

# Kaletra 80mg/20mg Oral Solution

Summary of Product Characteristics Updated 12-Nov-2019 | AbbVie Ltd

## 1. Name of the medicinal product

Kaletra (80 mg + 20 mg) / ml oral solution

## 2. Qualitative and quantitative composition

Each 1 ml of Kaletra oral solution contains 80 mg of lopinavir co-formulated with 20 mg of ritonavir as a pharmacokinetic enhancer.

Excipients with known effect:

Each 1 ml contains 356.3 mg of alcohol (42.4% v/v), 168.6 mg of high fructose corn syrup, 152.7 mg of propylene glycol (15.3% w/v) (see section 4.3), 10.2 mg of polyoxyl 40 hydrogenated castor oil and 4.1 mg of acesulfame potassium (see section 4.4).

For the full list of excipients, see section 6.1.

## 3. Pharmaceutical form

Oral solution

The solution is light yellow to orange.

## 4. Clinical particulars

### 4.1 Therapeutic indications

Kaletra is indicated in combination with other antiretroviral medicinal products for the treatment of human immunodeficiency virus (HIV-1) infected adults, adolescents and children aged from 14 days and older.

The choice of Kaletra to treat protease inhibitor experienced HIV-1 infected patients should be based on individual viral resistance testing and treatment history of patients (see sections 4.4 and 5.1).

### 4.2 Posology and method of administration

Kaletra should be prescribed by physicians who are experienced in the treatment of HIV infection.

#### Posology.

#### *Adults and adolescents*

The recommended dosage of Kaletra is 5 ml of oral solution (400/100 mg) twice daily taken with food.

#### *Paediatric population aged from 14 days and older*

The oral solution formulation is the recommended option for the most accurate dosing in children based on body surface area or body weight. However, if it is judged necessary to resort to solid oral dosage form for children weighing less than 40 kg or with a BSA between 0.5 and 1.4 m<sup>2</sup> and able to swallow tablets, Kaletra 100 mg/25 mg tablets may be used. The adult dose of Kaletra tablets (400/100 mg twice daily) may be used in children 40 kg or greater or with a Body Surface Area (BSA)\* greater than 1.4 m<sup>2</sup>. Kaletra tablets are administered orally and must be swallowed whole and not chewed, broken or crushed. Please refer to the Kaletra 100 mg/25 mg film-coated tablets Summary of Product Characteristics.

Total amounts of alcohol and propylene glycol from all medicines, including Kaletra oral solution, that are to be given to infants should be taken into account in order to avoid toxicity from these excipients (see section 4.4).

#### *Dosage recommendation for paediatric patients aged from 14 days to 6 months*

Paediatric dosing guidelines		
2 weeks to 6 months		
Based on weight (mg/kg)	Based on BSA (mg/m <sup>2</sup> )*	Frequency
16/4 mg/kg (corresponding to 0.2 ml/kg)	300/75 mg/m <sup>2</sup> (corresponding to 3.75 ml/m <sup>2</sup> )	Given twice daily with food

\*Body surface area can be calculated with the following equation

$$\text{BSA (m}^2\text{)} = \sqrt{(\text{Height (cm)} \times \text{Weight (kg)}) / 3600}$$

It is recommended that Kaletra not be administered in combination with efavirenz or nevirapine in patients less than 6 months of age.

*Dosage recommendation for paediatric patients older than 6 months to less than 18 years*

Without Concomitant Efavirenz or Nevirapine

The following tables contain dosing guidelines for Kaletra oral solution based on body weight and BSA.

Paediatric dosing guidelines based on body weight*		
> 6 months to 18 years		
Body weight (kg)	Twice daily oral solution dose (dose in mg/kg)	Volume of oral solution twice daily taken with food (80 mg lopinavir/20 mg ritonavir per ml)**
<b>7 to &lt; 15 kg</b>	12/3 mg/kg	
7 to 10 kg		1.25 ml
> 10 to < 15 kg		1.75 ml
<b>≥ 15 to 40 kg</b>	10/2.5 mg/kg	
15 to 20 kg		2.25 ml
> 20 to 25 kg		2.75 ml
> 25 to 30 kg		3.50 ml
> 30 to 35 kg		4.00 ml
> 35 to 40 kg		4.75 ml
<b>≥ 40 kg</b>	See adult dosage recommendation	

\*weight based dosing recommendations are based on limited data

\*\* the volume (ml) of oral solution represents the average dose for the weight range

Paediatric dosing guidelines for the dose 230/57.5 mg/m <sup>2</sup>	
> 6 months to < 18 years	
Body Surface Area* (m <sup>2</sup> )	Twice daily oral solution dose (dose in mg)
0.25	0.7 ml (57.5/14.4 mg)
0.40	1.2 ml (96/24 mg)
0.50	1.4 ml (115/28.8 mg)
0.75	2.2 ml (172.5/43.1 mg)
0.80	2.3 ml (184/46 mg)
1.00	2.9 ml (230/57.5 mg)
1.25	3.6 ml (287.5/71.9 mg)
1.3	3.7 ml (299/74.8 mg)
1.4	4.0 ml (322/80.5 mg)

1.5	4.3 ml (345/86.3 mg)
1.7	5 ml (402.5/100.6 mg)

\*Body surface area can be calculated with the following equation

$$BSA (m^2) = \sqrt{(Height (cm) \times Weight (kg)) / 3600}$$

#### Concomitant Therapy: Efavirenz or Nevirapine

The 230/57.5 mg/m<sup>2</sup> dosage might be insufficient in some children when co-administered with nevirapine or efavirenz. An increase of the dose of Kaletra to 300/75 mg/m<sup>2</sup> is needed in these patients. The recommended dose of 533/133 mg or 6.5 ml twice daily should not be exceeded.

#### *Children less than 14 days of age and premature neonates*

Kaletra oral solution should not be administered to neonates before a postmenstrual age (first day of the mother's last menstrual period to birth plus the time elapsed after birth) of 42 weeks and a postnatal age of at least 14 days has been reached (see section 4.4).

#### *Hepatic impairment*

In HIV-infected patients with mild to moderate hepatic impairment, an increase of approximately 30% in lopinavir exposure has been observed but is not expected to be of clinical relevance (see section 5.2). No data are available in patients with severe hepatic impairment. Kaletra must not be given to these patients (see section 4.3).

#### *Renal impairment*

Since the renal clearance of lopinavir and ritonavir is negligible, increased plasma concentrations are not expected in patients with renal impairment. Because lopinavir and ritonavir are highly protein bound, it is unlikely that they will be significantly removed by haemodialysis or peritoneal dialysis.

#### Method of administration

Kaletra is administered orally and should always be taken with food (see section 5.2). The dose should be administered using a calibrated 2 ml or 5 ml oral dosing syringe best corresponding to the volume prescribed.

### 4.3 Contraindications

Hypersensitivity to the active substances or to any of the excipients.

Severe hepatic insufficiency.

Kaletra contains lopinavir and ritonavir, both of which are inhibitors of the P450 isoform CYP3A. Kaletra should not be co-administered with medicinal products that are highly dependent on CYP3A for clearance and for which elevated plasma concentrations are associated with serious and/or life threatening events. These medicinal products include:

Medicinal product class	Medicinal products within class	Rationale
Concomitant medicinal product levels increased		
Alpha <sub>1</sub> -adrenoreceptor antagonist	Alfuzosin	Increased plasma concentrations of alfuzosin which may lead to severe hypotension. The concomitant administration with alfuzosin is contraindicated (see section 4.5).
Antianginal	Ranolazine	Increased plasma concentrations of ranolazine which may increase the potential for serious and/or life-threatening reactions (see section 4.5).
Antiarrhythmics	Amiodarone, dronedarone	Increased plasma concentrations of amiodarone and dronedarone. Thereby, increasing the risk of arrhythmias or other serious adverse reactions (see section 4.5).
Antibiotic	Fusidic Acid	Increased plasma concentrations of fusidic acid. The concomitant administration with fusidic acid is contraindicated in dermatological infections (see section 4.5).

Anticancer	Neratinib	Increased plasma concentrations of neratinib which may increase the potential for serious and/or life-threatening reactions (see section 4.5).
	Venetoclax	Increased plasma concentrations of venetoclax. Increased risk of tumor lysis syndrome at the dose initiation and during the ramp-up phase (see section 4.5).
Anti-gout	Colchicine	Increased plasma concentrations of colchicine. Potential for serious and/or life-threatening reactions in patients with renal and/or hepatic impairment (see sections 4.4 and 4.5).
Antihistamines	Astemizole, terfenadine	Increased plasma concentrations of astemizole and terfenadine. Thereby, increasing the risk of serious arrhythmias from these agents (see section 4.5).
Antipsychotics/ Neuroleptics	Lurasidone	Increased plasma concentrations of lurasidone which may increase the potential for serious and/or life-threatening reactions (see section 4.5).
	Pimozide	Increased plasma concentrations of pimozide. Thereby, increasing the risk of serious haematologic abnormalities, or other serious adverse effects from this agent (see section 4.5).
	Quetiapine	Increased plasma concentrations of quetiapine which may lead to coma. The concomitant administration with quetiapine is contraindicated (see section 4.5).
Ergot alkaloids	Dihydroergotamine, ergonovine, ergotamine, methylergonovine	Increased plasma concentrations of ergot derivatives leading to acute ergot toxicity, including vasospasm and ischaemia (see section 4.5).
GI motility agent	Cisapride	Increased plasma concentrations of cisapride. Thereby, increasing the risk of serious arrhythmias from this agent (see section 4.5).
Hepatitis C virus direct acting antivirals	Elbasvir/grazoprevir	Increased risk of alanine transaminase (ALT) elevations (see section 4.5).
	Ombitasvir/paritaprevir/ritonavir with or without dasabuvir	Increased plasma concentrations of paritaprevir; thereby, increasing the risk of alanine transaminase (ALT) elevations (see section 4.5).
Lipid-modifying agents HMG Co-A Reductase Inhibitors	Lovastatin, simvastatin	Increased plasma concentrations of lovastatin and simvastatin; thereby, increasing the risk of myopathy including rhabdomyolysis (see section 4.5).
Microsomal triglyceride transfer protein (MTTP) inhibitor	Lomitapide	Increased plasma concentrations of lomitapide (see section 4.5).
Phosphodiesterase (PDE5) inhibitors	Avanafil	Increased plasma concentrations of avanafil (see sections 4.4 and 4.5).
	Sildenafil	Contraindicated when used for the treatment of

		pulmonary arterial hypertension (PAH) only. Increased plasma concentrations of sildenafil. Thereby, increasing the potential for sildenafil-associated adverse events (which include hypotension and syncope). See section 4.4 and section 4.5 for co-administration of sildenafil in patients with erectile dysfunction.
	Vardenafil	Increased plasma concentrations of vardenafil (see sections 4.4 and 4.5)
Sedatives/hypnotics	Oral midazolam, triazolam	Increased plasma concentrations of oral midazolam and triazolam. Thereby, increasing the risk of extreme sedation and respiratory depression from these agents.  For caution on parenterally administered midazolam, see section 4.5.
<b>Lopinavir/ritonavir medicinal product level decreased</b>		
Herbal products	St. John's wort	Herbal preparations containing St John's wort ( <i>Hypericum perforatum</i> ) due to the risk of decreased plasma concentrations and reduced clinical effects of lopinavir and ritonavir (see section 4.5).

Kaletra oral solution is contraindicated in children below the age of 14 days, pregnant women, patients with hepatic or renal failure and patients treated with disulfiram or metronidazole due to the potential risk of toxicity from the excipient propylene glycol (see section 4.4).

#### 4.4 Special warnings and precautions for use

##### *Patients with coexisting conditions*

##### Hepatic impairment

The safety and efficacy of Kaletra has not been established in patients with significant underlying liver disorders. Kaletra is contraindicated in patients with severe liver impairment (see section 4.3). Patients with chronic hepatitis B or C and treated with combination antiretroviral therapy are at an increased risk for severe and potentially fatal hepatic adverse reactions. In case of concomitant antiviral therapy for hepatitis B or C, please refer to the relevant product information for these medicinal products.

Patients with pre-existing liver dysfunction including chronic hepatitis have an increased frequency of liver function abnormalities during combination antiretroviral therapy and should be monitored according to standard practice. If there is evidence of worsening liver disease in such patients, interruption or discontinuation of treatment should be considered.

Elevated transaminases with or without elevated bilirubin levels have been reported in HIV-1 mono-infected and in individuals treated for post-exposure prophylaxis as early as 7 days after the initiation of lopinavir/ritonavir in conjunction with other antiretroviral agents. In some cases the hepatic dysfunction was serious.

Appropriate laboratory testing should be conducted prior to initiating therapy with lopinavir/ritonavir and close monitoring should be performed during treatment.

##### Renal impairment

Since the renal clearance of lopinavir and ritonavir is negligible, increased plasma concentrations are not expected in patients with renal impairment. Because lopinavir and ritonavir are highly protein bound, it is unlikely that they will be significantly removed by haemodialysis or peritoneal dialysis.

##### Haemophilia

There have been reports of increased bleeding, including spontaneous skin haematomas and haemarthrosis in patients with haemophilia type A and B treated with protease inhibitors. In some patients additional factor VIII was given. In more than half of the reported cases, treatment with protease inhibitors was continued or reintroduced if treatment had been discontinued. A causal relationship had been evoked, although the mechanism of action had not been elucidated. Haemophiliac patients should therefore be made aware of the possibility of increased bleeding.

##### Pancreatitis

Cases of pancreatitis have been reported in patients receiving Kaletra, including those who developed hypertriglyceridaemia. In most of these cases patients have had a prior history of pancreatitis and/or concurrent therapy with other medicinal products associated with pancreatitis. Marked triglyceride elevation is a risk factor for development of pancreatitis. Patients with advanced HIV disease may be at risk of elevated triglycerides and pancreatitis.

Pancreatitis should be considered if clinical symptoms (nausea, vomiting, abdominal pain) or abnormalities in laboratory values (such as increased serum lipase or amylase values) suggestive of pancreatitis should occur. Patients who exhibit these signs or symptoms should be evaluated and Kaletra therapy should be suspended if a diagnosis of pancreatitis is made (see section 4.8).

#### Immune Reconstitution Inflammatory Syndrome

In HIV-infected patients with severe immune deficiency at the time of institution of combination antiretroviral therapy (CART), an inflammatory reaction to asymptomatic or residual opportunistic pathogens may arise and cause serious clinical conditions, or aggravation of symptoms. Typically, such reactions have been observed within the first few weeks or months of initiation of CART. Relevant examples are cytomegalovirus retinitis, generalised and/or focal mycobacterial infections, and *Pneumocystis jiroveci pneumonia*. Any inflammatory symptoms should be evaluated and treatment instituted when necessary.

Autoimmune disorders (such as Graves' disease and autoimmune hepatitis) have also been reported to occur in the setting of immune reconstitution; however, the reported time to onset is more variable and can occur many months after initiation of treatment.

#### Osteonecrosis

Although the etiology is considered to be multifactorial (including corticosteroid use, alcohol consumption, severe immunosuppression, higher body mass index), cases of osteonecrosis have been reported particularly in patients with advanced HIV-disease and/or long-term exposure to combination antiretroviral therapy (CART). Patients should be advised to seek medical advice if they experience joint aches and pain, joint stiffness or difficulty in movement.

#### PR interval prolongation

Lopinavir/ritonavir has been shown to cause modest asymptomatic prolongation of the PR interval in some healthy adult subjects. Rare reports of 2<sup>nd</sup> or 3<sup>rd</sup> degree atrioventricular block in patients with underlying structural heart disease and pre-existing conduction system abnormalities or in patients receiving drugs known to prolong the PR interval (such as verapamil or atazanavir) have been reported in patients receiving lopinavir/ritonavir. Kaletra should be used with caution in such patients (see section 5.1).

#### Weight and metabolic parameters

An increase in weight and in levels of blood lipids and glucose may occur during antiretroviral therapy. Such changes may in part be linked to disease control and life style. For lipids, there is in some cases evidence for a treatment effect, while for weight gain there is no strong evidence relating this to any particular treatment. For monitoring of blood lipids and glucose, reference is made to established HIV treatment guidelines. Lipid disorders should be managed as clinically appropriate.

#### Interactions with medicinal products

Kaletra contains lopinavir and ritonavir, both of which are inhibitors of the P450 isoform CYP3A. Kaletra is likely to increase plasma concentrations of medicinal products that are primarily metabolised by CYP3A. These increases of plasma concentrations of co-administered medicinal products could increase or prolong their therapeutic effect and adverse events (see sections 4.3 and 4.5).

Strong CYP3A4 inhibitors such as protease inhibitors may increase bedaquiline exposure which could potentially increase the risk of bedaquiline-related adverse reactions. Therefore, combination of bedaquiline with lopinavir/ritonavir should be avoided. However, if the benefit outweighs the risk, co-administration of bedaquiline with lopinavir/ritonavir must be done with caution. More frequent electrocardiogram monitoring and monitoring of transaminases is recommended (see section 4.5 and refer to the bedaquiline SmPC).

Co-administration of delamanid with a strong inhibitor of CYP3A (as lopinavir/ritonavir) may increase exposure to delamanid metabolite, which has been associated with QTc prolongation. Therefore, if co-administration of delamanid with lopinavir/ritonavir is considered necessary, very frequent ECG monitoring throughout the full delamanid treatment period is recommended (see section 4.5 and refer to the delamanid SmPC).

Life-threatening and fatal drug interactions have been reported in patients treated with colchicine and strong inhibitors of CYP3A like ritonavir. Concomitant administration with colchicine is contraindicated in patients with renal and/or hepatic impairment (see sections 4.3 and 4.5).

The combination of Kaletra with:

- tadalafil, indicated for the treatment of pulmonary arterial hypertension, is not recommended (see section 4.5);
- riociguat is not recommended (see section 4.5);

- vorapaxar is not recommended (see section 4.5);
- fusidic acid in osteo-articular infections is not recommended (see section 4.5);
- salmeterol is not recommended (see section 4.5);
- rivaroxaban is not recommended (see section 4.5).

The combination of Kaletra with atorvastatin is not recommended. If the use of atorvastatin is considered strictly necessary, the lowest possible dose of atorvastatin should be administered with careful safety monitoring. Caution must also be exercised and reduced doses should be considered if Kaletra is used concurrently with rosuvastatin. If treatment with an HMG-CoA reductase inhibitor is indicated, pravastatin or fluvastatin is recommended (see section 4.5).

#### *PDE5 inhibitors*

Particular caution should be used when prescribing sildenafil or tadalafil for the treatment of erectile dysfunction in patients receiving Kaletra. Co-administration of Kaletra with these medicinal products is expected to substantially increase their concentrations and may result in associated adverse events such as hypotension, syncope, visual changes and prolonged erection (see section 4.5). Concomitant use of avanafil or vardenafil and lopinavir/ritonavir is contraindicated (see section 4.3). Concomitant use of sildenafil prescribed for the treatment of pulmonary arterial hypertension with Kaletra is contraindicated (see section 4.3).

Particular caution must be used when prescribing Kaletra and medicinal products known to induce QT interval prolongation such as: chlorpheniramine, quinidine, erythromycin, clarithromycin. Indeed, Kaletra could increase concentrations of the co-administered medicinal products and this may result in an increase of their associated cardiac adverse reactions. Cardiac events have been reported with Kaletra in preclinical studies; therefore, the potential cardiac effects of Kaletra cannot be currently ruled out (see sections 4.8 and 5.3).

Co-administration of Kaletra with rifampicin is not recommended. Rifampicin in combination with Kaletra causes large decreases in lopinavir concentrations which may in turn significantly decrease the lopinavir therapeutic effect. Adequate exposure to lopinavir/ritonavir may be achieved when a higher dose of Kaletra is used but this is associated with a higher risk of liver and gastrointestinal toxicity. Therefore, this co-administration should be avoided unless judged strictly necessary (see section 4.5).

Concomitant use of Kaletra and fluticasone or other glucocorticoids that are metabolised by CYP3A4, such as budesonide and triamcinolone, is not recommended unless the potential benefit of treatment outweighs the risk of systemic corticosteroid effects, including Cushing's syndrome and adrenal suppression (see section 4.5).

#### Other

Patients taking the oral solution, particularly those with renal impairment or with decreased ability to metabolise propylene glycol (e.g. those of Asian origin), should be monitored for adverse reactions potentially related to propylene glycol toxicity (i.e. seizures, stupor, tachycardia, hyperosmolality, lactic acidosis, renal toxicity, haemolysis) (see section 4.3).

Kaletra is not a cure for HIV infection or AIDS. While effective viral suppression with antiretroviral therapy has been proven to substantially reduce the risk of sexual transmission, a residual risk cannot be excluded. Precautions to prevent transmission should be taken in accordance with national guidelines. People taking Kaletra may still develop infections or other illnesses associated with HIV disease and AIDS.

Besides propylene glycol as described above, Kaletra oral solution contains alcohol (42% v/v) which is potentially harmful for those suffering from liver disease, alcoholism, epilepsy, brain injury or disease as well as for pregnant women and children. It may modify or increase the effects of other medicines. Kaletra oral solution contains up to 0.8 g of fructose per dose when taken according to the dosage recommendations. This may be unsuitable in hereditary fructose intolerance. Kaletra oral solution contains up to 0.3 g of glycerol per dose. Only at high inadvertent doses, it can cause headache and gastrointestinal upset. Furthermore, polyoxol 40 hydrogenated castor oil and potassium present in Kaletra oral solution may cause only at high inadvertent doses gastrointestinal upset. Patients on a low potassium diet should be cautioned.

#### Particular risk of toxicity in relation to the amount of alcohol and propylene glycol contained in Kaletra oral solution

Healthcare professionals should be aware that Kaletra oral solution is highly concentrated and contains 42.4% alcohol (v/v) and 15.3% propylene glycol (w/v). Each 1 ml of Kaletra oral solution contains 356.3 mg of alcohol and 152.7 mg of propylene glycol.

Special attention should be given to accurate calculation of the dose of Kaletra, transcription of the medication order, dispensing information and dosing instructions to minimize the risk for medication errors and overdose. This is especially important for infants and young children.

Total amounts of alcohol and propylene glycol from all medicines that are to be given to infants should be taken into account in order to avoid toxicity from these excipients. Infants should be monitored closely for toxicity related to Kaletra oral solution including: hyperosmolality, with or without lactic acidosis, renal toxicity, central nervous system (CNS) depression (including stupor, coma, and apnea), seizures, hypotonia, cardiac arrhythmias and ECG changes, and

hemolysis. Postmarketing life-threatening cases of cardiac toxicity (including complete atrioventricular (AV) block, bradycardia, and cardiomyopathy), lactic acidosis, acute renal failure, CNS depression and respiratory complications leading to death have been reported, predominantly in preterm neonates receiving Kaletra oral solution (see sections 4.3 and 4.9).

Based on the findings in a paediatric study (observed exposures were approximately 35% AUC<sub>12</sub> and 75% lower C<sub>min</sub> than in adults), young children from 14 days to 3 months could have sub-optimal exposure with a potential risk of inadequate virologic suppression and emergence of resistance (see section 5.2).

Because Kaletra oral solution contains alcohol, it is not recommended for use with polyurethane feeding tubes due to potential incompatibility.

#### 4.5 Interaction with other medicinal products and other forms of interaction

Kaletra contains lopinavir and ritonavir, both of which are inhibitors of the P450 isoform CYP3A *in vitro*. Co-administration of Kaletra and medicinal products primarily metabolised by CYP3A may result in increased plasma concentrations of the other medicinal product, which could increase or prolong its therapeutic and adverse reactions. Kaletra does not inhibit CYP2D6, CYP2C9, CYP2C19, CYP2E1, CYP2B6 or CYP1A2 at clinically relevant concentrations (see section 4.3).

Kaletra has been shown *in vivo* to induce its own metabolism and to increase the biotransformation of some medicinal products metabolised by cytochrome P450 enzymes (including CYP2C9 and CYP2C19) and by glucuronidation. This may result in lowered plasma concentrations and potential decrease of efficacy of co-administered medicinal products.

Medicinal products that are contraindicated specifically due to the expected magnitude of interaction and potential for serious adverse events are listed in section 4.3.

Known and theoretical interactions with selected antiretrovirals and non-antiretroviral medicinal products are listed in the table below. This list is not intended to be inclusive or comprehensive. Individual SmPCs should be consulted.

##### Interaction table

Interactions between Kaletra and co-administered medicinal products are listed in the table below (increase is indicated as "↑", decrease as "↓", no change as "↔", once daily as "QD", twice daily as "BID" and three times daily as "TID").

Unless otherwise stated, studies detailed below have been performed with the recommended dosage of lopinavir/ritonavir (i.e. 400/100 mg twice daily).

Co-administered drug by therapeutic area	Effects on drug levels  Geometric Mean Change (%) in AUC, C <sub>max</sub> , C <sub>min</sub>  Mechanism of interaction	Clinical recommendation concerning co-administration with Kaletra
<b>Antiretroviral Agents</b>		
<i>Nucleoside/Nucleotide reverse transcriptase inhibitors (NRTIs)</i>		
Stavudine, Lamivudine	Lopinavir: ↔	No dose adjustment necessary.
Abacavir, Zidovudine	Abacavir, Zidovudine: Concentrations may be reduced due to increased glucuronidation by lopinavir/ritonavir.	The clinical significance of reduced abacavir and zidovudine concentrations is unknown.
Tenofovir disoproxil fumarate (DF), 300 mg QD (equivalent to 245 mg tenofovir disoproxil)	Tenofovir: AUC: ↑ 32% C <sub>max</sub> : ↔ C <sub>min</sub> : ↑ 51%  Lopinavir: ↔	No dose adjustment necessary.  Higher tenofovir concentrations could potentiate tenofovir associated adverse events, including renal disorders.
<i>Non-nucleoside reverse transcriptase inhibitors (NNRTIs)</i>		



Efavirenz, 600 mg QD	Lopinavir: AUC: ↓ 20% C <sub>max</sub> : ↓ 13% C <sub>min</sub> : ↓ 42%	The Kaletra tablets dosage should be increased to 500/125 mg twice daily when co-administered with efavirenz.
Efavirenz, 600 mg QD (Lopinavir/ritonavir 500/125 mg BID)	Lopinavir: ↔ (Relative to 400/100 mg BID administered alone)	
Nevirapine, 200 mg BID	Lopinavir: AUC: ↓ 27% C <sub>max</sub> : ↓ 19% C <sub>min</sub> : ↓ 51%	The Kaletra tablets dosage should be increased to 500/125 mg twice daily when co-administered with nevirapine.
Etravirine (Lopinavir/ritonavir tablet 400/100 mg BID)	Etravirine: AUC: ↓ 35% C <sub>min</sub> : ↓ 45% C <sub>max</sub> : ↓ 30% Lopinavir: AUC: ↔ C <sub>min</sub> : ↓ 20% C <sub>max</sub> : ↔	No dose adjustment necessary
Rilpivirine (Lopinavir/ritonavir capsule 400/100 mg BID)	Rilpivirine: AUC: ↑ 52% C <sub>min</sub> : ↑ 74% C <sub>max</sub> : ↑ 29%  Lopinavir: AUC: ↔ C <sub>min</sub> : ↓ 11% C <sub>max</sub> : ↔ (inhibition of CYP3A enzymes)	Concomitant use of Kaletra with rilpivirine causes an increase in the plasma concentrations of rilpivirine, but no dose adjustment is required.
<i>HIV CCR5 – antagonist</i>		
Maraviroc	Maraviroc: AUC: ↑ 295% C <sub>max</sub> : ↑ 97%  Due to CYP3A inhibition by lopinavir/ritonavir.	The dose of maraviroc should be decreased to 150 mg twice daily during co-administration with Kaletra 400/100 mg twice daily.
<i>Integrase inhibitor</i>		
Raltegravir	Raltegravir: AUC: ↔ C <sub>max</sub> : ↔ C <sub>12</sub> : ↓ 30%	No dose adjustment necessary

	Lopinavir: ↔	
<b>Co-administration with other HIV protease inhibitors (PIs)</b>		
According to current treatment guidelines, dual therapy with protease inhibitors is generally not recommended.		
Fosamprenavir/ ritonavir (700/100 mg BID)  (Lopinavir/ritonavir 400/100 mg BID)  or  Fosamprenavir (1400 mg BID)  (Lopinavir/ritonavir 533/133 mg BID)	Fosamprenavir:  Amprenavir concentrations are significantly reduced.	Co-administration of increased doses of fosamprenavir (1400 mg BID) with Kaletra (533/133 mg BID) to protease inhibitor-experienced patients resulted in a higher incidence of gastrointestinal adverse events and elevations in triglycerides with the combination regimen without increases in virological efficacy, when compared with standard doses of fosamprenavir/ritonavir. Concomitant administration of these medicinal products is not recommended.
Indinavir, 600 mg BID	Indinavir: AUC: ↔ C <sub>min</sub> : ↑ 3.5-fold C <sub>max</sub> : ↓ (relative to indinavir 800 mg TID alone) Lopinavir: ↔ (relative to historical comparison)	The appropriate doses for this combination, with respect to efficacy and safety, have not been established.
Saquinavir 1000 mg BID	Saquinavir: ↔	No dose adjustment necessary.
Tipranavir/ritonavir (500/100 mg BID)	Lopinavir: AUC: ↓ 55% C <sub>min</sub> : ↓ 70% C <sub>max</sub> : ↓ 47%	Concomitant administration of these medicinal products is not recommended.
<b>Acid reducing agents</b>		
Omeprazole (40 mg QD)	Omeprazole: ↔  Lopinavir: ↔	No dose adjustment necessary
Ranitidine (150 mg single dose)	Ranitidine: ↔	No dose adjustment necessary
<b>Alpha<sub>1</sub> adrenoreceptor antagonist</b>		
Alfuzosin	Alfuzosin:  Due to CYP3A inhibition by lopinavir/ritonavir, concentrations of alfuzosin are expected to increase.	Concomitant administration of Kaletra and alfuzosin is contra-indicated (see section 4.3) as alfuzosin-related toxicity, including hypotension, may be increased.
<b>Analgesics</b>		
Fentanyl	Fentanyl:  Increased risk of side-effects (respiratory depression, sedation) due to higher plasma concentrations because of CYP3A4 inhibition by lopinavir/ritonavir.	Careful monitoring of adverse effects (notably respiratory depression but also sedation) is recommended when fentanyl is concomitantly administered with Kaletra.

<i>Antianginal</i>		
Ranolazine	Due to CYP3A inhibition by lopinavir/ritonavir, concentrations of ranolazine are expected to increase.	The concomitant administration of Kaletra and ranolazine is contraindicated (see section 4.3).
<i>Antiarrhythmics</i>		
Amiodarone, Dronedarone	Amiodarone, Dronedarone: Concentrations may be increased due to CYP3A4 inhibition by lopinavir/ritonavir.	Concomitant administration of Kaletra and amiodarone or dronedarone is contraindicated (see section 4.3) as the risk of arrhythmias or other serious adverse reactions may be increased.
Digoxin	Digoxin: Plasma concentrations may be increased due to P-glycoprotein inhibition by lopinavir/ritonavir. The increased digoxin level may lessen over time as P-gp induction develops.	Caution is warranted and therapeutic drug monitoring of digoxin concentrations, if available, is recommended in case of co-administration of Kaletra and digoxin. Particular caution should be used when prescribing Kaletra in patients taking digoxin as the acute inhibitory effect of ritonavir on P-gp is expected to significantly increase digoxin levels. Initiation of digoxin in patients already taking Kaletra is likely to result in lower than expected increases of digoxin concentrations.
Bepidil, Systemic Lidocaine, and Quinidine	Bepidil, Systemic Lidocaine, Quinidine: Concentrations may be increased when co-administered with lopinavir/ritonavir.	Caution is warranted and therapeutic drug concentration monitoring is recommended when available.
<i>Antibiotics</i>		
Clarithromycin	Clarithromycin: Moderate increases in clarithromycin AUC are expected due to CYP3A inhibition by lopinavir/ritonavir.	For patients with renal impairment (CrCL < 30 ml/min) dose reduction of clarithromycin should be considered (see section 4.4). Caution should be exercised in administering clarithromycin with Kaletra to patients with impaired hepatic or renal function.
<i>Anticancer agents</i>		
Abemaciclib	Serum concentrations may be increased due to CYP3A inhibition by ritonavir.	Co-administration of abemaciclib and Kaletra should be avoided. If this co-administration is judged unavoidable, refer to the abemaciclib SmPC for dosage adjustment recommendations. Monitor for ADRs related to abemaciclib.
Apalutamide	Apalutamide is a moderate to strong CYP3A4 inducer and this may lead to a decreased exposure of lopinavir/ritonavir.  Serum concentrations of apalutamide may be increased due to CYP3A inhibition by lopinavir/ritonavir.	Decreased exposure of Kaletra may result in potential loss of virological response.  In addition, co-administration of apalutamide and Kaletra may lead to serious adverse events including seizure due to higher apalutamide levels. Concomitant use of Kaletra with apalutamide is not recommended.
Afatinib	Afatinib:	Caution should be exercised in administering afatinib with Kaletra. Refer

(Ritonavir 200 mg twice daily)	<p>AUC: ↑ C<sub>max</sub>: ↑</p> <p>The extent of increase depends on the timing of ritonavir administration.</p> <p>Due to BCRP (breast cancer resistance protein/ABCG2) and acute P-gp inhibition by lopinavir/ritonavir.</p>	to the afatinib SmPC for dosage adjustment recommendations. Monitor for ADRs related to afatinib.
Ceritinib	Serum concentrations may be increased due to CYP3A and P-gp inhibition by lopinavir/ritonavir.	Caution should be exercised in administering ceritinib with Kaletra. Refer to the ceritinib SmPC for dosage adjustment recommendations. Monitor for ADRs related to ceritinib.
Most tyrosine kinase inhibitors such as dasatinib and nilotinib, vincristine, vinblastine	<p>Most tyrosine kinase inhibitors such as dasatinib and nilotinib, also vincristine and vinblastine:</p> <p>Risk of increased adverse events due to higher serum concentrations because of CYP3A4 inhibition by lopinavir/ritonavir.</p>	Careful monitoring of the tolerance of these anticancer agents.
Encorafenib	Serum concentrations may be increased due to CYP3A inhibition by lopinavir/ritonavir.	Co-administration of encorafenib with Kaletra may increase encorafenib exposure which may increase the risk of toxicity, including the risk of serious adverse events such as QT interval prolongation. Co-administration of encorafenib and Kaletra should be avoided. If the benefit is considered to outweigh the risk and Kaletra must be used, patients should be carefully monitored for safety.
Ibrutinib	Serum concentrations may be increased due to CYP3A inhibition by lopinavir/ritonavir.	Co-administration of ibrutinib and Kaletra may increase ibrutinib exposure which may increase the risk of toxicity including risk of tumor lysis syndrome. Co-administration of ibrutinib and Kaletra should be avoided. If the benefit is considered to outweigh the risk and Kaletra must be used, reduce the ibrutinib dose to 140 mg and monitor patient closely for toxicity.
Neratinib	Serum concentrations may be increased due to CYP3A inhibition by ritonavir.	Concomitant use of neratinib with Kaletra is contraindicated due to serious and/or life-threatening potential reactions including hepatotoxicity (see section 4.3).
Venetoclax	Due to CYP3A inhibition by lopinavir/ritonavir.	<p>Serum concentrations may be increased due to CYP3A inhibition by lopinavir/ritonavir, resulting in increased risk of tumor lysis syndrome at the dose initiation and during the ramp-up phase (see section 4.3 and refer to the venetoclax SmPC).</p> <p>For patients who have completed the ramp-up phase and are on a steady daily dose of venetoclax, reduce the venetoclax dose by at least 75% when</p>

		used with strong CYP3A inhibitors (refer to the venetoclax SmPC for dosing instructions). Patients should be closely monitored for signs related to venetoclax toxicities.
<b>Anticoagulants</b>		
Warfarin	Warfarin: Concentrations may be affected when co-administered with lopinavir/ritonavir due to CYP2C9 induction.	It is recommended that INR (international normalised ratio) be monitored.
Rivaroxaban (Ritonavir 600 mg twice daily)	Rivaroxaban: AUC: ↑ 153% C <sub>max</sub> : ↑ 55% Due to CYP3A and P-gp inhibition by lopinavir/ritonavir.	Co-administration of rivaroxaban and Kaletra may increase rivaroxaban exposure which may increase the risk of bleeding.  The use of rivaroxaban is not recommended in patients receiving concomitant treatment with Kaletra (see section 4.4).
Vorapaxar	Serum concentrations may be increased due to CYP3A inhibition by lopinavir/ritonavir.	The co-administration of vorapaxar with Kaletra is not recommended (see section 4.4 and refer to the vorapaxar SmPC).
<b>Anticonvulsants</b>		
Phenytoin	Phenytoin: Steady-state concentrations was moderately decreased due to CYP2C9 and CYP2C19 induction by lopinavir/ritonavir.  Lopinavir: Concentrations are decreased due to CYP3A induction by phenytoin.	Caution should be exercised in administering phenytoin with Kaletra.  Phenytoin levels should be monitored when co-administering with Kaletra.  When co-administered with phenytoin, an increase of Kaletra dosage may be envisaged. Dose adjustment has not been evaluated in clinical practice.
Carbamazepine and Phenobarbital	Carbamazepine: Serum concentrations may be increased due to CYP3A inhibition by lopinavir/ritonavir.  Lopinavir: Concentrations may be decreased due to CYP3A induction by carbamazepine and phenobarbital.	Caution should be exercised in administering carbamazepine or phenobarbital with Kaletra.  Carbamazepine and phenobarbital levels should be monitored when co-administering with Kaletra.  When co-administered with carbamazepine or phenobarbital, an increase of Kaletra dosage may be envisaged. Dose adjustment has not been evaluated in clinical practice
Lamotrigine and Valproate	Lamotrigine: AUC: ↓ 50% C <sub>max</sub> : ↓ 46% C <sub>min</sub> : ↓ 56%  Due to induction of lamotrigine glucuronidation	Patients should be monitored closely for a decreased VPA effect when Kaletra and valproic acid or valproate are given concomitantly.  <u>In patients starting or stopping Kaletra while currently taking maintenance dose of lamotrigine: lamotrigine dose may need to be increased if Kaletra is added,</u>

	Valproate: ↓	or decreased if Kaletra is discontinued; therefore plasma lamotrigine monitoring should be conducted, particularly before and during 2 weeks after starting or stopping Kaletra, in order to see if lamotrigine dose adjustment is needed.  <u>In patients currently taking Kaletra and starting lamotrigine:</u> no dose adjustments to the recommended dose escalation of lamotrigine should be necessary.
<i>Antidepressants and Anxiolytics</i>		
Trazodone single dose (Ritonavir, 200 mg BID)	Trazodone: AUC: ↑ 2.4-fold  Adverse events of nausea, dizziness, hypotension and syncope were observed following co-administration of trazodone and ritonavir.	It is unknown whether the combination of Kaletra causes a similar increase in trazodone exposure. The combination should be used with caution and a lower dose of trazodone should be considered.
<i>Antifungals</i>		
Ketoconazole and Itraconazole	Ketoconazole, Itraconazole: Serum concentrations may be increased due to CYP3A inhibition by lopinavir/ritonavir.	High doses of ketoconazole and itraconazole (> 200 mg/day) are not recommended.
Voriconazole	Voriconazole: Concentrations may be decreased.	Co-administration of voriconazole and low dose ritonavir (100 mg BID) as contained in Kaletra should be avoided unless an assessment of the benefit/risk to patient justifies the use of voriconazole.
<i>Anti-gout agents</i>		
Colchicine single dose (Ritonavir 200 mg twice daily)	Colchicine: AUC: ↑ 3-fold C <sub>max</sub> : ↑ 1.8-fold  Due to P-gp and/or CYP3A4 inhibition by ritonavir.	Concomitant administration of Kaletra with colchicine in patients with renal and/or hepatic impairment is contraindicated due to a potential increase of colchicine-related serious and/or life-threatening reactions such as neuromuscular toxicity (including rhabdomyolysis) (see sections 4.3 and 4.4). A reduction in colchicine dosage or an interruption of colchicine treatment is recommended in patients with normal renal or hepatic function if treatment with Kaletra is required. Refer to colchicine prescribing information.
<i>Antihistamines</i>		
Astemizole Terfenadine	Serum concentrations may be increased due to CYP3A inhibition by lopinavir/ritonavir.	Concomitant administration of Kaletra and astemizole and terfenadine is contraindicated as it may increase the risk of serious arrhythmias from these agents (see section 4.3).
<i>Anti-infectives</i>		
Fusidic acid	Fusidic acid:	Concomitant administration of Kaletra with fusidic acid is contra-indicated in

	Concentrations may be increased due to CYP3A inhibition by lopinavir/ritonavir.	dermatological indications due to the increased risk of adverse events related to fusidic acid, notably rhabdomyolysis (see section 4.3). When used for osteo-articular infections, where the co-administration is unavoidable, close clinical monitoring for muscular adverse events is strongly recommended (see section 4.4).
<b>Antimycobacterials</b>		
Bedaquiline (single dose)  (Lopinavir/ritonavir 400/100 mg BID, multiple dose)	Bedaquiline: AUC: ↑ 22% C <sub>max</sub> : ↔  A more pronounced effect on bedaquiline plasma exposures may be observed during prolonged co-administration with lopinavir/ritonavir.  CYP3A4 inhibition likely due to lopinavir/ritonavir.	Due to the risk of bedaquiline related adverse events, the combination of bedaquiline and Kaletra should be avoided. If the benefit outweighs the risk, co-administration of bedaquiline with Kaletra must be done with caution. More frequent electrocardiogram monitoring and monitoring of transaminases is recommended (see section 4.4 and refer to the bedaquiline SmPC).
Delamanid (100 mg BID)  (Lopinavir/ritonavir 400/100 mg BID)	Delamanid: AUC: ↑ 22%  DM-6705 (delamanid active metabolite): AUC: ↑ 30%  A more pronounced effect on DM-6705 exposure may be observed during prolonged co-administration with lopinavir/ritonavir.	Due to the risk of QTc prolongation associated with DM-6705, if co-administration of delamanid with Kaletra is considered necessary, very frequent ECG monitoring throughout the full delamanid treatment period is recommended (see section 4.4 and refer to the delamanid SmPC).
Rifabutin, 150 mg QD	Rifabutin (parent drug and active 25-O-desacetyl metabolite): AUC: ↑ 5.7-fold C <sub>max</sub> : ↑ 3.5-fold	When given with Kaletra the recommended dose of rifabutin is 150 mg 3 times per week on set days (for example Monday-Wednesday-Friday). Increased monitoring for rifabutin-associated adverse reactions including neutropenia and uveitis is warranted due to an expected increase in exposure to rifabutin. Further dosage reduction of rifabutin to 150 mg twice weekly on set days is recommended for patients in whom the 150 mg dose 3 times per week is not tolerated. It should be kept in mind that the twice weekly dosage of 150 mg may not provide an optimal exposure to rifabutin thus leading to a risk of rifampicin resistance and a treatment failure. No dose adjustment is needed for Kaletra.
Rifampicin	Lopinavir: Large decreases in lopinavir concentrations may be observed due to CYP3A induction by rifampicin.	Co-administration of Kaletra with rifampicin is not recommended as the decrease in lopinavir concentrations may in turn significantly decrease the lopinavir therapeutic effect. A dose adjustment of Kaletra 400 mg/400 mg (i.e. Kaletra 400/100 mg + ritonavir 300

		mg) twice daily has allowed compensating for the CYP 3A4 inducer effect of rifampicin. However, such a dose adjustment might be associated with ALT/AST elevations and with increase in gastrointestinal disorders. Therefore, this co-administration should be avoided unless judged strictly necessary. If this co-administration is judged unavoidable, increased dose of Kaletra at 400 mg/400 mg twice daily may be administered with rifampicin under close safety and therapeutic drug monitoring. The Kaletra dose should be titrated upward only after rifampicin has been initiated (see section 4.4).
<b>Antipsychotics</b>		
Lurasidone	Due to CYP3A inhibition by lopinavir/ritonavir, concentrations of lurasidone are expected to increase.	The concomitant administration with lurasidone is contraindicated (see section 4.3).
Pimozide	Due to CYP3A inhibition by lopinavir/ritonavir, concentrations of pimozide are expected to increase.	Concomitant administration of Kaletra and pimozide is contraindicated as it may increase the risk of serious haematologic abnormalities or other serious adverse effects from this agent (see section 4.3)
Quetiapine	Due to CYP3A inhibition by lopinavir/ritonavir, concentrations of quetiapine are expected to increase.	Concomitant administration of Kaletra and quetiapine is contraindicated as it may increase quetiapine-related toxicity.
<b>Benzodiazepines</b>		
Midazolam	<p>Oral Midazolam:</p> <p>AUC: ↑ 13-fold</p> <p>Parenteral Midazolam:</p> <p>AUC: ↑ 4-fold</p> <p>Due to CYP3A inhibition by lopinavir/ritonavir</p>	Kaletra must not be co-administered with oral midazolam (see section 4.3), whereas caution should be used with co-administration of Kaletra and parenteral midazolam. If Kaletra is co-administered with parenteral midazolam, it should be done in an intensive care unit (ICU) or similar setting which ensures close clinical monitoring and appropriate medical management in case of respiratory depression and/or prolonged sedation. Dosage adjustment for midazolam should be considered especially if more than a single dose of midazolam is administered.
<b>Beta<sub>2</sub>-adrenoceptor agonist (long acting)</b>		
Salmeterol	<p>Salmeterol:</p> <p>Concentrations are expected to increase due to CYP3A inhibition by lopinavir/ritonavir.</p>	<p>The combination may result in increased risk of cardiovascular adverse events associated with salmeterol, including QT prolongation, palpitations and sinus tachycardia.</p> <p>Therefore, concomitant administration of Kaletra with salmeterol is not recommended (see section 4.4).</p>
<b>Calcium channel blockers</b>		



Felodipine, Nifedipine, and Nicardipine	Felodipine, Nifedipine, Nicardipine: Concentrations may be increased due to CYP3A inhibition by lopinavir/ritonavir.	Clinical monitoring of therapeutic and adverse effects is recommended when these medicines are concomitantly administered with Kaletra.
<i>Corticosteroids</i>		
Dexamethasone	Lopinavir: Concentrations may be decreased due to CYP3A induction by dexamethasone.	Clinical monitoring of antiviral efficacy is recommended when these medicines are concomitantly administered with Kaletra.
Inhaled, injectable or intranasal fluticasone propionate, budesonide, triamcinolone	Fluticasone propionate, 50 µg intranasal 4 times daily: Plasma concentrations ↑ Cortisol levels ↓ 86%	Greater effects may be expected when fluticasone propionate is inhaled. Systemic corticosteroid effects including Cushing's syndrome and adrenal suppression have been reported in patients receiving ritonavir and inhaled or intranasally administered fluticasone propionate; this could also occur with other corticosteroids metabolised via the P450 3A pathway e.g. budesonide and triamcinolone. Consequently, concomitant administration of Kaletra and these glucocorticoids is not recommended unless the potential benefit of treatment outweighs the risk of systemic corticosteroid effects (see section 4.4). A dose reduction of the glucocorticoid should be considered with close monitoring of local and systemic effects or a switch to a glucocorticoid, which is not a substrate for CYP3A4 (e.g. beclomethasone). Moreover, in case of withdrawal of glucocorticoids progressive dose reduction may have to be performed over a longer period.
<i>Phosphodiesterase(PDE5) inhibitors</i>		
Avanafil (ritonavir 600 mg BID)	Avanafil: AUC: ↑ 13-fold Due to CYP3A inhibition by lopinavir/ritonavir.	The use of avanafil with Kaletra is contraindicated (see section 4.3).
Tadalafil	Tadalafil: AUC: ↑ 2-fold Due to CYP3A4 inhibition by lopinavir/ritonavir.	<u>For the treatment of pulmonary arterial hypertension:</u> Co-administration of Kaletra with sildenafil is contraindicated (see section 4.3). Co-administration of Kaletra with tadalafil is not recommended.
Sildenafil	Sildenafil: AUC: ↑ 11-fold Due to CYP3A inhibition by lopinavir/ritonavir.	<u>For erectile dysfunction:</u> Particular caution must be used when prescribing sildenafil or tadalafil in patients receiving Kaletra with increased monitoring for adverse events including hypotension, syncope, visual changes and prolonged erection (see section 4.4). When co-administered with Kaletra, sildenafil doses must not exceed 25 mg

		in 48 hours and tadalafil doses must not exceed 10 mg every 72 hours
Vardenafil	Vardenafil: AUC: ↑ 49-fold Due to CYP3A inhibition by lopinavir/ritonavir.	The use of vardenafil with Kaletra is contraindicated (see section 4.3).
<i>Ergot alkaloids</i>		
Dihydroergotamine, ergonovine, ergotamine, methylergonovine	Serum concentrations may be increased due to CYP3A inhibition by lopinavir/ritonavir.	Concomitant administration of Kaletra and ergot alkaloids are contraindicated as it may lead to acute ergot toxicity, including vasospasm and ischaemia (see section 4.3).
<i>GI motility agent</i>		
Cisapride	Serum concentrations may be increased due to CYP3A inhibition by lopinavir/ritonavir.	Concomitant administration of Kaletra and cisapride is contraindicated as it may increase the risk of serious arrhythmias from this agent (see section 4.3).
<i>HCV direct acting antivirals</i>		
Elbasvir/grazoprevir (50/200 mg QD)	Elbasvir: AUC: ↑ 2.71-fold C <sub>max</sub> : ↑ 1.87-fold C <sub>24</sub> : ↑ 3.58-fold  Grazoprevir: AUC: ↑ 11.86-fold C <sub>max</sub> : ↑ 6.31-fold C <sub>24</sub> : ↑ 20.70-fold  (combinations of mechanisms including CYP3A inhibition)  Lopinavir: ↔	Concomitant administration of elbasvir/grazoprevir with Kaletra is contraindicated (see section 4.3).
Glecaprevir/pibrentasvir	Serum concentrations may be increased due to P-glycoprotein, BCRP and OATP1B inhibition by lopinavir/ritonavir.	Concomitant administration of glecaprevir/pibrentasvir and Kaletra is not recommended due to an increased risk of ALT elevations associated with increased glecaprevir exposure.
Ombitasvir/paritaprevir/ritonavir + dasabuvir  (25/150/100 mg QD + 400 mg BID)  Lopinavir/ritonavir 400/100 mg BID	Ombitasvir: ↔  Paritaprevir: AUC: ↑ 2.17-fold C <sub>max</sub> : ↑ 2.04-fold C <sub>trough</sub> : ↑ 2.36-fold  (inhibition of CYP3A/efflux transporters)  Dasabuvir: ↔	Co-administration is contraindicated.  Lopinavir/ritonavir 800/200 mg QD was administered with ombitasvir/paritaprevir/ritonavir with or without dasabuvir. The effect on DAAs and lopinavir was similar to that observed when lopinavir/ritonavir 400/100 mg BID was administered (see section 4.3).

	Lopinavir: ↔	
Ombitasvir/paritaprevir/ ritonavir (25/150/100 mg QD)  Lopinavir/ritonavir 400/100 mg BID	Ombitasvir: ↔  Paritaprevir: AUC: ↑ 6.10-fold C <sub>max</sub> : ↑ 4.76-fold C <sub>trough</sub> : ↑ 12.33-fold  (inhibition of CYP3A/efflux transporters)  Lopinavir: ↔	
Sofosbuvir/velpatasvir/ voxilaprevir	Serum concentrations of sofosbuvir, velpatasvir and voxilaprevir may be increased due to P-glycoprotein, BCRP and OATP1B1/3 inhibition by lopinavir/ritonavir. However, only the increase in voxilaprevir exposure is considered clinically relevant.	It is not recommended to co-administer Kaletra and sofosbuvir/velpatasvir/ voxilaprevir.
<i>HCV protease inhibitors</i>		
Simeprevir 200 mg daily (ritonavir 100 mg BID)	Simeprevir: AUC: ↑ 7.2-fold C <sub>max</sub> : ↑ 4.7-fold C <sub>min</sub> : ↑ 14.4-fold	It is not recommended to co-administer Kaletra and simeprevir.
<i>Herbal products</i>		
St John's wort ( <i>Hypericum perforatum</i> )	Lopinavir: Concentrations may be reduced due to induction of CYP3A by the herbal preparation St John's wort.	Herbal preparations containing St John's wort must not be combined with lopinavir and ritonavir. If a patient is already taking St John's wort, stop St John's wort and if possible check viral levels. Lopinavir and ritonavir levels may increase on stopping St John's wort. The dose of Kaletra may need adjusting. The inducing effect may persist for at least 2 weeks after cessation of treatment with St John's wort (see section 4.3). Therefore, Kaletra can be started safely 2 weeks after cessation of St John's wort.
<i>Immunosuppressants</i>		
Cyclosporin, Sirolimus (rapamycin), and Tacrolimus	Cyclosporin, Sirolimus (rapamycin), Tacrolimus:  Concentrations may be increased due to CYP3A inhibition by lopinavir/ritonavir.	More frequent therapeutic concentration monitoring is recommended until plasma levels of these products have been stabilised.
<i>Lipid lowering agents</i>		
Lovastatin and Simvastatin	Lovastatin, Simvastatin:  Markedly increased plasma concentrations due to CYP3A inhibition by lopinavir/ritonavir.	Since increased concentrations of HMG-CoA reductase inhibitors may cause myopathy, including rhabdomyolysis, the combination of these agents with Kaletra is contraindicated (see section 4.3).
<i>Lipid-modifying agents</i>		

Lomitapide	CYP3A4 inhibitors increase the exposure of lomitapide, with strong inhibitors increasing exposure approximately 27-fold. Due to CYP3A inhibition by lopinavir/ritonavir, concentrations of lomitapide are expected to increase.	Concomitant use of Kaletra with lomitapide is contraindicated (see prescribing information for lomitapide) (see section 4.3).
Atorvastatin	Atorvastatin: AUC: ↑ 5.9-fold C <sub>max</sub> : ↑ 4.7-fold Due to CYP3A inhibition by lopinavir/ritonavir.	The combination of Kaletra with atorvastatin is not recommended. If the use of atorvastatin is considered strictly necessary, the lowest possible dose of atorvastatin should be administered with careful safety monitoring (see section 4.4).
Rosuvastatin, 20 mg QD	Rosuvastatin: AUC: ↑ 2-fold C <sub>max</sub> : ↑ 5-fold  While rosuvastatin is poorly metabolised by CYP3A4, an increase of its plasma concentrations was observed. The mechanism of this interaction may result from inhibition of transport proteins.	Caution should be exercised and reduced doses should be considered when Kaletra is co-administered with rosuvastatin (see section 4.4).
Fluvastatin or Pravastatin	Fluvastatin, Pravastatin: No clinical relevant interaction expected. Pravastatin is not metabolised by CYP450. Fluvastatin is partially metabolised by CYP2C9.	If treatment with an HMG-CoA reductase inhibitor is indicated, fluvastatin or pravastatin is recommended.
<i>Opioids</i>		
Buprenorphine, 16 mg QD	Buprenorphine: ↔	No dose adjustment necessary.
Methadone	Methadone: ↓	Monitoring plasma concentrations of methadone is recommended.
<i>Oral contraceptives</i>		
Ethinyl Oestradiol	Ethinyl Oestradiol: ↓	In case of co-administration of Kaletra with contraceptives containing ethinyl oestradiol (whatever the contraceptive formulation e.g. oral or patch), additional methods of contraception must be used.
<i>Smoking cessation aids</i>		
Bupropion	Bupropion and its active metabolite, hydroxybupropion: AUC and C <sub>max</sub> ↓ ~50%  This effect may be due to induction of bupropion metabolism.	If the co-administration of Kaletra with bupropion is judged unavoidable, this should be done under close clinical monitoring for bupropion efficacy, without exceeding the recommended dosage, despite the observed induction.
<i>Thyroid hormone replacement therapy</i>		
Levothyroxine	Post-marketing cases have been reported indicating a potential interaction	Thyroid-stimulating hormone (TSH) should be monitored in patients treated

	between ritonavir containing products and levothyroxine.	with levothyroxine at least the first month after starting and/or ending lopinavir/ritonavir treatment.
<b>Vasodilating agents</b>		
Bosentan	<p>Lopinavir - ritonavir:</p> <p>Lopinavir/ritonavir plasma concentrations may decrease due to CYP3A4 induction by bosentan.</p> <p>Bosentan:</p> <p>AUC: ↑ 5-fold</p> <p>C<sub>max</sub>: ↑ 6-fold</p> <p>Initially, bosentan C<sub>min</sub>: ↑ by approximately 48-fold.</p> <p>Due to CYP3A4 inhibition by lopinavir/ritonavir.</p>	<p>Caution should be exercised in administering Kaletra with bosentan.</p> <p>When Kaletra is administered concomitantly with bosentan, the efficacy of the HIV therapy should be monitored and patients should be closely observed for bosentan toxicity, especially during the first week of co-administration.</p>
Riociguat	Serum concentrations may be increased due to CYP3A and P-gp inhibition by lopinavir/ritonavir.	The co-administration of riociguat with Kaletra is not recommended (see section 4.4 and refer to riociguat SmPC).
<b>Other medicinal products</b>		
Based on known metabolic profiles, clinically significant interactions are not expected between Kaletra and dapsone, trimethoprim/sulfamethoxazole, azithromycin or fluconazole.		

#### 4.6 Fertility, pregnancy and lactation

##### Pregnancy

As a general rule, when deciding to use antiretroviral agents for the treatment of HIV infection in pregnant women and consequently for reducing the risk of HIV vertical transmission to the newborn, the animal data as well as the clinical experience in pregnant women should be taken into account in order to characterise the safety for the foetus.

Lopinavir/ritonavir has been evaluated in over 3000 women during pregnancy, including over 1000 during the first trimester.

In post-marketing surveillance through the Antiretroviral Pregnancy Registry, established since January 1989, an increased risk of birth defects exposures with Kaletra has not been reported among over 1000 women exposed during the first trimester. The prevalence of birth defects after any trimester exposure to lopinavir is comparable to the prevalence observed in the general population. No pattern of birth defects suggestive of a common etiology was seen. Studies in animals have shown reproductive toxicity (see section 5.3). Based on the data mentioned, the malformative risk is unlikely in humans. Lopinavir can be used during pregnancy if clinically needed.

##### Breastfeeding

Studies in rats revealed that lopinavir is excreted in the milk. It is not known whether this medicinal product is excreted in human milk. As a general rule, it is recommended that mothers infected by HIV do not breastfeed their babies under any circumstances in order to avoid transmission of HIV.

##### Fertility

Animal studies have shown no effects on fertility. No human data on the effect of lopinavir/ritonavir on fertility are available.

#### 4.7 Effects on ability to drive and use machines

No studies on the effects on the ability to drive and use machines have been performed. Patients should be informed that nausea has been reported during treatment with Kaletra (see section 4.8).

Kaletra oral solution contains approximately 42% v/v alcohol.

#### 4.8 Undesirable effects

### a. Summary of the safety profile

The safety of Kaletra has been investigated in over 2600 patients in Phase II-IV clinical trials, of which over 700 have received a dose of 800/200 mg (6 capsules or 4 tablets) once daily. Along with nucleoside reverse transcriptase inhibitors (NRTIs), in some studies, Kaletra was used in combination with efavirenz or nevirapine.

The most common adverse reactions related to Kaletra therapy during clinical trials were diarrhoea, nausea, vomiting, hypertriglyceridaemia and hypercholesterolemia. Diarrhoea, nausea and vomiting may occur at the beginning of the treatment while hypertriglyceridaemia and hypercholesterolemia may occur later. Treatment emergent adverse events led to premature study discontinuation for 7% of subjects from Phase II-IV studies.

It is important to note that cases of pancreatitis have been reported in patients receiving Kaletra, including those who developed hypertriglyceridaemia. Furthermore, rare increases in PR interval have been reported during Kaletra therapy (see section 4.4).

### b. Tabulated list of adverse reactions

*Adverse reactions from clinical trials and post-marketing experience in adult and paediatric patients:*

The following events have been identified as adverse reactions. The frequency category includes all reported events of moderate to severe intensity, regardless of the individual causality assessment. The adverse reactions are displayed by system organ class. Within each frequency grouping, undesirable effects are presented in order of decreasing seriousness: very common ( $\geq 1/10$ ), common ( $\geq 1/100$  to  $< 1/10$ ), uncommon ( $\geq 1/1000$  to  $< 1/100$ ) and rare ( $\geq 1/10,000$  to  $< 1/1000$ ).

Undesirable effects in clinical studies and post-marketing in adult patients		
System organ class	Frequency	Adverse reaction
Infections and infestations	Very common	Upper respiratory tract infection
	Common	Lower respiratory tract infection, skin infections including cellulitis, folliculitis and furuncle
Blood and lymphatic system disorders	Common	Anaemia, leucopenia, neutropenia, lymphadenopathy
Immune system disorders	Common	Hypersensitivity including urticaria and angioedema
	Uncommon	Immune reconstitution inflammatory syndrome
Endocrine disorders	Uncommon	Hypogonadism
Metabolism and nutrition disorders	Common	Blood glucose disorders including diabetes mellitus, hypertriglyceridaemia, hypercholesterolemia, weight decreased, decreased appetite
	Uncommon	Weight increased, increased appetite
Psychiatric disorders	Common	Anxiety
	Uncommon	Abnormal dreams, libido decreased
Nervous system disorders	Common	Headache (including migraine), neuropathy (including peripheral neuropathy), dizziness, insomnia
	Uncommon	Cerebrovascular accident, convulsion, dysgeusia, ageusia, tremor
Eye disorders	Uncommon	Visual impairment
Ear and labyrinth disorders	Uncommon	Tinnitus, vertigo
Cardiac disorders	Uncommon	Atherosclerosis such as myocardial infarction <sup>1</sup> , atrioventricular block, tricuspid valve incompetence

Vascular disorders	Common	Hypertension
	Uncommon	Deep vein thrombosis
Gastrointestinal disorders	Very common	Diarrhoea, nausea
	Common	Pancreatitis <sup>1</sup> , vomiting, gastroesophageal reflux disease, gastroenteritis and colitis, abdominal pain (upper and lower), abdominal distension, dyspepsia, haemorrhoids, flatulence
	Uncommon	Gastrointestinal haemorrhage including gastrointestinal ulcer, duodenitis, gastritis and rectal haemorrhage, stomatitis and oral ulcers, faecal incontinence, constipation, dry mouth
Hepatobiliary disorders	Common	Hepatitis including AST, ALT and GGT increases
	Uncommon	Jaundice hepatic steatosis, hepatomegaly, cholangitis, hyperbilirubinemia
Skin and subcutaneous tissue disorders	Common	Rash including maculopapular rash, dermatitis/rash including eczema and seborrheic dermatitis, night sweats, pruritus
	Uncommon	Alopecia, capillaritis, vasculitis
	Rare	Steven-Johnson syndrome, erythema multiforme
Musculoskeletal and connective tissue disorders	Common	Myalgia, musculoskeletal pain including arthralgia and back pain, muscle disorders such as weakness and spasms
	Uncommon	Rhabdomyolysis, osteonecrosis
Renal and urinary disorders	Uncommon	Creatinine clearance decreased, nephritis, haematuria
Reproductive system and breast disorders	Common	Erectile dysfunction, menstrual disorders - amenorrhoea, menorrhagia
General disorders and administration site conditions	Common	Fatigue including asthenia

<sup>1</sup> See section 4.4: pancreatitis and lipids

#### c. Description of selected adverse reactions

Cushing's syndrome has been reported in patients receiving ritonavir and inhaled or intranasally administered fluticasone propionate; this could also occur with other corticosteroids metabolised via the P450 3A pathway e.g. budesonide (see section 4.4 and 4.5).

Increased creatine phosphokinase (CPK), myalgia, myositis, and rarely, rhabdomyolysis have been reported with protease inhibitors, particularly in combination with nucleoside reverse transcriptase inhibitors.

#### Metabolic parameters

Weight and levels of blood lipids and glucose may increase during antiretroviral therapy (see section 4.4).

In HIV-infected patients with severe immune deficiency at the time of initiation of combination antiretroviral therapy (CART), an inflammatory reaction to asymptomatic or residual opportunistic infections may arise. Autoimmune disorders (such as Graves' disease and autoimmune hepatitis) have also been reported; however, the reported time to onset is more variable and can occur many months after initiation of treatment (see section 4.4).

Cases of osteonecrosis have been reported, particularly in patients with generally acknowledged risk factors, advanced HIV disease or long-term exposure to combination antiretroviral therapy (CART). The frequency of this is unknown (see

section 4.4).

#### d. Paediatric populations

In children 14 days of age and older, the nature of the safety profile is similar to that seen in adults (see Table in section b).

#### 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 Yellow Card Scheme:

Website: [www.mhra.gov.uk/yellowcard](http://www.mhra.gov.uk/yellowcard) or search for MHRA Yellow Card in the Google Play or Apple App Store.

### **4.9 Overdose**

To date, there is limited human experience of acute overdose with Kaletra.

Overdoses with Kaletra oral solution have been reported (including fatal outcome). The following events have been reported in association with unintended overdoses in preterm neonates: complete atrioventricular block, cardiomyopathy, lactic acidosis, and acute renal failure.

The adverse clinical signs observed in dogs included salivation, emesis and diarrhoea/abnormal stool. The signs of toxicity observed in mice, rats or dogs included decreased activity, ataxia, emaciation, dehydration and tremors.

There is no specific antidote for overdose with Kaletra. Treatment of overdose with Kaletra is to consist of general supportive measures including monitoring of vital signs and observation of the clinical status of the patient. If indicated, elimination of unabsorbed active substance is to be achieved by emesis or gastric lavage. Administration of activated charcoal may also be used to aid in removal of unabsorbed active substance. Since Kaletra is highly protein bound, dialysis is unlikely to be beneficial in significant removal of the active substance.

However, dialysis can remove both alcohol and propylene glycol in the case of overdose with Kaletra oral solution.

## **5. Pharmacological properties**

### **5.1 Pharmacodynamic properties**

Pharmaco-therapeutic group: antivirals for systemic use, antivirals for treatment of HIV infections, combinations, ATC code: J05AR10

#### Mechanism of action

Lopinavir provides the antiviral activity of Kaletra. Lopinavir is an inhibitor of the HIV-1 and HIV-2 proteases. Inhibition of HIV protease prevents cleavage of the *gag-pol* polyprotein resulting in the production of immature, non-infectious virus.

#### Effects on the electrocardiogram

QTcF interval was evaluated in a randomised, placebo and active (moxifloxacin 400 mg once daily) controlled crossover study in 39 healthy adults, with 10 measurements over 12 hours on Day 3. The maximum mean (95% upper confidence bound) differences in QTcF from placebo were 3.6 (6.3) and 13.1(15.8) for 400/100 mg twice daily and supratherapeutic 800/200 mg twice daily LPV/r, respectively. The induced QRS interval prolongation from 6 ms to 9.5 ms with high dose lopinavir/ritonavir (800/200 mg twice daily) contributes to QT prolongation. The two regimens resulted in exposures on Day 3 which were approximately 1.5 and 3-fold higher than those observed with recommended once daily or twice daily LPV/r doses at steady state. No subject experienced an increase in QTcF of  $\geq 60$  ms from baseline or a QTcF interval exceeding the potentially clinically relevant threshold of 500 ms.

Modest prolongation of the PR interval was also noted in subjects receiving lopinavir/ritonavir in the same study on Day 3. The mean changes from baseline in PR interval ranged from 11.6 ms to 24.4 ms in the 12 hour interval post dose. Maximum PR interval was 286 ms and no second or third degree heart block was observed (see section 4.4).

#### Antiviral activity *in vitro*

The *in vitro* antiviral activity of lopinavir against laboratory and clinical HIV strains was evaluated in acutely infected lymphoblastic cell lines and peripheral blood lymphocytes, respectively. In the absence of human serum, the mean  $IC_{50}$  of lopinavir against five different HIV-1 laboratory strains was 19 nM. In the absence and presence of 50% human serum, the mean  $IC_{50}$  of lopinavir against HIV-1<sub>IIIB</sub> in MT4 cells was 17 nM and 102 nM, respectively. In the absence of human serum, the mean  $IC_{50}$  of lopinavir was 6.5 nM against several HIV-1 clinical isolates.

#### Resistance

*In vitro* selection of resistance HIV-1 isolates with reduced susceptibility to lopinavir have been selected *in vitro*. HIV-1 has been passaged *in vitro* with lopinavir alone and with lopinavir plus ritonavir at concentration ratios representing the range of plasma concentration ratios observed during Kaletra therapy. Genotypic and phenotypic analysis of viruses



selected in these passages suggest that the presence of ritonavir, at these concentration ratios, does not measurably influence the selection of lopinavir-resistant viruses. Overall, the *in vitro* characterisation of phenotypic cross-resistance between lopinavir and other protease inhibitors suggest that decreased susceptibility to lopinavir correlated closely with decreased susceptibility to ritonavir and indinavir, but did not correlate closely with decreased susceptibility to amprenavir, saquinavir, and nelfinavir.

#### *Analysis of resistance in ARV-naïve patients*

In clinical studies with a limited number of isolates analysed, the selection of resistance to lopinavir has not been observed in naïve patients without significant protease inhibitor resistance at baseline. See further the detailed description of the clinical studies.

#### *Analysis of resistance in PI-experienced patients*

The selection of resistance to lopinavir in patients having failed prior protease inhibitor therapy was characterised by analysing the longitudinal isolates from 19 protease inhibitor-experienced subjects in 2 Phase II and one Phase III studies who either experienced incomplete virologic suppression or viral rebound subsequent to initial response to Kaletra and who demonstrated incremental *in vitro* resistance between baseline and rebound (defined as emergence of new mutations or 2-fold change in phenotypic susceptibility to lopinavir). Incremental resistance was most common in subjects whose baseline isolates had several protease inhibitor-associated mutations, but < 40-fold reduced susceptibility to lopinavir at baseline. Mutations V82A, I54V and M46I emerged most frequently. Mutations L33F, I50V and V32I combined with I47V/A were also observed. The 19 isolates demonstrated a 4.3-fold increase in IC<sub>50</sub> compared to baseline isolates (from 6.2- to 43-fold, compared to wild-type virus).

Genotypic correlates of reduced phenotypic susceptibility to lopinavir in viruses selected by other protease inhibitors. The *in vitro* antiviral activity of lopinavir against 112 clinical isolates taken from patients failing therapy with one or more protease inhibitors was assessed. Within this panel, the following mutations in HIV protease were associated with reduced *in vitro* susceptibility to lopinavir: L10F/I/R/V, K20M/R, L24I, M46I/L, F53L, I54L/T/V, L63P, A71I/L/T/V, V82A/F/T, I84V and L90M. The median EC<sub>50</sub> of lopinavir against isolates with 0 – 3, 4 – 5, 6 – 7 and 8 – 10 mutations at the above amino acid positions was 0.8, 2.7, 13.5 and 44.0-fold higher than the EC<sub>50</sub> against wild type HIV, respectively. The 16 viruses that displayed > 20-fold change in susceptibility all contained mutations at positions 10, 54, 63 plus 82 and/or 84. In addition, they contained a median of 3 mutations at amino acid positions 20, 24, 46, 53, 71 and 90. In addition to the mutations described above, mutations V32I and I47A have been observed in rebound isolates with reduced lopinavir susceptibility from protease inhibitor experienced patients receiving Kaletra therapy, and mutations I47A and L76V have been observed in rebound isolates with reduced lopinavir susceptibility from patients receiving Kaletra therapy.

Conclusions regarding the relevance of particular mutations or mutational patterns are subject to change with additional data, and it is recommended to always consult current interpretation systems for analysing resistance test results.

#### *Antiviral activity of Kaletra in patients failing protease inhibitor therapy*

The clinical relevance of reduced *in vitro* susceptibility to lopinavir has been examined by assessing the virologic response to Kaletra therapy, with respect to baseline viral genotype and phenotype, in 56 patients previous failing therapy with multiple protease inhibitors. The EC<sub>50</sub> of lopinavir against the 56 baseline viral isolates ranged from 0.6 to 96-fold higher than the EC<sub>50</sub> against wild type HIV. After 48 weeks of treatment with Kaletra, efavirenz and nucleoside reverse transcriptase inhibitors, plasma HIV RNA ≤ 400 copies/ml was observed in 93% (25/27), 73% (11/15), and 25% (2/8) of patients with < 10-fold, 10 to 40-fold, and > 40-fold reduced susceptibility to lopinavir at baseline, respectively. In addition, virologic response was observed in 91% (21/23), 71% (15/21) and 33% (2/6) patients with 0 – 5, 6 – 7, and 8 – 10 mutations of the above mutations in HIV protease associated with reduced *in vitro* susceptibility to lopinavir. Since these patients had not previously been exposed to either Kaletra or efavirenz, part of the response may be attributed to the antiviral activity of efavirenz, particularly in patients harbouring highly lopinavir resistant virus. The study did not contain a control arm of patients not receiving Kaletra.

#### Cross-resistance

Activity of other protease inhibitors against isolates that developed incremental resistance to lopinavir after Kaletra therapy in protease inhibitor experienced patients: The presence of cross resistance to other protease inhibitors was analysed in 18 rebound isolates that had demonstrated evolution of resistance to lopinavir during 3 Phase II and one Phase III studies of Kaletra in protease inhibitor-experienced patients. The median fold IC<sub>50</sub> of lopinavir for these 18 isolates at baseline and rebound was 6.9- and 63-fold, respectively, compared to wild type virus. In general, rebound isolates either retained (if cross-resistant at baseline) or developed significant cross-resistance to indinavir, saquinavir and atazanavir. Modest decreases in amprenavir activity were noted with a median increase of IC<sub>50</sub> from 3.7- to 8-fold in the baseline and rebound isolates, respectively. Isolates retained susceptibility to tipranavir with a median increase of IC<sub>50</sub> in baseline and rebound isolates of 1.9- and 1.8-fold, respectively, compared to wild type virus. Please refer to the Aptivus Summary of Product Characteristics for additional information on the use of tipranavir, including genotypic predictors of response, in treatment of lopinavir-resistant HIV-1 infection.

#### Clinical results

The effects of Kaletra (in combination with other antiretroviral agents) on biological markers (plasma HIV RNA levels and CD4+ T-cell counts) have been investigated in controlled studies of Kaletra of 48 to 360 weeks duration.

#### Adult Use

##### Patients without prior antiretroviral therapy

Study M98-863 was a randomised, double-blind trial of 653 antiretroviral treatment naïve patients investigating Kaletra (400/100 mg twice daily) compared to nelfinavir (750 mg three times daily) plus stavudine and lamivudine. Mean baseline CD4+ T-cell count was 259 cells/mm<sup>3</sup> (range: 2 to 949 cells/mm<sup>3</sup>) and mean baseline plasma HIV-1 RNA was 4.9 log<sub>10</sub> copies/ml (range: 2.6 to 6.8 log<sub>10</sub> copies/ml).

Table 1

Outcomes at Week 48: Study M98-863		
	Kaletra (N=326)	Nelfinavir (N=327)
HIV RNA < 400 copies/ml*	75%	63%
HIV RNA < 50 copies/ml*†	67%	52%
Mean increase from baseline in CD4+ T-cell count (cells/mm <sup>3</sup> )	207	195

\* intent to treat analysis where patients with missing values are considered virologic failures

† p < 0.001

One-hundred thirteen nelfinavir-treated patients and 74 lopinavir/ritonavir-treated patients had an HIV RNA above 400 copies/ml while on treatment from Week 24 through Week 96. Of these, isolates from 96 nelfinavir-treated patients and 51 lopinavir/ritonavir-treated patients could be amplified for resistance testing. Resistance to nelfinavir, defined as the presence of the D30N or L90M mutation in protease, was observed in 41/96 (43%) patients. Resistance to lopinavir, defined as the presence of any primary or active site mutations in protease (see above), was observed in 0/51 (0%) patients. Lack of resistance to lopinavir was confirmed by phenotypic analysis.

Sustained virological response to Kaletra (in combination with nucleoside/nucleotide reverse transcriptase inhibitors) has been also observed in a small Phase II study (M97-720) through 360 weeks of treatment. One hundred patients were originally treated with Kaletra in the study (including 51 patients receiving 400/100 mg twice daily and 49 patients at either 200/100 mg twice daily or 400/200 mg twice daily). All patients converted to open-label Kaletra at the 400/100 mg twice daily dose between week 48 and week 72. Thirty-nine patients (39%) discontinued the study, including 16 (16%) discontinuations due to adverse events, one of which was associated with a death. Sixty-one patients completed the study (35 patients received the recommended 400/100 mg twice daily dose throughout the study).

Table 2

Outcomes at Week 360: Study M97-720	
	Kaletra (N=100)
HIV RNA < 400 copies/ml	61%
HIV RNA < 50 copies/ml	59%
Mean increase from baseline in CD4+ T-cell count (cells/mm <sup>3</sup> )	501

Through 360 weeks of treatment, genotypic analysis of viral isolates was successfully conducted in 19 of 28 patients with confirmed HIV RNA above 400 copies/ml revealed no primary or active site mutations in protease (amino acids at positions 8, 30, 32, 46, 47, 48, 50, 82, 84 and 90) or protease inhibitor phenotypic resistance.

##### Patients with prior antiretroviral therapy

M97-765 is a randomised, double-blind trial evaluating Kaletra at two dose levels (400/100 mg and 400/200 mg, both twice daily) plus nevirapine (200 mg twice daily) and two nucleoside reverse transcriptase inhibitors in 70 single protease inhibitor experienced, non-nucleoside reverse transcriptase inhibitor naïve patients. Median baseline CD<sub>4</sub> cell count was 349 cells/mm<sup>3</sup> (range 72 to 807 cells/mm<sup>3</sup>) and median baseline plasma HIV-1 RNA was 4.0 log<sub>10</sub> copies/ml (range 2.9 to 5.8 log<sub>10</sub> copies/ml).

Table 3

Outcomes at Week 24: Study M97-765	
	Kaletra 400/100 mg (N=36)
HIV RNA < 400 copies/ml (ITT)*	75%
HIV RNA < 50 copies/ml (ITT)*	58%
Mean increase from baseline in CD4+ T-cell count (cells/mm <sup>3</sup> )	174

\* intent to treat analysis where patients with missing values are considered virologic failures

M98-957 is a randomised, open-label study evaluating Kaletra treatment at two dose levels (400/100 mg and 533/133 mg, both twice daily) plus efavirenz (600 mg once daily) and nucleoside reverse transcriptase inhibitors in 57 multiple protease inhibitor experienced, non-nucleoside reverse transcriptase inhibitor naïve patients. Between week 24 and 48, patients randomised to a dose of 400/100 mg were converted to a dose of 533/133 mg. Median baseline CD<sub>4</sub> cell count was 220 cells/mm<sup>3</sup> (range 13 to 1030 cells/mm<sup>3</sup>).

Table 4

Outcomes at Week 48: Study M98-957	
	Kaletra 400/100 mg (N=57)
HIV RNA < 400 copies/ml*	65%
Mean increase from baseline in CD4+ T-cell count (cells/mm <sup>3</sup> )	94

\* intent to treat analysis where patients with missing values are considered virologic failures

#### Paediatric Use

M98-940 was an open-label study of a liquid formulation of Kaletra in 100 antiretroviral naïve (44%) and experienced (56%) paediatric patients. All patients were non-nucleoside reverse transcriptase inhibitor naïve. Patients were randomised to either 230 mg lopinavir/57.5 mg ritonavir per m<sup>2</sup> or 300 mg lopinavir/75 mg ritonavir per m<sup>2</sup>. Naïve patients also received nucleoside reverse transcriptase inhibitors. Experienced patients received nevirapine plus up to two nucleoside reverse transcriptase inhibitors. Safety, efficacy and pharmacokinetic profiles of the two dose regimens were assessed after 3 weeks of therapy in each patient. Subsequently, all patients were continued on the 300/75 mg per m<sup>2</sup> dose. Patients had a mean age of 5 years (range 6 months to 12 years) with 14 patients less than 2 years old and 6 patients one year or less. Mean baseline CD4+ T-cell count was 838 cells/mm<sup>3</sup> and mean baseline plasma HIV-1 RNA was 4.7 log<sub>10</sub> copies/ml.

Table 5

Outcomes at Week 48: Study M98-940*		
	Antiretroviral Naïve (N=44)	Antiretroviral Experienced (N=56)
HIV RNA < 400 copies/ml	84%	75%
Mean increase from baseline in CD4+ T-cell count (cells/mm <sup>3</sup> )	404	284

\* intent to treat analysis where patients with missing values are considered virologic failures

Study P1030 was an open-label, dose-finding trial evaluating the pharmacokinetic profile, tolerability, safety and efficacy of Kaletra oral solution at a dose of 300 mg lopinavir/75 mg ritonavir per m<sup>2</sup> twice daily plus 2 NRTIs in HIV-1 infected infants ≥ 14 days and < 6 months of age. At entry, median (range) HIV-1 RNA was 6.0 (4.7-7.2) log<sub>10</sub> copies/ml and median (range) CD4+T-cell percentage was 41 (16-59).

Table 6

Outcomes at Week 24: Study P1030		
	Age: $\geq 14$ days and $< 6$ weeks (N=10)	Age: $\geq 6$ weeks and $< 6$ months (N=21)
HIV RNA $< 400$ copies/ml*	70%	48%
Median change from baseline in CD4 <sup>+</sup> T-cell count (cells/mm <sup>3</sup> )	- 1% (95% CI: -10, 18) (n=6)	+ 4% (95% CI: -1, 9) (n=19)

\*Proportion of subjects who had HIV-1  $< 400$  copies/ml and had remained on study treatment

Study P1060 was a randomised controlled trial of nevirapine versus lopinavir/ritonavir-based therapy in subjects 2 to 36 months of age infected with HIV-1 who had (Cohort I) and had not (Cohort II) been exposed to nevirapine during pregnancy for prevention of mother-to-child transmission. Lopinavir/ritonavir was administered twice daily at 16/4 mg/kg for subjects 2 months to  $< 6$  months, 12/3 mg/kg for subjects  $\geq 6$  months and  $< 15$  kg, 10/2.5 mg/kg for subjects  $\geq 6$  months and  $\geq 15$  kg to  $< 40$  kg, or 400/100 mg for subjects  $\geq 40$  kg. The nevirapine-based regimen was 160-200 mg/m<sup>2</sup> once daily for 14 days, then 160-200 mg/m<sup>2</sup> every 12 hours. Both treatment arms included zidovudine 180 mg/m<sup>2</sup> every 12 hours and lamivudine 4 mg/kg every 12 hours. The median follow-up was 48 weeks in Cohort I and 72 weeks in Cohort II. At entry, median age was 0.7 years, median CD4 T-cell count was 1147 cells/mm<sup>3</sup>, median CD4 T-cell was 19%, and median HIV-1 RNA was  $> 750,000$  copies/ml. Among 13 subjects with viral failure in the lopinavir/ritonavir group with resistance data available no resistance to lopinavir/ritonavir was found.

Table 7

Outcomes at Week 24: Study P1060				
	Cohort I		Cohort II	
	lopinavir/ritonavir (N=82)	nevirapine (N=82)	lopinavir/ritonavir (N=140)	nevirapine (N=147)
Virologic failure*	21.7%	39.6%	19.3%	40.8%

\*Defined as confirmed plasma HIV-1 RNA level  $> 400$  copies/ml at 24 weeks or viral rebound  $> 4000$  copies/ml after Week 24. Overall failure rate combining the treatment differences across age strata, weighted by the precision of the estimate within each age stratum

p=0.015 (Cohort I); p< 0.001 (Cohort II)

The CHER study was a randomized, open-label study comparing 3 treatment strategies (deferred treatment, early treatment for 40 weeks, or early treatment for 96 weeks) in children with perinatally acquired HIV-1 infection. The treatment regimen was zidovudine plus lamivudine plus 300 mg lopinavir/75 mg ritonavir per m<sup>2</sup> twice daily until 6 months of age, then 230 mg lopinavir/57.5 mg ritonavir per m<sup>2</sup> twice daily. There were no reported events of failure attributed to therapy limiting toxicity.

Table 8

Hazard Ratio for Death or Failure of First-line Therapy Relative to ART Deferred Treatment: CHER Study		
	40 week arm (N=13)	96 week arm (N=13)
Hazard ratio for death or failure of therapy*	0.319	0.332

\* Failure defined as clinical, immunological disease progression, virological failure or regimen limiting ART toxicity  
p=0.0005 (40 week arm); p< 0.0008 (96 week arm)

## 5.2 Pharmacokinetic properties

The pharmacokinetic properties of lopinavir co-administered with ritonavir have been evaluated in healthy adult volunteers and in HIV-infected patients; no substantial differences were observed between the two groups. Lopinavir is essentially completely metabolised by CYP3A. Ritonavir inhibits the metabolism of lopinavir, thereby increasing the

plasma levels of lopinavir. Across studies, administration of Kaletra 400/100 mg twice daily yields mean steady-state lopinavir plasma concentrations 15 to 20-fold higher than those of ritonavir in HIV-infected patients. The plasma levels of ritonavir are less than 7% of those obtained after the ritonavir dose of 600 mg twice daily. The *in vitro* antiviral EC<sub>50</sub> of lopinavir is approximately 10-fold lower than that of ritonavir. Therefore, the antiviral activity of Kaletra is due to lopinavir.

### Absorption

Multiple dosing with 400/100 mg Kaletra twice daily for 2 weeks and without meal restriction produced a mean  $\pm$  SD lopinavir peak plasma concentration ( $C_{\max}$ ) of  $12.3 \pm 5.4$   $\mu\text{g/ml}$ , occurring approximately 4 hours after administration. The mean steady-state trough concentration prior to the morning dose was  $8.1 \pm 5.7$   $\mu\text{g/ml}$ . Lopinavir AUC over a 12 hour dosing interval averaged  $113.2 \pm 60.5$   $\mu\text{g}\cdot\text{h/ml}$ . The absolute bioavailability of lopinavir co-formulated with ritonavir in humans has not been established.

### Effects of food on oral absorption

Kaletra soft capsules and liquid have been shown to be bioequivalent under nonfasting conditions (moderate fat meal). Administration of a single 400/100 mg dose of Kaletra soft capsules with a moderate fat meal (500 – 682 kcal, 22.7 – 25.1% from fat) was associated with a mean increase of 48% and 23% in lopinavir AUC and  $C_{\max}$ , respectively, relative to fasting. For Kaletra oral solution, the corresponding increases in lopinavir AUC and  $C_{\max}$  were 80% and 54%, respectively. Administration of Kaletra with a high fat meal (872 kcal, 55.8% from fat) increased lopinavir AUC and  $C_{\max}$  by 96% and 43%, respectively, for soft capsules, and 130% and 56%, respectively, for oral solution. To enhance bioavailability and minimise variability Kaletra is to be taken with food.

### Distribution

At steady state, lopinavir is approximately 98 – 99% bound to serum proteins. Lopinavir binds to both alpha-1-acid glycoprotein (AAG) and albumin however, it has a higher affinity for AAG. At steady state, lopinavir protein binding remains constant over the range of observed concentrations after 400/100 mg Kaletra twice daily, and is similar between healthy volunteers and HIV-positive patients.

### Biotransformation

*In vitro* experiments with human hepatic microsomes indicate that lopinavir primarily undergoes oxidative metabolism. Lopinavir is extensively metabolised by the hepatic cytochrome P450 system, almost exclusively by isozyme CYP3A. Ritonavir is a potent CYP3A inhibitor which inhibits the metabolism of lopinavir and therefore, increases plasma levels of lopinavir. A <sup>14</sup>C-lopinavir study in humans showed that 89% of the plasma radioactivity after a single 400/100 mg Kaletra dose was due to parent active substance. At least 13 lopinavir oxidative metabolites have been identified in man. The 4-oxo and 4-hydroxymetabolite epimeric pair are the major metabolites with antiviral activity, but comprise only minute amounts of total plasma radioactivity. Ritonavir has been shown to induce metabolic enzymes, resulting in the induction of its own metabolism, and likely the induction of lopinavir metabolism. Pre-dose lopinavir concentrations decline with time during multiple dosing, stabilising after approximately 10 days to 2 weeks.

### Elimination

After a 400/100 mg <sup>14</sup>C-lopinavir/ritonavir dose, approximately  $10.4 \pm 2.3\%$  and  $82.6 \pm 2.5\%$  of an administered dose of <sup>14</sup>C-lopinavir can be accounted for in urine and faeces, respectively. Unchanged lopinavir accounted for approximately 2.2% and 19.8% of the administered dose in urine and faeces, respectively. After multiple dosing, less than 3% of the lopinavir dose is excreted unchanged in the urine. The effective (peak to trough) half-life of lopinavir over a 12 hour dosing interval averaged 5 – 6 hours, and the apparent oral clearance (CL/F) of lopinavir is 6 to 7 l/h.

### Special Populations

#### *Paediatrics*

Data from clinical trials in children below 2 years of age include the pharmacokinetics of Kaletra 300/75 mg/m<sup>2</sup> twice daily studied in a total of 31 paediatric patients, ranging in age from 14 days to 6 months. The pharmacokinetics of Kaletra 300/75 mg/m<sup>2</sup> twice daily with nevirapine and 230/57.5 mg/m<sup>2</sup> twice daily alone have been studied in 53 paediatric patients ranging in age from 6 months to 12 years. The mean (SD) for the studies are reported in the table below. The 230/57.5 mg/m<sup>2</sup> twice daily regimen without nevirapine and the 300/75 mg/m<sup>2</sup> twice daily regimen with nevirapine provided lopinavir plasma concentrations similar to those obtained in adult patients receiving the 400/100 mg twice daily regimen without nevirapine.

$C_{\max}$ ( $\mu\text{g/ml}$ )	$C_{\min}$ ( $\mu\text{g/ml}$ )	AUC <sub>12</sub> ( $\mu\text{g}\cdot\text{h/ml}$ )
<b>Age <math>\geq</math> 14 days to &lt; 6 weeks cohort (N = 9):</b>		
5.17 (1.84)	1.40 (0.48)	43.39 (14.80)

<b>Age ≥ 6 weeks to &lt; 6 months cohort (N = 18):</b>		
9.39 (4.91)	1.95 (1.80)	74.50 (37.87)
<b>Age ≥ 6 months to &lt; 12 years cohort (N = 53):</b>		
8.2 (2.9) <sup>a</sup>	3.4 (2.1) <sup>a</sup>	72.6 (31.1) <sup>a</sup>
10.0 (3.3) <sup>b</sup>	3.6 (3.5) <sup>b</sup>	85.8 (36.9) <sup>b</sup>
<b>Adult<sup>c</sup></b>		
12.3 (5.4)	8.1 (5.7)	113.2 (60.5)

a. Kaletra oral solution 230/57.5 mg/m<sup>2</sup> twice daily regimen without nevirapine

b. Kaletra oral solution 300/75 mg/m<sup>2</sup> twice daily regimen with nevirapine

c. Kaletra film-coated tablets 400/100 mg twice daily at steady state

#### *Gender, Race and Age*

Kaletra pharmacokinetics have not been studied in older people. No age or gender related pharmacokinetic differences have been observed in adult patients. Pharmacokinetic differences due to race have not been identified.

#### *Renal Insufficiency*

Kaletra pharmacokinetics have not been studied in patients with renal insufficiency; however, since the renal clearance of lopinavir is negligible, a decrease in total body clearance is not expected in patients with renal insufficiency.

#### *Hepatic Insufficiency*

The steady state pharmacokinetic parameters of lopinavir in HIV-infected patients with mild to moderate hepatic impairment were compared with those of HIV-infected patients with normal hepatic function in a multiple dose study with lopinavir/ritonavir 400/100 mg twice daily. A limited increase in total lopinavir concentrations of approximately 30% has been observed which is not expected to be of clinical relevance (see section 4.2).

### **5.3 Preclinical safety data**

Repeat-dose toxicity studies in rodents and dogs identified major target organs as the liver, kidney, thyroid, spleen and circulating red blood cells. Hepatic changes indicated cellular swelling with focal degeneration. While exposure eliciting these changes were comparable to or below human clinical exposure, dosages in animals were over 6-fold the recommended clinical dose. Mild renal tubular degeneration was confined to mice exposed with at least twice the recommended human exposure; the kidney was unaffected in rats and dogs. Reduced serum thyroxine led to an increased release of TSH with resultant follicular cell hypertrophy in the thyroid glands of rats. These changes were reversible with withdrawal of the active substance and were absent in mice and dogs. Coombs-negative anisocytosis and poikilocytosis were observed in rats, but not in mice or dogs. Enlarged spleens with histiocytosis were seen in rats but not other species. Serum cholesterol was elevated in rodents but not dogs, while triglycerides were elevated only in mice.

During *in vitro* studies, cloned human cardiac potassium channels (HERG) were inhibited by 30% at the highest concentrations of lopinavir/ritonavir tested, corresponding to a lopinavir exposure 7-fold total and 15-fold free peak plasma levels achieved in humans at the maximum recommended therapeutic dose. In contrast, similar concentrations of lopinavir/ritonavir demonstrated no repolarisation delay in the canine cardiac Purkinje fibres. Lower concentrations of lopinavir/ritonavir did not produce significant potassium (HERG) current blockade. Tissue distribution studies conducted in the rat did not suggest significant cardiac retention of the active substance; 72-hour AUC in heart was approximately 50% of measured plasma AUC. Therefore, it is reasonable to expect that cardiac lopinavir levels would not be significantly higher than plasma levels.

In dogs, prominent U waves on the electrocardiogram have been observed associated with prolonged PR interval and bradycardia. These effects have been assumed to be caused by electrolyte disturbance.

The clinical relevance of these preclinical data is unknown, however, the potential cardiac effects of this product in humans cannot be ruled out (see also sections 4.4 and 4.8).

In rats, embryofoetotoxicity (pregnancy loss, decreased foetal viability, decreased foetal body weights, increased frequency of skeletal variations) and postnatal developmental toxicity (decreased survival of pups) was observed at maternally toxic dosages. The systemic exposure to lopinavir/ritonavir at the maternal and developmental toxic dosages was lower than the intended therapeutic exposure in humans.

Long-term carcinogenicity studies of lopinavir/ritonavir in mice revealed a nongenotoxic, mitogenic induction of liver tumours, generally considered to have little relevance to human risk. Carcinogenicity studies in rats revealed no tumourigenic findings. Lopinavir/ritonavir was not found to be mutagenic or clastogenic in a battery of *in vitro* and *in vivo* assays including the Ames bacterial reverse mutation assay, the mouse lymphoma assay, the mouse micronucleus test and chromosomal aberration assays in human lymphocytes.

## 6. Pharmaceutical particulars

### 6.1 List of excipients

Oral solution contains:

alcohol (42.4% v/v),

high fructose corn syrup,

propylene glycol (15.3% w/v),

purified water,

glycerol,

povidone,

magnasweet-110 flavour (mixture of monoammonium glycyrrhizinate and glycerol),

vanilla flavour (containing p-hydroxybenzoic acid, p-hydroxybenzaldehyde, vanillic acid, vanillin, heliotropin, ethyl vanillin),

polyoxyl 40 hydrogenated castor oil,

cotton candy flavour (containing ethyl maltol, ethyl vanillin, acetoin, dihydrocoumarin, propylene glycol),

acesulfame potassium,

saccharin sodium,

sodium chloride,

peppermint oil,

sodium citrate,

citric acid,

levomenthol.

### 6.2 Incompatibilities

Not applicable.

### 6.3 Shelf life

2 years

### 6.4 Special precautions for storage

Store in a refrigerator (2°C - 8°C).

In use storage: If kept outside of the refrigerator, do not store above 25°C and discard any unused contents after 42 days (6 weeks). It is advised to write the date of removal from the refrigerator on the package.

### 6.5 Nature and contents of container

Kaletra oral solution is supplied in amber coloured multiple-dose polyethylene terephthalate (PET) bottles in a 60 ml size.

Two pack sizes are available for Kaletra oral solution:

- 120 ml (2 bottles x 60 ml) with 2 x 2 ml syringes with 0.1 ml graduations

For volumes up to 2 ml. For larger volumes an alternative pack is available.

- 300 ml (5 bottles x 60 ml) with 5 x 5 ml syringes with 0.1 ml graduations

For volumes greater than 2 ml. For smaller volumes an alternative pack is available.

### 6.6 Special precautions for disposal and other handling

No special requirements.

## 7. Marketing authorisation holder

AbbVie Deutschland GmbH & Co. KG

Knollstrasse

67061 Ludwigshafen

Germany

## 8. Marketing authorisation number(s)

EU/1/01/172/003

EU/1/01/172/009

## 9. Date of first authorisation/renewal of the authorisation

Date of first authorisation: 20 March 2001

Date of latest renewal: 20 March 2011

## 10. Date of revision of the text

31 October 2019

Detailed information on this product is available on the website of the European Medicines Agency

<http://www.ema.europa.eu>

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