SUMMARY OF PRODUCT CHARACTERISTICS

1. Name of the medicinal product
Ethambutol hydrochloride/isoniazid/rifampicin 275mg/75mg/150mg film-coated tablets

2. Qualitative and quantitative composition
Each tablet contains 275 mg of ethambutol hydrochloride, 75 mg of isoniazid and 150 mg of rifampicin.

For a full list of excipients, see section 6.1.

3. Pharmaceutical form
Tablet.

Brown, biconvex, capsule-shaped, film-coated tablet and plain on both sides.

4. Clinical particulars

4.1 Therapeutic indications
Ethambutol hydrochloride/isoniazid/rifampicin is a combination medicine for the initial treatment of tuberculosis due to *Mycobacterium tuberculosis*. Treatment regimens should follow the most recent WHO treatment guidelines, supplemented by other authoritative guidelines.

4.2 Posology and method of administration
For oral use.

Posology
Treatment regimens should follow the most recent WHO treatment guidelines, supplemented by other authoritative guidelines. Initial (intensive phase) treatment with ethambutol hydrochloride/isoniazid/rifampicin is normally given for 2 months in combination with pyrazinamide, which is generally followed by treatment with isoniazid and rifampicin (continuation phase). The duration of treatment depends on the regimen selected.

Typical recommended doses of ethambutol hydrochloride/isoniazid/rifampicin for initial (intensive phase) treatment in adults and children weighing more than 25 kg:

Patients' weight	**Dose**
25–29.9 kg	2 tablets once daily
30–34.9 kg	3 tablets once daily
35–64.9 kg	4 tablets once daily
65 kg and over	5 tablets once daily

Ethambutol hydrochloride/isoniazid/rifampicin should not be used for intermittent treatment regimens. Ethambutol hydrochloride/isoniazid/rifampicin should be taken as a single daily dose on an empty stomach (at least 1 hour before or 2 hours after a meal). Absorption may be reduced if taken with food e.g., to improve gastrointestinal tolerance.

If one of the active ingredients of this medicine needs to be discontinued or if the dose needs to be reduced then separate preparations of the ingredients (ethambutol, isoniazid and rifampicin) should be used. Supplementation with pyridoxine (vitamin B_6) may be considered, especially in malnourished individuals, children and those living with HIV (see section 4.4).

Renal impairment
Since dose adjustment may be necessary for patients with renal impairment (creatinine clearance ≤ 50 mL/minute), it is recommended that separate preparations of ethambutol, isoniazid, pyrazinamide, and rifampicin be used (see sections 4.3 and 4.4).

Hepatic impairment
Limited data indicate that the pharmacokinetics of isoniazid and rifampicin are altered in patients with hepatic impairment. Therefore, patients with hepatic impairment should be closely observed for signs of toxicity. Ethambutol hydrochloride/isoniazid/rifampicin must not be used in patients with a history of acute liver disease (see section 4.3).

Children, adolescents and patients weighing less than 25 kg
Ethambutol hydrochloride/isoniazid/rifampicin is not suitable for patients with a body weight below 25 kg since appropriate dose adjustments cannot be made. Alternative formulations should be used.

Elderly
No special dosage regimen is necessary, but hepatic or renal insufficiency should be considered. Supplementation of pyridoxine (vitamin B_6) may be useful.

Interruption of treatment
If treatment with ethambutol hydrochloride/isoniazid/rifampicin is interrupted for any reason including non-adherence, the product should not be used for resuming treatment. Ethambutol, isoniazid and rifampicin must be administered separately for the resumption of treatment because rifampicin needs to be reintroduced at a lower dose. Official guidance should be consulted on the resumption of treatment with tuberculosis medicines.

4.3 Contraindications
Hypersensitivity to rifampicin, isoniazid, ethambutol and/or any of the excipients listed in section 6.1. A history of acute liver disease, icterus or severe liver impairment, regardless of its origin. Renal impairment requiring dose adjustment (see section 4.4). Concomitant use with voriconazole or protease inhibitors for HIV or hepatitis C infection (see section 4.5).

4.4 Special warnings and precautions for use

Warnings
Where the patient's acetylation phenotype is known, patients with extremely fast or extremely slow acetylating capability should receive the four components separately to facilitate dose adjustment of isoniazid.

Ethambutol hydrochloride/isoniazid/rifampicin is not suitable for use in the treatment of patients with a body weight of less than 25 kg since appropriate dose adjustments cannot be made. Other formulations should be used that allow suitable doses to be given.
Hypersensitivity
In exceptional cases, rifampicin may provoke severe hypersensitivity reactions such as thrombocytopenia, purpura, haemolytic anaemia, dyspnoea asthma-like attacks, shock or renal failure. Ethambutol hydrochloride/isoniazid/rifampicin should be withdrawn immediately if severe acute hypersensitivity reactions occur. Patients who develop such reactions must never again be treated with rifampicin. Ethambutol hydrochloride/isoniazid/rifampicin should also be withdrawn if other signs of hypersensitivity appear, such as fever, flu-like symptoms or skin reactions. For safety reasons, treatment should not be continued or resumed with rifampicin.

The risk is higher in intermittent therapy or if treatment is resumed after discontinuation. If rifampicin therapy is temporarily discontinued for other reasons, rifampicin should be restarted carefully at a reduced dose, and with close monitoring. In this situation, ethambutol hydrochloride/isoniazid/rifampicin should not be used.

Cross-sensitivity
Patients hypersensitive to ethionamide, niacin (nicotinic acid), or other chemically related medications may also be hypersensitive to isoniazid.

Visual acuity
Given that ethambutol may cause ocular toxicity, patients should be advised to report promptly any changes in visual acuity. Therapy with ethambutol hydrochloride/isoniazid/rifampicin must be discontinued immediately if visual disturbances emerge (see section 4.8).

Ethambutol hydrochloride/isoniazid/rifampicin should be used with care in patients with visual defects and avoided in patients with pre-existing optic neuritis. An ophthalmic examination is recommended before starting treatment and every 4 weeks during treatment. It should include visual acuity, colour vision, field of vision and ophthalmoscopy. For patients with visual defects or renal insufficiency, the frequency of tests should be increased to every second or third week.

Patients who cannot report changes to their visual acuity should be more closely monitored for any deterioration during treatment with ethambutol. In young children and those with communication difficulties, parents or other family members should be advised about the need to report visual side effects.

Precautions
The precautions for the use of ethambutol hydrochloride/isoniazid/rifampicin are the same as those that apply to the administration of rifampicin, isoniazid, and ethambutol as individual medicinal products. Patients should be advised against interrupting treatment except as indicated by their healthcare provider (e.g., pending clinical evaluation if visual disturbances occur).

Liver toxicity
Rifampicin, isoniazid and ethambutol are metabolised in the liver. Elevated transaminase levels, above the upper limit of normal (ULN), commonly occur. Liver dysfunction that may occur in the first few weeks of treatment usually returns to the normal range spontaneously, without interruption of treatment, and usually by the third month of treatment.

With rifampicin, although slight elevations of liver enzymes are common, clinical jaundice or evidence of hepatitis are rare. In patients taking both isoniazid and rifampicin, a cholestatic pattern with elevated alkaline phosphatase suggests that rifampicin is the causative agent, whereas a rise in transaminases may be caused by isoniazid or rifampicin, or the combination of both. A moderate rise in bilirubin and/or transaminase levels is not in itself an indication for interrupting treatment; rather, the decision should be made after repeating these liver function tests, noting trends in the levels, and considering them in conjunction with the patient's clinical condition.

Interrupting isoniazid treatment is recommended when clinical jaundice or transaminases exceed 3 times the ULN. The fixed drug combination, ethambutol hydrochloride/isoniazid/rifampicin, should be replaced by individual component formulations of rifampicin, isoniazid and ethambutol to facilitate treatment in these clinical circumstances.

Withdrawing rifampicin, pyrazinamide and ethambutol is recommended if liver function does not return to normal or transaminases exceed 5 times the ULN. The fixed drug combination, ethambutol hydrochloride/isoniazid/rifampicin, should be replaced by individual component formulations to facilitate treatment in these clinical circumstances. Patients with impaired liver function should be treated with caution and under strict medical supervision.

In these patients, careful monitoring of liver function, especially serum glutamic pyruvic transaminase (SGPT/ALAT) and serum glutamic oxaloacetic transaminase (SGOT/ASAT) should be carried out before therapy and repeated weekly or fortnightly during therapy. If signs of hepatocellular damage occur, ethambutol hydrochloride/isoniazid/rifampicin should be withdrawn.

In general, the use of ethambutol hydrochloride/isoniazid/rifampicin in patients with a history of acute liver disease is contra-indicated (see section 4.3). The use of isoniazid should be carefully monitored in patients with chronic liver disease. Severe and sometimes fatal hepatitis caused by isoniazid may occur and may develop even after many months of treatment. Hepatotoxicity associated with isoniazid therapy (thought to be caused by the metabolite diacetylhydrazine) is rare in patients up to 20 years of age, but more common with increasing age and affects up to 3% of patients aged over 50 years. The incidence of severe hepatotoxicity can be minimised by careful monitoring of liver function. All patients should be instructed to immediately report signs or symptoms consistent with liver damage or other adverse effects. These include any of the following: unexplained anorexia, nausea, vomiting, dark urine, icterus, rash, persistent paraesthesias of the hands and feet, persistent fatigue and/or weakness of greater than 3 days duration and/or abdominal tenderness, especially of the right upper quadrant. If these symptoms appear or if signs suggestive of hepatic damage are detected, ethambutol hydrochloride/isoniazid/rifampicin should be discontinued promptly, since continued use in these cases may cause a more severe form of liver damage.

Ethambutol hydrochloride/isoniazid/rifampicin is not suitable for use in patients with chronic liver disease, or chronic alcoholics and undernourished patients if the dosage of rifampicin, isoniazid, pyrazinamide and ethambutol needs to be adjusted separately. For undernourished or elderly patients supplementation of pyridoxine (vitamin B6) may be useful because isoniazid in high doses can lead to pyridoxine (vitamin B6) deficiency. Pyridoxine supplementation is also recommended in malnourished children and adolescents, in those who are pregnant or breastfeeding, and those living with HIV, at a dosage of 0.5–1 mg/kg daily, increased to 2–5 mg/kg daily if peripheral neuropathy develops.

Peripheral neuropathy
This is a common toxic effect of isoniazid (see section 4.8). The frequency depends on the dose and predisposing conditions such as malnutrition, alcoholism or diabetes. The use of pyridoxine (vitamin B6) may prevent or diminish neuropathy due to isoniazid treatment especially in elderly and malnourished patients, and patients living with HIV. Pyridoxine should be given in line with official guidelines.

Epilepsy
Patients suffering from convulsive disorders must be kept under special observation during treatment with ethambutol hydrochloride/isoniazid/rifampicin because of the neurotoxic effects of isoniazid and ethambutol hydrochloride.

Haematological toxicity
Since rifampicin treatment has been associated with haemolytic anaemia, leukopenia and thrombocytopenia, full blood count should be monitored regularly throughout therapy with ethambutol hydrochloride/isoniazid/rifampicin. In case of severe haematological disturbances ethambutol hydrochloride/isoniazid/rifampicin should be discontinued and the patient should not be given rifampicin again.

Hyperuricaemia and gout
Ethambutol is excreted via the same pathway as uric acid, thereby leading to increased serum concentration of uric acid. Concomitant therapy with isoniazid or pyridoxine may enhance this effect. Patients with pre-existing hyperuricaemia or symptoms of gout should be monitored for signs of deterioration when treated with ethambutol (see sections 4.5 and 4.8).

Renal insufficiency
In renal insufficiency, the clearance of ethambutol and isoniazid is delayed, causing an increased systemic exposure. In case of renal insufficiency, ethambutol hydrochloride/isoniazid/rifampicin should not be used, as dose modifications of the active components may be necessary (see section 4.2).

Nephrotoxicity
Ethambutol hydrochloride/isoniazid/rifampicin should be discontinued in case of clinical signs of nephrotoxicity.

Diabetes mellitus
Patients with diabetes should be carefully monitored since blood glucose control may be affected by isoniazid.

Concomitant medications
Rifampicin is a potent inducer of the cytochrome P450 system and may increase the metabolism of concomitantly administered drugs resulting in subtherapeutic plasma levels and a lack of effect. Drugs that are eliminated by hepatic metabolism should only be used concomitantly with ethambutol hydrochloride/isoniazid/rifampicin if the plasma level or clinical response / undesirable effects can be monitored and the dose can be adequately adjusted (see section 4.5). Rifampicin has enzyme induction properties that can enhance the metabolism of endogenous substrates including adrenal corticosteroids, thyroid hormones and vitamin D.

Contraception
Additional non-hormonal means of contraception must be employed to prevent the possibility of pregnancy during treatment with rifampicin (see section 4.5).

Alcohol
The intake of alcoholic beverages should be avoided during treatment with ethambutol hydrochloride/isoniazid/rifampicin (see section 4.5).

Porphyria
Isolated reports have associated porphyria exacerbation with rifampicin administration.

Discoloration of body fluids
Ethambutol hydrochloride/isoniazid/rifampicin may cause a reddish-orange discolouration of body fluids such as urine, sputum and tears. This is due to rifampicin and does not require medical attention.

Laboratory tests
Full blood counts, liver function tests (SGPT/ALAT, SGOT/ASAT), renal function tests and monitoring serum uric acid should be performed before treatment and at regular intervals during treatment. The ocular examination is recommended during treatment with ethambutol hydrochloride.

4.5 Interaction with other medicinal products and other forms of interaction

Influence of other medicinal products on ethambutol hydrochloride/isoniazid/rifampicin
Antacids reduce the bioavailability of rifampicin, isoniazid and ethambutol. To avoid this interaction, ethambutol hydrochloride/isoniazid/rifampicin should be taken at least 1 hour before antacids. Corticosteroids can reduce the plasma levels of isoniazid, by increasing its metabolic and/or renal clearance.

Influence of ethambutol hydrochloride/isoniazid/rifampicin on other medicinal products
Rifampicin is a very potent inducer of the hepatic and intestinal cytochrome P-450 enzyme system (especially the CYP3A and CYP2C subfamilies)**.** Rifampicin is likely to accelerate the elimination of co-administered drugs that undergo biotransformation through these metabolic pathways. Rifampicin also induces UDP-glucuronyltransferase, another enzyme involved in the metabolism of several drugs. This can result in subtherapeutic plasma levels of co-administered drugs, with a decreased or even a loss of effect.

These effects approach their maximum after about 10 days of treatment and gradually return to normal in 2 or more weeks after discontinuation. This must be considered when co-administering other drugs. To maintain optimum therapeutic blood levels, doses of drugs metabolised by these enzymes may require adjustment when starting or stopping the concomitant administration of ethambutol hydrochloride/isoniazid/rifampicin.

In vitro, isoniazid inhibits CYP2C19 and CYP3A4. Therefore, it may reduce elimination and increase blood levels of drugs mainly eliminated through either of these pathways. However, when given with rifampicin, as when using ethambutol hydrochloride/isoniazid/rifampicin, these effects are likely to be outweighed by the hepatic enzyme induction due to rifampicin. The net effect on drugs affected in opposite ways by rifampicin and isoniazid (such as phenytoin, warfarin and theophylline) is hard to predict and may change over time. Concurrent use of isoniazid with other hepatotoxic or neurotoxic medicines may increase the hepatotoxicity and neurotoxicity of isoniazid and should be avoided.

Ethambutol has fewer significant pharmacokinetic or pharmacodynamic interactions with other medicines, but particular care may be needed if used with other medicines that also affect visual function. Therefore, mainly due to rifampicin, ethambutol hydrochloride/isoniazid/rifampicin may interact with a very large number of other drugs, primarily by reducing the exposure to co-administered agents, reducing their efficacy and increasing the risk of therapeutic failure. For many important medicines, no interaction data with rifampicin are available. However, clinically significant reductions in drug exposure may occur.

Whenever co-prescribing any drug together with ethambutol hydrochloride/isoniazid/rifampicin, the possibility of a drug-drug interaction should be considered. The following list of drug interactions with ethambutol hydrochloride/isoniazid/rifampicin is not exhaustive but is a selection of interactions of putative importance. The scope of the table is largely based on the WHO Essential Medicines List.

Table 1. List of drug interactions

Drugs	Interaction	Recommendations on co-administration
INFECTION		
Antiretrovirals		
Nucleoside analogues Zidovudine / rifampicin	Zidovudine AUC ↓ 47%	The clinical significance of the lowered zidovudine exposure is unknown. Dose modifications of zidovudine in this situation have not been formally evaluated.
Didanosine Emtricitabine Lamivudine Stavudine	No interaction expected	No dose adjustment is required.
Tenofovir alafenamide/ emtricitabine/ rifampicin	Interaction not studied. Co-administration of rifampicin, a P-gp inducer, may decrease tenofovir alafenamide plasma concentrations, which may result in loss of therapeutic effect and development of resistance.	Co-administration is not recommended.
Tenofovir disoproxil / rifampicin	Tenofovir AUC ↓ 13%	No dose adjustment is required.
Abacavir / rifampicin	Empirical data are lacking, but rifampicin may decrease abacavir exposure through induction of glucuronidation.	The efficacy of abacavir should be closely monitored in co-treatment.
Non-nucleoside analogues Efavirenz / rifampicin	Efavirenz AUC ↓ 26%	When co-treating with ethambutol hydrochloride/isoniazid/rifampicin, increasing the efavirenz dose to 800 mg daily may be considered
Nevirapine / rifampicin	Nevirapine: AUC ↓ 58%	Concomitant use of ethambutol hydrochloride/isoniazid/rifampicin and nevirapine is not recommended since appropriate doses of nevirapine when given concomitantly with rifampicin have not been established and the safety of the combination is

Drugs	Interaction	Recommendations on co-administration
		unknown,
Etravirine / rifampicin	Rifampicin is likely to significantly reduce exposure to etravirine.	Co-treatment of ethambutol hydrochloride/isoniazid/rifampicin and etravirine should be avoided.
Protease inhibitors Atazanavir / rifampicin Boceprevir Darunavir Fosamprenavir Indinavir Lopinavir Ritonavir Saquinavir Tipranavir	Protease inhibitor exposure will be reduced to a subtherapeutic level due to interaction with rifampicin. Increasing doses, or an increase in ritonavir-boosting, have been ineffective or ill-tolerated with a high rate of hepatotoxicity.	Ethambutol hydrochloride/isoniazid/rifampicin must not be co-administered with protease inhibitors for treating HIV or hepatitis C virus infections (see section 4.3).
Others Raltegravir / rifampicin	Raltegravir AUC ↓ 40%	Co-treatment should be avoided. If deemed necessary, consider increasing the raltegravir dose to 600 mg twice daily
Dolutegravir / rifampicin	Dolutegravir AUC ↓ 54%	A dose adjustment of dolutegravir to 50 mg twice daily is recommended when co-administered with ethambutol hydrochloride/isoniazid/rifampicin in the absence of integrase class resistance. In the presence of integrase class resistance, this combination should be avoided.
Elvitegravir/cobicistat/rifampicin	Co-administration has not been studied. Rifampicin is a potent inducer of CYP450 metabolism and may cause a significant decrease in the plasma concentration of elvitegravir and cobicistat resulting in a loss of therapeutic effect.	Co-administration is contraindicated.
Maraviroc / rifampicin	Maraviroc AUC ↓ 63%	Co-treatment should be avoided. If deemed necessary, the maraviroc dose should be increased to 600 mg twice daily.
Antivirals for hepatitis C infection		
Daclatasvir Elbasvir/Grazoprevir Glecaprevir/Pibrentasvir Ledipasvir/Sofosbuvir Ombitasvir/paritaprevir/ritonavir (with or without dasabuvir)	*Rifampicin:* Co-administration has not been studied but is expected to decrease concentrations of these hepatitis C virus	Co-administration of ethambutol hydrochloride/isoniazid/rifampicin with these antivirals is contraindicated (for further details see a summary of product characteristics of antivirals for

Drugs	Interaction	Recommendations on co-administration
Simeprevir Sofosbuvir (with or without velpatasvir with or without voxilaprevir) / Rifampicin Isoniazid	antivirals due to the induction of CYP3A4 by rifampicin and hence to reduce their therapeutic effect. <u>*Isoniazid:*</u> Co-administration has not been studied. Patients with current chronic liver disease should be carefully monitored. Severe and sometimes fatal hepatitis associated with isoniazid may develop even after many months of treatment.	treating hepatitis C virus infection).
Antifungals		
Ketoconazole / rifampicin	Ketoconazole AUC ↓ 80%	Co-administration should be avoided. If deemed necessary, a dose increase of ketoconazole may be required.
Fluconazole / rifampicin	Fluconazole AUC ↓ 23%	Monitor therapeutic effect. An increased dose of fluconazole may be required.
Itraconazole / rifampicin	Itraconazole AUC ↓ 64–88%	Co-administration should be avoided.
Voriconazole / rifampicin	Voriconazole AUC ↓ 96%	Co-administration is contraindicated. If necessary, rifabutin should be substituted for rifampicin.
Antibacterials/tuberculosis medicines		
Clarithromycin / rifampicin	Clarithromycin means a serum concentration ↓ of 85%. 14-OH clarithromycin levels are unchanged.	Co-administration should be avoided.
Chloramphenicol/rifampicin	Case reports indicate a 60–80% reduction in chloramphenicol exposure.	Co-administration should be avoided.
Ciprofloxacin / rifampicin	No significant interaction	No dose adjustment is required.
Doxycycline/rifampicin	Doxycycline AUC ↓ 50–60%	If co-treatment is considered necessary, the dose of doxycycline should be doubled.
Metronidazole / rifampicin	Metronidazole AUC i.v.↓ 33%	The clinical relevance of the interaction is unknown. Dose

Drugs	Interaction	Recommendations on co-administration
		adjustment is not routinely recommended. Efficacy should be monitored.
Sulfamethoxazole/rifampicin	Sulfamethoxazole AUC ↓ 23%	Interaction is probably not clinically significant. The efficacy of sulfamethoxazole should be monitored.
Trimethoprim/rifampicin	Trimethoprim AUC ↓ 47%	A dose increase of trimethoprim may be required. Efficacy should be monitored.
Ethionamide/rifampicin		Rifampicin and ethionamide should not be co-administered, due to an increased risk of hepatotoxicity.
Antimalarials		
Chloroquine / rifampicin		Empirical data are not available. Since chloroquine undergoes polymorphic hepatic metabolism, lower levels are likely during rifampicin co-therapy. Co-administration should be avoided.
Atovaquone / rifampicin	Atovaquone AUC ↓ 50% Rifampicin AUC ↑ 30%	Co-administration should be avoided.
Mefloquine / rifampicin	Mefloquine AUC ↓ 68%	Co-administration should be avoided.
Amodiaquine / rifampicin	Empirical data are not available. Since amodiaquine undergoes hepatic metabolism, clearance is likely increased when co-treating with rifampicin.	Co-administration should be avoided.
Quinine/rifampicin	Quinine AUC ↓ ≈ 80%. This has been associated with significantly higher recrudescence rates.	Co-administration should be avoided. If co-administration is deemed necessary, an increased dose of quinine should be considered.
Lumefantrine / rifampicin	Lumefantrine AUC ↓ 68%	Co-administration should be avoided.
Artemisinin and its derivatives / rifampicin	Artemether AUC ↓ 89% Dihydroarthemisinin AUC ↓ 85%	Co-administration should be avoided.

Drugs	Interaction	Recommendations on co-administration
ANALGESICS, ANTIPYRETICS, NON-STEROIDAL ANTI-INFLAMMATORY DRUGS		
Morphine / rifampicin	Morphine AUC p.o ↓ 30%, loss of analgesic effect.	Co-treatment should be avoided. If deemed necessary, efficacy should be monitored and the dose may need to be increased.
Codeine/rifampicin	Plasma levels of morphine, the active metabolite of codeine, are likely to be substantially reduced.	Efficacy should be monitored and codeine dose increased if necessary.
Paracetamol (acetaminophen) / rifampicin / isoniazid	Rifampicin may increase the glucuronidation of paracetamol and decrease its efficacy. There may be an increased risk of hepatotoxicity on co-administration, but data are inconclusive. Concurrent use with isoniazid may increase hepatotoxicity.	Co-administration of ethambutol hydrochloride/isoniazid/rifampicin and paracetamol should be avoided.
Etoricoxib / rifampicin	Rifampicin has been reported to produce a 65% decrease in etoricoxib plasma concentrations when given concomitantly.	Patients should be monitored for possible loss of analgesic effect; however, evidence to support an increase in analgesic dose is lacking.
ANTIEPILEPTICS		
Carbamazepine / rifampicin / isoniazid	Rifampicin is expected to decrease serum concentrations of carbamazepine whereas isoniazid may increase them. Neurological side effects and the risk of hepatotoxicity increase when co-treating with carbamazepine.	Co-administration of ethambutol hydrochloride/isoniazid/rifampicin and carbamazepine should be avoided.
Phenobarbital / rifampicin / isoniazid	Phenobarbital and rifampicin are both strong hepatic enzyme inducers, and each may lower the plasma concentrations of the other. Also, co-treatment with phenobarbital and isoniazid may increase the	Co-administration of ethambutol hydrochloride/isoniazid/rifampicin and phenobarbital should be undertaken with caution, and the patient monitored for clinical effects and, if possible, plasma drug concentrations.

Drugs	Interaction	Recommendations on co-administration
	risk of hepatotoxicity.	
Phenytoin / rifampicin isoniazid	Phenytoin AUC i.v. ↓ 42% Co-treatment with phenytoin and isoniazid may result in an increased risk of hepatotoxicity.	Co-treatment with phenytoin and ethambutol hydrochloride/isoniazid/rifampicin should be avoided.
Valproic acid / rifampicin	Interaction studies are lacking. Since valproic acid is eliminated through hepatic metabolism, including glucuronidation, reduced plasma levels of valproic acid are likely with concomitant use.	Co-treatment should be avoided. If deemed necessary, efficacy and, if possible, also plasma concentrations of valproic acid, should be carefully monitored.
Lamotrigine / rifampicin	Lamotrigine AUC ↓ 45%	Co-treatment should be avoided. If deemed necessary, the lamotrigine dose should be increased as appropriate.
IMMUNOSUPPRESSANTS		
Ciclosporin / rifampicin	Several studies and case reports have shown substantially increased ciclosporin clearance when co-administered with rifampicin.	Co-administration should be avoided. If deemed necessary, plasma concentrations of ciclosporin should be monitored and doses adapted accordingly (3- to 5-fold increases in ciclosporin dose have been required).
Tacrolimus / rifampicin Sirolimus Everolimus	Tacrolimus AUC i.v. ↓ 35%; AUC p.o ↓ 6870% Sirolimus AUC ↓ 82% Everolimus AUC ↓ 63%	Co-administration of ethambutol hydrochloride/isoniazid/rifampicin and mTOR inhibitors should be avoided. If deemed necessary, plasma drug concentrations should be monitored, and the dose increased as appropriate.
CARDIOVASCULAR MEDICINES		
ACE inhibitors		
Enalapril / rifampicin	No interaction expected	No dose adjustment is required.
Antiarrhythmics		
Lidocaine / rifampicin	Lidocaine CLi.v. ↑ 15%	No dose adjustment required
Verapamil / rifampicin	S-verapamil p.o CL/F ↑ 32-fold. With i.v. S-verapamil, CL ↑ 1.3-fold	Ethambutol hydrochloride/isoniazid/rifampicin and oral forms of verapamil should not be co-administered. If i.v. verapamil is given, the therapeutic effect should be carefully monitored; dose adjustment may

Drugs	Interaction	Recommendations on co-administration
		be required.
Anticoagulants		
Warfarin and other coumarin anticoagulants/rifampicin /isoniazid	Warfarin AUC ↓ 85% Isoniazid may inhibit the hepatic metabolism of warfarin.	Monitor closely and adjust warfarin dose as needed and reduce dose after withdrawing rifampicin treatment.
Beta-blockers		
Atenolol / rifampicin	Atenolol AUC ↓ 19%	No dose adjustment is required.
Calcium-channel blockers		
Amlodipine / rifampicin	Amlodipine is metabolised by CYP3A; lower exposure of amlodipine and potentially other calcium-channel blockers is expected when co-treating with rifampicin.	Efficacy should be monitored.
Cardiac glycosides		
Digoxin / rifampicin	AUC p.o ↓ 30%	When co-administering ethambutol hydrochloride/isoniazid/rifampicin with digoxin, the efficacy and plasma concentration of digoxin should be monitored. A dose increase may be required.
Statins		
Simvastatin / rifampicin	Simvastatin AUC ↓ 87% Simvastatin acid AUC ↓ 93%	Co-administration is not recommended.
Atorvastatin / rifampicin	Atorvastatin AUC ↓ 80%	Co-administration is not recommended
GASTROINTESTINAL MEDICINES		
Ranitidine / rifampicin	Ranitidine AUC ↓ 52%	Efficacy should be monitored, and the ranitidine dose increased if necessary.

Drugs	Interaction	Recommendations on co-administration
Antacids/isoniazid / rifampicin	Antacids may reduce the bioavailability of rifampicin, isoniazid and ethambutol, in the former case by up to a third. Aluminium hydroxide impairs the absorption of isoniazid.	Acid-suppressing drugs or antacids that do not contain aluminium hydroxide should be used if co-treatment with ethambutol hydrochloride/isoniazid/rifampicin is necessary. Ethambutol hydrochloride/isoniazid/rifampicin should be taken at least 1 hour before the antacid.
PSYCHOTHERAPEUTIC MEDICINES		
Anxiolytics and hypnotics		
Diazepam / rifampicin / isoniazid Midazolam Triazolam Alprazolam Nitrazepam	Diazepam AUC ↓ > 70% Midazolam AUC ↓ 98% Triazolam AUC ↓ 95% Alprazolam AUC ↓ 88% Reduced nitrazepam through concentrations, increased clearance.	Co-treatment is not recommended. Benzodiazepine withdrawal may occur in dependent individuals.
Zolpidem / rifampicin Zopiclone / rifampicin	Zolpidem AUC ↓73% Zopiclone AUC ↓82%	Co-administration should be avoided.
Antipsychotics		
Chlorpromazine / rifampicin / isoniazid	Rifampicin may reduce chlorpromazine exposure. Also, concomitant use of chlorpromazine with isoniazid may impair the metabolism of isoniazid.	Co-administration should be avoided. If considered necessary, patients should be carefully monitored for isoniazid toxicity.
Haloperidol / rifampicin Clozapine	Haloperidol clearance is substantially increased by rifampicin; theoretical considerations imply that the same applies to clozapine.	If co-treatment of ethambutol hydrochloride/isoniazid/rifampicin with haloperidol or clozapine is deemed necessary, monitor clinical efficacy. A dose increase may be required.
Tricyclic antidepressants		
Amitriptyline / rifampicin Nortriptyline	Case reports (supported by theoretical considerations) suggest that rifampicin considerably increases the clearance of tricyclic antidepressants.	Co-treatment should be avoided. If necessary, monitor for clinical response, side effects, and, if possible, plasma concentrations.

Drugs	Interaction	Recommendations on co-administration
HORMONES; OTHER ENDOCRINE MEDICINES AND CONTRACEPTIVES		
Corticosteroids		
Prednisolone Other systemically administered corticosteroids / rifampicin	Prednisolone AUC ↓ 66% For other corticosteroids, exposure is likely to be substantially decreased when co-treating with rifampicin.	Co-administration of ethambutol hydrochloride/isoniazid/rifampicin with corticosteroids should be avoided. If deemed necessary, the clinical status of the patient should be carefully monitored, and corticosteroid doses adjusted as needed.
Antidiabetics		
Glibenclamide / rifampicin Glimepiride Repaglinide	Glibenclamide AUC ↓ 39% Glimepiride AUC ↓ 34% Repaglinide AUC ↓ 57%	Blood glucose levels should be closely monitored. A dose increase of diabetes medication may be required.
Insulin	No interaction is expected.	No dose adjustment is required.
Thyroid hormones		
Levothyroxine/rifampicin	Case reports indicate that rifampicin may decrease the effect of levothyroxine.	TSH levels should be monitored.
Hormonal contraceptives		
Ethinylestradiol / rifampicin	Ethinylestradiol AUC ↓ 66%	Co-administration with ethambutol hydrochloride/isoniazid/rifampicin may be associated with decreased contraceptive efficacy. Barrier or other non-hormonal methods of contraception should be used.
Norethisterone (norethindrone) / rifampicin	Norethisterone AUC ↓ 51%	Co-administration with ethambutol hydrochloride/isoniazid/rifampicin may be associated with decreased contraceptive efficacy. Barrier or other non-hormonal methods of contraception should be used.
OTHERS		
Disulfiram / isoniazid	Concurrent use of disulfiram together with isoniazid may increase the incidence of adverse effects on the central nervous system.	Dose reduction or discontinuation of disulfiram may be necessary during therapy with ethambutol hydrochloride/isoniazid/rifampicin.

Drugs	Interaction	Recommendations on co-administration
Enflurane / isoniazid	Isoniazid may increase the formation of the potentially nephrotoxic inorganic fluoride metabolite of enflurane.	Co-administration of ethambutol hydrochloride/isoniazid/rifampicin with enflurane should be avoided.
Methadone/rifampicin	Methadone AUC ↓ 33-66%	Patients should be monitored for possible withdrawal effects and the methadone dose increased as appropriate (up to 2-3 fold).
Praziquantel / rifampicin	Praziquantel AUC ↓ 80-99%	Co-treatment with ethambutol hydrochloride/isoniazid/rifampicin should be avoided.
Theophylline/isoniazid / rifampicin	Isoniazid may increase the serum concentration of theophylline and rifampicin may increase it. The effects of the combination are unknown.	Theophylline dose adjustment may be needed.

Interactions with food
Isoniazid is an inhibitor of monoamine oxidase (MAO) and diamine oxidase (DAO), which can reduce tyramine and histamine metabolism, causing symptoms such as headache, sweating, palpitations, flushing, and hypotension. Patients should therefore be advised against ingesting foods rich in tyramine and/or histamine, such as cured meat, some cheeses (e.g., matured cheeses), and some fish (e.g., tuna, mackerel, salmon).

Concurrent daily use of alcohol may result in an increased incidence of isoniazid-induced hepatotoxicity (see section 4.4). Patients should therefore be strongly advised to avoid alcoholic beverages. Wine and beer may also contain tyramine and so cause adverse effects due to MAO inhibition.

Interactions with diagnostic tests
Rifampicin can delay the biliary excretion of contrast media during gallbladder radiographic examination. Microbiological methods used to determine folic acid and cyanocobalamin (vitamin B_{12}) plasma concentrations cannot be used during rifampicin treatment as rifampicin competes with bilirubin and BSP. To avoid false positive reactions, a BSP test should be carried out the morning before rifampicin administration.

4.6 Fertility, pregnancy and breastfeeding

Pregnancy
There are no well controlled studies with rifampicin in pregnant women. Studies on rifampicin at very high doses in animals have shown reproductive toxicity (see section 5.3). Although rifampicin has been reported to cross the placental barrier and appear in cord blood, the effect of rifampicin, alone or in combination with other antituberculosis drugs, on the human foetus is not known. The use of rifampicin in the third trimester has been associated with postnatal haemorrhage in the mother and infant. If ethambutol hydrochloride/isoniazid/rifampicin is used in the last weeks of

pregnancy, the mother and neonate should receive vitamin K. No adverse effects of isoniazid on the foetus have been reported.

Ethambutol crosses the placenta and may result in foetal plasma concentrations that are approximately 30% of maternal plasma concentrations. Limited clinical data on exposed pregnancies suggest no increase in the rate of foetal malformations in humans. Animal studies have shown a teratogenic potential (see section 5.3). Ethambutol hydrochloride/isoniazid/rifampicin can be used in pregnancy if the benefits are considered to outweigh the risks. The treatment of TB in pregnant women is the same as for non-pregnant women. As maternal TB increases the risk of vertical transmission of HIV, TB treatment must be started promptly to prevent transmission.

Supplemental pyridoxine (vitamin B_6) may be recommended in pregnancy (see section 4.4).

Breastfeeding
Rifampicin, isoniazid and ethambutol appear in human milk. However, concentrations in breast milk are so low that breastfeeding cannot be relied upon for adequate tuberculosis prophylaxis or therapy for nursing infants. No effects on the breastfed newborn/infants are anticipated. Ethambutol hydrochloride/isoniazid/rifampicin can be used during breast-feeding. In breast-fed infants whose mothers are taking isoniazid, there is a theoretical risk of vitamin B6 deficiency, with the potential for convulsions and neuropathy. Pyridoxine supplementation should be considered.

Fertility
No human data on the effect of ethambutol hydrochloride/isoniazid/rifampicin on fertility are available. Animal studies indicate that co-administration of ethambutol, rifampicin and isoniazid together with pyrazinamide has effects on fertility (see section 5.3).

4.7 Effects on the ability to drive and use machines
Ethambutol hydrochloride/isoniazid/rifampicin may have a minor to moderate influence on the ability to drive and use machines. The clinical status of the patient and the adverse reaction profile of ethambutol hydrochloride/isoniazid/rifampicin should be borne in mind when considering the patient's ability to drive or operate machinery. In particular, undesirable effects of ethambutol, such as confusion, disorientation, hallucinations, dizziness, malaise and visual disturbances (blurred vision, red-green colour blindness, loss of vision), and neurotoxicity associated with isoniazid, may impair the patient's ability to drive or operate machinery.

4.8 Undesirable effects
The most important adverse reactions of ethambutol hydrochloride/isoniazid/rifampicin are hepatotoxicity, neurotoxicity and effects on vision, due to the components of the fixed-dose combination.

The most important adverse reactions caused by *rifampicin* are hepatotoxicity, particularly cholestatic reactions and skin reactions. Rifampicin may cause subclinical, unconjugated hyperbilirubinaemia or jaundice without hepatocellular damage but occasionally causes hepatocellular injury. It can also potentiate the hepatotoxicity of the other anti-tuberculosis medications.

The most important adverse reactions of *isoniazid* are peripheral and central neurotoxic effects and hepatotoxicity. Severe and sometimes fatal hepatitis due to isoniazid therapy has been reported. The majority of cases have occurred within the first three months of therapy, but hepatotoxicity may also develop after a longer duration of treatment.

The most important adverse reaction of *ethambutol* is retrobulbar neuritis with reduced visual acuity. The frequency depends on the dose and duration of therapy. It has been reported in up to 3% of patients receiving ethambutol 20 mg/kg/day. Typical initial signs include impairment of colour vision (red-green blindness) and constriction of the visual field (central or peripheral scotoma). These changes are often reversible if therapy is immediately discontinued when visual disturbances occur (see section 4.4).

Tabulated list of adverse reactions
In the tables below, ADRs are listed under system organ class (SOC) and ranked by headings of frequency. Within each frequency grouping, adverse reactions are presented in the order of decreasing seriousness, using the following convention: very common (≥ 1/10), common (≥ 1/100 to < 1/10), uncommon (≥ 1/1000 to < 1/100), rare (≥ 1/10 000 to < 1/1000), very rare (< 1/10 000), not known (cannot be estimated from the available data). The table in this section is for adult patients only. Tables have been included for each of the components of the fixed-dose combination

Table 2. Undesirable effects of rifampicin daily therapy

Nervous system disorders	
Common	Tiredness, drowsiness, headache, light-headedness, dizziness
Rare	Ataxia, muscular weakness, myopathy
Psychiatric disorders	
Rare	Mental confusion, psychosis
Gastrointestinal disorders	
Common	Anorexia, nausea, abdominal pain, bloatedness
Rare	Vomiting, diarrhoea, isolated occurrences of erosive gastritis and pseudomembranous colitis, pancreatitis
Hepatobiliary disorders	
Common	Asymptomatic increase in liver enzymes
Rare	Hepatitis or jaundice, induction of porphyria
Renal and urinary disorders	
Rare	Elevations of blood urea nitrogen and serum uric acid. Acute renal failure due to haemoglobinuria, haematuria, interstitial nephritis, glomerulonephritis and tubular necrosis have been reported.
Endocrine disorders	
Not known	Adrenal insufficiency, induction of crisis in Addison patients
Metabolism and nutritional disorders	
Unknown	Decreased appetite
General disorders	
Very common	Pyrexia, chills
Common	Reddish discolouration of body fluids and secretions such as e.g. urine, sputum, lacrimal fluid, faeces, saliva and sweat; paradoxical drug reaction (appearance of new tuberculosis symptoms despite adherence and absence of resistance).
Not known	Collapse, shock, oedema
Blood and lymphatic system disorders	
Rare	Transient leucopenia, eosinophilia, agranulocytosis. Thrombocytopenia and thrombocytopenic purpura occur more frequently with intermittent therapy than with continuous daily treatment, during which they occur only very rarely. When rifampicin administration has been continued after the occurrence of purpura, cerebral haemorrhage and fatalities have been reported.

	Haemolysis, haemolytic anaemia
Not known	Disseminated intravascular coagulation has also been reported.
Skin and subcutaneous tissue disorders	
Common	Flushing, itching with or without skin rash, urticaria
Rare	Severe skin reactions such as Stevens-Johnson syndrome and generalised hypersensitivity reactions, e.g. exfoliative dermatitis, Lyell syndrome and pemphigoid reactions
Immune System Disorders	
Not known	Anaphylaxis
Musculoskeletal disorders	
Not known	Muscle weakness, myopathy, bone pain
Eye disorders	
Common	Reddening of the eyes, permanent discolouration of soft contact lenses
Rare	Visual disturbances, exudative conjunctivitis
Reproductive system and breast disorders	
Rare	Menstrual disturbances (in extreme cases, amenorrhoea);
Vascular disorders	
Not known	Shock, flushing, vasculitis, bleeding
Investigations	
Common	Blood bilirubin increased, aspartate aminotransferase increased and alanine aminotransferase increased

Ethambutol hydrochloride/isoniazid/rifampicin should not be used for intermittent treatment regimens. In patients taking rifampicin other than daily or in those resuming treatment after a temporary interruption, an influenza-like syndrome may occur, this being very probably of immunopathological origin. It is characterised by fever, shivering and possibly headache, dizziness and musculoskeletal pain. In rare cases, this flu-like syndrome may be followed by thrombocytopenia, purpura, dyspnoea, asthma-like attacks, haemolytic anaemia, shock and acute renal failure. These serious complications may, however, also set in suddenly without preceding flu-like syndrome, mainly when treatment is resumed after a temporary interruption or when rifampicin is given only once a week in high doses (≥ 25 mg/kg). When rifampicin is given in lower doses (600 mg) 2–3 times a week, the syndrome is less common, the incidence then being comparable to that observed during daily medication.

Table 3. Undesirable effects of isoniazid

Nervous system disorders	
Very common	Peripheral neuropathy is usually preceded by paraesthesia of the feet and hands. The frequency depends on the dose and predisposing conditions such as malnutrition, alcoholism or diabetes. It has been reported in 3.5 to 17% of patients treated with isoniazid. Concomitant pyridoxine administration largely reduces this risk (see section 4.4).
Uncommon	Seizures, toxic encephalopathy
Not known	Polyneuritis, presenting as muscle weakness, loss of tendon reflexes Hyperreflexia may be troublesome with doses of 10 mg/kg
Psychiatric disorders	
Uncommon	Memory impairment, toxic psychosis
Not known	Elevated mood, psychotic disorder Although isoniazid usually has a mood-elevating effect, mental disturbances, ranging from minor personality changes to major mental derangement have been reported; these are usually reversed on withdrawal of the drug

Gastrointestinal disorders

Not known nausea, vomiting, anorexia, dry mouth, epigastric distress, constipation, pancreatitis acute

Hepatobiliary disorders

Very common Transient elevation of serum transaminases

Uncommon Hepatitis

Not known Acute hepatic failure, liver injury, jaundice

The risk of these undesirable effects increases with age, especially over the age of 35; it may be serious and sometimes fatal with the development of necrosis.

Renal and urinary disorders

Not known Dysuria

Metabolic and nutritional disorders

Not known Hyperglycaemia, metabolic acidosis, pellagra, pyridoxine deficiency, nicotinic acid deficiency

Nicotinic acid deficiency may be related to isoniazid-induced pyridoxine deficiency which affects the conversion of tryptophan to nicotinic acid.

General disorders

Not known Pyrexia

Respiratory, thoracic and mediastinal disorders

Not known Pneumonitis (allergic), interstitial lung disease

Blood and lymphatic system disorders

Not known Anaemia (haemolytic, sideroblastic, or aplastic), thrombocytopenia, leucopenia (allergic), neutropenia with eosinophilia, agranulocytosis, lymphadenopathy

Skin and subcutaneous tissue disorders

Rare Toxic epidermal necrolysis, eosinophilia systemic symptoms

Not known Erythema multiforme, Stevens-Johnson syndrome, exfoliative dermatitis, pemphigus, rash, acne

Immune System Disorders

Not known Anaphylactic reactions

Musculoskeletal disorders

Not known Arthritis, systemic lupus erythematosus, lupus-like syndrome, rheumatic syndrome

Eye disorders

Uncommon Optic atrophy or neuritis

Ear and labyrinth disorders

Not known Deafness, tinnitus, vertigo

These have been reported in patients with end-stage renal impairment

Reproductive system and breast disorders

Not known Gynaecomastia

Vascular disorders

Not known Vasculitis

Investigations

Not known Anti-nuclear bodies

Miscellaneous

Withdrawal symptoms, which may occur on cessation of treatment, include headache, insomnia, excessive dreaming, irritability and nervousness.

Table 4. Undesirable effects of ethambutol

Nervous system disorders

Rare Peripheral neuritis, peripheral neuropathy, paraesthesia (especially in the extremities), numbness

Very rare Disorientation, dizziness, headache

Psychiatric disorders

Very rare Mental confusion and hallucination

Gastrointestinal disorders

Not known Nausea, vomiting, anorexia, flatulence, abdominal pain, diarrhoea

Hepatobiliary disorders

Very rare Hepatic failure

Not known Hepatitis, jaundice, increase in liver enzymes

Renal and urinary disorders

Very rare Nephrotoxicity including interstitial nephritis

Eye disorders

Uncommon Optic neuritis (decreased visual acuity, loss of vision, scotoma, colour blindness, visual disturbance, visual field defect, eye pain)

Blood and lymphatic systems disorders

Rare Thrombocytopenia,

Very rare Leucopenia, neutropenia

Respiratory, thoracic and mediastinal disorders

Very rare Pneumonitis, pulmonary infiltrates, with or without eosinophilia

Metabolism and nutrition disorders

Uncommon Hyperuricaemia

Very rare Gout

Immune system disorders

Very rare Hypersensitivity, anaphylactoid reactions (see also "Skin and subcutaneous tissue disorders")

Skin and subcutaneous tissue disorders

Rare Rash, pruritus, urticaria

Very rare Photosensitive lichenoid eruptions, bullous dermatitis, Stevens-Johnson syndrome, epidermal necrolysis

Musculoskeletal and connective tissue disorders

Very rare Joint pains

Reporting of suspected adverse reactions

Reporting suspected adverse reactions after authorisation of the medicinal product is important. It allows continued monitoring of the benefit/risk balance of the medicinal product. Healthcare professionals are asked to report any suspected adverse reactions via the e-PV desktop applications (https://drive.google.com/file/d/16hwTz0587ZWtSWadbBAMwQPOD_KSExZP/view) or search for e-PV Mobile applications on the Google Play or Apple App Store.

4.9 Overdose

Rifampicin

Nausea, vomiting, abdominal pain, pruritus, headache and increasing lethargy will probably occur within a short time after acute ingestion; unconsciousness may occur when there is severe hepatic disease. Transient increases in liver enzymes and/or bilirubin may occur. Brownish-red or orange colouration of the skin, urine, sweat, saliva, tears and faeces will occur, and its intensity is proportional to the amount ingested. Facial or periorbital oedema has also been reported in children. Hypotension, sinus tachycardia, ventricular arrhythmias, seizures and cardiac arrest were reported in some fatal cases.

The minimum acute lethal or toxic dose is not well established. However, nonfatal acute overdoses in adults have been reported with doses ranging from 9 to 12 g of rifampicin. Fatal acute overdoses in adults have been reported with doses ranging from 14 to 60 g. Alcohol or a history of alcohol abuse was involved in some of the fatal and nonfatal reports.

Nonfatal overdoses of 100 mg/kg for one to two doses have been reported in paediatric patients aged 1 to 4 years.

Management
Intensive supportive measures should be instituted and individual symptoms treated as they arise. The instillation of activated charcoal slurry into the stomach shortly after overdose may help absorb any remaining drug from the gastrointestinal tract. Antiemetic medication may be required to control severe nausea and vomiting. Active diuresis (with measured intake and output) will help promote excretion of the drug. Haemodialysis may be of value in some patients.

Isoniazid
Typical symptoms are seizures and metabolic acidosis, ketonuria and hyperglycaemia. In addition, there may be periorbital myoclonus, dizziness, tinnitus, tremor, hyperreflexia, paraesthesia, hallucinations, impaired consciousness, respiratory depression, apnoea, tachycardia, arrhythmias, hypotension, nausea, vomiting. fever, rhabdomyolysis, disseminated intravascular coagulation, hyperglycaemia, hyperkalaemia and liver involvement.

Doses of isoniazid exceeding 10 mg/kg may adversely affect the nervous system, e.g., in the form of peripheral neuropathy, and thus impair the patient's ability to drive or operate machinery. Isoniazid toxicity is potentiated by alcohol. The lethal dose is thought to be 80–150 mg/kg body weight. Administration of 3 g to a 5-year-old and 5–7.5 g to adults resulted in extremely severe intoxication. A 5-g dose in a 15-year old resulted in lethal intoxication. A dose of 900 mg in an 8-year old has resulted in moderate intoxication and 2–3 g in a 3-year old resulted in severe intoxication.

Management
Where considered appropriate, evacuation of the stomach (provided the patient is not experiencing seizures) and administration of activated charcoal can reduce absorption if instituted within a few hours of ingestion. Blood samples must be collected for immediate determination of blood gases, electrolytes, BUN, glucose etc. Subsequently, pyridoxine is given (intravenous bolus on a gram-per-gram basis, equal to the isoniazid dose; if the isoniazid dose is unknown an initial dose of 5 g in adults or 80 mg/kg in children should be considered), pyridoxine should be diluted to reduce vascular irritation and is administered for 30 minutes via infusion pump or syringe pump. The dose is repeated if necessary.

Intravenous diazepam (in case of seizures not responding to pyridoxine) and haemodialysis may be of value. Further treatment should be supportive, with special attention to monitoring and support of ventilation and correction of metabolic acidosis. There is no specific antidote.

Ethambutol
Loss of appetite, gastrointestinal disturbances, fever, headache, dizziness, confusion, hallucinations. Data on ethambutol overdose are scarce.

5. Pharmacological properties

5.1 Pharmacodynamic properties

Pharmacological classification: 7.3 Antituberculars.

Mechanism of action

In vitro, rifampicin is bactericidal against a wide range of organisms, including *Mycobacterium tuberculosis*. The mode of action is by inhibition of DNA-dependent RNA polymerase, inhibiting transcription. In tuberculosis, rifampicin is bactericidal for both intracellular and extracellular microorganisms. Microbial resistance may occur and is a result of alterations in the target enzyme (RNA polymerase).

Isoniazid is highly active against *Mycobacterium tuberculosis*. It is bactericidal *in vitro* and *in vivo* against actively dividing tubercle bacilli. Its primary action is to inhibit the synthesis of long-chain mycolic acids, which are unique constituents of mycobacterial cell walls. Resistance to isoniazid occurs rapidly if it is used alone in the treatment of mycobacterial disease.

Ethambutol at the recommended doses is a bacteriostatic that acts specifically against tubercle bacilli and those resistant to other antimycobacterial agents. It possesses very little sterilizing activity. The mechanism of action is not fully known. It diffuses into mycobacteria and appears to suppress multiplication by interfering with RNA synthesis. It is effective only against mycobacteria that are actively dividing. When ethambutol has been used alone for the treatment of tuberculosis, tubercle bacilli from these patients have developed resistance to ethambutol. No cross-resistance between ethambutol and other antituberculous agents has been reported. Ethambutol delays or reduces the incidence of the emergence of mycobacterial resistance to other antimycobacterial agents when used concurrently.

5.2 Pharmacokinetic properties

Absorption of ethambutol hydrochloride/isoniazid/rifampicin

The absorption characteristics of ethambutol hydrochloride/isoniazid/rifampicin have been determined after administration of four (4) ethambutol hydrochloride/isoniazid/rifampicin 275 mg/75 mg/150 mg tablets in healthy adult volunteers, in the fasted state, as follows:

Pharmacokinetic variable	Arithmetic mean value (± standard deviation)		
	Ethambutol	Isoniazid	Rifampicin
Maximum concentration (Cmax)	3.02 ± 1.02 µg/mL	7.14 ± 1.71 µg/mL	9.65 ± 2.03 µg/mL
Area under the curve ($AUC_{0-\infty}$), a measure of the extent of absorption	17.5 ± 3.7 µg·h/mL	39.8 ± 14.3 µg·h/mL	70.0 ± 20.0 µg·h/mL
Time to attain maximum concentration (Tmax)	3.08 ± 1.03 h	1.27 ± 0.78 h	2.34 ± 0.90 h

Table 5. Pharmacokinetic properties of ethambutol hydrochloride/isoniazid/rifampicin

	Rifampicin	Isoniazid	Ethambutol
Absorption			

Absolute bioavailability	90–95%	NA*	NA*
Oral bioavailability	> 90%	> 80%	70–80%
Food effect	No effect on the extent of absorption. The rate of absorption is reduced.	Reduced.	None
Distribution			
Volume of distribution (mean)	55 L	43 L	20 L
Plasma protein binding *in vitro*	60–90%	< 10%	10–40%
Tissue distribution	CSF concentrations are of the same order of magnitude as the unbound concentrations in plasma. Concentrations in the liver, spleen, kidneys and lung tissue are higher than serum concentrations. Penetrates vaginal and cervical tissue and into cervicovaginal fluid. Passes into the placenta; serum concentration in the foetus is about ⅓ of that in the mother.	Diffuses readily into all body fluids (cerebrospinal, pleural and ascitic fluids), tissues, organs and excreta (saliva, sputum and faeces). Crosses the placenta and passes into milk.	*CSF*: Relatively low concentrations distributed to CSF
Metabolism			
	Primarily hepatic, rapidly deacetylated.	Hepatic; primarily acetylated by N-acetyltransferase to N-acetylisoniazid	Hepatic
Active metabolite(s)	25-o-diacetyl rifampicin	Nicotinoyl-NAD adduct	NA*
Elimination			
Elimination half -life	3 - 5 hours Decreases to 2 - 3 hours after repeated administration	1.2 hours: Rapid acetylators 3.5 hours: Slow acetylators	3–4 hours

Mean systemic clearance (Cl/F)	5.7−9.0 L/hour	15.5 L/hour: slow NAT2 genotype 26.1 L/hour: rapid/intermediate NAT2 genotype	41 L/hour
% of the dose excreted in urine	30%	75−95%	60–80%
% of dose excreted in faeces	60−65%	< 10%	20%
Pharmacokinetic linearity	Non-linear	NA*	NA*
Drug interactions *(in vitro*)	Rifampicin induces hepatic enzymes	Isoniazid is a CYP450 inducer and inhibitor. Isoniazid is an arylamine n-acetyltransferase 2 substrate and inhibitor	NA*
Transporters	Solute carrier transporters (SLC) ATP Binding Cassette transporters (ABC) P-glycoprotein 1	NA*	NA*
Metabolizing enzymes	CYP450	CYP450: 2C19, 3A4	NA*

*Information not available

Special populations

Rifampicin
The half-life of rifampicin has been reported to be longer in patients with liver impairment or biliary obstruction. The half-life does not differ in patients with renal failure at doses not exceeding 600 mg daily, and consequently, no dosage adjustment is required. The half-life of rifampicin at a dose of 720 mg daily has not been established in patients with renal failure. Following a single 900 mg oral dose of rifampicin in patients with varying degrees of renal insufficiency, the mean half-life increased from 3.6 hours in healthy adults to 5.0, 7.3, and 11.0 hours in patients with glomerular filtration rates of 30 to 50 mL/min, less than 30 mL/min and anuric patients, respectively.

In one study, paediatric patients 6 to 58 months old were given rifampicin suspended in simple syrup or as dry powder mixed with applesauce at a dose of 10 mg/kg body weight. Peak serum concentrations of 10.7 ± 3.7 and 11.5 ± 5.1 mcg/mL were obtained 1 hour after pre-prandial ingestion of the drug suspension and the applesauce mixture, respectively. After the administration of either preparation, the t1/2 of rifampicin averaged 2.9 hours. It should be noted that in other studies in paediatric populations, at doses of 10 mg/kg body weight, mean peak serum concentrations of 3.5 mcg/mL to 15 mcg/mL have been reported.

Isoniazid
In slow acetylators with severely impaired renal function, accumulation of isoniazid may occur. An impaired liver function prolongs the elimination half-life of isoniazid.

Ethambutol
Half is increased up to 8 hours in cases of renal impairment. Ethambutol is not removed from the blood by haemodialysis.

5.3 Preclinical safety data

Rifampicin
After oral administration of 100 mg/kg rifampicin for 6 months in rats, no toxic effects were observed. After chronic administration of 200 mg/kg, swelling and hydropic degeneration of the liver were observed. In monkeys, vomiting, anorexia and weight loss were observed at chronic doses of 105 mg/kg/day. There is limited evidence for the carcinogenicity of rifampicin in mice. The available studies on mutagenicity indicate an absence of a mutagenic effect.

An increased incidence of congenital malformations (principally spina bifida and cleft palate) has been reported in the offspring of mice and rats given rifampicin at a dose of 150–250 mg/kg daily during pregnancy. Defective osteogenesis and embryotoxicity occurred when rifampicin doses up to 20 times the usual daily human dose were used in pregnant rabbits.

Fertility and reproductive performance were not affected by oral administration of rifampicin to male and female rats at doses of up to one-third of the human dose.

Isoniazid
Non-clinical data reveal no special hazard for humans at recommended doses based on conventional studies of safety pharmacology, repeated dose toxicity, genotoxicity and carcinogenic potential. Treatment of pregnant rats with isoniazid resulted in reduced litter sizes and decreased postnatal growth, development, and cognitive ability in the offspring. Spermatogenesis impairment was observed in treated rats.

Ethambutol
Toxicological studies on high prolonged doses produced evidence of myocardial damage heart failure, and depigmentation of the tapetum lucidum of the eyes in the dog. Degenerative changes in the central nervous system, apparently not dose-related, have also been noted in dogs over a prolonged period. In the rhesus monkey, neurological signs appeared after treatment with high doses given daily over several months. These were correlated with specific serum levels of ethambutol and with definite neuroanatomical changes in the central nervous system. Conflicting results are available on genotoxicity (negative Ames test, negative in human lymphocyte cell cultures, positive in mouse micronucleus).

Cleft palate, exencephaly and vertebral column abnormalities have been observed with high doses in studies in mice. Studies in rats and rabbits have shown that ethambutol in high doses causes minor abnormalities of the cervical vertebrae, limb reduction defects, hare lip and cleft palate in the offspring. Ethambutol decreases testosterone concentrations, spermatogenesis, and male fertility in high doses in rats when administered over 60 days.

A study in male rats determined that co-administration of four antituberculosis drugs, including ethambutol, rifampicin, isoniazid, and pyrazinamide, produced a range of adverse effects on the testes and in sperm, as well as an increase in pre-and post-implantation embryo lethality.

6. Pharmaceutical particulars

6.1 List of excipients

Core tablet
Ascorbic acid
Colloidal silicon dioxide
Crospovidone
Gelatin
Magnesium stearate
Microcrystalline cellulose
Pregelatinised starch.

Film-coat (Opadry 80W56578 Brown)
Iron oxide red,
Lecithin
Polyvinyl alcohol
Talc
Titanium oxide
Xanthan gum

6.2 Incompatibilities

Not applicable.

6.3 Shelf life

36 months

6.4 Special precautions for storage

Store in a dry place, below 25°C. Protect from light.

6.5 Nature and contents of the container

The tablets are packed in PVC/PVDC-aluminium blisters of 28 tablets.

24 blisters cards are packed in a carton along with a pack insert (24 x 28).

6.6 Special precautions for disposal and other handling

No special requirements. Any unused product or waste material should be disposed of in accordance with local requirements.

7. APPLICANT

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Kalpataru Inspire
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8. MANUFACTURER

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M.I.D.C., Chikalthana
Aurangabad - 431210
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9. REGISTRATION DETAILS

Zimbabwe registration number: 2019/7.3/5940
Zimbabwe category for distribution: Prescription Preparations (P.P.)

10. DATE OF REVISION OF THE TEXT

August 2023