

**ANNEX I**  
**SUMMARY OF PRODUCT CHARACTERISTICS**

## 1. NAME OF THE MEDICINAL PRODUCT

Volibris 5 mg film-coated tablets

## 2. QUALITATIVE AND QUANTITATIVE COMPOSITION

Each tablet contains 5 mg of ambrisentan.

### Excipient(s) with known effect:

Each tablet contains approximately 95 mg of lactose (as monohydrate), approximately 0.25 mg of lecithin (soya) (E322) and approximately 0.11 mg of Allura red AC Aluminium Lake (E129).

For the full list of excipients, see section 6.1.

## 3. PHARMACEUTICAL FORM

Film-coated tablet (tablet).

Pale-pink, square, convex, film-coated tablet with “GS” debossed on one side and “K2C” on the other side.

## 4. CLINICAL PARTICULARS

### 4.1 Therapeutic indications

Volibris is indicated for treatment of pulmonary arterial hypertension (PAH) in adult patients of WHO Functional Class (FC) II to III, including use in combination treatment (see section 5.1). Efficacy has been shown in idiopathic PAH (IPAH) and in PAH associated with connective tissue disease.

### 4.2 Posology and method of administration

Treatment must be initiated by a physician experienced in the treatment of PAH.

#### Posology

##### *Ambrisentan monotherapy*

Volibris is to be taken orally to begin at a dose of 5 mg once daily and may be increased to 10 mg daily depending upon clinical response and tolerability.

##### *Ambrisentan in combination with tadalafil*

When used in combination with tadalafil, Volibris should be titrated to 10 mg once daily.

In the AMBITION study, patients received 5 mg ambrisentan daily for the first 8 weeks before up titrating to 10 mg, dependent on tolerability (see section 5.1). When used in combination with tadalafil, patients were initiated with 5 mg ambrisentan and 20 mg tadalafil. Dependent on tolerability the dose of tadalafil was increased to 40 mg after 4 weeks and the dose of ambrisentan was increased to 10 mg after 8 weeks. More than 90% of patients achieved this. Doses could also be decreased depending on tolerability.

Limited data suggest that the abrupt discontinuation of ambrisentan is not associated with rebound worsening of PAH.

When co-administered with cyclosporine A, the dose of ambrisentan should be limited to 5 mg once daily and the patient should be carefully monitored (see sections 4.5 and 5.2).

### Special populations

#### Elderly patients

No dose adjustment is required in patients over the age of 65 (see section 5.2).

#### Patients with renal impairment

No dose adjustment is required in patients with renal impairment (see section 5.2). There is limited experience with ambrisentan in individuals with severe renal impairment (creatinine clearance <30 ml/min); therapy should be initiated cautiously in this subgroup and particular care taken if the dose is increased to 10 mg ambrisentan.

#### Patients with hepatic impairment

Ambrisentan has not been studied in individuals with hepatic impairment (with or without cirrhosis). Since the main routes of metabolism of ambrisentan are glucuronidation and oxidation with subsequent elimination in the bile, hepatic impairment might be expected to increase exposure ( $C_{max}$  and AUC) to ambrisentan. Therefore ambrisentan must not be initiated in patients with severe hepatic impairment, or clinically significant elevated hepatic aminotransferases (greater than 3 times the Upper Limit of Normal (>3xULN); see sections 4.3 and 4.4).

#### Paediatric population

The safety and efficacy of ambrisentan in children and adolescents aged below 18 years has not been established. No data are available.

#### Method of administration

It is recommended that the tablet is swallowed whole and it can be taken with or without food. It is recommended that the tablet should not be split, crushed or chewed.

### **4.3 Contraindications**

Hypersensitivity to the active substance, to soya, or to any of the excipients listed in section 6.1.

Pregnancy (see section 4.6).

Women of child-bearing potential who are not using reliable contraception (see sections 4.4 and 4.6).

Breast-feeding (see section 4.6).

Severe hepatic impairment (with or without cirrhosis) (see section 4.2).

Baseline values of hepatic aminotransferases (aspartate aminotransferases (AST) and/or alanine aminotransferases (ALT))>3xULN (see sections 4.2 and 4.4).

Idiopathic pulmonary fibrosis (IPF), with or without secondary pulmonary hypertension (see section 5.1).

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

Ambrisentan has not been studied in a sufficient number of patients to establish the benefit/risk balance in WHO functional class I PAH.

The efficacy of ambrisentan as monotherapy has not been established in patients with WHO functional class IV PAH. Therapy that is recommended at the severe stage of the disease (e.g. epoprostenol) should be considered if the clinical condition deteriorates.

##### Liver function

Liver function abnormalities have been associated with PAH. Cases consistent with autoimmune hepatitis, including possible exacerbation of underlying autoimmune hepatitis, hepatic injury and hepatic enzyme elevations potentially related to therapy have been observed with ambrisentan (see sections 4.8 and 5.1). Therefore hepatic aminotransferases (ALT and AST) should be evaluated prior to initiation of ambrisentan and treatment should not be initiated in patients with baseline values of ALT and/or AST >3xULN (see section 4.3).

Patients should be monitored for signs of hepatic injury and monthly monitoring of ALT and AST is recommended. If patients develop sustained, unexplained, clinically significant ALT and/or AST elevation, or if ALT and/or AST elevation is accompanied by signs or symptoms of hepatic injury (e.g. jaundice), ambrisentan therapy should be discontinued.

In patients without clinical symptoms of hepatic injury or of jaundice, re-initiation of ambrisentan may be considered following resolution of hepatic enzyme abnormalities. The advice of a hepatologist is recommended.

##### Haemoglobin concentration

Reductions in haemoglobin concentrations and haematocrit have been associated with endothelin receptor antagonists (ERAs) including ambrisentan. Most of these decreases were detected during the first 4 weeks of treatment and haemoglobin generally stabilised thereafter. Mean decreases from baseline (ranging from 0.9 to 1.2 g/dL) in hemoglobin concentrations persisted for up to 4 years of treatment with ambrisentan in the long-term open-label extension of the pivotal Phase 3 clinical studies. In the post-marketing period, cases of anaemia requiring blood cell transfusion have been reported (see section 4.8).

Initiation of ambrisentan is not recommended for patients with clinically significant anaemia. It is recommended that haemoglobin and/or haematocrit levels are measured during treatment with ambrisentan, for example at 1 month, 3 months and periodically thereafter in line with clinical practice. If a clinically significant decrease in haemoglobin or haematocrit is observed, and other causes have been excluded, dose reduction or discontinuation of treatment should be considered. The incidence of anaemia was increased when ambrisentan was dosed in combination with tadalafil (15% adverse event frequency), compared to the incidence of anaemia when ambrisentan and tadalafil were given as monotherapy (7% and 11%, respectively).

##### Fluid retention

Peripheral oedema has been observed with ERAs including ambrisentan. Most cases of peripheral oedema in clinical studies with ambrisentan were mild to moderate in severity, although it may occur with greater frequency and severity in patients  $\geq 65$  years. Peripheral oedema was reported more frequently with 10 mg ambrisentan in short-term clinical studies (see section 4.8).

Post-marketing reports of fluid retention occurring within weeks after starting ambrisentan have been received and, in some cases, have required intervention with a diuretic or hospitalisation for fluid

management or decompensated heart failure. If patients have pre-existing fluid overload, this should be managed as clinically appropriate prior to starting ambrisentan.

If clinically significant fluid retention develops during therapy with ambrisentan, with or without associated weight gain, further evaluation should be undertaken to determine the cause, such as ambrisentan or underlying heart failure, and the possible need for specific treatment or discontinuation of ambrisentan therapy. The incidence of peripheral oedema was increased when ambrisentan was dosed in combination with tadalafil (45% adverse event frequency), compared to the incidence of peripheral oedema when ambrisentan and tadalafil were given as monotherapy (38% and 28%, respectively). The occurrence of peripheral oedema was highest within the first month of treatment initiation.

#### Women of child-bearing potential

Volibris treatment must not be initiated in women of child-bearing potential unless the result of a pre-treatment pregnancy test is negative and reliable contraception is practiced. If there is any doubt on what contraceptive advice should be given to the individual patient, consultation with a gynaecologist should be considered. Monthly pregnancy tests during treatment with ambrisentan are recommended (see sections 4.3 and 4.6).

#### Pulmonary veno-occlusive disease

Cases of pulmonary oedema have been reported with vasodilating medicinal products, such as ERAs, when used in patients with pulmonary veno-occlusive disease. Consequently, if PAH patients develop acute pulmonary oedema when treated with ambrisentan, the possibility of pulmonary veno-occlusive disease should be considered.

#### Concomitant use with other medicinal products

Patients on ambrisentan therapy should be closely monitored when starting treatment with rifampicin (see sections 4.5 and 5.2).

#### Excipients

Volibris tablets contain lactose. Patients with rare hereditary problems of galactose intolerance, the Lapp lactase deficiency or glucose-galactose malabsorption should not take this medicine.

Volibris tablets contain the azo colouring agent Allura red AC Aluminium Lake (E129), which can cause allergic reactions.

Volibris tablets contain lecithin derived from soya. If a patient is hypersensitive to soya, ambrisentan must not be used (see section 4.3).

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

Ambrisentan does not inhibit or induce phase I or II drug metabolising enzymes at clinically relevant concentrations in *in vitro* and *in vivo* non-clinical studies, suggesting a low potential for ambrisentan to alter the profile of medicinal products metabolised by these pathways.

The potential for ambrisentan to induce CYP3A4 activity was explored in healthy volunteers with results suggesting a lack of inductive effect of ambrisentan on the CYP3A4 isoenzyme.

#### Cyclosporine A

Steady-state co-administration of ambrisentan and cyclosporine A resulted in a 2-fold increase in ambrisentan exposure in healthy volunteers. This may be due to the inhibition by cyclosporine A of transporters and metabolic enzymes involved in the pharmacokinetics of ambrisentan. Therefore the

dose of ambrisentan should be limited to 5 mg once daily when co-administered with cyclosporine A (see section 4.2). Multiple doses of ambrisentan had no effect on cyclosporine A exposure, and no dose adjustment of cyclosporine A is warranted.

#### Rifampicin

Co-administration of rifampicin (an inhibitor of Organic Anion Transporting Polypeptide [OATP], a strong inducer of CYP3A and 2C19, and inducer of P-gp and uridine-diphosphoglucuronosyltransferases [UGTs]) was associated with a transient (approximately 2-fold) increase in ambrisentan exposure following initial doses in healthy volunteers. However, by day 8, steady state administration of rifampicin had no clinically relevant effect on ambrisentan exposure. Patients on ambrisentan therapy should be closely monitored when starting treatment with rifampicin (see sections 4.4 and 5.2).

#### Phosphodiesterase inhibitors

Co-administration of ambrisentan with a phosphodiesterase inhibitor, either sildenafil or tadalafil (both substrates of CYP3A4) in healthy volunteers did not significantly affect the pharmacokinetics of the phosphodiesterase inhibitor or ambrisentan (see section 5.2).

#### Other targeted PAH treatments

The efficacy and safety of ambrisentan when co-administered with other treatments for PAH (e.g. prostanoids and soluble guanylate cyclase stimulators) has not been specifically studied in controlled clinical trials in PAH patients (see section 5.1). No specific drug-drug interactions with soluble guanylate cyclase stimulators or prostanoids are anticipated based on the known biotransformation data (see section 5.2). However, no specific drug-drug interactions studies have been conducted with these drugs. Therefore, caution is recommended in the case of co-administration.

#### Oral contraceptives

In a clinical study in healthy volunteers, steady-state dosing with ambrisentan 10 mg once daily did not significantly affect the single-dose pharmacokinetics of the ethinyl estradiol and norethindrone components of a combined oral contraceptive (see section 5.2). Based on this pharmacokinetic study, ambrisentan would not be expected to significantly affect exposure to oestrogen- or progestogen-based contraceptives.

#### Warfarin

Ambrisentan had no effects on the steady-state pharmacokinetics and anti-coagulant activity of warfarin in a healthy volunteer study (see section 5.2). Warfarin also had no clinically significant effects on the pharmacokinetics of ambrisentan. In addition, in patients, ambrisentan had no overall effect on the weekly warfarin-type anticoagulant dose, prothrombin time (PT) and international normalised ratio (INR).

#### Ketoconazole

Steady-state administration of ketoconazole (a strong inhibitor of CYP3A4) did not result in a clinically significant increase in exposure to ambrisentan (see section 5.2).

#### Effect of ambrisentan on xenobiotic transporters

*In vitro*, ambrisentan has no inhibitory effect on human transporters at clinically relevant concentrations, including the P-glycoprotein (Pgp), breast cancer resistance protein (BCRP), multi-drug resistance related protein 2 (MRP2), bile salt export pump (BSEP), organic anion transporting polypeptides (OATP1B1 and OATP1B3) and the sodium-dependent taurocholate co-transporting polypeptide (NTCP).

Ambrisentan is a substrate for Pgp-mediated efflux.

*In vitro* studies in rat hepatocytes also showed that ambrisentan did not induce Pgp, BSEP or MRP2 protein expression.

Steady-state administration of ambrisentan in healthy volunteers had no clinically relevant effects on the single-dose pharmacokinetics of digoxin, a substrate for Pgp (see section 5.2).

#### **4.6 Fertility, pregnancy and lactation**

##### Women of childbearing potential

Ambrisentan treatment must not be initiated in women of child-bearing potential unless the result of a pre-treatment pregnancy test is negative and reliable contraception is practiced. Monthly pregnancy tests during treatment with ambrisentan are recommended.

##### Pregnancy

Ambrisentan is contraindicated in pregnancy (see section 4.3). Animal studies have shown that ambrisentan is teratogenic. There is no experience in humans.

Women receiving ambrisentan must be advised of the risk of foetal harm and alternative therapy initiated if pregnancy occurs (see sections 4.3, 4.4 and 5.3).

##### Breast-feeding

It is not known whether ambrisentan is excreted in human breast milk. The excretion of ambrisentan in milk has not been studied in animals. Therefore breast-feeding is contraindicated in patients taking ambrisentan (see section 4.3).

##### Male fertility

The development of testicular tubular atrophy in male animals has been linked to the chronic administration of ERAs, including ambrisentan (see section 5.3). Although no clear evidence of a detrimental effect of ambrisentan long-term exposure on sperm count was found in ARIES-E study, chronic administration of ambrisentan was associated with changes in markers of spermatogenesis. A decrease in plasma inhibin-B concentration and an increase in plasma FSH concentration were observed. The effect on male human fertility is not known but a deterioration of spermatogenesis cannot be excluded. Chronic administration of ambrisentan was not associated with a change in plasma testosterone in clinical studies.

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

Ambrisentan has minor or moderate influence on the ability to drive and use machines. The clinical status of the patient and the adverse reaction profile of ambrisentan (such as hypotension, dizziness, asthenia, fatigue) should be borne in mind when considering the patient's ability to perform tasks that require judgement, motor or cognitive skills (see section 4.8). Patients should be aware of how they might be affected by ambrisentan before driving or using machines.

#### **4.8 Undesirable effects**

##### Summary of the safety profile

The safety of ambrisentan has been evaluated as monotherapy and/or in combination in clinical trials of more than 1200 patients with PAH (see section 5.1). Adverse reactions identified from 12 week placebo controlled clinical trial data are included below by system organ class and frequency. Information from longer term non-placebo controlled studies (ARIES-E and AMBITION (combination with tadalafil)) is also included below. No previously unknown adverse reactions were identified with long-term treatment or for ambrisentan in combination with tadalafil. With longer observation in uncontrolled studies (mean observation of 79 weeks), the safety profile was similar to that observed in the short term studies. Routine pharmacovigilance data are also presented.

Peripheral oedema, fluid retention and headache (including sinus headache, migraine) were the most common adverse reactions observed with ambrisentan. The higher dose (10 mg) was associated with a higher incidence of these adverse reactions, and peripheral oedema tended to be more severe in patients  $\geq 65$  years in short-term clinical studies (see section 4.4).

#### Tabulated list of adverse reactions

Frequencies are defined as: 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 ( $<1/10,000$ ) and not known (cannot be estimated from available data). For dose-related adverse reactions the frequency category reflects the higher dose of ambrisentan. Frequency categories do not account for other factors including varying study duration, pre-existing conditions and baseline patient characteristics. Adverse reaction frequency categories assigned based on clinical trial experience may not reflect the frequency of adverse events occurring during normal clinical practice. Within each frequency grouping, adverse reactions are presented in order of decreasing seriousness.

	<b>Ambrisentan (ARIES-C and post marketing)</b>	<b>Ambrisentan (AMBITION and ARIES-E)</b>	<b>Combination with tadalafil (AMBITION)</b>
<i>Blood and lymphatic system disorders</i>			
Anaemia (decreased haemoglobin, decreased haematocrit)	Common <sup>1</sup>	Very common	Very common
<i>Immune system disorders</i>			
Hypersensitivity reactions (e.g. angioedema, rash, pruritus)	Uncommon	Common	Common
<i>Nervous system disorders</i>			
Headache (including sinus headache, migraine)	Very common <sup>2</sup>	Very common	Very common
Dizziness	Common <sup>3</sup>	Very common	Very common
<i>Eye disorders</i>			
Blurred vision, visual impairment	Not known <sup>4</sup>	Common	Common
<i>Ear and labyrinth disorders</i>			
Tinnitus	NR	NR	Common
Sudden hearing loss	NR	NR	Uncommon
<i>Cardiac disorders</i>			
Cardiac failure	Common <sup>5</sup>	Common	Common
Palpitation	Common	Very common	Very common

<i>Vascular disorders</i>			
Hypotension	Common <sup>3</sup>	Common	Common
Flushing	Common	Common	Very common
Syncope	Uncommon <sup>3</sup>	Common	Common
<i>Respiratory, thoracic and mediastinal disorders</i>			
Epistaxis	Common <sup>3</sup>	Common	Common
Dyspnoea	Common <sup>3,6</sup>	Very common	Very common
Upper respiratory (e.g. nasal, sinus) congestion, sinusitis, nasopharyngitis, rhinitis	Common <sup>7</sup>		
Nasopharyngitis		Very common	Very common
Sinusitis, rhinitis		Common	Common
Nasal congestion		Very common	Very common
<i>Gastrointestinal disorders</i>			
Nausea, vomiting, diarrhoea	Common <sup>3</sup>		
Nausea		Very common	Very common
Vomiting		Common	Very common
Diarrhoea		Very common	Very common
Abdominal pain	Common	Common	Common
Constipation	Common	Common	Common
<i>Hepatobiliary disorders</i>			
Hepatic injury (see section 4.4)	Uncommon <sup>3,8</sup>	NR	NR
Autoimmune hepatitis (see section 4.4)	Uncommon <sup>3,8</sup>	NR	NR
Hepatic transaminases increased	Common <sup>3</sup>	NR	NR
<i>Skin and subcutaneous tissue disorders</i>			
Rash	NR	Common <sup>9</sup>	Very common <sup>9</sup>
<i>General disorders and administration site conditions</i>			
Peripheral oedema, fluid retention	Very common	Very common	Very common
Chest pain/discomfort	Common	Common	Very common

Asthenia	Common <sup>3</sup>	Common	Common
Fatigue	Common <sup>3</sup>	Very common	Very common

NR – not reported

<sup>1</sup> See section ‘*Description of selected adverse reactions*’.

<sup>2</sup> The frequency of headache appeared higher with 10 mg ambrisentan.

<sup>3</sup> Data derived from routine pharmacovigilance surveillance and frequencies based on placebo-controlled clinical trial experience.

<sup>4</sup> Data derived from routine pharmacovigilance surveillance

<sup>5</sup> Most of the reported cases of cardiac failure were associated with fluid retention. Data derived from routine pharmacovigilance surveillance, frequencies based on statistical modelling of placebo-controlled clinical trial data.

<sup>6</sup> Cases of worsening dyspnoea of unclear aetiology have been reported shortly after starting ambrisentan therapy.

<sup>7</sup> The incidence of nasal congestion was dose related during ambrisentan therapy.

<sup>8</sup> Cases of autoimmune hepatitis, including cases of exacerbation of autoimmune hepatitis, and hepatic injury have been reported during ambrisentan therapy.

<sup>9</sup> Rash includes rash erythematous, rash generalised, rash papular and rash pruritic

### Description of selected adverse reactions

#### Decreased haemoglobin

In the post-marketing period, cases of anaemia requiring blood cell transfusion have been reported (see section 4.4). The frequency of decreased haemoglobin (anaemia) was higher with 10 mg ambrisentan. Across the 12 week placebo controlled Phase 3 clinical studies, mean haemoglobin concentrations decreased for patients in the ambrisentan groups and were detected as early as week 4 (decrease by 0.83 g/dL); mean changes from baseline appeared to stabilise over the subsequent 8 weeks. A total of 17 patients (6.5%) in the ambrisentan treatment groups had decreases in haemoglobin of  $\geq 15\%$  from baseline and which fell below the lower limit of normal.

#### Reporting of suspected adverse reactions

Reporting suspected adverse reactions after authorisation of the medicinal product is important. It allows continued monitoring of the benefit/risk balance of the medicinal product. Healthcare professionals are asked to report any suspected adverse reactions via **the national reporting system listed in [Appendix V](#)**.

## **4.9 Overdose**

There is no experience in PAH patients of ambrisentan at daily doses greater than 10 mg. In healthy volunteers, single doses of 50 and 100 mg (5 to 10 times the maximum recommended dose) were associated with headache, flushing, dizziness, nausea and nasal congestion.

Due to the mechanism of action, an overdose of ambrisentan could potentially result in hypotension (see section 5.3). In the case of pronounced hypotension, active cardiovascular support may be required. No specific antidote is available.

## **5. PHARMACOLOGICAL PROPERTIES**

### **5.1 Pharmacodynamic properties**

Pharmacotherapeutic group: Anti-hypertensives, other anti-hypertensives, ATC code: C02KX02

## Mechanism of action

Ambrisentan is an orally active, propanoic acid-class, ERA selective for the endothelin A (ET<sub>A</sub>) receptor. Endothelin plays a significant role in the pathophysiology of PAH.

- Ambrisentan is a potent (K<sub>i</sub> 0.016 nM) and highly selective ET<sub>A</sub> antagonist (approximately 4000-fold more selective for ET<sub>A</sub> as compared to ET<sub>B</sub>).
- Ambrisentan blocks the ET<sub>A</sub> receptor subtype, localized predominantly on vascular smooth muscle cells and cardiac myocytes. This prevents endothelin-mediated activation of second messenger systems that result in vasoconstriction and smooth muscle cell proliferation.
- The selectivity of ambrisentan for the ET<sub>A</sub> over the ET<sub>B</sub> receptor is expected to retain ET<sub>B</sub> receptor mediated production of the vasodilators nitric oxide and prostacyclin.

## Clinical efficacy and safety

Two randomised, double-blind, multi-centre, placebo controlled, Phase 3 pivotal studies were conducted (ARIES-1 and 2). ARIES-1 included 201 patients and compared ambrisentan 5 mg and 10 mg with placebo. ARIES-2 included 192 patients and compared ambrisentan 2.5 mg and 5 mg with placebo. In both studies, ambrisentan was added to patients' supportive/background medication, which could have included a combination of digoxin, anticoagulants, diuretics, oxygen and vasodilators (calcium channel blockers, ACE inhibitors). Patients enrolled had IPAH or PAH associated with connective tissue disease (PAH-CTD). The majority of patients had WHO functional Class II (38.4%) or Class III (55.0%) symptoms. Patients with pre-existent hepatic disease (cirrhosis or clinically significantly elevated aminotransferases) and patients using other targeted therapy for PAH (e.g. prostanoids) were excluded. Haemodynamic parameters were not assessed in these studies.

The primary endpoint defined for the Phase 3 studies was improvement in exercise capacity assessed by change from baseline in 6 minute walk distance (6MWD) at 12 weeks. In both studies, treatment with ambrisentan resulted in a significant improvement in 6MWD for each dose of ambrisentan.

The placebo-adjusted improvement in mean 6MWD at week 12 compared to baseline was 30.6 m (95% CI: 2.9 to 58.3; p=0.008) and 59.4 m (95% CI: 29.6 to 89.3; p<0.001) for the 5 mg group, in ARIES 1 and 2 respectively. The placebo-adjusted improvement in mean 6MWD at week 12 in patients in the 10 mg group in ARIES-1 was 51.4 m (95% CI: 26.6 to 76.2; p<0.001).

A pre-specified combined analysis of the Phase 3 studies (ARIES-C) was conducted. The placebo-adjusted mean improvement in 6MWD was 44.6 m (95% CI: 24.3 to 64.9; p<0.001) for the 5 mg dose, and 52.5 m (95% CI: 28.8 to 76.2; p<0.001) for the 10 mg dose.

In ARIES-2, ambrisentan (combined dose group) significantly delayed the time to clinical worsening of PAH compared to placebo (p<0.001), the hazard ratio demonstrated an 80% reduction (95% CI: 47% to 92%). The measure included: death, lung transplantation, hospitalisation for PAH, atrial septostomy, addition of other PAH therapeutic agents and early escape criteria. A statistically significant increase (3.41 ± 6.96) was observed for the combined dose group in the physical functioning scale of the SF-36 Health Survey compared with placebo (-0.20 ± 8.14, p=0.005). Treatment with ambrisentan led to a statistically significant improvement in Borg Dyspnea Index (BDI) at week 12 (placebo-adjusted BDI of -1.1 (95% CI: -1.8 to -0.4; p=0.019; combined dose group)).

## Long term data

Patients enrolled into ARIES-1 and 2 were eligible to enter a long term open label extension study ARIES-E (n=383). The combined mean exposure was approximately 145 ± 80 weeks, and the maximum exposure was approximately 295 weeks. The main primary endpoints of this study were the incidence and severity of adverse events associated with long-term exposure to ambrisentan, including

serum LFTs. The safety findings observed with long-term ambrisentan exposure in this study were generally consistent with those observed in the 12 week placebo-controlled studies.

The observed probability of survival for subjects receiving ambrisentan (combined ambrisentan dose group) at 1, 2 and 3 years was 93%, 85% and 79% respectively.

In an open label study (AMB222), ambrisentan was studied in 36 patients to evaluate the incidence of increased serum aminotransferase concentrations in patients who had previously discontinued other ERA therapy due to aminotransferase abnormalities. During a mean of 53 weeks of treatment with ambrisentan, none of the patients enrolled had a confirmed serum ALT >3xULN that required permanent discontinuation of treatment. Fifty percent of patients had increased from 5 mg to 10 mg ambrisentan during this time.

The cumulative incidence of serum aminotransferase abnormalities >3xULN in all Phase 2 and 3 studies (including respective open label extensions) was 17 of 483 subjects over a mean exposure duration of 79.5 weeks. This is an event rate of 2.3 events per 100 patient years of exposure for ambrisentan. In the ARIES-E open label long term extension study, the 2 year risk of developing serum aminotransferase elevations >3xULN in patients treated with ambrisentan was 3.9%.

#### Other clinical information

An improvement in haemodynamic parameters was observed in patients with PAH after 12 weeks (n=29) in a Phase 2 study (AMB220). Treatment with ambrisentan resulted in an increase in mean cardiac index, a decrease in mean pulmonary artery pressure, and a decrease in mean pulmonary vascular resistance.

Decrease in systolic and diastolic blood pressures has been reported with ambrisentan therapy. In placebo controlled clinical trials of 12 weeks duration mean reduction in systolic and diastolic blood pressures from base line to end of treatment were 3mm Hg and 4.2 mm Hg respectively. The mean decreases in systolic and diastolic blood pressures persisted for up to 4 years of treatment with ambrisentan in the long term open label ARIES E study.

No clinically meaningful effects on the pharmacokinetics of ambrisentan or sildenafil were seen during a drug-drug interaction study in healthy volunteers, and the combination was well tolerated. The number of patients who received concomitant ambrisentan and sildenafil in ARIES-E and AMB222 was 22 patients (5.7%) and 17 patients (47%), respectively. No additional safety concerns were identified in these patients.

#### Clinical efficacy in combination with tadalafil

A multicenter, double-blind, active comparator, event-driven, Phase 3 outcome study (AMB112565/AMBITION) was conducted to assess the efficacy of initial combination of ambrisentan and tadalafil vs. monotherapy of either ambrisentan or tadalafil alone, in 500 treatment naive PAH patients, randomised 2:1:1, respectively. No patients received placebo alone. The primary analysis was combination group vs. pooled monotherapy groups. Supportive comparisons of combination therapy group vs. the individual monotherapy groups were also made. Patients with significant anaemia, fluid retention or rare retinal diseases were excluded according to the investigators' criteria. Patients with ALT and AST values >2xULN at baseline were also excluded.

At baseline, 96% of patients were naive to any previous PAH-specific treatment, and the median time from diagnosis to entry into the study was 22 days. Patients started on ambrisentan 5 mg and tadalafil 20 mg, and were titrated to 40 mg tadalafil at week 4 and 10 mg ambrisentan at week 8, unless there were tolerability issues. The median double-blind treatment duration for combination therapy was greater than 1.5 years.

The primary endpoint was the time to first occurrence of a clinical failure event, defined as:

- death, or
- hospitalisation for worsening PAH,
- disease progression;
- unsatisfactory long-term clinical response.

The mean age of all patients was 54 years (SD 15; range 18–75 years of age). Patients WHO FC at baseline was II (31%) and FC III (69%). Idiopathic or heritable PAH was the most common aetiology in the study population (56%), followed by PAH due to connective tissue disorders (37%), PAH associated with drugs and toxins (3%), corrected simple congenital heart disease (2%), and HIV (2%). Patients with WHO FC II and III had a mean baseline 6MWD of 353 metres.

### Outcome endpoints

Treatment with combination therapy resulted in a 50% risk reduction (hazard ratio [HR] 0.502; 95% CI: 0.348 to 0.724; p=0.0002) of the composite clinical failure endpoint up to final assessment visit when compared to the pooled monotherapy group [Figure 1 and Table 1]. The treatment effect was driven by a 63% reduction in hospitalisations on combination therapy, was established early and was sustained. Efficacy of combination therapy on the primary endpoint was consistent on the comparison to individual monotherapy and across the subgroups of age, ethnic origin, geographical region, aetiology (iPAH /hPAH and PAH-CTD). The effect was significant for both FC II and FC III patients.

Figure 1

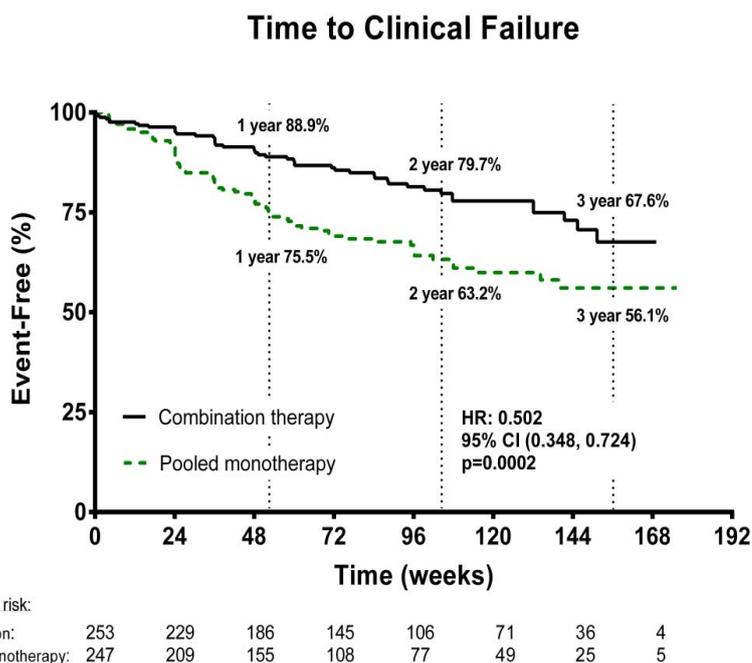


Table 1

	<b>Ambrisentan + Tadalafil (N=253)</b>	<b>Monotherapy Pooled (N=247)</b>	<b>Ambrisentan monotherapy (N=126)</b>	<b>Tadalafil monotherapy (N=121)</b>
<b>Time to First Clinical Failure Event (Adjudicated)</b>				
Clinical failure, no. (%)	46 (18%)	77 (31%)	43 (34)	34 (28)
Hazard ratio (95% CI)		0.502 (0.348, 0.724)	0.477 (0.314, 0.723)	0.528 (0.338, 0.827)
P-value, Log-rank test		0.0002	0.0004	0.0045

<b>Component as First Clinical Failure Event (Adjudicated)</b>				
Death (all-cause)	9 (4%)	8 (3%)	2 (2)	6 (5)
Hospitalisation for worsening PAH	10 (4%)	30 (12%)	18 (14)	12 (10)
Disease progression	10 (4%)	16 (6%)	12 (10)	4 (3)
Unsatisfactory long-term clinical response	17 (7%)	23 (9%)	11 (9)	12 (10)
<b>Time to First Hospitalisation for Worsening PAH (Adjudicated)</b>				
First hospitalisation, no. (%)	19 (8%)	44 (18%)	27 (21%)	17 (14%)
Hazard ratio (95% CI)		0.372	0.323	0.442
P-value, Log-rank test		0.0002	<0.0001	0.0124

### Secondary endpoints

Secondary endpoints were tested:

Table 2

Secondary Endpoints (change from baseline to week 24)	<b>Ambrisentan + Tadalafil</b>	<b>Monotherapy pooled</b>	Difference and Confidence Interval	p value
NT-proBNP (% reduction)	-67.2	-50.4	% difference -33.8; 95% CI: -44.8, -20.7	p<0.0001
% subjects achieving a satisfactory clinical response at week 24	39	29	Odds ratio 1.56; 95% CI: 1.05, 2.32	p=0.026
6MWD (metres, median change)	49.0	23.8	22.75m; 95% CI: 12.00, 33.50	p<0.0001

### Idiopathic Pulmonary Fibrosis

A study of 492 patients (ambrisentan N=329, placebo N=163) with idiopathic pulmonary fibrosis (IPF), 11% of which had secondary pulmonary hypertension (WHO group 3), has been conducted, but was terminated early when it was determined that the primary efficacy endpoint could not be met (ARTEMIS-IPF study). Ninety events (27%) of IPF progression (including respiratory hospitalisations) or death were observed in the ambrisentan group compared to 28 events (17%) in the placebo group. Ambrisentan is therefore contraindicated for patients with IPF with or without secondary pulmonary hypertension (see section 4.3).

## 5.2 Pharmacokinetic properties

### Absorption

Ambrisentan is absorbed rapidly in humans. After oral administration, maximum plasma concentrations ( $C_{max}$ ) of ambrisentan typically occur around 1.5 hours post-dose under both fasted and fed conditions.  $C_{max}$  and area under the plasma concentration-time curve (AUC) increase dose proportionally over the therapeutic dose range. Steady-state is generally achieved following 4 days of repeat dosing.

A food-effect study involving administration of ambrisentan to healthy volunteers under fasting conditions and with a high-fat meal indicated that the  $C_{max}$  was decreased 12% while the AUC remained unchanged. This decrease in peak concentration is not clinically significant, and therefore ambrisentan can be taken with or without food.

### Distribution

Ambrisentan is highly plasma protein bound. The *in vitro* plasma protein binding of ambrisentan was, on average, 98.8% and independent of concentration over the range of 0.2 – 20 microgram/ml. Ambrisentan is primarily bound to albumin (96.5%) and to a lesser extent to alpha<sub>1</sub>-acid glycoprotein.

The distribution of ambrisentan into red blood cells is low, with a mean blood:plasma ratio of 0.57 and 0.61 in males and females, respectively.

### Biotransformation

Ambrisentan is a non-sulphonamide (propanoic acid) ERA.

Ambrisentan is glucuronidated via several UGT isoenzymes (UGT1A9S, UGT2B7S and UGT1A3S) to form ambrisentan glucuronide (13%). Ambrisentan also undergoes oxidative metabolism mainly by CYP3A4 and to a lesser extent by CYP3A5 and CYP2C19 to form 4-hydroxymethyl ambrisentan (21%) which is further glucuronidated to 4-hydroxymethyl ambrisentan glucuronide (5%). The binding affinity of 4-hydroxymethyl ambrisentan for the human endothelin receptor is 65-fold less than ambrisentan. Therefore at concentrations observed in the plasma (approximately 4% relative to parent ambrisentan), 4-hydroxymethyl ambrisentan is not expected to contribute to pharmacological activity of ambrisentan.

*In vitro* data indicate that ambrisentan at 300  $\mu$ M resulted in less than 50 % inhibition of UGT1A1, UGT1A6, UGT1A9, UGT2B7 (up to 30%) or of cytochrome P450 enzymes 1A2, 2A6, 2B6, 2C8, 2C9, 2C19, 2D6, 2E1 and 3A4 (up to 25%). *In vitro*, ambrisentan has no inhibitory effect on human transporters at clinically relevant concentrations, including Pgp, BCRP, MRP2, BSEP, OATP1B1, OATP1B3 and NTCP. Furthermore, ambrisentan did not induce MRP2, Pgp or BSEP protein expression in rat hepatocytes. Taken together, the *in vitro* data suggest ambrisentan at clinically relevant concentrations (plasma  $C_{max}$  up to 3.2  $\mu$ M) would not be expected to have an effect on UGT1A1, UGT1A6, UGT1A9, UGT2B7 or cytochrome P450 enzymes 1A2, 2A6, 2B6, 2C8, 2C9, 2C19, 2D6, 2E1, 3A4 or transport via BSEP, BCRP, Pgp, MRP2, OATP1B1/3, or NTCP.

The effects of steady-state ambrisentan (10 mg once daily) on the pharmacokinetics and pharmacodynamics of a single dose of warfarin (25 mg), as measured by PT and INR, were investigated in 20 healthy volunteers. Ambrisentan did not have any clinically relevant effects on the pharmacokinetics or pharmacodynamics of warfarin. Similarly, co-administration with warfarin did not affect the pharmacokinetics of ambrisentan (see section 4.5).

The effect of 7-day dosing of sildenafil (20 mg three times daily) on the pharmacokinetics of a single dose of ambrisentan, and the effects of 7-day dosing of ambrisentan (10 mg once daily) on the

pharmacokinetics of a single dose of sildenafil were investigated in 19 healthy volunteers. With the exception of a 13% increase in sildenafil  $C_{\max}$  following co-administration with ambrisentan, there were no other changes in the pharmacokinetic parameters of sildenafil, N-desmethyl-sildenafil and ambrisentan. This slight increase in sildenafil  $C_{\max}$  is not considered clinically relevant (see section 4.5).

The effects of steady-state ambrisentan (10 mg once daily) on the pharmacokinetics of a single dose of tadalafil, and the effects of steady-state tadalafil (40 mg once daily) on the pharmacokinetics of a single dose of ambrisentan were studied in 23 healthy volunteers. Ambrisentan did not have any clinically relevant effects on the pharmacokinetics of tadalafil. Similarly, co-administration with tadalafil did not affect the pharmacokinetics of ambrisentan (see section 4.5).

The effects of repeat dosing of ketoconazole (400 mg once daily) on the pharmacokinetics of a single dose of 10 mg ambrisentan were investigated in 16 healthy volunteers. Exposures of ambrisentan as measured by  $AUC_{(0-\text{inf})}$  and  $C_{\max}$  were increased by 35% and 20%, respectively. This change in exposure is unlikely to be of any clinical relevance and therefore ambrisentan may be co-administered with ketoconazole.

The effects of repeat dosing of cyclosporine A (100 – 150 mg twice daily) on the steady-state pharmacokinetics of ambrisentan (5 mg once daily), and the effects of repeat dosing of ambrisentan (5 mg once daily) on the steady-state pharmacokinetics of cyclosporine A (100 – 150 mg twice daily) were studied in healthy volunteers. The  $C_{\max}$  and  $AUC(0-\tau)$  of ambrisentan increased (48% and 121%, respectively) in the presence of multiple doses of cyclosporine A. Based on these changes, the dose of ambrisentan should be limited to 5 mg once daily when co-administered with cyclosporine A (see section 4.2). However, multiple doses of ambrisentan had no clinically relevant effect on cyclosporine A exposure, and no dose adjustment of cyclosporine A is warranted.

The effects of acute and repeat dosing of rifampicin (600 mg once daily) on the steady-state pharmacokinetics of ambrisentan (10 mg once daily) were studied in healthy volunteers. Following initial doses of rifampicin, a transient increase in ambrisentan  $AUC(0-\tau)$  (121% and 116% after first and second doses of rifampicin, respectively) was observed, presumably due to a rifampicin-mediated OATP inhibition. However, there was no clinically relevant effect on ambrisentan exposure by day 8, following administration of multiple doses of rifampicin. Patients on ambrisentan therapy should be closely monitored when starting treatment with rifampicin (see sections 4.4 and 4.5).

The effects of repeat dosing of ambrisentan (10 mg) on the pharmacokinetics of single dose digoxin were studied in 15 healthy volunteers. Multiple doses of ambrisentan resulted in slight increases in digoxin  $AUC_{0-\text{last}}$  and trough concentrations, and a 29% increase in digoxin  $C_{\max}$ . The increase in digoxin exposure observed in the presence of multiple doses of ambrisentan was not considered clinically relevant, and no dose adjustment of digoxin is warranted (see section 4.5).

The effects of 12 days dosing with ambrisentan (10 mg once daily) on the pharmacokinetics of a single dose of oral contraceptive containing ethinyl estradiol (35  $\mu\text{g}$ ) and norethindrone (1 mg) were studied in healthy female volunteers. The  $C_{\max}$  and  $AUC_{(0-\infty)}$  were slightly decreased for ethinyl estradiol (8% and 4%, respectively), and slightly increased for norethindrone (13% and 14 %, respectively). These changes in exposure to ethinyl estradiol or norethindrone were small and are unlikely to be clinically significant (see section 4.5).

### Elimination

Ambrisentan and its metabolites are eliminated primarily in the bile following hepatic and/or extra-hepatic metabolism. Approximately 22% of the administered dose is recovered in the urine following oral administration with 3.3% being unchanged ambrisentan. Plasma elimination half-life in humans ranges from 13.6 to 16.5 hours.

## Special populations

Based on the results of a population pharmacokinetic analysis in healthy volunteers and patients with PAH, the pharmacokinetics of ambrisentan were not significantly influenced by gender or age (see section 4.2).

### *Renal impairment*

Ambrisentan does not undergo significant renal metabolism or renal clearance (excretion). In a population pharmacokinetic analysis, creatinine clearance was found to be a statistically significant covariate affecting the oral clearance of ambrisentan. The magnitude of the decrease in oral clearance is modest (20-40%) in patients with moderate renal impairment and therefore is unlikely to be of any clinical relevance. However, caution should be used in patients with severe renal impairment (see section 4.2).

### *Hepatic impairment*

The main routes of metabolism of ambrisentan are glucuronidation and oxidation with subsequent elimination in the bile and therefore hepatic impairment might be expected to increase exposure ( $C_{max}$  and AUC) of ambrisentan. In a population pharmacokinetic analysis, the oral clearance was shown to be decreased as a function of increasing bilirubin levels. However, the magnitude of effect of bilirubin is modest (compared to the typical patient with a bilirubin of 0.6 mg/dl, a patient with an elevated bilirubin of 4.5 mg/dl would have approximately 30% lower oral clearance of ambrisentan). The pharmacokinetics of ambrisentan in patients with hepatic impairment (with or without cirrhosis) has not been studied. Therefore ambrisentan should not be initiated in patients with severe hepatic impairment or clinically significant elevated hepatic aminotransferases ( $>3xULN$ ) (see sections 4.3 and 4.4).

## **5.3 Preclinical safety data**

Due to the class primary pharmacologic effect, a large single dose of ambrisentan (i.e. an overdose) could lower arterial pressure and have the potential for causing hypotension and symptoms related to vasodilation.

Ambrisentan was not shown to be an inhibitor of bile acid transport or to produce overt hepatotoxicity.

Inflammation and changes in the nasal cavity epithelium have been seen in rodents after chronic administration at exposures below the therapeutic levels in humans. In dogs, slight inflammatory responses were observed following chronic high dose administration of ambrisentan at exposures greater than 20-fold that observed in patients.

Nasal bone hyperplasia of the ethmoid turbinates has been observed in the nasal cavity of rats treated with ambrisentan, at exposure levels 3-fold the clinical AUC. Nasal bone hyperplasia has not been observed with ambrisentan in mice or dogs. In the rat, hyperplasia of nasal turbinate bone is a recognised response to nasal inflammation, based on experience with other compounds.

Ambrisentan was clastogenic when tested at high concentrations in mammalian cells *in vitro*. No evidence for mutagenic or genotoxic effects of ambrisentan were seen in bacteria or in two *in vivo* rodent studies.

There was no evidence of carcinogenic potential in 2 year oral studies in rats and mice. There was a small increase in mammary fibroadenomas, a benign tumor, in male rats at the highest dose only. Systemic exposure to ambrisentan in male rats at this dose (based on steady-state AUC) was 6-fold that achieved at the 10 mg/day clinical dose.

Testicular tubular atrophy, which was occasionally associated with aspermia, was observed in oral repeat dose toxicity and fertility studies with male rats and mice without safety margin. The testicular changes were not fully recoverable during the off-dose periods evaluated. However no testicular changes were observed in dog studies of up to 39 weeks duration at an exposure 35-fold that seen in humans based on AUC. In male rats, there were no effects of ambrisentan on sperm motility at all doses tested (up to 300 mg/kg/day). A slight (<10%) decrease in the percentage of morphologically normal sperms was noted at 300 mg/kg/day but not at 100 mg/kg/day (>9-fold clinical exposure at 10 mg/day). The effect of ambrisentan on male human fertility is not known.

Ambrisentan has been shown to be teratogenic in rats and rabbits. Abnormalities of the lower jaw, tongue, and/or palate were seen at all doses tested. In addition, the rat study showed an increased incidence of interventricular septal defects, trunk vessel defects, thyroid and thymus abnormalities, ossification of the basisphenoid bone, and the occurrence of the umbilical artery located on the left side of the urinary bladder instead of the right side. Teratogenicity is a suspected class effect of ERAs.

Administration of ambrisentan to female rats from late-pregnancy through lactation caused adverse events on maternal behaviour, reduced pup survival and impairment of the reproductive capability of the offspring (with observation of small testes at necropsy), at exposure 3-fold the AUC at the maximum recommended human dose.

## **6. PHARMACEUTICAL PARTICULARS**

### **6.1 List of excipients**

#### Tablet core

Lactose monohydrate  
Microcrystalline cellulose  
Croscarmellose sodium  
Magnesium stearate

#### Film coat

Polyvinyl alcohol (partially hydrolysed)  
Talc (E553b)  
Titanium dioxide (E171)  
Macrogol 3350  
Lecithin (soya) (E322)  
Allura red AC Aluminium Lake (E129)

### **6.2 Incompatibilities**

Not applicable.

### **6.3 Shelf life**

5 years.

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

This medicinal product does not require any special storage conditions.

### **6.5 Nature and contents of container**

PVC/PVDC/aluminium foil blisters.  
Pack sizes with unit dose blisters of 10x1 or 30x1 film-coated tablets.  
Not all pack sizes may be marketed.

## **6.6 Special precautions for disposal**

No special requirements for disposal.

## **7. MARKETING AUTHORISATION HOLDER**

Glaxo Group Ltd  
980 Great West Road  
Brentford  
Middlesex  
TW8 9GS  
United Kingdom

## **8. MARKETING AUTHORISATION NUMBER(S)**

EU/1/08/451/001

EU/1/08/451/002

## **9. DATE OF FIRST AUTHORISATION/RENEWAL OF THE AUTHORISATION**

Date of first authorisation: 21 April 2008

Date of latest renewal: 24 April 2013

## **10. DATE OF REVISION OF THE TEXT**

{MM/YYYY}

Detailed information on this medicinal product is available on the website of the European Medicines Agency <http://www.ema.europa.eu>.

## 1. NAME OF THE MEDICINAL PRODUCT

Volibris 10 mg film-coated tablets

## 2. QUALITATIVE AND QUANTITATIVE COMPOSITION

Each tablet contains 10 mg of ambrisentan.

### Excipient(s) with known effect:

Each tablet contains approximately 90 mg of lactose (as monohydrate), approximately 0.25 mg of lecithin (soya) (E322) and approximately 0.45 mg of Allura red AC Aluminium Lake (E129).

For the full list of excipients, see section 6.1.

## 3. PHARMACEUTICAL FORM

Film-coated tablet (tablet).

Deep-pink, oval, convex, film-coated tablet with “GS” debossed on one side and “KE3” on the other side.

## 4. CLINICAL PARTICULARS

### 4.1 Therapeutic indications

Volibris is indicated for treatment of pulmonary arterial hypertension (PAH) in adult patients of WHO Functional Class (FC) II to III, including use in combination treatment (see section 5.1). Efficacy has been shown in idiopathic PAH (IPAH) and in PAH associated with connective tissue disease.

### 4.2 Posology and method of administration

Treatment must be initiated by a physician experienced in the treatment of PAH.

#### Posology

##### *Ambrisentan monotherapy*

Volibris is to be taken orally to begin at a dose of 5 mg once daily and may be increased to 10 mg daily depending upon clinical response and tolerability.

##### *Ambrisentan in combination with tadalafil*

When used in combination with tadalafil, Volibris should be titrated to 10 mg once daily.

In the AMBITION study, patients received 5 mg ambrisentan daily for the first 8 weeks before up titrating to 10 mg, dependent on tolerability (see section 5.1). When used in combination with tadalafil, patients were initiated with 5 mg ambrisentan and 20 mg tadalafil. Dependent on tolerability the dose of tadalafil was increased to 40 mg after 4 weeks and the dose of ambrisentan was increased to 10 mg after 8 weeks. More than 90% of patients achieved this. Doses could also be decreased depending on tolerability.

Limited data suggest that the abrupt discontinuation of ambrisentan is not associated with rebound worsening of PAH.

When co-administered with cyclosporine A, the dose of ambrisentan should be limited to 5 mg once daily and the patient should be carefully monitored (see sections 4.5 and 5.2).

### Special populations

#### Elderly patients

No dose adjustment is required in patients over the age of 65 (see section 5.2).

#### Patients with renal impairment

No dose adjustment is required in patients with renal impairment (see section 5.2). There is limited experience with ambrisentan in individuals with severe renal impairment (creatinine clearance <30 ml/min); therapy should be initiated cautiously in this subgroup and particular care taken if the dose is increased to 10 mg ambrisentan.

#### Patients with hepatic impairment

Ambrisentan has not been studied in individuals with hepatic impairment (with or without cirrhosis). Since the main routes of metabolism of ambrisentan are glucuronidation and oxidation with subsequent elimination in the bile, hepatic impairment might be expected to increase exposure ( $C_{max}$  and AUC) to ambrisentan. Therefore ambrisentan must not be initiated in patients with severe hepatic impairment, or clinically significant elevated hepatic aminotransferases (greater than 3 times the Upper Limit of Normal (>3xULN); see sections 4.3 and 4.4).

#### Paediatric population

The safety and efficacy of ambrisentan in children and adolescents aged below 18 years has not been established. No data are available.

#### Method of administration

It is recommended that the tablet is swallowed whole and it can be taken with or without food. It is recommended that the tablet should not be split, crushed or chewed.

### **4.3 Contraindications**

Hypersensitivity to the active substance, to soya, or to any of the excipients listed in section 6.1.

Pregnancy (see section 4.6).

Women of child-bearing potential who are not using reliable contraception (see sections 4.4 and 4.6).

Breast-feeding (see section 4.6).

Severe hepatic impairment (with or without cirrhosis) (see section 4.2).

Baseline values of hepatic aminotransferases (aspartate aminotransferases (AST) and/or alanine aminotransferases (ALT))>3xULN (see sections 4.2 and 4.4).

Idiopathic pulmonary fibrosis (IPF), with or without secondary pulmonary hypertension (see section 5.1).

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

Ambrisentan has not been studied in a sufficient number of patients to establish the benefit/risk balance in WHO functional class I PAH.

The efficacy of ambrisentan as monotherapy has not been established in patients with WHO functional class IV PAH. Therapy that is recommended at the severe stage of the disease (e.g. epoprostenol) should be considered if the clinical condition deteriorates.

##### Liver function

Liver function abnormalities have been associated with PAH. Cases consistent with autoimmune hepatitis, including possible exacerbation of underlying autoimmune hepatitis, hepatic injury and hepatic enzyme elevations potentially related to therapy have been observed with ambrisentan (see sections 4.8 and 5.1). Therefore hepatic aminotransferases (ALT and AST) should be evaluated prior to initiation of ambrisentan and treatment should not be initiated in patients with baseline values of ALT and/or AST >3xULN (see section 4.3).

Patients should be monitored for signs of hepatic injury and monthly monitoring of ALT and AST is recommended. If patients develop sustained, unexplained, clinically significant ALT and/or AST elevation, or if ALT and/or AST elevation is accompanied by signs or symptoms of hepatic injury (e.g. jaundice), ambrisentan therapy should be discontinued.

In patients without clinical symptoms of hepatic injury or of jaundice, re-initiation of ambrisentan may be considered following resolution of hepatic enzyme abnormalities. The advice of a hepatologist is recommended.

##### Haemoglobin concentration

Reductions in haemoglobin concentrations and haematocrit have been associated with endothelin receptor antagonists (ERAs) including ambrisentan. Most of these decreases were detected during the first 4 weeks of treatment and haemoglobin generally stabilised thereafter. Mean decreases from baseline (ranging from 0.9 to 1.2 g/dL) in hemoglobin concentrations persisted for up to 4 years of treatment with ambrisentan in the long-term open-label extension of the pivotal Phase 3 clinical studies. In the post-marketing period, cases of anaemia requiring blood cell transfusion have been reported (see section 4.8).

Initiation of ambrisentan is not recommended for patients with clinically significant anaemia. It is recommended that haemoglobin and/or haematocrit levels are measured during treatment with ambrisentan, for example at 1 month, 3 months and periodically thereafter in line with clinical practice. If a clinically significant decrease in haemoglobin or haematocrit is observed, and other causes have been excluded, dose reduction or discontinuation of treatment should be considered. The incidence of anaemia was increased when ambrisentan was dosed in combination with tadalafil (15% adverse event frequency), compared to the incidence of anaemia when ambrisentan and tadalafil were given as monotherapy (7% and 11%, respectively).

##### Fluid retention

Peripheral oedema has been observed with ERAs including ambrisentan. Most cases of peripheral oedema in clinical studies with ambrisentan were mild to moderate in severity, although it may occur with greater frequency and severity in patients  $\geq 65$  years. Peripheral oedema was reported more frequently with 10 mg ambrisentan in short-term clinical studies (see section 4.8).

Post-marketing reports of fluid retention occurring within weeks after starting ambrisentan have been received and, in some cases, have required intervention with a diuretic or hospitalisation for fluid

management or decompensated heart failure. If patients have pre-existing fluid overload, this should be managed as clinically appropriate prior to starting ambrisentan.

If clinically significant fluid retention develops during therapy with ambrisentan, with or without associated weight gain, further evaluation should be undertaken to determine the cause, such as ambrisentan or underlying heart failure, and the possible need for specific treatment or discontinuation of ambrisentan therapy. The incidence of peripheral oedema was increased when ambrisentan was dosed in combination with tadalafil (45% adverse event frequency), compared to the incidence of peripheral oedema when ambrisentan and tadalafil were given as monotherapy (38% and 28%, respectively). The occurrence of peripheral oedema was highest within the first month of treatment initiation.

#### Women of child-bearing potential

Volibris treatment must not be initiated in women of child-bearing potential unless the result of a pre-treatment pregnancy test is negative and reliable contraception is practiced. If there is any doubt on what contraceptive advice should be given to the individual patient, consultation with a gynaecologist should be considered. Monthly pregnancy tests during treatment with ambrisentan are recommended (see sections 4.3 and 4.6).

#### Pulmonary veno-occlusive disease

Cases of pulmonary oedema have been reported with vasodilating medicinal products, such as ERAs, when used in patients with pulmonary veno-occlusive disease. Consequently, if PAH patients develop acute pulmonary oedema when treated with ambrisentan, the possibility of pulmonary veno-occlusive disease should be considered.

#### Concomitant use with other medicinal products

Patients on ambrisentan therapy should be closely monitored when starting treatment with rifampicin (see sections 4.5 and 5.2).

#### Excipients

Volibris tablets contain lactose. Patients with rare hereditary problems of galactose intolerance, the Lapp lactase deficiency or glucose-galactose malabsorption should not take this medicine.

Volibris tablets contain the azo colouring agent Allura red AC Aluminium Lake (E129), which can cause allergic reactions.

Volibris tablets contain lecithin derived from soya. If a patient is hypersensitive to soya, ambrisentan must not be used (see section 4.3).

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

Ambrisentan does not inhibit or induce phase I or II drug metabolising enzymes at clinically relevant concentrations in *in vitro* and *in vivo* non-clinical studies, suggesting a low potential for ambrisentan to alter the profile of medicinal products metabolised by these pathways.

The potential for ambrisentan to induce CYP3A4 activity was explored in healthy volunteers with results suggesting a lack of inductive effect of ambrisentan on the CYP3A4 isoenzyme.

#### Cyclosporine A

Steady-state co-administration of ambrisentan and cyclosporine A resulted in a 2-fold increase in ambrisentan exposure in healthy volunteers. This may be due to the inhibition by cyclosporine A of transporters and metabolic enzymes involved in the pharmacokinetics of ambrisentan. Therefore the

dose of ambrisentan should be limited to 5 mg once daily when co-administered with cyclosporine A (see section 4.2). Multiple doses of ambrisentan had no effect on cyclosporine A exposure, and no dose adjustment of cyclosporine A is warranted.

#### Rifampicin

Co-administration of rifampicin (an inhibitor of Organic Anion Transporting Polypeptide [OATP], a strong inducer of CYP3A and 2C19, and inducer of P-gp and uridine-diphosphoglucuronosyltransferases [UGTs]) was associated with a transient (approximately 2-fold) increase in ambrisentan exposure following initial doses in healthy volunteers. However, by day 8, steady state administration of rifampicin had no clinically relevant effect on ambrisentan exposure. Patients on ambrisentan therapy should be closely monitored when starting treatment with rifampicin (see sections 4.4 and 5.2).

#### Phosphodiesterase inhibitors

Co-administration of ambrisentan with a phosphodiesterase inhibitor, either sildenafil or tadalafil (both substrates of CYP3A4) in healthy volunteers did not significantly affect the pharmacokinetics of the phosphodiesterase inhibitor or ambrisentan (see section 5.2).

#### Other targeted PAH treatments

The efficacy and safety of ambrisentan when co-administered with other treatments for PAH (e.g. prostanoids and soluble guanylate cyclase stimulators) has not been specifically studied in controlled clinical trials in PAH patients (see section 5.1). No specific drug-drug interactions with soluble guanylate cyclase stimulators or prostanoids are anticipated based on the known biotransformation data (see section 5.2). However, no specific drug-drug interactions studies have been conducted with these drugs. Therefore, caution is recommended in the case of co-administration.

#### Oral contraceptives

In a clinical study in healthy volunteers, steady-state dosing with ambrisentan 10 mg once daily did not significantly affect the single-dose pharmacokinetics of the ethinyl estradiol and norethindrone components of a combined oral contraceptive (see section 5.2). Based on this pharmacokinetic study, ambrisentan would not be expected to significantly affect exposure to oestrogen- or progestogen-based contraceptives.

#### Warfarin

Ambrisentan had no effects on the steady-state pharmacokinetics and anti-coagulant activity of warfarin in a healthy volunteer study (see section 5.2). Warfarin also had no clinically significant effects on the pharmacokinetics of ambrisentan. In addition, in patients, ambrisentan had no overall effect on the weekly warfarin-type anticoagulant dose, prothrombin time (PT) and international normalised ratio (INR).

#### Ketoconazole

Steady-state administration of ketoconazole (a strong inhibitor of CYP3A4) did not result in a clinically significant increase in exposure to ambrisentan (see section 5.2).

#### Effect of ambrisentan on xenobiotic transporters

*In vitro*, ambrisentan has no inhibitory effect on human transporters at clinically relevant concentrations, including the P-glycoprotein (Pgp), breast cancer resistance protein (BCRP), multi-drug resistance related protein 2 (MRP2), bile salt export pump (BSEP), organic anion transporting polypeptides (OATP1B1 and OATP1B3) and the sodium-dependent taurocholate co-transporting polypeptide (NTCP).

Ambrisentan is a substrate for Pgp-mediated efflux.

*In vitro* studies in rat hepatocytes also showed that ambrisentan did not induce Pgp, BSEP or MRP2 protein expression.

Steady-state administration of ambrisentan in healthy volunteers had no clinically relevant effects on the single-dose pharmacokinetics of digoxin, a substrate for Pgp (see section 5.2).

#### **4.6 Fertility, pregnancy and lactation**

##### Women of childbearing potential

Ambrisentan treatment must not be initiated in women of child-bearing potential unless the result of a pre-treatment pregnancy test is negative and reliable contraception is practiced. Monthly pregnancy tests during treatment with ambrisentan are recommended.

##### Pregnancy

Ambrisentan is contraindicated in pregnancy (see section 4.3). Animal studies have shown that ambrisentan is teratogenic. There is no experience in humans.

Women receiving ambrisentan must be advised of the risk of foetal harm and alternative therapy initiated if pregnancy occurs (see sections 4.3, 4.4 and 5.3).

##### Breast-feeding

It is not known whether ambrisentan is excreted in human breast milk. The excretion of ambrisentan in milk has not been studied in animals. Therefore breast-feeding is contraindicated in patients taking ambrisentan (see section 4.3).

##### Male fertility

The development of testicular tubular atrophy in male animals has been linked to the chronic administration of ERAs, including ambrisentan (see section 5.3). Although no clear evidence of a detrimental effect of ambrisentan long-term exposure on sperm count was found in ARIES-E study, chronic administration of ambrisentan was associated with changes in markers of spermatogenesis. A decrease in plasma inhibin-B concentration and an increase in plasma FSH concentration were observed. The effect on male human fertility is not known but a deterioration of spermatogenesis cannot be excluded. Chronic administration of ambrisentan was not associated with a change in plasma testosterone in clinical studies.

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

Ambrisentan has minor or moderate influence on the ability to drive and use machines. The clinical status of the patient and the adverse reaction profile of ambrisentan (such as hypotension, dizziness, asthenia, fatigue) should be borne in mind when considering the patient's ability to perform tasks that require judgement, motor or cognitive skills (see section 4.8). Patients should be aware of how they might be affected by ambrisentan before driving or using machines.

#### **4.8 Undesirable effects**

##### Summary of the safety profile

The safety of ambrisentan has been evaluated as monotherapy and/or in combination in clinical trials of more than 1200 patients with PAH (see section 5.1). Adverse reactions identified from 12 week placebo controlled clinical trial data are included below by system organ class and frequency. Information from longer term non-placebo controlled studies (ARIES-E and AMBITION (combination with tadalafil)) is also included below. No previously unknown adverse reactions were identified with long-term treatment or for ambrisentan in combination with tadalafil. With longer observation in uncontrolled studies (mean observation of 79 weeks), the safety profile was similar to that observed in the short term studies. Routine pharmacovigilance data are also presented.

Peripheral oedema, fluid retention and headache (including sinus headache, migraine) were the most common adverse reactions observed with ambrisentan. The higher dose (10 mg) was associated with a higher incidence of these adverse reactions, and peripheral oedema tended to be more severe in patients  $\geq 65$  years in short-term clinical studies (see section 4.4).

#### Tabulated list of adverse reactions

Frequencies are defined as: 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 ( $<1/10,000$ ) and not known (cannot be estimated from available data). For dose-related adverse reactions the frequency category reflects the higher dose of ambrisentan. Frequency categories do not account for other factors including varying study duration, pre-existing conditions and baseline patient characteristics. Adverse reaction frequency categories assigned based on clinical trial experience may not reflect the frequency of adverse events occurring during normal clinical practice. Within each frequency grouping, adverse reactions are presented in order of decreasing seriousness.

	<b>Ambrisentan (ARIES-C and post marketing)</b>	<b>Ambrisentan (AMBITION and ARIES-E)</b>	<b>Combination with tadalafil (AMBITION)</b>
<i>Blood and lymphatic system disorders</i>			
Anaemia (decreased haemoglobin, decreased haematocrit)	Common <sup>1</sup>	Very common	Very common
<i>Immune system disorders</i>			
Hypersensitivity reactions (e.g. angioedema, rash, pruritus)	Uncommon	Common	Common
<i>Nervous system disorders</i>			
Headache (including sinus headache, migraine)	Very common <sup>2</sup>	Very common	Very common
Dizziness	Common <sup>3</sup>	Very common	Very common
<i>Eye disorders</i>			
Blurred vision, visual impairment	Not known <sup>4</sup>	Common	Common
<i>Ear and labyrinth disorders</i>			
Tinnitus	NR	NR	Common
Sudden hearing loss	NR	NR	Uncommon
<i>Cardiac disorders</i>			
Cardiac failure	Common <sup>5</sup>	Common	Common
Palpitation	Common	Very common	Very common

<i>Vascular disorders</i>			
Hypotension	Common <sup>3</sup>	Common	Common
Flushing	Common	Common	Very common
Syncope	Uncommon <sup>3</sup>	Common	Common
<i>Respiratory, thoracic and mediastinal disorders</i>			
Epistaxis	Common <sup>3</sup>	Common	Common
Dyspnoea	Common <sup>3,6</sup>	Very common	Very common
Upper respiratory (e.g. nasal, sinus) congestion, sinusitis, nasopharyngitis, rhinitis	Common <sup>7</sup>		
Nasopharyngitis		Very common	Very common
Sinusitis, rhinitis		Common	Common
Nasal congestion		Very common	Very common
<i>Gastrointestinal disorders</i>			
Nausea, vomiting, diarrhoea	Common <sup>3</sup>		
Nausea		Very common	Very common
Vomiting		Common	Very common
Diarrhoea		Very common	Very common
Abdominal pain	Common	Common	Common
Constipation	Common	Common	Common
<i>Hepatobiliary disorders</i>			
Hepatic injury (see section 4.4)	Uncommon <sup>3,8</sup>	NR	NR
Autoimmune hepatitis (see section 4.4)	Uncommon <sup>3,8</sup>	NR	NR
Hepatic transaminases increased	Common <sup>3</sup>	NR	NR
<i>Skin and subcutaneous tissue disorders</i>			
Rash	NR	Common <sup>9</sup>	Very common <sup>9</sup>
<i>General disorders and administration site conditions</i>			
Peripheral oedema, fluid retention	Very common	Very common	Very common
Chest pain/discomfort	Common	Common	Very common

Asthenia	Common <sup>3</sup>	Common	Common
Fatigue	Common <sup>3</sup>	Very common	Very common

NR – not reported

<sup>1</sup> See section ‘*Description of selected adverse reactions*’.

<sup>2</sup> The frequency of headache appeared higher with 10 mg ambrisentan.

<sup>3</sup> Data derived from routine pharmacovigilance surveillance and frequencies based on placebo-controlled clinical trial experience.

<sup>4</sup> Data derived from routine pharmacovigilance surveillance

<sup>5</sup> Most of the reported cases of cardiac failure were associated with fluid retention. Data derived from routine pharmacovigilance surveillance, frequencies based on statistical modelling of placebo-controlled clinical trial data.

<sup>6</sup> Cases of worsening dyspnoea of unclear aetiology have been reported shortly after starting ambrisentan therapy.

<sup>7</sup> The incidence of nasal congestion was dose related during ambrisentan therapy.

<sup>8</sup> Cases of autoimmune hepatitis, including cases of exacerbation of autoimmune hepatitis, and hepatic injury have been reported during ambrisentan therapy.

<sup>9</sup> Rash includes rash erythematous, rash generalised, rash papular and rash pruritic

### Description of selected adverse reactions

#### Decreased haemoglobin

In the post-marketing period, cases of anaemia requiring blood cell transfusion have been reported (see section 4.4). The frequency of decreased haemoglobin (anaemia) was higher with 10 mg ambrisentan. Across the 12 week placebo controlled Phase 3 clinical studies, mean haemoglobin concentrations decreased for patients in the ambrisentan groups and were detected as early as week 4 (decrease by 0.83 g/dL); mean changes from baseline appeared to stabilise over the subsequent 8 weeks. A total of 17 patients (6.5%) in the ambrisentan treatment groups had decreases in haemoglobin of  $\geq 15\%$  from baseline and which fell below the lower limit of normal.

#### Reporting of suspected adverse reactions

Reporting suspected adverse reactions after authorisation of the medicinal product is important. It allows continued monitoring of the benefit/risk balance of the medicinal product. Healthcare professionals are asked to report any suspected adverse reactions via **the national reporting system listed in [Appendix V](#)**.

## **4.9 Overdose**

There is no experience in PAH patients of ambrisentan at daily doses greater than 10 mg. In healthy volunteers, single doses of 50 and 100 mg (5 to 10 times the maximum recommended dose) were associated with headache, flushing, dizziness, nausea and nasal congestion.

Due to the mechanism of action, an overdose of ambrisentan could potentially result in hypotension (see section 5.3). In the case of pronounced hypotension, active cardiovascular support may be required. No specific antidote is available.

## **5. PHARMACOLOGICAL PROPERTIES**

### **5.1 Pharmacodynamic properties**

Pharmacotherapeutic group: Anti-hypertensives, other anti-hypertensives, ATC code: C02KX02

## Mechanism of action

Ambrisentan is an orally active, propanoic acid-class, ERA selective for the endothelin A (ET<sub>A</sub>) receptor. Endothelin plays a significant role in the pathophysiology of PAH.

- Ambrisentan is a potent (K<sub>i</sub> 0.016 nM) and highly selective ET<sub>A</sub> antagonist (approximately 4000-fold more selective for ET<sub>A</sub> as compared to ET<sub>B</sub>).
- Ambrisentan blocks the ET<sub>A</sub> receptor subtype, localized predominantly on vascular smooth muscle cells and cardiac myocytes. This prevents endothelin-mediated activation of second messenger systems that result in vasoconstriction and smooth muscle cell proliferation.
- The selectivity of ambrisentan for the ET<sub>A</sub> over the ET<sub>B</sub> receptor is expected to retain ET<sub>B</sub> receptor mediated production of the vasodilators nitric oxide and prostacyclin.

## Clinical efficacy and safety

Two randomised, double-blind, multi-centre, placebo controlled, Phase 3 pivotal studies were conducted (ARIES-1 and 2). ARIES-1 included 201 patients and compared ambrisentan 5 mg and 10 mg with placebo. ARIES-2 included 192 patients and compared ambrisentan 2.5 mg and 5 mg with placebo. In both studies, ambrisentan was added to patients' supportive/background medication, which could have included a combination of digoxin, anticoagulants, diuretics, oxygen and vasodilators (calcium channel blockers, ACE inhibitors). Patients enrolled had IPAH or PAH associated with connective tissue disease (PAH-CTD). The majority of patients had WHO functional Class II (38.4%) or Class III (55.0%) symptoms. Patients with pre-existent hepatic disease (cirrhosis or clinically significantly elevated aminotransferases) and patients using other targeted therapy for PAH (e.g. prostanoids) were excluded. Haemodynamic parameters were not assessed in these studies.

The primary endpoint defined for the Phase 3 studies was improvement in exercise capacity assessed by change from baseline in 6 minute walk distance (6MWD) at 12 weeks. In both studies, treatment with ambrisentan resulted in a significant improvement in 6MWD for each dose of ambrisentan.

The placebo-adjusted improvement in mean 6MWD at week 12 compared to baseline was 30.6 m (95% CI: 2.9 to 58.3; p=0.008) and 59.4 m (95% CI: 29.6 to 89.3; p<0.001) for the 5 mg group, in ARIES 1 and 2 respectively. The placebo-adjusted improvement in mean 6MWD at week 12 in patients in the 10 mg group in ARIES-1 was 51.4 m (95% CI: 26.6 to 76.2; p<0.001).

A pre-specified combined analysis of the Phase 3 studies (ARIES-C) was conducted. The placebo-adjusted mean improvement in 6MWD was 44.6 m (95% CI: 24.3 to 64.9; p<0.001) for the 5 mg dose, and 52.5 m (95% CI: 28.8 to 76.2; p<0.001) for the 10 mg dose.

In ARIES-2, ambrisentan (combined dose group) significantly delayed the time to clinical worsening of PAH compared to placebo (p<0.001), the hazard ratio demonstrated an 80% reduction (95% CI: 47% to 92%). The measure included: death, lung transplantation, hospitalisation for PAH, atrial septostomy, addition of other PAH therapeutic agents and early escape criteria. A statistically significant increase (3.41 ± 6.96) was observed for the combined dose group in the physical functioning scale of the SF-36 Health Survey compared with placebo (-0.20 ± 8.14, p=0.005). Treatment with ambrisentan led to a statistically significant improvement in Borg Dyspnea Index (BDI) at week 12 (placebo-adjusted BDI of -1.1 (95% CI: -1.8 to -0.4; p=0.019; combined dose group)).

## Long term data

Patients enrolled into ARIES-1 and 2 were eligible to enter a long term open label extension study ARIES-E (n=383). The combined mean exposure was approximately 145 ± 80 weeks, and the maximum exposure was approximately 295 weeks. The main primary endpoints of this study were the incidence and severity of adverse events associated with long-term exposure to ambrisentan, including

serum LFTs. The safety findings observed with long-term ambrisentan exposure in this study were generally consistent with those observed in the 12 week placebo-controlled studies.

The observed probability of survival for subjects receiving ambrisentan (combined ambrisentan dose group) at 1, 2 and 3 years was 93%, 85% and 79% respectively.

In an open label study (AMB222), ambrisentan was studied in 36 patients to evaluate the incidence of increased serum aminotransferase concentrations in patients who had previously discontinued other ERA therapy due to aminotransferase abnormalities. During a mean of 53 weeks of treatment with ambrisentan, none of the patients enrolled had a confirmed serum ALT >3xULN that required permanent discontinuation of treatment. Fifty percent of patients had increased from 5 mg to 10 mg ambrisentan during this time.

The cumulative incidence of serum aminotransferase abnormalities >3xULN in all Phase 2 and 3 studies (including respective open label extensions) was 17 of 483 subjects over a mean exposure duration of 79.5 weeks. This is an event rate of 2.3 events per 100 patient years of exposure for ambrisentan. In the ARIES-E open label long term extension study, the 2 year risk of developing serum aminotransferase elevations >3xULN in patients treated with ambrisentan was 3.9%.

#### Other clinical information

An improvement in haemodynamic parameters was observed in patients with PAH after 12 weeks (n=29) in a Phase 2 study (AMB220). Treatment with ambrisentan resulted in an increase in mean cardiac index, a decrease in mean pulmonary artery pressure, and a decrease in mean pulmonary vascular resistance.

Decrease in systolic and diastolic blood pressures has been reported with ambrisentan therapy. In placebo controlled clinical trials of 12 weeks duration mean reduction in systolic and diastolic blood pressures from base line to end of treatment were 3mm Hg and 4.2 mm Hg respectively. The mean decreases in systolic and diastolic blood pressures persisted for up to 4 years of treatment with ambrisentan in the long term open label ARIES E study.

No clinically meaningful effects on the pharmacokinetics of ambrisentan or sildenafil were seen during a drug-drug interaction study in healthy volunteers, and the combination was well tolerated. The number of patients who received concomitant ambrisentan and sildenafil in ARIES-E and AMB222 was 22 patients (5.7%) and 17 patients (47%), respectively. No additional safety concerns were identified in these patients.

#### Clinical efficacy in combination with tadalafil

A multicenter, double-blind, active comparator, event-driven, Phase 3 outcome study (AMB112565/AMBITION) was conducted to assess the efficacy of initial combination of ambrisentan and tadalafil vs. monotherapy of either ambrisentan or tadalafil alone, in 500 treatment naive PAH patients, randomised 2:1:1, respectively. No patients received placebo alone. The primary analysis was combination group vs. pooled monotherapy groups. Supportive comparisons of combination therapy group vs. the individual monotherapy groups were also made. Patients with significant anaemia, fluid retention or rare retinal diseases were excluded according to the investigators' criteria. Patients with ALT and AST values >2xULN at baseline were also excluded.

At baseline, 96% of patients were naive to any previous PAH-specific treatment, and the median time from diagnosis to entry into the study was 22 days. Patients started on ambrisentan 5 mg and tadalafil 20 mg, and were titrated to 40 mg tadalafil at week 4 and 10 mg ambrisentan at week 8, unless there were tolerability issues. The median double-blind treatment duration for combination therapy was greater than 1.5 years.

The primary endpoint was the time to first occurrence of a clinical failure event, defined as:

- death, or
- hospitalisation for worsening PAH,
- disease progression;
- unsatisfactory long-term clinical response.

The mean age of all patients was 54 years (SD 15; range 18–75 years of age). Patients WHO FC at baseline was II (31%) and FC III (69%). Idiopathic or heritable PAH was the most common aetiology in the study population (56%), followed by PAH due to connective tissue disorders (37%), PAH associated with drugs and toxins (3%), corrected simple congenital heart disease (2%), and HIV (2%). Patients with WHO FC II and III had a mean baseline 6MWD of 353 metres.

### Outcome endpoints

Treatment with combination therapy resulted in a 50% risk reduction (hazard ratio [HR] 0.502; 95% CI: 0.348 to 0.724; p=0.0002) of the composite clinical failure endpoint up to final assessment visit when compared to the pooled monotherapy group [Figure 1 and Table 1]. The treatment effect was driven by a 63% reduction in hospitalisations on combination therapy, was established early and was sustained. Efficacy of combination therapy on the primary endpoint was consistent on the comparison to individual monotherapy and across the subgroups of age, ethnic origin, geographical region, aetiology (iPAH /hPAH and PAH-CTD). The effect was significant for both FC II and FC III patients.

Figure 1

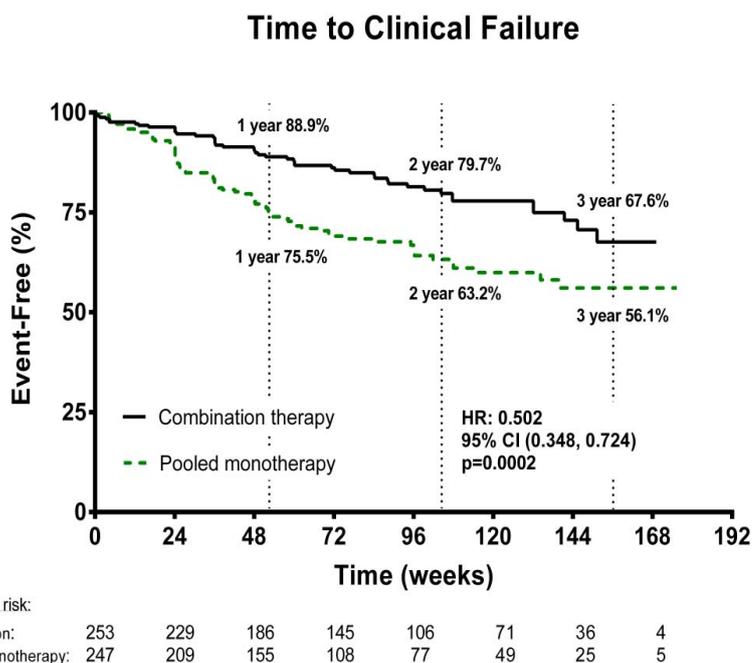


Table 1

	<b>Ambrisentan + Tadalafil (N=253)</b>	<b>Monotherapy Pooled (N=247)</b>	<b>Ambrisentan monotherapy (N=126)</b>	<b>Tadalafil monotherapy (N=121)</b>
<b>Time to First Clinical Failure Event (Adjudicated)</b>				
Clinical failure, no. (%)	46 (18%)	77 (31%)	43 (34)	34 (28)
Hazard ratio (95% CI)		0.502 (0.348, 0.724)	0.477 (0.314, 0.723)	0.528 (0.338, 0.827)
P-value, Log-rank test		0.0002	0.0004	0.0045

<b>Component as First Clinical Failure Event (Adjudicated)</b>				
Death (all-cause)	9 (4%)	8 (3%)	2 (2)	6 (5)
Hospitalisation for worsening PAH	10 (4%)	30 (12%)	18 (14)	12 (10)
Disease progression	10 (4%)	16 (6%)	12 (10)	4 (3)
Unsatisfactory long-term clinical response	17 (7%)	23 (9%)	11 (9)	12 (10)
<b>Time to First Hospitalisation for Worsening PAH (Adjudicated)</b>				
First hospitalisation, no. (%)	19 (8%)	44 (18%)	27 (21%)	17 (14%)
Hazard ratio (95% CI)		0.372	0.323	0.442
P-value, Log-rank test		0.0002	<0.0001	0.0124

### Secondary endpoints

Secondary endpoints were tested:

Table 2

Secondary Endpoints (change from baseline to week 24)	<b>Ambrisentan + Tadalafil</b>	<b>Monotherapy pooled</b>	Difference and Confidence Interval	p value
NT-proBNP (% reduction)	-67.2	-50.4	% difference -33.8; 95% CI: -44.8, -20.7	p<0.0001
% subjects achieving a satisfactory clinical response at week 24	39	29	Odds ratio 1.56; 95% CI: 1.05, 2.32	p=0.026
6MWD (metres, median change)	49.0	23.8	22.75m; 95% CI: 12.00, 33.50	p<0.0001

### Idiopathic Pulmonary Fibrosis

A study of 492 patients (ambrisentan N=329, placebo N=163) with idiopathic pulmonary fibrosis (IPF), 11% of which had secondary pulmonary hypertension (WHO group 3), has been conducted, but was terminated early when it was determined that the primary efficacy endpoint could not be met (ARTEMIS-IPF study). Ninety events (27%) of IPF progression (including respiratory hospitalisations) or death were observed in the ambrisentan group compared to 28 events (17%) in the placebo group. Ambrisentan is therefore contraindicated for patients with IPF with or without secondary pulmonary hypertension (see section 4.3).

## 5.2 Pharmacokinetic properties

### Absorption

Ambrisentan is absorbed rapidly in humans. After oral administration, maximum plasma concentrations ( $C_{max}$ ) of ambrisentan typically occur around 1.5 hours post-dose under both fasted and fed conditions.  $C_{max}$  and area under the plasma concentration-time curve (AUC) increase dose proportionally over the therapeutic dose range. Steady-state is generally achieved following 4 days of repeat dosing.

A food-effect study involving administration of ambrisentan to healthy volunteers under fasting conditions and with a high-fat meal indicated that the  $C_{max}$  was decreased 12% while the AUC remained unchanged. This decrease in peak concentration is not clinically significant, and therefore ambrisentan can be taken with or without food.

### Distribution

Ambrisentan is highly plasma protein bound. The *in vitro* plasma protein binding of ambrisentan was, on average, 98.8% and independent of concentration over the range of 0.2 – 20 microgram/ml. Ambrisentan is primarily bound to albumin (96.5%) and to a lesser extent to alpha<sub>1</sub>-acid glycoprotein.

The distribution of ambrisentan into red blood cells is low, with a mean blood:plasma ratio of 0.57 and 0.61 in males and females, respectively.

### Biotransformation

Ambrisentan is a non-sulphonamide (propanoic acid) ERA.

Ambrisentan is glucuronidated via several UGT isoenzymes (UGT1A9S, UGT2B7S and UGT1A3S) to form ambrisentan glucuronide (13%). Ambrisentan also undergoes oxidative metabolism mainly by CYP3A4 and to a lesser extent by CYP3A5 and CYP2C19 to form 4-hydroxymethyl ambrisentan (21%) which is further glucuronidated to 4-hydroxymethyl ambrisentan glucuronide (5%). The binding affinity of 4-hydroxymethyl ambrisentan for the human endothelin receptor is 65-fold less than ambrisentan. Therefore at concentrations observed in the plasma (approximately 4% relative to parent ambrisentan), 4-hydroxymethyl ambrisentan is not expected to contribute to pharmacological activity of ambrisentan.

*In vitro* data indicate that ambrisentan at 300  $\mu$ M resulted in less than 50 % inhibition of UGT1A1, UGT1A6, UGT1A9, UGT2B7 (up to 30%) or of cytochrome P450 enzymes 1A2, 2A6, 2B6, 2C8, 2C9, 2C19, 2D6, 2E1 and 3A4 (up to 25%). *In vitro*, ambrisentan has no inhibitory effect on human transporters at clinically relevant concentrations, including Pgp, BCRP, MRP2, BSEP, OATP1B1, OATP1B3 and NTCP. Furthermore, ambrisentan did not induce MRP2, Pgp or BSEP protein expression in rat hepatocytes. Taken together, the *in vitro* data suggest ambrisentan at clinically relevant concentrations (plasma  $C_{max}$  up to 3.2  $\mu$ M) would not be expected to have an effect on UGT1A1, UGT1A6, UGT1A9, UGT2B7 or cytochrome P450 enzymes 1A2, 2A6, 2B6, 2C8, 2C9, 2C19, 2D6, 2E1, 3A4 or transport via BSEP, BCRP, Pgp, MRP2, OATP1B1/3, or NTCP.

The effects of steady-state ambrisentan (10 mg once daily) on the pharmacokinetics and pharmacodynamics of a single dose of warfarin (25 mg), as measured by PT and INR, were investigated in 20 healthy volunteers. Ambrisentan did not have any clinically relevant effects on the pharmacokinetics or pharmacodynamics of warfarin. Similarly, co-administration with warfarin did not affect the pharmacokinetics of ambrisentan (see section 4.5).

The effect of 7-day dosing of sildenafil (20 mg three times daily) on the pharmacokinetics of a single dose of ambrisentan, and the effects of 7-day dosing of ambrisentan (10 mg once daily) on the

pharmacokinetics of a single dose of sildenafil were investigated in 19 healthy volunteers. With the exception of a 13% increase in sildenafil  $C_{\max}$  following co-administration with ambrisentan, there were no other changes in the pharmacokinetic parameters of sildenafil, N-desmethyl-sildenafil and ambrisentan. This slight increase in sildenafil  $C_{\max}$  is not considered clinically relevant (see section 4.5).

The effects of steady-state ambrisentan (10 mg once daily) on the pharmacokinetics of a single dose of tadalafil, and the effects of steady-state tadalafil (40 mg once daily) on the pharmacokinetics of a single dose of ambrisentan were studied in 23 healthy volunteers. Ambrisentan did not have any clinically relevant effects on the pharmacokinetics of tadalafil. Similarly, co-administration with tadalafil did not affect the pharmacokinetics of ambrisentan (see section 4.5).

The effects of repeat dosing of ketoconazole (400 mg once daily) on the pharmacokinetics of a single dose of 10 mg ambrisentan were investigated in 16 healthy volunteers. Exposures of ambrisentan as measured by  $AUC_{(0-\text{inf})}$  and  $C_{\max}$  were increased by 35% and 20%, respectively. This change in exposure is unlikely to be of any clinical relevance and therefore ambrisentan may be co-administered with ketoconazole.

The effects of repeat dosing of cyclosporine A (100 – 150 mg twice daily) on the steady-state pharmacokinetics of ambrisentan (5 mg once daily), and the effects of repeat dosing of ambrisentan (5 mg once daily) on the steady-state pharmacokinetics of cyclosporine A (100 – 150 mg twice daily) were studied in healthy volunteers. The  $C_{\max}$  and  $AUC(0-\tau)$  of ambrisentan increased (48% and 121%, respectively) in the presence of multiple doses of cyclosporine A. Based on these changes, the dose of ambrisentan should be limited to 5 mg once daily when co-administered with cyclosporine A (see section 4.2). However, multiple doses of ambrisentan had no clinically relevant effect on cyclosporine A exposure, and no dose adjustment of cyclosporine A is warranted.

The effects of acute and repeat dosing of rifampicin (600 mg once daily) on the steady-state pharmacokinetics of ambrisentan (10 mg once daily) were studied in healthy volunteers. Following initial doses of rifampicin, a transient increase in ambrisentan  $AUC(0-\tau)$  (121% and 116% after first and second doses of rifampicin, respectively) was observed, presumably due to a rifampicin-mediated OATP inhibition. However, there was no clinically relevant effect on ambrisentan exposure by day 8, following administration of multiple doses of rifampicin. Patients on ambrisentan therapy should be closely monitored when starting treatment with rifampicin (see sections 4.4 and 4.5).

The effects of repeat dosing of ambrisentan (10 mg) on the pharmacokinetics of single dose digoxin were studied in 15 healthy volunteers. Multiple doses of ambrisentan resulted in slight increases in digoxin  $AUC_{0-\text{last}}$  and trough concentrations, and a 29% increase in digoxin  $C_{\max}$ . The increase in digoxin exposure observed in the presence of multiple doses of ambrisentan was not considered clinically relevant, and no dose adjustment of digoxin is warranted (see section 4.5).

The effects of 12 days dosing with ambrisentan (10 mg once daily) on the pharmacokinetics of a single dose of oral contraceptive containing ethinyl estradiol (35  $\mu\text{g}$ ) and norethindrone (1 mg) were studied in healthy female volunteers. The  $C_{\max}$  and  $AUC_{(0-\infty)}$  were slightly decreased for ethinyl estradiol (8% and 4%, respectively), and slightly increased for norethindrone (13% and 14 %, respectively). These changes in exposure to ethinyl estradiol or norethindrone were small and are unlikely to be clinically significant (see section 4.5).

### Elimination

Ambrisentan and its metabolites are eliminated primarily in the bile following hepatic and/or extra-hepatic metabolism. Approximately 22% of the administered dose is recovered in the urine following oral administration with 3.3% being unchanged ambrisentan. Plasma elimination half-life in humans ranges from 13.6 to 16.5 hours.

## Special populations

Based on the results of a population pharmacokinetic analysis in healthy volunteers and patients with PAH, the pharmacokinetics of ambrisentan were not significantly influenced by gender or age (see section 4.2).

### *Renal impairment*

Ambrisentan does not undergo significant renal metabolism or renal clearance (excretion). In a population pharmacokinetic analysis, creatinine clearance was found to be a statistically significant covariate affecting the oral clearance of ambrisentan. The magnitude of the decrease in oral clearance is modest (20-40%) in patients with moderate renal impairment and therefore is unlikely to be of any clinical relevance. However, caution should be used in patients with severe renal impairment (see section 4.2).

### *Hepatic impairment*

The main routes of metabolism of ambrisentan are glucuronidation and oxidation with subsequent elimination in the bile and therefore hepatic impairment might be expected to increase exposure ( $C_{max}$  and AUC) of ambrisentan. In a population pharmacokinetic analysis, the oral clearance was shown to be decreased as a function of increasing bilirubin levels. However, the magnitude of effect of bilirubin is modest (compared to the typical patient with a bilirubin of 0.6 mg/dl, a patient with an elevated bilirubin of 4.5 mg/dl would have approximately 30% lower oral clearance of ambrisentan). The pharmacokinetics of ambrisentan in patients with hepatic impairment (with or without cirrhosis) has not been studied. Therefore ambrisentan should not be initiated in patients with severe hepatic impairment or clinically significant elevated hepatic aminotransferases ( $>3xULN$ ) (see sections 4.3 and 4.4).

## **5.3 Preclinical safety data**

Due to the class primary pharmacologic effect, a large single dose of ambrisentan (i.e. an overdose) could lower arterial pressure and have the potential for causing hypotension and symptoms related to vasodilation.

Ambrisentan was not shown to be an inhibitor of bile acid transport or to produce overt hepatotoxicity.

Inflammation and changes in the nasal cavity epithelium have been seen in rodents after chronic administration at exposures below the therapeutic levels in humans. In dogs, slight inflammatory responses were observed following chronic high dose administration of ambrisentan at exposures greater than 20-fold that observed in patients.

Nasal bone hyperplasia of the ethmoid turbinates has been observed in the nasal cavity of rats treated with ambrisentan, at exposure levels 3-fold the clinical AUC. Nasal bone hyperplasia has not been observed with ambrisentan in mice or dogs. In the rat, hyperplasia of nasal turbinate bone is a recognised response to nasal inflammation, based on experience with other compounds.

Ambrisentan was clastogenic when tested at high concentrations in mammalian cells *in vitro*. No evidence for mutagenic or genotoxic effects of ambrisentan were seen in bacteria or in two *in vivo* rodent studies.

There was no evidence of carcinogenic potential in 2 year oral studies in rats and mice. There was a small increase in mammary fibroadenomas, a benign tumor, in male rats at the highest dose only. Systemic exposure to ambrisentan in male rats at this dose (based on steady-state AUC) was 6-fold that achieved at the 10 mg/day clinical dose.

Testicular tubular atrophy, which was occasionally associated with aspermia, was observed in oral repeat dose toxicity and fertility studies with male rats and mice without safety margin. The testicular changes were not fully recoverable during the off-dose periods evaluated. However no testicular changes were observed in dog studies of up to 39 weeks duration at an exposure 35-fold that seen in humans based on AUC. In male rats, there were no effects of ambrisentan on sperm motility at all doses tested (up to 300 mg/kg/day). A slight (<10%) decrease in the percentage of morphologically normal sperms was noted at 300 mg/kg/day but not at 100 mg/kg/day (>9-fold clinical exposure at 10 mg/day). The effect of ambrisentan on male human fertility is not known.

Ambrisentan has been shown to be teratogenic in rats and rabbits. Abnormalities of the lower jaw, tongue, and/or palate were seen at all doses tested. In addition, the rat study showed an increased incidence of interventricular septal defects, trunk vessel defects, thyroid and thymus abnormalities, ossification of the basisphenoid bone, and the occurrence of the umbilical artery located on the left side of the urinary bladder instead of the right side. Teratogenicity is a suspected class effect of ERAs.

Administration of ambrisentan to female rats from late-pregnancy through lactation caused adverse events on maternal behaviour, reduced pup survival and impairment of the reproductive capability of the offspring (with observation of small testes at necropsy), at exposure 3-fold the AUC at the maximum recommended human dose.

## **6. PHARMACEUTICAL PARTICULARS**

### **6.1 List of excipients**

#### Tablet core

Lactose monohydrate  
Microcrystalline cellulose  
Croscarmellose sodium  
Magnesium stearate

#### Film coat

Polyvinyl alcohol (partially hydrolysed)  
Talc (E553b)  
Titanium dioxide (E171)  
Macrogol 3350  
Lecithin (soya) (E322)  
Allura red AC Aluminium Lake (E129)

### **6.2 Incompatibilities**

Not applicable.

### **6.3 Shelf life**

5 years.

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

This medicinal product does not require any special storage conditions.

### **6.5 Nature and contents of container**

PVC/PVDC/aluminium foil blisters.  
Pack sizes with unit dose blisters of 10x1 or 30x1 film-coated tablets.  
Not all pack sizes may be marketed.

## **6.6 Special precautions for disposal**

No special requirements for disposal.

## **7. MARKETING AUTHORISATION HOLDER**

Glaxo Group Ltd  
980 Great West Road  
Brentford  
Middlesex  
TW8 9GS  
United Kingdom

## **8. MARKETING AUTHORISATION NUMBER(S)**

EU/1/08/451/003

EU/1/08/451/004

## **9. DATE OF FIRST AUTHORISATION/RENEWAL OF THE AUTHORISATION**

Date of first authorisation: 21 April 2008

Date of latest renewal: 24 April 2013

## **10. DATE OF REVISION OF THE TEXT**

{MM/YYYY}

Detailed information on this medicinal product is available on the website of the European Medicines Agency <http://www.ema.europa.eu>.

## **ANNEX II**

- A. MANUFACTURER RESPONSIBLE FOR BATCH RELEASE**
- B. CONDITIONS OR RESTRICTIONS REGARDING SUPPLY AND USE**
- C. OTHER CONDITIONS AND REQUIREMENTS OF THE MARKETING AUTHORISATION**
- D. CONDITIONS OR RESTRICTIONS WITH REGARD TO THE SAFE AND EFFECTIVE USE OF THE MEDICINAL PRODUCT**

## **A. MANUFACTURER RESPONSIBLE FOR BATCH RELEASE**

### Name and address of the manufacturer responsible for batch release

Aspen Bad Oldesloe GmbH  
Industriestrasse 32-36  
D-23843 Bad Oldesloe  
Germany

or

Glaxo Operations UK Ltd  
(trading as GlaxoWellcome Operations)  
Harmire Road  
Barnard Castle  
Co. Durham DL12 8DT  
United Kingdom

The printed package leaflet of the medicinal product must state the name and address of the manufacturer responsible for the release of the concerned batch.

## **B. CONDITIONS OR RESTRICTIONS REGARDING SUPPLY AND USE**

Medicinal product subject to restricted medical prescription (see Annex I: Summary of Product Characteristics, section 4.2).

## **C. OTHER CONDITIONS AND REQUIREMENTS OF THE MARKETING AUTHORISATION**

### **• Periodic Safety Update Reports**

The requirements for submission of periodic safety update reports for this medicinal product are set out in the list of Union reference dates (EURD list) provided for under Article 107c(7) of Directive 2001/83/EC and any subsequent updates published on the European medicines web-portal.

## **D. CONDITIONS OR RESTRICTIONS WITH REGARD TO THE SAFE AND EFFECTIVE USE OF MEDICINAL PRODUCT**

### **• Risk Management Plan (RMP)**

The MAH shall perform the required pharmacovigilance activities and interventions detailed in the agreed RMP presented in Module 1.8.2 of the Marketing Authorisation and any agreed subsequent updates of the RMP.

An updated RMP should be submitted:

- At the request of the European Medicines Agency;
- Whenever the risk management system is modified, especially as the result of new information being received that may lead to a significant change to the benefit/risk profile or as the result of an important (pharmacovigilance or risk minimisation) milestone being reached.

### **• Additional risk minimisation measures**

The MAH must agree the details of a controlled distribution system with the National Competent Authorities and must implement such programme nationally to ensure that prior to prescribing (and where appropriate and in agreement with the National Competent Authority, dispensing) all health care professionals who intend to prescribe (and where appropriate, dispense) Volibris have been provided with the following:

- Product information (Summary of Product Characteristics (SmPC) and Package Leaflet)
- Healthcare professional information regarding Volibris
- Pre-prescription checklist for physicians
- Information about the post marketing surveillance study
- Information booklets for patients
- Information booklets for male partners of female patients with child-bearing potential
- Patient reminder cards
- Pregnancy reporting forms
- Adverse drug reaction reporting forms

#### Health care Professional information

The healthcare professional information regarding Volibris should contain the following key elements:

#### **Obligations of health care professionals in relation to the prescribing of Volibris:**

- That patients should be capable of complying with the requirements for the safe use of Volibris.
- The need to provide comprehensive advice and counselling to patients.
- The need to provide patients with the appropriate information booklet(s) and patient reminder card.
- Should consider monthly prescription of 30 day supply to ensure that patients and key test results are reviewed prior to further prescription.
- That the safety database of Volibris is limited and physicians are encouraged to enrol patients in a post marketing surveillance study.
- To report suspected adverse reactions and pregnancy.

#### **That Volibris is teratogenic**

- Volibris is contraindicated in pregnancy and in women of child-bearing potential who are not using reliable contraception.
- That women receiving Volibris should be advised of the risk of foetal harm.
- Guidance for identifying women of child-bearing potential and the actions the physician should take if unsure.

For women with child-bearing potential:

- Exclusion of pregnancy prior to treatment initiation and monthly pregnancy testing during treatment.
- The need to advise women (even if a woman has amenorrhoea) on the use of reliable contraception during treatment and for one month following permanent discontinuation of treatment.
- Definition of reliable contraception and the need to seek expert advice if unsure what is suitable for an individual patient.
- That if a woman of child-bearing potential needs to change or stop her method of contraception she should inform the physician prescribing her contraception that she is taking Volibris.
- That if a women of child-bearing potential needs to change or stop her method of contraception she should inform the physician prescribing Volibris.

- That the patient should contact her doctor immediately if pregnancy is suspected and that alternative therapy should be initiated if pregnancy confirmed.
- The need to refer patients who become pregnant to a physician specialised or experienced in teratology and its diagnosis for evaluation and advice.
- To report all cases of pregnancy occurring during therapy.

#### **That Volibris is potentially hepatotoxic**

- Contraindication in patients with severe hepatic impairment (with or without cirrhosis) and in patients with baseline values of hepatic aminotransferases (AST and/or ALT) >3X ULN.
- Hepatic aminotransferases (ALT and/or AST) should be evaluated prior to initiation of ambrisentan.
- During therapy, monthly monitoring of ALT and AST is recommended.
- Discontinuation of ambrisentan therapy if patients develop sustained, unexplained clinically significant ALT and/or AST elevation or if ALT and/or AST elevation is accompanied by signs or symptoms of hepatic injury (e.g. jaundice).
- In subjects without clinical symptoms of hepatic injury or jaundice, reinitiation of ambrisentan may be considered following resolution of hepatic enzyme abnormalities. The advice of a hepatologist is recommended.

#### **That treatment with Volibris often causes a decrease in haemoglobin and haematocrit**

- Initiation of Volibris is not recommended for patients with clinically significant anaemia.
- Patients taking Volibris should have their haemoglobin and/or haematocrit levels measured regularly.
- If tests show a clinically significant decrease in haemoglobin or haematocrit, and other causes have been excluded, consider reducing the dose of Volibris, or stopping treatment.

#### **That treatment with Volibris causes peripheral oedema and fluid retention**

- If a patient develops clinically significant peripheral oedema, with or without associated weight gain, carry out further evaluation to determine the cause and if appropriate consider discontinuation of Volibris.

**That chronic administration of Volibris in animals has been linked to testicular tubular atrophy and impaired fertility.** The effect of Volibris on human testicular function and male fertility is not known.

**That Volibris should be initiated with caution in patients with severe renal impairment.**

**That hypersensitivity reactions (e.g. angioedema, rash), although uncommon in short term clinical trials and common in longer term trials and in combination with tadalafil, have been reported with Volibris.**

#### Physician checklist

The physician pre-prescription checklist will highlight the contraindications to the use of ambrisentan and important pre-prescription assessments including:

- Liver function tests.
- Determination of child-bearing potential in female patients.
- Pregnancy test if female patient with child-bearing potential.
- That women of child-bearing potential are on reliable contraception.

#### Patient information

The information for patients should include the following information:

- That Volibris may cause serious birth defects in unborn babies conceived before, during, or within a month after stopping treatment.
- That Volibris cannot be initiated if patient is pregnant.
- Women with child-bearing potential must have a pregnancy test immediately prior to the first prescription and at monthly intervals whilst taking Volibris.
- The need to ensure that women of child-bearing potential are using reliable contraception and that patients should inform their doctors of any possibility of pregnancy before a new prescription is issued.
- That if a women of child-bearing potential needs to change or stop her method of contraception she should inform the physician prescribing her contraception that she is taking Volibris.
- That if a women of child-bearing potential needs to change or stop her method of contraception she should inform the physician prescribing Volibris.
- The need for female patients to contact their treating doctor immediately if they suspect that they might be pregnant.
- The need for the patient to discuss with her doctor if she is planning to become pregnant.
- That Volibris may cause liver injury.
- That because of the potential for liver injury and anaemia, patients should have regular blood tests and also tell their doctor if experiencing any symptoms of liver injury.
- That the patient should not give Volibris to any other person.
- That the patient should tell their doctor about any adverse event.

#### Booklet for male partners of women with child-bearing potential

The information for male partners of women with child-bearing potential should include the following information:

- That Volibris may cause serious birth defects in unborn babies conceived before, during, or within a month after stopping treatment.
- The need to ensure that women of child-bearing potential are using reliable contraception.
- That Volibris cannot be taken if a woman is or might become pregnant.

#### Patient reminder card

This should include key messages regarding the need for regular blood and pregnancy tests and provide spaces for the dates of appointments and the results of tests.

- **Obligation to conduct post-authorisation measures**

Not applicable:

**ANNEX III**  
**LABELLING AND PACKAGE LEAFLET**

## **A. LABELLING**

**PARTICULARS TO APPEAR ON THE OUTER PACKAGING**

**OUTER CARTON**

**1. NAME OF THE MEDICINAL PRODUCT**

Volibris 5 mg film-coated tablets

ambrisentan

**2. STATEMENT OF ACTIVE SUBSTANCE(S)**

Each tablet contains 5 mg ambrisentan

**3. LIST OF EXCIPIENTS**

Contains lactose, lecithin (soya) (E322) and Allura red AC Aluminium Lake (E129). See leaflet for further information

**4. PHARMACEUTICAL FORM AND CONTENTS**

10x1 film-coated tablets.

30x1 film-coated tablets.

**5. METHOD AND ROUTE(S) OF ADMINISTRATION**

Read the package leaflet before use.

Oral use.

**6. SPECIAL WARNING THAT THE MEDICINAL PRODUCT MUST BE STORED OUT OF THE SIGHT AND REACH OF CHILDREN**

Keep out of the sight and reach of children.

**7. OTHER SPECIAL WARNING(S), IF NECESSARY**

**8. EXPIRY DATE**

EXP

**9. SPECIAL STORAGE CONDITIONS**

**10. SPECIAL PRECAUTIONS FOR DISPOSAL OF UNUSED MEDICINAL PRODUCTS OR WASTE MATERIALS DERIVED FROM SUCH MEDICINAL PRODUCTS, IF APPROPRIATE**

**11. NAME AND ADDRESS OF THE MARKETING AUTHORISATION HOLDER**

Glaxo Group Ltd  
980 Great West Road  
Brentford  
Middlesex TW8 9GS  
United Kingdom

**12. MARKETING AUTHORISATION NUMBER(S)**

EU/1/08/451/001 10 film-coated tablets

EU/1/08/451/002 30 film-coated tablets

**13. BATCH NUMBER**

Lot

**14. GENERAL CLASSIFICATION FOR SUPPLY**

**15. INSTRUCTIONS ON USE**

**16. INFORMATION IN BRAILLE**

Volibris 5 mg

**17. UNIQUE IDENTIFIER – 2D BARCODE**

2D barcode carrying the unique identifier included.

**18. UNIQUE IDENTIFIER – HUMAN READABLE DATA**

PC:  
SN:  
NN:

**PARTICULARS TO APPEAR ON THE OUTER PACKAGING**

**OUTER CARTON**

**1. NAME OF THE MEDICINAL PRODUCT**

Volibris 10 mg film-coated tablets  
ambrisentan

**2. STATEMENT OF ACTIVE SUBSTANCE(S)**

Each tablet contains 10 mg ambrisentan

**3. LIST OF EXCIPIENTS**

Contains lactose, lecithin (soya) (E322) and Allura red AC Aluminium Lake (E129). See leaflet for further information

**4. PHARMACEUTICAL FORM AND CONTENTS**

10x1 film-coated tablets.  
30x1 film-coated tablets.

**5. METHOD AND ROUTE(S) OF ADMINISTRATION**

Read the package leaflet before use.  
Oral use.

**6. SPECIAL WARNING THAT THE MEDICINAL PRODUCT MUST BE STORED OUT OF THE SIGHT AND REACH OF CHILDREN**

Keep out of the sight and reach of children.

**7. OTHER SPECIAL WARNING(S), IF NECESSARY**

**8. EXPIRY DATE**

EXP

**9. SPECIAL STORAGE CONDITIONS**

**10. SPECIAL PRECAUTIONS FOR DISPOSAL OF UNUSED MEDICINAL PRODUCTS OR WASTE MATERIALS DERIVED FROM SUCH MEDICINAL PRODUCTS, IF APPROPRIATE**

**11. NAME AND ADDRESS OF THE MARKETING AUTHORISATION HOLDER**

Glaxo Group Ltd  
980 Great West Road  
Brentford  
Middlesex TW8 9GS  
United Kingdom

**12. MARKETING AUTHORISATION NUMBER(S)**

EU/1/08/451/003 10 film-coated tablets

EU/1/08/451/004 30 film-coated tablets

**13. BATCH NUMBER**

Lot

**14. GENERAL CLASSIFICATION FOR SUPPLY**

**15. INSTRUCTIONS ON USE**

**16. INFORMATION IN BRAILLE**

Volibris 10 mg

**17. UNIQUE IDENTIFIER – 2D BARCODE**

2D barcode carrying the unique identifier included.

**18. UNIQUE IDENTIFIER – HUMAN READABLE DATA**

PC:  
SN:  
NN:

**MINIMUM PARTICULARS TO APPEAR ON BLISTERS OR STRIPS**

**Blisters**

**1. NAME OF THE MEDICINAL PRODUCT**

Volibris 5 mg tablets

ambrisentan

**2. NAME OF THE MARKETING AUTHORISATION HOLDER**

Glaxo Group Ltd

**3. EXPIRY DATE**

EXP

**4. BATCH NUMBER**

Lot

**5. OTHER**

**MINIMUM PARTICULARS TO APPEAR ON BLISTERS OR STRIPS**

**Blisters**

**1. NAME OF THE MEDICINAL PRODUCT**

Volibris 10 mg tablets

ambrisentan

**2. NAME OF THE MARKETING AUTHORISATION HOLDER**

Glaxo Group Ltd

**3. EXPIRY DATE**

EXP

**4. BATCH NUMBER**

Lot

**5. OTHER**

**B. PACKAGE LEAFLET**

## Package leaflet: Information for the user

### Volibris 5 mg film-coated tablets Volibris 10 mg film-coated tablets

ambrisentan

#### **Read all of this leaflet carefully before you start taking this medicine because it contains important information for you.**

- Keep this leaflet. You may need to read it again.
- If you have any further questions, ask your doctor, pharmacist or nurse.
- This medicine has been prescribed for you only. Do not pass it on to others. It may harm them, even if their signs of illness are the same as yours.
- If you get any side effects talk to your doctor, pharmacist or nurse. This includes any possible side effects not listed in this leaflet. See section 4.

#### **What is in this leaflet:**

1. What Volibris is and what it is used for
2. What you need to know before you take Volibris
3. How to take Volibris
4. Possible side effects
5. How to store Volibris
6. Contents of the pack and other information

#### **1. What Volibris is and what it is used for**

Volibris contains the active substance ambrisentan. It belongs to a group of medicines called other antihypertensives (used to treat high blood pressure).

It is used to treat pulmonary arterial hypertension (PAH) in adults. PAH is high blood pressure in the blood vessels (the pulmonary arteries) that carry blood from the heart to the lungs. In people with PAH, these arteries get narrower, so the heart has to work harder to pump blood through them. This causes people to feel tired, dizzy and short of breath.

Volibris widens the pulmonary arteries, making it easier for the heart to pump blood through them. This lowers the blood pressure and relieves the symptoms.

Volibris may also be used in combination with other medicines used to treat PAH.

#### **2. What you need to know before you take Volibris**

##### **Don't take Volibris:**

- if you are **allergic** to ambrisentan, soya, or any of the other ingredients of this medicine (listed in section 6)
- **if you are pregnant**, if you are **planning to become pregnant**, or if you **could become pregnant** because you are not using reliable birth control (contraception). Please read the information under 'Pregnancy'
- if you are **breast feeding**. Read the information under 'Breast-feeding'
- if you **have liver disease**. Talk to your doctor, who will decide whether this medicine is suitable for you
- if you have **scarring of the lungs**, of unknown cause (idiopathic pulmonary fibrosis).

## Warnings and precautions

Talk to your doctor before taking this medicine if you have:

- liver problems
- anaemia (a reduced number of red blood cells)
- swelling in the hands, ankles or feet caused by fluid (*peripheral oedema*)
- lung disease where the veins in the lungs are blocked (*pulmonary veno-occlusive disease*).

→ **Your doctor will decide** whether Volibris is suitable for you.

## You will need regular blood tests

Before you start taking Volibris, and at regular intervals while you're taking it, your doctor will take blood tests to check:

- whether you have anaemia
- whether your liver is working properly.

→ It is important that you have these regular blood tests for as long as you are taking Volibris.

Signs that your liver may not be working properly include:

- loss of appetite
- feeling sick (nausea)
- being sick (vomiting)
- high temperature (fever)
- pain in your stomach (abdomen)
- yellowing of your skin or the whites of your eyes (jaundice)
- dark-coloured urine
- itching of your skin.

If you notice any of these signs:

→ **Tell your doctor immediately.**

## Children and adolescents

Volibris is not recommended for children and adolescents aged under 18 years as the safety and effectiveness is not known in this age group.

## Other medicines and Volibris

Tell your doctor or pharmacist if you're taking, have recently taken or might take any other medicines.

Your doctor may need to adjust your dose of Volibris if you start taking cyclosporine A (a medicine used after transplant or to treat psoriasis).

If you're taking rifampicin (an antibiotic used to treat serious infections) your doctor will monitor you when you first start taking Volibris.

If you're taking other medicines used to treat PAH (e.g. iloprost, epoprostenol, sildenafil) your doctor may need to monitor you.

→ **Tell your doctor or pharmacist** if you are taking any of these medicines.

### **Pregnancy**

Volibris may harm unborn babies conceived before, during or soon after treatment.

→ **If it is possible you could become pregnant, use a reliable form of birth control** (contraception) while you're taking Volibris. Talk to your doctor about this.

→ **Don't take Volibris if you are pregnant or planning to become pregnant.**

→ **If you become pregnant or think that you may be pregnant** while you're taking Volibris, **see your doctor immediately.**

**If you are a woman who could become pregnant, your doctor will ask you to take a pregnancy test** before you start taking Volibris and regularly while you are taking this medicine.

### **Breast-feeding**

It is not known if Volibris is transferred to breast milk.

→ **Don't breast-feed while you're taking Volibris.** Talk to your doctor about this.

### **Fertility**

If you are a man taking Volibris, it is possible that this medicine may lower your sperm count. Talk to your doctor if you have any questions or concerns about this.

### **Driving and using machines**

Volibris may cause side effects, such as low blood pressure, dizziness, tiredness (see section 4), that may affect your ability to drive or use machines. The symptoms of your condition can also make you less fit to drive or use machines.

→ **Don't drive or use machines if you're feeling unwell.**

### **Volibris contains lactose, lecithin (soya) and Allura red AC Aluminium Lake (E129)**

Volibris tablets contain small amounts of a sugar called lactose. If you have been told by your doctor that you have an intolerance to some sugars:

→ **Contact your doctor** before taking Volibris.

Volibris tablets contain lecithin derived from soya. If you are allergic to soya, do not use this medicine (see section 2 'Don't take Volibris').

Volibris tablets contain a colouring called Allura red AC Aluminium Lake (E129) which can cause allergic reactions (see section 4).

## **3. How to take Volibris**

**Always take this medicine exactly as your doctor or pharmacist has told you to.** Check with your doctor or pharmacist if you're not sure.

### **How much Volibris to take**

The usual dose of Volibris is one 5 mg tablet, once a day. Your doctor may decide to increase your dose to 10 mg, once a day.

If you take cyclosporine A, do not take more than one 5 mg tablet of Volibris, once a day.

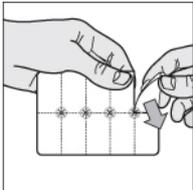
### How to take Volibris

It is best to take your tablet at the same time each day. Swallow the tablet whole, with a glass of water, do not split, crush or chew the tablet. You can take Volibris with or without food.

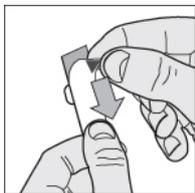
### Taking out a tablet

These tablets come in special packaging to prevent children removing them.

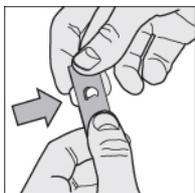
**1. Separate one tablet:** tear along the cutting lines to separate one “pocket” from the strip.



**2. Peel back the outer layer:** starting at the coloured corner, lift and peel over the pocket.



**3. Push out the tablet:** gently push one end of the tablet through the foil layer.



### If you take more Volibris than you should

If you take too many tablets you may be more likely to have side effects, such as headache, flushing, dizziness, nausea (feeling sick), or low blood pressure that could cause light-headedness:

→ **Ask your doctor or pharmacist for advice** if you take more tablets than prescribed.

### If you forget to take Volibris

If you forget a dose of Volibris, just take the tablet as soon as you remember, then carry on as before.

→ **Don't take two doses at the same time to make up for a forgotten dose.**

### Don't stop taking Volibris without your doctor's advice

Volibris is a treatment that you will need to keep on taking to control your PAH.

→ **Don't stop taking Volibris unless you have agreed this with your doctor.**

If you have any further questions on the use of this medicine, ask your doctor or pharmacist.

#### 4. Possible side effects

Like all medicines, this medicine can cause side effects, although not everybody gets them.

##### **Conditions you and your doctor need to look out for:**

##### **Allergic reactions**

This is a common side effect that may affect **up to one in 10** people. You may notice a rash or itching and swelling (usually of the face, lips, tongue or throat), which may cause difficulty in breathing or swallowing

##### **Swelling (oedema), especially of the ankles and feet**

This is a very common side effect that may affect **more than one in 10** people

##### **Heart failure**

This is due to the heart not pumping out enough blood, causing shortness of breath, extreme tiredness and swelling in the ankles and legs. This is a common side effect that may affect **up to one in 10** people

##### **Anaemia (reduced number of red blood cells)**

This is a blood disorder which can cause tiredness, weakness, shortness of breath, and generally feeling unwell. Sometimes this requires a blood transfusion. This is a very common side effect that may affect **more than one in 10** people

##### **Hypotension (low blood pressure)**

This can cause light-headedness. This is a common side effect that may affect **up to one in 10** people

→ **Tell your doctor straight away** if you get these effects or if they happen suddenly after taking Volibris.

**It is important to have regular blood tests**, to check for anaemia and that your liver is working properly. **Make sure that you have also read the information in section 2** under ‘You will need regular blood tests’ and ‘Signs that your liver may not be working properly’.

##### **Other side effects include**

##### **Very common side effects:**

- headache
- dizziness
- palpitations (fast or irregular heart beats)
- worsening shortness of breath shortly after starting Volibris
- a runny or blocked nose, congestion or pain in the sinuses
- feeling sick (nausea)
- diarrhoea
- feeling tired

##### **In combination with tadalafil (another PAH medicine)**

In addition to the above:

- flushing (redness of the skin)
- being sick (vomiting)
- rash
- chest pain/discomfort.

### **Common side effects:**

- blurry or other changes to vision
- fainting
- abnormal blood test results for liver function
- a runny nose
- constipation
- pain in your stomach (abdomen)
- chest pain or discomfort
- flushing (redness of the skin)
- being sick (vomiting)
- feeling weak
- nose bleed
- rash

### **In combination with tadalafil**

In addition to the above, except abnormal blood test results for liver function:

- ringing in the ears (*tinnitus*) only when taking the combination treatment.

### **Uncommon side effects:**

- liver injury
- inflammation of the liver caused by the body's own defences (*autoimmune hepatitis*)

### **In combination with tadalafil**

- sudden hearing loss.

### **Reporting of side effects**

If you get any side effects, talk to your doctor, pharmacist or nurse. This includes any possible side effects not listed in this leaflet. You can also report side effects directly via **the national reporting system** listed in [Appendix V](#). By reporting side effects you can help provide more information on the safety of this medicine.

## **5. How to store Volibris**

Keep this medicine out of the sight and reach of children.

Do not use this medicine after the expiry date which is stated on the carton and blister after EXP.

The expiry date refers to the last day of that month.

This medicine does not require any special storage conditions.

Do not throw away any medicines via wastewater or household waste. Ask your pharmacist how to throw away medicines you no longer use. These measures will help protect the environment.

## **6. Contents of the pack and other information**

### **What Volibris contains**

The active substance is ambrisentan.

Each film-coated tablet contains 5 or 10 mg.

The other ingredients are: lactose monohydrate, microcrystalline cellulose, croscarmellose sodium, magnesium stearate, polyvinyl alcohol, talc (E553b), titanium dioxide (E171), macrogol 3350, lecithin (soya) (E322) and Allura red AC Aluminium Lake (E129).

### **What Volibris looks like and contents of the pack**

Volibris 5 mg film-coated tablet (tablet) is a pale pink, square, convex tablet engraved with 'GS' on one face and 'K2C' on the other.

Volibris 10 mg film-coated tablet (tablet) is a deep pink, oval, convex tablet engraved with 'GS' on one face and 'KE3' on the other.

Volibris is supplied as 5 mg and 10 mg film-coated tablets in unit dose blister packs of 10x1 or 30x1 tablets.

Not all pack sizes may be marketed.

### **Marketing Authorisation Holder**

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Detailed information on this medicine is available on the European Medicines Agency web site:  
<http://www.ema.europa.eu>. There are also links to other websites about rare diseases and treatments.