

ANNEX I
SUMMARY OF PRODUCT CHARACTERISTICS

▼ This medicinal product is subject to additional monitoring. This will allow quick identification of new safety information. Healthcare professionals are asked to report any suspected adverse reactions. See section 4.8 for how to report adverse reactions.

1. NAME OF THE MEDICINAL PRODUCT

Sovaldi 400 mg film-coated tablets

2. QUALITATIVE AND QUANTITATIVE COMPOSITION

Each film-coated tablet contains 400 mg of sofosbuvir.

For the full list of excipients, see section 6.1.

3. PHARMACEUTICAL FORM

Film-coated tablet.

Yellow, capsule-shaped, film-coated tablet of dimensions 20 mm x 9 mm, debossed on one side with “GSI” and “7977” on the other side.

4. CLINICAL PARTICULARS

4.1 Therapeutic indications

Sovaldi is indicated in combination with other medicinal products for the treatment of chronic hepatitis C (CHC) in adults and in adolescents aged 12 to <18 years (see sections 4.2, 4.4 and 5.1).

For hepatitis C virus (HCV) genotype specific activity, see sections 4.4 and 5.1.

4.2 Posology and method of administration

Sovaldi treatment should be initiated and monitored by a physician experienced in the management of patients with CHC.

Posology

Adults

The recommended dose is one 400 mg tablet, taken orally, once daily with food (see section 5.2).

Sovaldi should be used in combination with other medicinal products. Monotherapy of Sovaldi is not recommended (see section 5.1). Refer also to the Summary of Product Characteristics of the medicinal products that are used in combination with Sovaldi. The recommended co-administered medicinal product(s) and treatment duration for Sovaldi combination therapy are provided in Table 1.

Table 1: Recommended co-administered medicinal product(s) and treatment duration for adults treated with Sovaldi combination therapy

Patient population*	Treatment	Duration
Patients with genotype 1, 4, 5 or 6 CHC	Sovaldi + ribavirin + peginterferon alfa	12 weeks ^{a,b}
	Sovaldi + ribavirin Only for use in patients ineligible or intolerant to peginterferon alfa (see section 4.4)	24 weeks
Patients with genotype 2 CHC	Sovaldi + ribavirin	12 weeks ^b
Patients with genotype 3 CHC	Sovaldi + ribavirin + peginterferon alfa	12 weeks ^b
	Sovaldi + ribavirin	24 weeks
Patients with CHC awaiting liver transplantation	Sovaldi + ribavirin	Until liver transplantation ^c

* Includes patients co-infected with human immunodeficiency virus (HIV).

a. For previously treated patients with HCV genotype 1 infection, no data exists with the combination of Sovaldi, ribavirin and peginterferon alfa (see section 4.4).

b. Consideration should be given to potentially extending the duration of therapy beyond 12 weeks and up to 24 weeks; especially for those subgroups who have one or more factors historically associated with lower response rates to interferon-based therapies (e.g. advanced fibrosis/cirrhosis, high baseline viral concentrations, black race, IL28B non CC genotype, prior null response to peginterferon alfa and ribavirin therapy).

c. See Special patient populations – Patients awaiting liver transplantation below.

The dose of ribavirin, when used in combination with Sovaldi is weight-based (<75 kg = 1,000 mg and ≥75 kg = 1,200 mg) and administered orally in two divided doses with food.

Concerning co-administration with other direct-acting antivirals against HCV, see section 4.4.

Dose modification in adults

Dose reduction of Sovaldi is not recommended.

If sofosbuvir is used in combination with peginterferon alfa, and a patient has a serious adverse reaction potentially related to this drug, the peginterferon alfa dose should be reduced or discontinued. Refer to the peginterferon alfa Summary of Product Characteristics for additional information about how to reduce and/or discontinue the peginterferon alfa dose.

If a patient has a serious adverse reaction potentially related to ribavirin, the ribavirin dose should be modified or discontinued, if appropriate, until the adverse reaction abates or decreases in severity. Table 2 provides guidelines for dose modifications and discontinuation based on the patient's haemoglobin concentration and cardiac status.

Table 2: Ribavirin dose modification guideline for co-administration with Sovaldi in adults

Laboratory values	Reduce ribavirin dose to 600 mg/day if:	Discontinue ribavirin if:
Haemoglobin in patients with no cardiac disease	<10 g/dL	<8.5 g/dL
Haemoglobin in patients with history of stable cardiac disease	≥2 g/dL decrease in haemoglobin during any 4 week treatment period	<12 g/dL despite 4 weeks at reduced dose

Once ribavirin has been withheld due to either a laboratory abnormality or clinical manifestation, an attempt may be made to restart ribavirin at 600 mg daily and further increase the dose to 800 mg daily. However, it is not recommended that ribavirin be increased to the original assigned dose (1,000 mg to 1,200 mg daily).

Paediatric population

In adolescents aged 12 to < 18 years, the recommended dose of Sovaldi is one tablet once daily with food (see section 5.2).

Sovaldi should be used in combination with other medicinal products. Monotherapy of Sovaldi is not recommended. The recommended treatment regimen and durations for Sovaldi combination therapy are provided in Table 3 and Table 4.

Table 3: Recommended treatment regimen and durations for adolescents aged 12 to < 18 years treated with Sovaldi

Patient population*	Treatment and duration
Patients with genotype 2 CHC	Sovaldi + ribavirin ^a for 12 weeks ^b
Patients with genotype 3 CHC	Sovaldi + ribavirin ^a for 24 weeks

* Includes patients co infected with human immunodeficiency virus (HIV).

a. See Table 4 for weight based ribavirin dosing recommendations

b. Consideration should be given to potentially extending the duration of therapy beyond 12 weeks and up to 24 weeks; especially for those subgroups who have one or more factors historically associated with lower response rates to interferon based therapies (e.g. advanced fibrosis/cirrhosis, high baseline viral concentrations, black race, IL28B non CC genotype, prior null response to peginterferon alfa and ribavirin therapy).

Table 4: Recommended dosing for ribavirin in combination therapy with Sovaldi in adolescents aged 12 to < 18 years

Body weight kg (lbs)	RBV daily dose*
<47 (<103)	15 mg/kg/day
47-49 (103-108)	600 mg/day
50-65 (110-143)	800 mg/day
66-80 (145-176)	1000 mg/day
>81 (178)	1200 mg/day

* The daily dosage of ribavirin is weight-based and is administered orally in two divided doses with food.

Dose modification in the paediatric population

Dose reduction of Sovaldi is not recommended.

If a patient has a serious adverse reaction potentially related to ribavirin, the ribavirin dose should be modified or discontinued, if appropriate, until the adverse reaction abates or decreases in severity. Refer to the ribavirin prescribing information for guidance on dose modification or discontinuation.

Discontinuation of dosing in adults and adolescents

If the other medicinal products used in combination with Sovaldi are permanently discontinued, Sovaldi should also be discontinued (see section 4.4).

Special patient populations

Elderly

No dose adjustment is warranted for elderly patients (see section 5.2).

Renal impairment

No dose adjustment of Sovaldi is required for patients with mild or moderate renal impairment. The safety and appropriate dose of Sovaldi have not been established in patients with severe renal impairment (estimated glomerular filtration rate [eGFR] <30 mL/min/1.73 m²) or end stage renal disease (ESRD) requiring haemodialysis (see section 5.2).

Hepatic impairment

No dose adjustment of Sovaldi is required for patients with mild, moderate or severe hepatic impairment (Child-Pugh-Turcotte [CPT] class A, B or C) (see section 5.2). The safety and efficacy of Sovaldi have not been established in patients with decompensated cirrhosis.

Patients awaiting liver transplantation

The duration of administration of Sovaldi in patients awaiting liver transplantation should be guided by an assessment of the potential benefits and risks for the individual patient (see section 5.1).

Liver transplant recipients

Sovaldi in combination with ribavirin is recommended for 24 weeks in liver transplant recipients. A starting ribavirin dose of 400 mg administered orally in two divided doses with food is recommended. If the starting dose of ribavirin is well-tolerated, the dose can be titrated up to a maximum of 1,000-1,200 mg daily (1,000 mg for patients weighing <75 kg and 1,200 mg for patients weighing ≥75 kg). If the starting dose of ribavirin is not well-tolerated, the dose should be reduced as clinically indicated based on haemoglobin levels (see section 5.1).

Paediatric population

The safety and efficacy of Sovaldi in children and adolescents aged <12 years have not yet been established. No data on paediatric patients < 12 years are available.

Method of administration

The film-coated tablet is for oral use. Patients should be instructed to swallow the tablet whole. The film-coated tablet should not be chewed or crushed, due to the bitter taste of the active substance. The tablet should be taken with food (see section 5.2).

Patients should be instructed that if vomiting occurs within 2 hours of dosing an additional tablet should be taken. If vomiting occurs more than 2 hours after dosing, no further dose is needed. These recommendations are based on the absorption kinetics of sofosbuvir and GS-331007 suggesting that the majority of the dose is absorbed within 2 hours after dosing.

If a dose is missed and it is within 18 hours of the normal time, patients should be instructed to take the tablet as soon as possible and then patients should take the next dose at the usual time. If it is after 18 hours then patients should be instructed to wait and take the next dose at the usual time. Patients should be instructed not to take a double dose.

4.3 Contraindications

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

Use with potent P-gp inducers

Medicinal products that are potent P-glycoprotein (P-gp) inducers in the intestine (rifampicin, rifabutin, St. John's wort [*Hypericum perforatum*], carbamazepine, phenobarbital and phenytoin).

Co-administration will significantly decrease sofosbuvir plasma concentration and could result in loss of efficacy of Sovaldi (see section 4.5).

4.4 Special warnings and precautions for use

General

Sovaldi is not recommended for administration as monotherapy and should be prescribed in combination with other medicinal products for the treatment of hepatitis C infection. If the other medicinal products used in combination with Sovaldi are permanently discontinued, Sovaldi should also be discontinued (see section 4.2). Consult the Summary of Product Characteristics for co-prescribed medicinal products before starting therapy with Sovaldi.

Severe bradycardia and heart block

Cases of severe bradycardia and heart block have been observed when sofosbuvir is used in combination with another direct-acting antiviral (DAAs, including daclatasvir, simeprevir and ledipasvir) and concomitant amiodarone with or without other drugs that lower heart rate. The mechanism is not established.

The concomitant use of amiodarone was limited through the clinical development of sofosbuvir plus DAAs. Cases are potentially life threatening, therefore amiodarone should only be used in patients on Sovaldi and another DAA when other alternative anti-arrhythmic treatments are not tolerated or are contraindicated. Patients also taking beta blockers, or those with underlying cardiac comorbidities and/or advanced liver disease may be at increased risk for symptomatic bradycardia with coadministration of amiodarone.

Should concomitant use of amiodarone be considered necessary it is recommended that patients are closely monitored when initiating Sovaldi and another DAA. Patients who are identified as being at high risk of bradyarrhythmia should be continuously monitored for 48 hours in an appropriate clinical setting.

Due to the long half-life of amiodarone, appropriate monitoring should also be carried out for patients who have discontinued amiodarone within the past few months and are to be initiated on Sovaldi in combination with another DAA.

All patients receiving Sovaldi and another DAA in combination with amiodarone with or without other drugs that lower heart rate should also be warned of the symptoms of bradycardia and heart block and should be advised to seek medical advice urgently should they experience them.

Treatment-experienced patients with genotype 1, 4, 5 and 6 HCV infection

Sovaldi has not been studied in a Phase 3 study in treatment-experienced patients with genotype 1, 4, 5 and 6 HCV infection. Thus, the optimal treatment duration in this population has not been established (see also sections 4.2 and 5.1).

Consideration should be given to treating these patients, and potentially extending the duration of therapy with sofosbuvir, peginterferon alfa and ribavirin beyond 12 weeks and up to 24 weeks; especially for those subgroups who have one or more factors historically associated with lower response rates to interferon-based therapies (advanced fibrosis/cirrhosis, high baseline viral concentrations, black race, IL28B non CC genotype).

Treatment of patients with genotype 5 or 6 HCV infection

The clinical data to support the use of Sovaldi in patients with genotype 5 and 6 HCV infection is very limited (see section 5.1).

Interferon-free therapy for genotype 1, 4, 5 and 6 HCV infection

Interferon-free regimens for patients with genotype 1, 4, 5 and 6 HCV infection with Sovaldi have not been investigated in Phase 3 studies (see section 5.1). The optimal regimen and treatment duration

have not been established. Such regimens should only be used for patients that are intolerant to or ineligible for interferon therapy, and are in urgent need of treatment.

Co-administration with other direct-acting antivirals against HCV

Sovaldi should only be co-administered with other direct-acting antiviral medicinal products if the benefit is considered to outweigh the risks based upon available data. There are no data to support the co-administration of Sovaldi and telaprevir or boceprevir. Such co-administration is not recommended (see also section 4.5).

Pregnancy and concomitant use with ribavirin

When Sovaldi is used in combination with ribavirin or peginterferon alfa/ribavirin, women of childbearing potential or their male partners must use an effective form of contraception during the treatment and for a period of time after the treatment as recommended in the Summary of Product Characteristics for ribavirin. Refer to the Summary of Product Characteristics for ribavirin for additional information.

Use with moderate P-gp inducers

Medicinal products that are moderate P-gp inducers in the intestine (e.g. oxcarbazepine and modafinil) may decrease sofosbuvir plasma concentration leading to reduced therapeutic effect of Sovaldi. Co-administration of such medicinal products is not recommended with Sovaldi (see section 4.5).

Renal impairment

The safety of Sovaldi has not been assessed in patients with severe renal impairment (eGFR <30 mL/min/1.73 m²) or ESRD requiring haemodialysis. Furthermore, the appropriate dose has not been established. When Sovaldi is used in combination with ribavirin or peginterferon alfa/ribavirin, refer also to the Summary of Product Characteristics for ribavirin for patients with creatinine clearance (CrCl) <50 mL/min (see also section 5.2).

HCV/HBV (hepatitis B virus) co-infection

Cases of hepatitis B virus (HBV) reactivation, some of them fatal, have been reported during or after treatment with direct-acting antiviral agents. HBV screening should be performed in all patients before initiation of treatment. HBV/HCV co-infected patients are at risk of HBV reactivation, and should therefore be monitored and managed according to current clinical guidelines.

Paediatric population

Sovaldi is not recommended for use in paediatric patients < 12 years because the safety and efficacy have not been established in this population.

4.5 Interaction with other medicinal products and other forms of interaction

Sofosbuvir is a nucleotide prodrug. After oral administration of Sovaldi, sofosbuvir is rapidly absorbed and subject to extensive first-pass hepatic and intestinal metabolism. Intracellular hydrolytic prodrug cleavage catalysed by enzymes including carboxylesterase 1 and sequential phosphorylation steps catalysed by nucleotide kinases result in formation of the pharmacologically active uridine nucleoside analogue triphosphate. The predominant inactive circulating metabolite GS-331007 that accounts for greater than 90% of drug-related material systemic exposure is formed through pathways sequential and parallel to formation of active metabolite. The parent sofosbuvir accounts for approximately 4% of drug-related material systemic exposure (see section 5.2). In clinical pharmacology studies, both sofosbuvir and GS-331007 were monitored for purposes of pharmacokinetic analyses.

Sofosbuvir is a substrate of drug transporter P-gp and breast cancer resistance protein (BCRP) while GS-331007 is not.

Medicinal products that are potent P-gp inducers in the intestine (rifampicin, rifabutin, St. John's wort, carbamazepine, phenobarbital and phenytoin) may significantly decrease sofosbuvir plasma concentration leading to reduced therapeutic effect of Sovaldi and thus are contraindicated with

Sovaldi (see section 4.3). Medicinal products that are moderate P-gp inducers in the intestine (e.g. oxcarbazepine and modafinil) may decrease sofosbuvir plasma concentration leading to reduced therapeutic effect of Sovaldi. Co-administration with such medicinal products is not recommended with Sovaldi (see section 4.4). Co-administration of Sovaldi with medicinal products that inhibit P-gp and/or BCRP may increase sofosbuvir plasma concentration without increasing GS-331007 plasma concentration, thus Sovaldi may be co-administered with P-gp and/or BCRP inhibitors. Sofosbuvir and GS-331007 are not inhibitors of P-gp and BCRP and thus are not expected to increase exposures of medicinal products that are substrates of these transporters.

The intracellular metabolic activation pathway of sofosbuvir is mediated by generally low affinity and high capacity hydrolase and nucleotide phosphorylation pathways that are unlikely to be affected by concomitant medicinal products (see section 5.2).

Patients treated with vitamin K antagonists

As liver function may change during treatment with Sovaldi, a close monitoring of International Normalised Ratio (INR) values is recommended.

Other interactions

Drug interaction information for Sovaldi with potential concomitant medicinal products is summarised in Table 5 below (where 90% confidence interval (CI) of the geometric least-squares mean (GLSM) ratio were within “↔”, extended above “↑”, or extended below “↓” the predetermined equivalence boundaries). The table is not all-inclusive.

Table 5: Interactions between Sovaldi and other medicinal products

Medicinal product by therapeutic areas	Effects on drug levels. Mean ratio (90% confidence interval) for AUC, C _{max} , C _{min} ^{a,b}	Recommendation concerning co-administration with Sovaldi
<i>ANALEPTICS</i>		
Modafinil	Interaction not studied. <i>Expected:</i> ↓ Sofosbuvir ↔ GS-331007	Co-administration of Sovaldi with modafinil is expected to decrease the concentration of sofosbuvir, leading to reduced therapeutic effect of Sovaldi. Such co-administration is not recommended.
<i>ANTIARRHYTHMICS</i>		
Amiodarone	Interaction not studied.	Use only if no other alternative is available. Close monitoring is recommended if this medicinal product is administered with Sovaldi and another DAA (see sections 4.4 and 4.8).
<i>ANTICOAGULANTS</i>		
Vitamin K antagonists	Interaction not studied	Close monitoring of INR is recommended with all vitamin K antagonists. This is due to liver function changes during treatment with Sovaldi.
<i>ANTICONSULSANTS</i>		
Carbamazepine Phenobarbital Phenytoin	Interaction not studied. <i>Expected:</i> ↓ Sofosbuvir ↔ GS-331007	Sovaldi is contraindicated with carbamazepine, phenobarbital and phenytoin, potent intestinal P-gp inducers (see section 4.3).
Oxcarbazepine	Interaction not studied. <i>Expected:</i> ↓ Sofosbuvir ↔ GS-331007	Co-administration of Sovaldi with oxcarbazepine is expected to decrease the concentration of sofosbuvir, leading to reduced therapeutic effect of Sovaldi. Such co-administration is not recommended (see section 4.4).

Medicinal product by therapeutic areas	Effects on drug levels. Mean ratio (90% confidence interval) for AUC, C _{max} , C _{min} ^{a,b}	Recommendation concerning co-administration with Sovaldi
ANTIMYCOBACTERIALS		
Rifampicin ^f (600 mg single dose)	<i>Sofosbuvir</i> ↓ C _{max} 0.23 (0.19, 0.29) ↓ AUC 0.28 (0.24, 0.32) C _{min} (NA) <i>GS-331007</i> ↔ C _{max} 1.23 (1.14, 1.34) ↔ AUC 0.95 (0.88, 1.03) C _{min} (NA)	Sovaldi is contraindicated with rifampicin, a potent intestinal P-gp inducer (see section 4.3).
Rifabutin Rifapentine	Interaction not studied. <i>Expected:</i> ↓ Sofosbuvir ↔ GS-331007	Sovaldi is contraindicated with rifabutin, a potent intestinal P-gp inducer (see section 4.3). Co-administration of Sovaldi with rifapentine is expected to decrease the concentration of sofosbuvir, leading to reduced therapeutic effect of Sovaldi. Such co-administration is not recommended.
HERBAL SUPPLEMENTS		
St. John's wort (<i>Hypericum perforatum</i>)	Interaction not studied. <i>Expected:</i> ↓ Sofosbuvir ↔ GS-331007	Sovaldi is contraindicated with St. John's wort, a potent intestinal P-gp inducer (see section 4.3).
HCV ANTIVIRAL AGENTS: HCV PROTEASE INHIBITORS		
Boceprevir (BOC) Telaprevir (TPV)	Interaction not studied. <i>Expected:</i> ↑ Sofosbuvir (TPV) ↔ Sofosbuvir (BOC) ↔ GS-331007 (TPV or BOC)	No drug-drug interaction data exists regarding the co-administration of Sovaldi with boceprevir or telaprevir.
NARCOTIC ANALGESICS		
Methadone ^f (Methadone maintenance therapy [30 to 130 mg/daily])	<i>R-methadone</i> ↔ C _{max} 0.99 (0.85, 1.16) ↔ AUC 1.01 (0.85, 1.21) ↔ C _{min} 0.94 (0.77, 1.14) <i>S-methadone</i> ↔ C _{max} 0.95 (0.79, 1.13) ↔ AUC 0.95 (0.77, 1.17) ↔ C _{min} 0.95 (0.74, 1.22) <i>Sofosbuvir</i> ↓ C _{max} 0.95 ^c (0.68, 1.33) ↑ AUC 1.30 ^c (1.00, 1.69) C _{min} (NA) <i>GS-331007</i> ↓ C _{max} 0.73 ^c (0.65, 0.83) ↔ AUC 1.04 ^c (0.89, 1.22) C _{min} (NA)	No dose adjustment of sofosbuvir or methadone is required when sofosbuvir and methadone are used concomitantly.

Medicinal product by therapeutic areas	Effects on drug levels. Mean ratio (90% confidence interval) for AUC, C _{max} , C _{min} ^{a,b}	Recommendation concerning co-administration with Sovaldi
IMMUNOSUPPRESSANTS		
Ciclosporin ^e (600 mg single dose)	<p><i>Ciclosporin</i> ↔ C_{max} 1.06 (0.94, 1.18) ↔ AUC 0.98 (0.85, 1.14) C_{min} (NA)</p> <p><i>Sofosbuvir</i> ↑ C_{max} 2.54 (1.87, 3.45) ↑ AUC 4.53 (3.26, 6.30) C_{min} (NA)</p> <p><i>GS-331007</i> ↓ C_{max} 0.60 (0.53, 0.69) ↔ AUC 1.04 (0.90, 1.20) C_{min} (NA)</p>	No dose adjustment of sofosbuvir or ciclosporin is required when sofosbuvir and ciclosporin are used concomitantly.
Tacrolimus ^e (5 mg single dose)	<p><i>Tacrolimus</i> ↓ C_{max} 0.73 (0.59, 0.90) ↔ AUC 1.09 (0.84, 1.40) C_{min} (NA)</p> <p><i>Sofosbuvir</i> ↓ C_{max} 0.97 (0.65, 1.43) ↑ AUC 1.13 (0.81, 1.57) C_{min} (NA)</p> <p><i>GS-331007</i> ↔ C_{max} 0.97 (0.83, 1.14) ↔ AUC 1.00 (0.87, 1.13) C_{min} (NA)</p>	No dose adjustment of sofosbuvir or tacrolimus is required when sofosbuvir and tacrolimus are used concomitantly.
HIV ANTIVIRAL AGENTS: REVERSE TRANSCRIPTASE INHIBITORS		
Efavirenz ^f (600 mg once daily) ^d	<p><i>Efavirenz</i> ↔ C_{max} 0.95 (0.85, 1.06) ↔ AUC 0.96 (0.91, 1.03) ↔ C_{min} 0.96 (0.93, 0.98)</p> <p><i>Sofosbuvir</i> ↓ C_{max} 0.81 (0.60, 1.10) ↔ AUC 0.94 (0.76, 1.16) C_{min} (NA)</p> <p><i>GS-331007</i> ↓ C_{max} 0.77 (0.70, 0.84) ↔ AUC 0.84 (0.76, 0.92) C_{min} (NA)</p>	No dose adjustment of sofosbuvir or efavirenz is required when sofosbuvir and efavirenz are used concomitantly.
Emtricitabine ^f (200 mg once daily) ^d	<p><i>Emtricitabine</i> ↔ C_{max} 0.97 (0.88, 1.07) ↔ AUC 0.99 (0.94, 1.05) ↔ C_{min} 1.04 (0.98, 1.11)</p> <p><i>Sofosbuvir</i> ↓ C_{max} 0.81 (0.60, 1.10) ↔ AUC 0.94 (0.76, 1.16) C_{min} (NA)</p> <p><i>GS-331007</i> ↓ C_{max} 0.77 (0.70, 0.84) ↔ AUC 0.84 (0.76, 0.92) C_{min} (NA)</p>	No dose adjustment of sofosbuvir or emtricitabine is required when sofosbuvir and emtricitabine are used concomitantly.

Medicinal product by therapeutic areas	Effects on drug levels. Mean ratio (90% confidence interval) for AUC, C _{max} , C _{min} ^{a,b}	Recommendation concerning co-administration with Sovaldi
Tenofovir disoproxil fumarate ^f (300 mg once daily) ^d	<p><i>Tenofovir</i> ↑ C_{max} 1.25 (1.08, 1.45) ↔ AUC 0.98 (0.91, 1.05) ↔ C_{min} 0.99 (0.91, 1.07)</p> <p><i>Sofosbuvir</i> ↓ C_{max} 0.81 (0.60, 1.10) ↔ AUC 0.94 (0.76, 1.16) C_{min} (NA)</p> <p><i>GS-331007</i> ↓ C_{max} 0.77 (0.70, 0.84) ↔ AUC 0.84 (0.76, 0.92) C_{min} (NA)</p>	No dose adjustment of sofosbuvir or tenofovir disoproxil fumarate is required when sofosbuvir and tenofovir disoproxil fumarate are used concomitantly.
Rilpivirine ^f (25 mg once daily)	<p><i>Rilpivirine</i> ↔ C_{max} 1.05 (0.97, 1.15) ↔ AUC 1.06 (1.02, 1.09) ↔ C_{min} 0.99 (0.94, 1.04)</p> <p><i>Sofosbuvir</i> ↑ C_{max} 1.21 (0.90, 1.62) ↔ AUC 1.09 (0.94, 1.27) C_{min} (NA)</p> <p><i>GS-331007</i> ↔ C_{max} 1.06 (0.99, 1.14) ↔ AUC 1.01 (0.97, 1.04) C_{min} (NA)</p>	No dose adjustment of sofosbuvir or rilpivirine is required when sofosbuvir and rilpivirine are used concomitantly.
HIV ANTIVIRAL AGENTS: HIV PROTEASE INHIBITORS		
Darunavir boosted with ritonavir ^f (800/100 mg once daily)	<p><i>Darunavir</i> ↔ C_{max} 0.97 (0.94, 1.01) ↔ AUC 0.97 (0.94, 1.00) ↔ C_{min} 0.86 (0.78, 0.96)</p> <p><i>Sofosbuvir</i> ↑ C_{max} 1.45 (1.10, 1.92) ↑ AUC 1.34 (1.12, 1.59) C_{min} (NA)</p> <p><i>GS-331007</i> ↔ C_{max} 0.97 (0.90, 1.05) ↔ AUC 1.24 (1.18, 1.30) C_{min} (NA)</p>	No dose adjustment of sofosbuvir or darunavir (ritonavir boosted) is required when sofosbuvir and darunavir are used concomitantly.
HIV ANTIVIRAL AGENTS: INTEGRASE INHIBITORS		
Raltegravir ^f (400 mg twice daily)	<p><i>Raltegravir</i> ↓ C_{max} 0.57 (0.44, 0.75) ↓ AUC 0.73 (0.59, 0.91) ↔ C_{min} 0.95 (0.81, 1.12)</p> <p><i>Sofosbuvir</i> ↔ C_{max} 0.87 (0.71, 1.08) ↔ AUC 0.95 (0.82, 1.09) C_{min} (NA)</p> <p><i>GS-331007</i> ↔ C_{max} 1.09 (0.99, 1.20) ↔ AUC 1.03 (0.97, 1.08) C_{min} (NA)</p>	No dose adjustment of sofosbuvir or raltegravir is required when sofosbuvir and raltegravir are used concomitantly.

Medicinal product by therapeutic areas	Effects on drug levels. Mean ratio (90% confidence interval) for AUC, C _{max} , C _{min} ^{a,b}	Recommendation concerning co-administration with Sovaldi
ORAL CONTRACEPTIVES		
Norgestimate/ethinyl estradiol	<p><i>Norgestromin</i> ↔ C_{max} 1.06 (0.93, 1.22) ↔ AUC 1.05 (0.92, 1.20) C_{min} (NA)</p> <p><i>Norgestrel</i> ↔ C_{max} 1.18 (0.99, 1.41) ↔ AUC 1.19 (0.98, 1.44) C_{min} (NA)</p> <p><i>Ethinyl estradiol</i> ↔ C_{max} 1.14 (0.96, 1.36) ↔ AUC 1.08 (0.93, 1.25) C_{min} (NA)</p>	No dose adjustment of norgestimate/ethinyl estradiol is required when sofosbuvir and norgestimate/ethinyl estradiol are used concomitantly.

NA = not available/not applicable

a. Mean ratio (90% CI) of co-administered drug pharmacokinetics with/without sofosbuvir and mean ratio of sofosbuvir and GS-331007 with/without co-administered drug. No effect = 1.00

b. All interaction studies conducted in healthy volunteers

c. Comparison based on historical control

d. Administered as Atripla

e. Bioequivalence boundary 80%-125%

f. Equivalence boundary 70%-143%

4.6 Fertility, pregnancy and lactation

Women of childbearing potential / contraception in males and females

When Sovaldi is used in combination with ribavirin or peginterferon alfa/ribavirin, extreme care must be taken to avoid pregnancy in female patients and in female partners of male patients. Significant teratogenic and/or embryocidal effects have been demonstrated in all animal species exposed to ribavirin (see section 4.4). Women of childbearing potential or their male partners must use an effective form of contraception during treatment and for a period of time after the treatment has concluded as recommended in the Summary of Product Characteristics for ribavirin. Refer to the Summary of Product Characteristics for ribavirin for additional information.

Pregnancy

There are no or limited amount of data (less than 300 pregnancy outcomes) from the use of sofosbuvir in pregnant women.

Animal studies do not indicate direct or indirect harmful effects with respect to reproductive toxicity. No effects on foetal development have been observed in rats and rabbits at the highest doses tested. However, it has not been possible to fully estimate exposure margins achieved for sofosbuvir in the rat relative to the exposure in humans at the recommended clinical dose (see section 5.3).

As a precautionary measure, it is preferable to avoid the use of Sovaldi during pregnancy.

However, if ribavirin is co-administered with sofosbuvir, the contraindications regarding use of ribavirin during pregnancy apply (see also the Summary of Product Characteristics for ribavirin).

Breast-feeding

It is unknown whether sofosbuvir and its metabolites are excreted in human milk.

Available pharmacokinetic data in animals has shown excretion of metabolites in milk (for details see section 5.3).

A risk to newborns/infants cannot be excluded. Therefore, Sovaldi should not be used during breast-feeding.

Fertility

No human data on the effect of Sovaldi on fertility are available. Animal studies do not indicate harmful effects on fertility.

4.7 Effects on ability to drive and use machines

Sovaldi has moderate influence on the ability to drive and use machines. Patients should be informed that fatigue and disturbance in attention, dizziness and blurred vision have been reported during treatment with sofosbuvir in combination with peginterferon alfa and ribavirin (see section 4.8).

4.8 Undesirable effects

Summary of the safety profile in adults

During treatment with sofosbuvir in combination with ribavirin or with peginterferon alfa and ribavirin, the most frequently reported adverse drug reactions were consistent with the expected safety profile of ribavirin and peginterferon alfa treatment, without increasing the frequency or severity of the expected adverse drug reactions.

Assessment of adverse reactions is based on pooled data from five Phase 3 clinical studies (both controlled and uncontrolled).

The proportion of patients who permanently discontinued treatment due to adverse reactions was 1.4% for patients receiving placebo, 0.5% for patients receiving sofosbuvir + ribavirin for 12 weeks, 0% for patients receiving sofosbuvir + ribavirin for 16 weeks, 11.1% for patients receiving peginterferon alfa + ribavirin for 24 weeks and 2.4% for patients receiving sofosbuvir + peginterferon alfa + ribavirin for 12 weeks.

Tabulated summary of adverse reactions

Sovaldi has mainly been studied in combination with ribavirin, with or without peginterferon alfa. In this context, no adverse drug reactions specific to sofosbuvir have been identified. The most common adverse drug reactions occurring in patients receiving sofosbuvir and ribavirin or sofosbuvir, ribavirin and peginterferon alfa were fatigue, headache, nausea and insomnia.

The following adverse drug reactions have been identified with sofosbuvir in combination with ribavirin or in combination with peginterferon alfa and ribavirin (Table 6). The adverse reactions are listed below by body system organ class and frequency. Frequencies are defined as follows: 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 $< 1/1,000$) or very rare ($< 1/10,000$).

Table 6: Adverse drug reactions identified with sofosbuvir in combination with ribavirin or peginterferon alfa and ribavirin

Frequency	SOF ^a + RBV ^b	SOF + PEG ^c + RBV
<i>Infections and infestations:</i>		
Common	nasopharyngitis	
<i>Blood and lymphatic system disorders:</i>		
Very common	haemoglobin decreased	anaemia, neutropenia, lymphocyte count decreased, platelet count decreased
Common	anaemia	
<i>Metabolism and nutrition disorders:</i>		
Very common		decreased appetite
Common		weight decreased
<i>Psychiatric disorders:</i>		
Very common	insomnia	insomnia
Common	depression	depression, anxiety, agitation
<i>Nervous system disorders:</i>		
Very common	headache	dizziness, headache
Common	disturbance in attention	migraine, memory impairment, disturbance in attention
<i>Eye disorders:</i>		
Common		vision blurred
<i>Respiratory, thoracic and mediastinal disorders:</i>		
Very common		dyspnoea, cough
Common	dyspnoea, dyspnoea exertional, cough	dyspnoea exertional
<i>Gastrointestinal disorders:</i>		
Very common	nausea	diarrhoea, nausea, vomiting
Common	abdominal discomfort, constipation, dyspepsia	constipation, dry mouth, gastroesophageal reflux
<i>Hepatobiliary disorders:</i>		
Very common	blood bilirubin increased	blood bilirubin increased
<i>Skin and subcutaneous tissue disorders:</i>		
Very common		rash, pruritus
Common	alopecia, dry skin, pruritus	alopecia, dry skin
<i>Musculoskeletal and connective tissue disorders:</i>		
Very common		arthralgia, myalgia
Common	arthralgia, back pain, muscle spasms, myalgia	back pain, muscle spasms
<i>General disorders and administration site conditions:</i>		
Very common	fatigue, irritability	chills, fatigue, influenza-like illness, irritability, pain, pyrexia
Common	pyrexia, asthenia	chest pain, asthenia

a. SOF = sofosbuvir; b. RBV = ribavirin; c. PEG = peginterferon alfa.

Other special population(s)

HIV/HCV co-infection

The safety profile of sofosbuvir and ribavirin in HCV/HIV co-infected adult patients was similar to that observed in mono-infected HCV patients treated with sofosbuvir and ribavirin in Phase 3 clinical studies (see section 5.1).

Patients awaiting liver transplantation

The safety profile of sofosbuvir and ribavirin in HCV infected adult patients prior to liver transplantation was similar to that observed in patients treated with sofosbuvir and ribavirin in Phase 3 clinical studies (see section 5.1).

Liver transplant recipients

The safety profile of sofosbuvir and ribavirin in liver transplant adult recipients with chronic hepatitis C was similar to that observed in patients treated with sofosbuvir and ribavirin in Phase 3 clinical studies (see section 5.1). In study 0126, decreases in haemoglobin during treatment were very common with 32.5% (13/40 patients) experiencing a decline in haemoglobin to <10 g/dL, 1 of whom

also had a decline to <8.5 g/dL. Eight patients (20%) received epoetin and/or a blood product. In 5 patients (12.5%), study drugs were discontinued, modified or interrupted due to adverse events.

Paediatric population

The safety and efficacy of Sovaldi in adolescents aged 12 to <18 years are based on data from 50 patients who were treated with Sovaldi and ribavirin for 12 weeks (genotype 2 patients) and 24 weeks (genotype 3 patients) in a Phase 2, open-label clinical trial. The adverse reactions observed were consistent with those observed in clinical studies of Sovaldi plus ribavirin in adults (see Table 6).

Description of selected adverse reactions

Cardiac arrhythmias

Cases of severe bradycardia and heart block have been observed when sofosbuvir is used in combination with another DAA (including daclatasvir, simeprevir and ledipasvir) and concomitant amiodarone and/or other drugs that lower heart rate (see sections 4.4 and 4.5).

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

The highest documented dose of sofosbuvir was a single suprathreshold dose of sofosbuvir 1,200 mg administered to 59 healthy subjects. In that study, there were no untoward effects observed at this dose level, and adverse reactions were similar in frequency and severity to those reported in the placebo and sofosbuvir 400 mg treatment groups. The effects of higher doses are unknown.

No specific antidote is available for overdose with Sovaldi. If overdose occurs the patient must be monitored for evidence of toxicity. Treatment of overdose with Sovaldi consists of general supportive measures including monitoring of vital signs as well as observation of the clinical status of the patient. Haemodialysis can efficiently remove (53% extraction ratio) the predominant circulating metabolite GS-331007. A 4-hour haemodialysis session removed 18% of the administered dose.

5. PHARMACOLOGICAL PROPERTIES

5.1 Pharmacodynamic properties

Pharmacotherapeutic group: Direct-acting antiviral; ATC code: J05AX15

Mechanism of action

Sofosbuvir is a pan-genotypic inhibitor of the HCV NS5B RNA-dependent RNA polymerase, which is essential for viral replication. Sofosbuvir is a nucleotide prodrug that undergoes intracellular metabolism to form the pharmacologically active uridine analog triphosphate (GS-461203), which can be incorporated into HCV RNA by the NS5B polymerase and acts as a chain terminator. In a biochemical assay, GS-461203 inhibited the polymerase activity of the recombinant NS5B from HCV genotype 1b, 2a, 3a and 4a with a 50% inhibitory concentration (IC₅₀) value ranging from 0.7 to 2.6 µM. GS-461203 (the active metabolite of sofosbuvir) is not an inhibitor of human DNA and RNA polymerases nor an inhibitor of mitochondrial RNA polymerase.

Antiviral activity

In HCV replicon assays, the effective concentration (EC₅₀) values of sofosbuvir against full-length replicons from genotype 1a, 1b, 2a, 3a and 4a were 0.04, 0.11, 0.05, 0.05 and 0.04 µM, respectively, and EC₅₀ values of sofosbuvir against chimeric 1b replicons encoding NS5B from genotype 2b, 5a or 6a were 0.014 to 0.015 µM. The mean ± SD EC₅₀ of sofosbuvir against chimeric replicons encoding NS5B sequences from clinical isolates was 0.068 ± 0.024 µM for genotype 1a (n = 67),

0.11 ± 0.029 µM for genotype 1b (n = 29), 0.035 ± 0.018 µM for genotype 2 (n = 15) and 0.085 ± 0.034 µM for genotype 3a (n = 106). In these assays, the *in vitro* antiviral activity of sofosbuvir against the less common genotypes 4, 5 and 6 was similar to that observed for genotypes 1, 2 and 3.

The presence of 40% human serum had no effect on the anti-HCV activity of sofosbuvir.

Resistance

In cell culture

HCV replicons with reduced susceptibility to sofosbuvir have been selected in cell culture for multiple genotypes including 1b, 2a, 2b, 3a, 4a, 5a and 6a. Reduced susceptibility to sofosbuvir was associated with the primary NS5B substitution S282T in all replicon genotypes examined. Site-directed mutagenesis of the S282T substitution in replicons of 8 genotypes conferred 2- to 18-fold reduced susceptibility to sofosbuvir and reduced the replication viral capacity by 89% to 99% compared to the corresponding wild-type. In biochemical assays, recombinant NS5B polymerase from genotypes 1b, 2a, 3a and 4a expressing the S282T substitution showed reduced susceptibility to GS-461203 compared to respective wild-types.

In clinical studies - Adults

In a pooled analysis of 991 patients who received sofosbuvir in Phase 3 studies, 226 patients qualified for resistance analysis due to virologic failure or early study drug discontinuation and having HCV RNA >1,000 IU/mL. Post-baseline NS5B sequences were available for 225 of the 226 patients, with deep sequencing data (assay cutoff of 1%) from 221 of these patients. The sofosbuvir-associated resistance substitution S282T was not detected in any of these patients by deep sequencing or population sequencing. The S282T substitution in NS5B was detected in a single subject receiving Sovaldi monotherapy in a Phase 2 study. This subject harboured <1% HCV S282T at baseline and developed S282T (>99%) at 4 weeks post-treatment which resulted in a 13.5-fold change in sofosbuvir EC₅₀ and reduced viral replication capacity. The S282T substitution reverted to wild-type over the next 8 weeks and was no longer detectable by deep sequencing at 12 weeks post-treatment.

Two NS5B substitutions, L159F and V321A, were detected in post-treatment relapse samples from multiple genotype 3 HCV infected patients in the Phase 3 clinical studies. No shift in the phenotypic susceptibility to sofosbuvir or ribavirin of subject isolates with these substitutions was detected. In addition, S282R and L320F substitutions were detected on treatment by deep sequencing in a pre-transplant subject with a partial treatment response. The clinical significance of these findings is unknown.

Effect of baseline HCV polymorphisms on treatment outcome

Adult population

Baseline NS5B sequences were obtained for 1,292 patients from Phase 3 studies by population sequencing and the S282T substitution was not detected in any subject with available baseline sequence. In an analysis evaluating the effect of baseline polymorphisms on treatment outcome, no statistically significant association was observed between the presence of any HCV NS5B variant at baseline and treatment outcome.

Paediatric population

Baseline NS5B sequences were obtained for 47 patients in the Phase 2 study. Among these, one patient was found to have a NS5B RAV substitution (F289L). This patient achieved SVR12.

Cross-resistance

HCV replicons expressing the sofosbuvir-associated resistance substitution S282T were fully susceptible to other classes of anti-HCV agents. Sofosbuvir retained activity against the NS5B substitutions L159F and L320F associated with resistance to other nucleoside inhibitors. Sofosbuvir was fully active against substitutions associated with resistance to other direct-acting antivirals with different mechanisms of actions, such as NS5B non-nucleoside inhibitors, NS3 protease inhibitors and NS5A inhibitors.

Clinical efficacy and safety

The efficacy of sofosbuvir was evaluated in five Phase 3 studies in a total of 1,568 adult patients with genotypes 1 to 6 chronic hepatitis C. One study was conducted in treatment-naïve patients with genotype 1, 4, 5 or 6 chronic hepatitis C in combination with peginterferon alfa 2a and ribavirin and the other four studies were conducted in patients with genotype 2 or 3 chronic hepatitis C in combination with ribavirin including one in treatment-naïve patients, one in interferon intolerant, ineligible or unwilling patients, one in patients previously treated with an interferon-based regimen, and one in all patients irrespective of prior treatment history or ability to receive treatment with interferon. Patients in these studies had compensated liver disease including cirrhosis. Sofosbuvir was administered at a dose of 400 mg once daily. The ribavirin dose was weight-based at 1,000-1,200 mg daily administered in two divided doses, and the peginterferon alfa 2a dose, where applicable, was 180 µg per week. Treatment duration was fixed in each study and was not guided by patients' HCV RNA levels (no response guided algorithm).

Plasma HCV RNA values were measured during the clinical studies using the COBAS TaqMan HCV test (version 2.0), for use with the High Pure System. The assay had a lower limit of quantification (LLOQ) of 25 IU/mL. Sustained virologic response (SVR) was the primary endpoint to determine the HCV cure rate for all studies which was defined as HCV RNA less than LLOQ at 12 weeks after the end of treatment (SVR12).

Clinical studies in patients with genotype 1, 4, 5 and 6 chronic hepatitis C

Treatment-naïve adult patients - NEUTRINO (study 110)

NEUTRINO was an open-label, single-arm study that evaluated 12 weeks of treatment with sofosbuvir in combination with peginterferon alfa 2a and ribavirin in treatment-naïve patients with genotype 1, 4, 5 or 6 HCV infection.

Treated patients (n = 327) had a median age of 54 years (range: 19 to 70); 64% of the patients were male; 79% were White; 17% were Black; 14% were Hispanic or Latino; mean body mass index was 29 kg/m² (range: 18 to 56 kg/m²); 78% had baseline HCV RNA greater than 6 log₁₀ IU/mL; 17% had cirrhosis; 89% had HCV genotype 1 and 11% had HCV genotype 4, 5 or 6. Table 7 presents the response rates for the treatment group of sofosbuvir + peginterferon alfa + ribavirin.

Table 7: Response rates in study NEUTRINO

	SOF+PEG+RBV 12 weeks (n = 327)
Overall SVR12	91% (296/327)
Outcome for patients without SVR12	
On-treatment virologic failure	0/327
Relapse ^a	9% (28/326)
Other ^b	1% (3/327)

a. The denominator for relapse is the number of patients with HCV RNA <LLOQ at their last on-treatment assessment.

b. Other includes patients who did not achieve SVR12 and did not meet virologic failure criteria (e.g., lost to follow-up).

Response rates for selected subgroups are presented in Table 8.

Table 8: SVR12 rates for selected subgroups in NEUTRINO

	SOF+PEG+RBV 12 weeks (n = 327)
Genotype	
Genotype 1	90% (262/292)
Genotype 4, 5 or 6	97% (34/35)
Cirrhosis	
No	93% (253/273)
Yes	80% (43/54)
Race	
Black	87% (47/54)
Non-Black	91% (249/273)

SVR12 rates were similarly high in patients with baseline IL28B C/C allele [94/95 (99%)] and non-C/C (C/T or T/T) allele [202/232 (87%)].

27/28 patients with genotype 4 HCV achieved SVR12. A single subject with genotype 5 and all 6 patients with genotype 6 HCV infection in this study achieved SVR12.

Clinical studies in patients with genotype 2 and 3 chronic hepatitis C
Treatment-naïve adults - FISSION (study 1231)

FISSION was a randomised, open-label, active-controlled study that evaluated 12 weeks of treatment with sofosbuvir and ribavirin compared to 24 weeks of treatment with peginterferon alfa 2a and ribavirin in treatment-naïve patients with genotype 2 or 3 HCV infection. The ribavirin doses used in the sofosbuvir + ribavirin and peginterferon alfa 2a + ribavirin arms were weight-based 1,000-1,200 mg/day and 800 mg/day regardless of weight, respectively. Patients were randomised in a 1:1 ratio and stratified by cirrhosis (presence *versus* absence), HCV genotype (2 *versus* 3) and baseline HCV RNA level (<6 log₁₀ IU/mL *versus* ≥6 log₁₀ IU/mL). Patients with genotype 2 or 3 HCV were enrolled in an approximately 1:3 ratio.

Treated patients (n = 499) had a median age of 50 years (range: 19 to 77); 66% of the patients were male; 87% were White; 3% were Black; 14% were Hispanic or Latino; mean body mass index was 28 kg/m² (range: 17 to 52 kg/m²); 57% had baseline HCV RNA levels greater than 6 log₁₀ IU/mL; 20% had cirrhosis; 72% had HCV genotype 3. Table 9 presents the response rates for the treatment groups of sofosbuvir + ribavirin and peginterferon alfa + ribavirin.

Table 9: Response rates in study FISSION

	SOF+RBV 12 weeks (n = 256)^a	PEG+RBV 24 weeks (n = 243)
Overall SVR12	67% (171/256)	67% (162/243)
Genotype 2	95% (69/73)	78% (52/67)
Genotype 3	56% (102/183)	63% (110/176)
Outcome for patients without SVR12		
On-treatment virologic failure	< 1% (1/256)	7% (18/243)
Relapse ^b	30% (76/252)	21% (46/217)
Other ^c	3% (8/256)	7% (17/243)

a. The efficacy analysis includes 3 patients with recombinant genotype 2/1 HCV infection.

b. The denominator for relapse is the number of patients with HCV RNA <LLOQ at their last on-treatment assessment.

c. Other includes patients who did not achieve SVR12 and did not meet virologic failure criteria (e.g., lost to follow-up).

The difference in the overall SVR12 rates between sofosbuvir + ribavirin and peginterferon alfa + ribavirin treatment groups was 0.3% (95% confidence interval: -7.5% to 8.0%) and the study met the predefined non-inferiority criterion.

Response rates for patients with cirrhosis at baseline are presented in Table 10 by HCV genotype.

Table 10: SVR12 rates by cirrhosis and genotype in study FISSION

	Genotype 2		Genotype 3	
	SOF+RBV 12 weeks (n = 73) ^a	PEG+RBV 24 weeks (n = 67)	SOF+RBV 12 weeks (n = 183)	PEG+RBV 24 weeks (n = 176)
Cirrhosis				
No	97% (59/61)	81% (44/54)	61% (89/145)	71% (99/139)
Yes	83% (10/12)	62% (8/13)	34% (13/38)	30% (11/37)

a. The efficacy analysis includes 3 patients with recombinant genotype 2/1 HCV infection.

Interferon intolerant, ineligible or unwilling adults - POSITRON (study 107)

POSITRON was a randomised, double-blinded, placebo-controlled study that evaluated 12 weeks of treatment with sofosbuvir and ribavirin (n = 207) compared to placebo (n = 71) in patients who are interferon intolerant, ineligible or unwilling. Patients were randomised in 3:1 ratio and stratified by cirrhosis (presence *versus* absence).

Treated patients (n = 278) had a median age of 54 years (range: 21 to 75); 54% of the patients were male; 91% were White; 5% were Black; 11% were Hispanic or Latino; mean body mass index was 28 kg/m² (range: 18 to 53 kg/m²); 70% had baseline HCV RNA levels greater than 6 log₁₀ IU/mL; 16% had cirrhosis; 49% had HCV genotype 3. The proportions of patients who were interferon intolerant, ineligible, or unwilling were 9%, 44%, and 47%, respectively. Most patients had no prior HCV treatment (81.3%). Table 11 presents the response rates for the treatment groups of sofosbuvir + ribavirin and placebo.

Table 11: Response rates in study POSITRON

	SOF+RBV 12 weeks (n = 207)	Placebo 12 weeks (n = 71)
Overall SVR12	78% (161/207)	0/71
Genotype 2	93% (101/109)	0/34
Genotype 3	61% (60/98)	0/37
Outcome for patients without SVR12		
On-treatment virologic failure	0/207	97% (69/71)
Relapse ^a	20% (42/205)	0/0
Other ^b	2% (4/207)	3% (2/71)

a. The denominator for relapse is the number of patients with HCV RNA <LLOQ at their last on-treatment assessment.

b. Other includes patients who did not achieve SVR12 and did not meet virologic failure criteria (e.g., lost to follow-up).

The SVR12 rate in the sofosbuvir + ribavirin treatment group was statistically significant when compared to placebo (p <0.001).

Table 12 presents the subgroup analysis by genotype for cirrhosis and interferon classification.

Table 12: SVR12 rates for selected subgroups by genotype in POSITRON

	SOF+RBV 12 weeks	
	Genotype 2 (n = 109)	Genotype 3 (n = 98)
Cirrhosis		
No	92% (85/92)	68% (57/84)
Yes	94% (16/17)	21% (3/14)
Interferon classification		
Ineligible	88% (36/41)	70% (33/47)
Intolerant	100% (9/9)	50% (4/8)
Unwilling	95% (56/59)	53% (23/43)

Previously treated adults - FUSION (study 108)

FUSION was a randomised, double-blinded study that evaluated 12 or 16 weeks of treatment with sofosbuvir and ribavirin in patients who did not achieve SVR with prior interferon-based treatment

(relapsers and nonresponders). Patients were randomised in a 1:1 ratio and stratified by cirrhosis (presence *versus* absence) and HCV genotype (2 *versus* 3).

Treated patients (n = 201) had a median age of 56 years (range: 24 to 70); 70% of the patients were male; 87% were White; 3% were Black; 9% were Hispanic or Latino; mean body mass index was 29 kg/m² (range: 19 to 44 kg/m²); 73% had baseline HCV RNA levels greater than 6 log₁₀ IU/mL; 34% had cirrhosis; 63% had HCV genotype 3; 75% were prior relapsers. Table 13 presents the response rates for the treatment groups of sofosbuvir + ribavirin for 12 weeks and 16 weeks.

Table 13: Response rates in study FUSION

	SOF+RBV 12 weeks (n = 103)^a	SOF+RBV 16 weeks (n = 98)^a
Overall SVR12	50% (51/103)	71% (70/98)
Genotype 2	82% (32/39)	89% (31/35)
Genotype 3	30% (19/64)	62% (39/63)
Outcome for patients without SVR12		
On-treatment virologic failure	0/103	0/98
Relapse ^b	48% (49/103)	29% (28/98)
Other ^c	3% (3/103)	0/98

a. The efficacy analysis includes 6 patients with recombinant genotype 2/1 HCV infection.

b. The denominator for relapse is the number of patients with HCV RNA <LLOQ at their last on-treatment assessment.

c. Other includes patients who did not achieve SVR12 and did not meet virologic failure criteria (e.g., lost to follow-up).

Table 14 presents the subgroup analysis by genotype for cirrhosis and response to prior HCV treatment.

Table 14: SVR12 rates for selected subgroups by genotype in study FUSION

	Genotype 2		Genotype 3	
	SOF+RBV 12 weeks (n = 39)	SOF+RBV 16 weeks (n = 35)	SOF+RBV 12 weeks (n = 64)	SOF+RBV 16 weeks (n = 63)
Cirrhosis				
No	90% (26/29)	92% (24/26)	37% (14/38)	63% (25/40)
Yes	60% (6/10)	78% (7/9)	19% (5/26)	61% (14/23)
Response to prior HCV treatment				
Relapser	86% (25/29)	89% (24/27)	31% (15/49)	65% (30/46)
Nonresponder	70% (7/10)	88% (7/8)	27% (4/15)	53% (9/17)

Treatment-naïve and previously treated adults - VALENCE (study 133)

VALENCE was a Phase 3 study that evaluated sofosbuvir in combination with weight-based ribavirin for the treatment of genotype 2 or 3 HCV infection in treatment-naïve patients or patients who did not achieve SVR with prior interferon-based treatment, including patients with compensated cirrhosis. The study was designed as a direct comparison of sofosbuvir and ribavirin *versus* placebo for 12 weeks. However, based on emerging data, the study was unblinded and all HCV genotype 2 patients continued to receive sofosbuvir and ribavirin for 12 weeks, whilst treatment for HCV genotype 3 patients was extended to 24 weeks. Eleven HCV genotype 3 patients had already completed treatment with sofosbuvir and ribavirin for 12 weeks at the time of the amendment.

Treated patients (n = 419) had a median age of 51 years (range: 19 to 74); 60% of the patients were male; median body mass index was 25 kg/m² (range: 17 to 44 kg/m²); the mean baseline HCV RNA level was 6.4 log₁₀ IU/mL; 21% had cirrhosis; 78% had HCV genotype 3; 65% were prior relapsers. Table 15 presents the response rates for the treatment groups of sofosbuvir + ribavirin for 12 weeks and 24 weeks.

Placebo recipients are not included in the tables since none achieved SVR12.

Table 15: Response rates in study VALENCE

	Genotype 2 SOF+RBV 12 weeks (n = 73)	Genotype 3 SOF+RBV 12 weeks (n = 11)	Genotype 3 SOF+RBV 24 weeks (n = 250)
Overall SVR12	93% (68/73)	27% (3/11)	84% (210/250)
Outcome for patients without SVR12			
On-treatment virologic failure	0% (0/73)	0% (0/11)	0.4% (1/250)
Relapse ^a	7% (5/73)	55% (6/11)	14% (34/249)
Other ^b	0% (0/73)	18% (2/11)	2% (5/250)

a. The denominator for relapse is the number of patients with HCV RNA <LLOQ at their last on-treatment assessment.

b. Other includes patients who did not achieve SVR12 and did not meet virologic failure criteria (e.g., lost to follow-up).

Table 16 presents the subgroup analysis by genotype for cirrhosis and exposure to prior HCV treatment.

Table 16: SVR12 rates for selected subgroups by genotype in study VALENCE

	Genotype 2 SOF+RBV 12 weeks (n = 73)	Genotype 3 SOF+RBV 24 weeks (n = 250)
Treatment-naïve	97% (31/32)	93% (98/105)
Non-cirrhotic	97% (29/30)	93% (86/92)
Cirrhotic	100% (2/2)	92% (12/13)
Treatment-experienced	90% (37/41)	77% (112/145)
Non-cirrhotic	91% (30/33)	85% (85/100)
Cirrhotic	88% (7/8)	60% (27/45)

SVR12 to SVR24 concordance

The concordance between SVR12 and SVR24 (SVR 24 weeks after the end of the treatment) following treatment with sofosbuvir in combination with ribavirin or ribavirin and pegylated interferon demonstrates a positive predictive value of 99% and a negative predictive value of 99%.

Clinical efficacy and safety in special populations

HCV/HIV co-infected adult patients - PHOTON-1 (study 123)

Sofosbuvir was studied in an open-label clinical study evaluating the safety and efficacy of 12 or 24 weeks of treatment with sofosbuvir and ribavirin in patients with genotype 1, 2 or 3 chronic hepatitis C co-infected with HIV-1. Genotype 2 and 3 patients were either treatment-naïve or experienced, whereas genotype 1 patients were naïve to prior treatment. Treatment duration was 12 weeks in treatment-naïve patients with genotype 2 or 3 HCV infection, and 24 weeks in treatment-experienced patients with genotype 3 HCV infection, as well as patients with genotype 1 HCV infection. Patients received 400 mg sofosbuvir and weight-based ribavirin (1,000 mg for patients weighing <75 kg or 1,200 mg for patients weighing ≥75 kg). Patients were either not on antiretroviral therapy with a CD4+ cell count >500 cells/mm³ or had virologically suppressed HIV-1 with a CD4+ cell count >200 cells/mm³. 95% of patients received antiretroviral therapy at the time of enrolment. Preliminary SVR12 data are available for 210 patients.

Table 17 presents the response rates by genotype and exposure to prior HCV treatment.

Table 17: Response rates in study PHOTON-1

	Genotype 2/3 treatment-naïve SOF+RBV 12 weeks (n = 68)	Genotype 2/3 treatment-experienced SOF+RBV 24 weeks (n = 28)	Genotype 1 treatment-naïve SOF+RBV 24 weeks (n = 114)
Overall SVR12	75% (51/68)	93% (26/28)	76% (87/114)
Outcome for patients without SVR12			
On-treatment virologic failure	1% (1/68)	0/28	1% (1/114)
Relapse ^a	18% (12/67)	7% (2/28)	22% (25/113)
Other ^b	6% (4/68)	0/28	1% (1/114)

a. The denominator for relapse is the number of patients with HCV RNA <LLOQ at their last on-treatment assessment.

b. Other includes patients who did not achieve SVR12 and did not meet virologic failure criteria (e.g., lost to follow-up).

Table 18 presents the subgroup analysis by genotype for cirrhosis.

Table 18: SVR12 rates for selected subgroups by genotype in study PHOTON-1

	HCV genotype 2		HCV genotype 3	
	SOF+RBV 12 weeks TN (n = 26)	SOF+RBV 24 weeks TE (n = 15)	SOF+RBV 12 weeks TN (n = 42)	SOF+RBV 24 weeks TE (n = 13)
Overall	88% (23/26)	93% (14/15)	67% (28/42)	92% (12/13)
No cirrhosis	88% (22/25)	92% (12/13)	67% (24/36)	100% (8/8)
Cirrhosis	100% (1/1)	100% (2/2)	67% (4/6)	80% (4/5)

TN = treatment-naïve; TE = treatment-experienced.

Adult patients awaiting liver transplantation - Study 2025

Sofosbuvir was studied in HCV infected patients prior to undergoing liver transplantation in an open-label clinical study evaluating the safety and efficacy of sofosbuvir and ribavirin administered pre-transplant to prevent post-transplant HCV reinfection. The primary endpoint of the study was post-transplant virologic response (pTVR, HCV RNA <LLOQ at 12 weeks post-transplant). HCV infected patients, regardless of genotype, with hepatocellular carcinoma (HCC) meeting the MILAN criteria received 400 mg sofosbuvir and 1,000-1,200 mg ribavirin daily for a maximum of 24 weeks, subsequently amended to 48 weeks, or until the time of liver transplantation, whichever occurred first. An interim analysis was conducted on 61 patients who received sofosbuvir and ribavirin; the majority of patients had HCV genotype 1, 44 patients were CPT class A and 17 patients were CPT class B. Of these 61 patients, 44 patients underwent liver transplantation following up to 48 weeks of treatment with sofosbuvir and ribavirin; 41 had HCV RNA <LLOQ at the time of transplantation. The virologic response rates of the 41 patients transplanted with HCV RNA <LLOQ is described in Table 19. Duration of viral suppression prior to transplantation was the most predictive factor for pTVR in those who were HCV RNA <LLOQ at the time of transplantation.

Table 19: Virologic response post-transplant in patients with HCV RNA <LLOQ at the time of liver transplantation

	Week 12 post-transplant (pTVR)^b
Virologic response in evaluable patients ^a	23/37 (62%)

a. Evaluable patients are defined as those who have reached the specified time point at the time of the interim analysis.

b. pTVR: post-transplant virologic response (HCV RNA <LLOQ at 12 weeks post-procedure).

In patients that discontinued therapy at 24 weeks, according to protocol, the relapse rate was 11/15.

Adult liver transplant recipients - Study 0126

Sofosbuvir was studied in an open-label clinical study evaluating the safety and efficacy of 24 weeks of treatment with sofosbuvir and ribavirin in liver transplant recipients with chronic hepatitis C. Eligible patients were ≥18 years old and had undergone liver transplantation 6 to 150 months prior to

screening. Patients had HCV RNA $\geq 10^4$ IU/mL at screening and documented evidence of chronic HCV infection pre-transplantation. The starting dose of ribavirin was 400 mg given in a divided daily dose. If patients maintained haemoglobin levels ≥ 12 g/dL, ribavirin dose was increased at weeks 2, 4, and up to every 4 weeks until the appropriate weight-based dose was reached (1,000 mg daily in patients < 75 kg, 1,200 mg daily in patients ≥ 75 kg). The median ribavirin dose was 600 mg-800 mg daily at weeks 4-24.

Forty patients (33 with HCV genotype 1 infection, 6 with HCV genotype 3 infection, and 1 with HCV genotype 4 infection) were enrolled, 35 of whom had previously failed interferon-based treatment, and 16 of whom had cirrhosis. 28 out of 40 (70%) patients achieved SVR12: 22/33 (73%) with HCV genotype 1 infection, 6/6 (100%) with HCV genotype 3 infection, and 0/1 (0%) with HCV genotype 4 infection. All patients who achieved SVR12 achieved SVR24 and SVR48.

Overview of outcomes by therapeutic regimen and treatment duration, a comparison across studies

The following tables (Table 20 to Table 23) present data from Phase 2 and Phase 3 studies relevant to the dosing to help clinicians determine the best regimen for individual patients.

Table 20: Outcomes by therapeutic regimen and treatment duration, a comparison across studies in genotype 1 HCV infection

Patient population (Study number/name)	Regimen/Duration	Subgroup	SVR12 rate % (n/N)
Treatment-naïve ^a (NEUTRINO)	SOF+PEG+RBV 12 weeks	Overall	90% (262/292)
		Genotype 1a	92% (206/225)
		Genotype 1b	83% (55/66)
		No cirrhosis	93% (253/273)
		Cirrhosis	80% (43/54)
Treatment-naïve and co-infected with HIV (PHOTON-1)	SOF+RBV 24 weeks	Overall	76% (87/114)
		Genotype 1a	82% (74/90)
		Genotype 1b	54% (13/24)
		No cirrhosis	77% (84/109)
		Cirrhosis	60% (3/5)
Treatment-naïve (QUANTUM ^b and 11-1-0258 ^b)	SOF+RBV 24 weeks	Overall ^c	65% (104/159)
		Genotype 1a ^c	69% (84/121)
		Genotype 1b ^c	53% (20/38)
		No cirrhosis ^c	68% (100/148)
		Cirrhosis ^c	36% (4/11)

n = number of patients with SVR12 response; N = total number of patients per group.

a. For previously treated patients with genotype 1 HCV infection, no data exists with the combination of sofosbuvir, peginterferon alfa and ribavirin. Consideration should be given to treating these patients, and potentially extending the duration of therapy with sofosbuvir, peginterferon alfa and ribavirin beyond 12 weeks and up to 24 weeks; especially for those subgroups who have one or more factors historically associated with lower response rates to interferon-based therapies (prior null response to peginterferon alfa and ribavirin therapy, advanced fibrosis/cirrhosis, high baseline viral concentrations, black race, IL28B non CC genotype).

b. These are exploratory or Phase 2 studies. The outcomes should be interpreted with caution, as subject numbers are small and SVR rates may be impacted by the selection of patients.

c. Summary data from both studies.

Table 21: Outcomes by therapeutic regimen and treatment duration, a comparison across studies in genotype 2 HCV infection

Patient population (Study number/name)	Regimen/Duration	Subgroup	SVR12 rate % (n/N)
Treatment-naïve (FISSION)	SOF+RBV 12 weeks	Overall	95% (69/73)
		No cirrhosis	97% (59/61)
		Cirrhosis	83% (10/12)
Interferon intolerant, ineligible or unwilling (POSITRON)	SOF+RBV 12 weeks	Overall	93% (101/109)
		No cirrhosis	92% (85/92)
		Cirrhosis	94% (16/17)
Treatment-experienced (FUSION)	SOF+RBV 12 weeks	Overall	82% (32/39)
		No cirrhosis	90% (26/29)
		Cirrhosis	60% (6/10)
Treatment-naïve (VALENCE)	SOF+RBV 12 weeks	Overall	97% (31/32)
		No cirrhosis	97% (29/30)
		Cirrhosis	100% (2/2)
Treatment-experienced (VALENCE)	SOF+RBV 12 weeks	Overall	90% (37/41)
		No cirrhosis	91% (30/33)
		Cirrhosis	88% (7/8)
Treatment-experienced (FUSION)	SOF+RBV 16 weeks	Overall	89% (31/35)
		No cirrhosis	92% (24/26)
		Cirrhosis	78% (7/9)
Treatment-naïve co-infected with HIV (PHOTON-1)	SOF+RBV 12 weeks	Overall	88% (23/26)
		No cirrhosis	88% (22/25)
		Cirrhosis	100% (1/1)
Treatment-experienced co-infected with HIV (PHOTON-1)	SOF+RBV 24 weeks	Overall ^a	93% (14/15)
		No cirrhosis ^a	92% (12/13)
		Cirrhosis ^a	100% (2/2)
Treatment-naïve (ELECTRON ^b and PROTON ^b)	SOF+PEG+RBV 12 weeks	Overall ^c	96% (25/26)
Treatment-experienced (LONESTAR-2 ^b)	SOF+PEG+RBV 12 weeks	Overall	96% (22/23)
		No cirrhosis	100% (9/9)
		Cirrhosis	93% (13/14)

n = number of patients with SVR12 response; N = total number of patients per group.

a. These data are preliminary.

b. These are exploratory or Phase 2 studies. The outcomes should be interpreted with caution, as subject numbers are small and SVR rates may be impacted by the selection of patients. In the ELECTRON study (N = 11), the duration of peginterferon alfa ranged from 4-12 weeks in combination with sofosbuvir + ribavirin.

c. All patients were non-cirrhotic in these two studies.

Table 22: Outcomes by therapeutic regimen and treatment duration, a comparison across studies in genotype 3 HCV infection

Patient population (Study number/name)	Regimen/Duration	Subgroup	SVR12 rate % (n/N)
Treatment-naïve (FISSION)	SOF+RBV 12 weeks	Overall	56% (102/183)
		No cirrhosis	61% (89/145)
		Cirrhosis	34% (13/38)
Interferon intolerant, ineligible or unwilling (POSITRON)	SOF+RBV 12 weeks	Overall	61% (60/98)
		No cirrhosis	68% (57/84)
		Cirrhosis	21% (3/14)
Treatment-experienced (FUSION)	SOF+RBV 12 weeks	Overall	30% (19/64)
		No cirrhosis	37% (14/38)
		Cirrhosis	19% (5/26)
Treatment-experienced (FUSION)	SOF+RBV 16 weeks	Overall	62% (39/63)
		No cirrhosis	63% (25/40)
		Cirrhosis	61% (14/23)
Treatment-naïve (VALENCE)	SOF+RBV 24 weeks	Overall	93% (98/105)
		No cirrhosis	94% (86/92)
		Cirrhosis	92% (12/13)
Treatment-experienced (VALENCE)	SOF+RBV 24 weeks	Overall	77% (112/145)
		No cirrhosis	85% (85/100)
		Cirrhosis	60% (27/45)
Treatment-naïve co-infected with HIV (PHOTON-1)	SOF+RBV 12 weeks	Overall	67% (28/42)
		No cirrhosis	67% (24/36)
		Cirrhosis	67% (4/6)
Treatment-experienced co-infected with HIV (PHOTON-1)	SOF+RBV 24 weeks	Overall ^a	92% (12/13)
		No cirrhosis ^a	100% (8/8)
		Cirrhosis ^a	80% (4/5)
Treatment-naïve (ELECTRON ^b and PROTON ^b)	SOF+PEG+RBV 12 weeks	Overall ^c	97% (38/39)
Treatment-experienced (LONESTAR-2 ^b)	SOF+PEG+RBV 12 weeks	Overall	83% (20/24)
		No cirrhosis	83% (10/12)
		Cirrhosis	83% (10/12)

n = number of patients with SVR12 response; N = total number of patients per group.

a. These data are preliminary.

b. These are exploratory or Phase 2 studies. The outcomes should be interpreted with caution, as subject numbers are small and SVR rates may be impacted by the selection of patients. In the ELECTRON study (N = 11), the duration of peginterferon alfa ranged from 4-12 weeks in combination with sofosbuvir + ribavirin.

c. All patients were non-cirrhotic in these two studies.

Table 23: Outcomes by therapeutic regimen and treatment duration, a comparison across studies in genotype 4, 5 and 6 HCV infection

Patient population (Study number/name)	Regimen/Duration	Subgroup	SVR12 rate % (n/N)
Treatment-naïve (NEUTRINO)	SOF+PEG+RBV 12 weeks	Overall	97% (34/35)
		No cirrhosis	100% (33/33)
		Cirrhosis	50% (1/2)

n = number of patients with SVR12 response; N = total number of patients per group.

Paediatric population

The efficacy of sofosbuvir in HCV-infected patients aged 12 to <18 years was evaluated in a Phase 2, open label clinical trial that enrolled 50 patients with genotype 2 (n = 13) or genotype 3 (n = 37) chronic HCV infection. Patients with HCV genotype 2 or 3 infection in the trial were treated with sofosbuvir with ribavirin for 12 or 24 weeks, respectively.

Of the 50 treated patients, the median age was 15 years (range: 12 to 17); 42% of the patients were female; 90% were White, 4% were Black, and 2% were Asian; 4% were Hispanic/Latino; mean body mass index was 22 kg/m² (range: 16 to 32 kg/m²); 18% were treatment experienced; 66% had baseline HCV RNA levels greater than or equal to 800,000 IU/mL; 74% of patients had non-CC IL28B alleles

(CT or TT); and no patients had known cirrhosis. The majority of patients (69%) had been infected through vertical transmission.

The SVR12 rate was 100% (13/13) in genotype 2 patients and 97% (36/37) in genotype 3 patients. No patient experienced on-treatment virologic failure or relapse. One patient with genotype 3 HCV infection achieved SVR4 but did not return for the SVR12 visit.

5.2 Pharmacokinetic properties

Sofosbuvir is a nucleotide prodrug that is extensively metabolised. The active metabolite is formed in hepatocytes and not observed in plasma. The predominant (>90%) metabolite, GS-331007, is inactive. It is formed through sequential and parallel pathways to the formation of active metabolite.

Absorption

The pharmacokinetic properties of sofosbuvir and the predominant circulating metabolite GS-331007 have been evaluated in healthy adult subjects and in patients with chronic hepatitis C. Following oral administration, sofosbuvir was absorbed quickly and the peak plasma concentration was observed ~0.5-2 hour post-dose, regardless of dose level. Peak plasma concentration of GS-331007 was observed between 2 to 4 hours post-dose. Based on population pharmacokinetic analysis in patients with genotypes 1 to 6 HCV infection (n = 986), steady-state AUC₀₋₂₄ for sofosbuvir and GS-331007 was 1,010 ng•h/mL and 7,200 ng•h/mL, respectively. Relative to healthy subjects (n = 284), the sofosbuvir and GS-331007 AUC₀₋₂₄ was 57% higher and 39% lower, respectively in HCV infected patients.

Effects of food

Relative to fasting conditions, the administration of a single dose of sofosbuvir with a standardised high fat meal slowed the rate of absorption of sofosbuvir. The extent of absorption of sofosbuvir was increased approximately 1.8-fold, with little effect on peak concentration. The exposure to GS-331007 was not altered in the presence of a high-fat meal.

Distribution

Sofosbuvir is not a substrate for hepatic uptake transporters, organic anion-transporting polypeptide (OATP) 1B1 or 1B3, and organic cation transporter (OCT) 1. While subject to active tubular secretion, GS-331007 is not a substrate for renal transporters including organic anion transporter (OAT) 1 or 3, OCT2, MRP2, P-gp, BCRP or MATE1. Sofosbuvir and GS-331007 are not inhibitors of drug transporters P-gp, BCRP, MRP2, BSEP, OATP1B1, OATP1B3 and OCT1. GS-331007 is not an inhibitor of OAT1, OCT2, and MATE1.

Sofosbuvir is approximately 85% bound to human plasma proteins (*ex vivo* data) and the binding is independent of drug concentration over the range of 1 µg/mL to 20 µg/mL. Protein binding of GS-331007 was minimal in human plasma. After a single 400 mg dose of [¹⁴C]-sofosbuvir in healthy subjects, the blood to plasma ratio of ¹⁴C-radioactivity was approximately 0.7.

Biotransformation

Sofosbuvir is extensively metabolised in the liver to form the pharmacologically active nucleoside analog triphosphate GS-461203. The metabolic activation pathway involves sequential hydrolysis of the carboxyl ester moiety catalysed by human cathepsin A (CatA) or carboxylesterase 1 (CES1) and phosphoramidate cleavage by histidine triad nucleotide-binding protein 1 (HINT1) followed by phosphorylation by the pyrimidine nucleotide biosynthesis pathway. Dephosphorylation results in the formation of nucleoside metabolite GS-331007 that cannot be efficiently rephosphorylated and lacks anti-HCV activity *in vitro*. Sofosbuvir and GS-331007 are not substrates or inhibitors of UGT1A1 or CYP3A4, CYP1A2, CYP2B6, CYP2C8, CYP2C9, CYP2C19, and CYP2D6 enzymes.

After a single 400 mg oral dose of [¹⁴C]-sofosbuvir, sofosbuvir and GS-331007 accounted for approximately 4% and >90% of drug-related material (sum of molecular weight-adjusted AUC of sofosbuvir and its metabolites) systemic exposure, respectively.

Elimination

Following a single 400 mg oral dose of [¹⁴C]-sofosbuvir, mean total recovery of the dose was greater than 92%, consisting of approximately 80%, 14%, and 2.5% recovered in urine, faeces, and expired air, respectively. The majority of the sofosbuvir dose recovered in urine was GS-331007 (78%) while 3.5% was recovered as sofosbuvir. This data indicate that renal clearance is the major elimination pathway for GS-331007 with a large part actively secreted. The median terminal half-lives of sofosbuvir and GS-331007 were 0.4 and 27 hours respectively.

Linearity/non-linearity

The dose linearity of sofosbuvir and its primary metabolite, GS-331007, was evaluated in fasted healthy subjects. Sofosbuvir and GS-331007 AUCs are near dose proportional over the dose range of 200 mg to 400 mg.

Pharmacokinetics in special populations

Gender and race

No clinically relevant pharmacokinetic differences due to gender or race have been identified for sofosbuvir and GS-331007.

Elderly

Population pharmacokinetic analysis in HCV infected patients showed that within the age range (19 to 75 years) analysed, age did not have a clinically relevant effect on the exposure to sofosbuvir and GS-331007. Clinical studies of sofosbuvir included 65 patients aged 65 and over. The response rates observed for patients over 65 years of age were similar to that of younger patients across treatment groups.

Renal impairment

The pharmacokinetics of sofosbuvir were studied in HCV negative patients with mild (eGFR ≥ 50 and < 80 mL/min/1.73 m²), moderate (eGFR ≥ 30 and < 50 mL/min/1.73 m²), severe renal impairment (eGFR < 30 mL/min/1.73 m²) and patients with ESRD requiring haemodialysis following a single 400 mg dose of sofosbuvir. Relative to patients with normal renal function (eGFR > 80 mL/min/1.73 m²), the sofosbuvir AUC_{0-inf} was 61%, 107% and 171% higher in mild, moderate and severe renal impairment, while the GS-331007 AUC_{0-inf} was 55%, 88% and 451% higher, respectively. In patients with ESRD, relative to patients with normal renal function, sofosbuvir AUC_{0-inf} was 28% higher when sofosbuvir was dosed 1 hour before haemodialysis compared with 60% higher when sofosbuvir was dosed 1 hour after haemodialysis. The AUC_{0-inf} of GS-331007 in patients with ESRD could not be reliably determined. However, data indicate at least 10-fold and 20-fold higher exposure to GS-331007 in ESRD compared to normal patients when Sovaldi was administered 1 hour before or 1 hour after haemodialysis, respectively.

Haemodialysis can efficiently remove (53% extraction ratio) the predominant circulating metabolite GS-331007. A 4-hour haemodialysis session removed approximately 18% of administered dose. No dose adjustment is required for patients with mild or moderate renal impairment. The safety of Sovaldi has not been assessed in patients with severe renal impairment or ESRD (see section 4.4).

Hepatic impairment

The pharmacokinetics of sofosbuvir were studied following 7-day dosing of 400 mg sofosbuvir in HCV infected patients with moderate and severe hepatic impairment (CPT class B and C). Relative to patients with normal hepatic function, the sofosbuvir AUC₀₋₂₄ was 126% and 143% higher in moderate and severe hepatic impairment, while the GS-331007 AUC₀₋₂₄ was 18% and 9% higher, respectively. Population pharmacokinetics analysis in HCV infected patients indicated that cirrhosis had no clinically relevant effect on the exposure to sofosbuvir and GS-331007. No dose adjustment of sofosbuvir is recommended for patients with mild, moderate and severe hepatic impairment (see section 4.2).

Paediatric population

Sofosbuvir and GS-331007 exposures in adolescents aged 12 to <18 years were similar to those in adults from Phase 2/3 studies following administration of sofosbuvir (400 mg). The pharmacokinetics of sofosbuvir and GS-331007 have not been established in paediatric patients < 12 years of age.

Pharmacokinetic/pharmacodynamic relationship(s)

Efficacy, in terms of rapid virologic response, has been shown to correlate with exposure to sofosbuvir as well as GS 331007. However, neither of these entities has been evidenced to be a general surrogate marker for efficacy (SVR12) at the therapeutic 400 mg dose.

5.3 Preclinical safety data

In repeat dose toxicology studies in rat and dog, high doses of the 1:1 diastereomeric mixture caused adverse liver (dog) and heart (rat) effects and gastrointestinal reactions (dog). Exposure to sofosbuvir in rodent studies could not be detected likely due to high esterase activity; however, exposure to the major metabolite GS-331007 at the adverse dose was 29 times (rat) and 123 times (dog) higher than the clinical exposure at 400 mg sofosbuvir. No liver or heart findings were observed in chronic toxicity studies at exposures 9 times (rat) and 27 times (dog) higher than the clinical exposure.

Sofosbuvir was not genotoxic in a battery of *in vitro* or *in vivo* assays, including bacterial mutagenicity, chromosome aberration using human peripheral blood lymphocytes and *in vivo* mouse micronucleus assays.

Carcinogenicity studies in mice and rats do not indicate any carcinogenicity potential of sofosbuvir administered at doses up to 600 mg/kg/day in mouse and 750 mg/kg/day in rat. Exposure to GS-331007 in these studies was up to 30 times (mouse) and 15 times (rat) higher than the clinical exposure at 400 mg sofosbuvir.

Sofosbuvir had no effects on embryo-foetal viability or on fertility in rat and was not teratogenic in rat and rabbit development studies. No adverse effects on behaviour, reproduction or development of offspring in rat were reported. In rabbit studies exposure to sofosbuvir was 9 times the expected clinical exposure. In the rat studies, exposure to sofosbuvir could not be determined but exposure margins based on the major human metabolite ranged from 8 to 28 times higher than the clinical exposure at 400 mg sofosbuvir.

Sofosbuvir-derived material was transferred through the placenta in pregnant rats and into the milk of lactating rats.

6. PHARMACEUTICAL PARTICULARS

6.1 List of excipients

Tablet core

Mannitol (E421)
Microcrystalline cellulose (E460(i))
Croscarmellose sodium
Colloidal anhydrous silica (E551)
Magnesium stearate (E470b)

Film-coating

Polyvinyl alcohol (E1203)
Titanium dioxide (E171)
Macrogol 3350 (E1521)
Talc (E553b)
Yellow iron oxide (E172)

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

Sovaldi tablets are supplied in high density polyethylene (HDPE) bottles with a polypropylene child-resistant closure containing 28 film-coated tablets with a silica gel desiccant and polyester coil.

The following pack sizes are available: outer cartons containing 1 bottle of 28 film-coated tablets and outer cartons containing 84 (3 bottles of 28) film-coated tablets.

Not all pack sizes may be marketed.

6.6 Special precautions for disposal

Any unused medicinal product or waste material should be disposed of in accordance with local requirements.

7. MARKETING AUTHORISATION HOLDER

Gilead Sciences International Ltd.
Cambridge
CB21 6GT
United Kingdom

8. MARKETING AUTHORISATION NUMBER(S)

EU/1/13/894/001
EU/1/13/894/002

9. DATE OF FIRST AUTHORISATION/RENEWAL OF THE AUTHORISATION

Date of first authorisation: 16 January 2014

10. DATE OF REVISION OF THE TEXT

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(S) 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(S) RESPONSIBLE FOR BATCH RELEASE

Name and address of the manufacturer(s) responsible for batch release

Gilead Sciences Ireland UC
IDA Business & Technology Park
Carrigtohill, County Cork
Ireland

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.

The marketing authorisation holder shall submit the first periodic safety update report for this product within 6 months following authorisation.

D. CONDITIONS OR RESTRICTIONS WITH REGARD TO THE SAFE AND EFFECTIVE USE OF THE 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.

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

The MAH shall complete, within the stated timeframe, the below measures:

Description	Due date
In order to evaluate the recurrence of hepatocellular carcinoma associated with Sovaldi, the MAH shall conduct and submit the results of a prospective safety study using data deriving from a cohort of a well-defined group of patients, based on an agreed protocol. The final study report shall be submitted by:	Q2 2021

ANNEX III
LABELLING AND PACKAGE LEAFLET

A. LABELLING

PARTICULARS TO APPEAR ON THE OUTER PACKAGING AND THE IMMEDIATE PACKAGING

BOTTLE AND CARTON LABELLING

1. NAME OF THE MEDICINAL PRODUCT

Sovaldi 400 mg film-coated tablets
sofosbuvir

2. STATEMENT OF ACTIVE SUBSTANCE(S)

Each film-coated tablet contains 400 mg of sofosbuvir.

3. LIST OF EXCIPIENTS

4. PHARMACEUTICAL FORM AND CONTENTS

28 film-coated tablets.
84 (3 bottles of 28) 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

Gilead Sciences International Ltd.
Cambridge
CB21 6GT
United Kingdom

12. MARKETING AUTHORISATION NUMBER(S)

EU/1/13/894/001 28 film-coated tablets
EU/1/13/894/002 84 (3 bottles of 28) film-coated tablets

13. BATCH NUMBER

Lot

14. GENERAL CLASSIFICATION FOR SUPPLY

Medicinal product subject to medical prescription.

15. INSTRUCTIONS ON USE

16. INFORMATION IN BRAILLE

Sovaldi [Outer packaging only]

17. UNIQUE IDENTIFIER – 2D BARCODE

2D barcode carrying the unique identifier included.

18. UNIQUE IDENTIFIER - HUMAN READABLE DATA

PC: {number}
SN: {number}
NN: {number}

B. PACKAGE LEAFLET

Package leaflet: Information for the user

Sovaldi 400 mg film-coated tablets sofosbuvir

▼ This medicine is subject to additional monitoring. This will allow quick identification of new safety information. You can help by reporting any side effects you may get. See the end of section 4 for how to report side effects.

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 or pharmacist.
- 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 or pharmacist. This includes any possible side effects not listed in this leaflet. See section 4.

What is in this leaflet

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

1. What Sovaldi is and what it is used for

Sovaldi contains the active substance sofosbuvir which is given to treat hepatitis C virus infection in adults and adolescents from the age of 12 years up to the age of 18 years.

Hepatitis C is a virus that infects the liver. This medicine works by lowering the amount of hepatitis C virus in your body and removing the virus from your blood over a period of time.

Sovaldi is always taken with other medicines. It will not work on its own. It is commonly taken with either:

- Ribavirin, or
- Peginterferon alfa and ribavirin

It is very important that you also read the leaflets for the other medicines that you will be taking with Sovaldi. If you have any questions about your medicines, please ask your doctor or pharmacist.

2. What you need to know before you take Sovaldi

Do not take Sovaldi

- If you are allergic to sofosbuvir or any of the other ingredients of this medicine (listed in section 6 of this leaflet).

→If this applies to you, tell your doctor immediately.

- **If you are currently taking any of the following medicines:**
 - **Rifampicin and rifabutin** (antibiotics used to treat infections, including tuberculosis);
 - **St. John's wort** (*Hypericum perforatum* – herbal medicine used to treat depression);

- **Carbamazepine, phenobarbital and phenytoin** (medicines used to treat epilepsy and prevent seizures).

Warnings and precautions

Sovaldi is always taken with other medicines (see section 1 above). Talk to your doctor or pharmacist before taking this medicine if you:

- Currently take, or have taken in the last few months, the medicine amiodarone to treat irregular heartbeats (your doctor may consider alternative treatments if you have taken this medicine);
- Have liver problems other than hepatitis C, e.g. if you are awaiting a liver transplantation;
- Have a current or previous infection with the hepatitis B virus, since your doctor may want to monitor you more closely;
- Have kidney problems. Talk to your doctor or pharmacist if you have severe kidney problems or if you are on kidney dialysis as the effects of Sovaldi on patients with severe kidney problems have not been fully tested.

Tell your doctor immediately if you are taking any medicines for heart problems and during treatment you experience:

- shortness of breath or worsening of any shortness of breath you already have
- light-headedness
- palpitations
- fainting

Blood tests

Your doctor will test your blood before, during and after your treatment with Sovaldi. This is so your doctor can:

- Decide what other medicines you should take with Sovaldi and for how long;
- Confirm that your treatment has worked and you are free of the hepatitis C virus.

Children and adolescents

Do not give this medicine to children under 12 years of age. The use of Sovaldi in children under 12 years of age has not yet been studied.

Other medicines and Sovaldi

Tell your doctor or pharmacist if you are taking, have recently taken or might take any other medicines. This includes herbal medicines and medicines obtained without a prescription.

Warfarin and other similar medicines called vitamin K antagonists used to thin the blood. Your doctor may need to increase the frequency of your blood tests to check how well your blood can clot.

In particular, do not take Sovaldi if you are taking any of the following medicines:

- Oxcarbazepine (a medicine used to treat epilepsy and prevent seizures);
- Modafinil (a medicine to treat people with narcolepsy to help them stay awake).

This is because they may make Sovaldi work less well.

Tell your doctor if you take any of the following medicines:

- amiodarone, used to treat irregular heartbeats.

If you are not sure, talk to your doctor or pharmacist.

Pregnancy and contraception

Pregnancy must be avoided due to the use of Sovaldi together with ribavirin. Ribavirin can be very damaging to an unborn baby. Therefore, you and your partner must take special precautions in sexual activity if there is any chance for pregnancy to occur.

- Sovaldi is commonly used together with ribavirin. Ribavirin can damage your unborn baby. It is therefore very important that you (or your partner) **do not become pregnant** during this therapy.
- You or your partner must use an effective birth control method **during treatment and afterwards**. It is very important that you read the “Pregnancy” section in the ribavirin package leaflet very carefully. Ask your doctor for effective contraceptive method suitable for you.
- If you or your partner become pregnant during Sovaldi treatment or in the months that follow, you must **contact your doctor immediately**.

Breast-feeding

You should not breast-feed during treatment with Sovaldi. It is not known whether sofosbuvir, the active substance of Sovaldi, passes into human breast milk.

Driving and using machines

When taking Sovaldi together with other medicines for the treatment of hepatitis C infection, patients have reported tiredness, dizziness, blurred vision and reduced attention. If you have any of these side effects, do not drive or use any tools or machines.

3. How to take Sovaldi

Always take this medicine exactly as your doctor has told you. Check with your doctor or pharmacist if you are not sure.

Recommended dose

The recommended dose is **one tablet once a day** with food. Your doctor will tell you for how long you should take Sovaldi.

Swallow the tablet whole. Do not chew, crush or split the tablet as it has a very bitter taste. Tell your doctor or pharmacist if you have problems swallowing tablets.

Sovaldi should always be taken in combination with other medicinal products for use against hepatitis C.

If you are sick (vomit) **less than 2 hours** after taking Sovaldi, take another tablet. If you vomit **more than 2 hours** after taking it you do not need to take another tablet until your next regularly scheduled tablet.

If you take more Sovaldi than you should

If you accidentally take more than the recommended dose you should contact your doctor or nearest emergency department immediately for advice. Keep the tablet bottle with you so that you can easily describe what you have taken.

If you forget to take Sovaldi

It is important not to miss a dose of this medicine.

If you do miss a dose:

- **and you notice within 18 hours** of the time you usually take Sovaldi, you must take the tablet as soon as possible. Then take the next dose at your usual time.
- **and you notice 18 hours or more** after the time you usually take Sovaldi, wait and take the next dose at your usual time. Do not take a double dose (two doses close together).

Do not stop taking Sovaldi

Do not stop taking this medicine unless your doctor tells you to. It is very important that you complete the full course of treatment to give the medicines the best chance to treat your hepatitis C virus infection.

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.

When you take Sovaldi in combination with another medicine to treat hepatitis C virus infection (including daclatasvir, simeprevir and ledipasvir) and amiodarone (a medicine used for heart problems), you may get one or more of the side effects below:

- slow or irregular heartbeat or heart rhythm problems
 - shortness of breath or worsening of any shortness of breath you already have
- Tell your doctor or your pharmacist if you notice any of the above side effects during therapy.

When you take Sovaldi with ribavirin or both peginterferon alfa and ribavirin, you may get one or more of the side effects below:

Very common side effects

(may affect more than 1 in 10 people)

- fever, chills, flu-like symptoms
- diarrhoea, feeling sick (nausea), being sick (vomiting)
- trouble sleeping (insomnia)
- feeling tired and irritable
- headache
- rash, itchy skin
- loss of appetite
- feeling dizzy
- muscle aches and pains, pain in the joints
- shortness of breath, cough

Blood tests may also show:

- low red blood cell count (anaemia); the signs may include feeling tired, headaches, shortness of breath when exercising
- low white blood cell count (neutropenia); the signs may include getting more infections than usual, including fevers and chills, or sore throat or mouth ulcers
- low blood platelet count
- changes in your liver (as shown by increased amounts of a substance called bilirubin in the blood)

Common side effects

(may affect up to 1 in 10 people)

- changes in your mood, feeling depressed, feeling anxious and feeling agitated
- blurred vision
- severe headaches (migraine), memory loss, loss of concentration
- weight loss
- shortness of breath when exercising
- stomach discomfort, constipation, dry mouth, indigestion, acid reflux
- hair loss and thinning hair
- dry skin
- back pain, muscle spasms
- chest pain, feeling weak
- getting a cold (nasopharyngitis)

→If any of the side effects get serious tell your doctor.

Reporting of side effects

If you get any side effects, talk to your doctor or pharmacist. This includes any possible side effects not listed in this leaflet. You can also report any side effects directly to 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 Sovaldi

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 bottle and carton 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 to protect the environment.

6. Contents of the pack and other information

What Sovaldi contains

- **The active substance is** sofosbuvir. Each film-coated tablet contains 400 mg of sofosbuvir.

- **The other ingredients are**

Tablet core:

Mannitol, microcrystalline cellulose, croscarmellose sodium, colloidal anhydrous silica, magnesium stearate.

Film-coating:

Polyvinyl alcohol, titanium dioxide, macrogol 3350, talc, yellow iron oxide.

What Sovaldi looks like and contents of the pack

The film-coated tablets are yellow, capsule-shaped tablets, debossed on one side with “GSI” and “7977” on the other side.

Each bottle contains a silica gel desiccant (drying agent) that must be kept in the bottle to help protect your tablets. The silica gel desiccant is contained in a separate sachet or canister and should not be swallowed.

The following pack sizes are available: outer cartons containing 1 bottle of 28 film-coated tablets and 84 (3 bottles of 28) film-coated tablets. Not all pack sizes may be marketed.

Marketing Authorisation Holder

Gilead Sciences International Ltd.
Cambridge
CB21 6GT
United Kingdom

Manufacturer

Gilead Sciences Ireland UC
IDA Business & Technology Park
Carrigtohill
County Cork
Ireland

For any information about this medicine, please contact the local representative of the Marketing Authorisation Holder:

België/Belgique/Belgien

Gilead Sciences Belgium SPRL-BVBA
Tél/Tel: + 32 (0) 24 01 35 50

България

Gilead Sciences International Ltd.
Тел.: + 44 (0) 20 7136 8820

Česká republika

Gilead Sciences s.r.o.
Tel: + 420 910 871 986

Danmark

Gilead Sciences Sweden AB
Tlf: + 46 (0) 8 5057 1849

Deutschland

Gilead Sciences GmbH
Tel: + 49 (0) 89 899890-0

Eesti

Gilead Sciences Poland Sp. z o.o.
Tel: +48 (0) 22 262 8702

Ελλάδα

Gilead Sciences Ελλάς Μ.ΕΠΕ.
Τηλ: + 30 210 8930 100

España

Gilead Sciences, S.L.
Tel: + 34 91 378 98 30

France

Gilead Sciences
Tél: + 33 (0) 1 46 09 41 00

Hrvatska

Gilead Sciences International Ltd.
Tel: + 44 (0) 20 7136 8820

Ireland

Gilead Sciences Ltd.
Tel: + 353 214 825999

Ísland

Gilead Sciences Sweden AB
Sími: + 46 (0) 8 5057 1849

Italia

Gilead Sciences S.r.l.
Tel: + 39 02 439201

Lietuva

Gilead Sciences Poland Sp. z o.o.
Tel: +48 (0) 22 262 8702

Luxembourg/Luxemburg

Gilead Sciences Belgium SPRL-BVBA
Tél/Tel: + 32 (0) 24 01 35 50

Magyarország

Gilead Sciences International Ltd.
Tel: + 44 (0) 20 7136 8820

Malta

Gilead Sciences International Ltd.
Tel: + 44 (0) 20 7136 8820

Nederland

Gilead Sciences Netherlands B.V.
Tel: + 31 (0) 20 718 36 98

Norge

Gilead Sciences Sweden AB
Tlf: + 46 (0) 8 5057 1849

Österreich

Gilead Sciences GesmbH
Tel: + 43 1 260 830

Polska

Gilead Sciences Poland Sp. z o.o.
Tel: +48 22 262 8702

Portugal

Gilead Sciences, Lda.
Tel: + 351 21 7928790

România

Gilead Sciences International Ltd.
Tel: + 44 (0) 20 7136 8820

Slovenija

Gilead Sciences International Ltd.
Tel: + 44 (0) 20 7136 8820

Slovenská republika

Gilead Sciences Slovakia s.r.o.
Tel: + 421 232 121 210

Suomi/Finland

Gilead Sciences Sweden AB
Puh/Tel: + 46 (0) 8 5057 1849

Κύπρος

Gilead Sciences Ελλάς Μ.ΕΠΕ.
Τηλ: + 30 210 8930 100

Sverige

Gilead Sciences Sweden AB
Tel: + 46 (0) 8 5057 1849

Latvija

Gilead Sciences Poland Sp. z o.o.
Tel: +48 (0) 22 262 8702

United Kingdom

Gilead Sciences Ltd.
Tel: + 44 (0) 8000 113700

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Detailed information on this medicine is available on the European Medicines Agency web site:
<http://www.ema.europa.eu>