

Binozyt Powder for Oral Suspension 200mg/5ml**1. NAME OF THE MEDICINAL PRODUCT**

Binozyt Powder for Oral Suspension 200 mg/5 mL

2. QUALITATIVE AND QUANTITATIVE COMPOSITION

Each 5 ml prepared suspension contains 204.8 mg azithromycin monohydrate equivalent to 200 mg azithromycin.

Excipients:

Sucrose 3.70 g/ 5 ml

Aspartame 0.03 g/ 5 ml

For a full list of excipients see section 6.1.

3. PHARMACEUTICAL FORM

Powder for oral suspension.

White to off-white coloured powder.

4. CLINICAL PARTICULARS**4.1 Therapeutic indications**

Azithromycin is indicated for infections caused by susceptible organisms; in lower respiratory tract infections including bronchitis and pneumonia, in odontostomatological infections, in skin and soft tissue infections, in acute otitis media and in upper respiratory tract infections including sinusitis and pharyngitis/tonsillitis (Penicillin is the usual drug of choice in the treatment of *Streptococcus pyogenes* pharyngitis, including the prophylaxis of rheumatic fever. Azithromycin is generally effective in the eradication of streptococci from the oropharynx; however, data establishing the efficacy of azithromycin and the subsequent prevention of rheumatic fever are not available at present.)

In sexually transmitted diseases in men and women, azithromycin is indicated for the treatment of uncomplicated genital infections due to *Chlamydia trachomatis*. It is also indicated for the treatment of chancroid due to *Haemophilus ducreyi* and uncomplicated genital infections due to non-multiresistant *Neisseria gonorrhoeae*; concurrent infection with *Treponema pallidum* should be excluded.

Azithromycin is indicated, either alone or in combination with rifabutin, for prophylaxis against *Mycobacterium avium*-intracellulare complex (MAC) infection, an opportunistic infection prevalent in patients with advanced human immunodeficiency virus (HIV).

Considerations should be given to official guidance on the appropriate use of antibacterial agents.

4.2 Posology and method of administrationIn Adults

For the treatment of sexually transmitted diseases caused by *Chlamydia trachomatis*, or susceptible *Neisseria gonorrhoeae*, the dose is 1000 mg as a single oral dose.

For prophylaxis against MAC infections in patients infected with the HIV, the dose is 1200 mg once per week.

For all other indications in which the oral formulation is administered, the total dosage of 1500 mg should be given as 500 mg daily for 3 days. As an alternative, the same total dose can be given over 5 days with 500 mg given on Day 1, then 250 mg daily on Days 2 to 5.

In Children

The maximum recommended total dose for any treatment is 1500 mg for children.

The total dose of 30 mg/kg should be given as a single daily dose of 10 mg/kg daily for 3 days or given over 5 days with a single daily dose of 10 mg/kg on Day 1, then 5 mg/kg on Days 2-5.

For children weighing less than 15 kg, azithromycin suspension should be measured as closely as possible.

For children weighing 15 kg or more, azithromycin suspension should be administered according to the guide provided below:

Azithromycin suspension 30 mg/kg Total Treatment Dose			
Weight (kg)	3-day Regimen	5-day Regimen	Contents of the bottle (mg)
< 15	10 mg/kg/day on days 1- 3.	10 mg/kg/day on day 1, then 5 mg/kg/day once daily on days 2-5	600
15-25	200 mg (5 ml) once daily on days 1-3	200 mg (5 ml) on day 1, then 100 mg (2.5 ml) once daily on days 2-5.	600
26-35	300 mg (7.5 ml) once daily on days 1-3	300 mg (7.5 ml) on day 1, then 150 mg (3.75 ml) once daily on days 2-5.	900
36-45	400 mg (10 ml) once daily on days 1-3	400 mg (10 ml) on day 1, then 200 mg (5 ml) once daily on days 2-5.	1200
> 45	Dose as per adult	Dose as per adult	1500

Azithromycin tablets should only be administered to children weighing more than 45 kg.

Safety and efficacy for the prevention of MAC in children have not been established. Based on pediatric pharmacokinetic data, a dose of 20 mg/kg would be similar to the adult dose of 1200 mg but with a higher C_{max} .

Special populations

In the Elderly

The same dosage as in adult patients is used in the elderly. Elderly patients may be more susceptible to the development of torsades de pointes arrhythmia than younger patients (see section 4.4).

In Patients with Renal Impairment

No dose adjustment is necessary in patients with mild to moderate renal impairment (GFR 10-80 ml/min). Caution should be exercised when azithromycin is administered to patients with severe renal impairment (GFR < 10 ml/min) (see section 4.4 and section 5.2).

In Patients with Hepatic Impairment

The same dosage as in patients with normal hepatic function may be used in patients with mild to moderate hepatic impairment (see section 4.4).

Method of administration

Before use, the powder should be reconstituted with water into a white to off white coloured, homogenous suspension, see section 6.6. After reconstitution, the drug can be administered using a PE/PP syringe for oral use.

Oral azithromycin should be administered as a single daily dose.

Azithromycin powder for oral suspension can be taken with or without food.

4.3 Contraindications

The use of this product is contraindicated in patients with hypersensitivity to azithromycin, erythromycin, any macrolide or ketolide antibiotic or to any of the excipients listed in section 6.1.

4.4 Special warnings and special precautions for use

Hypersensitivity

As with erythromycin and other macrolides, rare serious allergic reactions, including angioedema and anaphylaxis (rarely fatal), dermatologic reactions including Acute Generalized Exanthematous Pustulosis (AGEP), Stevens Johnson Syndrome (SJS) and Toxic Epidermal Necrolysis (TEN) (rarely fatal), and Drug Reaction with Eosinophilia and Systemic Symptoms (DRESS) have been reported. Some of these reactions with azithromycin have resulted in recurrent symptoms and required a longer period of observation and treatment.

If an allergic reaction occurs, the drug should be discontinued and appropriate therapy should be instituted. Physicians should be aware that reappearance of the allergic symptoms may occur when symptomatic therapy is discontinued.

Hepatotoxicity

Since liver is the principal route of elimination for azithromycin, the use of azithromycin should be undertaken with caution in patients with significant hepatic disease.

Abnormal liver function, hepatitis, cholestatic jaundice, hepatic necrosis, and hepatic failure have been reported, some of which have resulted in death. Discontinue azithromycin immediately if signs and symptoms of hepatitis occur.

Infantile hypertrophic pyloric stenosis (IHPS)

Following the use of azithromycin in neonates (treatment up to 42 days of life), infantile hypertrophic pyloric stenosis (IHPS) has been reported. Parents and caregivers should be informed to contact their physician if vomiting or irritability with feeding occurs.

Ergot derivatives

In patients receiving ergot derivatives, ergotism has been precipitated by co-administration of some macrolide antibiotics. There are no data concerning the possibility of an interaction between ergot and azithromycin. However, because of the theoretical possibility of ergotism, azithromycin and ergot derivatives should not be co-administered.

Superinfection

As with any antibiotic preparation, observation for signs of superinfection with non-susceptible organisms, including fungi, is recommended.

***Clostridium difficile*-associated diarrhea**

Clostridium difficile associated diarrhea (CDAD) has been reported with use of nearly all antibacterial agents, including azithromycin, and may range in severity from mild diarrhea to fatal colitis. Treatment with antibacterial agents alters the normal flora of the colon leading to overgrowth of *C. difficile*.

C. difficile produces toxins A and B which contribute to the development of CDAD. Hypertoxin producing strains of *C. difficile* cause increased morbidity and mortality, as these infections can be refractory to antimicrobial therapy and may require colectomy. CDAD must be considered in all patients who present with diarrhea following antibiotic use. Careful medical history is necessary since CDAD has been reported to occur over two months after the administration of antibacterial agents.

Renal impairment

In patients with severe renal impairment (GFR <10 ml/min) a 33% increase in systemic exposure to azithromycin was observed (see section 5.2).

Prolongation of the QT interval

Prolonged cardiac repolarization and QT interval, imparting a risk of developing cardiac arrhythmia and torsades de pointes, have been seen in treatment with macrolides, including azithromycin (see section 4.8 Undesirable effects). Prescribers should consider the risk of QT prolongation, which can be fatal when weighing the risks and benefits of azithromycin for at-risk groups including:

- Patients with congenital or documented QT prolongation
- Patients currently receiving treatment with other active substances known to prolong QT interval such as antiarrhythmics of classes IA and III; antipsychotic agents; antidepressants; and fluoroquinolones
- Patients with electrolyte disturbance, particularly in cases of hypokalaemia and hypomagnesaemia
- Patients with clinically relevant bradycardia, cardiac arrhythmia or cardiac insufficiency
- Elderly patients: elderly patients may be more susceptible to drug-associated effects on the QT interval

QTc interval prolongation was studied in a randomized, placebo-controlled parallel trial in 116 healthy subjects who received either chloroquine (1000 mg) alone or in combination with azithromycin (500 mg, 1000 mg, and 1500 mg once daily). Co-administration of azithromycin increased the QTc interval in a dose- and concentration-dependent manner. In comparison to chloroquine alone, the maximum mean (95% upper confidence bound) increases in QTcF were 5 (10) ms, 7 (12) ms and 9 (14) ms with the co-administration of 500 mg, 1000 mg and 1500 mg azithromycin, respectively.

Myasthenia gravis

Exacerbations of the symptoms of myasthenia gravis and new onset of myasthenia syndrome have been reported in patients receiving azithromycin therapy (See section 4.8).

Safety and efficacy for the prevention or treatment of *Mycobacterium Avium* Complex in children have not been established.

Azithromycin is not the substance of first choice for the treatment of pharyngitis and tonsillitis caused by *Streptococcus pyogenes*. For this and for the prophylaxis of acute rheumatic fever, penicillin is the treatment of first choice.

In case of sexually transmitted diseases, a concomitant infection by *T. palladium* should be excluded.

Caution in diabetic patients: 5 ml of reconstituted suspension contain 3.70 g of sucrose. Due to the sucrose content (3.70g/ 5 ml of reconstituted suspension), this medicinal product is not indicated for persons with fructose intolerance (hereditary fructose intolerance), glucose-galactose malabsorption or saccharase-isomaltase deficiency.

The medicinal product contains a source of phenylalanine. May be harmful for people with phenylketonuria.

Azithromycin is not indicated for the treatment of infected burn wounds.

4.5 Interactions with other medicinal products and other forms of interaction**Antacids**

In a pharmacokinetic study investigating the effects of simultaneous administration of antacids and azithromycin, no effect on overall bioavailability was seen, although peak serum concentrations were reduced by approximately 24%. In patients receiving both azithromycin and antacids, the drugs should not be taken simultaneously.

Cetirizine

In healthy volunteers, co-administration of a 5-day regimen of azithromycin with cetirizine 20 mg at steady-state resulted in no pharmacokinetic interaction and no significant changes in the QT interval.

Didanosine (Dideoxyinosine)

Co-administration of 1200 mg/day azithromycin with 400 mg/day didanosine in 6 HIV-positive subjects did not appear to affect the steady-state pharmacokinetics of didanosine as compared with placebo.

Digoxin and colchicine

Concomitant administration of macrolide antibiotics, including azithromycin, with P-glycoprotein substrates such as digoxin and colchicine, has been reported to result in increased serum levels of the P-glycoprotein substrate. Therefore, if azithromycin and P-glycoprotein substrates such as digoxin are administered concomitantly, the possibility of elevated serum digoxin concentrations should be considered. Clinical monitoring, and possibly serum digoxin levels, during treatment with azithromycin and after its discontinuation are necessary.

Zidovudine

Single 1000 mg doses and multiple 1200 mg or 600 mg doses of azithromycin had little effect on the plasma pharmacokinetics or urinary excretion of zidovudine or its glucuronide metabolite. However, administration of azithromycin increased the concentrations of phosphorylated zidovudine, the clinically active metabolite, in peripheral blood mononuclear cells. The clinical significance of this finding is unclear, but it may be of benefit to patients.

Azithromycin does not interact significantly with the hepatic cytochrome P450 system. It is not believed to undergo the pharmacokinetic drug interactions as seen with erythromycin and other macrolides. Hepatic cytochrome P450 induction or inactivation via cytochrome-metabolite complex does not occur with azithromycin.

Pharmacokinetic studies have been conducted between azithromycin and the following drugs known to undergo significant cytochrome P450-mediated metabolism.

Ergot

There is a theoretical possibility of interaction between azithromycin and ergot derivatives (see section 4.4).

Atorvastatin

Co-administration of atorvastatin (10 mg daily) and azithromycin (500 mg daily) did not alter the plasma concentrations of atorvastatin (based on a HMG CoA-reductase inhibition assay). However, post-marketing cases of rhabdomyolysis in patients receiving azithromycin with statins have been reported.

Carbamazepine

In a pharmacokinetic interaction study in healthy volunteers, no significant effect was observed on the plasma levels of carbamazepine or its active metabolite in patients receiving concomitant azithromycin.

Cimetidine

In a pharmacokinetic study investigating the effects of a single dose of cimetidine, given 2 hours before azithromycin, on the pharmacokinetics of azithromycin, no alteration of azithromycin pharmacokinetics was seen.

Coumarin-type Oral Anticoagulants

In a pharmacokinetic interaction study, azithromycin did not alter the anticoagulant effect of a single 15 mg dose of warfarin administered to healthy volunteers. There have been reports received in the post-marketing period of potentiated anticoagulation subsequent to co-administration of azithromycin and coumarin-type oral anticoagulants. Although a causal

relationship has not been established, consideration should be given to the frequency of monitoring prothrombin time when azithromycin is used in patients receiving coumarin-type oral anticoagulants.

Cyclosporin

In a pharmacokinetic study with healthy volunteers that were administered a 500 mg/day oral dose of azithromycin for 3 days and were then administered a single 10 mg/kg oral dose of cyclosporin, the resulting cyclosporin C_{max} and AUC_{0-5} were found to be significantly elevated. Consequently, caution should be exercised before considering concurrent administration of these drugs. If co-administration of these drugs is necessary, cyclosporin levels should be monitored and the dose adjusted accordingly.

Efavirenz

Co-administration of a 600 mg single dose of azithromycin and 400 mg efavirenz daily for 7 days did not result in any clinically significant pharmacokinetic interactions.

Fluconazole

Co-administration of a single dose of 1200 mg azithromycin did not alter the pharmacokinetics of a single dose of 800 mg fluconazole. Total exposure and half-life of azithromycin were unchanged by the co-administration of fluconazole; however, a clinically insignificant decrease in C_{max} (18%) of azithromycin was observed.

Indinavir

Co-administration of a single dose of 1200 mg azithromycin had no statistically significant effect on the pharmacokinetics of indinavir administered as 800 mg three times daily for 5 days.

Methylprednisolone

In a pharmacokinetic interaction study in healthy volunteers, azithromycin had no significant effect on the pharmacokinetics of methylprednisolone.

Midazolam

In healthy volunteers, co-administration of azithromycin 500 mg/day for 3 days did not cause clinically significant changes in the pharmacokinetics and pharmacodynamics of a single 15 mg dose of midazolam.

Nelfinavir

Co-administration of azithromycin (1200 mg) and nelfinavir at steady-state (750 mg three times daily) resulted in increased azithromycin concentrations. No clinically significant adverse effects were observed and no dose adjustment is required.

Rifabutin

Co-administration of azithromycin and rifabutin did not affect the serum concentrations of either drug.

Neutropenia was observed in subjects receiving concomitant treatment of azithromycin and rifabutin. Although neutropenia has been associated with the use of rifabutin, a causal relationship to combination with azithromycin has not been established (see section 4.8).

Sildenafil

In normal healthy male volunteers, there was no evidence of an effect of azithromycin (500 mg daily for 3 days) on the AUC and C_{max} of sildenafil or its major circulating metabolite.

Terfenadine

Pharmacokinetic studies have reported no evidence of an interaction between azithromycin and terfenadine. There have been rare cases reported where the possibility of such an interaction could not be entirely excluded; however, there was no specific evidence that such an interaction had occurred.

Theophylline

There is no evidence of a clinically significant pharmacokinetic interaction when azithromycin and theophylline are co-administered to healthy volunteers.

Triazolam

In 14 healthy volunteers, co-administration of azithromycin 500 mg on Day 1 and 250 mg on Day 2 with 0.125 mg triazolam on Day 2 had no significant effect on any of the pharmacokinetic variables for triazolam compared to triazolam and placebo.

Trimethoprim/sulfamethoxazole

Co-administration of trimethoprim/sulfamethoxazole (160 mg/800 mg) for 7 days with azithromycin 1200 mg on Day 7 had no significant effect on peak concentrations, total exposure or urinary excretion of either trimethoprim or sulfamethoxazole.

Azithromycin serum concentrations were similar to those seen in other studies.

4.6 Pregnancy and Lactation

Pregnancy

Animal reproduction studies have been performed at doses up to moderately maternally toxic dose concentrations. In these studies, no evidence of harm to the fetus due to azithromycin was found. There are, however, no adequate and well-controlled studies in pregnant women. Because animal reproduction studies are not always predictive of human response, azithromycin should be used during pregnancy only if clearly needed.

Lactation

Limited information available from published literature indicates that azithromycin is present in human milk at an estimated highest median daily dose of 0.1 to 0.7 mg/kg/day. No serious adverse effects of azithromycin on the breast-fed infants were observed.

A decision must be made whether to discontinue breast-feeding or to discontinue/abstain from azithromycin therapy taking into account the benefit of breast-feeding for the child and the benefit of therapy for the woman.

Fertility

In fertility studies conducted in rat, reduced pregnancy rates were noted following administration of azithromycin. The relevance of this finding to humans is unknown.

4.7 Effects on ability to drive and use machines

There is no evidence to suggest that azithromycin may have an effect on a patient's ability to drive or operate machinery.

4.8 Undesirable effects

Azithromycin is well tolerated with a low incidence of side effects.

In clinical trials, the following undesirable effects have been reported:

Blood and Lymphatic System Disorders: Transient episodes of mild neutropenia have occasionally been observed in clinical trials, although a causal relationship to azithromycin has not been established.

Ear and Labyrinth Disorders: Hearing impairment (including hearing loss, deafness and/or tinnitus) has been reported in some patients receiving azithromycin. Many of these have been associated with prolonged use of high doses in investigational studies. In those cases where follow-up information was available, the majority of these events were reversible.

Gastrointestinal Disorders: Nausea, vomiting, diarrhea, loose stools, abdominal discomfort (pain/cramps), and flatulence.

Hepatobiliary Disorders: Abnormal liver function.

Skin and Subcutaneous Tissue Disorders: Allergic reactions including rash and angioedema.

General Disorders and Administration Site Conditions: Local pain and inflammation at the site of infusion.

In post-marketing experience, the following additional undesirable effects have been reported:

Infections and Infestations: Moniliasis and vaginitis.

Blood and Lymphatic System Disorders: Thrombocytopenia.

Immune System Disorders: Anaphylaxis (rarely fatal) (see section 4.4).

Metabolism and Nutrition Disorders: Anorexia.

Psychiatric Disorders: Aggressive reaction, nervousness, agitation, and anxiety.

Nervous System Disorders: Dizziness, convulsions, headache, hyperactivity, hypoesthesia, paresthesia, somnolence, and syncope. There have been rare reports of taste/smell perversion and/or loss.

Ear and Labyrinth Disorders: Deafness, tinnitus, hearing impaired, and vertigo.

Cardiac Disorders: Palpitations and arrhythmias including ventricular tachycardia have been reported. There have been rare reports of QT prolongations and torsades de pointes (see section 4.4).

Vascular Disorders: Hypotension.

Gastrointestinal Disorders: Vomiting/diarrhea (rarely resulting in dehydration), dyspepsia, constipation, pseudomembranous colitis, pancreatitis, and rare reports of tongue discoloration.

Hepatobiliary Disorders: Hepatitis and cholestatic jaundice have been reported, as well as rare cases of hepatic necrosis and hepatic failure, which have resulted in death (see section 4.4).

Skin and Subcutaneous Tissue Disorders: Allergic reactions including pruritus, rash, photosensitivity, edema, urticaria, and angioedema. Rarely, serious cutaneous adverse reactions including erythema multiforme, AGEP, SJS, TEN and DRESS have been reported.

Musculoskeletal and Connective Tissue Disorders: Arthralgia.

Renal and Urinary Disorders: Interstitial nephritis and acute renal failure.

General Disorders and Administration Site Conditions: Asthenia, fatigue, and malaise.

4.9 Overdose

Adverse events experienced in higher than recommended doses were similar to those seen at normal doses. In the event of overdosage, general symptomatic and supportive measures are indicated as required.

5. Pharmacological properties

5.1 Pharmacodynamic properties

Pharmacotherapeutic group: Macrolides, ATC Code: J01FA10

Mode of action

Azithromycin is the first of a subclass of macrolide antibiotics, known as azalides, and is chemically different from erythromycin. Chemically it is derived by insertion of a nitrogen atom into the lactone ring of erythromycin A.

The chemical name of azithromycin is 9-deoxy-9a-aza-9a-methyl-9a-homoerythromycin A. The molecular weight is 749.0.

Azithromycin binds to the 23S rRNA of the 50S ribosomal subunit. It blocks protein synthesis by inhibiting the transpeptidation/translocation step of protein synthesis and by inhibiting the assembly of the 50S ribosomal subunit.

Mechanism of resistance

The two most frequently encountered mechanisms of resistance to macrolides, including azithromycin, are target modification (most often by methylation of 23S rRNA) and active efflux. The occurrence of these resistance mechanisms varies from species to species and, within a species, the frequency of resistance varies by geographical location.

The most important ribosomal modification that determines reduced binding of macrolides is post-transcriptional (N6)-dimethylation of adenine at nucleotide A2058 (*Escherichia coli* numbering system) of the 23S rRNA by methylases encoded by *erm* (erythromycin ribosome methylase) genes. Ribosomal modifications often determine cross-resistance (MLS^B phenotype) to other classes of antibiotics whose ribosomal binding sites overlap those of the macrolides: the lincosamides (including clindamycin), and the streptogramin B (which include, for example, the quinupristin component of quinupristin/dalfopristin). Different *erm* genes are present in different bacterial species, in particular streptococci and staphylococci. Susceptibility to macrolides can also be affected by less frequently encountered mutational changes in nucleotides A2058 and A2059, and at some other positions of 23S rRNA, or in the large subunit ribosomal proteins L4 and L22.

Efflux pumps occur in a number of species, including gram-negatives, such as *Haemophilus influenzae* (where they may determine intrinsically higher minimal inhibitory concentrations [MICs]) and staphylococci. In streptococci and enterococci, an efflux pump that recognizes 14- and 15-membered macrolides (which include, respectively, erythromycin and azithromycin) is encoded by *mef* (A) genes.

Methodology for determining the *in vitro* susceptibility of bacteria to azithromycin

Susceptibility testing should be conducted using standardized laboratory methods, such as those described by the Clinical and Laboratory Standards Institute (CLSI). These include dilution methods (MIC determination) and disk susceptibility methods. Both CLSI and the European Committee on Antimicrobial Susceptibility Testing (EUCAST) provide interpretive criteria for these methods.

Based on a number of studies, it is recommended that the *in vitro* activity of azithromycin be tested in ambient air, to ensure physiological pH of the growth medium. Elevated CO₂ tensions, as often used for streptococci and anaerobes, and occasionally for other species, result in a reduction in the pH of the medium. This has a greater adverse effect on the apparent potency of azithromycin than on that of other macrolides.

The CLSI susceptibility breakpoints, based on broth microdilution or agar dilution testing, with incubation in ambient air, are given in the table below.

CLSI Dilution Susceptibility Interpretive Criteria

Organism	Broth microdilution MIC (mg/L)		
	Susceptible	Intermediate	Resistant
<i>Haemophilus</i> species	≤4	-	≥8 ^b
<i>Moraxella catarrhalis</i>	≤0.25	-	-

<i>Neisseria meningitidis</i>	≤2	-	≤ ^b
<i>Staphylococcus aureus</i>	≤2	4	≥8
Streptococci ^a	≤0.5	1	≥2

a Includes *Streptococcus pneumoniae*, β-hemolytic streptococci and viridans streptococci.

b The current absence of data on resistant strains precludes defining any category other than susceptible. If strains yield MIC results other than susceptible, they should be submitted to a reference laboratory for further testing.

Incubation in ambient air.

CLSI = Clinical and Laboratory Standards Institute; MIC = Minimal inhibitory concentration.

Source: CLSI M45, 2015; CLSI M100, 2018.

Susceptibility can also be determined by the disk diffusion method, measuring inhibition zone diameters after incubation in ambient air. Susceptibility disks contain 15 µg of azithromycin. Interpretive criteria for inhibition zones, established by the CLSI on the basis of their correlation with MIC susceptibility categories, are listed in the table below.

CLSI Disk Zone Interpretive Criteria

Organism	Disk inhibition zone diameter (mm)		
	Susceptible	Intermediate	Resistant
<i>Haemophilus</i> species	≥12	-	-
<i>Moraxella catarrhalis</i>	≥26	-	-
<i>Neisseria meningitidis</i>	≥20	-	-
<i>Staphylococcus aureus</i>	≥18	14 - 17	≤13
Streptococci ^a	≥18	14 - 17	≤13

a Includes *Streptococcus pneumoniae*, β-hemolytic streptococci and viridans streptococci.

Incubation in ambient air.

CLSI = Clinical and Laboratory Standards Institute; mm = Millimeters.

Source: CLSI M45, 2015; CLSI M100, 2018.

The validity of both the dilution and disk diffusion test methods should be verified using quality control (QC) strains, as indicated by the CLSI. Acceptable limits when testing azithromycin against these organisms are listed in the table below.

Quality Control Ranges for Azithromycin Susceptibility Tests

Broth microdilution MIC	
Organism	Quality control range (mg/L azithromycin)
<i>Haemophilus influenzae</i> ATCC 49247	1 - 4
<i>Staphylococcus aureus</i> ATCC 29213	0.5 - 2
<i>Streptococcus pneumoniae</i> ATCC 49619	0.06 - 0.25
Disk inhibition zone diameter (15 µg disk)	
Organism	Quality control range (mm)
<i>Haemophilus influenzae</i> ATCC 49247	13 - 21
<i>Staphylococcus aureus</i> ATCC 25923	21 - 26
<i>Streptococcus pneumoniae</i> ATCC 49619	19 - 25

Incubation in ambient air.

CLSI = Clinical and Laboratory Standards Institute; MIC = Minimal inhibitory concentration;

mm = Millimeters.

Source: CLSI M100, 2018.

EUCAST has also established susceptibility breakpoints for azithromycin based on MIC determination. The EUCAST susceptibility criteria are listed in the table below.

EUCAST Susceptibility Breakpoints for Azithromycin

	MIC (mg/L)	
	Susceptible	Resistant
<i>Staphylococcus</i> species	≤1	>2
<i>Streptococcus pneumoniae</i>	≤0.25	>0.5
β-hemolytic streptococci ^a	≤0.25	>0.5
<i>Haemophilus influenzae</i>	≤0.12	>4
<i>Moraxella catarrhalis</i>	≤0.25	>0.5

<i>Neisseria gonorrhoeae</i>	≤0.25	>0.5
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a Includes Groups A, B, C, G.

EUCAST = European Committee on Antimicrobial Susceptibility Testing; MIC = Minimal inhibitory concentration.

Source: EUCAST Web site.

EUCAST Clinical Breakpoint Table v. 8.0, valid from 2018-01-01

Antibacterial spectrum

The susceptibility of bacterial species to azithromycin is shown below.

The prevalence of acquired resistance may vary geographically and with time for selected species and local information on resistance is desirable, particularly when treating severe infections. As necessary, expert advice should be sought when the local prevalence of resistance is such that the utility of the agent in at least some types of infections is questionable.

In-vitro susceptibility data do not always correlate with clinical results.

Commonly susceptible species

Aerobic gram-positive bacteria:

Streptococci (Groups C, F, G) and *Viridans* group streptococci.

Aerobic gram-negative bacteria:

Bordetella pertussis, *Haemophilus ducreyi*, *Haemophilus influenzae**[§], *Haemophilus parainfluenzae**, *Legionella pneumophila*, *Moraxella catarrhalis** and *Neisseria gonorrhoeae*.

Other:

*Chlamydia pneumoniae**, *Chlamydia trachomatis*, *Mycoplasma pneumoniae** and *Ureaplasma urealyticum*.

Species for which acquired resistance may be a problem

Aerobic gram-positive bacteria:

*Streptococcus pneumoniae**

*Streptococcus pyogenes**

Staphylococcus aureus

Inherently resistant organisms:

Enterobacteriaceae

Pseudomonas spp.

Note: Azithromycin demonstrates cross-resistance with erythromycin-resistant gram-positive strains and most strains of methicillin resistant staphylococci.

*Species for which efficacy has been demonstrated in clinical trials.

§Species with natural intermediate susceptibility.

5.2 Pharmacokinetic properties

Absorption

Following oral administration in humans, azithromycin is widely distributed throughout the body; bioavailability is approximately 37%. The time taken to peak plasma levels is 2 to 3 hours.

Distribution

In animal studies, high azithromycin concentrations have been observed in phagocytes. In experimental models, higher concentrations of azithromycin are released during active phagocytosis than from non-stimulated phagocytes. In animal models, this results in high concentrations of azithromycin being delivered to the site of infection.

Pharmacokinetic studies in humans have shown markedly higher azithromycin levels in tissues than in plasma (up to 50 times the maximum observed concentration in plasma), indicating that the drug is heavily tissue bound. Concentrations in target tissues, such as lung, tonsil and prostate, exceed the MIC₉₀ for likely pathogens after a single dose of 500 mg.

Following oral administration of daily doses of 600 mg azithromycin, C_{max} was 0.33 µg/ml and 0.55 µg/ml at Day 1 and Day 22, respectively. Mean peak concentrations observed in leukocytes, the major site of disseminated MAC infection, were 252 µg/ml (±49%) and remained above 146 µg/ml (±33%) for 24 hours at steady-state.

Elimination

Plasma terminal elimination half-life closely reflects the tissue depletion half-life of 2 to 4 days. About 12% of an intravenously administered dose is excreted in the urine unchanged over 3 days; the majority in the first 24 hours. Biliary excretion of azithromycin is a major route of elimination for unchanged drug, following oral administration.

Very high concentrations of unchanged drug have been found in human bile, together with 10 metabolites, formed by N- and O-demethylation, hydroxylation of the desosamine and aglycone rings, and cleavage of the cladinose conjugate.

Comparison of HPLC and microbiological assays in tissues suggests that metabolites play no part in the microbiological activity of azithromycin.

Pharmacokinetics in special populations

Renal impairment

The pharmacokinetics of azithromycin in subjects with mild to moderate renal impairment (GFR 10–80 ml/min) were not affected following a single 1 gram dose of immediate release azithromycin. Statistically significant differences in AUC₀₋₁₂₀ (8.8 µg·h/ml vs. 11.7 µg·h/ml), C_{max} (1.0 µg/ml vs. 1.6 µg/ml) and CL_r (2.3 ml/min/kg vs. 0.2 ml/min/kg) were observed between the group with severe renal impairment (GFR <10 ml/min) and the group with normal renal function.

Hepatic impairment

In patients with mild (Class A) to moderate (Class B) hepatic impairment, there is no evidence of a marked change in serum pharmacokinetics of azithromycin compared to those with normal hepatic function. In these patients, urinary clearance of azithromycin appears to increase, perhaps to compensate for reduced hepatic clearance.

Elderly

In elderly volunteers (>65 years), slightly higher AUC values were seen after a 5-day regimen than in young volunteers (<40 years), but these are not considered clinically significant, and hence no dose adjustment is recommended.

5.3 Preclinical safety data

Phospholipidosis (intracellular phospholipid accumulation) has been observed in several tissues (e.g. eye, dorsal root ganglia, liver, gallbladder, kidney, spleen, and/or pancreas) of mice, rats, and dogs given multiple doses of azithromycin. Phospholipidosis has been observed to a similar extent in the tissues of neonatal rats and dogs. The effect has been shown to be reversible after cessation of azithromycin treatment. The significance of the finding for animals and humans is unknown.

6. PHARMACEUTICAL PARTICULARS

6.1 List of excipients

Sucrose
Xanthan gum
Hydroxypropylcellulose
Trisodium phosphate anhydrous
Silica, colloidal anhydrous

Aspartame
Cream caramel flavour
Titanium dioxide

6.2 Incompatibilities

Not applicable.

6.3 Shelf life

Unopened bottle with dry powder: Please refer to outer carton.

Any unused suspension should be discarded 5 days after reconstitution.

6.4 Special precautions for storage

Unopened bottle with dry powder: Store below 30°C.

Reconstituted suspension: Store below 30°C for 5 days. Any unused suspension should be discarded after 5 days. Store in the original package.

6.5 Nature and contents of container

HDPE bottles with a PP/PE-childproof closure with retaining ring.

PE/PP-dosage syringe (10 ml), graduated in 0.25 ml divisions.

Content of the bottle after reconstitution: 15 ml (600 mg), 20 ml (800 mg), 22.5 ml (900 mg), 30 ml (1200 mg) or 37.5 ml (1500 mg).

Not all pack sizes may be marketed.

6.6 Special precautions for disposal and other handling

Preparation of the suspension:

Shake the dry powder loose. Add the amount of water described below to the powder.

For 15 ml (600 mg) bottle: add 8.0 ml water.

For 20 ml (800 mg) bottle: add 10.5 ml water.

For 22.5 ml (900 mg) bottle: add 11.0 ml water.

For 30 ml (1200 mg) bottle: add 15.0 ml water.

For 37.5 ml (1500 mg) bottle: add 18.5 ml water.

Shake well until a white to off white coloured, homogenous suspension is achieved. Shake the bottle well before each use. For administration, the syringe adapter should be placed in the neck of the bottle and the stopper should be opened.

7. Manufacturer

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8. Date of revision of the text

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