT prolongation (rarely reported) Torsades de pointes	Increased disopyramide plasma levels, resulting in ventricular fibrillation and QT prolongation, coincident with the co-administration of disopyramide and clarithromycin have rarely been reported. There have been post-marketed reports of torsades de pointes occurring with concurrent use of clarithromycin and quinidine or disopyramide. Electrocardiograms should be monitored for QTc prolongation during co-administration of clarithromycin with these drugs. Serum levels of these medications should be monitored during clarithromycin therapy.
Ergotamine / Dihydroergotamine	C	Potential ischemic reactions Potential ergot toxicity	Post-marketing reports indicate that co-administration of clarithromycin with ergotamine or dihydroergotamine has been associated with acute ergot toxicity characterized by severe peripheral vasospasm, dysesthesia, and ischemia of the extremities and other tissues including the central nervous system. Concomitant administration of clarithromycin and these medicinal products is contraindicated. See (**CONTRAINDICATIONS**)
Etravirine	CT	↓ clarithromycin ↑14-OH-clarithromycin	Clarithromycin exposure was decreased by etravirine; however, concentrations of the active metabolite, 14- OH-clarithromycin, were increased. Because 14-OH-clarithromycin has reduced activity against *Mycobacterium avium* complex (MAC), overall activity against this pathogen may be altered; therefore alternatives to clarithromycin should be considered for the treatment of MAC.
Fluconazole	CT	↑ clarithromycin C_{min} & AUC	Concomitant administration of fluconazole 200 mg daily and clarithromycin 500 mg twice daily to 21 healthy volunteers led to increases in the mean steady-state clarithromycin C_{min} and AUC of 33% and 18%, respectively. Steady-state concentrations of 14-OH-clarithromycin were not significantly affected by concomitant administration of fluconazole. No clarithromycin dose adjustment is necessary.

Itraconazole	CT, P	↑ levels of clarithromycin ↑ levels of itraconazole	Both clarithromycin and itraconazole are substrates and inhibitors of CYP3A, leading to a bi-directional drug interaction. Clarithromycin may increase the plasma levels of itraconazole, while itraconazole may increase the plasma levels of clarithromycin. Patients taking itraconazole and clarithromycin concomitantly should be monitored closely for signs or symptoms of increased or prolonged pharmacologic effect.
Lansoprazole / Omeprazole	CT	Mild change of lansoprazole and 14-OH-clarithromycin concentrations ↑ omeprazole C_{max} & AUC_{0-24} ↑ levels of clarithromycin	One study demonstrated that concomitant administration of clarithromycin and lansoprazole resulted in mild changes of serum concentrations of lansoprazole and 14-OH-clarithromycin. However, no dosage adjustment is considered necessary based on these data. Clarithromycin 500 mg three times daily was given in combination with omeprazole 40 mg once daily to healthy subjects. The steady-state plasma concentrations of omeprazole were increased (i.e., $C_{max,}$ AUC_{0-24}, and $t_{1/2}$ increased by 30%, 89%, and 34%, respectively), by concomitant administration of clarithromycin. The mean 24-hour gastric pH value was 5.2 when omeprazole was administered alone and 5.7 when co-administered with clarithromycin. To a lesser extent, omeprazole administration increases the serum concentrations of clarithromycin. Omeprazole administration also increases tissue and mucus concentrations of clarithromycin.
HMG-CoA Reductase Inhibitors Lovastatin / Simvastatin Atorvastatin Rosuvastatin	C C	Rhabdomyolysis (rarely reported)	Concomitant use of clarithromycin with lovastatin or simvastatin is contraindicated. See (**CONTRAINDICATIONS**) and (**WARNINGS AND PRECAUTIONS**, HMG-CoA Reductase Inhibitors). Rhabdomyolysis coincident with the co-administration of clarithromycin and the HMG-CoA reductase inhibitors, lovastatin and simvastatin, has rarely been reported. Rare reports of rhabdomyolysis have also been reported in patients taking atorvastatin or rosuvastatin concomitantly with clarithromycin. Concurrent use of atorvastatin and clarithromycin may result in increased atorvastatin exposure.
Oral Hypoglycemic Agents Insulin	C P	Hypoglycemia	The concomitant use of clarithromycin and oral hypoglycaemic agents and/or insulin can result in significant hypoglycaemia. With certain hypoglycaemic drugs such as nateglinide, pioglitazone, repaglinide and rosiglitazone, inhibition of CYP3A enzyme by clarithromycin may be involved and could cause hypoglycaemia when used concomitantly. Careful monitoring of glucose is recommended.
Rifabutin	C	↓ clarithromycin ↑ rifabutin	Clarithromycin has been reported to increase serum and tissue concentration of rifabutin and thus may increase the risk of toxicity. Clarithromycin levels decrease when co-administered with rifabutin. Concomitant administration of clarithromycin and rifabutin in the treatment of *Mycobacterial Avium* complex infections resulted in rifabutin-associated uveitis. A case control study in AIDS patients showed that concomitant administration of rifabutin and clarithromycin resulted in an approximately 50% reduction in serum clarithromycin

			concentration, approximately 77% increase in the area under the plasma concentration-time curve of rifabutin, and a 236% increase in the area under the plasma concentration-time curve of rifabutin's active metabolite. The increase in rifabutin and/or its metabolite contributed to the development of uveitis (the incidence of uveitis was 14% in patients weighing >65 kg, 45% in patients between 55 and 65 kg, and 64%in patients <55 kg).
Ritonavir / Indinavir	CT	↑ clarithromycin C_{max}, C_{min}, & AUC ↑ indinavir AUC ↑ clarithromycin AUC	A pharmacokinetic study demonstrated that the concomitant administration of ritonavir 200 mg every 8 hours and clarithromycin 500 mg every 12 hours resulted in a marked inhibition of the metabolism of clarithromycin. The clarithromycin C_{max} increased by 31%, C_{min} increased 182% and AUC increased by 77% with concomitant administration of ritonavir. An essentially complete inhibition of the formation of 14-[R]-hydroxy-clarithromycin was noted. Because of the large therapeutic window for clarithromycin, no dosage reduction should be necessary in patients with normal renal function. However, for patients with renal impairment, the following dosage adjustments should be considered: For patients with creatinine clearance 30 to 60 mL/min the dose of clarithromycin should be reduced by 50%. For patients with creatinine clearance < 30 mL/min the dose of clarithromycin should be decreased by 75%. Doses of clarithromycin greater than 1g/day should not be co-administered with ritonavir. Similar dose adjustments should be considered in patients with reduced renal function when ritonavir is used as a pharmacokinetic enhancer with other HIV protease inhibitors including atazanavir and saquinavir. One study demonstrated that the concomitant administration of clarithromycin and indinavir resulted in a metabolic interaction; the clarithromycin AUC increased by 53% and the indinavir AUC was increased by 20%, but the individual variation was large. No dose adjustment is necessary with normal renal function.
Saquinavir	CT	↑ saquinavir AUC and C_{max} ↑ clarithromycin AUC	Both clarithromycin and saquinavir are substrates and inhibitors of CYP3A, and there is evidence of a bi-directional drug interaction. Concomitant administration of clarithromycin (500 mg twice daily) and saquinavir (soft gelatin capsules, 1200 mg three times daily) to 12 healthy volunteers resulted in steady-state AUC and C_{max} values of saquinavir which were 177% and 187% higher than those seen with saquinavir alone. Clarithromycin AUC and C_{max} values were approximately 40% higher than those seen with clarithromycin alone. No dose adjustment is required when the 2 drugs are co-administered for a limited time at the doses/formulations studied. Observations from drug interaction studies using the soft gelatin capsule formulation may not be representative of the effects seen using the saquinavir hard gelatin capsule. Observations from drug interaction studies performed with saquinavir alone may not be representative of the effects seen with saquinavir/ritonavir therapy. When saquinavir is co-administered with ritonavir, consideration should be given to the potential effects of ritonavir on

			clarithromycin.
Tacrolimus	P	Potential ↑ in tacrolimus concentrations	Concomitant administration of tacrolimus and clarithromycin may result in increased plasma levels of tacrolimus and increased risk of toxicity.
Theophylline	P	Potential ↑ in theophylline concentrations	Clarithromycin use in patients who are receiving theophylline may be associated with an increase of serum theophylline concentrations. Monitoring of serum theophylline concentrations should be considered for patients receiving high doses of theophylline or with baseline concentrations in the upper therapeutic range.
Tolterodine	P	↑ serum tolterodine concentrations	The primary route of metabolism for tolterodine is via the 2D6 isoform of cytochrome P450 (CYP2D6). However, in a subset of the population devoid of CYP2D6, the identified pathway of metabolism is via CYP3A. In this population subset, inhibition of CYP3A results in significantly higher serum concentrations of tolterodine. A reduction of tolterodine dosage may be necessary in the presence of CYP3A inhibitors, such as clarithromycin in the CYP2D6 poor metabolizer population.
Calcium Channel Blockers Verapamil Amlodipine Diltiazem	C	Potential ↑ in verapamil concentrations	Hypotension, bradyarrhythmias, and lactic acidosis have been observed in patients receiving concurrent verapamil, belonging to the calcium channel blockers drug class.
Oral Anticoagulants Warfarin / Acenocoumarol	C	↑ anticoagulant effect	There have been reports of increased anticoagulant effect when clarithromycin and oral anticoagulants are used concurrently. Anticoagulant parameters should be closely monitored. Adjustment of the anticoagulant dose may be necessary. Clarithromycin has also been reported to increase the anticoagulant effect of acenocoumarol. There is a risk of serious hemorrhage and significant elevations in International Normalized Ratio (INR) and prothrombin time when clarithromycin is co-administered with warfarin. INR and prothrombin times should be frequently monitored while patients are receiving clarithromycin and oral anticoagulants concurrently. See (**WARNINGS AND PRECAUTIONS, Use with Other Drugs,** Oral Anticoagulants).
Zidovudine	C	Potential ↓ in zidovudine concentrations	Simultaneous oral administration of clarithromycin tablets and zidovudine to HIV-infected adult patients may result in decreased steady-state zidovudine concentrations. Clarithromycin appears to interfere with the absorption of simultaneously administered oral zidovudine, and therefore, this interaction can be largely avoided by staggering the doses of clarithromycin and zidovudine. This interaction does not appear to occur in pediatric HIV-infected patients taking clarithromycin suspension with zidovudine or dideoxyinosine. Similar interaction studies have not been conducted with clarithromycin extended-release (ER) and zidovudine.
Phosphodiesterase inhibitors	P	↑ phosphodiesterase inhibitor exposure	Sildenafil, tadalafil, and vardenafil are metabolized, at least in part, by CYP3A, and CYP3A may be inhibited by concomitantly administered clarithromycin. Co-administration of clarithromycin with sildenafil, tadalafil or vardenafil would likely result in

			increased phosphodiesterase inhibitor exposure. Reduction of sildenafil, tadalafil and vardenafil dosages should be considered when these drugs are co-administered with clarithromycin.
Triazolobenzodiaz-epines (e.g., triazolam, alprazolam) Other related benzodiazepines (e.g., midazolam)	CT, C, P	↑ midazolam AUC	When midazolam was co-administered with clarithromycin tablets (500 mg twice daily), midazolam AUC was increased 2.7-fold after intravenous administration of midazolam and 7-fold after oral administration. Concomitant administration of oral midazolam and clarithromycin should be avoided. If intravenous midazolam is co-administered with clarithromycin, the patient must be closely monitored to allow dose adjustment of midazolam. The same precautions should also apply to other benzodiazepines that are metabolized by CYP3A, including triazolam and alprazolam. For benzodiazepines which are not dependent on CYP3A for their elimination (temazepam, nitrazepam, lorazepam), a clinically important interaction with clarithromycin is unlikely. There have been post-marketing reports of drug interactions and central nervous system (CNS) effects (e.g., somnolence and confusion) with the concomitant use of clarithromycin and triazolam. Monitoring the patient for increased CNS pharmacological effects is suggested.
Other drugs metabolized by CYP3A (e.g., alfentanil, bromocriptine, cilostazol, methylprednisolone, vinblastine)	C, P	Potential increase in serum concentration	Interactions with erythromycin and/or clarithromycin have been reported with a number of other drugs metabolized by CYP3A, such as alfentanil, bromocriptine, cilostazol, methylprednisolone, or vinblastine. Serum concentrations of drugs metabolized by CYP3A should be monitored closely in patients concurrently receiving erythromycin or clarithromycin.
Other drugs metabolized by cytochrome P450 isoforms other than CYP3A (e.g., hexobarbital, phenytoin, and valproate)	C, P	Potential change in serum concentration	Interactions with erythromycin and/or clarithromycin have been reported with drugs metabolized by other cytochrome P450 isoforms (i.e., not CYP3A), such as hexobarbital, phenytoin, and valproate. Serum concentrations of these drugs should be monitored closely in patients concurrently receiving erythromycin or clarithromycin.
Other drug inducers of the cytochrome P450 system (e.g, efavirenz, nevirapine, rifampin, rifabutin, rifampicin, phenobarbital, rifapentine)	CT, P	↓ levels of clarithromycin	Strong inducers of the cytochrome P450 metabolism system such as efavirenz, nevirapine, rifampin, rifabutin, rifampicin, phenobarbital and rifapentine* may accelerate the metabolism of clarithromycin and thus lower the plasma levels of clarithromycin, while increasing those of 14-OH-clarithromycin, a metabolite that is also microbiologically active. Since the microbiological activities of clarithromycin and 14-OH-clarithromycin are different for different bacteria, the intended therapeutic effect could be impaired during concomitant administration of clarithromycin and enzyme inducers.
Legend: C = Case Study; CT = Clinical Trial; P = Potential Interactions with other drugs have not been established. * not marketed in Canada.			

Combination Therapy with Omeprazole and/or Amoxicillin

For more information on drug interactions for omeprazole and amoxicillin, refer to their respective Product Monographs, under **DRUG INTERACTIONS**.

Drug-Food Interactions

Clarithromycin tablets may be given with or without meals.

Drug-Herb Interactions

St. John's Wort (*Hypericum perforatum*) is an inducer of CYP3A and may induce the metabolism of clarithromycin. This may result in sub-therapeutic levels of clarithromycin leading to reduced efficacy.

Drug-Laboratory Interactions

Interactions with laboratory tests have not been established.

Drug-Lifestyle Interactions

Effects on Ability to Drive and Use Machines

There are no data on the effect of clarithromycin on the ability to drive or use machines. The potential for dizziness, vertigo, confusion and disorientation, which may occur with the medication, should be taken into account before patients drive or use machines.

DOSAGE AND ADMINISTRATION

RAN-CLARITHROMYCIN tablets cannot be used in children less than 12 years old and the tablet cannot be divided or split in half.

Dosing Considerations

RAN-CLARITHROMYCIN tablets may be given with or without meals.

In patients with both hepatic and renal impairments or in the presence of severe renal impairment, decreased dosage of clarithromycin or prolonged dosing intervals might be appropriate. See (**DOSAGE AND ADMINISTRATION, Recommended Dose and Dosage Adjustment**).

In children with renal impairment and a creatinine clearance < 30 mL/min, the dosage of clarithromycin should be reduced by one-half, i.e., up to 250 mg once daily, or 250 mg twice daily in more severe infections. Dosage should not be continued beyond 14 days in these patients.

Recommended Dose and Dosage Adjustment

Adults with Respiratory Tract or Skin Infections

The adult dosage of RAN-CLARITHROMYCIN is 250 mg to 500 mg every 12 hours (**Table 12**) for 7 to 14 days. For infections caused by less susceptible organisms, the upper dosage should be used.

Table 12 Adult Dosage Guidelines		
Infection	**Dosage (b.i.d.)**	**Duration**
Upper Respiratory Tract Pharyngitis/tonsillitis Acute maxillary sinusitis	**250-500 mg** 250 mg 500 mg	 10 days 7 to 14 days
Lower Respiratory Tract Acute exacerbation of chronic bronchitis and pneumonia	**250-500 mg** 250-500 mg	7 to 14 days
Uncomplicated Skin and Skin Structure Infections	**250 mg**	7 to 14 days
Legend: b.i.d. = twice daily		

In the treatment of Group A streptococcus infections, therapy should be continued for 10 days. The usual drug of choice in the treatment of streptococcal infections and the prophylaxis of rheumatic fever is penicillin administered by either the intramuscular or the oral route.

Clarithromycin is generally effective in the eradication of *S. pyogenes* from the nasopharynx; however, data establishing the efficacy of clarithromycin in the subsequent prevention of rheumatic fever are not presently available.

Renal Impairment

In patients with renal impairment and a creatinine clearance < 30 mL/min., the dosage of clarithromycin tablets should be reduced by one-half, i.e., 250 mg once daily, or 250 mg twice daily in more severe infections. Dosage should not be continued beyond 14 days in these patients. The safety and efficacy of 500 mg clarithromycin in patients with severe renal impairment has not been established.

Hepatic Impairment

In patients with both hepatic and renal impairments or in the presence of severe renal impairment, decreased dosage of clarithromycin or prolonged dosing intervals may be appropriate. Clarithromycin may be administered without dosage adjustment in the presence of hepatic impairment if there is normal renal function.

Eradication of *Helicobacter Pylori*

Triple Therapy: Clarithromycin/omeprazole/amoxicillin

The recommended dose is clarithromycin 500 mg twice daily in conjunction with omeprazole 20 mg daily and amoxicillin 1 g twice daily for 10 days. See (**CLINICAL TRIALS, Eradication of *Helicobacter pylori*, Triple Therapy: clarithromycin/omeprazole/amoxicillin**).

For more information on omeprazole or amoxicillin, refer to their respective Product Monographs, under **DOSAGE AND ADMINISTRATION**.

(For additional information on the use of clarithromycin in triple therapy for the treatment of *H. pylori* infection and active duodenal ulcer recurrence, refer to the Hp-PAC® Product Monograph.)

Dual Therapy: Clarithromycin/omeprazole

In patients who are sensitive to penicillin-based therapy (e.g. amoxicillin), dual therapy with clarithromycin and omeprazole may provide a feasible alternative.

The recommended dose is clarithromycin 500 mg three times daily plus omeprazole 40 mg once daily for 14 days, followed by 20 mg omeprazole once daily for 14 days. See (**CLINICAL TRIALS, Eradication of *Helicobacter pylori*, Dual Therapy: clarithromycin/omeprazole**).

Optimal therapeutic regimens consisting of a shorter treatment duration for the eradication of *H. pylori* are yet to be determined.

Adults with Mycobacterial Infections

Prophylaxis

The recommended dose of clarithromycin tablets for the prevention of disseminated *M. avium* disease is 500 mg twice daily.

Treatment

Clarithromycin is recommended as the primary agent for the treatment of disseminated infection due to MAC. Clarithromycin should be used in combination with other antimycobacterial drugs which have shown *in vitro* activity against MAC, including ethambutol and rifampin. Although no controlled clinical trial information is available for combination therapy with clarithromycin, the U.S. Public Health Service Task Force has provided recommendations for the treatment of MAC.

The recommended dose for mycobacterial infections in adults is 500 mg twice daily.

Treatment of disseminated MAC infections in AIDS patients should continue for life if clinical and mycobacterial improvement are observed.

Renal Impairment

Based on a study done with clarithromycin, patients with severe renal impairment (creatinine clearance < 30 mL/min) have greater clarithromycin exposure than patients with normal renal function (creatinine clearance ≥ 80 mL/min). Clarithromycin C_{max} was about 3.3 times higher and AUC was about 4.2 times higher in the patients with severe renal impairment. The maximum daily clarithromycin dose for patients with severe renal impairment is 500 mg. The safety and efficacy of 500 mg clarithromycin in patients with severe renal impairment has not been established.

In the same study, patients with moderate renal impairment (creatinine clearance 30 to 79 mL/min) had greater clarithromycin exposure than patients with normal renal function, but the elevations were much less than those observed in severe renal impairment. Compared to the subjects with normal renal function, the clarithromycin C_{max} was about 52% higher and the AUC

was about 74% higher in the patients with moderate renal impairment. No clarithromycin dose adjustment is required for patients with moderate renal impairment.

Hepatic Impairment

Based on studies done with clarithromycin, no adjustment of dosage is necessary for subjects with moderate or severe hepatic impairment but with normal renal function.

Children with Mycobacterial Infections

Clarithromycin is recommended as the primary agent for the treatment of disseminated infection due to MAC. Clarithromycin should be used in combination with other antimycobacterial drugs which have shown *in vitro* activity against MAC, including ethambutol and rifampin. Although no controlled clinical trial information is available for combination therapy with clarithromycin, the U.S. Public Health Service Task Force has provided recommendations for the treatment of MAC.

RAN-CLARITHROMYCIN tablets cannot be used in children less than 12 years old and the tablet cannot be divided or split in half. In children, the recommended dose is 7.5 mg/kg twice daily up to 500 mg twice daily clarithromycin per day in 2 divided doses.

Note: RAN-CLARITHROMYCIN is available as a tablet. Therefore, when the oral suspension treatment is recommended, the product monograph for clarithromycin oral suspension should be consulted.

Treatment of disseminated MAC infections in AIDS patients should continue for life if clinical and mycobacterial improvement are observed.

Missed Dose

If a dose of clarithromycin is missed, the patient should take the dose as soon as possible and then return to their normal scheduled dose. However, if a dose is skipped, the patient should not double the next dose.

Administration

RAN-CLARITHROMYCIN tablets cannot be used in children less than 12 years old and the tablet cannot be divided or split in half.

RAN-CLARITHROMYCIN tablets may be taken with or without food.

OVERDOSAGE

For management of a suspected drug overdose, contact your regional Poison Control Centre immediately.

Reports indicate that the ingestion of large amounts of clarithromycin can be expected to produce gastrointestinal symptoms. Adverse reactions accompanying overdosage should be treated by the prompt elimination of unabsorbed drug and supportive measures.

Clarithromycin is protein bound (70%). No data are available on the elimination of clarithromycin by hemodialysis or peritoneal dialysis.

ACTION AND CLINICAL PHARMACOLOGY

Mechanism of Action

General

Clarithromycin exerts its antibacterial action by binding to the 50S ribosomal subunit of susceptible bacteria and suppressing protein synthesis.

Pharmacodynamics

Eradication of *Helicobacter pylori*

H. pylori is now established as a major etiological factor in duodenal ulcer disease. The presence of *H. pylori* may damage the mucosal integrity due to the production of enzymes (catalase, lipases, phospholipases, proteases, and urease), adhesins and toxins; the generated inflammatory response contributes to mucosal damage.

The concomitant administration of an antimicrobial(s) such as clarithromycin and an antisecretory agent, improves the eradication of *H. pylori* as compared to individual drug administration. The higher pH resulting from antisecretory treatment optimizes the environment for the pharmacologic action of the antimicrobial agent(s) against *H. pylori.*

Pharmacokinetics

A summary of clarithromycin pharmacokinetic parameters following the administration of clarithromycin film-coated tablets is provided in **Table 13**. For details see **DETAILED PHARMACOLOGY, Pharmacokinetics** in PART II of the Product Monograph.

Table 13 Clarithromycin Pharmacokinetic Parameters following the Administration of Clarithromycin Film-coated Tablets				
Single dose*	**C_{max} (mg/L)**	**t_{max} (hr)**	**$t_{½}$ (hr)**	**AUC_{0-t} (mg•hr/L)**
250 mg Mean	1	1.5	2.7	5.47
500 mg Mean	1.77	2.2	---	11.66
Multiple Doses**				
250 mg b.i.d. Mean	1	---	3 to 4	6.34
500 mg b.i.d. Mean	3.38	2.1	5 to 7	44.19
* Single doses (from **Table 33** and **Table 34**) ** Multiple doses (from **Table 34**) Legend: b.i.d. = twice daily				

Absorption

The absolute bioavailability of 250 mg and 500 mg clarithromycin tablets is approximately 50%. Food slightly delays the onset of clarithromycin absorption but does not affect the extent of bioavailability. Therefore, clarithromycin tablets may be given without regard to meals.

In fasting healthy human subjects, peak serum concentrations are attained within 2 hours after oral dosing. Steady-state peak serum clarithromycin concentrations, which are attained within 2 to 3 days, are approximately 1 mg/L with a 250 mg dose twice daily and 2 to 3 mg/L with a 500 mg dose twice daily. The elimination half-life of clarithromycin is about 3 to 4 hours with 250 mg twice daily dosing but increases to about 5 to 7 hours with 500 mg administered twice daily.

Clarithromycin displays non-linear pharmacokinetics at clinically relevant doses, producing greater than proportional increases in AUC with increasing dose. The degree of non-linearity is reduced on chronic clarithromycin administration (i.e., at steady-state). The non-linearity of the pharmacokinetics of the principle metabolite, 14-OH-clarithromycin, is slight at the recommended doses of 250 mg and 500 mg administered twice daily. With 250 mg twice daily, 14-OH-clarithromycin attains a peak steady-state concentration of about 0.6 mg/L and has an elimination half-life of 5 to 6 hours. With a 500 mg twice daily dose, the peak steady-state of 14 OH-concentrations of clarithromycin are slightly higher (up to 1 mg/L) and its elimination half-life is about 7 hours. With either dose, the steady-state concentration of this metabolite is generally attained within 2 to 3 days.

Adult Patients with HIV

Steady-state concentrations of clarithromycin and 14-OH-clarithromycin observed following administration of 500 mg doses of clarithromycin twice a day to adult patients with HIV infection were similar to those observed in healthy volunteers. However, at the higher clarithromycin doses which may be required to treat mycobacterial infections, clarithromycin concentrations can be much higher than those observed at 500 mg clarithromycin doses. In adult HIV-infected patients taking 2000 mg/day in two divided doses, steady-state clarithromycin C_{max}

values ranged from 5 to10 mg/L. C_{max} values as high as 27 mg/L have been observed in HIV-infected adult patients taking 4000 mg/day in two divided doses of clarithromycin tablets.

Elimination half-lives appeared to be lengthened at these higher doses as well. The higher clarithromycin concentrations and longer elimination half-lives observed at these doses are consistent with the known non-linearity in clarithromycin pharmacokinetics.

Clarithromycin and omeprazole

Clarithromycin 500 mg three times daily and omeprazole 40 mg once daily were studied in fasting healthy adult subjects. When clarithromycin was given alone as 500 mg every 8 hours, the mean steady-state C_{max} value was approximately 3.8 mcg/mL and the mean C_{min} value was approximately 1.8 mcg/mL. The mean AUC_{0-8} for clarithromycin was 22.9 mcg•hr/mL. The T_{max} and half-life were 2.1 hours and 5.3 hours, respectively, when clarithromycin was dosed at 500 mg three times daily. When clarithromycin was administered with omeprazole, increases in omeprazole half-life and AUC_{0-24} were observed. For all subjects combined, the mean omeprazole AUC_{0-24} was 89% greater and the harmonic mean for omeprazole $t_{½}$ was 34% greater when omeprazole was administered with clarithromycin than when omeprazole was administered alone. When clarithromycin was administered with omeprazole, the steady-state C_{max}, C_{min}, and AUC_{0-8} of clarithromycin were increased by 10%, 27%, and 15%, respectively over values achieved when clarithromycin was administered with placebo.

Distribution

Clarithromycin distributes readily into body tissues and fluids, and provides tissue concentrations that are higher than serum concentrations. Examples from tissue and serum concentrations are presented in **Table 14**.

Table 14
Representative Clarithromycin Tissue and Serum Concentrations Following the Administration of 250 mg b.i.d of Clarithromycin Film-Coated Tablets

	Concentrations	
Tissue Type	**Tissue (mcg/g)**	**Serum (mg/L)**
Tonsil	1.6	0.8
Lung	8.8	1.7
Leukocytes*	9.2	1.0

* *in vitro* data.
Legend: b.i.d. = twice daily

Metabolism

Clarithromycin is principally excreted by the liver and kidney. The major metabolite found in urine is 14-OH-clarithromycin.

Excretion

At 250 mg twice daily, approximately 20% of an orally administered dose of clarithromycin film-coated tablet is excreted in the urine as the unchanged parent drug. The urinary excretion of unchanged clarithromycin is somewhat greater (approximately 30%) with 500 mg twice daily

dosing. The renal clearance of clarithromycin is, however, relatively independent of the dose size and approximates the normal glomerular filtration rate. The major metabolite found in urine is 14-OH-clarithromycin which accounts for an additional 10 to 15% of the dose with twice daily dosing at either 250 mg or 500 mg. Most of the remainder of the dose is eliminated in the feces, primarily via the bile. About 5 to 10% of the parent drug is recovered from the feces. Fecal metabolites are largely products of N-demethylation, 14-hydroxylation or both.

Special Populations and Conditions

Pediatrics

RAN-CLARITHROMYCIN cannot be used in children less than 12 years old.

Geriatrics

Dosage adjustment should be considered in elderly with severe renal impairment. In a steady-state study in which healthy elderly subjects (age 65 to 81 years old) were given 500 mg of clarithromycin every 12 hours, the maximum concentrations of clarithromycin and 14-OH-clarithromycin were increased. The AUC was also increased. These changes in pharmacokinetics parallel known age-related decreases in renal function. In clinical trials, elderly patients did not have an increased incidence of adverse events when compared to younger patients.

Hepatic Insufficiency

The steady-state concentrations of clarithromycin in subjects with impaired hepatic function did not differ from those in normal subjects; however, the 14-OH-clarithromycin concentrations were lower in the hepatically impaired subjects. The decreased formation of 14-OH-clarithromycin was at least partially offset by an increase in renal clearance of clarithromycin in subjects with impaired hepatic function when compared to healthy subjects. See (**WARNINGS AND PRECAUTIONS, Hepatic/Biliary/Pancreatic)** and (**DOSAGE AND ADMINISTRATION, Recommended Dose and Dosage Adjustment**).

Renal Insufficiency

The elimination of clarithromycin was impaired in patients with impaired renal function. The daily dose of clarithromycin should be limited to 500 mg in patients with severe renal impairment (creatinine clearance < 30 mL/min). See (**WARNINGS AND PRECAUTIONS, Renal**) and (**DOSAGE AND ADMINISTRATION, Recommended Dose and Dosage Adjustment**).

STORAGE AND STABILITY

Store film-coated tablets between 15° C and 25° C in a tightly closed container. Protect from light.

DOSAGE FORMS, COMPOSITION AND PACKAGING

DOSAGE FORMS AND COMPOSITION

Medicinal Ingredient:

Each yellow, oval-shaped, biconvex, film-coated tablet, debossed with **'C1'** on one side and plain on other side contains 250 mg of clarithromycin for oral administration.

Each light yellow, oval-shaped, biconvex, film-coated tablet, debossed with **'C2'** on one side and plain on other side contains 500 mg of clarithromycin for oral administration.

Non-Medicinal Ingredients: Each RAN-CLARITHROMYCIN tablet also contains the following non-medicinal ingredients:

250 mg tablet:	croscarmellose sodium, D&C yellow #10 aluminum lake, hydroxypropyl cellulose, hypromellose, magnesium stearate, microcrystalline cellulose, povidone, propylene glycol, purified talc, silica, colloidal anhydrous; stearic acid and titanium dioxide.
500 mg tablet:	croscarmellose sodium, D&C yellow #10 aluminum lake, hydroxypropyl cellulose, hypromellose, magnesium stearate, microcrystalline cellulose, povidone, propylene glycol, purified talc, silica, colloidal anhydrous; stearic acid and titanium dioxide.

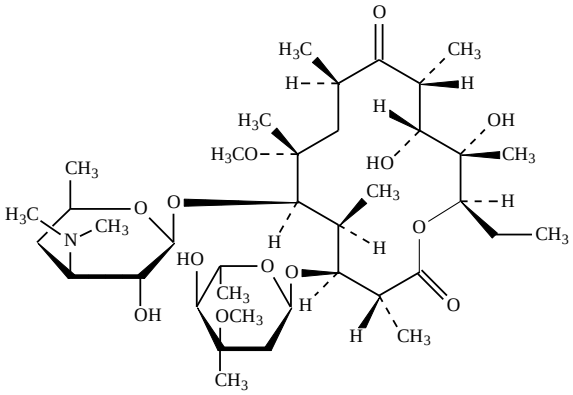
PACKAGING

RAN-CLARITHROMYCIN (clarithromycin tablets, USP) 250 mg and 500 mg are supplied in HDPE bottles of 100 and 500.

PART II: SCIENTIFIC INFORMATION

PHARMACEUTICAL INFORMATION

Drug Substance

Proper name:	Clarithromycin
Chemical name:	(3R*, 4S*, 5S*, 6R*, 7R*, 9R*, 11R*, 12R*, 13S*, 14R*)-4-[(2,6-dideoxy-3-C-methyl-3-0-methyl-alpha-L-ribo-hexopyranosyl)oxy]-14-ethyl-12,13- dihydroxy-7-methoxy-3,5,7,9,11,13-hexamethyl-6-[[3,4,6-trideoxy-3-(dimethylamino)-beta-D-xylo-hexopyranosyl]oxy]oxacyclotetradecane-2-10-dione.
Molecular formula:	$C_{38}H_{69}NO_{13}$
Molecular mass:	748 g/mol
Structural formula:	

Clarithromycin

Physicochemical properties:	Clarithromycin is a white or almost white crystalline powder. It is practically insoluble in water, soluble in acetone and in methylene chloride, slightly soluble in methanol. The pK_a of clarithromycin is 8.48; the pH of a 0.2% (Methanol: Water, 5:95) slurry is 8.8. The partition coefficient of clarithromycin is influenced by the pH of the water phase and polarity of the organic phase. For octanol (dipole moment = 0.25): water, the partition co-efficient varies from 5.63 to 46.0 for pH water increases from 2 to 8. The melting point of clarithromycin is approximately 225°C.

CLINICAL TRIALS

Comparative Bioavailability Studies

A blinded, balanced, randomized, two-treatment, two-period, two-sequence, single-dose, crossover, bioequivalence study comparing RAN-CLARITHROMYCIN 500 mg film-coated tablets (Ranbaxy Pharmaceuticals Canada Inc.) with [Pr]BIAXIN® BID (containing clarithromycin 500 mg) (Abbott Laboratories Limited, Canada) in 24 healthy, adult, male, human subjects under fasting condition was conducted.

Table 15
Summary Table Of The Comparative Bioavailability Data
Clarithromycin (1 x 500 mg Tablets)
From measured data
Least Square Geometric Mean/Arithmetic Mean (CV %)

Parameter	Test*	Reference†	% Ratio of LS Geometric Means	90% Confidence Interval
AUC_{0-T} (µg*hr/mL)	22.90/ 23.50 (21.9)	24.60/ 25.89 (34.6)	93.08	85.28-101.60
AUC_{0-I} (µg*hr/mL)	25.24/ 25.68 (19.2)	26.20/ 27.68 (35.9)	94.46	86.77-102.84
C_{max} (µg/mL)	2.72/ 2.88 (36.4)	2.85/ 2.99 (32.4)	95.43	83.44-109.15
T_{max}~ (h)	1.62 (0.75-8.00)	2.00 (1.25-6.00)	-	-
$T_{½}$ $ (h)	5.68 (15.3)	5.60 (17.9)	-	-

*[Pr] RAN-CLARITHROMYCIN tablets 500 mg (Ranbaxy Pharmaceuticals Canada Inc.)
† [Pr]BIAXIN® BID (clarithromycin tablets, USP) 500 mg (Abbott Laboratories Limited, Canada) was purchased in Canada.
~ Expressed as Median (Range) only
$ Expressed as Arithmetic Mean (CV %) only

Mycobacterial Infections

Prophylaxis

Table 16
Summary of Demographics and Trial Design Prophylaxis Against *M. avium* Complex

Study #	Trial design	Dosage, route of administration and duration	Study subjects Immunocompromised patients with CD_4 counts < 100 cells/µL	Mean age (Range)
561	Double-blind	clarithromycin 500 mg b.i.d (≈ 10.6 months) Placebo b.i.d (8.2 months)	341 341	Adult

Legend: b.i.d. = twice daily

More patients in the placebo arm than the clarithromycin arm discontinued prematurely from the study (75.6% and 67.4%, respectively). However, if premature discontinuations due to *Mycobacterium avium* complex (MAC) or death are excluded, approximately equal percentages of patients on each arm (54.8% on clarithromycin and 52.5% on placebo) discontinued study drug early for other reasons.

Table 17
Summary of Efficacy Results in Immunocompromised Adult Patients Receiving Prophylaxis Against *M. avium* Complex

	Clarithromycin	Placebo	Hazard Ratio (95% CI)	p-value	Risk reduction
MAC bacteremia					
# patients developed MAC	19/333 (5.7%)	53/334 (15.9%)	0.307 (0.177, 0.533)	< 0.001*	- 69.3%
Survival					
# patients died	106/341 (31.1%)	136/341 (39.9%)	0.710 (0.533, 0.934)	0.014*	28.2%
Emergence of MAC Signs/Symptoms					
	# meeting criterion/total	# meeting criterion/total			
Wt. loss >10%	5/333 (2%)	23/322 (7%)	0.179 (0.067, 0.481)	0.001*	82.1%
Moderate/severe pyrexia	2/332 (< 1%)	10/329 (3%)	0.191 (0.041, 0.883)	0.034*	80.9%
Moderate/severe night sweats	1/325 (< 1%)	7/327 (2%)	0.130 (0.016, 1.081)	0.059	87.0%
Mod./severe night sweats or pyrexia	2/325 (< 1%)	13/326 (4%)	0.140 (0.031, 0.632)	0.011*	86.0%
Moderate/severe anemia	0/319 (0%)		0		
Grade 3 or 4 LFT	3/325 (< 1%)		0.739 (0.118, 4.649)	0.747	
Quality of Life Subscores (time to first decrease of ≥ 10 points)					
	# meeting criterion/total	# meeting criterion/total			
Overall health	180/317 (57%)	184/318 (58%)	0.809 (0.645, 1.015)	0.068	
Physical function	210/299 (70%)	236/306 (77%)	0.781 (0.637, 0.956)	0.017*	- 21.9%
Role function	111/189 (59%)	131/211 (62%)	0.922 (0.690, 1.233)	0.585	
Social function	187/327 (57%)	197/331 (60%)	0.823 (0.662, 1.024)	0.08	
Cognitive function	174/336 (52%)	170/339 (50%)	0.990 (0.790, 1.240)	0.929	
Pain	201/331 (61%)	217/336 (65%)	0.902 (0.731, 1.113)	0.355	
Mental Health	179/336 (53%)	184/338 (54%)	0.842 (0.672, 1.055)	0.134	
Energy/fatigue	208/328 (63%)	217/335 (65%)	0.784 (0.636, 0.966)	0.022*	- 21.6%
Health distress	170/335 (51%)	191/335 (57%)	0.807 (0.647, 1.007)	0.057	
Quality of life	199/330 (60%)	199/333 (60%)	0.902 (0.727, 1.120)	0.352	
Hospitalization					
# patients hospitalized	166/339 (49%)	189/330 (57%)	0.764 (0.610, 0.955)	0.018*	23.6%

On an intent-to-treat basis, the 1-year cumulative incidence of MAC bacteremia was 5.0% for patients randomized to clarithromycin and 19.4% for patients randomized to placebo (**Table 18**). While only 19 of the 341 patients randomized to clarithromycin developed MAC, 11 of these cases were resistant to clarithromycin. The patients with resistant MAC bacteremia had a median baseline CD_4 count of 10 cells/mm^3 (range 2 to 25 cells/mm^3). Information regarding the clinical course and response to treatment of the patients with resistant MAC bacteremia is limited. The 8 patients who received clarithromycin and developed susceptible MAC bacteremia had a median baseline CD_4 count of 25 cells/mm^3 (range 10 to 80 cells/mm^3). Comparatively, 53 of the 341 placebo patients developed MAC; none of these isolates were resistant to clarithromycin. The median baseline CD_4 count was 15 cells/mm^3 for placebo patients that developed MAC.

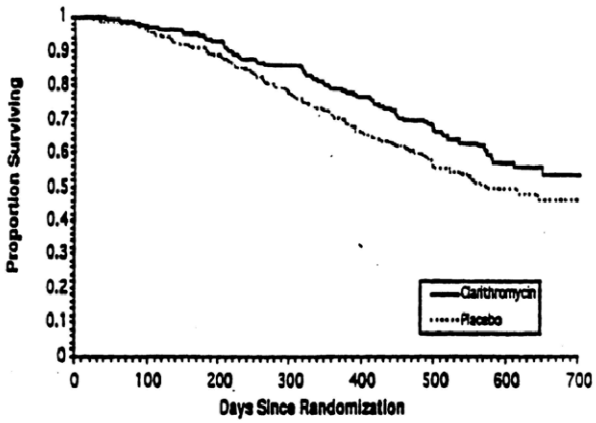


Figure 1: Survival of All Randomized Immunocompromized Adult Patients Receiving Clarithromycin in Prophylaxis Against *M. avium* Complex or Placebo

Table 18
Cumulative Incidence of MAC Bacteremia and Mortality in Immunocompromised Adult Patients Receiving Prophylaxis Against M. *avium* Complex

	Cumulative Incidence of MAC Bacteremia*		Cumulative Mortality	
	Clarithromycin	**Placebo**	**Clarithromycin**	**Placebo**
6 month	1.0 %	9.5 %	6.4 %	9.3 %
12 month	5.0 %	19.4 %	20.8 %	29.7 %
18 month	10.1 %	26.8 %	36.8 %	46.8 %

* from Kaplan-Meier estimates.

Since the analysis at 18 months includes patients no longer receiving prophylaxis the survival benefit of clarithromycin may be underestimated.

Treatment of Mycobacterial Infections

Three studies summarized in **Table 19** were designed to evaluate the following end points:

- Change in MAC bacteremia or blood cultures negative for *M. avium*.
- Change in clinical signs and symptoms of MAC infection including one or more of the following: fever, night sweats, weight loss, diarrhea, splenomegaly, and hepatomegaly.

Table 19
Summary of Demographics and Trial Design Efficacy of Clarithromycin in the Treatment of Mycobacterial Infections

Study #	Trial design	Dosage, route of administration and duration	Study subjects (n=number)	Mean age (Range)
500	Randomized, double-blind	500 mg b.i.d 1000 mg b.i.d 2000 mg b.i.d.	CDC-defined AIDS and CD_4 counts < 100 cells/µL (n=154)	Adult
577	Open - label*	500 mg b.i.d 1000 mg b.i.d	CDC-defined AIDS and CD_4 counts < 100 cells/µL (n=469)	Adult
521	Pediatric Study	3.75 mg/kg b.i.d. 7.5 mg/kg b.i.d. 15 mg/kg b.i.d.	CDC-defined AIDS and CD_4 counts < 100 cells/µL (n=25)	1-20 mo

*compassionate use.
Legend: b.i.d. = twice daily

The results of the Study 500 are described below. The Study 577 results were similar to the results of the Study 500. Results with the 7.5 mg/kg twice daily dose in the pediatric study were comparable to those for the 500 mg twice daily regimen in the adult studies.

MAC Bacteremia

Decreases in MAC bacteremia or negative blood cultures were seen in the majority of patients in all dose groups. Mean reductions in colony forming units (CFU) are shown below. Included in the table are results from a separate study with a 4-drug regimen (ciprofloxacin, ethambutol, rifampicin, and clofazimine). Since patient populations and study procedures may vary between these 2 studies, comparisons between the clarithromycin results and the combination therapy results should be interpreted cautiously (**Table 20**).

Table 20
Mean Reductions in Log CFU from Baseline
(After 4 Weeks of Therapy)

500 mg b.i.d.	1000 mg b.i.d.	2000 mg b.i.d.	Four Drug Regimen
(N=35)	(N=32)	(N=26)	(N=24)
1.5	2.3	2.3	1.4

Legend: b.i.d. = twice daily

Although the 1000 mg and 2000 mg twice daily doses showed significantly better control of bacteremia during the first 4 weeks during therapy, no significant differences were seen beyond that point. The percent of patients whose blood was sterilized as shown by 1 or more negative cultures at any time during acute therapy was 61% (30/49) for the 500 mg twice daily group and 59% (29/49) and 52% (25/28) for the 1000 and 2000 mg twice daily groups, respectively. The percent of patients who had 2 or more negative cultures during acute therapy that were sustained through study Day 84 was 25% (12/49) in both the 500 and 1000 mg twice daily groups and 8% (4/48) for the 2000 mg twice daily group. By Day 84, 23% (11/49), 37% (18/49), and 56% (27/48) of patients had died or discontinued from the study, and 14% (7/49), 12% (6/49), and 13% (6/48) of patients had relapsed in the 500, 1000, and 2000 mg twice daily dose groups,

respectively. All of the isolates had a minimum inhibitory concentration (MIC) < 8 mcg/mL at pretreatment. Relapse was almost always accompanied by an increase in MIC. The median time to first negative culture was 54, 41, and 29 days for the 500, 1000, and 2000 mg twice daily groups, respectively.

Clinically Significant Disseminated MAC Disease

Among patients experiencing night sweats prior to therapy, 84% showed resolution or improvement at some point during the 12 weeks of clarithromycin at 500 to 2000 mg twice daily doses. Similarly, 77% of patients reported resolution or improvement in fevers at some point. Response rates for clinical signs of MAC are given in **Table 21**.

Table 21
Response Rates for Clinical Signs of MAC

Resolution of Fever			**Resolution of Night Sweats**		
b.i.d. dose (mg)	% ever afebrile	% afebrile ≥ 6 weeks	b.i.d dose (mg)	% ever resolving	% resolving ≥ 6 weeks
500	67	23	500	85	42
1000	67	12	1000	70	33
2000	62	22	2000	72	36
Weight Gain > 3%			**Hemoglobin Increase > 1 g**		
b.i.d. dose (mg)	% ever gaining	% gaining ≥ 6 weeks	b.i.d. dose (mg)	% ever increasing	%increasing ≥ 6 weeks
500	33	14	500	58	26
1000	26	17	1000	37	6
2000	26	12	2000	62	18

Legend: b.i.d. = twice daily

The median duration of response, defined as improvement of resolution of clinical signs and symptoms, was 2 to 6 weeks.

Since the study was not designed to determine the benefit of monotherapy beyond 12 weeks, the duration of response may be underestimated for the 25 to 33% of patients who continued to show clinical response after 12 weeks.

Survival

Median survival time from study entry (Study 500) was 249 days at the 500 mg twice daily dose compared to 215 days with the 1000 mg twice daily dose. However, during the first 12 weeks of therapy, there were 2 deaths in 53 patients in the 500 mg twice daily group *versus* 13 deaths in 51 patients in the 1000 mg twice daily group. The reason for this apparent mortality difference is not known. Survival in the 2 groups was similar beyond 12 weeks. The median survival times for these dosages were similar to recent historical controls with MAC when treated with combination therapies.

Median survival time from study entry in Study 577 was 199 days for the 500 mg twice daily dose and 179 days for the 1000 mg twice daily dose. During the first 4 weeks of therapy, while patients were maintained on their originally assigned dose, there were 11 deaths in 255 patients taking 500 mg twice daily and 18 deaths in 214 patients taking 1000 mg twice daily.

Eradication of *Helicobacter pylori*

Triple Therapy: clarithromycin/omeprazole/amoxicillin

In a well controlled double-blind study, *Helicobacter pylori (H. pylori*) infected duodenal ulcer patients received triple therapy with clarithromycin 500 mg twice daily, omeprazole 20 mg daily and amoxicillin 1000 mg twice daily for 10 days or dual therapy with clarithromycin 500 mg three times daily and omeprazole 40 mg daily for 14 days. *H. pylori* was eradicated in 90% of the patients receiving clarithromycin triple therapy and in 60% of the patients receiving dual therapy.

A summary of the Trial Design is presented in **Table 22**.

Table 22
Summary of the Trial Design Efficacy of Clarithromycin in the Eradication of *Helicobacter pylori*— Triple Therapy

Study #	Trial design	Dosage, route of administration and duration	Study subjects (n=number)	Mean age (Range)
183	Phase III, randomized, double-blind, multicenter	*Treatment 1* Clarithromycin 500 mg b.i.d. with Omeprazole 20 mg q.d. and Amoxicillin 1000 mg b.i.d. *Treatment 2* Clarithromycin 500 mg b.i.d. with Omeprazole 40 mg q.d. oral *Treatment 1*: 10 days *Treatment 2*: 14 days	267 patients	18 to 75 years

Legend: b.i.d. = twice daily; q.d. = once daily

The ulcer healing rates and corresponding 95% confidence intervals are presented in **Table 23**.

Table 23
Ulcer Healing [95% C.I.] at 4- to 6-Week Follow-up

Patient Subset	Clarithromycin + Omeprazole + Amoxicillin	Clarithromycin + Omeprazole	p-value
Clinically Evaluable	93% (118/127) [87.0, 96.7]	91% (104/114) [84.5, 95.7]	0.641
Intent-to-Treat #1	93% (122/131) [87.4, 96.8]	92% (111/121) [85.3, 96.0]	0.812
Intent-to-Treat #2	90% (122/136) [83.3, 94.3]	85% (111/130) [78.1, 91.0]	0.353

- An ulcer was defined as a circumscribed break in the duodenal mucosa that measured 5 to 25 mm in the longest diameter with apparent depth and was covered with an exudate.
- Duodenal ulcer was identified by endoscopy and *H. pylori* infection at baseline was defined as at least two of three positive tests from ^{13}C UBT, CLOtest®, histology and culture.
- *H. pylori* eradication at 4 to 6 weeks post-treatment was defined as at least two of three negative tests from ^{13}C UBT gastric biopsy for culture, histology and CLOtest®.

Intent-to-Treat #1:	excluded patients with no confirmed evidence of *H. pylori* pretreatment, patients who had no duodenal ulcer pretreatment, and patients who did not return for a particular visit or did not have a particular procedure performed (e.g., endoscopy).
Intent-to-Treat #2:	excluded patients with no confirmed evidence of *H. pylori* pretreatment and patients with no duodenal ulcer pretreatment, but included as failures patients who did not return for a particular visit or did not have a particular procedure performed (e.g., endoscopy).

The *H. pylori* eradication rates and corresponding 95% confidence intervals are summarized in **Table 24**.

For all patient subsets, triple therapy with clarithromycin, omeprazole, and amoxicillin achieved a statistically higher eradication rate than dual therapy ($p < 0.001$). These differences were also observed when the eradication rates were adjusted for potentially influential factors such as ulcer characteristics, age, and smoking. In addition, the eradication rates within each treatment group were similar for smokers and non-smokers.

Table 24
Global Eradication [95% C.I.] at 4- to 6-Week Follow-up

	Clarithromycin + Omeprazole + Amoxicillin	Clarithromycin + Omeprazole	p-value
Bacteriologically Evaluable	91% (115/127) [84.1, 95.0]	59% (68/115) [49.6, 68.2]	< 0.001
Intent-to-Treat #1	90% (120/133) [83.9, 94.7]	60% (72/120) [50.7, 68.8]	< 0.001
Intent-to-Treat #2	88% (120/136) [81.6, 93.1]	55% (72/130) [46.4, 64.1]	< 0.001

- An ulcer was defined as a circumscribed break in the duodenal mucosa that measured 5 to 25 mm in the longest diameter with apparent depth and was covered with an exudate.
- Duodenal ulcer was identified by endoscopy and *H. pylori* infection at baseline was defined as at least two of three positive tests from ^{13}C UBT, CLOtest®, histology and culture.
- *H. pylori* eradication at 4 to 6 weeks post-treatment was defined as at least two of three negative tests from ^{13}C UBT gastric biopsy for culture, histology and CLOtest®.

Intent-to-Treat #1: excluded patients with no confirmed evidence of *H. pylori* pretreatment, patients who had no duodenal ulcer pretreatment, and patients who did not return for a particular visit or did not have a particular procedure performed (e.g., endoscopy).

Intent-to-Treat #2: excluded patients with no confirmed evidence of *H. pylori* pretreatment and patients with no duodenal ulcer pretreatment, but included as failures patients who did not return for a particular visit or did not have a particular procedure performed (e.g., endoscopy).

International, Randomized, Double-Blind, Placebo-Controlled Study

In an international, randomized, double-blind, placebo-controlled study involving more than 100 patients in each of 6 treatment groups, patients with proven duodenal ulcer disease were randomized to treatment twice daily for 1 week with omeprazole, 20 mg (O), plus either placebo (P) or combinations of 2 of the following antimicrobials: amoxicillin, 1g (A), clarithromycin, 250 mg or 500 mg (C250, C500), or metronidazole, 400 mg (M). *H. pylori* eradication rates for the "all-patients-treated" analysis were 96% (OAC500), 95% (OMC250), 90% (OMC500), 84% (OAC250), 79% (OAM), and 1% (OP).

Independent, Open and Non-Randomized Study

In an independent, open, and non-randomized study, *H. pylori* infected patients received eradication therapy with clarithromycin 500 mg twice daily in conjunction with amoxicillin 1000 mg twice daily and omeprazole 20 mg once daily (Group A) or omeprazole 20 mg twice daily (Group B) for 7 days. In those patients not previously treated with anti-*H. pylori* therapy, *H. pylori* was eradicated in 88% of patients in Group A and 86% of patients in Group B.

(For additional information on the use of clarithromycin in triple therapy for the treatment of *H. pylori* infection and active duodenal ulcer recurrence, refer to the Hp-PAC® Product Monograph).

Dual Therapy: Clarithromycin/omeprazole

H. pylori is strongly associated with peptic ulcer disease. Ninety to 100% of patients with duodenal ulcers are infected with this pathogen. Eradication of *H. pylori* has been shown to

reduce the rate of duodenal ulcer recurrence, thereby reducing the need for maintenance anti-secretory therapy.

In 4 well controlled, double-blind studies, *H. pylori* infected duodenal ulcer patients received eradication therapy with clarithromycin 500 mg three times daily and omeprazole 40 mg daily for 14 days followed by omeprazole 40 mg (study A) or omeprazole 20 mg (studies B, C and D) daily for an additional 14 days; patients in each control group received omeprazole alone for 28 days.

European Studies

A summary of the Trial Design is presented in **Table 25**.

Table 25
Summary of the Trial Design Efficacy of Clarithromycin in the Eradication of *Helicobacter pylori*-Dual Therapy

Study #	Trial design	Dosage, route of administration and duration	Study subjects (n=number)
A	Phase III, randomized, controlled, double-blind, multicenter study	*Treatment (1)*: Clarithromycin 500 mg t.i.d + omeprazole 40 mg q.d. for 14 days, followed by omeprazole 40 mg q.d. for 14 days.	*H. pylori* infected duodenal ulcer patients (n=69)*
		Treatment (2): Placebo (no clarithromycin) + omeprazole 40 mg q.d. for 14 days, followed by omeprazole 40 mg q.d. for 14 days.	*H. pylori* infected duodenal ulcer patients (n=75)*

* Number of evaluable patients as per **Table 26.**
Legend: t.i.d. = three times daily; q.d. = once daily

Results of Study A are displayed in **Table 26**.

Table 26
Study A: Efficacy of Clarithromycin in the Eradication of *Helicobacter pylori*-Dual

Results	Treatment (1) Clarithromycin + Omeprazole*	Treatment (2) Omeprazole*	Statistical Significance
Ulcer Healing Rates at Post-Treatment	100% (65/65)	99% (72/73)	> 0.999
Ulcer Prevalence Rate			
6-Month Follow-up Visit	4% (2/53)	54% (37/69)	< 0.001
12-Month Follow-Up Visit	4% (2/48)	78% (49/63)	< 0.001
***H. pylori* Global Eradication Rate**			
4- to 6-Week Follow-up Visit	83% (57/69)	1% (1/75)	< 0.001

* For details of treatment see **Table 25**

A summary of the Trial Design is presented in **Table 27**.

Table 27
Summary of the Trial Design Efficacy of Clarithromycin in the Eradication of *Helicobacter pylori* - Dual Therapy

Study #	Trial design	Dosage, route of administration and duration	Study subjects (n=number)
B	Phase III, randomized, controlled, double-blind, multicenter study	*Treatment (1)*: Clarithromycin 500 mg t.i.d + omeprazole 40 mg q.d. for 14 days, followed by omeprazole 20 mg q.d. for 14 days.	*H. pylori* infected duodenal ulcer patients (n=93)*
		Treatment (2): Placebo (no clarithromycin) + omeprazole 40 mg q.d. for 14 days, followed by omeprazole 20 mg q.d. for 14 days.	*H. pylori* infected duodenal ulcer patients (n=96)*

* Number of evaluable patients as per Table 28
Legend: t.i.d. = three times daily; q.d. = once daily

Results of Study B are displayed in **Table 28**.

Table 28
Study B: Efficacy of Clarithromycin in the Eradication of *Helicobacter pylori* - Dual Therapy

Results	Treatment (1) Clarithromycin + Omeprazole*	Treatment (2) Omeprazole*	Statistical Significance
Ulcer Healing Rates at Post-Treatment	99% (86/87)	95% (84/88)	0.368
Ulcer Prevalence Rate 6-Month Follow-up Visit 12-Month Follow-Up Visit	11% (9/79) N/A	52% (45/86) N/A	< 0.001 N/A
***H. pylori* Global Eradication Rate** 4- to 6-Week Follow-up Visit	74% (69/93)	4% (4/96)	< 0.001

N/A No information available.
* For details of treatment see **Table 27**

North American Studies

A summary of the Trial Design is presented in **Table 29**.

Table 29
Summary of Demographics and Trial Design Efficacy of Clarithromycin in the Eradication of *Helicobacter pylori* - Dual Therapy

Study #	Trial design	Dosage, route of administration and duration	Study subjects (n=number)
C	Controlled, double-blind study	*Treatment (1)*: Clarithromycin 500 mg t.i.d. + omeprazole 40 mg q.d. for 14 days, followed by 20 mg omeprazole q.d. for 14 days.	*H. pylori* infected duodenal ulcer patients (n=69)*
		Treatment (2): Clarithromycin 500 mg t.i.d. for 14 days + placebo q.d. (no omeprazole) for 28 days.	*H. pylori* infected duodenal ulcer patients (n=70)*
		Treatment (3): Placebo t.i.d. (no clarithromycin) + omeprazole 40 mg q.d. (14 days), followed by omeprazole 20 mg q.d. (14 days).	*H. pylori* infected duodenal ulcer patients (n=65)*

* Number of evaluable patients as per **Table 30**
Legend: t.i.d. = three times daily; q.d. = once daily

Results of the Study C are displayed in **Table 30**.

Table 30
Study C: Efficacy of Clarithromycin in the Eradication of *Helicobacter pylori* - Dual Therapy

Results	Treatment (1) Clarithromycin + Omeprazole	Treatment (2) Clarithromycin	Treatment (3) Omeprazole	Treatment (1) *vs* Treatment (2) p-value	Treatment (1) *vs* Treatment (3) p-value
Ulcer Healing Rates at Post-Treatment	87% (60/69)	63% (44/70)	85% (55/65)	0.002	0.806
Ulcer Prevalence Rate 6-Month Follow-up Visit	53% (30/57)	65% (44/68)	72% (41/57)	0.203	0.053
***H. pylori* Global Eradication Rate**					
4- to 6-Wk Follow-up Visit	74% (43/58)	34% (15/44)	0% (0/55)	< 0.001	< 0.001
3-Month Follow-up Visit	77% (37/48)	37% (13/35)	3% (1/38)	< 0.001	< 0.001

A summary of the Trial Design is presented in **Table 31**.

Table 31
Summary of Demographics and Trial Design Efficacy of Clarithromycin in the Eradication of *Helicobacter pylori*-Dual Therapy

Study #	Trial design	Dosage, route of administration and duration	Study subjects (n=number)
D	Controlled, double-blind study	*Treatment (1)*: Clarithromycin 500 mg t.i.d + omeprazole 40 mg q.d. for 14 days, followed by 20 mg omeprazole q.d. for 14 days.	*H. pylori* infected duodenal ulcer patients (n=82)*
		Treatment (2): Clarithromycin 500 mg t.i.d. for 14 days + placebo q.d. (no omeprazole) for 28 days.	*H. pylori* infected duodenal ulcer patients (n=86)*
		Treatment (3): Placebo t.i.d. (no clarithromycin) + omeprazole 40 mg q.d. (14 days), followed by omeprazole 20 mg q.d. (14 days).	*H. pylori* infected duodenal ulcer patients (n=88)*

* Number of enrolled patients
Legend s: t.i.d. = three times daily; q.d. = once daily

Results of the Study D are displayed in **Table 32**.

Table 32
Study D: Efficacy of Clarithromycin in the Eradication of *Helicobacter pylori*-Dual Therapy

Results	Treatment (1) Clarithromycin + Omeprazole	Treatment (2) Clarithromycin	Treatment (3) Omeprazole	Treatment (1) *vs* Treatment (2) p-value	Treatment (1) *vs* Treatment (3) p-value
Ulcer Healing Rates at Post-Treatment	94% (60/64)	71% (50/70)	89% (62/70)	< 0.001	0.371
Ulcer Prevalence Rate					
6-Month Follow-up Visit	30% (18/60)	49% (32/65)	76% (50/66)	0.031	< 0.001
***H. pylori* Global Eradication Rate**					
4- to 6-Wk Follow-up Visit	64% (41/64)	38% (18/48)	0% (0/62)	0.007	< 0.001
3-Month Follow-up Visit	72% (41/57)	40% (19/48)	0% (0/44)	0.001	< 0.001

Overall summary

In study A, *H. pylori* was eradicated in over 80% of patients who received clarithromycin and omeprazole and in only 1% of patients receiving omeprazole alone. In studies B, C, and D, the combined eradication rate was over 70% in patients receiving clarithromycin and omeprazole and less than 1% in patients receiving omeprazole alone. In each study, the rate of ulcer recurrence at 6 months was statistically lower in the clarithromycin and omeprazole treated patients when compared to patients receiving omeprazole alone.

DETAILED PHARMACOLOGY

General

Helicobacter pylori

The presence of *H. pylori* may damage the mucosal integrity and defenses so that exposure to acid/pepsin, even in normal concentrations, produces ulceration.

H. pylori displays potent urease activity which may produce an alkaline environment around the organism. Excess ammonia produced by urea hydrolysis is toxic to mucosal cells and may lead to parietal cell failure and/or to a disturbance of the normal negative feedback of acid to the antral G-cells which secrete gastrin. In addition, *H. pylori* produces catalases, lipases, phospholipases, proteases, adhesins and toxins. These enzymes may further degrade the mucous layer and damage the epithelial cell membrane. Also, the presence of *H. pylori* stimulates an active inflammatory response which contributes to mucosal damage.

Gustavson *et al.* (1995) showed that concentrations of 39.3, 23.1 and 25.2 mcg/g clarithromycin were achieved in the gastric mucosa 2, 4, and 6 hours respectively after administering 500 mg clarithromycin three times daily and that corresponding concentrations of the 14-OH metabolite were 3.2, 1.1, and 4.1 mcg/g respectively. Similar results were obtained whether or not clarithromycin was given alone or together with 40 mg omeprazole once daily (Logan *et al*., 1995). Although the activity of the 14-OH metabolite is about half of the parent drug and its concentrations are lower, it may still contribute antibacterial activity.

Pharmacokinetics

Pharmacokinetics for clarithromycin and 14-OH-clarithromycin metabolite following the oral administration of a single dose or multiple doses of clarithromycin are outlined below.

Pharmacokinetics for clarithromycin and 14-OH-clarithromycin metabolite was first studied following the oral administration of a single dose of 250 mg or 500 mg or multiple doses of clarithromycin 250 mg tablet.

Single Dose

Plasma levels were determined in 20 subjects following oral administration of a single-dose of 250 mg or 500 mg of clarithromycin under fasting conditions. C_{max} occurred at 1.00 and 1.77 (mg/L) and T_{max} were 1.5 and 2.2 hours, respectively for the 250 mg and 500 mg (**Table 33**, **Figure 2** and **Figure 3**).

Table 33 Mean (± SD) Pharmacokinetic Parameters for Clarithromycin Administered as a Single Dose in the Absence of Food		
Variable	**Clarithromycin Dose**	
	250 mg	**500 mg**
Number of male evaluable patients	20	20
C_{max} (mg/L)	1.00 ± 0.34	1.77 ± 0.65
C_{max}/100 mg[1]	0.40	0.35
T_{max} (hr)	1.5 ± 0.8	2.2 ± 0.7
AUC (mg•hr/L)	5.47 ± 1.93[2]	11.66 ± 3.67[3]
AUC/100 mg[1]	2.19	2.33

[1] $C_{max}/100\ mg = C_{max} \times \frac{100\ mg}{dose}$; $AUC/100\ mg = AUC \times \frac{100\ mg}{dose}$

[2] $AUC_{0\text{-}12\ hr}$

[3] $AUC_{0\text{-}14\ hr}$

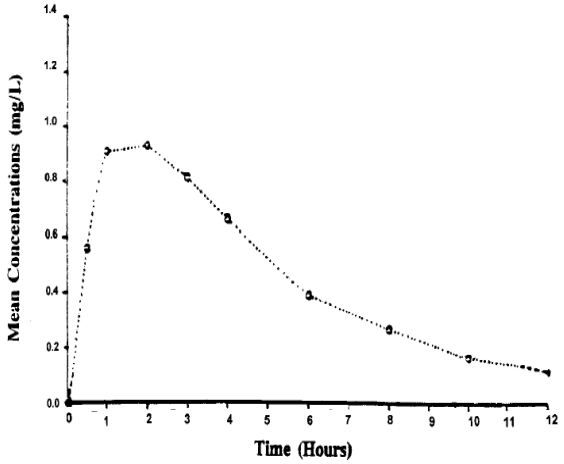


Figure 2: Plasma Clarithromycin Concentration (mg/mL) *vs* Time Following Oral Administration of a Single Dose of Clarithromycin 250 mg

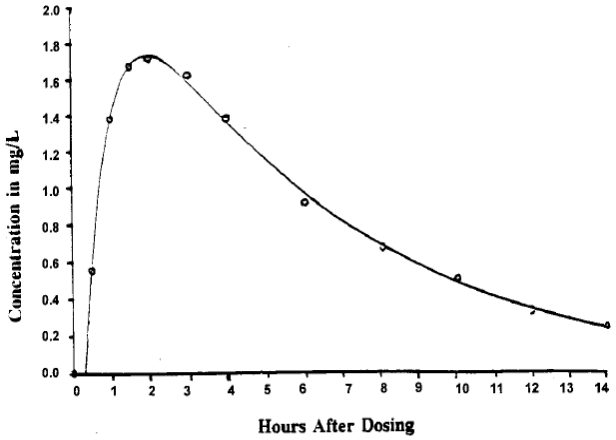


Figure 3: Plasma Clarithromycin Concentration (mg/L) *vs* Time Following Oral Administration of a Single Dose of Clarithromycin 500 mg

Multiple Dose

Representative estimated pharmacokinetic parameters for clarithromycin and 14-OH-clarithromycin metabolite after a single oral 250 mg dose and after the 5th dose of clarithromycin administered orally at 250 mg twice daily are listed in **Table 34**.

Table 34
Representative Estimated Single and Multiple-Dose Pharmacokinetic Parameters for Clarithromycin and 14-OH-Clarithromycin

Variables	Single Dose (250 mg)		Multiple Dose after 5th Dose (250 mg b.i.d.)	
	Clari.	**14-OH**	**Clari.**	**14-OH**
C_{max} (mg/L)	0.74 ± 0.24	0.61 ± 0.17	1.00 ± 0.29	0.63 ± 0.19
$t_{½}$ (hr)	2.7	4.2	3.5	4.7
AUC_{0-12} (mg•h/L)	4.27 ± 1.52	4.91 ± 1.12	6.34 ± 1.82	4.72 ± 1.29

Legend: Clari. = clarithromycin; 14-OH = 14-OH-clarithromycin; b.i.d. = twice daily

The pharmacokinetics of clarithromycin and its 14-OH metabolite indicate that the steady-state concentration is achieved by the 5th dose using 250 mg of clarithromycin twice daily.

The mean plasma concentration-time along the predicted curves for clarithromycin and 14-OH-clarithromycin metabolite are shown in **Figure 4.**

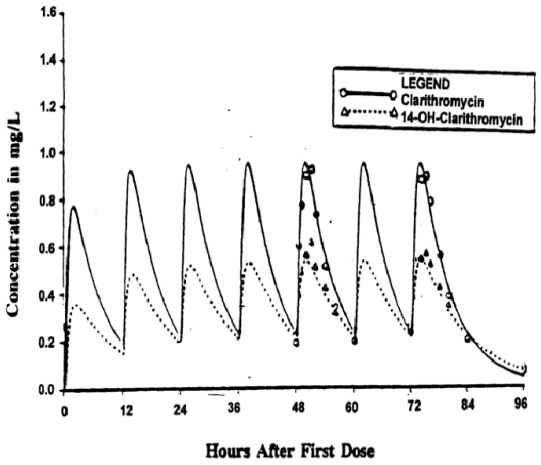


Figure 4: Mean Plasma Concentrations of Clarithromycin and 14-OH-Clarithromycin *vs* Time Following Seven 250 mg B.I.D. Oral Doses of Clarithromycin

At 250 mg twice daily, approximately 20% of an orally administered dose is excreted in the urine as the unchanged parent drug. The urinary excretion of unchanged clarithromycin is somewhat greater (approximately 30%) with 500 mg twice daily dosing. The renal clearance of clarithromycin is, however, relatively independent of the dose size and approximates the normal glomerular filtration rate. The major metabolite found in urine is 14-OH-clarithromycin which accounts for an additional 10 to 15% of the dose with twice daily dosing at either 250 mg or 500 mg.

Most of the remainder of the dose is eliminated in the feces, primarily via the bile. About 5 to 10% of the parent drug is recovered from the feces. Fecal metabolites are largely products of N-demethylation, 14-hydroxylation or both.

The steady-state concentrations of clarithromycin in subjects with impaired hepatic function did not differ from those in normal subjects; however, the 14-OH-clarithromycin concentrations were lower in the hepatically impaired subjects. The decreased formation of 14-OH-clarithromycin was at least partially offset by an increase in renal clearance of clarithromycin in the subjects with impaired hepatic function when compared to healthy subjects.

The pharmacokinetics of clarithromycin were also altered in subjects with impaired renal function. See (**WARNINGS AND PRECAUTIONS, Renal**) and (**DOSAGE AND ADMINISTRATION, Recommended Dose and Dosage Adjustment**).

Clarithromycin and Omeprazole

A pharmacokinetic study was conducted with clarithromycin 500 mg three times daily and omeprazole 40 mg once daily. When clarithromycin was given alone at 500 mg every 8 hours, the mean steady-state C_{max} value was approximately 31% higher and the mean C_{min} value was approximately 119% higher than when clarithromycin is compared with a previous study at 500 mg every 12 hours. The mean AUC_{0-24} for clarithromycin was 65% greater when 500 mg clarithromycin was given every 8 hours rather than every 12 hours. Neither T_{max} nor half-life values appeared substantially different between the every-8-hour and every-12-hour regimens.

When clarithromycin was administered with omeprazole, increases in omeprazole half-life and AUC_{0-24} were observed. For all subjects combined, the mean omeprazole AUC_{0-24} was 89% greater and the harmonic mean for omeprazole $t_{½}$ was 34% greater when omeprazole was administered with clarithromycin than when omeprazole was administered alone. When clarithromycin was administered with omeprazole, the steady-state C_{max}, C_{min}, and AUC_{0-8} of clarithromycin were increased by 10%, 27%, and 15%, respectively over values achieved when clarithromycin was administered with placebo.

At steady-state, clarithromycin gastric mucus concentrations 6 hours post dosing were approximately 25-fold higher in the clarithromycin/omeprazole group compared with the clarithromycin alone group. Six hours post-dosing, mean clarithromycin gastric tissue concentrations were approximately 2-fold higher when clarithromycin was given with omeprazole than when clarithromycin was given with placebo.

Clarithromycin distributes readily into body tissues and fluids, and provides tissue concentrations that are higher than serum concentrations. Examples from tissue and serum concentrations are presented in **Table 35**.

Table 35
Representative Clarithromycin Tissue and Serum Concentrations

Tissue Type	Concentrations (after 250 mg b.i.d.)	
	Tissue (mcg/g)	Serum (mcg/mL)
Tonsil	1.6	0.8
Lung	8.8	1.7
Leukocytes*	9.2	1.0

* *in vitro* data.
Legend: b.i.d. = twice daily

MICROBIOLOGY

Clarithromycin exerts its antimicrobial action by binding to the 50S ribosomal subunit of susceptible microorganisms resulting in inhibition of protein synthesis.

Clarithromycin is active *in vitro* against various aerobic and anaerobic gram-positive and gram-negative organisms as well as most MAC microorganisms. The *in vitro* activity of clarithromycin is presented in **Table 36**.

Additionally, the 14-OH-clarithromycin metabolite also has significant antimicrobial activity which may be additive to the activity of the parent compound. Against *Haemophilus influenzae*, 14-OH clarithromycin is twice as active as the parent compound *in vitro*. However, for MAC isolates, the 14-OH metabolite was 4 to 7 times less active than clarithromycin. The clinical significance of this activity against MAC is unknown.

Clarithromycin is bactericidal to *H. pylori*; this activity is greater at neutral pH than at acid pH.

The ranges of MICs of clarithromycin, 14-OH-clarithromycin metabolite and the MICs required to inhibit 50% (MIC_{50}) and 90% (MIC_{90}) of bacteria are presented in **Table 37** and **Table 38**. Beta-lactamase production should not have any effect on clarithromycin activity.

Cross-resistance to azithromycin has been documented. Attention should be paid to the possibility of cross resistance between clarithromycin and other macrolide drugs, as well as lincomycin and clindamycin.

The *in vitro* data indicate enterobacteriaceae, pseudomonas species and other non-lactose fermenting gram negative bacilli are not sensitive to clarithromycin.

Table 36
***In Vitro* Susceptibility® of Strains of Gram-Positive and Gram-Negative Bacteria to Clarithromycin**

Microorganisms	Number of Strains	Cumulative % of Strains Inhibited at MIC (mg/L)											
		.031	.062	.125	.250	.500	1.00	2.00	4.00	8.00	16.0	32.0	64.0
Gram Positive													
Staphylococcus aureus methicillin resistant	25	-	4	4	8	8	12	12	12	12	12	12	100
Staphylococcus aureus methicillin susceptible	126	-	20	75	84	86	87	87	87	88	88	88	100
All *Staphylococcus aureus*	151	-	17	63	72	73	74	74	74	75	75	75	100
Staphylococcus epidermidis	59	-	18	37	42	44	45	47	50	50	54	54	100
Other coagulase negative staphylococcus	27	-	14	44	44	48	48	48	55	55	59	59	100
Streptococcus pyogenes (GrA)	48	89	91	93	97	97	97	100	-	-	-	-	-
Enterococcus	97	1	4	8	25	59	61	63	63	64	64	68	100
Streptococcus pneumoniae	26	38	84	84	84	100	-	-	-	-	-	-	-
Streptococcus agalactiae (GrB)	41	95	95	95	95	95	97	100	-	-	-	-	-
Streptococcus viridans	15	86	86	86	93	93	93	93	93	93	93	93	100
Other β-hemolytic Streptococcus	19	78	78	78	84	84	84	89	89	94	94	94	100
Corynebacterium species	11	27	45	54	63	63	63	81	81	90	100	-	-
Listeria monocytogenes	7	28	100	-	-	-	-	-		-	-	-	-
Gram Negative													
Neisseria gonorrhoeae	39	23	35	64	100	-	-	-	-	-	-	-	-
Haemophilus influenzae	56	3	3	3	7	16	37	80	100	-	-	-	-
Neisseria meningitides	6	-	33	50	83	100	-	-	-	-	-	-	-
Campylobacter species	30	-	10	10	43	80	93	100	-	-	-	-	-

* MICs do not take into account the antimicrobial activity of the 14-OH-clarithromycin metabolite.

Table 37
***In vitro* Susceptibility of Different Bacteria to Clarithromycin**

Microorganisms	Number of strains	MIC (mg/L) Range	50%	90%
Mycoplasma pneumoniae	30	≤0.004-0.125	≤0.004	≤0.031
Bordetella pertussis	18	≤0.008-0.06	≤0.008	0.03
Legionella pneumophila	14	0.12-0.25	0.12	0.25
Haemophilus influenzae	22	2-8	4	8
Moraxella catarrhalis	17	0.03-0.25	0.06	0.25
Chlamydia trachomatis	11	0.002-0.008	0.004	0.008
Neisseria gonorrhoea	26	0.0625-4	0.125	0.5
Mycobacterium avium	30	4-32	8	16
Mycobacterium avium-intracellulare	124	< 0.25-4	1	2
Mycobacterium chelonae	137	--	--	0.25
Mycobacterium fortuitum	86	--	2.0	>8.0
Mycobacterium kansassi	24	≤0.125-0.25	≤0.125	0.25
Pasteurella multocida	10	1.0-4	1.0	2.0
Bacteriodes melaninogenicus	12	≤0.125-0.2	≤0.125	≤0.125
Clostridium perfringens	10	0.25-0.5	0.5	0.5
Staphylococcus aureus (methicillin sensitive)	20	0.06-0.25	0.17	0.24
Streptococcus pyogenes	10	≤0.06	≤0.06	≤0.06
Chlamydia pneumoniae	49	0.004-0.025	0.016	0.031
Helicobacter pylori †	13	0.03-0.06	0.03	0.03

† ***Hardy DJ, Hanson CW, Hensey DM, Beyer JM, Fernandes PB. Susceptibility of Campylobacter pylori to macrolides and fluoroquinolones. J Antimicrob Chemother 1988;22:631-636.***

Table 38
***In vitro* Susceptibility of Different Bacteria to 14-OH-Clarithromycin**

Microorganisms	Number of strains	MIC (mg/L) Range	50%	90%
Streptococcus pyogenes	15	0.015-0.03	0.015	0.03
Streptococcus pneumoniae	13	≤0.004-0.015	0.008	0.015
Streptococcus agalactiae	15	0.03-0.06	0.06	0.06
Listeria monocytogenes	14	0.25-0.5	0.5	0.5
Moraxella catarrhalis	17	0.03-0.12	0.06	0.12
Neisseria gonorrhoeae	15	0.06-1	0.25	0.5
Campylobacter jejuni	12	0.25-2	0.5	2
Legionella pneumophila	14	0.12-0.5	0.25	0.5
Haemophilus influenzae	22	1-4	2	4
Bordetella pertussis	18	≤0.008-0.06	0.015	0.06
Bacteroides fragilis	10	0.5->128	1	1
Clostridium perfringens	10	0.5-0.5	0.5	0.5
Propionibacterum acnes	12	0.03->128	0.03	0.06

Clarithromycin Kill Kinetics Against *Helicobacter pylori*

Figure 5 illustrates the kill kinetics of clarithromycin and 14-OH-clarithromycin against *H. pylori* at 8 × MIC and at pH 8.0; and **Figure 6** illustrates the kill kinetics of clarithromycin and amoxicillin against *H. pylori* at pH 6.5.

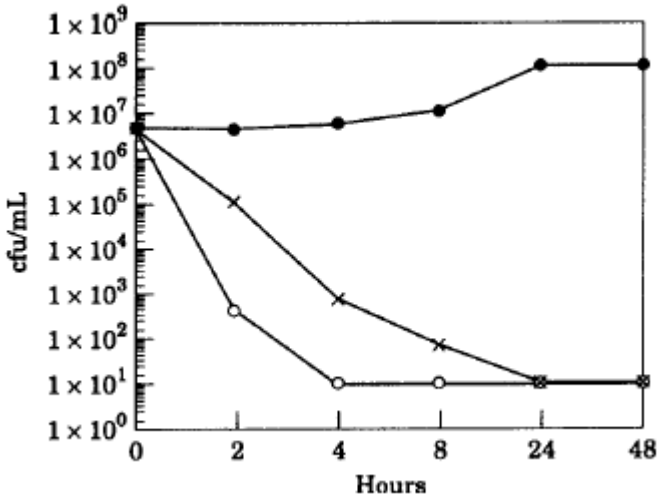


Figure 5: Kill kinetics of clarithromycin and 14-OH-clarithromycin against *H. pylori* strain 2597 at 8 × MIC and at pH 8.0. A flask was inoculated to produce a starting inoculum of approximately 10^6 cfu/mL. The flask was then incubated in an anaerobe jar with CampyPak® and shaken gently at 37 ^{0}C. Counts were done at 0, 2, 4, 8, 24, and 48 h in physiological saline after 72 h incubation. ●, No antimicrobial; o, clarithromycin (0.12 mg/L); x, 14-OH-clarithromycin (0.24 mg/L).

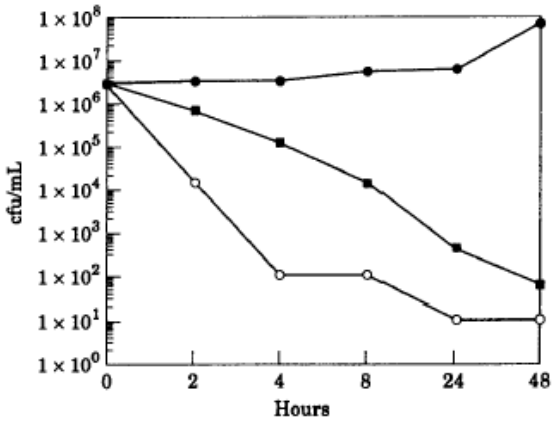


Figure 6: Kill kinetics of clarithromycin and amoxicillin against *H. pylori* strain 2597 at pH 6.5. Counts were done at 0, 2, 4, 8, 24, and 48 h in physiological saline after 72 h incubation. ●, No antimicrobial; o, clarithromycin (3 mg/L); ■, amoxicillin (3 mg/L)

Susceptibility Testing excluding *Mycobacteria* and *Helicobacter*

Dilution Techniques

Quantitative methods are used to determine antimicrobial minimal inhibitory concentrations (MICs). These MICs provide estimates of the susceptibility of bacteria to antimicrobial compounds. The MICs should be determined using a standardized procedure. Standardized procedures are based on a dilution method[43] (broth or agar) or equivalent with standardized inoculum concentrations and standardized concentrations of clarithromycin powder.

The standard single disc susceptibility test (using the 15 mcg clarithromycin disc) and the dilution susceptibility test should be interpreted according to the criteria in **Table 39**.

Table 39
Criteria for the Interpretation of Standard Single Disc and Dilution Susceptibility Tests except for *H. influenzae* and *H. pylori*

	Zone Diameter (mm)	Appropriate MIC Correlate (mg/L)
Susceptible	≥ 18	≤ 2
Intermediate*	14 to 17	4
Resistant	≤ 13	≥ 8

* Indicates that the test results are equivocal; therefore, dilution tests may be indicated.
N.B. These criteria and the definition are in agreement with NCCLS. Documents M2-A6[44] and M100-S8[45].

The standard single disc susceptibility test (using the 15 mcg clarithromycin disc) for *H.Influenzae* should be interpreted according to the criteria in **Table 40**.

Table 40
Criteria for the Interpretation of Standard Single Disc and Dilution Susceptibility Tests for *H. influenzae*

	Zone Diameter (mm)	Appropriate MIC Correlate (mg/L)
Susceptible	≥ 13	≤ 8
Intermediate*	11 to 12	16
Resistant	≤ 10	≥ 32

* Indicates that the test results are equivocal; therefore, dilution tests may be indicated.
N.B. According to the revised NCCLS 1997 and 1998 Guidelines, the zone diameter and MIC values reflect both the activities of the parent compound and 14-OH metabolite.

A report of "Susceptible" indicates that the pathogen is likely to respond to monotherapy with clarithromycin.

A report of "Intermediate" indicates that the result be considered equivocal, and if the microorganism is not fully susceptible to alternative clinically feasible drugs, the test should be repeated. This category implies possible clinical applicability in body sites where clarithromycin is physiologically concentrated or in situations where high clarithromycin dosages can be used. This category provides a buffer zone which prevents small uncontrolled technical factors from causing major discrepancies in interpretations.

A report of "Resistant" indicates that achievable drug concentrations are unlikely to be inhibitory, and other therapy should be selected.

Diffusion Techniques

Quantitative methods that require measurement of zone diameters also provide reproducible estimates of the susceptibility of bacteria to antimicrobial compounds. One such standardized procedure[44] requires the use of standardized inoculum concentrations. This procedure uses paper disks impregnated with 15-mcg clarithromycin to test the susceptibility of microorganisms to clarithromycin.

Reports from the laboratory providing results of the standard single-disk susceptibility test with a 15-mcg clarithromycin disk should be interpreted according to the criteria in **Table 39**.

Standardized Dilution Techniques

Standardized susceptibility test procedures require the use of laboratory control microorganisms to control the technical aspects of the laboratory procedures. Standard clarithromycin powder should provide the following MIC values for *S. aureus* and *H. influenzae* (**Table 41**).

Table 41
Standard Clarithromycin Powder MIC Values

Microorganisms		MIC (mcg/mL)
S. aureus	ATCC 29213	0.12 to 0.5
H. influenzae	ATCC 49247	4 to 16

Standardized Diffusion Techniques

As with standardized dilution techniques, diffusion methods require the use of laboratory control microorganisms that are used to control the technical aspects of the laboratory procedures. For the diffusion technique, the 15-mcg clarithromycin disk should provide the following zone diameters for *S. aureus* and *H. influenzae* (**Table 42**).

Table 42
Zone Diameter for the 15 mcg Clarithromycin Disc

Microorganisms		Zone Diameter (mm)
S. aureus	ATCC 25923	26 to 32
H. influenzae	ATCC 49247	11 to 17

In vitro Activity of Clarithromycin against Mycobacteria

Clarithromycin has demonstrated *in vitro* activity against MAC microorganisms isolated from both AIDS and non-AIDS patients. While gene probe techniques may be used to distinguish *M. avium* species from *M. intracellulare*, many studies only reported results on MAC isolates.

Various *in vitro* methodologies employing broth or solid media at different pH's, with and without oleic acid-albumin-dextrose-catalase (OADC), have been used to determine clarithromycin MIC values for mycobacterial species. In general, MIC values decrease more than 16-fold as the pH of Middlebrook 7H12 broth increases from 5.0 to 7.4. At pH 7.4, MIC values determined with Mueller-Hinton agar were 4- to 8-fold higher than those observed with Middlebrook 7H12 media. Utilization of OADC in these assays has been shown to further alter MIC values.

Clarithromycin activity against 80 MAC isolates from AIDS patients and 211 MAC isolates from non-AIDS patients was evaluated using a microdilution method with Middlebrook 7H9 broth. Results showed MIC values of ≤ 4.0 mcg/mL in 81% and 89% of the AIDS and non-AIDS MAC isolates, respectively. Twelve percent of the non-AIDS isolates had an MIC value ≤ 0.5 mcg/mL. Clarithromycin activity was evaluated against phagocytized MAC in mouse and human macrophage cell cultures as well as in the beige mouse infection model.

Clarithromycin activity was evaluated against *Mycobacterium tuberculosis* microorganisms. In 1 study utilizing the agar dilution method with Middlebrook 7H10 media, 3 of 30 clinical isolates had an MIC of 2.5 mcg/mL. Clarithromycin inhibited all isolates at > 10.0 mcg/mL.

Susceptibility Testing for *Mycobacterium avium* Complex

The disk diffusion and dilution techniques for susceptibility testing against gram-positive and gram-negative bacteria should not be used for determining clarithromycin MIC values against mycobacteria. *In vitro* susceptibility testing methods and diagnostic products currently available for determining MIC values against MAC organisms have not been standardized nor validated. Clarithromycin MIC values will vary depending on the susceptibility testing method employed, composition and pH of the media, and the utilization of nutritional supplements. Breakpoints to determine whether clinical isolates of *M. avium* or *M. intracellulare* are susceptible or resistant to clarithromycin have not been established.

In vitro* Activity of Clarithromycin against *Helicobacter pylori

Clarithromycin has demonstrated *in vitro* activity against *H. pylori* isolated from patients with duodenal ulcers. *In vitro* susceptibility testing methods (broth microdilution, agar dilution, E-test, and disk diffusion) and diagnostic products currently available for determining MICs and zone sizes have not been standardized, validated, or approved for testing *H. pylori*. The clarithromycin MIC values and zone sizes will vary depending on the susceptibility testing methodology employed, media, growth additives, pH, inoculum concentration tested, growth phase, incubation atmosphere, and time.

Susceptibility Test for *Helicobacter pylori*

In vitro susceptibility testing methods and diagnostic products currently available for determining MICs and zone sizes have not been standardized, validated, or approved for testing *H. pylori* microorganisms. MIC values for *H. pylori* isolates collected during 2 U.S. clinical trials evaluating clarithromycin plus omeprazole were determined by broth microdilution MIC methodology (Hachem CY *et al*., 1996). Results obtained during the clarithromycin plus omeprazole clinical trials fell into a distinct bimodal distribution of susceptible and resistant clarithromycin MICs.

If the broth microdilution MIC methodology published in Hachem CY *et al*., 1996 is used and the following tentative breakpoints are employed, there should be reasonable correlation between MIC results and clinical and microbiological outcomes for patients treated with clarithromycin plus omeprazole (**Table 43**).

Table 43 Susceptibility Testing for *Helicobacter pylori* in Patients Treated with Clarithromycin and Omeprazole	
MIC (mcg/mL)	**Interpretation**
≤ 0.06	Susceptible (S)
0.12 to 2.0	Intermediate (I)
≥ 4	Resistant (R)

These breakpoints should not be used to interpret results obtained using alternative methods.

TOXICOLOGY

Acute Toxicity

The acute toxicity of clarithromycin administered by a variety of routes, was studied in mice and rats. The median lethal dose by the oral route ranged from 2.7 to > 5.0 g/kg. Acute toxicity did not differ markedly between sexes (**Table 44**).

Table 44 Acute LD_{50} values of Clarithromycin			
Species	**Sex**	**Route**	**LD_{50} value (g/kg)**
Mice	M	p.o.	2.74
	F	p.o.	2.7
	M	s.c.	> 5.0
	F	s.c.	> 5.0
	M	i.p.	1.03
	F	i.p.	0.85
	M	i.v.	0.17
	F	i.v.	0.2
Rats	M	p.o.	3.47
	F	p.o.	2.7
	M	s.c.	> 5.0
	F	s.c.	> 5.0
	M	i.p.	6.69
	F	i.p.	7.58
Legend: i.p. = intraperitoneal; i.v. = intravenous; p.o. = oral; s.c. = subcutaneous			

The primary signs of toxicity included reduction in activities, behaviours, weight gains, respiration rates and sedation. The emetic activity of clarithromycin prevented the determination of the lethal dose in dog.

The acute oral toxicity of clarithromycin in very young mice and rats was determined. The median lethal dose (1.2 g/kg) was about 2-fold that seen in the older rodents.

Subchronic Toxicity

Studies were conducted in rats, dogs and monkeys with clarithromycin administered orally. The duration of administration ranged from 14 days to 42 days.

Rats

One study in rats (with oral doses up to 800 mg/kg/day) failed to show adverse effects in rats exposed to 50 mg/kg/day for 4 weeks. The clinical signs observed at toxic doses were reduced

motility, piloerection, hypothermia and perineal urine staining. Changes occurred in biochemical parameters at 200 and 800 mg/kg/day indicative of hepatotoxicity which was confirmed by histopathologic findings of hepatocyte necrosis.

Other pathologic findings at the top 2 dose levels included swelling of the renal cortical tubular epithelia and atrophic changes to the lymphatic and genital systems. The same toxicity profile was observed in immature rats following the daily administration of oral doses up to 150 mg/kg/day of clarithromycin for 6 weeks. At 150 mg/kg/day, there was an increase in relative weights of liver and kidneys.

Dogs

Dogs were dosed orally with 0, 6.25, 25, 100 or 400 mg/kg/day of clarithromycin daily for 28 days. Emesis occurred sporadically in the treated dogs. No other adverse effects were seen in dogs exposed to 6.25 mg/kg/day. The clinical signs at higher dosages included loose stools, lacrimation and conjunctivitis.

Slight anorexia was noted in dogs receiving 100 mg/kg/day or more. Dogs at 400 mg/kg/day exhibited reduced red blood cell count, hematocrit, hemoglobin concentration, serum albumin, and mean urine pH and specific gravity. Increases were seen in serum transaminase, alkaline phosphatase, and total bilirubin concentrations.

Bilirubin was detected in the urine. Other pathologic changes at 400 mg/kg/day included biliary hyperplasia, gastric glandular atrophy, renal tubule epithelial atrophy, edema of the iris, ciliary body and choroid, capillary proliferation in the cornea, suppression of spermatogenesis, and adrenal medullary degeneration.

Monkeys

Monkeys were treated daily for 1 month with oral doses of 0, 25, 100 or 400 mg/kg/day. Two animals out of 10 receiving 400 mg/kg/day died. Salivation was recorded at all dosage levels. No other adverse effects were seen in animals treated daily with 25 mg/kg/day.
The clinical signs observed at higher doses and most frequently at 400 mg/kg/day were vomiting, emesis, sunken eyes, dehydration, emaciation, low rectal temperature, body weight loss, reduced food consumption, cloudiness of the cornea and reduction in intra-ocular pressure. Yellow discoloured feces were passed on a few isolated occasions by some animals given a dose of 400 mg/kg/day. As with the other species, the liver was the primary target at toxic doses as shown by early elevation of serum concentration of glucose, BUN, creatinine, ALT, AST, LDH, amylase and/or triglyceride; an electrolyte imbalance and low levels of protein, cholesterol, phospholipid; elevated leucine aminopeptidase (LAP).

Principal histopathologic changes were seen mainly in high dose monkeys, but some mid-dose monkeys exhibited similar alterations. Changes included necrosis and vacuolation of hepatocytes, vacuolation of renal cortical tubules, no spermatogenesis, thymic regression and single cell necrosis of the stomach. In man the recommended dose is 500 to 1000 mg/day or 7.1 to 14.3 mg/kg/day (70 kg person).

Chronic Toxicity

Rats (20/sex/group) were treated daily with oral doses of 0, 15, 37.5, 75 or 150 mg/kg/day for 3 months. There were 8 incidental deaths, but none of them were considered treatment related.

Clinical signs included increased salivation, dehydration, hyperactivity and were observed in a dose-related manner. The only toxic effect noted, was some variation in body weight gain. No toxicologically significant changes occurred in hematology, biochemistry or urinalysis results.

Post mortem, there was an increase in mean relative liver and kidney weights at the top dose level. No microscopic changes were detected in the kidneys, but in the liver, there was a sex/dose-related increase in multinucleated hepatocytes. Effects were only seen in females at 150 mg/kg/day but in males occurred as low as 37.5 mg/kg/day.

A 6-month oral study was performed in rats (20 to 27/sex/group) at dosages of 0, 1 to 6, 8, 40 or 200 mg/kg/ day. Seven male and female rats from the control group and the 40 and 200 mg/kg/day groups were allowed a 63-day non-dosed recovery period. No mortalities occurred. Body weight and food intake were reduced at high doses during the dosing phase but normalized during recovery.

Water intake and urine volume increased in males and females of the 40 and 200 mg/ kg/day groups. Dose-related hematological changes included reduced erythrocytes and HCT with increased MCV, MCH and MCHC and relative eosinophil counts. Biochemical changes were mainly restricted to the high dose group and included increased ALP and decreased phospholipids; decreased total cholesterol and triglycerides, and increased AST and ALT in males only and decreased albumin in females only.

Organ weight increases were found to include cecum, adrenals, liver, and spleen. Histopathological examinations showed drug-related, recovery-reversible increases in multinucleated hepatocytes associated with minimal and focal necrosis in livers of both sexes at the top 2 dose levels. No relevant pathology was found in the cecum, adrenals or spleen to account for the increased weights. After recovery only the 200 mg/kg/day group had increased multinucleated hepatocytes.

Dogs (7/sex/group) were administered daily with oral doses of 0, 10, 30, or 100 mg/kg/day of clarithromycin for 3 months. Emesis occurred at levels of 30 mg/kg and above. One male high-dose dog was killed *in extremis* on day 69. Drug-related lesions were seen in the liver, gall bladder, thymus and stomach.

Hematological and biochemical changes at the high dose level included, decreased RBC and HCT, increased ALT, ALP, GGT, and decreased total protein and albumin. No significant organ weight changes were recorded, but treatment-related microscopic alterations in the liver and stomach of mild- and high-dose dogs were seen, as well as changes in gall bladder, spleen and thymus of high-dose animals.

A 6-month oral study was also performed in dogs (4 to 5/sex/group) at dosages of 0, 0.8, 4, 20 or 100 mg/kg/day. At the 0 and 100 mg/kg levels, 1 male and 1 female dog were allowed a 1-month, non-dosed, recovery period. One male-high dose dog died on day 174. This death was considered to be as a direct result of clarithromycin administration. Histopathologic examination revealed hepatic parenchymal damage, identifying the cause of clinical jaundice. Clinical signs during the dosing phase of the study were restricted to the top 2 dose levels and included emesis and ocular signs. Food consumption and water intake were reduced at 20 and 100 mg/kg/day.

Hematologic changes at 100 mg/kg were indicative of subclinical anemia. Biochemical alterations at the same level were associated with liver damage. Ocular changes were only apparent at the top dose level.

Increase in the weights of lung, liver, spleen, adrenals and kidneys were found at 100 mg/kg/day. Histopathologic examination of these organs showed degeneration of liver parenchyma, and toxic effects in adrenals. The thymus weight was reduced at 100 mg/kg/day. At the end of the recovery period all findings had regressed or reduced.

Monkeys (5 to 6/sex/group) were similarly administered clarithromycin at levels of 0, 25, 50 or 100 mg/kg/day for 6 months. At the 0 and 100 mg/kg levels, 1 male and 1 female monkey were allowed a one-month recovery period. One high-dose female died in week 25. Inhalation of vomit was considered to be the cause of death. Clinical signs were restricted to a dose-related incidence of emesis and salivation. No treatment-related effects were found in food consumption, ophthalmoscopy or hematology. Weight loss was restricted to 1 high-dose female. Minor serum chemistry changes were seen at the 100 mg/kg level, particularly in plasma proteins. Urinalysis revealed a dose-related lowering of pH and SG at 13 weeks only. Organ weight increases in liver, adrenal and kidneys were seen at high doses, but pathology was restricted to minimal liver changes consisting of cytoplasmic rarefaction of centrilobular hepatocytes. All changes were reversed during the recovery period.

Carcinogenicity

Long-term studies in animals have not been performed to evaluate the carcinogenic potential of clarithromycin.

Mutagenicity

The following *in vitro* mutagenicity tests have been conducted with clarithromycin: *Salmonella*/mammalian microsome test, bacterial induced mutation frequency test, *in vitro* chromosome aberration test, rat hepatocyte DNA synthesis assay, mouse lymphoma assay, mouse dominant lethal study, mouse micronucleus test.

All tests had negative results except the *in vitro* chromosome aberration test which was weakly positive in one test and negative in another. In addition, a Bacterial Reverse-Mutation Test (Ames Test) has been performed on clarithromycin metabolites with negative results.

Reproduction and Teratology

Fertility and reproduction studies have shown that daily doses of 150 to160 mg/kg/day to male and female rats caused no adverse effects on the estrous cycle, fertility, parturition, or number and viability of offspring. Plasma levels in rats after 150 mg/kg/day were 2 times the human serum levels.

In the 150 mg/kg/day monkey studies, plasma levels were 3 times the human serum levels. When given orally after 150 mg/kg/day, clarithromycin was shown to produce embryonic loss in monkeys. This effect has been attributed to marked maternal toxicity of the drug at this high dose.

In rabbits, *in utero* fetal loss occurred at an intravenous dose of 33 mg/m^2, which is 17 times less than the maximum proposed human oral daily dose of 618 mg/m^2.

Special Studies

Acute Renal Toxicity

There was no evidence of nephrotoxicity of clarithromycin in the rat at doses up to 500 mg/kg/day.

Hepatotoxicity

In the *in vitro* and *in vivo* hepatotoxicity studies comparing clarithromycin with erythromycin, it was found that clarithromycin caused no greater cytotoxicity than erythromycin stearate and much less toxicity than erythromycin estolate. Hepatic enzyme induction was not found in doses below 500 mg/kg/day. In cynomolgus monkeys, the closest metabolic model for humans, elevations of ALT and LDH were identified at 200 mg/kg/day.

In dogs, a rise of ALT has been seen at 100 mg/kg/day, and in Wistar rats, a similar elevation of enzymes was seen at 200 mg/kg/day. Morphologic lesions related to prolonged exposure to clarithromycin (up to 6 months) have been consistent with reportedly reversible changes in rat, dog and monkey studies. Such doses are many times beyond the therapeutic range in humans, which is within 8 to 10 mg/kg/day.

Ocular Toxicity

Ocular lesions appear confined to dogs and monkeys receiving lethal doses, which were large multiples of the human therapeutic dose. Radiolabelled clarithromycin studies indicate the eye is not selectively burdened by drug deposits and that clearance from this tissue follows that seen in other tissues. Opacities occur in the cornea following widespread extraocular tissue changes which are detectable via numerous diagnostic methods. Reduced intraocular pressure precedes corneal opacity in a relatively predictive manner. Some evidence for transient opacity and at least partial resolution was noted in animal studies, but most animals succumbed to other organ dysfunctions shortly after opacities were observed.

Animals given doses close to the therapeutic dose had no ocular changes. No ophthalmologic effects were noted in rabbits treated at doses of 40 and 160 mg/kg/day for 28 days.

Ototoxicity

No effects on pinna reflex were seen in guinea pigs at a dose of 400 mg/kg/day but inner and outer hair cells disappeared suggesting toxic damage. No evidence of damage was reported at 200 mg/kg/day.

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PART III: CONSUMER INFORMATION

PrRAN™-CLARITHROMYCIN
Clarithromycin Tablets
250 mg and 500 mg
USP

This leaflet is Part III of a three-part "Product Monograph" published when RAN-CLARITHROMYCIN was approved for sale in Canada and is designed specifically for consumers. This leaflet is a summary and will not tell you everything about RAN-CLARITHROMYCIN. Contact your doctor or pharmacist if you have any questions about the drug.

ABOUT THIS MEDICATION

What the medication is used for:

RAN-CLARITHROMYCIN is used to treat certain infections caused by bacteria, such as pneumonia, bronchitis, infections of the sinuses, skin, and throat.

When used with other medications, it can treat infection caused by a bacterium called *Helicobacter pylori* (*H. pylori)* and reduce the risk of duodenal ulcer recurrence. A duodenal ulcer is a sore on the lining of the duodenum, which is the beginning of the small intestine.

It can also be prescribed to prevent and combat MAC disease in patients with HIV. MAC is a short word for *Mycobacterium avium* complex, the germs that cause MAC disease.

What it does:

RAN-CLARITHROMYCIN is an antibiotic that kills bacteria in your body.

When it should not be used:

Do not take RAN-CLARITHROMYCIN if you have ever had an allergic reaction to it, or if you are sensitive to it or erythromycin, or other antibacterial agents of the same family or to any ingredient in the formulation. See (**What the important non-medicinal ingredients are**).

Do not take RAN-CLARITHROMYCIN if you are taking astemizole*, cisapride*, colchicine, pimozide, terfenadine*, ergotamine, dihydroergotamine, lovastatin or simvastatin. Astemizole*, cisapride*, pimozide, terfenadine*, ergotamine, dihydroergotamine and colchicine can interact with RAN-CLARITHROMYCIN, possibly leading to an irregular heartbeat pattern; deaths have occurred.

* no longer marketed in Canada.

Do not take RAN-CLARITHROMYCIN if you have ever developed liver problems after using clarithromycin.

Do not use RAN-CLARITHROMYCIN if you have a history of heart disturbance or irregular heart beat (arrhythmias, QT prolongation, torsade de points).

What the medicinal ingredient is:
The medicinal ingredient is clarithromycin.

What the important non-medicinal ingredients are:
The non-medicinal ingredients are the following: croscarmellose sodium, D&C yellow #10 aluminum lake, hydroxypropyl cellulose, hypromellose, magnesium stearate, microcrystalline cellulose, povidone, propylene glycol, purified talc, silica, colloidal anhydrous; stearic acid and titanium dioxide.

What dosage forms it comes in:
This medicine comes in tablets (RAN-CLARITHROMYCIN, 250 mg and 500 mg).

WARNINGS AND PRECAUTIONS

Serious Warnings and Precautions

RAN-CLARITHROMYCIN should not be used in pregnancy unless advised by your doctor due to potential hazards to the fetus. Do not take RAN-CLARITHROMYCIN without first talking to your doctor if you are breast-feeding a baby.

Before taking RAN- CLARITHROMYCIN, tell your doctor if you have liver or kidney disease. You may not be able to take clarithromycin, or you may require a lower dose and special monitoring during therapy. Talk to your doctor if RAN- CLARITHROMYCIN gives you prolonged and severe diarrhea.

The development of antibiotic resistance has been seen in patients with HIV receiving clarithromycin. To avoid failure of the treatment with a potential for developing antimicrobial resistance and a risk of failure with subsequent therapy, you/your child should follow closely the prescribed regimen.

BEFORE you use RAN- CLARITHROMYCIN talk to your doctor or pharmacist:

- about all health problems you have now or have had in the past;
- about all other medicines you are taking, including non-prescription medicines, nutritional supplements, or herbal products. See (**INTERACTIONS WITH THIS MEDICATION**);
- if you have or develop severe diarrhea as this may be a sign of a more serious condition;
- if you have kidney problems;
- if you have liver problems;
- if you are taking astemizole, terfenadine, cisapride, pimozide, ergotamine, dihydroergotamine, digoxin, colchicine, atorvastatin, pravastatin, lovastatin or simvastatin.
- if you have any unusual or allergic reaction (rash, difficulty breathing) to clarithromycin or any of the non-medicinal ingredients in RAN-CLARITHROMYCIN (see **What the**

important non-medicinal ingredients are), other medicines, foods, dyes, or preservatives;
- if you are pregnant, trying to get pregnant or are breast-feeding because clarithromycin has been detected in human breast milk.
- if you are elderly with a history of liver or kidney problems and taking colchicine.

WHILE taking RAN-CLARITHROMYCIN, contact your doctor if:

- You develop symptoms of myasthenia gravis or the symptoms of your existing myasthenia gravis worsen. These symptoms could include muscle weakness that gets worse with activity and gets better with rest, drooping eyelid, blurred or double vision, difficulty chewing and swallowing, or trouble breathing.
- You develop symptoms of hepatitis (liver inflammation) such as abdominal pain, nausea, vomiting, yellowing of skin and eyes, dark urine etc. Stop taking the drug immediately.

INTERACTIONS WITH THIS MEDICATION

Drugs that may interact with RAN-CLARITHROMYCIN includes:

Alfentanil, alprazolam, amlodipine, astemizole*/terfenadine*, atazanavir, atorvastatin, bromocriptine, carbamazepine, cilostazol, cisapride*/pimozide, colchicine, cyclosporine, digoxin, diltiazem, disopyramide/quinidine, efavirenz, ergotamine/ dihydroergotamine, etravirine, fluconazole, hexobarbital, insulin, itraconazole, lansoprazole/omeprazole, lovastatin/pravastatin/simvastatin, methylprednisolone, midazolam/triazolam, nateglinide, nevirapine, phenobarbital, phenytoin, pioglitazone, repaglinide, rifabutin/rifampin, rifapentine*, ritonavir/indinavir, rosiglitazone, rosuvastatin, saquinavir, sildenafil, St. John's Wort (*Hypericum perforatum*), tacrolimus, tadalafil, theophylline, tolterodine, valproic acid, vardenafil, verapamil, vinblastine, warfarin/acenocoumarol, zidovudine and drugs metabolized by cytochrome P450 system.

* not marketed in Canada.

PROPER USE OF THIS MEDICATION

RAN-CLARITHROMYCIN tablets cannot be used in children less than 12 years old and the tablet cannot be divided or split in half.

Usual Adult Dose:

RAN-CLARITHROMYCIN may be taken with or without meals.

Respiratory Tract or Skin Infections:

The usual dosage of RAN-CLARITHROMYCIN is 250 mg to 500 mg every 12 hours for 7 to 14 days.

Infections with *H. pylori:*

Triple Therapy: RAN-CLARITHROMYCIN + Omeprazole +Amoxicillin

The recommended dose is the following for 10 days:
- RAN-CLARITHROMYCIN: 500 mg every 12 hours
- Omeprazole: 20 mg once daily
- Amoxicillin: 1 g every 12 hours

Dual Therapy: RAN-CLARITHROMYCIN + Omeprazole

The recommended dose is the following for 14 days:

- RAN-CLARITHROMYCIN: 500 mg every 8 hours
- Omeprazole: 40 mg once daily

followed by 20 mg omeprazole once daily for 14 days

MAC disease:

The recommended dose of RAN-CLARITHROMYCIN for prevention and treatment of MAC disease is 500 mg every 12 hours.

Treatment of disseminated MAC infection (MAC infection spread through your whole body) in patients with HIV should continue for life if improvement of symptoms is observed.

Overdose:

In case of overdose, contact your healthcare professional, hospital emergency department or regional poison control centre, even if there are no symptoms. Symptoms of RAN-CLARITHROMYCIN overdose are abdominal pain, vomiting, nausea, and diarrhea.

Missed Dose:

If you miss a dose, take it as soon as you remember unless it is almost time for the next dose. In that case, skip the missed dose and take the next one as directed. Do not take double or extra doses.

SIDE EFFECTS AND WHAT TO DO ABOUT THEM

Like all medicines, RAN-CLARITHROMYCIN can cause side effects. The majority of side effects observed in clinical trials with RAN-CLARITHROMYCIN were of a mild and transient nature.

The following adverse reactions were reported during the clinical studies with clarithromycin, the medicinal ingredient (occurring between 1% and 10% in clinical trials) or during post-marketing surveillance: abdominal pain, abnormal taste, diarrhea, ear disorder, flatulence, indigestion, headache, nausea, rash, vomiting. Talk to your doctor or pharmacist if any of these side effects persist or become bothersome.

Serious side effects from RAN-CLARITHROMYCIN are not common.

If dizziness, confusion or disorientation occur while taking RAN-CLARITHROMYCIN, do not drive or operate machinery.

SERIOUS SIDE EFFECTS, HOW OFTEN THEY HAPPEN AND WHAT TO DO ABOUT THEM

Symptom/effect		Talk with your doctor or pharmacist		Stop taking drug and seek immediate emergency medical attention
		Only if severe	In all cases	
Uncommon	Allergic reactions*			√
	Severe diarrhea		√	
	Severe abdominal cramps		√	
	Irregular heart beat			√

*Allergic reactions, with symptoms such as itching, skin eruptions, rash, sore throat, fever, swelling, skin rash, itchiness, difficulty breathing, lightheadedness/dizziness.

This is not a complete list of side effects. For any unexpected effects while taking RAN-CLARITHROMYCIN, contact your doctor or pharmacist.

HOW TO STORE IT

Keep RAN-CLARITHROMYCIN and all other medicines out of reach of children.

Store at room temperature between 15° C and 25° C in a tightly closed container. Protect from light. Do not use beyond the expiration date.

REPORTING SUSPECTED SIDE EFFECTS

You can report any suspected adverse reactions associated with the use of health products to the Canada Vigilance Program by one of the following 3 ways:

- **Report on line at:**
  www.healthcanada.gc.ca/medeffect
- **Call toll-free at 1-866-234-2345**
- **Complete a Canada Vigilance Reporting Form and:**
  -Fax toll-free to 1-866-678-6789
  -Mail to: Canada Vigilance Program
  Health Canada
  Postal Locator 0701E
  Ottawa, ON K1A 0K9

Postage paid labels, Canada Vigilance Reporting Form and the adverse reaction reporting guidelines are available on the MedEffect™ Canada Web site at
http://www.healthcanada.gc.ca/medeffect

NOTE: Should you require information related to the management of side effects, contact your health professional. The Canada Vigilance Program does not provide medical advice.

MORE INFORMATION

This document plus the full Product Monograph, prepared for health professionals can be found by contacting the sponsor, Ranbaxy Pharmaceuticals Canada Inc. at: 1-866-840-1340.

RANBAXY

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