



CLINICAL CARE OPTIONS®
HEPATITIS

HCV Treatment Options in 2017/2018: What's Here and What's Coming Soon

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Disclosures

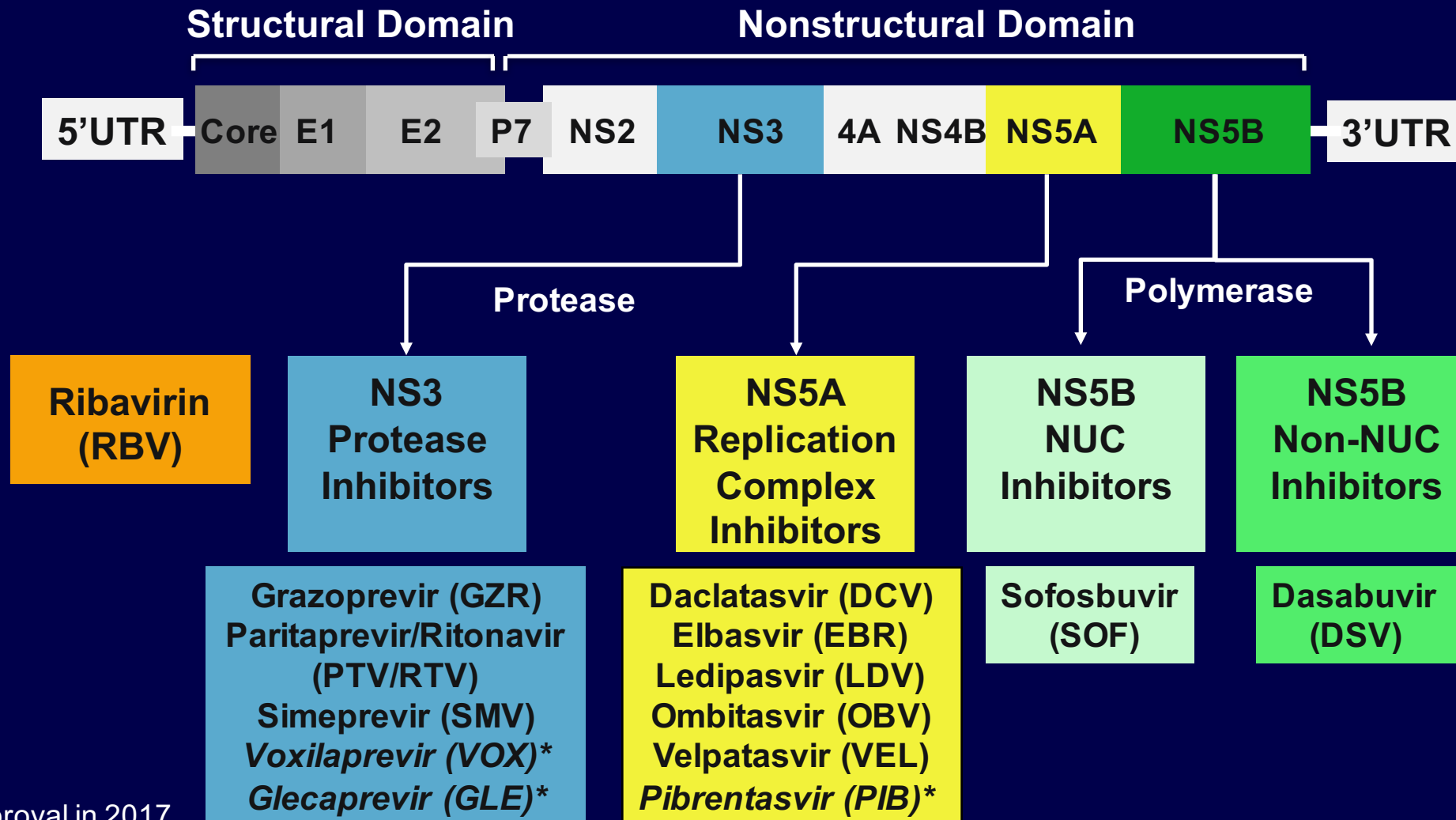
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Where HCV Therapy Stands Now

- Interferon is gone in the US; ribavirin . . . not quite
- SVR in > 95% of pts
- “Difficult-to-cure” populations no longer difficult
 - Black race
 - Cirrhosis
 - Renal failure and kidney transplant
 - HIV coinfection
 - Older age
 - Liver transplant
 - Persons who inject drugs (PWID)
 - Genotype 3 remains more challenging (but not by much)
- Emergent issues and controversies:
 - HBV reactivation
 - HCC recurrence after DAA therapy
- Cost and access issues persist but improving

Approved DAAs From Multiple Classes: Basis of 2016 Combination HCV Regimens



*Possible approval in 2017.

Treatment Options for Genotype 1



Recommended for GT1 Treatment-Naive or IFN-Experienced Pts Without Cirrhosis

HCV GT	Recommended Regimens (All 12 Wks Except as Noted)
1a	<ul style="list-style-type: none">LDV/SOF (8 wks if tx naive, nonblack, no HIV, and HCV RNA < 6 million IU/mL)SOF/VELDCV + SOFSMV + SOFEBR/GZR*OBV/PTV/RTV/DSV extended release + RBV or OBV/PTV/RTV + DSV BID + RBV
1b	<ul style="list-style-type: none">LDV/SOF (8 wks if tx naive, nonblack, no HIV, and HCV RNA < 6 million IU/mL)SOF/VELDCV + SOFSMV + SOFEBR/GZROBV/PTV/RTV/DSV extended release or OBV/PTV/RTV + DSV BID

*Only if no baseline NS5A elbasvir RASs detected.

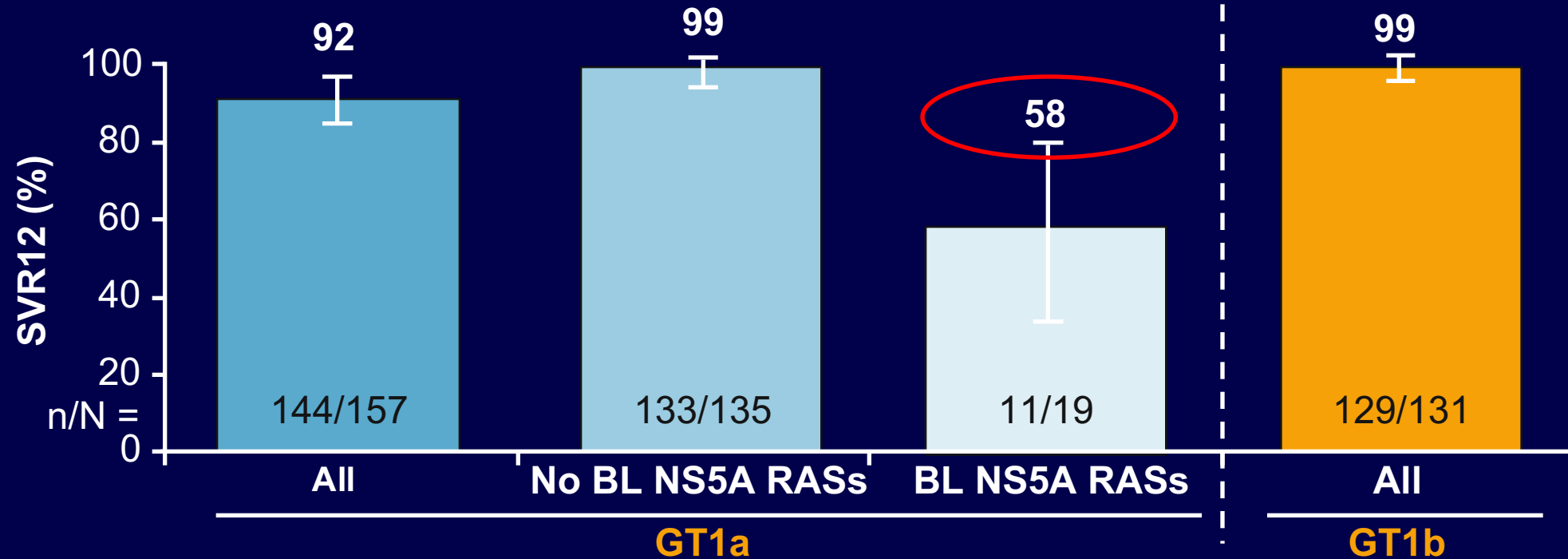
Recommended for GT1 Treatment-Naive or IFN-Experienced Pts With Compensated Cirrhosis

HCV GT	Recommended Regimens (All 12 Wks)	
	Treatment Naive	IFN/RBV Experienced
1a	<ul style="list-style-type: none"> ▪ EBR/GZR* ▪ LDV/SOF ▪ SOF/VEL 	<ul style="list-style-type: none"> ▪ EBR/GZR* ▪ LDV/SOF + RBV ▪ SOF/VEL
1b	<ul style="list-style-type: none"> ▪ EBR/GZR ▪ LDV/SOF ▪ OBV/PTV/RTV/DSV ER ▪ OBV/PTV/RTV+ DSV BID ▪ SOF/VEL 	<ul style="list-style-type: none"> ▪ EBR/GZR ▪ LDV/SOF + RBV ▪ OBV/PTV/RTV/DSV ER ▪ OBV/PTV/RTV+ DSV BID ▪ SOF/VEL

*Only if no baseline NS5A elbasvir RASs detected.

Adjust EBR/GZR Duration Based on Baseline NS5A RASs in GT1a

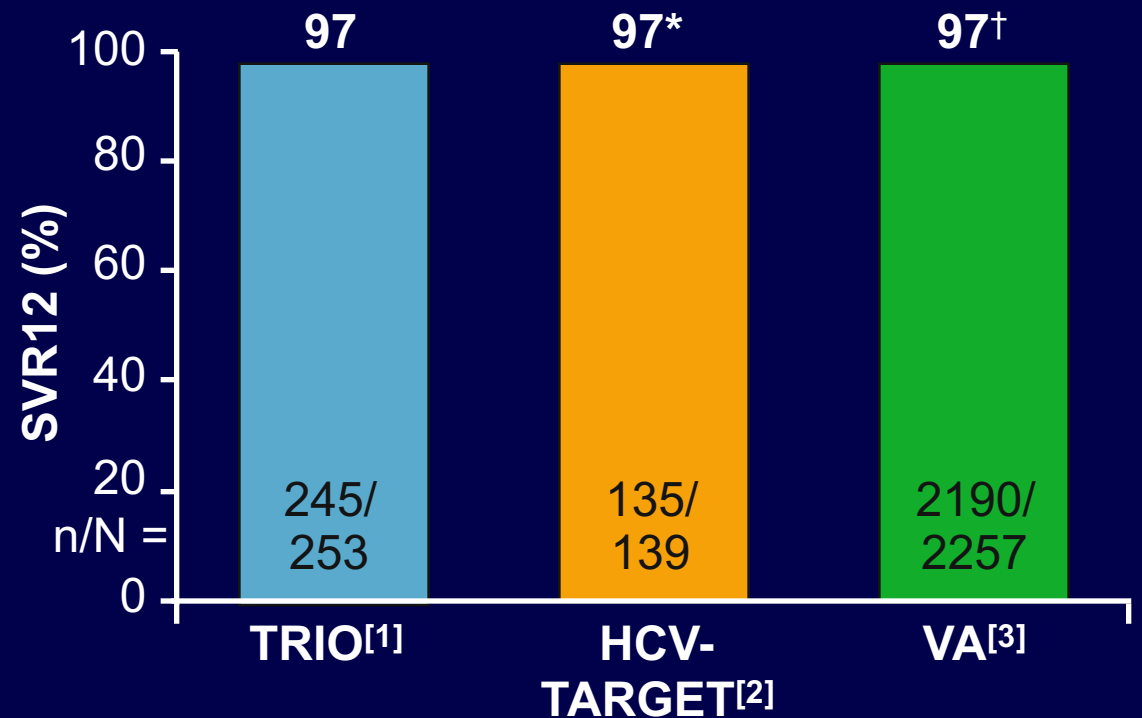
C-EDGE Treatment Naive: 12 Wks of Elbasvir/Grazoprevir



If NS5A RASs in GT1a, treat with EBR/GZR + RBV for 16 wks (alternative)
No baseline RAS testing needed in GT1b pts

TRIO, HCV-TARGET, VA: Real-World Efficacy of EBR/GZR

- Analyses of SVR12 rates in HCV-infected pts using specialty pharmacies and providers in real-world cohorts
 - US TRIO Network^[1]
 - US and international clinical practices^[2]
 - US Veterans Affairs Healthcare System^[3]



*For pts missing SVR12 outcome, data replaced with SVR4 outcome. †For pts missing SVR12 outcome, data replaced with HCV RNA test results obtained during posttreatment Wks 4-12.

Resistance Considerations



- Most pts with failure of current DAAs have emergent resistance-associated substitutions (RASs)
 - NS5A RASs persist much longer than PI RASs
- 15% of pts have baseline NS5A RASs with variable effects on GT1a response
- Second-generation drugs designed to cover RASs



Treatment Options for Genotype 3



Recommended for Treatment-Naive Pts With Genotype 3 HCV

Cirrhosis?	RAS Test?	RAS Test Result	Recommended regimens
No	Don't test	-	DCV + SOF 12 wks SOF/VEL 12 wks
Yes	Test	No Y93	DCV + SOF ± RBV 24 wks SOF/VEL 12 wks
		Y93	DCV + SOF + RBV 24 wks SOF/VEL + RBV 12 wks

Recommended for PegIFN/RBV-Experienced Pts With Genotype 3 HCV

Cirrhosis?	RAS Test?	RAS Test Result	Recommended regimens
No	Test	No Y93	DCV + SOF 12 wks SOF/VEL 12 wks
		Y93	DCV + SOF + RBV 12 wks SOF/VEL + RBV 12 wks
Yes	Don't test	-	EBR/GZR + SOF 12 wks SOF/VEL + RBV 12 wks

Need for RBV Based on Baseline Y93 RAS in GT3 With Cirrhosis *or* Previous PegIFN/RBV

- Based on very low SVR12 rates in these groups when treated without RBV
- For pts with both cirrhosis *and* previous pegIFN/RBV, RBV required regardless of Y93 status (unless using EBR/GZR + SOF)
- These recommendations are pending further data on optimal regimen^[1]

GT3 Study and Population	SVR12, %	
	No Y93H	Y93H
ALLY-3: DCV + SOF for 12 Wks^[2]		
▪ Overall	92 (n = 162)	54 (n = 13)
▪ No cirrhosis	98 (n = 128)	67 (n = 9)
▪ Cirrhosis	71 (n = 34)	25 (n = 4)
ASTRAL-3: SOF/VEL for 12 Wks^[3]		
▪ Overall	97 (n = 249)	84 (n = 25)

1. AASLD/IDSA. HCV guidance. April 2017. 2. Nelson DR, et al. Hepatology. 2015;61:1127-1135. 3. Foster GR, et al. N Engl J Med. 2015;373:2608-2617.



Treatment Options for Genotypes 2, 4, 5, 6



Recommended Regimens for Treatment-Naive Pts With GT 2, 4, 5, 6 HCV

- All regimens 12 wks

HCV GT	No Cirrhosis	Compensated Cirrhosis
2	<ul style="list-style-type: none">▪ SOF/VEL	<ul style="list-style-type: none">▪ SAME
4	<ul style="list-style-type: none">▪ OBV/PTV/RTV + RBV▪ SOF/VEL▪ EBR/GZR▪ LDV/SOF	<ul style="list-style-type: none">▪ SAME
5 or 6	<ul style="list-style-type: none">▪ SOF/VEL▪ LDV/SOF	<ul style="list-style-type: none">▪ SAME

Recommended Regimens for PegIFN/RBV-Experienced Pts With GT2, 4, 5, 6 HCV

- All regimens 12 wks unless noted otherwise

HCV GT	No Cirrhosis	Compensated Cirrhosis
2	<ul style="list-style-type: none"> ▪ SOF/VEL 	<ul style="list-style-type: none"> ▪ SAME
4	<ul style="list-style-type: none"> ▪ OBV/PTV/RTV + RBV ▪ SOF/VEL ▪ EBR/GZR* ▪ LDV/SOF 	<ul style="list-style-type: none"> ▪ SAME ▪ SAME ▪ SAME ▪ LDV/SOF + RBV
5 or 6	<ul style="list-style-type: none"> ▪ SOF/VEL ▪ LDV/SOF 	<ul style="list-style-type: none"> ▪ SAME

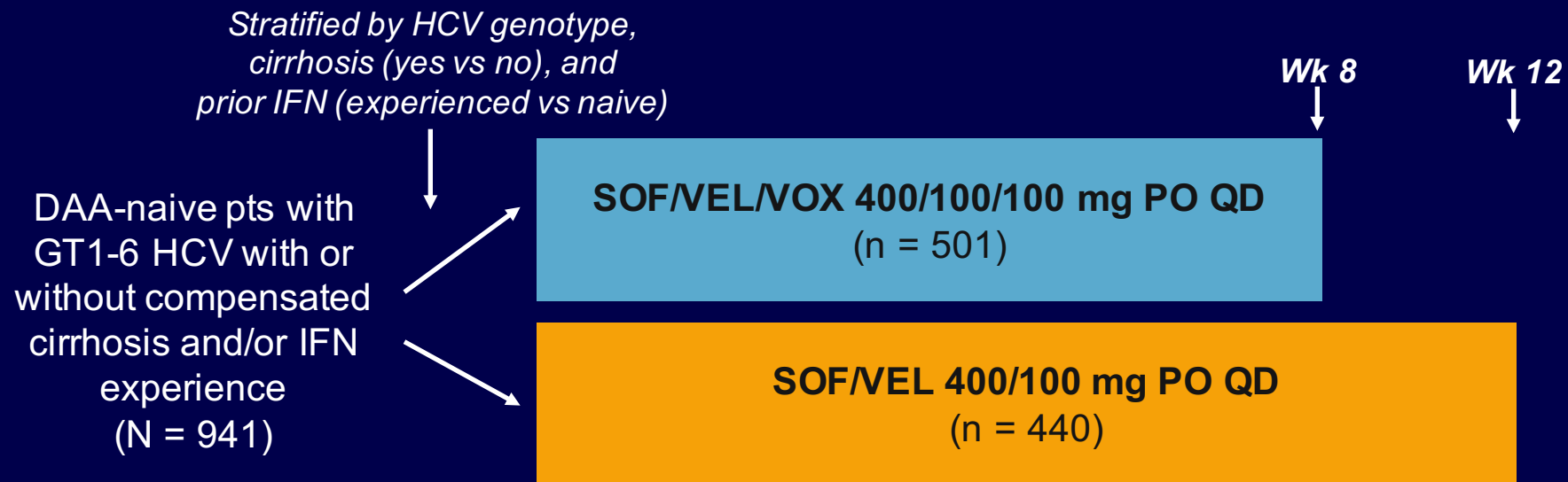
*Previous relapse only; pts with previous virologic nonresponse or breakthrough should be treated with 16 wks with addition of RBV.

Late-Phase Investigational HCV Regimens by Drug Classes

Regimen	NS5B Polymerase Nucleotide Inhibitor (. . . buvir)	NS3/4A Protease Inhibitor (. . . previr)	NS5A Inhibitor (. . . asvir)
Sofosbuvir/velpatasvir/voxilaprevir	SOF	VOX	VEL
Glecaprevir/pibrentasvir	--	GLE	PIB
Grazoprevir/ruzasvir/uprifosbuvir	UPR	GZR	RZR
AL-335 + odalasvir + simeprevir	AL-335	SMV	ODV

POLARIS-2: 8-Wk SOF/VEL/VOX vs 12-Wk SOF/VEL for DAA-Naive GT1-6 Pts

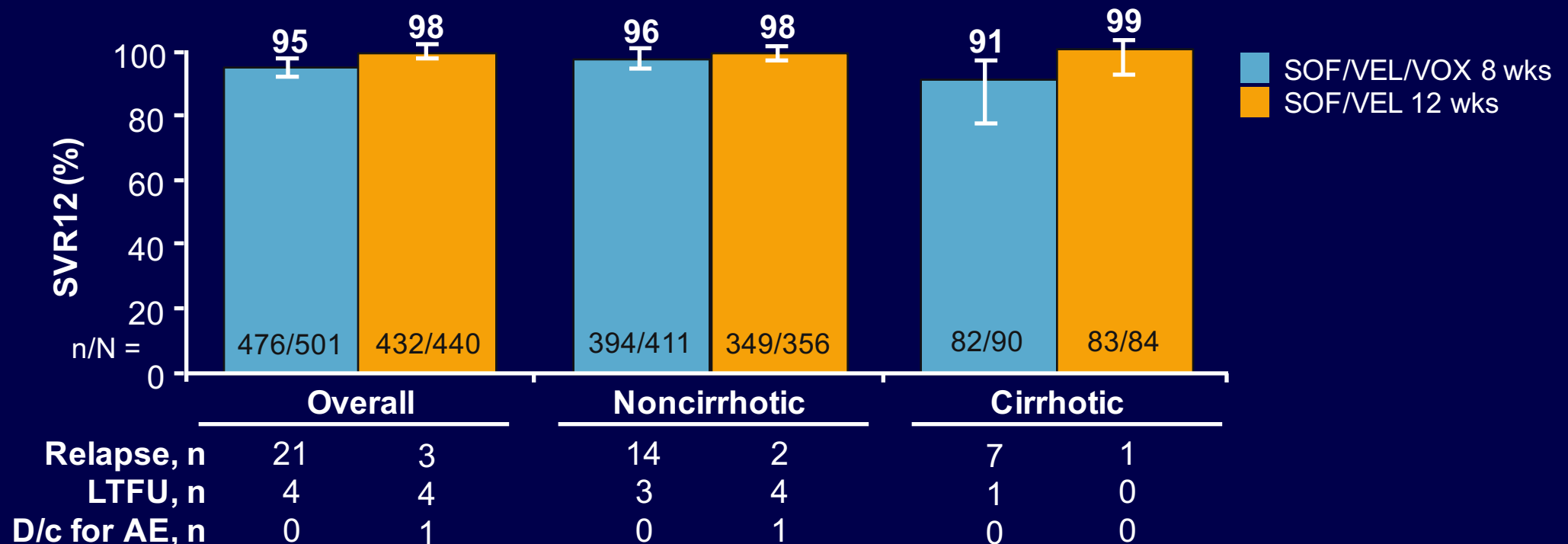
- Randomized, open-label, active-controlled phase III trial



*Treatment allocation randomized in pts with GT1-4 HCV; pts with GT5/6 HCV allocated to SOF/VEL/VOX arm; cirrhotic pts with GT3 HCV infection enrolled in POLARIS-3.

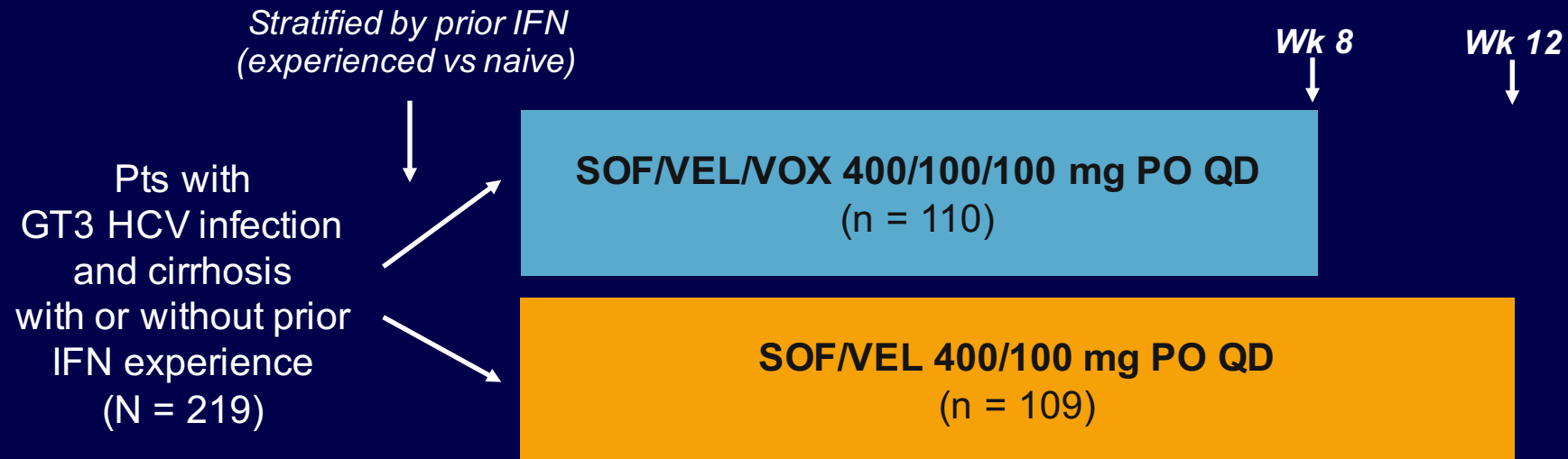
POLARIS-2: SVR12 Rates With 8-Wk SOF/VEL/VOX vs 12-Wk SOF/VEL

- 8-wk SOF/VEL/VOX did not meet criteria for noninferiority vs 12-wk SOF/VEL
 - Treatment difference: -3.4% (95% CI: -6.2% to -0.6%)
 - 14/21 pts with relapse to SOF/VEL/VOX 8 wks had GT1a



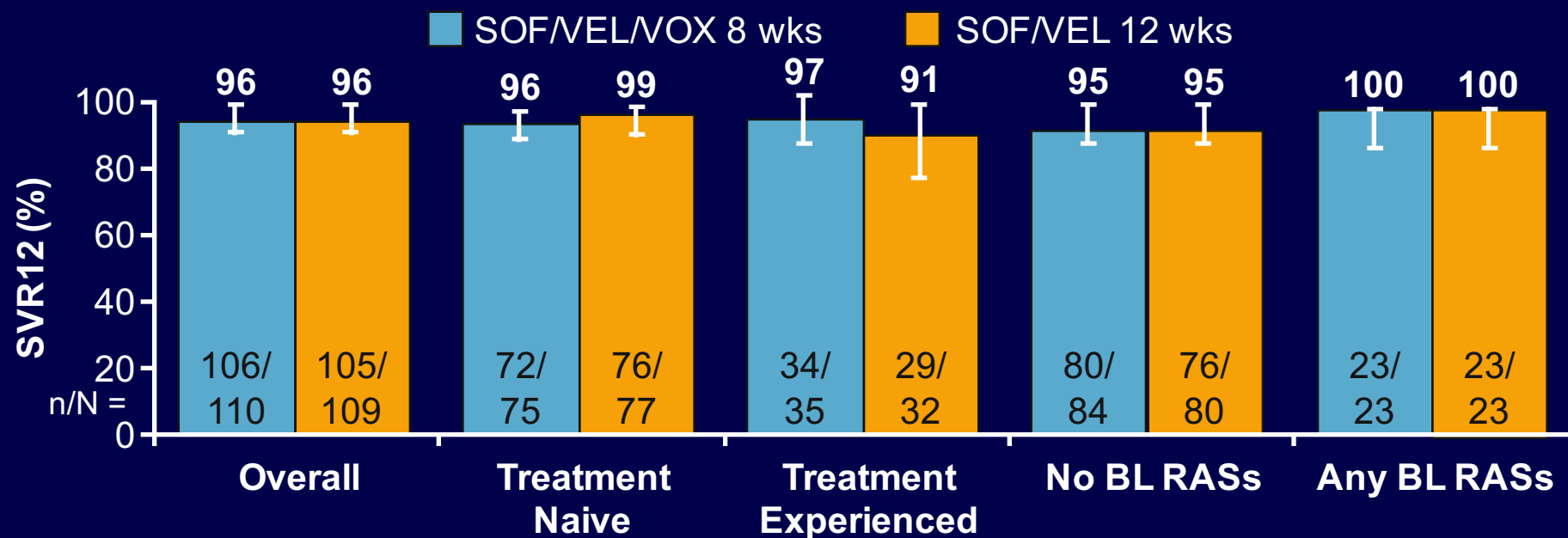
POLARIS-3: 8-Wk SOF/VEL/VOX vs 12-Wk SOF/VEL for Cirrhotic, DAA Naive GT3

- Randomized, open-label, active-controlled phase III trial



- IFN experience in 29% to 32% of pts

POLARIS-3: SVR12 Rates With 8-Wk SOF/VEL/VOX for Cirrhotic GT3 Pts



- SVR rates similar between treatment arms, and both regimens superior to prespecified historic SVR rate of 83% ($P < .001$ for each arm)
- Overall VF: SOF/VEL/VOX, $n = 2$ relapses; SOF/VEL, $n = 1$ each for relapse and on-treatment failure
- No treatment-emergent RASs in SOF/VEL/VOX arm**; Y93H in both VFs in SOF/VEL arm

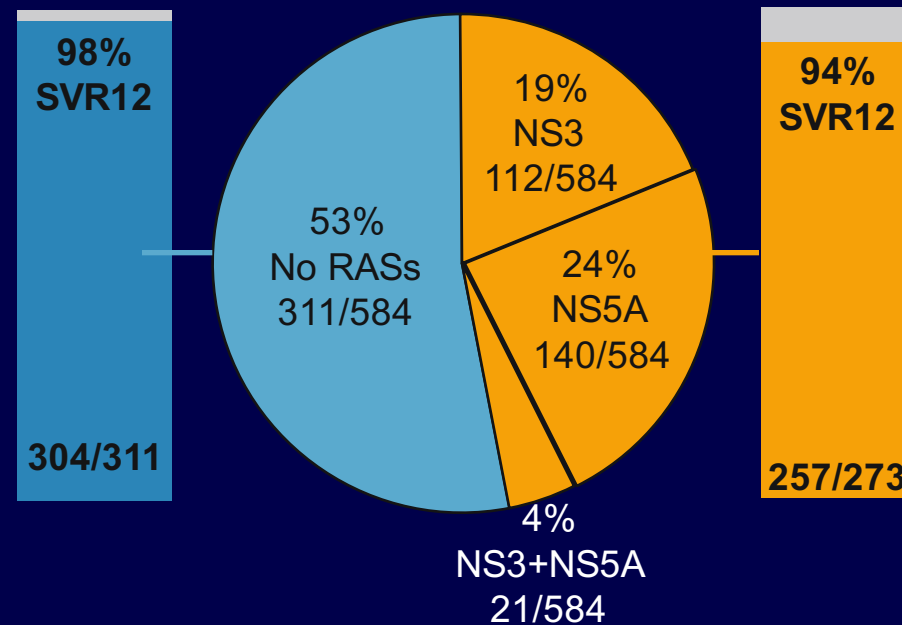
POLARIS-2, -3: Safety of SOF/VEL/VOX for 8 Wks

Outcome, %	POLARIS-2		POLARIS-3	
	SOF/VEL/VOX 8 Wks (n = 501)	SOF/VEL 12 Wks (n = 440)	SOF/VEL/VOX 8 Wks (n = 110)	SOF/VEL 12 Wks (n = 109)
Any AE	72	69	75	74
Serious AE	3	2	2	3
D/c for AE	0	< 1	0	1
Death	0	0	1	0
AE in > 10% of pts				
▪ Headache	27	23	25	29
▪ Fatigue	21	20	25	28
▪ Diarrhea	18	7	15	5
▪ Nausea	16	9	21	9



POLARIS-2, -3: Pooled Analysis of BL RAS Effect on SOF/VEL/VOX in DAA-Naive Pts

- 606 DAA-naive pts treated with 8-wk SOF/VEL/VOX in POLARIS-2 and -3
 - RASs assessed by deep sequencing (15% assay cutoff)



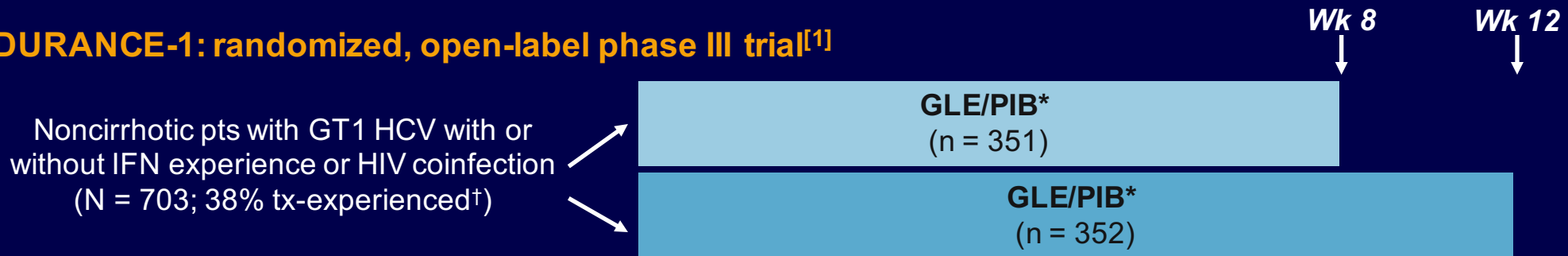
- VOX-specific and VEL-specific RASs had no impact on SVR
- No emergent RASs in 22/23 pts who relapsed after 8 wks of SOF/VEL/VOX

**ENDURANCE Studies:
Glecaprevir/Pibrentasvir in
Noncirrhotic Patients**

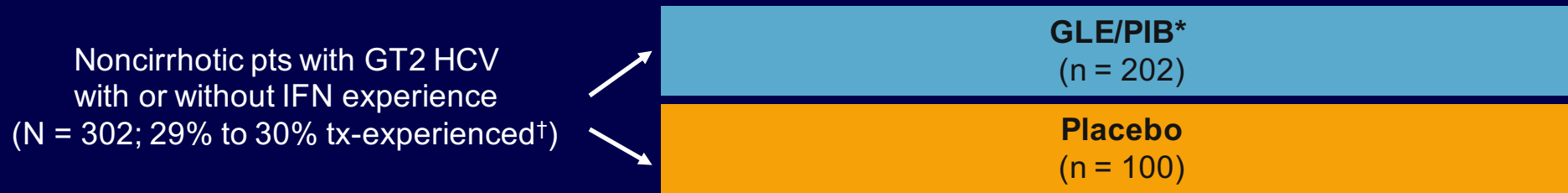


ENDURANCE-1, -2, -4: GLE/PIB for Treatment of GT1, 2, 4, 5, 6 HCV

ENDURANCE-1: randomized, open-label phase III trial^[1]



ENDURANCE-2: randomized, double-blind, placebo-controlled phase III trial^[2]



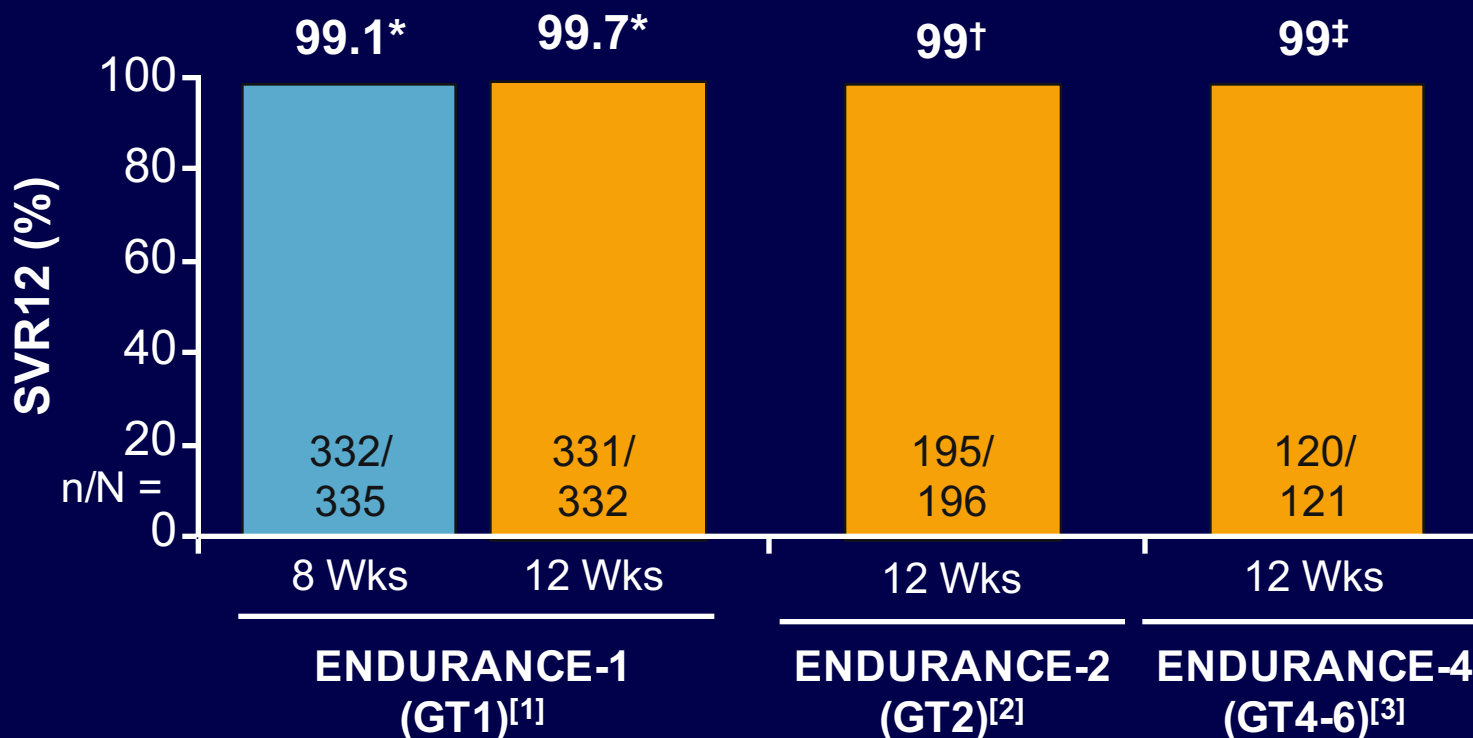
ENDURANCE-4: open-label, single-arm phase III trial^[3]



*Dosing: GLE/PIB given as 3 coformulated 100/40-mg tablets QD for a total dose of 300/120 mg.

[†]Treatment experience permitted: IFN or pegIFN ± RBV or SOF + RBV ± pegIFN.

ENDURANCE-1, -2, -4 Studies: Efficacy of GLE/PIB for Treating GT1, 2, 4, 5, 6 HCV



1 case of on-treatment virologic failure at Day 29 in pt with GT1a HCV infection

*ITT-PS analysis: included all pts receiving ≥ 1 dose of study drug; excluded pts with HIV coinfection or SOF experience.

†ITT analysis: excluded pts with SOF experience. ‡ITT analysis.

ENDURANCE-1, -2, -4 Studies: Safety of GLE/PIB for Treating GT1, 2, 4, 5, 6 HCV

Outcome, %	ENDURANCE-1 ^[1]		ENDURANCE-2 ^[2]		ENDURANCE-4 ^[3]
	GLE/PIB 8 Wks (n = 351)	GLE/PIB 12 Wks (n = 352)	GLE/PIB 12 Wks (n = 202)	PBO 12 Wks (n = 100)	GLE/PIB 12 Wks (n = 121)
Any AE	62	66	65	58	69
D/c for AE	0	< 1	0	0	2
Serious AE	1	1	1	1	< 1
Death	0	< 1	0	0	0
AE in ≥ 10% of pts					
▪ Fatigue	9	12	11	10	17
▪ Headache	19	18	12	12	21
AST grade ≥ 3*	0	< 1	1	1	0
ALT grade ≥ 3*	0	0	< 1	2	0
Total bilirubin grade 3 [†]	< 1	< 1	< 1	0	0

*> 5 times ULN. †3-10 times ULN.

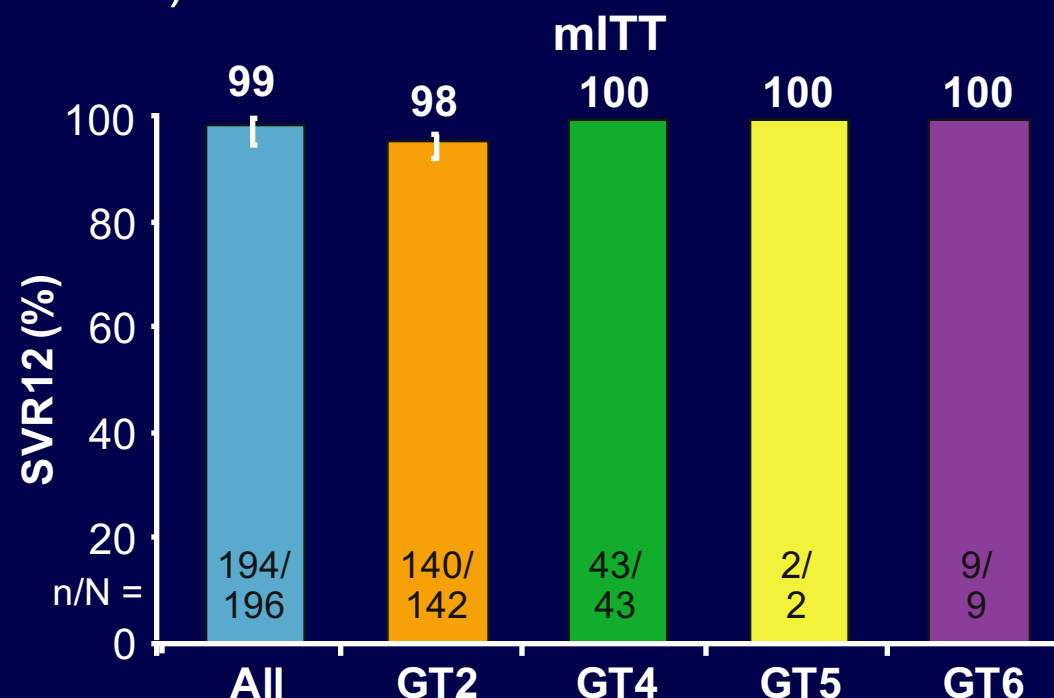
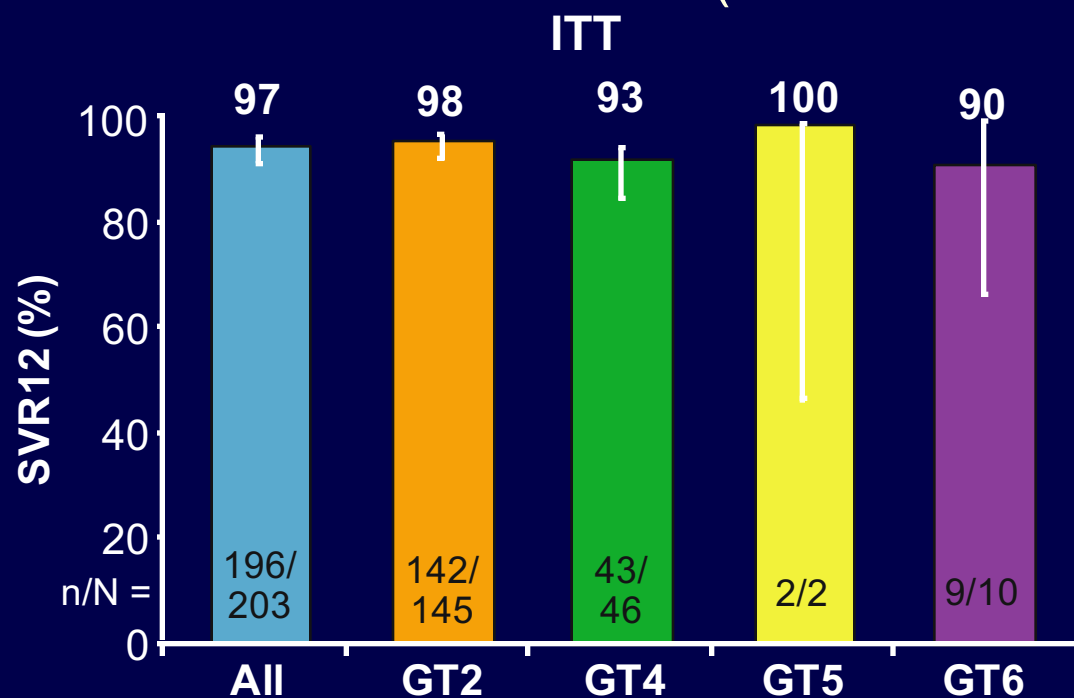
1. Zeuzem S, et al. AASLD 2016. Abstract 253. 2. Kowdley KV, et al. AASLD 2016. Abstract 73. 3. Asselah T, et al. AASLD 2016. Abstract 114.



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SURVEYOR 2, Part 4: 8 Wks GLE/PIB For Pts With GT 2, 4, 5, 6 HCV Without Cirrhosis

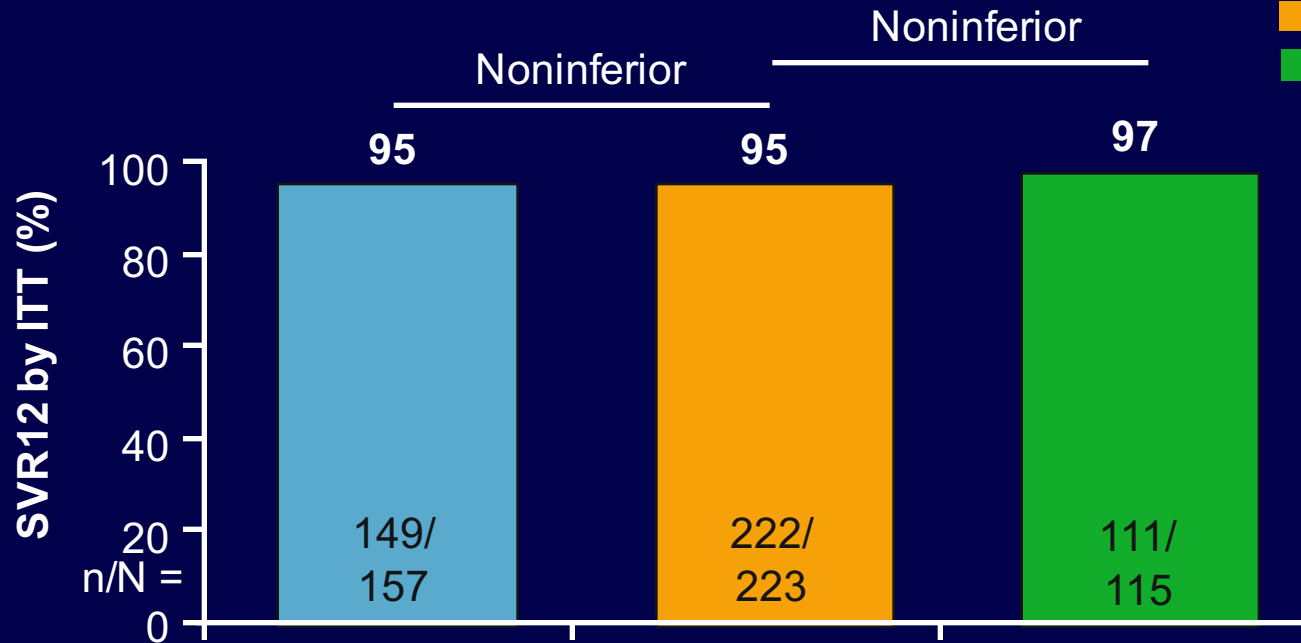
- 99% SVR12 rate with 8-wk regimen in DAA-naive pts with GT2 HCV – noninferior to 95% historical control (SOF + RBV for 12 wks)



Relapse	2	2	0	0	0
D/C	2	1	1	0	0
No SVR12 data	3	0	2	0	1

ENDURANCE-3: Glecaprevir/Pibrentasvir in GT3 HCV Without Cirrhosis

- Most pts had history of IDU (63% to 66%)



- 8-wk GLE/PIB
- 12-wk GLE/PIB
- 12-wk DCV + SOF

Failure, n (%)	8-wk GLE/PIB	12-wk GLE/PIB	12-wk DCV + SOF
Breakthrough	1 (1)	1 (< 1)	0
Relapse	5 (3)	3 (1)	1 (1)
AE-related d/c	0	1 (< 1)	1 (1)
LTFU	2 (1)	4 (2)*	2 (2)

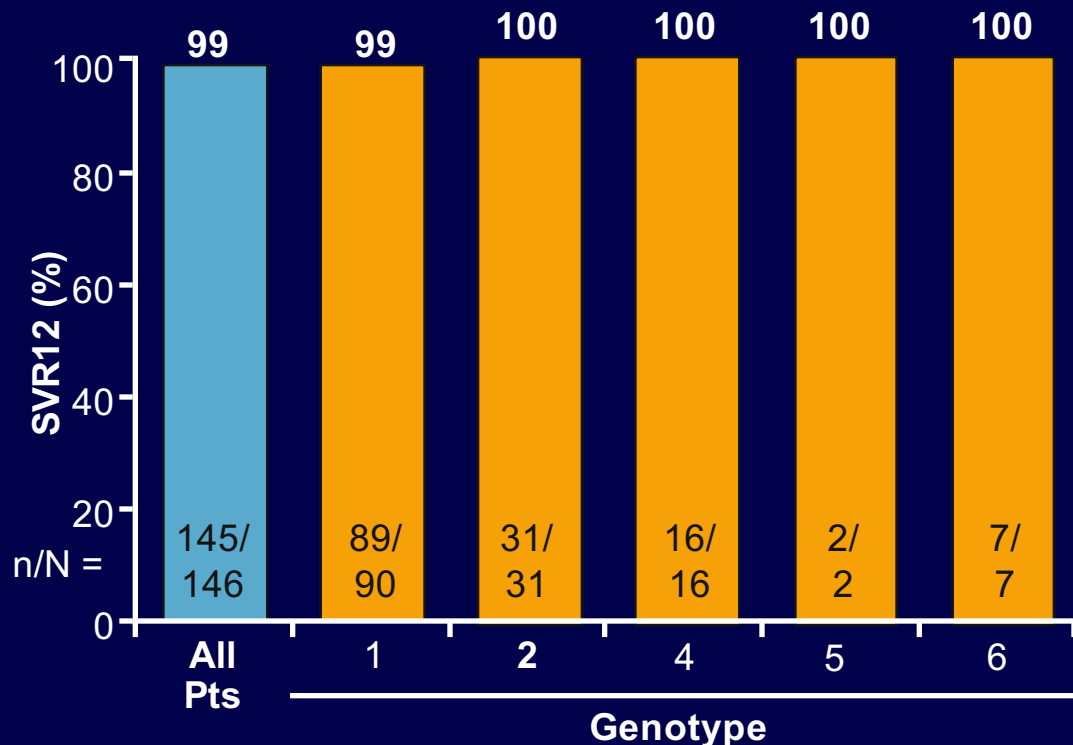
- No serious AEs deemed related to study drug
- No clinically relevant ALT increases, 1 isolated bilirubin increase (G/P 8 wks), 1 isolated neutrophil count decrease (G/P 12 wks)

*2 other failures due to consent withdrawal and noncompliance.



EXPEDITION-1: Glecaprevir/Pibrentasvir in GT1, 2, 4, 5, or 6 HCV and Compensated Cirrhosis

- Tx-naive and tx-exp'd pts enrolled^[1,2]
 - 1 relapse in pt with GT1a HCV with new NS5A mutations (Q30R, H58D)



- No AE-related discontinuations or DAA-related serious AEs^[1,2]
 - 1 death deemed unrelated to study drug
- Rare grade 3 laboratory abnormalities

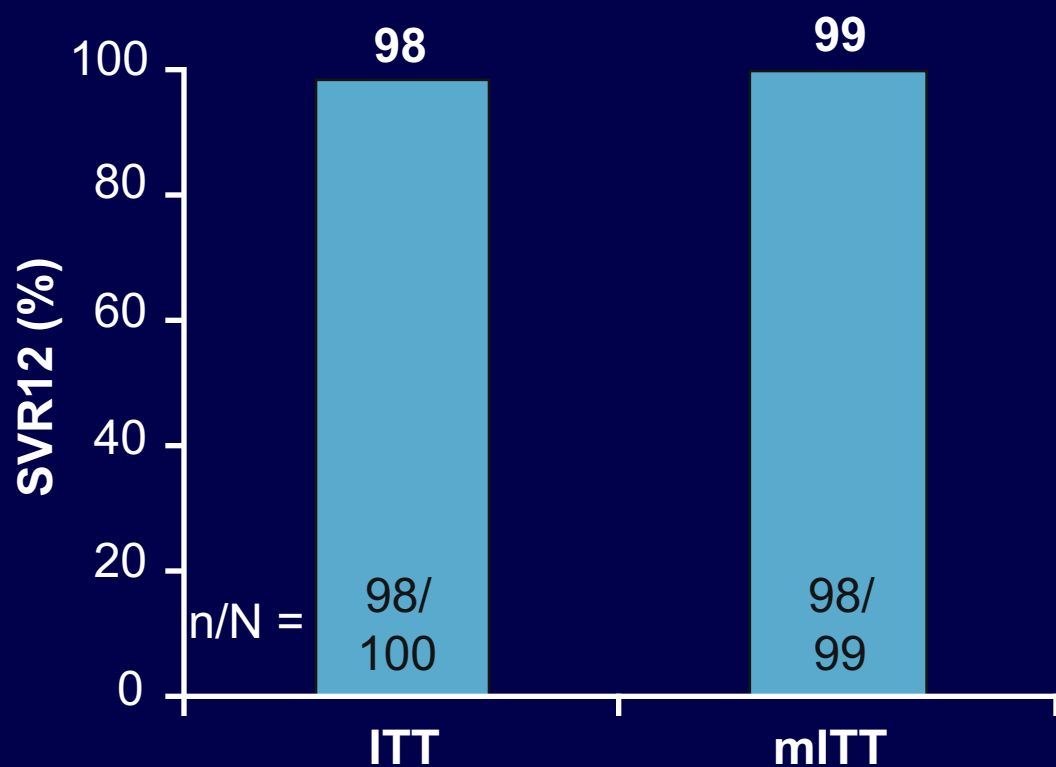
AE, ^[1,2] n (%)	Pts (N = 146)
Any AE	101 (69)
Any serious AE	11 (8)
AEs occurring in ≥ 10% of pts	
▪ Fatigue	28 (19)
▪ Headache	20 (14)
▪ Pruritus	14 (10)
HCC	2 (1)

- In EXPEDITION-2,^[3] 98% SVR12 rate with GLE/PIB for 8 or 12 wks (without vs with cirrhosis) in HCV/HIV-coinfected pts

1. Forns X, et al. EASL 2017. Abstract GS-006. 2. ClinicalTrials.gov. NCT02642432.
 3. Rockstroh J, et al. EASL 2017. Abstract LBP-522.

MAGELLAN-2: Glecaprevir/Pibrentasvir for 12 Wks in GT1-6 HCV With Liver or Renal Transplant

- Liver/kidney transplant: 80%/20%
- 1 relapse in pt with GT3a HCV; 1 pt LTFU

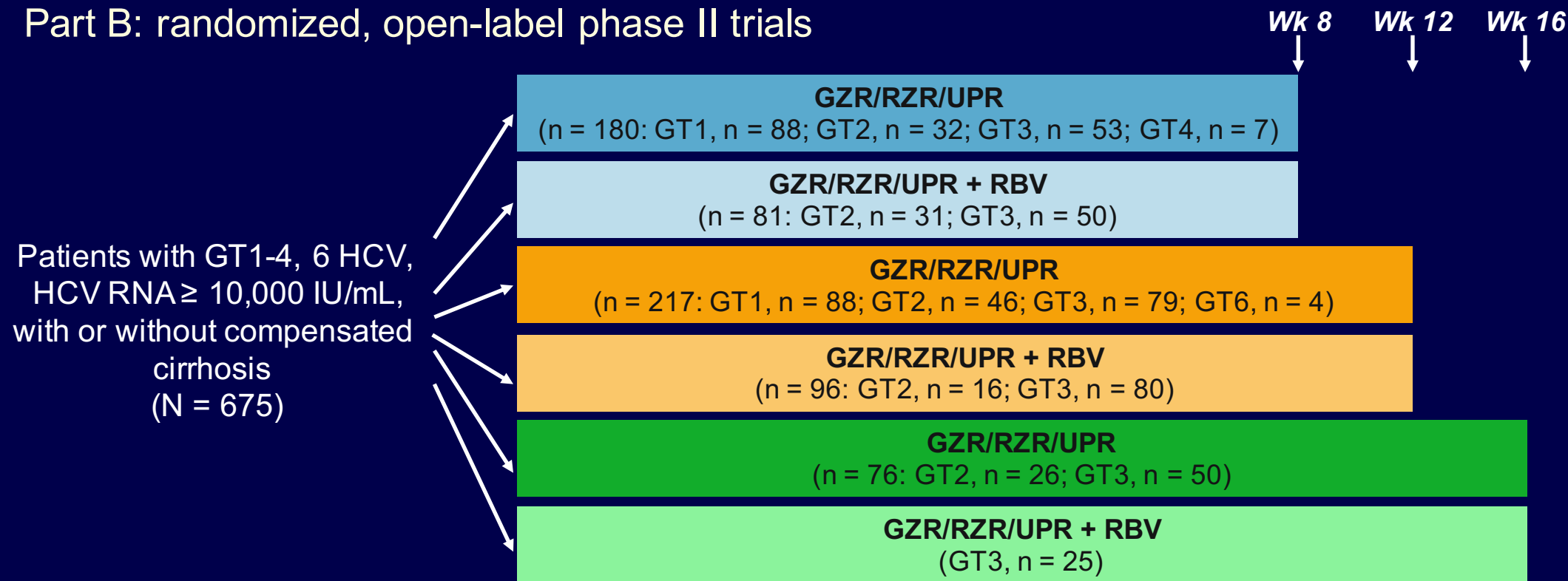


- No deaths during study, 1 pt with transplant rejection (unrelated to DAA)

Outcome, %	GLE/PIB (N = 100)
Any AE	85
Serious AE	8
▪DAA related	2
D/c for AE	1
▪DAA related	0
AEs in ≥ 10% of pts	
▪Headache	22
▪Fatigue	22
▪Nausea	12
▪Pruritus	12
Grade ≥ 3 abnormality	
▪AST	0
▪ALT	1
▪Total bilirubin	1
▪CrCl	2

C-CREST 1 & 2: GZR/RZR/UPR ± RBV for Treating Pts With GT1-4, 6 HCV

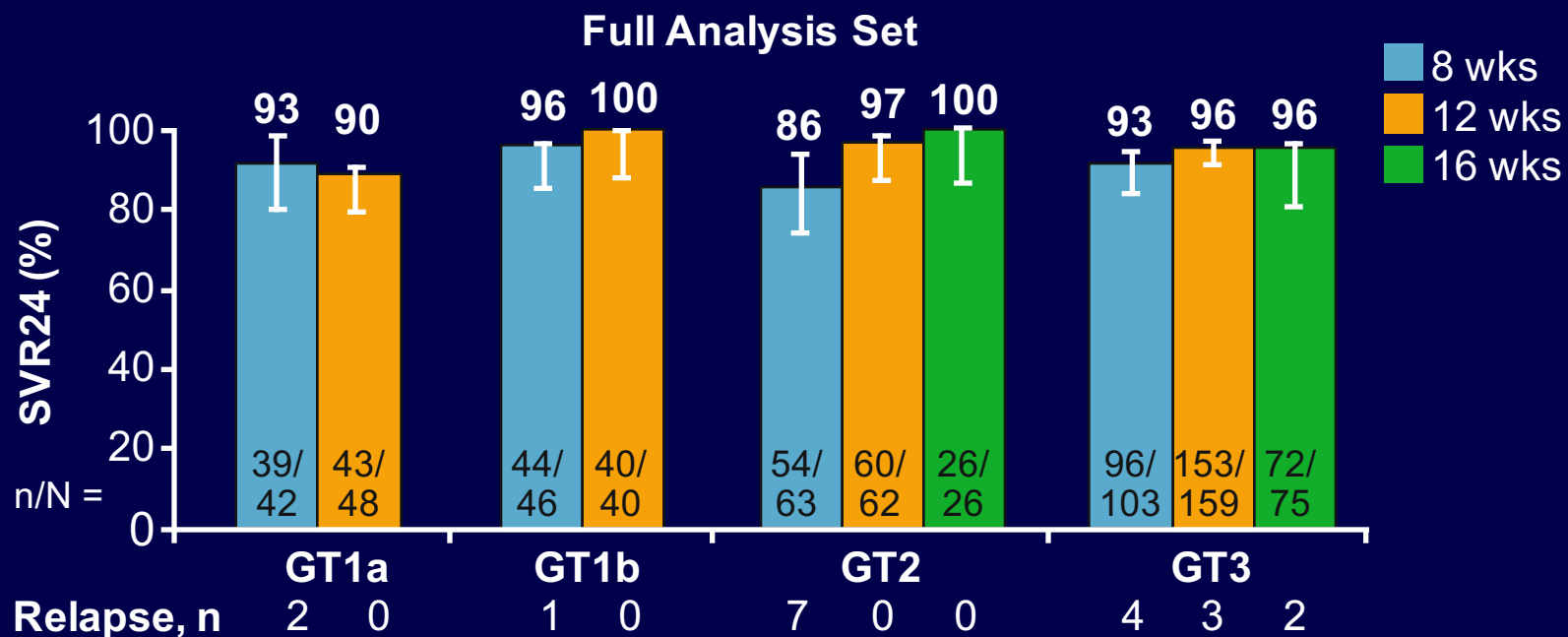
- Part B: randomized, open-label phase II trials



Dosing: GZR/RZR/UPR dosed as two 50/30/225-mg tablets QD. Pts with GT3 HCV could be treatment naive or have failed on pegIFN/RBV; all others treatment naive. Cirrhosis definition in notes.

- Baseline: 35% to 43% cirrhotic; 44% of GT3 pts had prior pegIFN/RBV

C-CREST 1 & 2: Efficacy of GZR/RZR/UPR ± RBV for Pts With GT1-4, 6 HCV



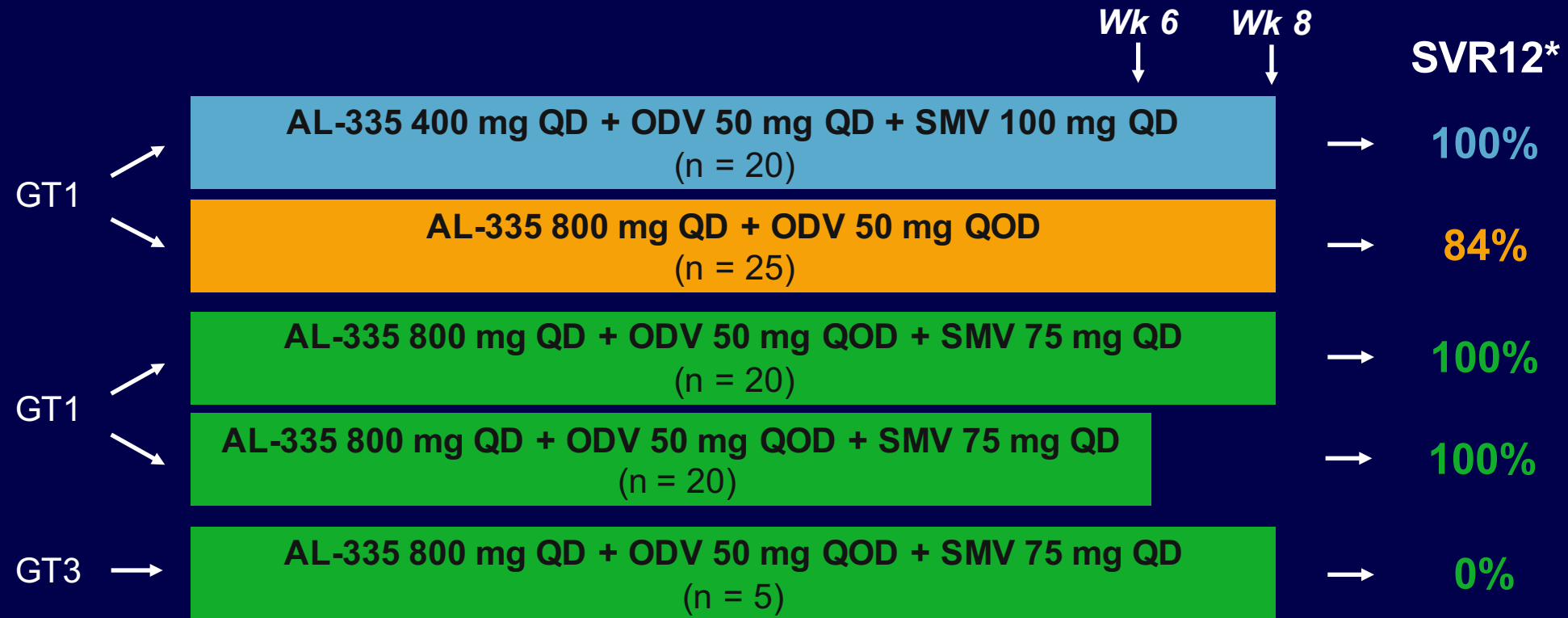
100% SVR12 rates in 7 pts with GT4 (treated for 8 wks) and 4 pts with GT6 (treated for 12 wks) HCV infection

- Presence of cirrhosis, use of ribavirin, prior tx experience did not impact SVR12 rates

SVR12 by Baseline RAS Presence, % (n/N)	GT2 HCV		GT3 HCV	
	No L31M	L31M	No Y93H	Y93H
8 wks	94 (31/33)	81 (21/26)	98 (95/97)	50 (2/4)
12 wks	100 (28/28)	100 (31/31)	99 (147/148)	71 (5/7)

AL-335 + ODV ± SMV for ≤ 12 Wks in Treatment-Naive Pts With GT1/3 HCV ± Cirrhosis

- Randomized, open-label phase IIa trial; treatment-naive patients with GT1/3 HCV infection with or without cirrhosis



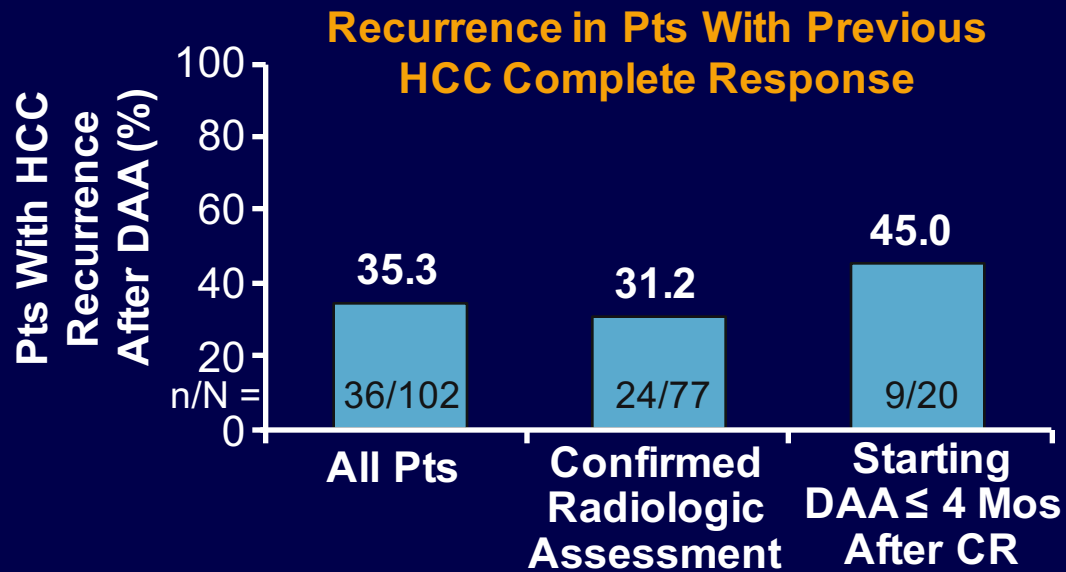
*All pts with SVR12 also achieved SVR24.

Do DAAs Increase the Risk of de Novo or Recurrent HCC?



High Rate of HCC Recurrence With DAAs

- Retrospective study of pts with history of HCC before starting DAA



- 10 pts had second HCC recurrence or progression

- Among pts starting DAAs ≤ 4 mos after CR, 4 pts (20%) died
 - Deaths occurred in Mos 9, 10, 15, 16 after starting DAA

Endpoint	Pts With Recurrence (n = 24)*
Median time from DAA start to first recurrence, mos (IQR)	3.5 (2-7.6)
Median time from first to second recurrence/progression, mos (IQR)	6.0 (3.2-8.2)
<ul style="list-style-type: none"> Within 6 mos of first recurrence, n/n (%) Death, n (%) 	6/20 (30) 5 (20.8)

*Pts from cohort with confirmed radiologic assessment, no confounding factors.



HCC Occurrence or Recurrence Equivalent in Pts With SVR to DAAs vs IFN

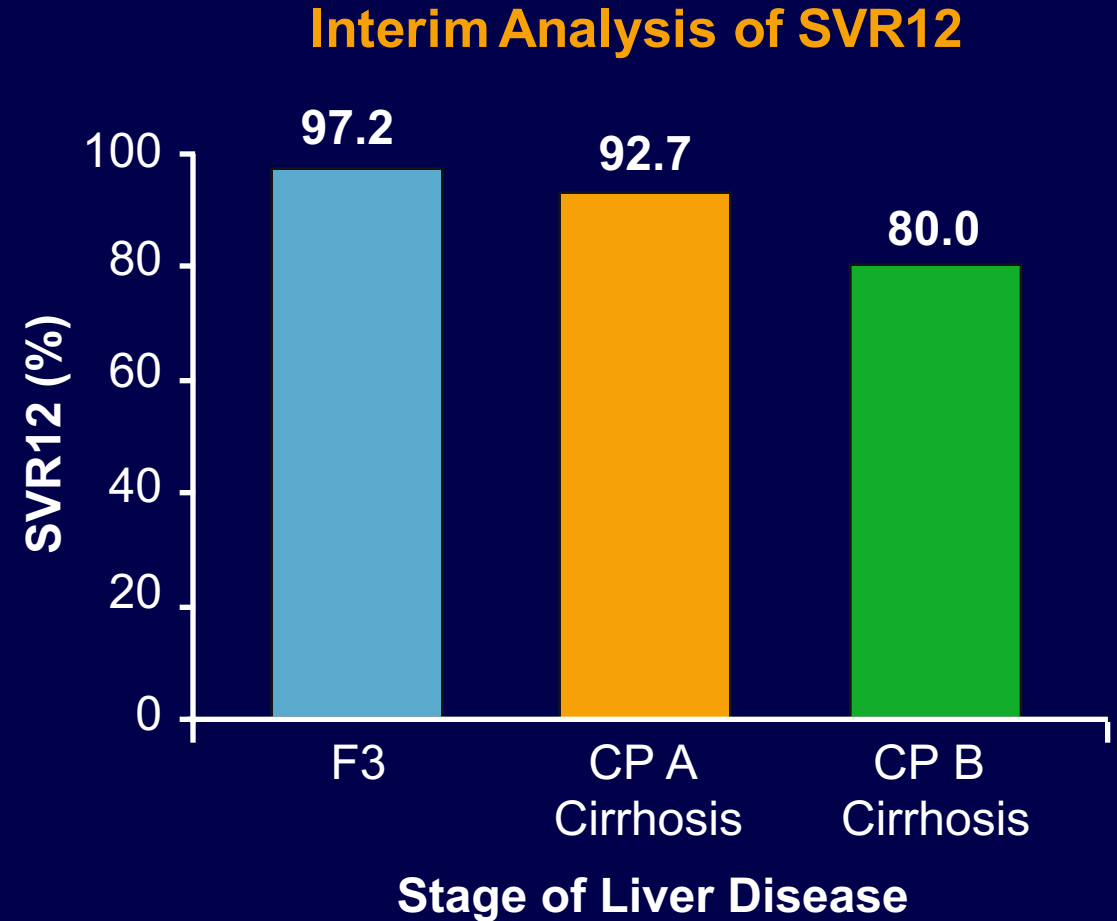
- Meta-analysis and meta-regression analysis of 41 studies (N = 13,875)
 - HCC occurrence in cirrhotic pts who achieved SVR with DAAs or IFN
 - HCC recurrence in pts who had had curative treatment for liver cancer

HCC and Risk Factor	Adjusted RR (95% CI)	P Value
HCC occurrence		
▪ Average follow-up	0.77 (0.62-0.97)	.03
▪ Average age	1.06 (0.99-1.14)	.08
▪ Treatment (DAA vs IFN)	0.75 (0.22-2.52)	.62
HCC recurrence		
▪ Average follow-up	0.79 (0.55-1.15)	.19
▪ Average age	1.11 (0.96-1.27)	.14
▪ Treatment (DAA vs IFN)	0.62 (0.11-3.45)	.56



De Novo HCC in HCV-Infected Pts Treated With Oral DAAs

- Italian pts with HCV and advanced liver disease treated with DAAs and monitored January 2015 - June 2016
 - N = 3075
- Mean follow-up after starting DAA therapy: 300.8 days
 - 41 pts developed HCC
- HCC incidence analyzed by multivariate Cox regression (forward stepwise selection)



De Novo HCC in HCV-Infected Pts Treated With Oral DAAs

Subgroup	HCC Incidence in Cirrhotic Pts, % per Pt-Yr	P Value
Child-Pugh score A/B	1.64/2.92	.58
DAA regimen		
▪SOF + RBV	3.32	
▪LDV/SOF ± RBV	1.45	.90
▪SMV + SOF ± RBV	1.35	
▪DCV + SOF ± RBV	1.12	
▪OBV/PTV/RTV + DSV ± RBV	1.88	
APRI score < 2.5/≥ 2.5	1.52/3.27	.02
SVR12 no/yes	8.38/1.55	.001

De Novo HCC in HCV-Infected Pts Treated With Oral DAAs

Subgroup	HCC Incidence in Cirrhotic Pts, % per Pt-Yr	P Value
Child-Pugh score A/B	1.64/2.92	.58
DAA regimen		
<p>Cirrhotic pts with HCV treated with DAAs are not at increased risk of developing HCC compared with untreated pts</p>		
▪OBV/PTV/RTV + DSV ± RBV	1.88	
APRI score < 2.5/≥ 2.5	1.52/3.27	.02
SVR12 no/yes	8.38/1.55	.001

HBV Reactivation During HCV DAA Therapy



HBV Reactivation in Pts Receiving HCV DAAs

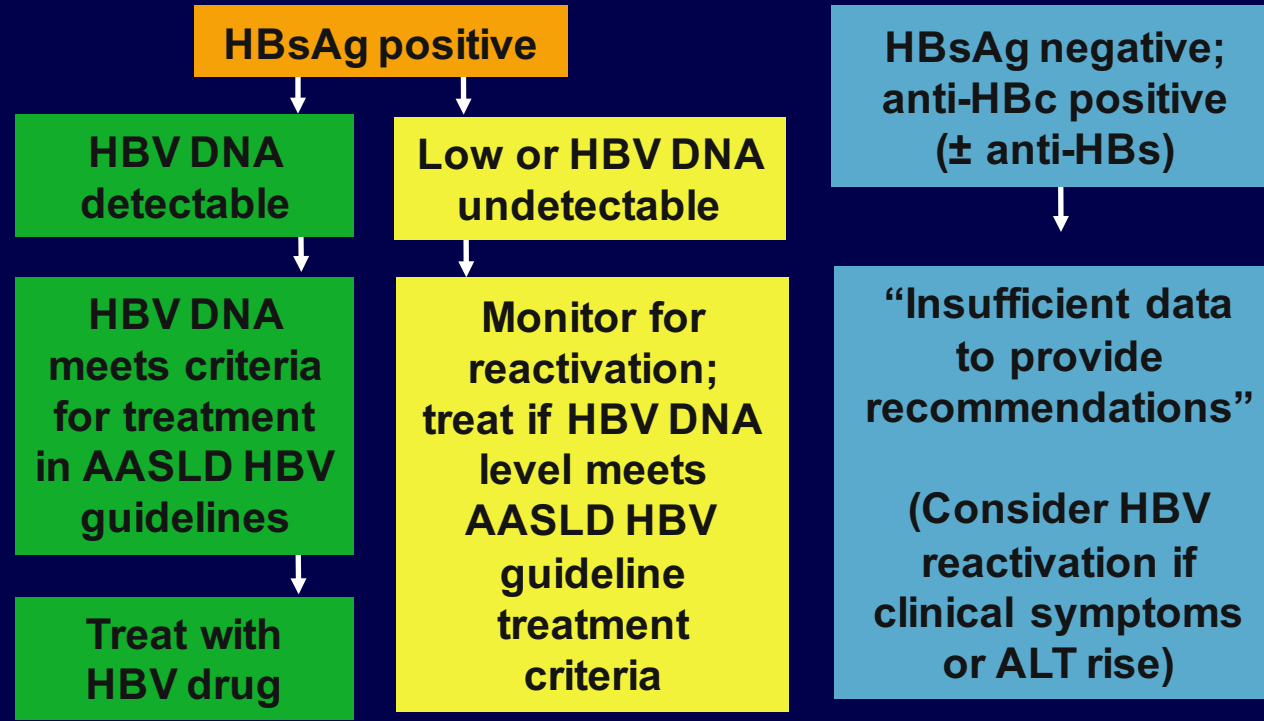
- Case reports of HBV reactivation in pts treated with SMV + SOF ± RBV,^[1,2] DCV + ASV,^[3,4] and LDV/SOF^[5]
 - Possibly due to loss of host immune response to HBV^[6]
- 29 confirmed cases of HBV reactivation in HCV DAA recipients in ~ 3 yrs (November 2013 to October 2016)^[7]
 - Most cases occurred within 4-8 wks of HCV DAA initiation
- **October 2016 FDA issued boxed warning**

1. Collins JM, et al. Clin Infect Dis. 2015;61:1304-1306. 2. Ende AR, et al. J Med Case Rep. 2015;9:164. 3. Hayashi K, et al. Clin J Gastroenterol. 2016;9:252-256. 4. Takayama H, et al. Hepatol Res. 2016;46:489-491. 5. De Monte A, et al. J Clin Virol. 2016;78:27-30. 6. Balagopal A, et al. Clin Infect Dis. 2015;61:1307-1309. 7. Bersoff-Matcha SJ, et al. AASLD 2016. Abstract LB-17.



HBV Testing/Monitoring During HCV DAA Therapy

- Test all pts initiating HCV therapy for HBsAg, anti-HBc, and anti-HBs
 - Vaccinate if no HBV markers; follow flow chart below if HBV markers present



Conclusions

- Multiple current regimens highly effective and safe across genotypes; confirmed in “real-world” studies
- GLE/PIB appears poised to be an 8-wk pangenotypic regimen for DAA-naive noncirrhotic pts
- Short duration SOF/VEL/VOX not superior to current regimens for DAA-naive pts; likely to find niche in pts with previous DAA failure
- GZR/RZR/UPR a promising pangenotypic regimen; phase III trial results awaited
- Controversy persists re: HCC recurrence after DAA-induced SVR
- Little evidence for spike in de novo HCC after SVR
- HBV reactivation very rare in anti-HBc–positive pts; precautions in HBsAg-positive pts especially with HBV viremia

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