Treatment of HCV Genotype 4

This is a PDF version of the following document:
Module 5: Treatment of Chronic Hepatitis C Infection
Lesson 4: Treatment of HCV Genotype 4

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Introduction

Background

In the United States, genotype 4 infection accounts for only 1 to 2% of all hepatitis C virus (HCV) infections.[1] Globally, approximately 20% of all hepatitis C infections are caused by genotype 4.[2] In addition, genotype 4 is the dominant HCV genotype in Egypt, North Africa, and the Middle East.[3] In Egypt, approximately 15% of the population has hepatitis C infection and genotype 4 infection accounts for more than 90% of the HCV infections; most of these cases of hepatitis C were acquired via contaminated needles in the anti-schistosomiasis program or with contaminated blood transfusion. More recently, the prevalence of hepatitis C genotype 4 infection has increased significantly in Southern Europe, particularly in France, Italy, Greece, and Spain.[4,5] The following discussion regarding initial treatment and retreatment of patients with genotype 4 chronic hepatitis C assumes patients and their clinicians have already made the decision to initiate hepatitis C therapy.

Medications used to Treat Hepatitis C

The HCV Medications section on this web site provides detailed information for each of the FDA-approved medications listed in the treatment recommendations, including links to the full prescribing information and to patient assistance programs. The direct-acting antiviral agents exert their action at specific steps in the HCV life cycle. There are three major classes of direct-acting antiviral medications: nonstructural proteins 3/4A (NS3/4A) protease inhibitors, NS5A inhibitors, and NS5B polymerase inhibitors (Figure 1); the NS5B polymerase inhibitors include the nucleoside analogs and nonnucleoside analogs.[6,7] Adherence with the treatment regimen is extremely important. Thus, patients should receive detailed counseling regarding the importance of adherence prior to starting therapy, as well as intensive monitoring and follow-up during therapy.

Approach to Choosing HCV Genotype 4 Regimen

For persons chronically infected with genotype 4 HCV, two key factors influence the choice and duration of therapy: cirrhosis status and prior treatment experience. In addition, the cost of the regimen, insurance coverage, and provider or patient reference can play a major role in the regimen choice. For the initial treatment of persons with genotype 4 HCV infection, the estimated wholesale acquisition cost for regimens in the recommended category in the American Association for the Study of Liver Diseases and Infectious Diseases Society of America (AASLD-IDSA) HCV Guidance ranges from approximately $26,400 to $94,500 for those without cirrhosis and from $39,600 to $94,500 for those with compensated cirrhosis (Figure 2). The following treatment recommendations are based on the AASLD-IDSA HCV Guidance for adults with genotype 4 HCV.[8,9]

- AASLD-IDSA HCV Guidance for Treatment-Naïve& Patients with Genotype 4 HCV

- AASLD-IDSA HCV Guidance for Treatment-Experienced Patients with Genotype 4 HCV

HCV Genotype 4: Initial Treatment

Background

In the era prior to availability of direct-acting antivirals, available data suggest that treatment-naïve adults with HCV genotype 4 who were treated with a 48-week course of peginterferon plus ribavirin had SVR12 rates that ranged from 43 to 70%, with even lower SVR12 rates (25 to 30%) in cirrhotics with HCV genotype 4 infection.[10,11,12,13] Subsequently, several studies showed improved SVR12 responses with initial treatment of patients with genotype 4 HCV using sofosbuvir plus ribavirin,[14,15] simeprevir plus sofosbuvir,[16,17,18] simeprevir plus peginterferon plus ribavirin,[18] and daclatasvir plus peginterferon plus ribavirin[19]. Recent studies have shown SVR12 rates greater than 95% in treatment-naïve adults with several all-oral DAA regimens, including glecaprevir-pibrentasvir,[20,21,22] sofosbuvir-velpatasvir,[23] elbasvir-grazoprevir,[24,25] ledipasvir-sofosbuvir[26,27], and ombitasvir-paritaprevir-ritonavir[28,29].

Factors to Consider Prior to Choosing Initial Treatment Regimen

For adults chronically infected with HCV genotype 4, the recommended regimens for a treatment-naïve individual are usually the same without cirrhosis or with compensated cirrhosis; one important exception is that glecaprevir-pibrentasvir is used for 8 weeks without cirrhosis and for 12 weeks with compensated cirrhosis. The management of HCV genotype 4 in persons with decompensated cirrhosis, renal impairment, HIV coinfection, acute hepatitis C infection, or post-liver transplantation is not addressed in this lesson.

AASLD-IDSA HCV Guidance for Initial Treatment of HCV Genotype 4

The following is a summary of the AASLD-IDSA HCV Guidance for the initial treatment of adults with HCV genotype 4 infection, including those without cirrhosis or with compensated cirrhosis.[30,31] For individuals with cirrhosis, the AASLD-IDSA HCV Guidance defines compensated cirrhosis as Child-Turcotte-Pugh class A and decompensated cirrhosis as Child-Turcotte-Pugh class B or class C. The AASLD-IDSA HCV Guidance for treatment-naïve adults with HCV genotype 4 has four recommended options: glecaprevir-pibrentasvir, sofosbuvir-velpatasvir, elbasvir-grazoprevir, and ledipasvir-sofosbuvir. The recommended regimens are listed by evidence level; when the evidence level is considered equivalent, the regimens are listed alphabetically.

Table 1. AASLD-IDSA HCV Guidance for Genotype 4: Initial Treatment Treatment-Naïve Genotype 4 Without Cirrhosis

Recommended and alternative regimens listed by evidence level and alphabetically

Recommended for Treatment-Naïve Genotype 4 Without Cirrhosis
Glecaprevir-Pibrentasvir *Fixed-dose combination of glecaprevir (100 mg)/pibrentasvir (40 mg) three tablets once daily for 8 weeks*
Rating: Class I, Level A

Recommended for Treatment-Naïve Genotype 4 Without Cirrhosis
Sofosbuvir-Velpatasvir *Fixed-dose combination of sofosbuvir (400 mg)/velpatasvir (100 mg) one tablet once daily for 12 weeks*
Rating: Class I, Level A

Recommended for Treatment-Naïve Genotype 4 Without Cirrhosis

Elbasvir-Grazoprevir
Fixed-dose combination of elbasvir (50 mg)/grazoprevir (100 mg) one tablet once daily for 12 weeks

Rating: Class IIa, Level B

Recommended for Treatment-Naïve Genotype 4 Without Cirrhosis

Ledipasvir-Sofosbuvir
Fixed-dose combination of ledipasvir (90 mg)/sofosbuvir (400 mg) one tablet once daily for 12 weeks

Rating: Class IIa, Level B

Alternative for Treatment-Naïve Genotype 4 Without Cirrhosis

Ombitasvir-Paritaprevir-Ritonavir + **Ribavirin**
Fixed-dose combination of ombitasvir (12.5 mg)/paritaprevir (75 mg)/ritonavir (50 mg) two tablets once daily for 12 weeks + *1000 mg if <75 kg or 1200 mg if ≥75 kg for 12 weeks*

Rating: Class I, Level A
Note: The ribavirin daily dose is given in two divided doses.

Source: AASLD-IDSA. Recommendations for testing, management, and treating hepatitis C. Initial treatment of HCV infection: treatment-naive genotype 4 without cirrhosis. [AASLD-IDSA Hepatitis C Guidance] - Accessed November 15, 2017.

Table 2. AASLD-IDSA HCV Guidance for Genotype 4: Initial Treatment Treatment-Naïve Genotype 4 With Compensated Cirrhosis^

Recommended and alternative regimens listed by evidence level and alphabetically

Recommended for Treatment-Naïve Genotype 4 With Compensated Cirrhosis^

Sofosbuvir-Velpatasvir
Fixed-dose combination of sofosbuvir (400 mg)/velpatasvir (100 mg) one tablet once daily for 12 weeks

Rating: Class I, Level A

Recommended for Treatment-Naïve Genotype 4 With Compensated Cirrhosis^

Glecaprevir-Pibrentasvir
Fixed-dose combination of glecaprevir (100 mg)/pibrentasvir (40 mg) three tablets once daily for 12 weeks

Rating: Class I, Level B

Recommended for Treatment-Naïve Genotype 4 With Compensated Cirrhosis^

Elbasvir-Grazoprevir
Fixed-dose combination of elbasvir (50 mg)/grazoprevir (100 mg) one tablet once daily for 12 weeks

Rating: Class IIa, Level B

Recommended for Treatment-Naïve Genotype 4 With Compensated Cirrhosis^

Ledipasvir-Sofosbuvir
Fixed-dose combination of ledipasvir (90 mg)/sofosbuvir (400 mg) one tablet once daily for 12 weeks

Rating: Class IIa, Level B

Alternative for Treatment-Naïve Genotype 4 With Compensated Cirrhosis^

Ombitasvir-Paritaprevir-Ritonavir + **Ribavirin**
Fixed-dose combination of ombitasvir (12.5 mg)/paritaprevir (75 mg)/ritonavir (50 mg) two tablets once daily for 12 weeks + *1000 mg if <75 kg or 1200 mg if ≥75 kg for 12 weeks*

Rating: Class I, Level A
Note: (i) See statement on FDA warning regarding the use of paritaprevir/ritonavir/ombitasvir ± dasabuvir in patients with cirrhosis. (ii) The ribavirin daily dose is given in two divided doses.

^For treatment of patients with decompensated cirrhosis, see the AASLD-IDSA Guidance: Unique Populations—Patients with Decompensated Cirrhosis.

Source: AASLD-IDSA. Recommendations for testing, management, and treating hepatitis C. Initial treatment of HCV infection: treatment-naive genotype 4 with compensated cirrhosis. [AASLD-IDSA Hepatitis C Guidance] - Accessed November 15, 2017.

Key Studies for Initial Treatment of Adults with HCV Genotype 4

The following key studies were used to support the AASLD-IDSA HCV Guidance for initial treatment of adults with chronic hepatitis C genotype 4 infection.[30,31]

Elbasvir-Grazoprevir

- C-EDGE Treatment-Naive: The C-EDGE Treatment-Naive trial was a randomized phase 3 study that evaluated elbasvir-grazoprevir (50/100 mg) once daily in treatment-naïve adults with HCV genotype 1, 4, or 6, including subject without cirrhosis and those with compensated cirrhosis.[32] Among participants with HCV genotype 4 infection, 100% (18 of 18) achieved an SVR12.

Glecaprevir-Pibrentasvir

- SURVEYOR-I and SURVEYOR-II: The SURVEYOR-I (for genotypes 1, 4, 5 and 6) was a phase 2 open-label trial of non-cirrhotic adults, including treatment-naïve and peginterferon plus

ribavirin-experienced patients.[22] Part 1 of this study evaluated the efficacy of various doses of glecaprevir-pibrentasvir for 12 weeks and Part 2 examined the optimized dose of 300/120 mg for 8 versus 12 weeks. Of the 22 patients with genotype 4 infection who received 12 weeks of glecaprevir-pibrentasvir 300/120 mg daily, 100% (22 of 22) achieved an SVR12.

- SURVEYOR-II (Part 4): The SURVEYOR-II (Part 4) was a phase 3 single-arm open-label trial to evaluate the safety and efficacy of 8 weeks of glecaprevir-pibrentasvir in 203 adults with genotype 2, 4, 5 or 6 infection without cirrhosis, of whom 46 had genotype 4 infection (most were treatment-naïve).[20] Using intent-to-treat analysis, 93% (43 of 46) of the participants with HCV genotype 4 achieved an SVR12; the 3 who did not achieve an SVR12 were lost to follow-up and their response to treatment was unknown.

Ledipasvir-Sofosbuvir

- NIAID SYNERGY (Genotype 4): This single-center, open-label phase 2a trial evaluated the safety and efficacy of a 12-week course of ledipasvir-sofosbuvir in 21 adults with HCV genotype 4 infection; among those enrolled, 62% (13 of 21) were treatment-naïve patients and 33% (7 of 21) had compensated cirrhosis.[27] An SVR12 was achieved in 100% (20 of 20) of the participants. In the intent-to-treat analysis, there was one treatment failure; this patient was treatment-naïve and withdrew at week 7 of the study due to non-adherence with therapy.
- **Egyptian Multicenter Study**: This open-label multicenter study evaluated the efficacy of ledipasvir-sofosbuvir, with or without ribavirin, for 8 or 12 weeks in 256 Egyptian adults with genotype 4 infection; 170 were treatment-naïve and 85 were treatment-experienced.[33] For the treatment-naïve participants without cirrhosis who received 8 weeks of therapy, 97% (35 of 36) of those receiving ledipasvir-sofosbuvir achieved an SVR12, compared with the 91% (32 of 35) who received ledipasvir-sofosbuvir plus ribavirin. With 12 weeks of therapy in treatment-naïve patients without cirrhosis, the SVR12 rates were 100% (34 of 34) in the ledipasvir-sofosbuvir arm and 97% (33 of 34) with ledipasvir-sofosbuvir plus ribavirin. For treatment-naïve individuals with compensated cirrhosis, the SVR12 rates were 100% (8 of 8) with 12 weeks of ledipasvir-sofosbuvir plus ribavirin; all other regimens had SVR12 rates less than 90%, but the number of persons with cirrhosis in the treatment-naïve group was small.

Ombitasvir-Paritaprevir-Ritonavir

- AGATE-II: This phase 3, open-label, partly randomized trial enrolled treatment-naïve or treatment-experienced adults with HCV genotype 4 infection, including 100 participants with cirrhosis and 60 without cirrhosis.[29] The study was conducted at five academic and hepatology centers in Egypt. Participants without cirrhosis received 12 weeks ombitasvir-paritaprevir-ritonavir plus weight-based ribavirin. Individuals with compensated cirrhosis were randomized to receive ombitasvir-paritaprevir-ritonavir for 12 weeks or 24 weeks. Overall, including both treatment-naïve and treatment-experienced participants, more than 90% achieved an SVR 12, including 94% (94 of 100) in those without cirrhosis, 97% (30 of 31) in those with compensated cirrhosis treated with 12 weeks, and 93% (27 of 29) in those with compensated cirrhosis treated with 24 weeks.
- PEARL-I: In the phase 2b PEARL-I study, investigators examined the efficacy of a 12-week course of ombitasvir plus paritaprevir plus ritonavir with or without ribavirin in adults with chronic HCV genotype 4 infection; the study enrolled treatment-naïve and treatment-experienced adults, but excluded individuals with cirrhosis.[28] The regimen used in this trial did not include dasabuvir, because dasabuvir does not have activity against HCV genotype 4. For the 86 treatment-naïve recipients of ombitasvir plus paritaprevir plus ritonavir without ribavirin, an SVR12 was achieved in 91% (40 of 44) compared with an SVR12 rate of 100% (42 of of 42) in participants treated with ombitasvir plus paritaprevir plus ritonavir with ribavirin. This study, showed an excellent treatment response with a 24-week regimen of ombitasvir plus paritaprevir plus ritonavir for genotype 4 infection, particularly if ribavirin is

added to the regimen.

Sofosbuvir-Velpatasvir

- ASTRAL-1: In the phase 3 ASTRAL-1 trial, investigators randomized treatment-naïve and treatment-experienced adults with chronic hepatitis C genotype 1, 2, 4, 5, or 6 infection in a 5:1 ratio to receive a 12-week course of either sofosbuvir-velpatasvir or placebo.[23] The study included 116 adults with HCV genotype 4. Among the treatment-naive participants with genotype 4 infection who received sofosbuvir-velpatasvir, 100% (64 of 64) achieved an SVR12.
- POLARIS-2: In this phase 3, open-labeled trial, adults with chronic hepatitis C genotype 1-4 infection who were naïve to direct-acting antiviral therapy (prior peginterferon and ribavirin allowed) were randomized to either 8 weeks of sofosbuvir-velpatasvir-voxilaprevir or 12 weeks of sofosbuvir-velpatasvir.[34] Compensated cirrhosis was present in 18%. For the participants with genotype 4 infection treated with sofosbuvir-velpatasvir, 98% (56 of 57) achieved an SVR12.

HCV Genotype 4: Retreating Persons who Failed Prior Therapy

Background

The data regarding the retreatment of patients with genotype 4 who have failed prior therapy are limited but growing, and suggest high efficacy of currently available direct-acting antivirals. More choices exist for peginterferon plus ribavirin-experienced patients than DAA-experienced patients, largely because more retreatment data exist for the former than latter group.

Factors to Consider Prior to Choosing Retreatment Regimen

For retreatment of patients with genotype 4 hepatitis C in whom prior therapy with peginterferon and ribavirin failed, the recommended treatment regimens are very similar for patients without cirrhosis or with compensated cirrhosis. The only difference is that ribavirin is added to the ledipasvir-sofosbuvir regimen in patients with compensated cirrhosis, thus making this an alternative regimen rather than a recommended regimen for this subset of patients. The management of HCV genotype 4 in persons with decompensated cirrhosis, renal impairment, HIV coinfection, acute hepatitis C infection, or post-liver transplantation is not addressed in this lesson.

AASLD-IDSA HCV Guidance for Retreatment of HCV Genotype 4

The following is a summary of the AASLD-IDSA HCV Guidance for retreatment of adults with hepatitis C genotype 4; the retreatment guidance includes (1) patients in whom prior therapy with peginterferon and ribavirin failed, and (2) patients in whom a DAA-based regimen failed, including failures with NS5A inhibitors.[31,35] For individuals with cirrhosis, the AASLD-IDSA HCV Guidance defines compensated cirrhosis as Child-Turcotte-Pugh class A and decompensated cirrhosis as Child-Turcotte-Pugh class B or class C. The recommended regimens are listed by evidence level; when the evidence level is considered equivalent, the regimens are listed alphabetically.

Table 3. AASLD-IDSA HCV Guidance for Genotype 4: Retreatment Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients Without Cirrhosis

Recommended and alternative regimens listed by evidence level and alphabetically

Recommended for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients Without Cirrhosis
Sofosbuvir-Velpatasvir *Fixed-dose combination of sofosbuvir (400 mg)/velpatasvir (100 mg) one tablet once daily for 12 weeks*
Rating: Class I, Level A

Recommended for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients Without Cirrhosis
Glecaprevir-Pibrentasvir *Fixed-dose combination of glecaprevir (100 mg)/pibrentasvir (40 mg) three tablets once daily for 8 weeks*
Rating: Class I, Level B

Recommended for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients Without Cirrhosis

Elbasvir-Grazoprevir
**Fixed-dose combination of elbasvir (50 mg)/grazoprevir (100 mg) one tablet once daily for 12 weeks*

For patients who experienced virologic relapse after prior peginterferon plus ribavirin therapy.

Rating: Class IIa, Level B

Recommended for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients Without Cirrhosis

Ledipasvir-Sofosbuvir
Fixed-dose combination of ledipasvir (90 mg)/sofosbuvir (400 mg) one tablet once daily for 12 weeks

Rating: Class IIa, Level B

Alternative for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients Without Cirrhosis

Ombitasvir-Paritaprevir-Ritonavir *Fixed-dose combination of ombitasvir (12.5 mg)/paritaprevir (75 mg)/ritonavir (50 mg) two tablets once daily for 12 weeks*	+	**Ribavirin** *1000 mg/day if <75 kg or 1200 mg/day if ≥75 kg for 12 weeks*

Rating: Class I, Level A
Note: The ribavirin daily dose is given in two divided doses.

Alternative for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients Without Cirrhosis

Elbasvir-Grazoprevir **Fixed-dose combination of elbasvir (50 mg)/grazoprevir (100 mg) one tablet once daily for 16 weeks*	+	**Ribavirin** *1000 mg/day if <75 kg or 1200 mg/day if ≥75 kg for 16 weeks*

For patients with prior on-treatment virologic failure (failure to suppress or breakthrough) while on peginterferon plus ribavirin).

Rating: Class IIa, Level B
Note: The ribavirin daily dose is given in two divided doses.

Source: AASLD-IDSA. Recommendations for testing, management, and treating hepatitis C. Retreatment of persons in whom prior therapy has failed: peginterferon plus ribavirin-experienced, genotype 4 patients without cirrhosis. [AASLD-IDSA Hepatitis C Guidance] - Accessed November 15, 2017.

Table 4. AASLD-IDSA HCV Guidance for Genotype 4: Retreatment AASLD-IDSA HCV Guidance for Peginterferon plus Ribavirin-Experienced,

Genotype 4 Patients With Compensated Cirrhosis^

Recommended and alternative regimens listed by evidence level and alphabetically

Recommended for AASLD-IDSA HCV Guidance for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients With Compensated Cirrhosis^

Sofosbuvir-Velpatasvir
Fixed-dose combination of sofosbuvir (400 mg)/velpatasvir (100 mg) one tablet once daily for 12 weeks

Rating: Class I, Level A

Recommended for AASLD-IDSA HCV Guidance for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients With Compensated Cirrhosis^

Elbasvir-Grazoprevir
Fixed-dose combination of elbasvir (50 mg)/grazoprevir (100 mg) one tablet once daily for 12 weeks

For patients who experienced virologic relapse after prior peginterferon plus ribavirin therapy.

Rating: Class IIa, Level B

Recommended for AASLD-IDSA HCV Guidance for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients With Compensated Cirrhosis^

Glecaprevir-Pibrentasvir
Fixed-dose combination of glecaprevir (100 mg)/pibrentasvir (40 mg) three tablets once daily for 12 weeks

Rating: Class IIa, Level B

Alternative for AASLD-IDSA HCV Guidance for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients With Compensated Cirrhosis^

Ombitasvir-Paritaprevir-Ritonavir + **Ribavirin**
Fixed-dose combination of ombitasvir (12.5 mg)/paritaprevir (75 mg)/ritonavir (50 mg) two tablets once daily for 12 weeks + *1000 mg/day if <75 kg or 1200 mg/day if ≥75 kg for 12 weeks*

Please see statement on FDA warning regarding the use of ombitasvir-paritaprevir-ritonavir ± dasabuvir in patients with cirrhosis.

Rating: Class I, Level A
Note: The ribavirin daily dose is given in two divided doses.

Alternative for AASLD-IDSA HCV Guidance for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients With Compensated Cirrhosis^

Elbasvir-Grazoprevir + **Ribavirin**
Fixed-dose combination of elbasvir (50 mg)/grazoprevir (100 mg) one tablet once daily for 16 weeks + *1000 mg/day if <75 kg or 1200 mg/day if ≥75 kg for 16 weeks*

For patients with prior on-treatment virologic failure (failure to suppress or breakthrough) while on peginterferon plus ribavirin

Rating: Class IIa, Level B

Note: The ribavirin daily dose is given in two divided doses.

Alternative for AASLD-IDSA HCV Guidance for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients With Compensated Cirrhosis^

Ledipasvir-Sofosbuvir *Fixed-dose combination of ledipasvir (90 mg)/sofosbuvir (400 mg) one tablet once daily for 12 weeks*	+	**Ribavirin** *1000 mg/day if <75 kg or 1200 mg/day if ≥75 kg for 12 weeks*

Rating: Class IIa, Level B

^For treatment of patients with decompensated cirrhosis, see the AASLD-IDSA Guidance: Unique Populations—Patients with Decompensated Cirrhosis.

Source: AASLD-IDSA. Recommendations for testing, management, and treating hepatitis C. Retreatment of persons in whom prior therapy has failed: peginterferon/ribavirin-experienced, genotype 4 patients with compensated cirrhosis. [AASLD-IDSA Hepatitis C Guidance] - Accessed November 15, 2017.

Table 5. AASLD-IDSA HCV Guidance for Genotype 4: Retreatment DAA-Experienced (Including NS5A Inhibitors), Genotype 4 Patients With or Without Compensated Cirrhosis^

Recommended and alternative regimens listed by evidence level and alphabetically

Recommended for DAA-Experienced (Including NS5A Inhibitors), Genotype 4 Patients With or Without Compensated Cirrhosis^

Sofosbuvir-Velpatasvir-Voxilaprevir
Fixed-dose combination of sofosbuvir (400 mg)/velpatasvir (100 mg)/voxilaprevir (100 mg) one tablet once daily for 12 weeks

Rating: Class I, Level A

^For treatment of patients with decompensated cirrhosis, see the AASLD-IDSA Guidance: Unique Populations—Patients with Decompensated Cirrhosis.

Source: AASLD-IDSA. Recommendations for testing, management, and treating hepatitis C. Retreatment of persons in whom prior therapy has failed: DAA-experienced (including NS5A inhibitors), genotype 4 patients with or without compensated cirrhosis. [AASLD-IDSA Hepatitis C Guidance] - Accessed November 15, 2017.

Key Studies for Retreatment of Adults with Genotype 4

The following key studies were used to support the recommendations for treatment of patients with chronic hepatitis C and genotype 4 infection who have previously received treatment and had virologic nonresponse (partial response or null response) with a regimen that included peginterferon and ribavirin.

Elbasvir-Grazoprevir

- C-EDGE Treatment-Experienced: In the phase 3, C-EDGE Treatment-Experienced trial, investigators enrolled 420 previously treated adults with genotypes 1, 4, or 6 to receive 12 or 16 weeks of elbasvir-grazoprevir, with or without ribavirin.[22] All participants had previously failed peginterferon and ribavirin. For the individuals with HCV genotype 4 who received treatment, 86% (32 of 37) achieved an SVR12.

- **Integrated Pooled Analysis of Elbasvir-Grazoprevir**: In this study, investigators conducted a pooled analysis of 103 patients with genotype 4 infection enrolled in all of the phase 2/3 elbasvir-grazoprevir trials.[24] Of these, 37 were treatment-experienced with prior peginterferon plus ribavirin therapy. The subset analysis suggested that either 12 or 16 weeks of elbasvir-grazoprevir without ribavirin may be suboptimal among treatment-experienced patients (SVR12 rates were 60 to 78% with wide confidence intervals). Among 9 individuals with viral relapse (as opposed to prior on-treatment failure) on peginterferon plus ribavirin, 100% (9 of 9) achieved an SVR12. Seven of these 9 patients were treated with elbasvir-grazoprevir with ribavirin.

Glecaprevir-Pibrentasvir

- ENDURANCE-4: In this single-arm, phase 3 trial, 121 non-cirrhotic adults with genotype 4, 5 or 6 infection were assigned to treatment with a 12-week course of glecaprevir-pibrentasvir.[20] Among those enrolled, 32% were treatment-experienced and all had previously received either interferon plus ribavirin or peginterferon plus ribavirin. There were 76 participants with genotype 4 enrolled, but details regarding how many of these individuals with genotype 4 infection were treatment-experienced were not given. Among the participants with genotype 4, 99% (75 of 76) achieved an SVR12; the only individual who did not achieve an SVR discontinued therapy after only 12 days. Findings from ENDURANCE-4 were published in conjunction with ENDURANCE-2 and SURVEYOR-II, Part 4.

Ledipasvir-Sofosbuvir

- **Egyptian Multicenter Study**: This open-label multicenter study evaluated the efficacy of ledipasvir-sofosbuvir, with or without ribavirin for 8 or 12 weeks in 256 Egyptian adults with HCV genotype 4 infection; among those enrolled, 74 were interferon-experienced and 11 had prior treatment with sofosbuvir (either sofosbuvir plus ribavirin or 8 weeks of ledipasvir-sofosbuvir, with or without ribavirin).[33] The interferon-experienced participants were randomized to receive a 12-week treatment course with either ledipasvir-sofosbuvir or ledipasvir-sofosbuvir plus ribavirin. All sofosbuvir-experienced patients were assigned to the 12-week regimen of ledipasvir-sofosbuvir plus ribavirin. For the interferon-experienced patients, 94% (34 of 36) achieved an SVR12 with ledipasvir-sofosbuvir and 100% (38 of 38) had an SVR12 with ledipasvir-sofosbuvir plus ribavirin. All 11 (100%) of the sofosbuvir achieved and SVR12.
- NIAID SYNERGY (Genotype 4): In this phase 2a, open-label cohort, investigators enrolled 21 adults with chronic HCV genotype 4 infection to receive a 12-week course of ledipasvir and sofosbuvir.[27] Twenty participants completed the 12-week treatment course and 12 received the fixed-dose combination of ledipasvir-sofosbuvir. For those enrolled, 38% (8 of 21) had failed prior treatment. For these treatment-experienced participants, 100% (8 of 8)

achieved an SVR12.

Ombitasvir-Paritaprevir-Ritonavir

- PEARL-I: In the phase 2b PEARL-I study, investigators examined the efficacy of a 12-week course of ombitasvir plus paritaprevir plus ritonavir, with or without ribavirin in treatment-naïve and treatment-experienced adults with chronic HCV genotype 4 infection; the treatment-experienced participants all received a regimen that included ribavirin.[28] Individuals with cirrhosis were excluded from the study. Among the genotype 4 treatment-experienced participants, 100% (49 of 49) achieved an SVR12 with ombitasvir plus paritaprevir plus ritonavir and ribavirin. Note the regimen used in this trial did not include dasabuvir since this drug does not have activity against genotype 4 HCV.

Sofosbuvir-Velpatasvir

- ASTRAL-1: In the phase 3 ASTRAL-1 trial, investigators randomized treatment-naïve and treatment-experienced adults with chronic hepatitis C genotype 1, 2, 4, 5, or 6 infection in a 5:1 ratio to receive a 12-week course of either sofosbuvir-velpatasvir or placebo.[23] The study included 116 participants with genotype 4. Among the treatment-experienced patients with genotype 4 infection who received sofosbuvir-velpatasvir, 100% (52 of 52) achieved an SVR 12.

Summary Points

- Genotype 4 hepatitis C virus infection is not common in the United States, but it is highly prevalent in the Middle East, Africa, and Southern Europe.
- For initial therapy of adults with HCV genotype 4 infection without cirrhosis, four regimens are recommended by the AASLD-IDSA HCV Guidance: (a) glecaprevir-pibrentasvir for 8 weeks, (b) sofosbuvir-velpatasvir for 12 weeks, (c) elbasvir-grazoprevir for 12 weeks, or (d) ledipasvir-sofosbuvir for 12 weeks.
- For initial therapy adults with HCV genotype 4 and compensated cirrhosis, the recommended regimens and rating of evidence are the same as for persons without cirrhosis, with the exception of glecaprevir-pibrentasvir which should be given for 12 weeks for individual with compensated cirrhosis.
- For retreatment of genotype 4 patients without cirrhosis who previously failed therapy with peginterferon and ribavirin, the recommended regimens are similar to those noted above for naïve patients: (a) glecaprevir-pibrentasvir for 8 weeks, (b) sofosbuvir-velpatasvir for 12 weeks, (c) elbasvir-grazoprevir for 12 weeks (in those patients who had a viral relapse with peginterferon/ribavirin), or (d) ledipasvir-sofosbuvir for 12 weeks.
- For the retreatment of genotype 4 patients with compensated cirrhosis with prior peginterferon/ribavirin experience, three 12-week regimens are recommended: (a) sofosbuvir-velpatasvir, (b) elbasvir-grazoprevir (same conditions as noted above) or (c) glecaprevir-pibrentasvir.
- For the retreatment of adults with HCV genotype 4 (with or without cirrhosis) who are DAA-experienced (with or without prior NS5A inhibitor), the main recommended regimen is sofosbuvir-velpatasvir-voxilaprevir.

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Figures

Figure 1 Classes of Direct-Acting Antiviral Agents Used to Treat HCV

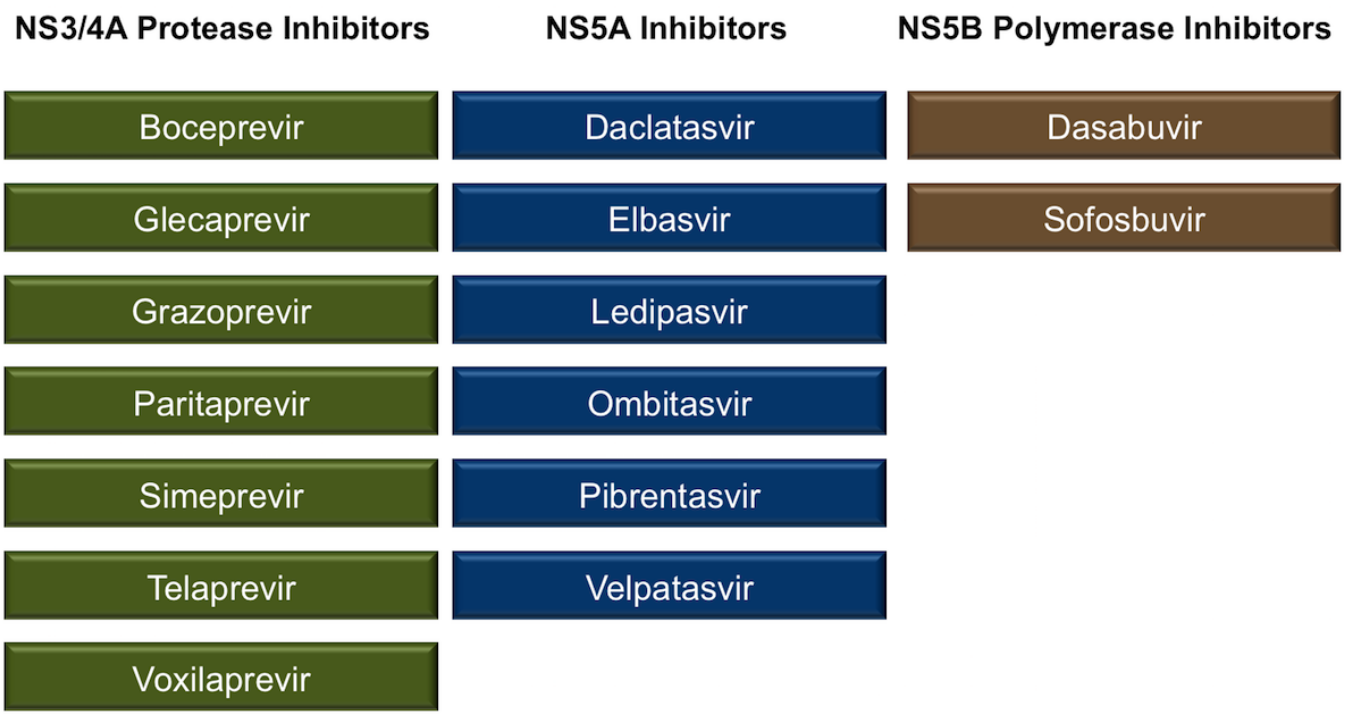

Figure 2 Cost of Medication Regimens Used to Treat Genotype 4 Chronic HCV

This figure shows the approximate cost of recommended regimens used for initial treatment adults with genotype 4 chronic HCV, including persons without cirrhosis and with compensated cirrhosis. The cost estimates are based on available wholesale acquisition price data.

Estimated Cost of Recommended Regimens for Initial Treatment HCV GT4	
Regimens and Duration of Therapy	**Cost of Regimen***
Genotype 4 HCV Without Cirrhosis	
Glecaprevir-Pibrentasvir for 8 weeks	$26,400
Sofosbuvir-Velpatasvir for 12 weeks	$74,760
Elbasvir-Grazoprevir for 12 weeks	$54,600
Ledipasvir-Sofosbuvir for 12 weeks	$94,500
Genotype 4 HCV With Compensated Cirrhosis	
Glecaprevir-Pibrentasvir for 12 weeks	$39,600
Sofosbuvir-Velpatasvir for 12 weeks	$74,760
Elbasvir-Grazoprevir for 12 weeks	$54,600
Ledipasvir-Sofosbuvir for 12 weeks	$94,500
*Cost estimates based on Wholesale Acquisition Cost (WAC)	

Table 1. AASLD-IDSA HCV Guidance for Genotype 4: Initial Treatment Treatment-Naïve Genotype 4 Without Cirrhosis

Recommended and alternative regimens listed by evidence level and alphabetically

Recommended for Treatment-Naïve Genotype 4 Without Cirrhosis

Glecaprevir-Pibrentasvir
Fixed-dose combination of glecaprevir (100 mg)/pibrentasvir (40 mg) three tablets once daily for 8 weeks

Rating: Class I, Level A

Recommended for Treatment-Naïve Genotype 4 Without Cirrhosis

Sofosbuvir-Velpatasvir
Fixed-dose combination of sofosbuvir (400 mg)/velpatasvir (100 mg) one tablet once daily for 12 weeks

Rating: Class I, Level A

Recommended for Treatment-Naïve Genotype 4 Without Cirrhosis

Elbasvir-Grazoprevir
Fixed-dose combination of elbasvir (50 mg)/grazoprevir (100 mg) one tablet once daily for 12 weeks

Rating: Class IIa, Level B

Recommended for Treatment-Naïve Genotype 4 Without Cirrhosis

Ledipasvir-Sofosbuvir
Fixed-dose combination of ledipasvir (90 mg)/sofosbuvir (400 mg) one tablet once daily for 12 weeks

Rating: Class IIa, Level B

Alternative for Treatment-Naïve Genotype 4 Without Cirrhosis

Ombitasvir-Paritaprevir-Ritonavir + **Ribavirin**
Fixed-dose combination of ombitasvir (12.5 mg)/paritaprevir (75 mg)/ritonavir (50 mg) two tablets once daily for 12 weeks + *1000 mg if <75 kg or 1200 mg if ≥75 kg for 12 weeks*

Rating: Class I, Level A
Note: The ribavirin daily dose is given in two divided doses.

Source: AASLD-IDSA. Recommendations for testing, management, and treating hepatitis C. Initial treatment of HCV infection: treatment-naive genotype 4 without cirrhosis. [AASLD-IDSA Hepatitis C Guidance] - Accessed November 15, 2017.

Table 2. AASLD-IDSA HCV Guidance for Genotype 4: Initial Treatment Treatment-Naïve Genotype 4 With Compensated Cirrhosis^

Recommended and alternative regimens listed by evidence level and alphabetically

Recommended for Treatment-Naïve Genotype 4 With Compensated Cirrhosis^

Sofosbuvir-Velpatasvir
Fixed-dose combination of sofosbuvir (400 mg)/velpatasvir (100 mg) one tablet once daily for 12 weeks

Rating: Class I, Level A

Recommended for Treatment-Naïve Genotype 4 With Compensated Cirrhosis^

Glecaprevir-Pibrentasvir
Fixed-dose combination of glecaprevir (100 mg)/pibrentasvir (40 mg) three tablets once daily for 12 weeks

Rating: Class I, Level B

Recommended for Treatment-Naïve Genotype 4 With Compensated Cirrhosis^

Elbasvir-Grazoprevir
Fixed-dose combination of elbasvir (50 mg)/grazoprevir (100 mg) one tablet once daily for 12 weeks

Rating: Class IIa, Level B

Recommended for Treatment-Naïve Genotype 4 With Compensated Cirrhosis^

Ledipasvir-Sofosbuvir
Fixed-dose combination of ledipasvir (90 mg)/sofosbuvir (400 mg) one tablet once daily for 12 weeks

Rating: Class IIa, Level B

Alternative for Treatment-Naïve Genotype 4 With Compensated Cirrhosis^

Ombitasvir-Paritaprevir-Ritonavir *Fixed-dose combination of ombitasvir (12.5 mg)/paritaprevir (75 mg)/ritonavir (50 mg) two tablets once daily for 12 weeks*	+	**Ribavirin** *1000 mg if <75 kg or 1200 mg if ≥75 kg for 12 weeks*

Rating: Class I, Level A
Note: (i) See statement on FDA warning regarding the use of paritaprevir/ritonavir/ombitasvir ± dasabuvir in patients with cirrhosis. (ii) The ribavirin daily dose is given in two divided doses.

^For treatment of patients with decompensated cirrhosis, see the AASLD-IDSA Guidance: Unique Populations—Patients with Decompensated Cirrhosis.

Source: AASLD-IDSA. Recommendations for testing, management, and treating hepatitis C. Initial treatment of HCV infection: treatment-naive genotype 4 with compensated cirrhosis. [AASLD-IDSA Hepatitis C Guidance] - Accessed November 15, 2017.

Table 3. AASLD-IDSA HCV Guidance for Genotype 4: Retreatment Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients Without Cirrhosis

Recommended and alternative regimens listed by evidence level and alphabetically

Recommended for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients Without Cirrhosis

Sofosbuvir-Velpatasvir
Fixed-dose combination of sofosbuvir (400 mg)/velpatasvir (100 mg) one tablet once daily for 12 weeks

Rating: Class I, Level A

Recommended for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients Without Cirrhosis

Glecaprevir-Pibrentasvir
Fixed-dose combination of glecaprevir (100 mg)/pibrentasvir (40 mg) three tablets once daily for 8 weeks

Rating: Class I, Level B

Recommended for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients Without Cirrhosis

Elbasvir-Grazoprevir
**Fixed-dose combination of elbasvir (50 mg)/grazoprevir (100 mg) one tablet once daily for 12 weeks*

For patients who experienced virologic relapse after prior peginterferon plus ribavirin therapy.

Rating: Class IIa, Level B

Recommended for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients Without Cirrhosis

Ledipasvir-Sofosbuvir
Fixed-dose combination of ledipasvir (90 mg)/sofosbuvir (400 mg) one tablet once daily for 12 weeks

Rating: Class IIa, Level B

Alternative for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients Without Cirrhosis

Ombitasvir-Paritaprevir-Ritonavir *Fixed-dose combination of ombitasvir (12.5 mg)/paritaprevir (75 mg)/ritonavir (50 mg) two tablets once daily for 12 weeks*	+	**Ribavirin** *1000 mg/day if <75 kg or 1200 mg/day if ≥75 kg for 12 weeks*

Rating: Class I, Level A
Note: The ribavirin daily dose is given in two divided doses.

Alternative for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients Without Cirrhosis

Elbasvir-Grazoprevir **Fixed-dose combination of elbasvir (50 mg)/grazoprevir (100 mg) one tablet once daily for 16 weeks*	+	**Ribavirin** *1000 mg/day if <75 kg or 1200 mg/day if ≥75 kg for 16 weeks*

For patients with prior on-treatment virologic failure (failure to suppress or breakthrough) while on peginterferon plus ribavirin).

Rating: Class IIa, Level B
Note: The ribavirin daily dose is given in two divided doses.

Source: AASLD-IDSA. Recommendations for testing, management, and treating hepatitis C. Retreatment of persons in whom prior therapy has failed: peginterferon plus ribavirin-experienced, genotype 4 patients without cirrhosis. [AASLD-IDSA Hepatitis C Guidance] - Accessed November 15, 2017.

Table 4. AASLD-IDSA HCV Guidance for Genotype 4: Retreatment AASLD-IDSA HCV Guidance for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients With Compensated Cirrhosis^

Recommended and alternative regimens listed by evidence level and alphabetically

Recommended for AASLD-IDSA HCV Guidance for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients With Compensated Cirrhosis^

Sofosbuvir-Velpatasvir
Fixed-dose combination of sofosbuvir (400 mg)/velpatasvir (100 mg) one tablet once daily for 12 weeks

Rating: Class I, Level A

Recommended for AASLD-IDSA HCV Guidance for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients With Compensated Cirrhosis^

Elbasvir-Grazoprevir
Fixed-dose combination of elbasvir (50 mg)/grazoprevir (100 mg) one tablet once daily for 12 weeks

For patients who experienced virologic relapse after prior peginterferon plus ribavirin therapy.

Rating: Class IIa, Level B

Recommended for AASLD-IDSA HCV Guidance for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients With Compensated Cirrhosis^

Glecaprevir-Pibrentasvir
Fixed-dose combination of glecaprevir (100 mg)/pibrentasvir (40 mg) three tablets once daily for 12 weeks

Rating: Class IIa, Level B

Alternative for AASLD-IDSA HCV Guidance for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients With Compensated Cirrhosis^

Ombitasvir-Paritaprevir-Ritonavir + **Ribavirin**
Fixed-dose combination of ombitasvir (12.5 mg)/paritaprevir (75 mg)/ritonavir (50 mg) two tablets once daily for 12 weeks + *1000 mg/day if <75 kg or 1200 mg/day if ≥75 kg for 12 weeks*

Please see statement on FDA warning regarding the use of ombitasvir-paritaprevir-ritonavir ± dasabuvir in patients with cirrhosis.

Rating: Class I, Level A
Note: The ribavirin daily dose is given in two divided doses.

Alternative for AASLD-IDSA HCV Guidance for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients With Compensated Cirrhosis^

Elbasvir-Grazoprevir + **Ribavirin**
Fixed-dose combination of elbasvir (50 mg)/grazoprevir (100 mg) one tablet + *1000 mg/day if <75 kg or 1200 mg/day if ≥75 kg for 16 weeks*

once daily for 16 weeks

For patients with prior on-treatment virologic failure (failure to suppress or breakthrough) while on peginterferon plus ribavirin

Rating: Class IIa, Level B
Note: The ribavirin daily dose is given in two divided doses.

Alternative for AASLD-IDSA HCV Guidance for Peginterferon plus Ribavirin-Experienced, Genotype 4 Patients With Compensated Cirrhosis^

Ledipasvir-Sofosbuvir *Fixed-dose combination of ledipasvir (90 mg)/sofosbuvir (400 mg) one tablet once daily for 12 weeks*	+	**Ribavirin** *1000 mg/day if <75 kg or 1200 mg/day if ≥75 kg for 12 weeks*

Rating: Class IIa, Level B

^For treatment of patients with decompensated cirrhosis, see the AASLD-IDSA Guidance: Unique Populations—Patients with Decompensated Cirrhosis.

Source: AASLD-IDSA. Recommendations for testing, management, and treating hepatitis C. Retreatment of persons in whom prior therapy has failed: peginterferon/ribavirin-experienced, genotype 4 patients with compensated cirrhosis. [AASLD-IDSA Hepatitis C Guidance] - Accessed November 15, 2017.

Table 5. AASLD-IDSA HCV Guidance for Genotype 4: Retreatment DAA-Experienced (Including NS5A Inhibitors), Genotype 4 Patients With or Without Compensated Cirrhosis^

Recommended and alternative regimens listed by evidence level and alphabetically

Recommended for DAA-Experienced (Including NS5A Inhibitors), Genotype 4 Patients With or Without Compensated Cirrhosis^
Sofosbuvir-Velpatasvir-Voxilaprevir *Fixed-dose combination of sofosbuvir (400 mg)/velpatasvir (100 mg)/voxilaprevir (100 mg) one tablet once daily for 12 weeks*
Rating: Class I, Level A

^For treatment of patients with decompensated cirrhosis, see the AASLD-IDSA Guidance: Unique Populations—Patients with Decompensated Cirrhosis.

Source: AASLD-IDSA. Recommendations for testing, management, and treating hepatitis C. Retreatment of persons in whom prior therapy has failed: DAA-experienced (including NS5A inhibitors), genotype 4 patients with or without compensated cirrhosis. [AASLD-IDSA Hepatitis C Guidance] - Accessed November 15, 2017.