

# AUSTRALIAN PRODUCT INFORMATION

## ATARIS 10mg, 20mg Film Coated Tablets

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### 1. NAME OF THE MEDICINE

Leflunomide

### 2. QUALITATIVE AND QUANTITATIVE COMPOSITION

Leflunomide is a white to off white powder, practically insoluble in water and freely soluble in methanol, ethanol or acetone and sparingly soluble in methylene chloride.

ATARIS 10 mg and 20 mg tablets contain sugars (as lactose).

For the full list of excipients, see Section 6.1 List of excipients.

### 3. PHARMACEUTICAL FORM

**ATARIS 10 Tablets:** film coated - 10 mg: white, round biconvex tablets

**ATARIS 20 Tablets:** film coated - 20 mg: yellow, round biconvex tablets with a scoreline on one side

### 4. CLINICAL PARTICULARS

#### 4.1. THERAPEUTIC INDICATIONS

Treatment of active rheumatoid arthritis.

Treatment of active psoriatic arthritis.

Leflunomide is not indicated for the treatment of psoriasis that is not associated with manifestations of arthritic disease.

The combined use of leflunomide with other disease modifying antirheumatic drugs (DMARDs) has not been adequately studied (see Section 4.4 SPECIAL WARNING AND PRECAUTIONS FOR USE).

#### 4.2. DOSE AND METHOD OF ADMINISTRATION

##### Rheumatoid arthritis and psoriatic arthritis

###### Loading dose

ATARIS therapy is started with a loading dose of 100 mg once daily for three days. Avoiding a loading dose may decrease the risk of adverse events if ATARIS is used in combination with methotrexate. This could be especially important for patients at increased risk of haematological or hepatic toxicity, e.g. those receiving concomitant treatment with methotrexate or other immunosuppressive agents or on such medications in the recent past. (See Section 4.4 SPECIAL WARNING AND PRECAUTIONS FOR USE).

###### Maintenance dose

The recommended maintenance dose for rheumatoid arthritis is leflunomide 20 mg once daily. Doses higher than 20 mg/day are not recommended. If dosing at 20 mg/day is not well tolerated, the dose may be decreased to 10 mg daily. The recommended maintenance dose for psoriatic arthritis is 20 mg once daily.

Liver enzymes and haematological parameters must be monitored and dose adjustments or discontinuation may be necessary (see Section 4.4 SPECIAL WARNING AND PRECAUTIONS FOR USE). Due to the prolonged half-life of the active metabolite of leflunomide, patients should be carefully observed after dose reduction since it may take several weeks for metabolite levels to decline.

ATARIS tablets should be swallowed whole with sufficient liquid. Absorption of ATARIS is not affected if it is taken with food.

An improvement in the patient's rheumatoid condition may begin as early as four weeks after starting therapy with ATARIS, however, there may be further improvement in the condition after four to six months of treatment.

At present there is not enough experience available to make dosage recommendations for patients with a serum creatinine concentration of > 133 micromol/L (1.5 mg/dL).

No dosage adjustment is required in the elderly.

#### **Compatibility with other antirheumatic drugs**

If the patient is already receiving NSAIDs and/or low dose corticosteroids, these may be continued after starting ATARIS.

See Section 4.4 SPECIAL WARNING AND PRECAUTIONS FOR USE for information about coadministration with methotrexate and other hepatotoxic and haematotoxic drugs.

### **4.3. CONTRAINDICATIONS**

Patients with hypersensitivity to leflunomide or to any of the excipients in the tablets.

Patients with severe immunodeficiency states, e.g. acquired immunodeficiency syndrome (AIDS).

Patients with significantly impaired bone marrow function or significant anaemia, leucopenia or thrombocytopenia due to causes other than rheumatoid arthritis or psoriatic arthritis.

Patients with severe, uncontrolled infections. Patients with impairment of liver function.

Pregnant women.

Women of childbearing potential who are not using reliable contraception during treatment with leflunomide and for a certain period of time thereafter, as long as the plasma levels of the active metabolite are above 0.02 mg/L, unless undergoing washout treatment (see Section 4.6 FERTILITY, PREGNANCY AND LACTATION).

Women who are breastfeeding. Patients with severe hypoproteinaemia.

Patients who have or have had Stevens-Johnson syndrome, toxic epidermal necrolysis or erythema multiforme.

### **4.4. SPECIAL WARNING AND PRECAUTIONS FOR USE**

#### **Concomitant use with hepatotoxic and haematotoxic agents**

Increased monitoring frequency is advised when leflunomide is used in combination with other hepatotoxic and haematotoxic agents (see Section 4.5 INTERACTIONS WITH OTHER MEDICINES AND OTHER FORMS OF INTERACTIONS). Pancytopenia is a rare event, which has been reported with leflunomide, with a fatal outcome in isolated cases. These events have been reported most frequently in cases of recent, concomitant or subsequent use of potentially myelotoxic/haematotoxic agents, such as methotrexate. (The incidence of pancytopenia associated with methotrexate alone is reported in published literature to be between 0.6 and 2.1 %.) If the patient has any evidence of pancytopenia on routine haematological monitoring, stop leflunomide, commence washout procedure and continue close haematological monitoring until confirmed resolution (see Section. 4.9 OVERDOSE).

Concomitant treatment with methotrexate and/or other hepatotoxic medications is associated with an increased risk of serious hepatic reactions. To minimise the risk of serious adverse reactions, it is essential that all monitoring recommendations are strictly adhered to. Due to the prolonged half-life of A771726 (usually one to four weeks), adverse reactions may occur or persist even after leflunomide administration has been discontinued (see Section 4.8 ADVERSE EFFECTS (UNDESIRABLE EFFECTS)). If a severe adverse reaction to leflunomide occurs, or if for any reason A771726 needs to be cleared rapidly from the body, colestyramine or charcoal has to be initiated as described in Section 4.9 OVERDOSE and continued/repeated as clinically necessary. For suspected severe immunological/ allergic reactions, more prolonged colestyramine or charcoal administration may be necessary to achieve rapid and sufficient clearance. Washout procedures must be performed in circumstances when serious effects occur (e.g. hepatotoxicity, haematotoxicity or allergic reactions), in the case of desired or unintended pregnancy and if for any other reason A771726 needs to be cleared rapidly from the body.

### **Haematological monitoring**

A complete blood cell count including differential white blood cell count and platelets should be performed in all patients before the start of leflunomide treatment and monthly for the first six months, followed by every six to eight weeks thereafter. If used with concomitant methotrexate and/or other potential immunosuppressives, chronic monitoring should be monthly.

In patients with pre-existing anaemia, leucopenia and/or thrombocytopenia as well as in patients with impaired bone marrow function or those at risk of bone marrow suppression, the risk for occurrence of haematological reactions is increased.

### **Use in hepatic impairment**

In clinical trials, leflunomide treatment was associated with elevations of liver function tests, primarily alanine aminotransferase (ALT) and aspartate aminotransferase (AST). These effects were generally reversible. Most transaminase elevations were mild (less than or equal to 2 x upper limit of normal (ULN)) and usually resolved while continuing treatment. Clinically significant elevations (> 2 and less than or equal to 3 x ULN) were less common and were generally asymptomatic and reversible with dose reduction or, if persistent, discontinuation of leflunomide.

More marked elevations (> 3 x ULN) occurred rarely and usually reversed with dose reduction; persistent elevations resolved after discontinuation of leflunomide. Overall, persistent elevations after dose reduction were uncommon and were usually associated with concomitant NSAID use. Biopsy data did not suggest that leflunomide was associated with the development of cirrhosis or hepatic fibrosis.

Very rare cases of severe liver injury, with fatal outcome in isolated cases, have been reported during treatment with leflunomide. Most of the cases occurred within the first six months of treatment. Although confounding factors were present in many cases, a causal relationship to leflunomide cannot be excluded. It is considered essential that monitoring recommendations are strictly adhered to. (See Section 4.4 SPECIAL WARNING AND PRECAUTIONS FOR USE).

In the US4001 combination study of leflunomide in patients with persistent active rheumatoid arthritis receiving stable background methotrexate for at least six months without liver enzyme elevation (n = 263), 226 patients received up to 48 weeks the addition of leflunomide to methotrexate therapy. In this study, patients with inadequate response to a stable dose of methotrexate for six months were administered leflunomide with a loading dose of one 100 mg tablet daily for two days and thereafter, patients received a maintenance dose of 10 mg daily. These doses are both lower than the recommended initial dose of monotherapy with leflunomide. If dosing at 10 mg/day was not well tolerated clinically, the dose was decreased to leflunomide 10 mg every other day. If the 10 mg daily dose was tolerated, but disease activity persisted at eight weeks or thereafter, the dose of leflunomide was increased to a maximum of 20 mg daily. In the six month placebo controlled study phase the incidence of ALT elevations > threefold ULN on

leflunomide added to methotrexate therapy was 3.8 versus 0.8% when placebo was added to methotrexate. (The incidence of > threefold ULN ALT elevations for leflunomide monotherapy in study US301, MN301 and MN302 was 1.5 to 4.4%.) ALT elevations > twofold ULN reversed to less than or equal to twofold ULN and normalised to < 1.2-fold ULN with leflunomide dose reduction or discontinuation. Milder elevations of > 1.2 to < twofold ULN normalised without change in leflunomide dose in most cases, although a minority normalised after dose reduction or discontinuation.

### **Liver function monitoring**

ALT and AST must be checked before the start of leflunomide treatment and monitored at monthly or more frequent intervals for at least the first six months and then, if stable, every six to eight weeks thereafter. In addition, if leflunomide and methotrexate are given concomitantly, ALT, AST and serum albumin testing must be performed monthly. For confirmed ALT or AST elevations between two and threefold the ULN, dose reduction may allow continued administration of leflunomide under close monitoring. For minor elevations in ALT or AST (< twofold ULN), repeat testing in two to four weeks. For moderate elevations in ALT or AST (> twofold but < threefold ULN), closely monitor, with LFTs every two to four weeks and dosage reduction. If ALT or AST elevations between two and threefold ULN persist or if ALT or AST elevations of more than threefold ULN are present, leflunomide should be discontinued. Colestyramine or activated charcoal should be administered to more rapidly lower A771726 levels, with close monitoring including retreatment with colestyramine or activated charcoal as indicated.

### **Peripheral neuropathy**

Peripheral neuropathy has been reported rarely in patients receiving leflunomide. Most patients recovered after discontinuation of leflunomide, but some patients had persistent symptoms. For patients older than 60 years, concomitant neurotoxic medications and diabetes may increase the risk for peripheral neuropathy. If a patient taking leflunomide develops a peripheral neuropathy, consider discontinuing leflunomide therapy and perform wash-out procedure (see Section 4.9 OVERDOSE).

### **Infections**

It is known that medications with immunosuppressive properties may cause patients to be more susceptible to infections, including opportunistic infections, and these may be more severe in nature. Infections may, therefore, require early and vigorous treatment. In the event that severe, uncontrolled infections occur, it may be necessary to stop leflunomide and administer a washout with colestyramine (see Section 4.9 OVERDOSE).

Rare cases of Progressive Multifocal Leukoencephalopathy (PML) have been reported in patients receiving leflunomide among other suppressants.

Before starting treatment, all patients should be evaluated for active and inactive (“latent”) tuberculosis, as per local recommendations.

Patients with a history of tuberculosis should be carefully monitored because of the possibility of reactivation of the infection.

### **Respiratory**

Interstitial lung disease has been reported rarely during treatment with leflunomide (see Section 4.8 ADVERSE EFFECTS (UNDESIRABLE EFFECTS)). Interstitial lung disease is a potentially fatal disorder, which may occur acutely during therapy. Pulmonary symptoms, such as cough and dyspnoea, may be a reason for further investigation. Discontinuation of the therapy and implementation of a washout with colestyramine (see Section 4.9 OVERDOSE) may be appropriate. Patients should be informed about the early warning signs of interstitial lung disease and asked to contact their physician as soon as possible if these symptoms appear or worsen during therapy.

### **Immunosuppression**

Although there is no clinical experience in the following patient populations, leflunomide is not recommended for patients with severe immunodeficiency, bone marrow dysplasia or severe uncontrolled infections because of the theoretical potential for immunosuppression. In the event that a serious infection occurs, it may be necessary to interrupt therapy with leflunomide and administer colestyramine or charcoal (see Section 4.9 OVERDOSE). Rarely, severe infections including sepsis, which may be fatal, have been reported in patients receiving leflunomide. Most of the reports were confounded by concomitant immunosuppressant therapy and/or comorbid illness which, in addition to rheumatoid disease, may predispose patients to infection.

In postmarketing experience, there have been reports of pancytopenia (rare), agranulocytosis (very rare) and thrombocytopenia (rare) in patients receiving leflunomide (see Section 4.4 SPECIAL WARNING AND PRECAUTIONS FOR USE). In most of these cases, patients received concomitant treatment with methotrexate or other immunosuppressive agents or they had recently discontinued these therapies. Some cases had a prior history of significant haematological abnormality. If leflunomide is used in such patients, it should be done with caution and with frequent haematological monitoring (see Section 4.4 SPECIAL WARNING AND PRECAUTIONS FOR USE). The use of leflunomide in combination therapy with methotrexate has not been adequately studied in a controlled setting.

If evidence of bone marrow suppression occurs in a patient taking leflunomide, treatment with leflunomide should be stopped and colestyramine or charcoal should be used to reduce the plasma concentration of leflunomide (see Section 4.9 OVERDOSE).

In any situation in which the decision is made to switch from leflunomide to another antirheumatic agent with a known potential for haematological suppression, it would be prudent to monitor for haematological toxicity, because there will be overlap of systemic exposure to both compounds. Leflunomide washout with colestyramine or charcoal may decrease this risk, but also may induce disease worsening if the patient had been responding to leflunomide treatment.

In dogs treated with leflunomide, a delayed healing of accidental cornea lesions was observed. This effect may be attributed to the immunosuppressive effect of leflunomide. Its clinical relevance is, however, unclear.

Patients with tuberculin reactivity must be carefully monitored because of the risk of tuberculosis reactivation.

### **Antigenicity**

Leflunomide was not antigenic in the active systemic and passive cutaneous anaphylaxis test in guinea pigs and was devoid of sensitising properties.

### **Blood pressure monitoring**

Blood pressure should be checked before the start of leflunomide treatment and periodically thereafter.

### **Skin reactions**

In case of ulcerative stomatitis, leflunomide administration should be discontinued. Cases of Stevens-Johnson syndrome, toxic epidermal necrolysis and drug reaction with eosinophilia and symptoms have been reported in patients treated with leflunomide. As soon as skin and/or mucosal reactions are observed which raise the suspicion of such severe reactions, leflunomide and any other possible associated medication must be discontinued, and colestyramine or charcoal should be used immediately to reduce the plasma concentration of leflunomide (see Section 4.9. OVERDOSE). A complete washout is essential in such cases. In such cases re-exposure to leflunomide is contraindicated.

### **Use in hepatic impairment**

See Section 5.2 PHARMACOKINETIC PROPERTIES- HEPATIC IMPAIRMENT.

**Use in renal impairment**

Leflunomide was administered as a single oral 100 mg dose to three haemodialysis patients and three patients on continuous peritoneal dialysis (CAPD). The pharmacokinetics of A771726 in CAPD subjects appeared to be similar to healthy volunteers. A more rapid elimination of A771726 was observed in haemodialysis subjects which was not due to extraction of drug in the dialysate but instead to displacement of protein binding. Caution should be used when leflunomide is administered to patients with renal impairment (see Section 5.2 PHARMACOKINETIC PROPERTIES).

**Use in the elderly**

Leflunomide should be used with caution in patients over 75 years as its safety and efficacy have not been studied in this age group.

**Paediatric use**

The safety and effectiveness of leflunomide in paediatric patients have not been fully evaluated. Leflunomide is not recommended for use in patients under 18 years (see Section 5.2 PHARMACOKINETIC PROPERTIES).

**Effects on Laboratory Tests**

See Section 4.4 SPECIAL WARNING AND PRECAUTIONS FOR USE.

**4.5. INTERACTIONS WITH OTHER MEDICINES AND OTHER FORMS OF INTERACTIONS**

The enzymes involved in the metabolism of leflunomide and its metabolites are not precisely known. *In vitro* studies indicate that A771726 inhibits cytochrome P450 2C9 (CYP2C9) activity. Caution is advised when leflunomide is given together with drugs, other than NSAIDs, metabolised by CYP2C9, such as phenytoin, warfarin and tolbutamide (see below). The extensive protein binding of A771726 could lead to displacement of other highly bound drugs.

**Cimetidine**

An *in vivo* interaction study with cimetidine (nonspecific cytochrome P450 inhibitor) has demonstrated a lack of a significant interaction.

**Rifampicin**

Following concomitant administration of a single dose of leflunomide to subjects receiving multiple doses of rifampicin (nonspecific cytochrome P450 inducer) A771726 peak levels were increased by approximately 40%, whereas the area under the curve was not significantly changed. The mechanism of this effect is unclear.

Because of the potential for A771726 levels to continue to increase with multiple dosing, caution should be exercised if patients are to be receiving both leflunomide and rifampicin.

**Warfarin**

Increased prothrombin time when leflunomide and warfarin were coadministered has been rarely reported. *In vitro* plasma protein binding interaction studies with warfarin at clinically relevant concentrations showed no interaction. This does not exclude the possibility of an interaction by other means, such as inhibition of drug metabolism.

This has not been studied.

Repeated doses of A771726 had no effect on the pharmacokinetics of S-warfarin, indicating that A771726 is not an inhibitor or an inducer of CYP2C9. However, a decrease in peak international normalised ratio (INR) was observed when A771726 was co-administered with warfarin as compared with warfarin alone. Therefore, when warfarin is co-administered, close INR follow-up and monitoring is recommended.

### **Nonsteroidal anti-inflammatory drugs (NSAIDs)**

NSAIDs (including COX-2 inhibitors) are known to cause hepatotoxicity, therefore caution is advised when leflunomide is used concomitantly (see Section 4.4 SPECIAL WARNING AND PRECAUTIONS FOR USE). Studies showed that ibuprofen and diclofenac did not displace A771726. A771726 displaced ibuprofen and diclofenac and the unbound fraction of these drugs was increased by 10 to 50%. In clinical trials, no safety problems were observed when leflunomide and NSAIDs metabolised by CYP2C9 were coadministered.

### **Tolbutamide**

In *in vitro* studies, A771726 was shown to cause increases ranging from 13 to 50% in the free fraction of tolbutamide at concentrations in the clinical range. The clinical significance of this finding is unknown. The unbound fraction of A771726 was increased two to threefold in the presence of tolbutamide.

### **Methotrexate**

In a small (n = 30) combination study of leflunomide (10 to 20 mg/day) with methotrexate (10 to 25 mg/week) coadministration increased the risk of hepatotoxicity. Baseline disease characteristics reflect a patient population with active RA (average tender and swollen joint count of 16) and longstanding disease (mean duration 13.6 years). No pharmacokinetic interaction was identified. A greater than threefold increase in liver enzymes was seen in five patients. All of these increases resolved, two with continuation of both drugs and three after discontinuation of leflunomide. A two to threefold increase was seen in an additional five patients.

All elevations resolved, two with continuation of both drugs and three after discontinuation of leflunomide. Three patients met ACR criteria for liver biopsy (1: Roegnik grade I; 2: Roegnik grade IIIa). (See Section 4.4 SPECIAL WARNING AND PRECAUTIONS FOR USE).

### **Hepatotoxic and haematotoxic drugs**

Increased side effects may occur when leflunomide is given concomitantly with hepatotoxic or haematotoxic drugs or when leflunomide treatment is followed by such drugs without a washout period. The possibility of additive risks of side effects may persist for a long time after switching treatments. Therefore, the initiation of leflunomide treatment has to be carefully considered given these benefit/risk aspects.

Due to a potential for additive hepatotoxic effects, it is recommended that excessive alcohol consumption is avoided during treatment with leflunomide.

### **Tri-Phasic Oral contraceptives**

When leflunomide was administered concomitantly with a low dose oral tri-phasic contraceptive to healthy female volunteers, there was no effect on either the anti-ovulatory activity of the contraceptive or the pharmacokinetics of A771726.

### **Effect on Oral Contraceptive (0.03 mg ethinylestradiol and 0.15 mg levonorgestrel)**

There was an increase in mean ethinylestradiol  $C_{max}$  and  $AUC_{0-24}$  and levonorgestrel  $C_{max}$  and  $AUC_{0-24}$  following repeated doses of A771726. While this interaction is not expected to adversely impact the efficacy of oral contraceptives, consideration should be given to the type oral contraceptive treatment.

### **Vaccinations**

No clinical data are available on the efficacy and safety of vaccinations under leflunomide treatment. Vaccination with live vaccines is, however, not recommended. A live vaccine should only be given after a period of at least six months has elapsed after stopping leflunomide.

### **Colestyramine and activated charcoal**

It is recommended that patients receiving leflunomide are not treated with colestyramine or activated charcoal because this leads to a rapid and significant decrease in plasma A771726 (the active metabolite of

leflunomide) concentration. The mechanism is thought to be by interruption of enterohepatic recycling and/or gastrointestinal dialysis of A771726.

### **Pharmacokinetic and Pharmacodynamics Interactions**

The following pharmacokinetic and pharmacodynamic interaction studies were conducted with A771726 (principal active metabolite of leflunomide). As similar drug-drug interactions cannot be excluded from leflunomide at recommended doses, the following recommendations should be considered in patients treated with leflunomide:

#### *Effect on Repaglinide (CYP2C8 substrate)*

There was an increase in mean repaglinide  $C_{max}$  and AUC following repeated doses of A771726, suggesting that A771726 is an inhibitor of CYP2C8 *in vivo*. Therefore, monitoring patients with concomitant use of drugs metabolised by CYP2C8, such as repaglinide, paclitaxel, pioglitazone or rosiglitazone, is recommended as they may have higher exposure.

#### *Effect on Caffeine (CYP1A2 substrate)*

Repeated doses of A771726 decreased mean  $C_{max}$  and AUC of caffeine (CYP1A2 substrate) suggesting that A771726 may be a weak inducer of CYP1A2 *in vivo*. Therefore, medicinal products metabolised by CYP1A2 (such as duloxetine, alosetron, theophylline and tizanidine) should be used with caution during concomitant treatment, as it could lead to the reduction of the efficacy of these products.

#### *Effect on Organic Anion Transporter 3 (OAT3) Substrates*

There was an increase in mean cefaclor  $C_{max}$  and AUC following repeated doses of A771726, suggesting that A771726 is an inhibitor of OAT3 *in vivo*. Therefore, when co-administered with substrates of OAT3, such as cefaclor, benzylpenicillin, ciprofloxacin, indomethacin, ketoprofen, frusemide, cimetidine, methotrexate, zidovudine, caution is recommended.

#### *Effect on BCRP and/or Organic Anion Transporting Polypeptide B1 and B3 (OATP1B1/B3) Substrates*

There was an increase in mean rosuvastatin  $C_{max}$  and AUC following repeated doses of A771726. If used together, the dose of rosuvastatin should not exceed the recommended starting dose. For other substrates of BCRP (eg. methotrexate, topotecan, sulfasalazine, daunorubicin, doxorubicin) and OATP family especially HMG-CoA reductase inhibitors (eg. simvastatin, atorvastatin, pravastatin, methotrexate, nateglinide, repaglinide, rifampicin) concomitant administration should also be undertaken with caution. Patients should be closely monitored for signs and symptoms of excessive exposure to the medicinal products and reduction of the dose of these medicinal products should be considered.

## **4.6. FERTILITY, PREGNANCY AND LACTATION**

### **Effects on fertility**

Oral administration of leflunomide at doses up to 4 mg/kg/day (plasma A771726 concentrations (AUC) about 10 to 25 times lower than that expected in humans) in rats had no effect on fertility, however, impairment of spermatogenesis has been observed in rats, dogs and mice treated with oral leflunomide at higher doses or for longer periods (plasma A771726 AUC similar to or much lower than that expected in humans).

### **Use in pregnancy (Category X)**

As A771726 is teratogenic in rats and rabbits, it may cause foetal harm in humans. Leflunomide must not be given to pregnant women, or women of childbearing potential who are not using reliable contraception during treatment with leflunomide and for a certain period of time thereafter (waiting period or abbreviated washout period; see below). Pregnancy must be excluded before the start of treatment with leflunomide.

It is recommended that women of childbearing potential only receive leflunomide after it has been confirmed that they are using a reliable form of contraception. In a study in which leflunomide was given to healthy

female volunteers concomitantly with a triphasic oral contraceptive pill containing ethinylestradiol 30 microgram, there was no reduction in contraceptive activity of the pill, and A771726 pharmacokinetics were within predicted ranges.

Patients must be advised that if there is any delay in the onset of menses or any other reason to suspect pregnancy, they must notify their doctor immediately to test for pregnancy. If the test is positive, the doctor and patient must discuss the risk to the foetus. It is possible that by rapidly lowering the blood level of the active metabolite at the first delay of menses, using the drug elimination procedure described below, the risk to the foetus may be decreased.

#### Washout procedure

For women who have been treated with leflunomide and who may become pregnant, one of the following washout procedures is recommended prior to conception after stopping treatment with leflunomide: colestyramine 8 g is administered three times daily for a cumulative period of eleven days; alternatively, activated charcoal 50 g is administered four times daily for a total period of eleven days.

The eleven days do not need to be consecutive unless there is a need to lower the A771726 plasma level rapidly. Both colestyramine and activated charcoal may influence the absorption of oestrogens and progestogens such that reliable contraception with oral contraceptives may not be guaranteed during the washout procedure with colestyramine and activated charcoal. Use of alternative contraceptive methods is recommended.

#### Plasma monitoring

After the washout procedure has been performed, A771726 plasma levels of < 0.02 mg/L must be verified by two separate tests at least 14 days apart. Human plasma levels of the active metabolite less than 0.02 mg/L are expected to have minimal risk based on available data. Without the drug elimination procedure, it may take up to two years to reach A771726 levels < 0.02 mg/L (after stopping treatment with leflunomide), due to individual variation in drug clearance. However, verification of A771726 levels < 0.02 mg/L by two separate tests at an interval of at least 14 days is required.

See Section 8 SPONSOR for contact details to arrange sample collection for assay of A771726.

#### Use in males

Available information does not suggest that leflunomide would be associated with an increased risk of male mediated foetal toxicity. However, animal studies to evaluate this specific risk have not been conducted. To minimise any possible risk, men wishing to father a child should consider discontinuing use of leflunomide and taking colestyramine 8 g three times daily for eleven days or activated charcoal 50 g four times daily for eleven days.

#### **Use in lactation**

Animal studies indicate that leflunomide or its metabolites pass into breast milk. Therefore women must not breastfeed while they are receiving leflunomide.

### **4.7. EFFECTS ON ABILITY TO DRIVE AND USE MACHINES**

The effects of this medicine on a person's ability to drive and use machines were not assessed as part of its registration."

### **4.8. ADVERSE EFFECTS (UNDESIRABLE EFFECTS)**

In controlled studies, the adverse events in Table 1 were reported, regardless of causality. Differences between leflunomide and placebo were observed for diarrhoea, elevated liver enzymes (ALT and AST), hair loss and rash

Table 1. Percentage of patients with adverse events ≥3% in any leflunomide treated group

Adverse event	All rheumatoid arthritis studies	Placebo controlled studies				Active Controlled studies	
	LEF (%) (n 1,339) <sup>1</sup>	Studies MN301 and US301				Study MN302*	
		LEF (%) (n = 315)	PL (%) (n = 210)	SSZ (%) (n=133)	MTX (%) (n=182)	LEF (%) (n = 501)	MTX (%) (n=498)
<b>Body as a whole</b>							
Allergic reaction	2	5	2	0	6	1	2
Asthenia	3	6	4	5	6	3	3
Flu syndrome	2	4	2	0	7	0	0
Infection	4	0	0	0	0	0	0
Injury, accident	5	7	5	3	11	6	7
Pain	2	4	2	2	5	1	< 1
Abdominal pain	6	5	4	4	8	6	4
Back pain	5	6	3	4	9	8	7
<b>Cardiovascular</b>							
Hypertension <sup>2</sup>	10	9	4	4	3	10	4
Chest pain	2	4	2	2	4	1	2
<b>Gastrointestinal</b>							
Anorexia	3	3	2	5	2	3	3
Diarrhoea	17	27	12	10	20	22	10
Dyspepsia	5	10	10	9	13	6	7
Gastroenteritis	3	1	1	0	6	3	3
Abnormal liver enzymes	5	10	2	4	10	6	17
Nausea	9	13	11	19	18	13	18
Gastrointestinal/ abdominal pain	5	6	4	7	8	8	8
Mouth ulcer	3	5	4	3	10	3	6
Vomiting	2	5	4	4	3	3	3
<b>Metabolic and nutritional</b>							
Hypokalaemia	1	3	1	1	1	1	< 1
Weight loss	4	2	1	2	0	2	2
<b>Musculoskeletal system</b>							
Arthralgia	1	4	3	0	9	< 1	1
Leg cramps	1	4	2	2	6	0	0
Joint disorder	4	2	2	2	2	8	6
Synovitis	2	< 1	1	0	2	4	2
Tenosynovitis	3	2	0	1	2	5	1
<b>Nervous system</b>							
Dizziness	4	5	3	6	5	7	6
Headache	7	13	11	12	21	10	8
Paraesthesia	2	3	1	1	2	4	3
<b>Respiratory system</b>							
Bronchitis	7	5	2	4	7	8	7
Increased cough	3	4	5	3	6	5	7
Respiratory	15	21	21	20	32	27	25

Adverse event	All rheumatoid arthritis studies	Placebo controlled studies				Active Controlled studies	
		Studies MN301 and US301				Study MN302*	
	LEF (%) (n 1,339) <sup>1</sup>	LEF (%) (n = 315)	PL (%) (n = 210)	SSZ (%) (n=133)	MTX (%) (n=182)	LEF (%) (n = 501)	MTX (%) (n=498)
infection							
Pharyngitis	3	2	1	2	1	3	3
Pneumonia	2	3	0	0	1	2	2
Rhinitis	2	5	2	4	3	2	2
Sinusitis	2	5	5	0	10	1	1
<b>Skin and appendages</b>							
Hair loss	10	9	1	6	6	17	10
Eczema	2	1	1	1	1	3	2
Pruritus	4	5	2	3	2	6	2
Rash	10	12	7	11	9	11	10
Dry skin	2	3	2	2	0	3	1
<b>Urogenital system</b>							
Urinary tract infection	5	5	7	4	2	5	6

\* Only 10% of patients in MN302 received folate. All patients in US301 received folate.

<sup>1</sup>Includes all controlled and uncontrolled trials with leflunomide.

<sup>2</sup>Hypertension as a pre-existing condition was over-represented in all leflunomide treatment groups in phase III trials. Analysis of new onset hypertension revealed no difference among the treatment groups.

LEF = leflunomide; PL = placebo; SSZ = sulfasalazine; MTX = methotrexate

In addition, the following adverse events have been reported in 1 to 3% of the RA patients in the leflunomide treatment group in controlled clinical trials.

**Body as a whole**

Abscess, cyst, fever, hernia, malaise, pain, neck pain, pelvic pain.

**Cardiovascular**

Angina pectoris, migraine, palpitation, arrhythmia, tachycardia, vasculitis, vasodilation, varicose vein.

**Gastrointestinal**

Cholelithiasis, colitis, constipation, oesophagitis, flatulence, gastritis, gingivitis, melaena, oral moniliasis, pharyngitis, salivary gland enlarged, stomatitis (or aphthous stomatitis), tooth disorder.

**Endocrine**

Diabetes mellitus, hyperthyroidism.

**Haemic and lymphatic system**

Anaemia (including iron deficiency anaemia), ecchymosis, leucopenia, lymphadenopathy.

**Metabolic and nutritional**

Increased creatine phosphokinase, peripheral oedema, hyperglycaemia, hyperlipidaemia.

**Musculoskeletal system**

Arthrosis, bursitis, muscle cramps, myalgia, bone necrosis, bone pain, tendon rupture.

**Nervous system**

Anxiety, depression, dry mouth, insomnia, neuralgia, neuritis, sleep disorder, sweating, vertigo.

**Respiratory system**

Asthma, dyspnoea, epistaxis, lung disorder.

**Skin and appendages**

Acne, contact dermatitis, fungal dermatitis, hair discolouration, haematoma, herpes simplex, herpes zoster, nail disorder, skin nodule, subcutaneous nodule, maculopapular rash, skin disorder, skin discolouration, skin ulcer.

**Special senses**

Blurred vision, cataract, conjunctivitis, eye disorder, taste perversion.

**Urogenital system**

Albuminuria, cystitis, dysuria, haematuria, menstrual disorder, vaginal moniliasis, prostate disorder, urinary frequency.

Other less common adverse events seen in clinical trials include one case of anaphylactic reaction which occurred in phase II following rechallenge of drug after withdrawal due to rash (rare); urticaria, transient thrombocytopenia (uncommon), eosinophilia (rare); and leucopenia  $< 2 \times 10^9/L$  (rare). A causal relationship of these events to leflunomide has not been established.

Mild hyperlipidaemia may occur. Uric acid levels usually decrease due to a uricosuric effect. Laboratory findings for which a clinical relevance could not be established include small increases in LDH and CK, and a small decrease in phosphate.

The overall incidence of infections in clinical studies was comparable between patients taking leflunomide and those taking placebo. Immunosuppressive medications are, however, known to increase susceptibility to infections (see Section 4.4 SPECIAL WARNING AND PRECAUTIONS FOR USE). In clinical studies, the incidence of rhinitis and bronchitis (5 versus 2%) and pneumonia (3 versus 0%) was slightly increased in patients treated with leflunomide compared to placebo. The overall incidence of infections was comparable between leflunomide and placebo. The risk of malignancy, particularly lymphoproliferative disorders, is also known to be increased with use of some immunosuppressive drugs.

When significant side effects occur, the dosage of leflunomide may be reduced or treatment with the drug stopped.

**Adverse events in paediatric patients with polyarticular course juvenile rheumatoid arthritis**

The safety of leflunomide was studied in 74 patients with polyarticular course JRA, ranging in age from 3 to 17 years (47 patients from the active controlled study and 27 from the open label safety and pharmacokinetic study). The most common adverse events included abdominal pain, diarrhoea, nausea, vomiting, oral ulcers, upper respiratory tract infections, alopecia, rash, headache and dizziness. Less common adverse events included anaemia, hypertension and weight loss. 14 paediatric patients experience ALT and/or AST elevations, nine between 1.2 and threefold the upper limit of normal and five between three and eightfold the upper limit of normal.

**Postmarketing data**

Adverse reactions reported during the postmarketing period are detailed below. These reactions are classified within body system categories using the following definitions. Common: greater than or equal to 1/100 and < 1/10; uncommon: greater than or equal to 1/1,000 and < 1/100; rare: greater than or equal to 1/10,000 and < 1/1,000; very rare: < 1/10,000.

**Allergic reactions, skin and appendages**

*Common:* mild allergic reactions (including maculopapular and other rashes), pruritus, eczema, dry skin, increased hair loss.

*Uncommon:* urticaria.

*Very rare:* severe anaphylactoid reactions. Stevens-Johnson syndrome, toxic epidermal necrolysis, erythema multiforme. In case reports received so far, a causal relationship with leflunomide treatment could not be established, but cannot be excluded. Vasculitis, including cutaneous necrotising vasculitis. Due to the underlying disease, a causal relationship could not be established.

**Haemic and lymphatic system**

*Common:* leucopenia (leucocytes > 2g /L)

*Uncommon:* thrombocytopenia with platelet count < 100 x 10<sup>9</sup>/L (< 100 g/L).

*Rare:* eosinophilia, leucopenia (leucocytes < 2 g/L), pancytopenia.

*Very rare:* agranulocytosis.

**Liver**

*Common:* elevation of liver parameters (transaminases [especially ALT], less often gamma-GT, alkaline phosphatase, bilirubin), colitis including microscopic colitis.

*Rare:* hepatitis, jaundice/cholestasis.

*Very rare:* severe liver injury, e.g. hepatic failure, and acute hepatic necrosis, that may be fatal, pancreatitis.

**Infection**

*Rare:* severe infections, including opportunistic infections, and sepsis, which may be fatal. (Most of the case reports were confounded by concomitant immunosuppressant therapy and/or comorbid illness, in addition to rheumatoid disease, which may predispose patients to infection.)

**Cardiovascular**

*Common:* increase in blood pressure.

*Rare:* severe increase in blood pressure

*Not known:* pulmonary hypertension.

**Respiratory, thoracic and mediastinal disorders**

*Rare:* interstitial lung disease (including interstitial pneumonitis), which may be fatal.

**Nervous system**

*Common:* headache, dizziness, paraesthesia.

*Uncommon:* taste disturbances, anxiety.

*Very rare:* peripheral neuropathy.

### **Gastrointestinal Disorders**

*Common:* diarrhoea, nausea, anorexia, vomiting, oral mucosal disorders (e.g. aphthous stomatitis, mouth ulceration), abdominal pain, colitis including microscopic colitis.

### **Skin and subcutaneous tissue disorders**

*Very rare:* cutaneous lupus erythematosus, pustular psoriasis or worsening psoriasis, drug reaction with eosinophilia and systemic symptoms (DRESS) (see section 4.4 SPECIAL WARNING AND PRECAUTIONS FOR USE).

### **Musculoskeletal**

*Common:* tenosynovitis.

*Uncommon:* tendon rupture.

### **Reproduction System**

*Not known:* marginal (reversible) decreases in sperm concentration, total sperm count, and rapid progressive motility.

### **Other**

*Common:* weight loss, asthenia.

*Uncommon:* hypophosphataemia.

*Not known:* hypouricemia.

*Not known:* renal failure

Recent, concomitant or consecutive use of potentially myelotoxic agents may be associated with a higher risk of haematological effects.

In most reported cases of pancytopenia, SJS (Stevens-Johnson syndrome) and TEN (toxic epidermal necrolysis), comedication was given which is associated with the risk of pancytopenia or SJS or TEN.

Very rare cases of severe liver injury, with fatal outcome in isolated cases, have been reported during treatment with leflunomide. This risk may be increased when leflunomide is combined with other DMARDs (disease modifying antirheumatic drugs). Most of the cases occurred within the first six months of treatment. Although confounding factors were present in many cases, a causal relationship to leflunomide cannot be excluded. It is considered essential that monitoring recommendations are strictly adhered to.

### **Reporting suspected adverse effects**

Reporting suspected adverse reactions after registration of the medical 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 at <http://www.tga.gov.au/reporting-problems>.

## **4.9. OVERDOSE**

### **Symptoms**

There have been reports of chronic overdose in patients taking leflunomide at daily dose up to five times the recommended daily dose and reports of acute overdose.

There were no adverse events reported in the majority of case reports of overdose. Adverse events were consistent with the safety profile for leflunomide. The most frequent adverse events observed were diarrhoea, abdominal pain, leucopenia, anaemia and elevated liver function tests.

### **Treatment**

In the event of a significant overdose or toxicity, colestyramine or charcoal administration is recommended to accelerate elimination. Colestyramine given orally at a dose of 8 g three times a day for 24 hours to three healthy volunteers decreased plasma levels of A771726 by approximately 40% in 24 hours and by 49 to 65% in 48 hours.

Administration of activated charcoal (powder made into a suspension) orally or via nasogastric tube (50 g every six hours for 24 hours) has been shown to reduce plasma concentrations of the active metabolite A771726 by 37% in 24 hours and by 48% in 48 hours.

These washout procedures may be repeated if clinically necessary.

Studies with both haemodialysis and CAPD (chronic ambulatory peritoneal dialysis) indicated that A771726, the primary metabolite of leflunomide, is not dialysable.

For information on the management of overdose, contact the Poison Information Centre on 131126 (Australia).

## **5. PHARMACOLOGICAL PROPERTIES**

### **5.1. PHARMACODYNAMIC PROPERTIES**

#### **Mechanism of action**

Leflunomide is an isoxazole immunomodulatory agent which is effective in animal models of arthritis and other autoimmune diseases, allergy and transplantation. *In vivo*, leflunomide is rapidly metabolised to the ring opened form, A771726, which is the active drug. It has immunomodulating/immunosuppressive characteristics, acts as an antiproliferative agent, and displays weak anti-inflammatory properties. The antiproliferative activity is reversed by the addition of uridine to the cell culture, indicating that A771726 acts at the level of the pyrimidine biosynthesis pathway.

Binding studies using radiolabelled ligand demonstrate that the active metabolite binds to and inhibits the human enzyme dihydroorotate dehydrogenase (DHODH, an enzyme involved in de novo pyrimidine synthesis). Together, these data suggest that, *in vivo*, at concentrations achievable in patients receiving leflunomide, pyrimidine synthesis in lymphocytes and other rapidly dividing cell populations may be inhibited. Further, the inhibition of tyrosine kinase activity has been reported, for both *in vitro* and *in vivo* situations. The *in vitro* activity does not seem to be mediated directly through enzyme inhibition and takes place only at much higher concentrations of A771726 than is necessary for the inhibition of DHODH. Leflunomide has demonstrated prophylactic and therapeutic effects in animal models of autoimmune disease. In animal models of chronic graft versus host disease and solid organ graft rejection, leflunomide has prolonged rejection time or reversed ongoing rejection reactions. In a model of experimental septicaemia, leflunomide did not alter the resistance of mice to bacterial pathogens.

#### **Clinical trials**

##### **Adult rheumatoid arthritis**

The efficacy of leflunomide in the treatment of rheumatoid arthritis has been demonstrated in three large, multicentre, long-term clinical trials against placebo (PL), sulfasalazine (SSZ) and methotrexate (MTX). Of the patients receiving leflunomide, the majority received it for more than 336 days. The highest doses used for an extended period in the trials were leflunomide 20 mg/day, SSZ 2 g/day and MTX 15 mg/week. Study MN301 (leflunomide versus placebo versus sulfasalazine) was conducted in two parts: a six month comparison of the

safety and efficacy of leflunomide versus placebo versus sulfasalazine followed by a six month extension study (MN303) to evaluate the effect of leflunomide on the progression of rheumatoid arthritis, in comparison to SSZ, by using X-rays of hands and feet to assess joint destruction. Study US301 (leflunomide versus placebo versus methotrexate with concomitant folic acid) was designed to compare the efficacy and safety of leflunomide in patients with active rheumatoid arthritis who had never previously received methotrexate. Study MN302 (leflunomide versus methotrexate without concomitant folic acid) was designed to compare the efficacy and safety of leflunomide versus methotrexate in patients with rheumatoid arthritis.

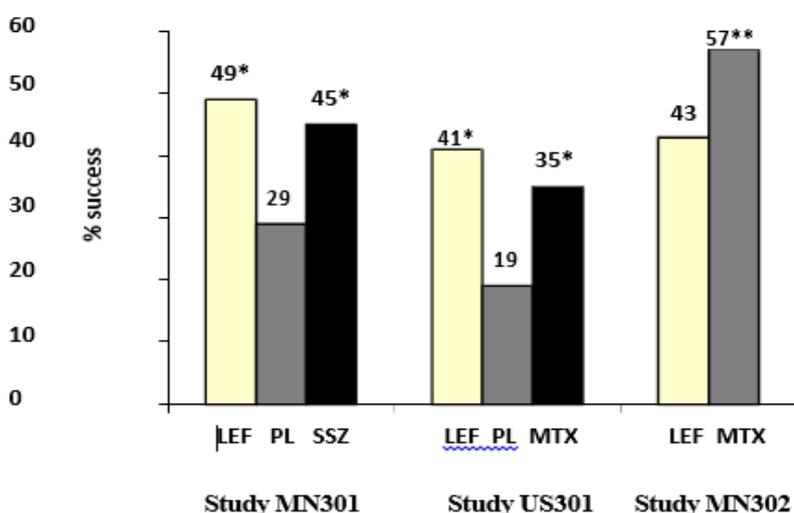
**ACR criteria**

The outcome measures in these trials were: the 'ACR responder' rates over time, the 'ACR success' rates per treatment group, X-ray evaluation of disease progression, and health related quality of life measures. An 'ACR 20 responder', based upon American College of Rheumatology (ACR) criteria, is a patient with greater than or equal to 20% improvement in both tender and swollen joint count and in three of the following five criteria: doctor's global assessment, patient global assessment, function/ disability measure, visual analogue pain scale and erythrocyte sedimentation rate (ESR) or C- reactive protein (CRP). Similarly, an 'ACR 50 responder' and an 'ACR 70 responder' are, respectively, patients with greater than or equal to 50% and greater than or equal to 70% improvement in both tender and swollen joint count and in three of the following five criteria: doctor's global assessment, patient global assessment, function/disability measure, visual analogue pain scale and ESR or CRP. An 'ACR success' is a patient who completes the trial and is an ACR responder at the trial endpoint.

The clinical trials demonstrated a significant decrease in tender and swollen joint counts and scores, decreased morning stiffness and pain, improvement in patient and physician global assessments, increase in functional ability and improvement in quality of life [as measured by the Health Assessment Questionnaire (HAQ) and Modified Health Assessment Questionnaire (MHAQ)], retardation of joint destruction (as documented by X-ray analysis measuring both erosions and joint space narrowing), and a decrease in erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) and rheumatoid factor (RF) levels. Clinical improvement started at approximately 4 weeks, usually stabilised within 4 to 6 months and was maintained for the duration of treatment.

Leflunomide demonstrated a consistent degree of efficacy across the 3 controlled trials. Leflunomide was statistically significantly superior to placebo in reducing the signs and symptoms of RA. ACR 20 successes for leflunomide treatment in US301 and MN301 were approximately twice that seen in placebo patients: 41% and 49% respectively in leflunomide-treated patients compared to 19% and 29% respectively in placebo-treated patients. Figure 1 displays ACR 20 Responder rates for each treatment group at endpoint.

Figure 1. ACR20 successes (% responder at endpoint)



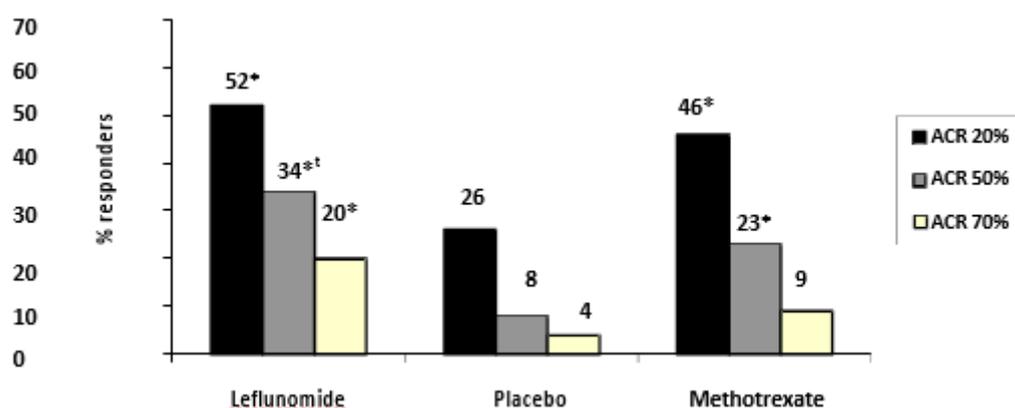
\* p ≤ 0.01 vs placebo, \*\* p ≤ 0.01 vs LEF

LEF = leflunomide; PL = placebo; SSZ = sulfasalazine; MTX = methotrexate

Comparisons		95% confidence interval	P value
US301	Leflunomide vs placebo	(12, 32)	< 0.0001
	Methotrexate vs placebo	(8, 30)	0.0005
	Leflunomide vs methotrexate	(-4, 16)	Not significant
MN301	Leflunomide vs placebo	(7, 33)	0.0026
	Methotrexate vs placebo	(4, 29)	0.0121
	Leflunomide vs methotrexate	(-8, 16)	Not significant
MN302	Leflunomide vs methotrexate	(-19, 7)	< 0.0001

ACR 20, 50 and 70% response rates in all treatment groups of the US301 trial are shown in Figure 2. In US301, the ACR 20% response rate of patients treated with leflunomide was significantly increased from that seen in placebo treated patients and similar to that seen in patients treated with methotrexate. Similarly, ACR 50% and 70% responses were approximately two times higher in patients treated with leflunomide or methotrexate than in patients who received placebo.

Figure 2. ACR response rates in US301



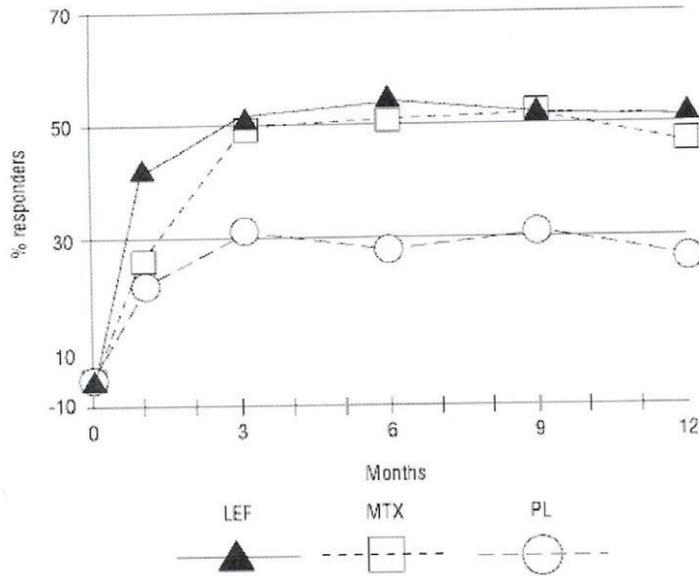
\* p < 0.01 vs placebo, <sup>†</sup>p < 0.05 vs methotrexate

Comparisons		95% confidence interval	P value
ACR 20	Leflunomide vs placebo	(15, 37)	< 0.0001
	Methotrexate vs placebo	(9, 31)	0.0005
	Leflunomide vs methotrexate	(-4, 16)	not significant
ACR 50	Leflunomide vs placebo	(18, 35)	< 0.0001
	Methotrexate vs placebo	(7, 23)	0.0006
	Leflunomide vs methotrexate	(2, 21)	0.016
ACR 70	Leflunomide vs placebo	(9, 23)	0.0001
	Methotrexate vs placebo	(-0.3, 11)	not significant
	Leflunomide vs methotrexate	(4, 18)	0.004

**ACR response over time**

ACR 20 responder rate (%) versus time in US301 is shown in Figure 3. This figure shows that: leflunomide treatment effect was evident by one month, stabilised by three to six months and continued throughout the course of treatment; area under curve (AUC) analysis of ACR responders versus time demonstrated that leflunomide was statistically equivalent to the active comparator (methotrexate). No consistent differences were demonstrated; and response rates over time showed an early and sustained response in leflunomide patients in all three trials (MN301, US301, MN302).

Figure 3. US301 responders over time

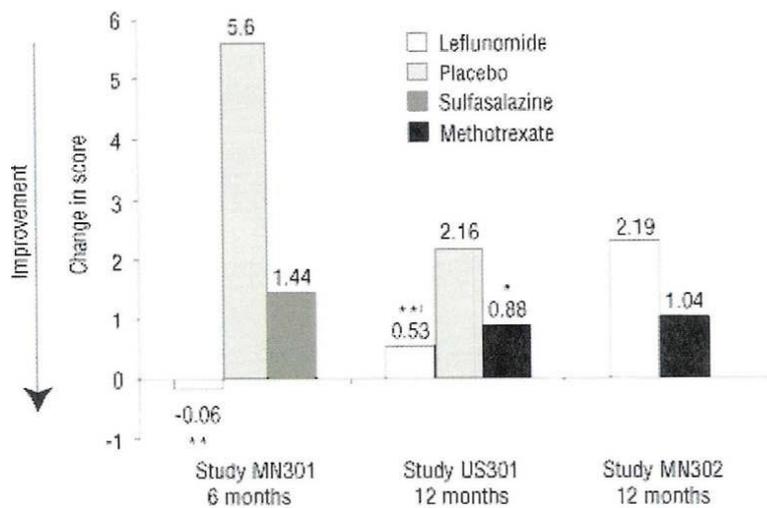


LEF = leflunomide; MTX = methotrexate; PL = placebo

**X-ray data**

Figure 4 displays the change from baseline to endpoint in progression of disease as measured by the Sharp X-ray score combining erosion and joint space narrowing. Leflunomide was significantly superior to placebo in reducing the progression of disease as measured by the Sharp score.

Figure 4. Change in total Sharp score



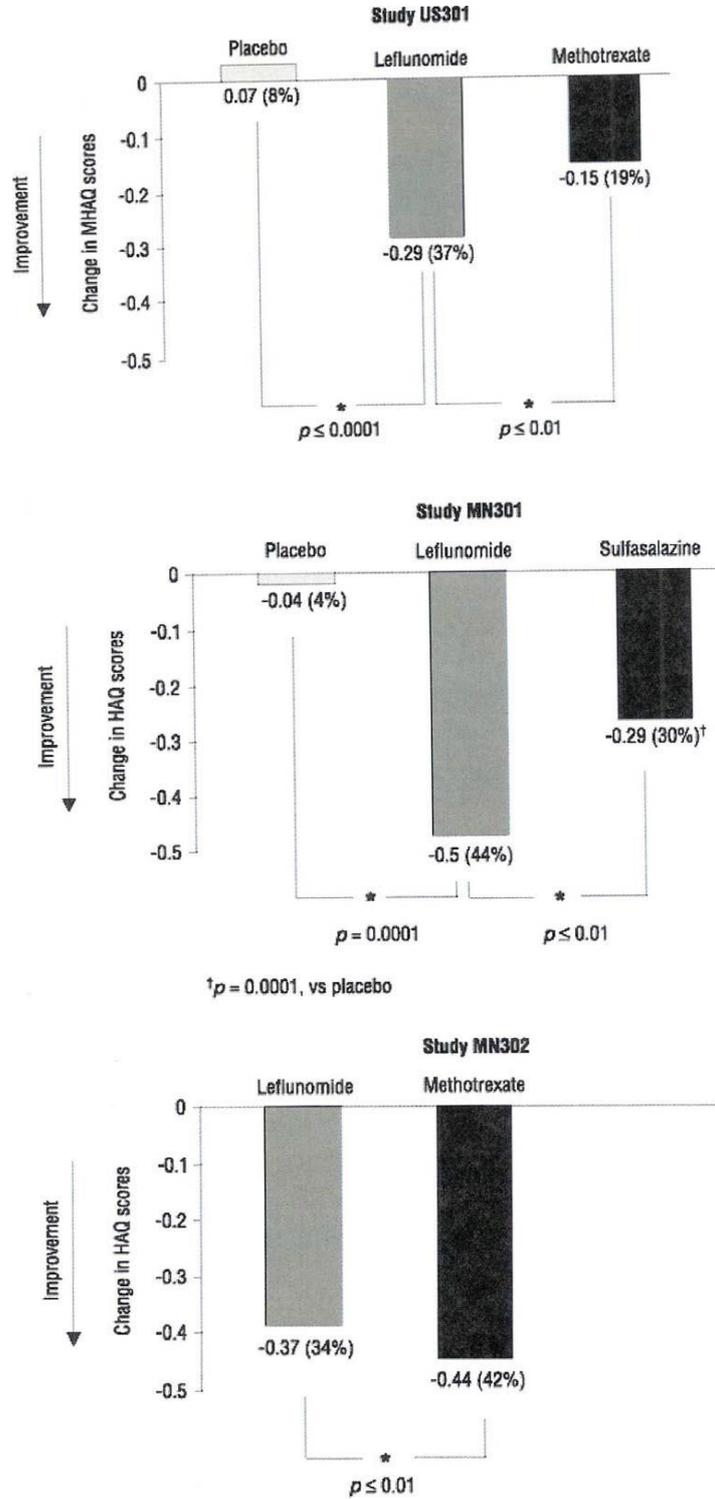
\*\* p ≤ 0.01, vs placebo; † p ≤ 0.05, vs MTX; \* p ≤ 0.05, vs placebo

Comparisons		95% confidence interval	P value
US301	Leflunomide vs placebo	(-4.0, -1.1)	0.0007
	Methotrexate vs placebo	(-2.6, -0.2)	0.0187
	Leflunomide vs methotrexate	(-2.1, 0.0)	0.0494
MN301	Leflunomide vs placebo	(-9.0, -1.4)	0.0081
	Sulfasalazine vs placebo	(-7.7, 0.0)	Not significant
	Leflunomide vs sulfasalazine	(-5.4, 2.3)	Not significant
MN302	Leflunomide vs methotrexate	(-2.7, 8.0)	Not significant

**Functional ability/ quality of life**

The change in patients' functional ability as measured by the HAQ/MHAQ disability index is shown in Figure 5. The quality of life assessment carried out in MN301 and US301 showed that leflunomide was significantly superior to placebo. These studies also showed that leflunomide was significantly superior to SSZ and MTX in increasing the ability of subjects to perform activities of daily life. In MN302, MTX (without folic acid) achieved a greater response.

Figure 5. Change in functional ability (HAQ/MHAQ scores)



**Paediatrics**

Leflunomide was studied in a single multicentre, double blind, active controlled trial in 94 patients (1:1 randomisation) with polyarticular course juvenile rheumatoid arthritis (JRA) as defined by the American College of Rheumatology (ACR).

Approximately 68% of paediatric patients receiving leflunomide, versus 89% of paediatric patients receiving the active comparator, improved by week 16 (end of study) employing the JRA Definition of Improvement (DOI) greater than or equal to responder endpoint. In this trial, the loading dose and maintenance dose of

leflunomide was based on three weight categories: < 20 kg, 20 to 40 kg and > 40 kg. The response rate to leflunomide in paediatric patients less than or equal to 40 kg was less robust than in paediatric patients > 40 kg suggesting suboptimal dosing in smaller weight paediatric patients, as studied, resulting in less efficacious plasma concentration, despite reduced clearance of A771726 (see Section 5.2 PHARMACOKINETIC PROPERTIES).

Paediatric population pharmacokinetic analysis

The pharmacokinetics of oral leflunomide have been investigated in 73 paediatric patients with polyarticular course JRA. The results of a population pharmacokinetic analysis demonstrated that there is a similarly wide intersubject variability in the apparent total oral clearance in paediatric patients as in adults. Bodyweight was strongly correlated with the apparent volume of distribution (apparent volume of distribution (L) = 5.8 x (actual bodyweight/40 kg) 0.769) and weakly correlated with apparent total oral clearance (apparent total oral clearance (L/hour) = 0.02 x (actual bodyweight/40 kg)0.43) in paediatric patients with polyarticular course JRA. The half-life of A771726 decreased as bodyweight decreased. (See Table 2.)

Table 2. Typical values for the apparent total oral clearance, apparent volume of distribution and half-life of A771726 at elected bodyweights in paediatric patients with polyarticular course JRA

<b>Body weight (kg)</b>	<b>Apparent total oral clearance (L/h)</b>	<b>Apparent volume of distribution (L)</b>	<b>Half-life (days)</b>
10	0.011	2.00	5.2
20	0.015	3.4	6.6
30	0.018	4.65	7.6
40	0.020	5.80	8.4
50	0.022	6.89	9.0
60	0.024	7.92	9.6
70	0.025	8.92	10.1

JRA: juvenile rheumatoid arthritis

The use of a loading dose may increase toxicity associated with leflunomide when used in children. The population pharmacokinetic data indicate that adult doses of leflunomide would be inappropriate in some children who would require a dose calculated from bodyweight. The safety and effectiveness of leflunomide in paediatric patients have not been fully evaluated. Leflunomide is not recommended for use in patients under 18 years.

**Psoriatic arthritis**

The efficacy of leflunomide was demonstrated in a six month randomised, double blind, placebo controlled study in 188 psoriatic arthritis (PsA) patients. Adult patients with PsA were randomised to receive either leflunomide 100 mg/day for three days followed by 20 mg/day for the remainder of the period or placebo. In the leflunomide group, of the patients that were fully analysable (n = 186), 59% had an improvement of the Psoriatic Arthritis Treatment Response Criteria (PsARC), the primary endpoint, compared with 29.7% in the placebo group (p < 0.0001). The PsARC is a measure combining a doctor global assessment, a patient global self-assessment, a joint pain/tenderness score and a joint swelling score. Improvement of the PsARC is defined

as a decrease by greater than or equal to 1 point for global assessments. An improvement of at least 2 of the above, one of which had to be joint pain/tenderness or joint swelling score and no worsening in any of the four measures was required to be considered a responder. See Table 3

Table 3. Mean change in the components of the PsARC responder index<sup>a</sup>

Components	Placebo controlled study (6 months)		
	LEF (n = 95)	Placebo (N = 91)	p-Values
Joint pain/tenderness score <sup>a</sup>	-9.1	-4.6	p < 0.01
Joint swelling score <sup>a</sup> Physician	-6.8	-4.2	p < 0.01
global assessment – improvement by at least 1 category	52.6%	34.1%	p < 0.01
Patient global self-assessment – Improvement by at least 1 category	31.6%	30.8%	p < 0.01

<sup>a</sup>Negative change indicates improvement  
 One 5-point Likert Scale (1 = very good; 5 = very poor) PsARC = Psoriatic Arthritis Treatment Criteria  
 LEF = leflunomide

In a differing analysis which excluded some patients, the Psoriasis Area and Severity Index (PASI) was assessed to reflect changes in the extent and severity of psoriasis lesions as judged by erythema, desquamation and infiltration. Leflunomide resulted in a significant improvement in PASI scores over the 24 week study relative to placebo, with a mean (+/- SD) improvement of 22.4% (+/- 51.6%) in the leflunomide group compared with a deterioration of 2.2% (+/- 70.4%) in the placebo group (p = 0.0030). See Table 4.

Table 4. PASI: baseline endpoint comparison of leflunomide versus placebo

Variable	Mean (± SD)		Treatment comparison (p-Value)
	Placebo	LEF	
PASI (FAS)	n = 90	n = 92	0.003
Baseline	9.5 ± 8.8	8.7 ± 5.5	
Endpoint	8.8 ± 8.7	6.6 ± 6.5	
Change from baseline to endpoint	-0.6 ± 6.1	-2.1 ± 5.9	
PASI (PPS)	n = 81	n = 81	0.004
Baseline	8.8 ± 8.0	8.7 ± 5.8	
Endpoint	8.3 ± 8.3	6.2 ± 6.1	
Change from baseline to endpoint	-0.5 ± 6.3	-2.5 ± 5.7	

<sup>a</sup>p-Values were calculated for difference between the treatment groups using ANOVA based on ranked percentage changes from baseline  
 PASI = Psoriasis Area and Severity Index  
 LEF = leflunomide

Compared with the placebo group, a significantly greater proportion of patients in the leflunomide group experienced a greater than or equal to 50% reduction in PASI scores (PASI 50; 18.9 versus 30.4%; p = 0.050) a greater than or equal to 75% reduction in PASI scores (PASI 75; 7.8 versus 17.4%; p = 0.048) from baseline.

The efficacy of leflunomide in psoriatic arthritis has been assessed in a single study (n = 188) and although the results of that study were statistically significant, supporting studies have not been performed. The efficacy of leflunomide in psoriatic arthritis patients has not been investigated beyond six months. The adverse events observed in the clinical study in PsA patients were comparable to the adverse events seen in the clinical trials in rheumatoid arthritis patients. Data on the safety of leflunomide in patients with PsA have been largely inferred from experience in patients with rheumatoid arthritis.

## 5.2. PHARMACOKINETIC PROPERTIES

### Absorption

Following administration, leflunomide is rapidly and almost completely metabolised by the opening of the isoxazole ring to form the active metabolite, A771726, by first-pass metabolism in the gut wall and liver. Plasma samples taken four hours after the ingestion of leflunomide reveal only A771726. An absolute bioavailability study has not been performed in humans. In animals, however, the bioavailability of A771726 after administration of leflunomide ranged from 76% in dog to > 90% in mouse. Following oral administration, peak levels of A771726 occurred between 6 and 12 hours after dosing. Due to the very long half-life of A771726 (approximately two weeks), a loading dose of leflunomide 100 mg for three days was used in clinical studies to facilitate the rapid attainment of steady-state levels of A771726. Without a loading dose, it is estimated that attainment of steady-state plasma concentrations would require nearly two months of dosing. There was evidence from multiple dosing studies in patients with rheumatoid arthritis that pharmacokinetic parameters were linear over the loading dose phase used in clinical trials (i.e. 100 mg daily for three days) and over daily maintenance doses of 5 to 25 mg. In these studies the clinical effect was closely related to plasma concentration of A771726 and to the daily dose of leflunomide. Factors such as age, sex and body size had only a small, clinically irrelevant influence on interindividual variability in A771726 clearance. The plasma concentrations shown in Table 5 following both loading doses and continued clinical dosing indicate that A771726 plasma levels are dose proportional.

Table 5. Pharmacokinetic parameters for A771726 after administration of leflunomide for 24 days to patients (n = 54) with rheumatoid arthritis (study YU204)

Pharmacokinetic parameter (mean ± SD)	Maintenance dose (loading dose)		
	5 mg (50mg)	10 mg (100 mg)	25 mg (100 mg)
C <sub>24</sub> (day 1) (mcg/mL)*	4.0 ± 0.6	8.4 ± 2.1	8.5 ± 2.2
C <sub>24</sub> (ss) (mcg/mL)**	8.8 ± 2.9	18 ± 9.6	63 ± 36
Half-life (days)	15 ± 3	14 ± 5	18 ± 9

\* Concentration at 24 hours after loading dose

\*\* Concentration at 24 hours after maintenance doses at steady state

Relative to an oral solution, leflunomide tablets are 80% bioavailable. Food does not affect the bioavailability of leflunomide.

A bioequivalence study was conducted between Leflunomide 100 mg and Arava®. The point estimate and 90% confidence intervals for the ratio of AUC<sub>0-144h</sub> were found to be 90.59% and 84.59-97.03% respectively while those for the ratio of C<sub>max</sub> were 86.89% and 80.01-94.36% respectively.

### Distribution

In human plasma from healthy volunteers, A771726 was extensively bound (>99.3%) to albumin. The unbound fraction of A771726 was 0.62%. Binding of A771726 was linear up to 573 microgram/mL. Binding of A771726 appeared slightly reduced and more variable in plasma from patients with rheumatoid arthritis or chronic renal insufficiency such that the unbound fraction increased to 0.80 and 1.44% in these two patient groups, respectively. Consistent with extensive protein binding, A771726 had a low apparent volume of distribution (approximately 11 L). Average plasma concentration of A771726 at steady state is approximately 30 microgram/mL for a maintenance dose of 20 mg/day.

### Metabolism

Leflunomide is metabolised to one primary (A771726) and many minor metabolites. The metabolic biotransformation of A771726 is not controlled by a single enzyme and has been shown to occur in microsomal and cytosolic cellular fractions. At the present time the specific site of leflunomide metabolism is unknown. *In vivo* and *in vitro* studies suggest a role for both the gastrointestinal wall and the liver in metabolism.

In a study with radiolabelled <sup>14</sup>C-leflunomide in three healthy men, no unchanged leflunomide was detected in plasma, urine or faeces. The only radiolabelled metabolite detected in plasma was A771726 and there was no preferential uptake by erythrocytes. The metabolite 4-trifluoromethylaniline (TFMA) has been detected in the plasma of animals and humans but concentrations were very low compared with A771726 (nanogram/mL compared to microgram/mL) and often below the limit of quantification. Concentrations in humans were typically < 10 nanogram/mL while the highest recorded values were approximately 20 nanogram/mL.

**Excretion**

The active metabolite, A771726, is eliminated by further metabolism and subsequent renal excretion as well as by direct biliary excretion. In a study of radiolabelled leflunomide, excretion of radioactivity was slow, and between 89 and 94% of total radioactivity was excreted within 28 days. Approximately 43% of the total radioactivity was eliminated in the urine and 48% was eliminated in the faeces. The principal urinary metabolites were glucuronide products derived from leflunomide (mainly in 0 to 24 hour samples) and an oxanilic acid derivative of A771726. The principal faecal component was A771726. In small studies using activated charcoal (n = 1) or colestyramine (n = 3) to facilitate drug elimination, the *in vivo* plasma half-life of A771726 was reduced from > one week to approximately one day (see Section 4.9 OVERDOSE). Similar reductions in plasma half-life were observed for a series of volunteers (n = 96) enrolled in pharmacokinetic trials who were given colestyramine. This suggests that biliary recycling is a major contributor to the long elimination half- life of A771726. Studies with both haemodialysis and CAPD (chronic ambulatory peritoneal dialysis) indicate that A771726 is not dialysable. After independent intravenous administration of A771726, clearance averaged 31 mL/hour with an elimination half-life of ten days. A similar clearance estimate (29 +/- 17 mL/hour) was obtained from population pharmacokinetics analysis of rheumatoid arthritis patients enrolled in pivotal safety and efficacy studies.

**Paediatric Pharmacokinetics**

The pharmacokinetics of A771726 following oral administration of leflunomide have been investigated in 73 paediatric patients with polyarticular course juvenile rheumatoid arthritis (JRA) who ranged in age from 3 to 17 years. The results of a population pharmacokinetic analysis of these trials have demonstrated that paediatric patients with bodyweights less than or equal to 40 kg have a reduced clearance of A771726 relative to adult rheumatoid arthritis patients. See Table 6

Table 6. Population pharmacokinetic estimate of A771726 clearance following oral administration of leflunomide in paediatric patients with polyarticular course JRA (mean ± SD (range))

n	Body weight (kg)	CL (mL/hour)
10	< 20	18 ± 9.8 (6.8-37)
30	20-40	18 ± 9.5 (4.2-4.3)
33	> 40	26 ± 16 ( 69.7-93.6)

JRA: juvenile rheumatoid arthritis

**Special Populations**

Gender

Gender has not been shown to cause a consistent change in the *in vivo* pharmacokinetics of leflunomide and A771726.

Age

Age has been shown to cause a change in the *in vivo* pharmacokinetics of leflunomide and A771726 (see Section 5.2 PHARMACOKINETIC PROPERTIES). Data in patients > 65 years are limited.

### Smoking

A population based pharmacokinetic analysis of the phase III data indicated that smokers had a 38% increase in clearance over nonsmokers. However, no difference in clinical efficacy was seen between smokers and nonsmokers.

### Chronic Renal Impairment

In single dose studies in patients (n = 6) with chronic renal impairment requiring either chronic ambulatory peritoneal dialysis (CAPD) or haemodialysis, neither had a significant impact on circulating levels of A771726. The free fraction of A771726 was almost doubled, but the mechanism of this increase is not known. In light of the fact that the kidneys play a role in drug elimination, and without adequate studies of leflunomide use in patients with renal impairment, caution should be used when leflunomide is administered to these patients.

### Hepatic Impairment

Since the active metabolite of leflunomide, A771726, is highly protein bound and cleared via hepatic metabolism and biliary secretion, and given the risk of hepatotoxicity, leflunomide is contraindicated in patients with impairment of liver function.

## **5.3. PRECLINICAL SAFETY DATA**

### **Genotoxicity**

Leflunomide (A771726) was not mutagenic in bacteria (*Salmonella typhimurium* and *Escherichia coli*) or Chinese hamster ovary cells, did not cause chromosomal damage *in vivo* (mouse and Chinese hamster bone marrow cells), and did not induce unscheduled synthesis of DNA *in vitro* in mammalian cells. A minor metabolite of leflunomide, trifluoromethylaniline, was mutagenic and caused chromosomal damage in *in vitro* assays, but it did not cause chromosomal damage *in vivo* (Chinese hamster bone marrow cells) at concentrations higher than those expected in humans.

### **Carcinogenicity**

A two year carcinogenicity study of oral leflunomide in mice showed an increased incidence of malignant lymphoma in males given leflunomide 15 mg/kg/day (associated with plasma A771726 concentrations (area under the curve (AUC)) similar to that expected in humans), an increase in bronchioalveolar adenomas in males given greater than or equal to 5 mg/kg/day (A771726 AUC similar to or about 50% lower than that expected in humans) and an increase in bronchioalveolar adenomas and carcinomas in females given 1.5 mg/kg/day (A771726 AUC at least 10 to 20 times lower than that expected in humans). The increase in the development of malignant lymphomas was probably due to the immunosuppressant effect of leflunomide. A no effect dose or AUC for the development of lung tumours in female mice was not established, but the relevance of these findings for humans was not clear. Leflunomide showed no carcinogenicity activity in rats given oral leflunomide at doses up to 6 mg/kg/day (associated with A771726 AUC 25 to 65 times lower than that expected in humans).

The risk of malignancy, particularly lymphoproliferative disorders, is increased with the use of some immunosuppression medications. There is a potential for immunosuppression with leflunomide. No apparent increase in the incidence of malignancies and lymphoproliferative disorders was reported in the clinical trials of leflunomide, but larger and longer-term studies would be needed to determine whether there is an increased risk of malignancy or lymphoproliferative disorders with leflunomide

## **6. PHARMACEUTICAL PARTICULARS**

### **6.1. LIST OF EXCIPIENTS**

Microcrystalline cellulose, lactose monohydrate, maize starch, povidone, crospovidone, colloidal anhydrous silica and magnesium stearate. The 10 mg and 100 mg tablets also contain Opadry II complete film coating

system OY-LS-28908 White (Proprietary Ingredient #4527) and the 20 mg tablets Opadry aqueous film coating OY-SR-6497 Yellow (Proprietary Ingredient #3965).

## 6.2. INCOMPATIBILITIES

Incompatibilities were either not assessed or not identified as part of the registration of this medicine.

## 6.3. SHELF LIFE

In Australia, information on the shelf life can be found on the public summary of the Australian Register of Therapeutic Goods (ARTG). The expiry date can be found on the packaging.

## 6.4. SPECIAL PRECAUTIONS FOR STORAGE

Store below 30°C in a dry place.

Keep the container tightly closed

## 6.5. NATURE AND CONTENTS OF CONTAINER

*Container type:* HDPE bottle

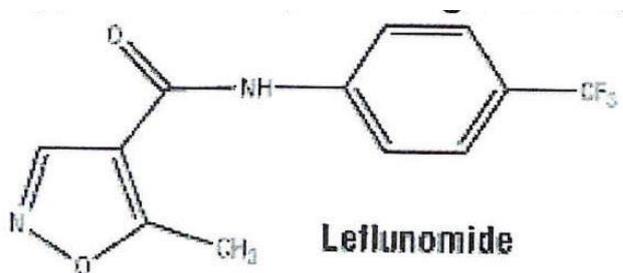
*Pack sizes:* 30 tablets

## 6.6. SPECIAL PRECAUTIONS FOR DISPOSAL

In Australia, any unused medicine or waste material should be disposed of by taking to your local pharmacy.

## 6.7. PHYSICOCHEMICAL PROPERTIES

**Chemical structure**



**CAS Number**

75706-12-6

*Chemical Name:* 5-methyl-N-[4-(trifluoromethyl)phenyl]isoxazole-4 carboxamide, an isoxazole derivative.

*Molecular Formula:* C<sub>12</sub>H<sub>9</sub>F<sub>3</sub>N<sub>2</sub>O<sub>2</sub>

*Molecular Weight:* 270.2

## 7. MEDICINE SCHEDULE (POISONS STANDARD)

S4 (Prescription Only Medicine)

## 8. SPONSOR

Southern Cross Pharma Pty Ltd  
 Suite 5, 118 Church Street  
 Hawthorn  
 Vic, 3122

For instructions in relation to plasma monitoring of A771726 please either:  
 Fax: 02 4471 2687, or  
 Email: [nstacey@southernxp.com](mailto:nstacey@southernxp.com)

## 9. DATE OF FIRST APPROVAL

3 March 2011

## 10. DATE OF REVISION

24 January 2020

### Summary table of changes

Section Changed	Summary of new Information
2, 4.4, 4.5, 4.6, 4.9, 5.2, 6.1	Minor Editorial Changes
4.4, 4.5, 4.8	Safety Related Changes