

## **1. NAME OF THE MEDICINAL PRODUCT**

### **LT- Artemether + Lumefantrine**

ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG

## **2. QUALITATIVE AND QUANTITATIVE COMPOSITION**

### **Composition:**

Each uncoated coated caplet contains:

Artemether PhI 80 mg

Lumefantrine 480 mg

## **3. PHARMACEUTICAL FORM**

Uncoated Tablets

Yellow coloured, elongated, biconvex, uncoated tablets with breakline on one side and plain on the other side

## **4. Clinical particulars**

### **4.1 Therapeutic indications**

Artemether and lumefantrine combination therapy is indicated for the treatment of acute uncomplicated malaria caused by *Plasmodium falciparum*, including malaria acquired in chloroquine-resistant areas. May also be used to treat uncomplicated malaria when the *Plasmodium* species has not been identified. Indicated for use in adults and children greater than 5 kg.

### **4.2 Posology and method of administration**

Posology

Adults and children weighing 35 kg and above

For patients 12 years of age and above and 35 kg body weight and above, a course of treatment comprises six doses of four tablets i.e. total of 24 tablets, given over a period of 60 hours as follows: the first dose of four tablets, given at the time of initial diagnosis, should be followed by five further doses of four tablets given at 8, 24, 36, 48 and 60 hours thereafter.

Children and infants weighing 5 kg to less than 35 kg

A six-dose regimen is recommended with 1 to 3 tablets per dose, depending on bodyweight: 5 to less than 15 kg bodyweight: the first dose of one tablet, given at the time of initial diagnosis, should be followed by five further doses of one tablet given at 8, 24, 36, 48 and 60 hours thereafter. 15 to less than 25 kg bodyweight: the first dose of two tablets, given at the time of initial diagnosis, should be followed by five further doses of two tablets given at 8, 24, 36, 48 and 60 hours thereafter. 25 to less than 35 kg bodyweight: the first dose of three tablets, given at the time of initial diagnosis, should be followed by

five further doses of three tablets given at 8, 24, 36, 48 and 60 hours thereafter.

Infants weighing less than 5 kg

The safety and efficacy of Artemether and Lumefantrine Tablet 20 + 120 mg tablets have not been established in infants weighing less than 5 kg and no dosing recommendations can be made. Currently available data are described in section 5.1 and

## 5.2.

### **Older people**

There is no information suggesting that the dosage in patients over 65 years of age should be different than in younger adults.

### **Method of administration**

Tablets for oral administration.

To increase absorption, Artemether and Lumefantrine Tablet 20 + 120 mg should be taken with food or a milky drink (see section 5.2). If patients are unable to tolerate food, Artemether and Lumefantrine Tablet 20 + 120 mg should be administered with water, but the systemic exposure may be reduced. Patients who vomit within 1 hour of taking the medication should repeat the dose.

For administration to small children and infants, the tablet/s may be crushed.

## **4.3 Contraindications**

### **Contraindicated in patients with:**

- patients with known hypersensitivity to the active substances or to any of the excipients listed in section 6.1.
- patients with severe malaria according to WHO definition\*.
- patients who are taking any drug which is metabolised by the cytochrome enzyme CYP2D6 (e.g. metoprolol, imipramine, amitriptyline, clomipramine).
- patients with a family history of sudden death or of congenital prolongation of the QTc interval on electrocardiograms, or with any other clinical condition known to prolong the QTc interval.
- patients taking drugs that are known to prolong the QTc interval (proarrhythmic). These drugs include: - antiarrhythmics of classes IA and III, - neuroleptics, antidepressive agents, - certain antibiotics including some agents of the following classes: macrolides, fluoroquinolones, imidazole and triazole antifungal agents, - certain nonsedating antihistamines (terfenadine, astemizole), - cisapride, - flecainide
- patients with a history of symptomatic cardiac arrhythmias or with clinically relevant bradycardia or with congestive cardiac failure accompanied by reduced left ventricle ejection fraction.
- patients with disturbances of electrolyte balance e.g. hypokalemia or hypomagnesemia.
- patients taking drugs that are strong inducers of CYP3A4 such as rifampin, carbamazepine, phenytoin, St. John's wort (*Hypericum perforatum*). (\*Presence of one or more of the following clinical or laboratory features: Clinical manifestation: Prostration; impaired consciousness or unarousable coma; failure to feed; deep breathing, respiratory distress (acidotic breathing); multiple convulsions; circulatory collapse or shock; pulmonary edema (radiological); abnormal bleeding; clinical jaundice; hemoglobinuria

## **4.4 Special warnings and precautions for use**

ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG must not be used in the first trimester of pregnancy in situations where other suitable and effective antimalarials are available. ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG has not been evaluated for the treatment of severe malaria, including cases of cerebral malaria or other severe manifestations such as pulmonary oedema or renal failure. Due to limited data on safety and efficacy, ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG should

not be given concurrently with any other antimalarial agent unless there is no other treatment option. If a patient deteriorates whilst taking ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG, alternative treatment for malaria should be started without delay. In such cases, monitoring of the ECG is recommended and steps should be taken to correct any electrolyte disturbances. The long elimination half-life of lumefantrine must be taken into account when administering quinine in patients previously treated with ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG. If quinine is given after ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG, close monitoring of the ECG is advised. If ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG is given after mefloquine, close monitoring of food intake is advised. In patients previously treated with halofantrine

ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG /480 MG should not be administered earlier than one month after the last halofantrine dose. ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG is not indicated and has not been evaluated for prophylaxis of malaria. ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG should be used cautiously in patients on anti-retroviral drugs (ARTs) since decreased artemether, DHA, and/or lumefantrine concentrations may result in a decrease of antimalarial efficacy of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG. Like other antimalarials (e.g. halofantrine, quinine and quinidine) ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG has the potential to cause QT prolongation. Caution is recommended when combining ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG with drugs exhibiting variable patterns of inhibition, moderate induction or competition for CYP3A4 as the therapeutic effects of some drugs could be altered. Drugs that have a mixed inhibitory/induction effect on CYP3A4, especially antiretroviral drugs such as HIV protease inhibitors and non-nucleoside reverse transcriptase inhibitors should be used with caution in patients taking ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG. Caution is recommended when combining ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG with hormonal contraceptives. MEFAARTTABLETS (ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG) may reduce the effectiveness of hormonal contraceptives.

Therefore, patients using oral, transdermal patch, or other systemic hormonal contraceptives should be advised to use an additional non-hormonal method of birth control for about one month.

Patients who remain averse to food during treatment should be closely monitored as the risk of recrudescence may be greater.

#### Renal impairment

No specific studies have been carried out in this group of patients. There is no significant renal excretion of lumefantrine, artemether and dihydroartemisinin in studies conducted in healthy volunteers and clinical experience is limited. No dose adjustment for the use of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG /480 MG in patients with renal impairment is recommended. Caution is advised when administering ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG /480 MG to patients with severe renal impairment. In these patients, ECG and blood potassium monitoring is advised.

#### Hepatic impairment

No specific studies have been carried out in this group of patients. In patients with severe hepatic impairment, a clinically relevant increase of exposure to artemether and lumefantrine and/or their metabolites cannot be ruled out. Therefore caution should be exercised in dosing patients with severe hepatic impairment. In these patients, ECG and blood potassium monitoring is advised. No dose adjustment is recommended for patients with mild to moderate hepatic impairment.

#### Older people

There is no information suggesting that the dosage in patients over 65 years of age should be different than in younger adults.

#### New infections

Data for a limited number of patients in a malaria endemic area show that new infections can be treated with a second course of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG. In the absence of carcinogenicity study data, and due to lack of clinical experience, more than two courses of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG cannot be recommended.

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

Data on safety and efficacy are limited, and Artemether and Lumefantrine Tablet 20 + 120 mg should therefore not be given concurrently with other antimalarials unless there is no other treatment option (see section 4.4).

If Artemether and Lumefantrine Tablet 20 + 120 mg is given following administration of mefloquine or quinine, close monitoring of food intake (for mefloquine) or of the ECG (for quinine) is advised. The long elimination half-life of lumefantrine must be taken into account when administering quinine in patients previously treated with Artemether and Lumefantrine Tablet 20 + 120 mg. In patients previously treated with halofantrine, Artemether and Lumefantrine Tablet 20 + 120 mg should not be administered earlier than one month after the last halofantrine dose (see section 4.4).

#### **Mefloquine**

A drug interaction study with Artemether and Lumefantrine Tablet 20 + 120 mg in man involved administration of a 6-dose regimen over 60 hours in healthy volunteers which was commenced at 12 hours after completion of a 3-dose regimen of mefloquine or placebo. Plasma mefloquine concentrations from the time of addition of Artemether and Lumefantrine Tablet 20 + 120 mg were not affected compared with a group which received mefloquine followed by placebo.

Pre-treatment with mefloquine had no effect on plasma concentrations of artemether or the artemether/dihydroartemisinin ratio but there was a significant reduction in plasma levels of lumefantrine, possibly due to lower absorption secondary to a mefloquine-induced decrease in bile production. Patients should be encouraged to eat at dosing times to compensate for the decrease in bioavailability.

### **Quinine**

A drug interaction study in healthy male volunteers showed that the plasma concentrations of lumefantrine and quinine were not affected when i.v. quinine (10 mg/kg BW over 2 hours) was given sequentially 2 hours after the last (sixth) dose of Artemether and Lumefantrine Tablet 20 + 120 mg (so as to produce concurrent plasma peak levels of lumefantrine and quinine). Plasma concentrations of artemether and dihydroartemisinin (DHA) appeared to be lower. In this study, administration of Artemether and Lumefantrine Tablet 20 + 120 mg to 14 subjects had no effect on QTc interval. Infusion of quinine alone in 14 other subjects caused a transient prolongation of QTc interval, which was consistent with the known cardiotoxicity of quinine. This effect was slightly, but significantly, greater when quinine was infused after Artemether and Lumefantrine Tablet 20 + 120 mg in 14 additional subjects. It would thus appear that the inherent risk of QTc prolongation associated with i.v. quinine was enhanced by prior administration of Artemether and Lumefantrine Tablet 20 + 120 mg.

### **Concomitant use requiring caution**

#### **Interactions affecting the use of Artemether and Lumefantrine Tablet 20 + 120 mg**

##### **Interaction with CYP3A4 inhibitors**

Both artemether and lumefantrine are metabolised predominantly by the cytochrome enzyme CYP3A4, but do not inhibit this enzyme at therapeutic concentrations.

##### **Ketoconazole**

The concurrent oral administration of ketoconazole with Artemether and Lumefantrine Tablet 20 + 120 mg led to a modest increase ( $\leq 2$ -fold) in artemether, DHA, and lumefantrine exposure in healthy adult subjects. This increase in exposure to the antimalarial combination was not associated with increased side effects or changes in electrocardiographic parameters. Based on this study, dose adjustment of Artemether and Lumefantrine Tablet 20 + 120 mg is considered unnecessary in falciparum malaria patients when administered in association with ketoconazole or other potent CYP3A4 inhibitors.

Artemether and Lumefantrine Tablet 20 + 120 mg should be used cautiously with drugs that inhibit CYP3A4 and are contraindicated with drugs which additionally are known to prolong QTc (see Section 4.3 Contraindications), due to potential for increased concentrations of lumefantrine which could lead to QT prolongation.

##### **Interaction with weak to moderate inducers of CYP3A4**

When Artemether and Lumefantrine Tablet 20 + 120 mg is co-administered with moderate inducers of CYP3A4, it may result in decreased concentrations of artemether and/or lumefantrine and loss of antimalarial efficacy (see section 4.4).

##### **Interaction with anti-retroviral drugs such as protease inhibitors and non-nucleoside reverse transcriptase inhibitors**

Both artemether and lumefantrine are metabolized by CYP3A4. ARTs, such as protease inhibitors and non-nucleoside reverse transcriptase inhibitors, are known to have variable patterns of inhibition, induction or competition for CYP3A4.

Artemether and Lumefantrine Tablet 20 + 120 mg should be used cautiously in patients on ARTs since decreased artemether, DHA, and/or lumefantrine concentrations may result in a decrease of antimalarial efficacy of Artemether and Lumefantrine Tablet 20 + 120 mg, and increased lumefantrine concentrations may cause QT prolongation (see Section 4.4).

##### **Lopinavir/ ritonavir**

In a clinical study in healthy volunteers, lopinavir/ritonavir decreased the systemic exposures to artemether and DHA by approximately 40% but increased the exposure to lumefantrine by approximately 2.3- fold. Exposures to lopinavir/ritonavir were not significantly affected by concomitant use of Artemether and Lumefantrine Tablet 20 + 120 mg.

##### **Nevirapine**

In a clinical study in HIV-infected adults, nevirapine significantly reduced the median C<sub>max</sub> and AUC of artemether by approximately 61% and 72%, respectively and reduced the median C<sub>max</sub> and AUC of dihydroartemisinin by approximately 45% and 37%, respectively. Lumefantrine C<sub>max</sub> and AUC were non-significantly reduced by nevirapine. Artemether/lumefantrine reduced the median C<sub>max</sub> and AUC of nevirapine by approximately 43% and 46% respectively.

**Efavirenz**

Efavirenz decreased the exposures to artemether, DHA, and lumefantrine by approximately 50%, 45%, and 20%, respectively. Exposures to efavirenz were not significantly affected by concomitant use of Artemether and Lumefantrine Tablet 20 + 120 mg.

**Interactions resulting in effects of Artemether and Lumefantrine Tablet 20 + 120 mg on other drugs****Interaction with drugs metabolized by CYP450 enzymes**

When Artemether and Lumefantrine Tablet 20 + 120 mg is co-administered with substrates of CYP3A4 it may result in decreased concentrations of the substrate and potential loss of substrate efficacy. Studies in humans have demonstrated that artemisinins have some capacity to induce CYP3A4 and CYP2C19 and inhibit CYP2D6 and CYP1A2. Although the magnitude of the changes was generally low it is possible that these effects could alter the therapeutic response of drugs that are predominantly metabolised by these enzymes (see sections 4.4 and 5.2).

**Interaction with hormonal contraceptives**

In vitro, the metabolism of ethinyl estradiol and levonorgestrel was not induced by artemether, DHA, or lumefantrine. However, artemether has been reported to weakly induce, in humans, the activity of CYP2C19, CYP2B6, and CYP3A.

Therefore, Artemether and Lumefantrine Tablet 20 + 120 mg may potentially reduce the effectiveness of hormonal contraceptives. Patients using oral, transdermal patch, or other systemic hormonal contraceptives should be advised to use an additional nonhormonal method of birth control for about one month (see sections 4.4 and 4.6).

**Drug-food/drink interactions**

Artemether and Lumefantrine Tablet 20 + 120 mg should be taken with food or drinks rich in fat such as milk as the absorption of both artemether and lumefantrine is increased (see Section 4.2).

Grapefruit juice should be used cautiously during Artemether and Lumefantrine Tablet 20 + 120 mg treatment. Administration of artemether with grapefruit juice in healthy adult subjects resulted in an approximately two fold increase in systemic exposure to the parent drug

## **4.6 Pregnancy and Lactation**

**Women of childbearing potential**

Women using oral, transdermal patch, or other systemic hormonal contraceptives should be advised to use an additional non-hormonal method of birth control for about one month (see section 4.4).

**Pregnancy**

A meta-analysis of observational studies including over 500 artemether-lumefantrine exposed women in their first trimester of pregnancy assessed adverse pregnancy outcomes. The data showed that compared to quinine, artemisinin treatment, including artemether-lumefantrine, was not associated with an increased risk of miscarriage, stillbirth or congenital anomalies. However, due to the limitations of these studies, the risk of adverse pregnancy outcomes for artemetherlumefantrine exposed women in early pregnancy cannot be excluded.

Safety data from pregnancy studies including over 1200 pregnant women who were exposed to artemether-lumefantrine during the second or third trimester did not show an increase in adverse pregnancy outcomes or teratogenic effects over background rates.

Studies in animals have shown reproductive toxicity (see section 5.3).

Artemether and Lumefantrine Tablet 20 + 120 mg treatment is not recommended during the first trimester of pregnancy in situations where other suitable and effective antimalarials are available (see section 4.4).

However, it should not be withheld in life-threatening situations, where no other effective antimalarials are available. During the second and third trimester, Artemether and Lumefantrine Tablet 20 + 120 mg treatment should be considered if the expected benefit to the mother outweighs the risk to the foetus.

**Breast-feeding**

Animal data suggest excretion into breast milk but no data are available in humans. Women taking Artemether and Lumefantrine Tablet 20 + 120 mg should not breast-feed during their treatment. Due to the long elimination half-life of lumefantrine (2 to 6 days), it is recommended that breast-feeding should not resume until at least one week after the last dose of Artemether and Lumefantrine Tablet 20 + 120 mg unless potential benefits to the mother and child outweigh the risks of Artemether and Lumefantrine Tablet 20 + 120 mg

treatment.

### Fertility

There is no information on the effects of Artemether and Lumefantrine Tablet 20 + 120 mg on human fertility (see section 5.3).

## 4.8 Effects on ability to drive and use machines

Patients receiving ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG should be warned that dizziness or fatigue/asthenia may occur in which case they should not drive or use machines.

## 4.7 Undesirable effects

The safety of Artemether and Lumefantrine Tablet 20 + 120 mg has been evaluated in 20 clinical trials with more than 3500 patients. A total of 1810 adults and adolescents above 12 years of age as well as 1788 infants and children of 12 years of age and below have received Artemether and Lumefantrine Tablet 20 + 120 mg in clinical trials.

Adverse reactions reported from clinical studies and post-marketing experience are listed below according to system organ class.

Adverse reactions are ranked under headings of frequency using the MedDRA frequency convention:

Very common ( $\geq 1/10$ )

Common ( $\geq 1/100$  to  $<1/10$ )

Uncommon ( $\geq 1/1,000$  to  $<1/100$ )

Rare ( $\geq 1/10,000$  to  $<1/1,000$ )

Very rare ( $<1/10,000$ )

Not known (cannot be estimated from available data).

**Table 1 Frequency of Undesirable effects**

Adults and adolescents above 12 years of age	Infants and children of 12 years of age and below (incidence estimates)	
<b>Blood and lymphatic system disorders</b>		
Delayed haemolytic anaemia#	Not Known	Not Known
<b>Immune system disorders</b>		
Hypersensitivity	Not known	Rare
<b>Metabolism and nutrition disorders</b>		
Decreased appetite	Very common	Very common (16.8 %)
<b>Psychiatric disorders</b>		
Sleep disorders	Very common	Common (6.4 %)
Insomnia	Common	Uncommon
<b>Nervous system disorders</b>		
Headache	Very common	Very common (17.1 %)
Dizziness	Very common	Common (5.5 %)
Paraesthesia	Common	--
Ataxia, hypoaesthesia	Uncommon	--
Somnolence	Uncommon	Uncommon
Clonus	Common	Uncommon
<b>Cardiac disorders</b>		
Palpitations	Very common	Common (1.8 %)
Electrocardiogram QT prolonged	Common	Common (5.3 %)
<b>Respiratory, thoracic and</b>		

<b>mediastinal disorders</b>		
Cough	Common	Very common (22.7 %)
<b>Gastrointestinal disorders</b>		
Vomiting	Very common	Very common (20.2 %)
Abdominal pain	Very common	Very common (12.1 %)
Nausea	Very common	Common (6.5 %)
Diarrhoea	Common	Common (8.4 %)
<b>Hepatobiliary disorders</b>		
Liver function tests increased	Uncommon	Common (4.1 %)
<b>Skin and subcutaneous tissue disorders</b>		
Rash	Common	Common (2.7 %)
Pruritus	Common	Uncommon
Urticaria	Uncommon	Uncommon
Angioedema*	Not known	Not known
<b>Musculoskeletal and connective tissue disorders</b>		
Arthralgia	Very common	Common (2.1 %)
Myalgia	Very common	Common (2.2 %)
<b>General disorders and administration site conditions</b>		
Asthenia	Very common	Common (5.2 %)
Fatigue	Very common	Common (9.2 %)
Gait disturbance	Common	--

\*: These adverse reactions were reported during post-marketing experience. Because these spontaneously reported events are from a population of uncertain size, it is difficult to estimate their frequency.

#

: Has been reported up to a few weeks after treatment has been stopped.

#### 4.8 Overdose

In cases of suspected overdosage symptomatic and supportive therapy should be given as appropriate, which should include ECG and blood potassium monitoring.

### 5. PHARMACOLOGICAL PROPERTIES

#### 5.1 Pharmacodynamics properties

Pharmacotherapeutic group: antimalarials,

ATC code: P01 BF01

##### Pharmacodynamic effects

ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG comprises a fixed ratio of 1:6 parts of artemether and lumefantrine, respectively. The site of antiparasitic action of both components is the food vacuole of the malarial parasite, where they are thought to interfere with the conversion of haem, a toxic intermediate produced during haemoglobin breakdown, to the nontoxic haemozoin, malaria pigment. Lumefantrine is thought to interfere with the polymerisation process, while artemether generates reactive metabolites as a result of the interaction between its peroxide bridge and haem iron. Both artemether and lumefantrine have a secondary action involving inhibition of nucleic acid- and protein



synthesis within the malarial parasite. ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG has been reported to have potent activity in terms of clearing gametocytes.

By 2015, resistance to artemisinins emerged in Southeast Asia. Studies with ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG in this region showed delayed parasite clearance (manifested as a higher proportion of patients with parasitemia on Day 3 after initiation of treatment), although overall efficacy as measured by cure rates after 28 days, remained high (WHO 2014). In Africa, only isolated reports on delayed parasite clearance are available and a clear trend towards resistance development was not observed.

#### Treatment of Acute Uncomplicated *P. falciparum* Malaria

The efficacy of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG Tablets was evaluated for the treatment of acute, uncomplicated malaria (defined as symptomatic *P. falciparum* malaria without signs and symptoms of severe malaria or evidence of vital organ dysfunction) in five 6-dose regimen studies and one study comparing the 6-dose regimen with the 4-dose regimen. Baseline parasite density ranged from 500/μl - 200,000/μl (0.01% to 4% parasitemia) in the majority of patients. Studies were conducted in otherwise healthy, partially immune or non-immune adults and children (≥5kg body weight) with uncomplicated malaria in Thailand, sub-Saharan Africa, Europe, and South America.

## **5.2 Pharmacokinetic properties**

Pharmacokinetic characterisation of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG is limited by the lack of an intravenous formulation, and the very high inter- and intra-subject variability of artemether and lumefantrine plasma concentrations and derived pharmacokinetic parameters (AUC, C<sub>max</sub>).

### Absorption

Artemether is absorbed fairly rapidly and dihydroartemisinin, the active metabolite of artemether, appears rapidly in the systemic circulation with peak plasma concentrations of both compounds reached about 2 hours after dosing. Mean C<sub>max</sub> and AUC values of artemether ranged between 60.0–104 ng/ml and 146–338 ng·h/ml, respectively, in fed healthy adults after a single dose of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG, 80 mg artemether/480 mg lumefantrine. Mean C<sub>max</sub> and AUC values of dihydroartemisinin ranged between 49.7–104 ng/mL and 169–308 ng·h/ml, respectively. Absorption of lumefantrine, a highly lipophilic compound, starts after a lag-time of up to 2 hours, with peak plasma concentration (mean between 5.10–9.80 μg/ml) about 6–8 hours after dosing. Mean AUC values of lumefantrine ranged between 108 and 243 μg·h/ml. Food enhances the absorption of both artemether and lumefantrine: in healthy volunteers the relative bioavailability of artemether was increased more than two-fold, and that of lumefantrine sixteen-fold compared with fasted conditions when ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG was taken after a high-fat meal.

Food has also been shown to increase the absorption of lumefantrine in patients with malaria, although to a lesser extent (approximately two-fold), most probably due to the lower fat content of the food ingested by acutely ill patients. The food interaction data indicate that absorption of lumefantrine under fasted conditions is very poor (assuming 100% absorption after a high-fat meal, the amount absorbed under fasted conditions would be <10% of the dose). Patients should therefore be encouraged to take the medication with a normal diet as soon as food can be tolerated.

### Distribution

Artemether and lumefantrine are both highly bound to human serum proteins *in vitro* (95.4% and 99.7%, respectively). Dihydroartemisinin is also bound to human serum proteins (47–76%).

### Biotransformation

Artemether is rapidly and extensively metabolised (substantial first-pass metabolism) both *in vitro* and in humans. Human liver microsomes metabolise artemether to the biologically active main metabolite dihydroartemisinin (demethylation), predominantly through the isoenzyme CYP3A4/5. This metabolite has also been detected in humans *in vivo*.

Glucuronidation of dihydroartemisinin is predominately catalysed by UGT1A9 and UGT2B7.

Dihydroartemisinin is further converted to inactive metabolites.

The pharmacokinetics of artemether in adults is time-dependent. During repeated administration of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG, plasma artemether levels decreased significantly, while levels of the active metabolite (dihydroartemisinin) increased, although not to a statistically significant degree. The ratio of day 3/day 1 AUC for artemether was between 0.19 and 0.44, and was between 1.06 and 2.50 for dihydroartemisinin. This suggests that there was induction of the enzyme responsible for the metabolism of artemether. Artemether and dihydroartemisinin were reported to have a mild inducing effect on CYP3A4 activity. The clinical evidence of induction is consistent with the *in vitro* data described in section 4.5

Lumefantrine is N-debutylated, mainly by CYP3A4, in human liver microsomes. *In vivo* in animals (dogs and rats), glucuronidation of lumefantrine takes place directly and after oxidative biotransformation. In humans, the exposure to lumefantrine increases with repeated administration of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG over the 3-day treatment period, consistent with the slow elimination of the compound (see section 5.2 Elimination). Systemic exposure to the metabolite desbutyl-lumefantrine, for which the *in vitro* antiparasitic effect is 5 to 8 fold higher than that for lumefantrine, was less than 1% of the exposure to the parent drug. Desbutyl-lumefantrine data is not available specifically for an African population. *In vitro*, lumefantrine significantly inhibits the activity of CYP2D6 at therapeutic plasma concentrations (see sections 4.3 and 4.5).

### Elimination

Artemether and dihydroartemisinin are rapidly cleared from plasma with a terminal half-life of about 2 hours. Lumefantrine is eliminated very slowly with an elimination half-life of 2 to 6 days. Demographic characteristics such as sex and weight appear to have no clinically relevant effects on the pharmacokinetics of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG.

Limited urinary excretion data are available for humans. In 16 healthy volunteers, neither lumefantrine nor artemether was found in urine after administration of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG, and only traces of dihydroartemisinin were detected (urinary excretion of dihydroartemisinin amounted to less than 0.01% of the artemether dose).

In animals (rats and dogs), no unchanged artemether was detected in faeces and urine due to its rapid and extensive first-pass metabolism, but numerous metabolites (partly identified) have been detected in faeces, bile and urine. Lumefantrine was excreted unchanged in faeces and with traces only in urine. Metabolites of lumefantrine were eliminated in bile/faeces.

### Dose proportionality

No specific dose proportionality studies were performed. Limited data suggest a dose-proportional increase of systemic exposure to lumefantrine when doubling the ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG dose. No conclusive data is available for artemether.

### Bioavailability/bioequivalence studies

Systemic exposure to lumefantrine, artemether and dihydroartemisinin was similar following administration of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG as dispersible tablets and crushed tablets in healthy adults.

Systemic exposure to lumefantrine was similar following administration of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG dispersible tablets and intact tablets in healthy adults. However, exposure to artemether and dihydroartemisinin was significantly lower (by 20-35%) for the dispersible than for the intact tablet. These findings are not considered to be clinically relevant for the use of the dispersible tablets in the paediatric population since adequate efficacy of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG dispersible tablets was demonstrated in this population. The dispersible tablet is not recommended for use in adults.

### Older people

No specific pharmacokinetic studies have been performed in elderly patients. However, there is no information suggesting that the dosage in patients over 65 years of age should be different than in younger adults.

### Paediatric population

In paediatric malaria patients, mean  $C_{max}$  (CV%) of artemether (observed after first dose of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG) were 223 (139%), 198 (90%) and 174 ng/ml (83%) for body weight groups 5-<15, 15-<25 and 25-<35 kg, respectively, compared to 186 ng/ml (67%) in adult malaria patients. The associated mean  $C_{max}$  of DHA were 54.7 (108%), 79.8 (101%) and 65.3 ng/mL (36%), respectively compared to 101 ng/ml (57%) in adult malaria patients. AUC of lumefantrine (population mean, covering the six doses of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG) were 577, 699 and 1150  $\mu\text{g}\cdot\text{h}/\text{ml}$  for paediatric malaria patients in body weight groups 5-<15, 15-<25 and 25-<35 kg, respectively, compared to a mean AUC of 758  $\mu\text{g}\cdot\text{h}/\text{ml}$  (87%) in adult malaria patients. The elimination half-lives of artemether and lumefantrine in children are unknown.

### Infants weighing <5 kg

Study B2306 (see section 5.1) showed that the  $C_{max}$  of artemether and DHA in infants with uncomplicated *P. falciparum* malaria weighing <5 kg and older than 28 days of age who were treated with artemether/lumefantrine dispersible tablets, was on average 2- to 3-fold higher than that in pediatric patients with a body weight  $\geq 5$  kg and children up to 12 years of age treated with the same dose of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG tablets. The mean  $C_{max}$  of lumefantrine was similar to that observed in pediatric patients with a body weight  $\geq 5$  kg.

### Race/Ethnicity

Pharmacokinetics of artemether, DHA and lumefantrine in the Japanese population was found to be consistent with other populations.

### Hepatic and Renal impairment

No specific pharmacokinetic studies have been performed either in patients with hepatic or renal insufficiency or elderly patients. The primary clearance mechanism of both artemether and lumefantrine may be affected in patients with hepatic impairment. In patients with severe hepatic impairment, a clinically significant increase of exposure to artemether and lumefantrine and/or their metabolites cannot be ruled out. Therefore, caution should be exercised in dosing patients with severe hepatic impairment. Based on the pharmacokinetic data in 16 healthy subjects showing no or insignificant renal excretion of lumefantrine, artemether and dihydroartemisinin, no dose adjustment for the use of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG in patients with renal impairment is advised.

### **5.3 Preclinical safety data**

#### General toxicity

The main changes observed in repeat-dose toxicity studies were associated with the expected pharmacological action on erythrocytes, accompanied by responsive secondary haematopoiesis.

#### Neurotoxicity

Studies in dogs and rats have shown that intramuscular injections of artemether resulted in brain lesions. Changes observed mainly in brainstem nuclei included chromatolysis, eosinophilic cytoplasmic granulation, spheroids, apoptosis and dark neurons. Lesions were observed in rats dosed for at least 7 days and dogs for at least 8 days, but lesions were not observed after shorter intramuscular treatment courses or after oral dosing. The estimated artemether 24 h AUC after 7 days of dosing at the no observed effect level is approximately 7-fold greater or more than the estimated artemether 24 h AUC in adult humans. The hearing threshold was affected at 20 dB by oral artemether administration to dogs at a dose of about 29 times the highest artemether clinical dose (160 mg/day) based on body surface area comparisons. Most nervous system disorder adverse events in the studies of the 6-dose regimen were mild in intensity and resolved by the end of the study.

#### Mutagenicity

Artemether and lumefantrine were not genotoxic/clastogenic based on *in vitro* and *in vivo* testing.

#### Carcinogenicity

Carcinogenicity studies were not conducted.

#### Reproductive toxicity studies

Embryotoxicity was observed in rat and rabbit reproductive toxicity studies conducted with artemether, a derivative of artemisinin. Artemisinins are known to be embryotoxic. Lumefantrine alone caused no sign of reproductive or development toxicity at doses up to 1,000 mg/kg/day in rats and rabbits, doses which are at least 10 times higher than the daily human dose based on body surface area comparisons.

Reproductive toxicity studies performed with the artemether-lumefantrine combination caused maternal toxicity and increased post-implantation loss in rats and rabbits.

Artemether caused increases in post-implantation loss and teratogenicity (characterised as a low incidence of cardiovascular and skeletal malformations) in rats and rabbits. The embryotoxic artemether dose in the rat yields artemether and dihydroartemisinin exposures similar to those achieved in humans based on AUC.

### Fertility

Artemether-lumefantrine administration yielded altered sperm motility, abnormal sperm, reduced epididymal sperm count, increased testes weight, and embryotoxicity; other reproductive effects (decreased implants and viable embryos, increased preimplantation loss) were also observed. The no adverse effect level for fertility was 300 mg/kg/day. The relevance to this finding in humans is unknown.

### Juvenile toxicity studies

A study investigated the neurotoxicity of oral artemether in juvenile rats. Mortality, clinical signs and reductions in body weight parameters occurred most notably in younger rats. Despite the systemic toxicity noted, there were no effects of artemether on any of the functional tests performed and there was no evidence of a direct neurotoxic effect in juvenile rats.

Very young animals are more sensitive to the toxic effect of artemether than adult animals. There is no difference in sensitivity in slightly older animals compared to adult animals. Clinical studies have established the safety of artemether and lumefantrine administration in patients weighing 5 kg and above.

### Cardiovascular Safety Pharmacology

In toxicity studies in dogs at doses  $\geq 600$  mg/kg/day, there was some evidence of prolongation of the QTc interval (safety margin of 1.3-fold to 2.2-fold for artemether using calculated free C<sub>max</sub>), at higher doses than intended for use in man. In vitro hERG assays showed a safety margin of  $>100$  for artemether and dihydroartemisinin. The hERG IC<sub>50</sub> was 8.1  $\mu$ M for lumefantrine and 5.5  $\mu$ M for its desbutyl metabolite.

## **6. PHARMACEUTICAL PARTICULARS**

### **6.1 List of excipients**

Microcrystalline Cellulose BP, Maize Starch BP, Sodium lauryl Sulphate USP, Sodium Starch Glycolate USP, Colloidal Silicon Dioxide BP, Cross Carmellose sodium, Magnesium Stearate BP, Purified Water BP are used as excipients in the manufacturing process of ARTEMETHER AND LUMEFANTRINE TABLETS 80 MG/480 MG

### **6.2 Incompatibilities**

Not applicable.

### **6.3 Shelf life**

24 Month

### **6.4 Special precautions for storage**

Store below 30°C. Protect from light and moisture.

### **6.5 Nature and contents of container <and special equipment for use, administration or implantation**

1 X 6 TABLET ALUMINIUM/ AMBER PVDC BLISTER PACK

#### **6.6 Special precautions for disposal**

No special requirements

#### **7. APPLICANT**

**M/S. LIFE THREADS LTD..**

C/O Pharmacist C. J. Nnamani, # 1, West Road 1, Off Nnamdi Azikiwe Avenue, Trans-Ekulu,  
Enugu Nigeria

#### **8. DRUG PRODUCT MANUFACTURER**

**CIRON DRUGS & PHARMACEUTICALS PVT. LTD.**

C- 1101/1102, Lotus Corporate Park, Graham Firth Steel Compound,  
Jay Coach Junction, Western Express Highway, Goregaon (East) Mumbai,  
Maharashtra, India – 400063

Tel: +91-22-62748000

Fax: +91-22-26780784

E Mail: mail@cionpharma.com

Website: www.cironpharma.com

#### **9. NAFDAC REGISTRATION NUMBER**

C4-0237