Immunotherapy and Targeted Therapy in Melanoma

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CMO, Cancer Expert Now

Overview of Options: Metastatic

- Immunotherapy (All patients)
  - Single agent
    - Anti-PD1 (pembrolizumab or nivolumab)
  - Combination
    - Anti-PD1/anti-CTLA4 (ipilimumab, nivolumab)
    - Anti-PD1/ anti-LAG3 (nivolumab, relatlimab)
- Targeted therapy (BRAF+ patients)
  - BRAF/MEK combo (3 available regimens)
- Triple therapy (BRAF+ patients)
  - BRAF/MEK + anti-PD1 (vemurafenib, cobimetinib + atezolizumab

Overview of Options
Adjuvant Therapy

- Immunotherapy (All patients)
  - Anti-PD1
    - Pembrolizumab or nivolumab)
- Targeted therapy (BRAF+ patients)
  - BRAF/MEK combo
    - Dabrafenib/trametinib

Overview of Options: Metastatic

- Immunotherapy (All patients)
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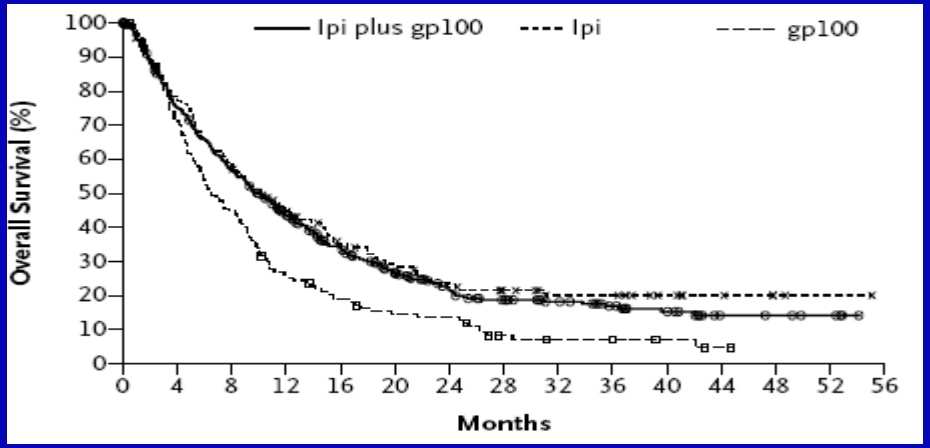
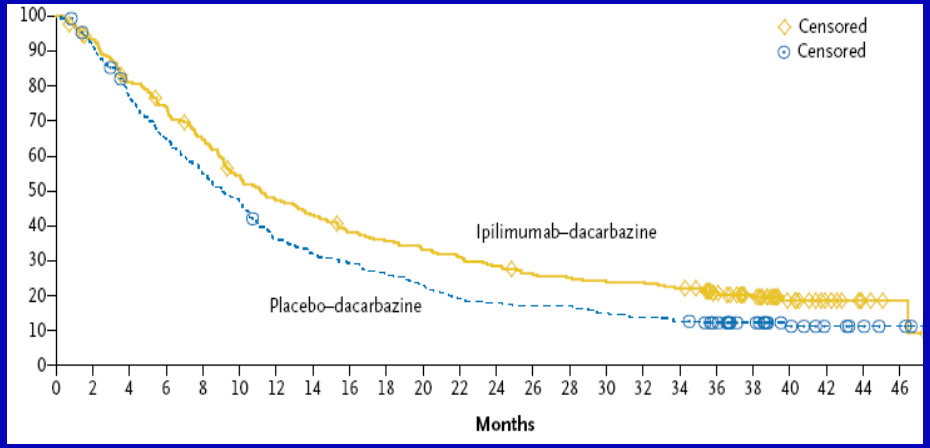
Anti-CTLA4 Ipilimumab Changed the Landscape



HR: 0.66 and 0.68
Pre-treated pts
Ipi 3 mg/kg +/- gp100

Hodi FS, et al. *N Engl J Med.* 2010;363:711-23.



HR: 0.72
First line
Ipi 10 mg/kg + DTIC

Robert C, et al. *N Engl J Med*. 2011;364:2517-26.

Ipilimumab became the standard of care for advanced melanoma in 2011

But could we do better?

Keynote-006 Front-line Pembrolizumab vs Ipilimumab

Patients

- Unresectable, stage III or IV melanoma
- ≤1 prior therapy, excluding anti–CTLA-4, PD-1, or PD-L1 agents
- Known *BRAF* status[b]
- ECOG PS 0-1
- No active brain metastases
- No serious autoimmune disease

Stratification factors:
- ECOG PS (0 vs 1)
- Line of therapy (first vs second)
- PD-L1 status (positive[c] vs negative)

R
1:1:1

- Pembrolizumab 10 mg/kg IV Q2W
- Pembrolizumab 10 mg/kg IV Q3W
- Ipilimumab 3 mg/kg IV Q3W x 4 doses

- **Primary end points: PFS and OS**
- **Secondary end points: ORR, duration of response, safety**

[a]Patients enrolled from 83 sites in 16 countries.

[b]Prior anti-BRAF targeted therapy was not required for patients with normal LDH levels and no clinically significant tumor-related symptoms or evidence of rapidly progressing disease.

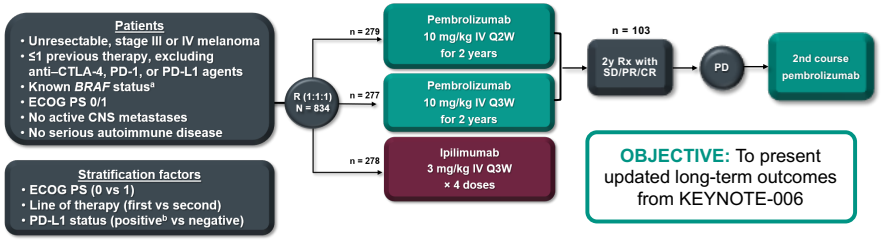
[c]Defined as membranous PD-L1 expression in ≥1% of tumor cells as assessed by IHC using the 22C3 antibody.

Long-Term Survival From Pembrolizumab Completion and Pembrolizumab Retreatment: Phase 3 KEYNOTE-006 in Advanced Melanoma

G. V. Long[1-4], J. Schachter[5], A. Arance[6], J.-J. Grob[7], L. Mortier[8], A. Daud[9], M. S. Carlino[1,2,10,11], A. Ribas[12], C. M. McNeil[2,13], M. Lotem[14], J. Larkin[15], P. Lorigan[16], B. Neyns[17], C. U. Blank[18], T. M. Petrella[19], O. Hamid[20], E. Jensen[21], C. Krepler[21], S. J. Diede[21], C. Robert[22]

ASCO 2020

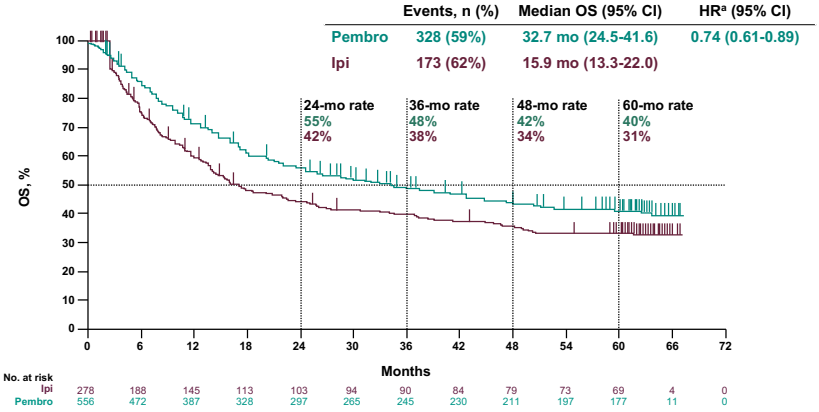
[1]Melanoma Institute Australia, Sydney, NSW, Australia; [2]University of Sydney, Sydney, NSW, Australia; [3]Royal North Shore Hospital, Sydney, NSW, Australia; [4]Mater Hospital, North Sydney, NSW, Australia; [5]Sheba Medical Center, Tel HaShomer Hospital, Tel Aviv, Israel, [6]Hospital Clinic de Barcelona, Barcelona, Spain; [7]Aix Marseille University, Hôpital de la Timone, Marseille, France; [8]Université Lille, Centre Hospitalier Regional Universitaire de Lille, Lille, France; [9]UCSF, San Francisco, CA, USA; [10]Blacktown Hospital, Blacktown, NSW, Australia; [11]Crown Princess Mary Cancer Centre, Westmead Hospital, Sydney, NSW, Australia; [12]David Geffen School of Medicine at UCLA, Los Angeles, CA, USA; [13]Chris O'Brien Lifehouse, Camperdown, NSW, Australia; [14]Sharett Institute of Oncology, Hadassah Hebrew Medical Center, Jerusalem, Israel; [15]Royal Marsden Hospital, London, England; [16]University of Manchester and the Christie NHS Foundation Trust, Manchester, England; [17]Universitair Ziekenhuis Brussel, Brussels, Belgium; [18]Netherlands Cancer Institute, Amsterdam, Netherlands; [19]Sunnybrook Health Sciences Centre, Toronto, ON, Canada; [20]The Angeles Clinic and Research Institute, Los Angeles, CA, USA; [21]Merck & Co., Inc., Kenilworth, NJ, USA; [22]Gustave Roussy and Paris-Sud University, Villejuif, France



- Two pembrolizumab arms pooled as similar efficacy[2]
- Patients completing ≥94 weeks of pembrolizumab with SD/PR/CR were considered to have completed 2 years of treatment
- Patients could receive a 2nd course of 1 year of pembrolizumab if progressed after SD/PR/CR
- Data cut-off: July 31, 2019; median follow-up: 66.8 months (range, 65.0-70.4); time from last patient enrolled to data cutoff, 65.0 months

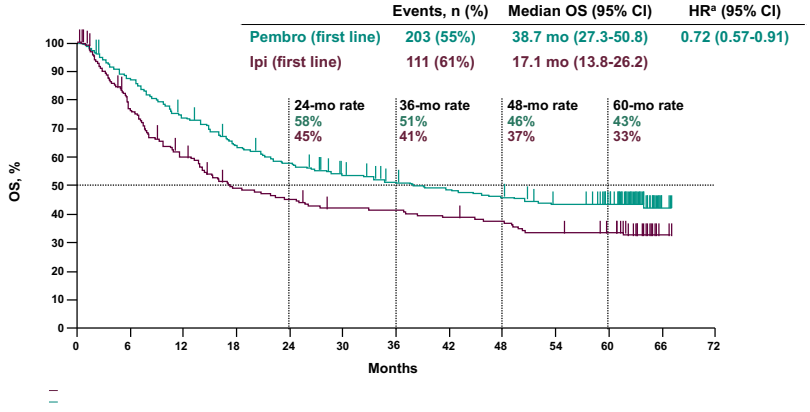
[a]Prior anti-BRAF therapy was not required for patients with normal LDH levels and no clinically significant tumor-related symptoms or evidence of rapidly progressing disease.
[b]Defined as ≥1% staining in tumor and adjacent immune cells as assessed by IHC using 22C3 antibody.

Overall Survival: Total Population



Data cut-off: July 31, 2019. [a]Based on Cox regression model with treatment as a covariate stratified by line of therapy (1st vs 2nd), PD-L1 status (positive vs negative) and ECOG (0 vs 1); in instances where there were no patients in one of the treatment groups involved in a comparison for a particular stratum, that stratum was excluded from the treatment comparison.

Overall Survival: First Line Patients



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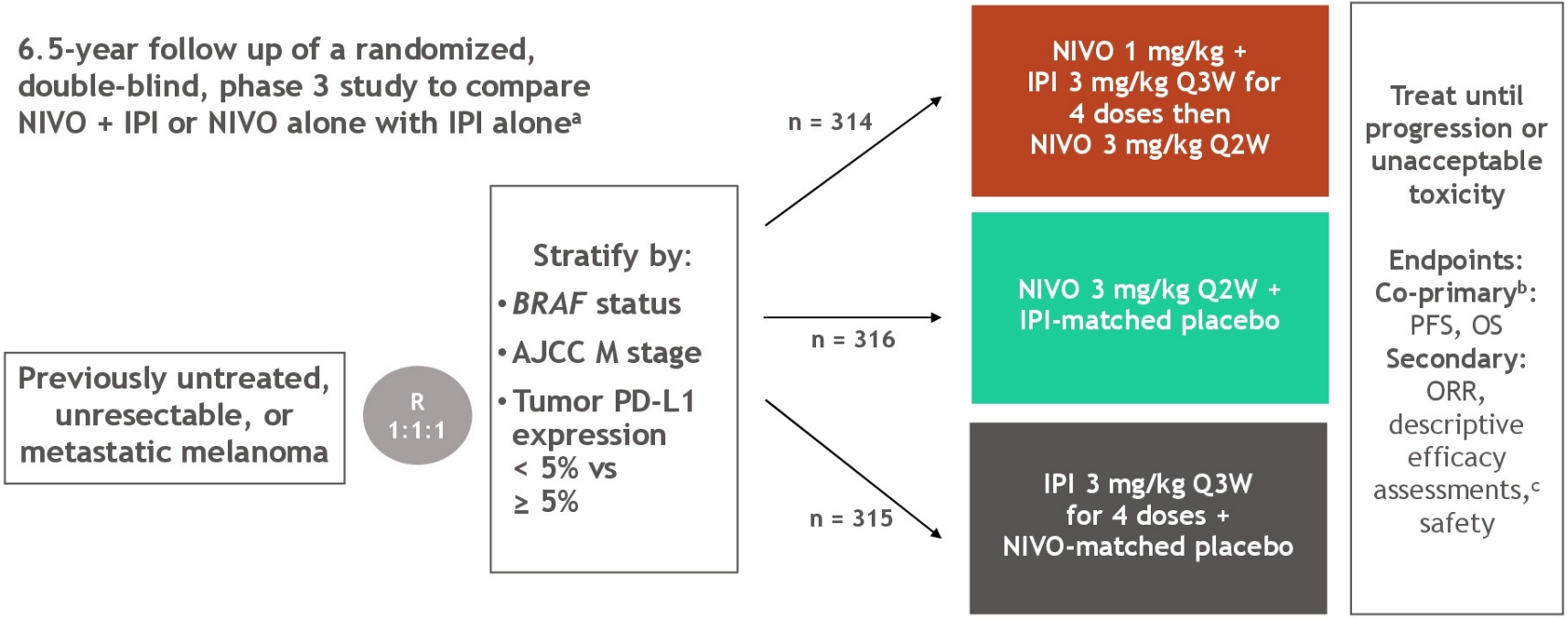
Anti PD-1 is better than ipilimumab and produces durable long-term benefit in about 40% of patients

But what about combining CTLA-4 and PD-1?

CheckMate 067: study design

6.5-year follow up of a randomized, double-blind, phase 3 study to compare NIVO + IPI or NIVO alone with IPI alone[a]

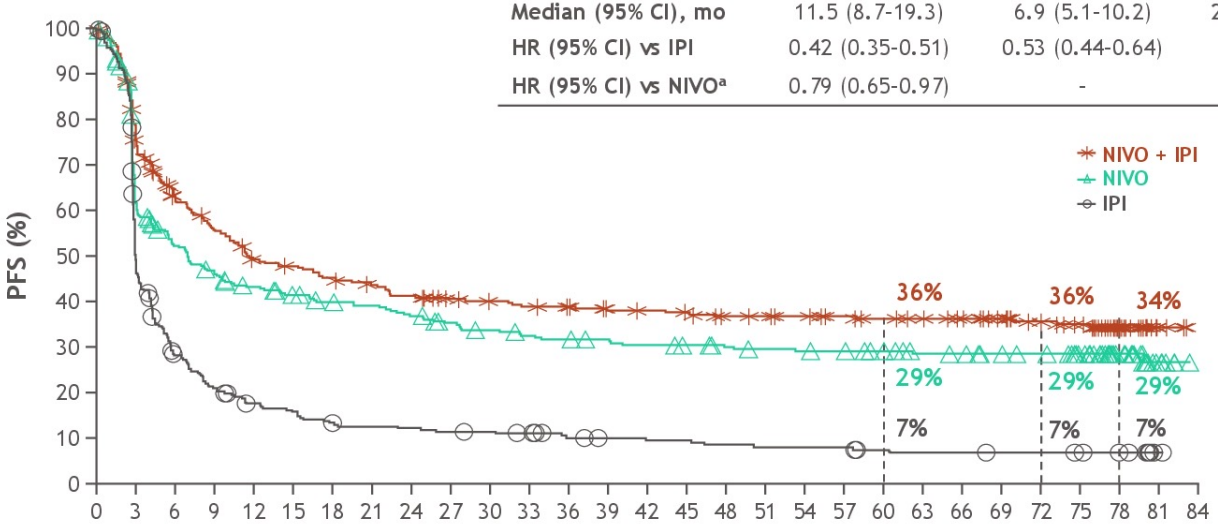


Database lock: October 19, 2020; minimum follow-up of 77 months for all patients

[a]The study was not powered for a comparison between NIVO+IPI and NIVO. [b]NIVO + IPI or NIVO vs IPI alone. [c]NIVO + IPI vs NIVO alone. AJCC, American Joint Committee on Cancer; M stage, metastasis stage; ORR, objective response rate; PD-L1, programmed death ligand 1; PFS, progression-free survival; Q2W, every 2 weeks; Q3W, every 3 weeks.

Progression-free survival

	NIVO + IPI (n = 314)	NIVO (n = 316)	IPI (n = 315)
Median (95% CI), mo	11.5 (8.7-19.3)	6.9 (5.1-10.2)	2.9 (2.8-3.2)
HR (95% CI) vs IPI	0.42 (0.35-0.51)	0.53 (0.44-0.64)	-
HR (95% CI) vs NIVO[a]	0.79 (0.65-0.97)	-	-



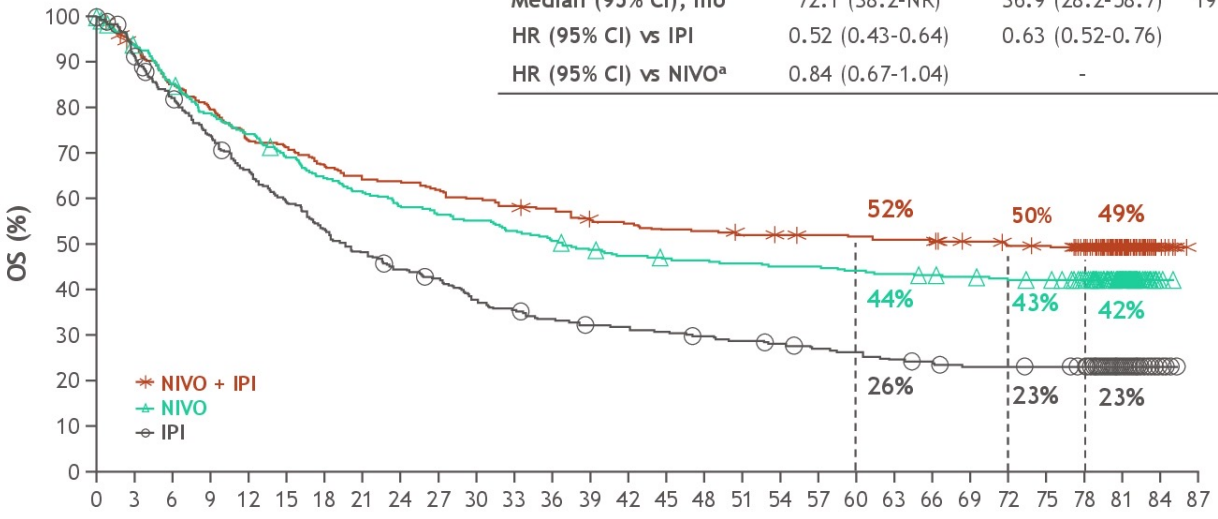
No. at risk

NIVO + IPI	314	218	174	155	136	131	124	117	110	104	101	98	96	92	90	88	83	82	80	77	74	72	69	64	58	52	29	3	0
NIVO	316	177	151	132	120	112	106	103	97	89	84	80	78	76	73	71	68	66	65	64	60	55	54	51	49	42	24	7	0
IPI	315	136	78	58	46	42	34	32	31	29	28	26	21	19	18	18	16	15	15	15	12	11	11	10	10	9	7	1	0

[a]Descriptive analysis.

Overall survival

	NIVO + IPI (n = 314)	NIVO (n = 316)	IPI (n = 315)
Median (95% CI), mo	72.1 (38.2-NR)	36.9 (28.2-58.7)	19.9 (16.8-24.6)
HR (95% CI) vs IPI	0.52 (0.43-0.64)	0.63 (0.52-0.76)	-
HR (95% CI) vs NIVO[a]	0.84 (0.67-1.04)	-	-



No. at risk

NIVO + IPI	314	292	265	248	227	222	210	201	199	193	187	181	179	172	169	164	163	159	158	157	156	154	153	150	147	145	138	66	10	0
NIVO	316	292	266	245	231	214	201	191	181	175	171	164	158	150	145	142	141	139	137	137	134	132	130	128	126	124	117	59	3	0
IPI	315	285	253	227	203	181	163	148	135	128	113	107	100	95	94	91	87	84	81	77	75	70	68	64	64	63	61	32	7	0

[a]Descriptive analysis.

Safety Summary

- With an additional 19 months of follow-up, safety was consistent with the initial report[1]

	NIVO+IPI (N=313)		NIVO (N=313)		IPI (N=311)	
Patients reporting event, %	Any Grade	Grade 3-4	Any Grade	Grade 3-4	Any Grade	Grade 3-4
Treatment-related adverse event (AE)	95.8	58.5	86.3	20.8	86.2	27.7
Treatment-related AE leading to discontinuation	39.6	31.0	11.5	7.7	16.1	14.1
Treatment-related death, n (%)	2 (0.6)[a]		1 (0.3)[b]		1 (0.3)[b]	

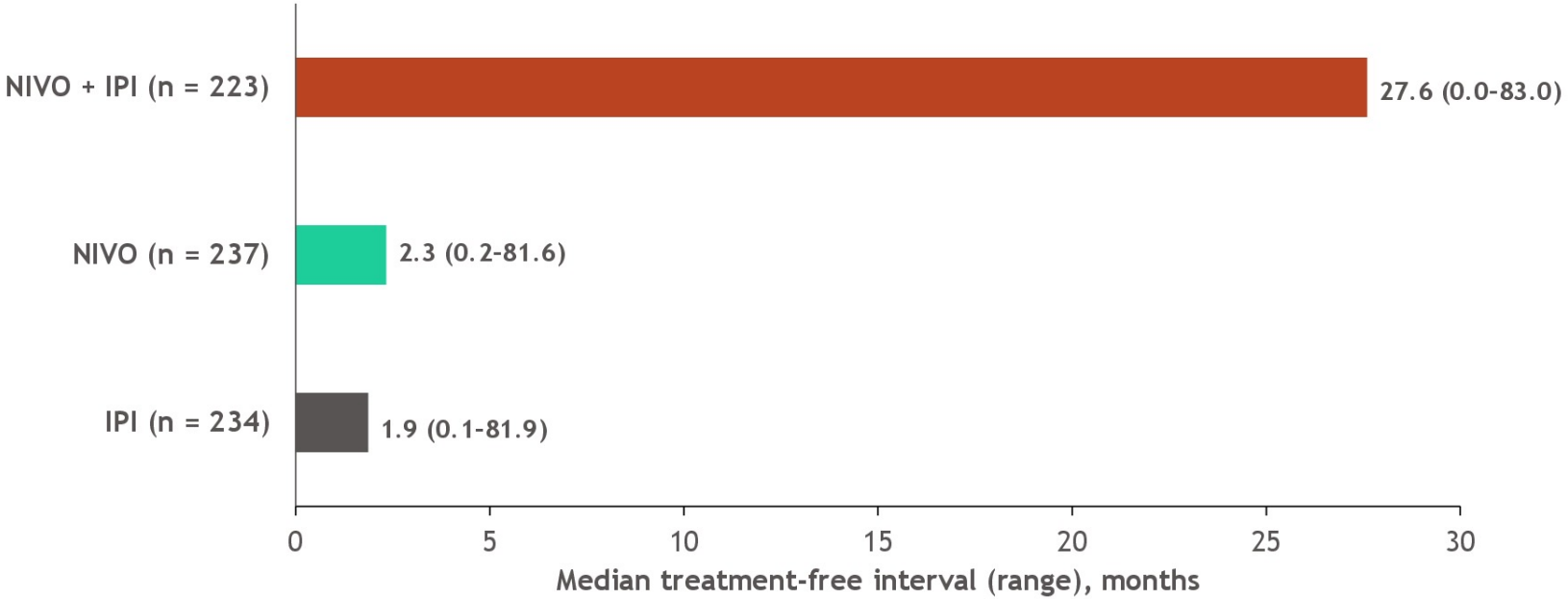
- Most select AEs were managed and resolved within 3-4 weeks (85–100% across organ categories)
- ORR was 70.7% for pts who discontinued NIVO+IPI due to AEs, with median OS not reached

[a]Cardiomyopathy (NIVO+IPI, n=1); Liver necrosis (NIVO+IPI, n=1). Both deaths occurred >100 days after the last treatment.
[b]Neutropenia (NIVO, n=1); colon perforation (IPI, n=1).[1]

1. Larkin J, et al. *NEJM* 2015;373:23–34.

Treatment-free interval following study therapy discontinuation

- Patients analyzed were those who (1) were alive or (2) who died following subsequent systemic therapy

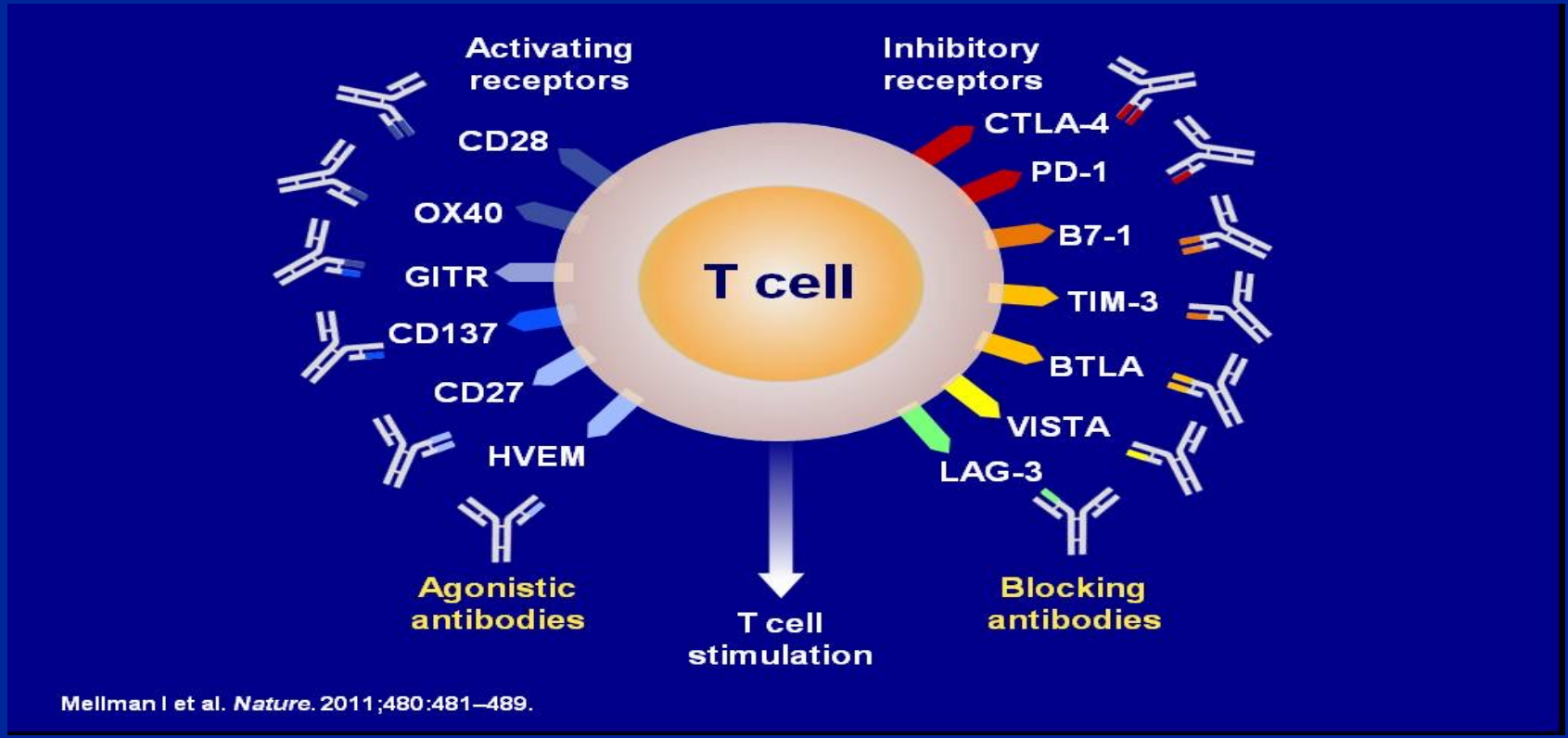


- Median duration of treatment was 3.6 mo (range, 0-80.1) with NIVO + IPI, 8.6 mo (0-79.8) with NIVO, and 3.7 mo (0-49.9) with IPI

Combination anti-CTLA4 and anti-PD1 (ipilimumab + nivolumab) produced durable benefit in about 50% of patients but with significant toxicity

Is there another combination available?

T-Cell Immune Checkpoints



Study design

- RELATIVITY-047 is a global, randomized, double-blind, phase 2/3 study

Key eligibility criteria
- Previously untreated, unresectable, or metastatic melanoma
- ECOG PS 0–1

R 1:1
- NIVO 480 mg + RELA 160 mg FDC IV Q4W
- NIVO 480 mg IV Q4W

Primary endpoint
- PFS by BICR[a]

Secondary endpoints
- OS[b]
- ORR by BICR[c]

Stratified by: LAG-3,[d] PD-L1,[e] *BRAF*, and AJCC v8 M stage
Endpoints were tested in hierarchy: PFS → OS → ORR

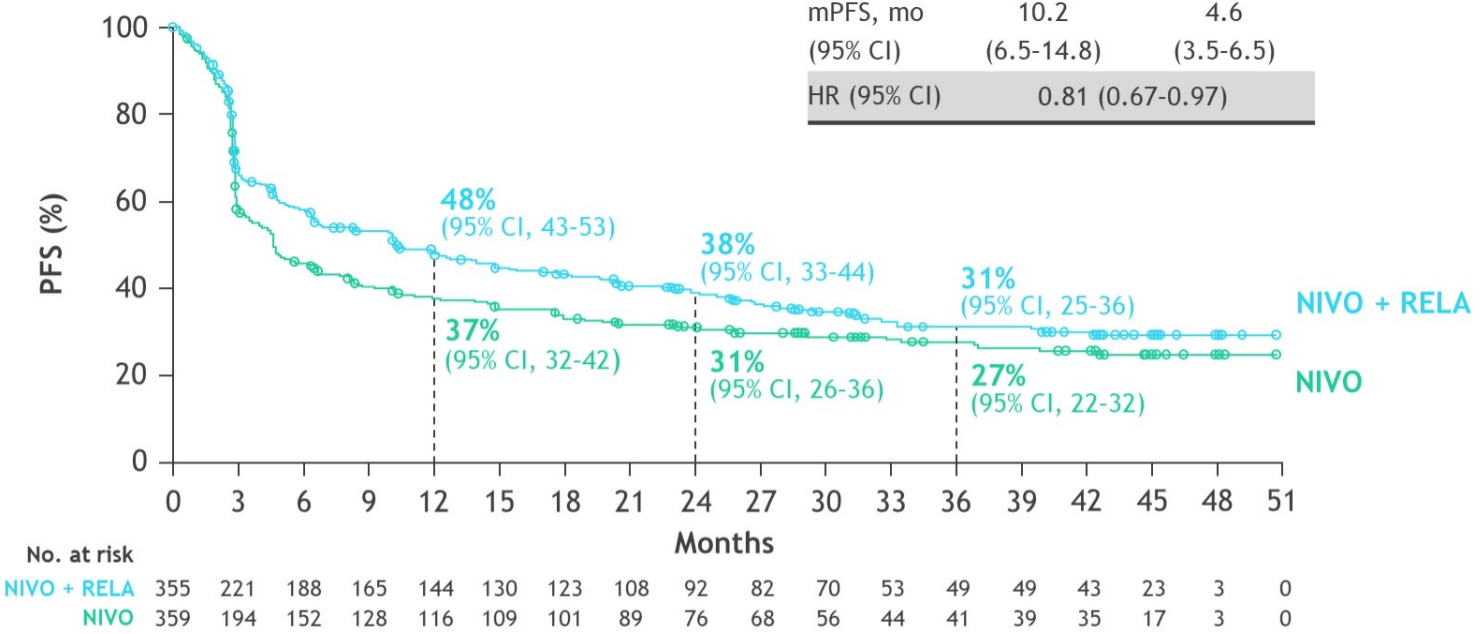
Database lock	March 9, 2021	October 28, 2021	October 27, 2022
Min. follow-up[f]	1.3 months	8.7 months	21.0 months
Median follow-up	13.2 months	19.3 months	25.3 months
Endpoint(s)	PFS per BICR	OS, ORR per BICR, and updated PFS per BICR	Updated PFS per BICR, OS, and ORR per BICR

RELATIVITY-047 (NCT03470922).
[a]First tumor assessment (RECIST v1.1) was performed 12 weeks after randomization, every 8 weeks up to 52 weeks, and then every 12 weeks. [b]OS boundary for statistical significance was $P < 0.04302$ (2-sided) analyzed at 69% power; target HR, 0.75. [c]ORR could not be formally tested and was descriptively analyzed. [d]LAG-3 expression on immune cells (1%) was determined by an analytically validated IHC assay (Labcorp, Burlington, NC, USA). [e]PD-L1 expression on tumor cells (1%) was determined by a validated Agilent Dako PD-L1 IHC 28-8 pharmDx test (Agilent, Santa Clara, CA, USA). [f]Minimum potential follow-up was defined as the time from last patient randomized to last patient, last visit.

PFS by BICR

Updated primary endpoint

	NIVO + RELA (n = 355)	NIVO (n = 359)
mPFS, mo	10.2	4.6
(95% CI)	(6.5-14.8)	(3.5-6.5)
HR (95% CI)	0.81 (0.67-0.97)	

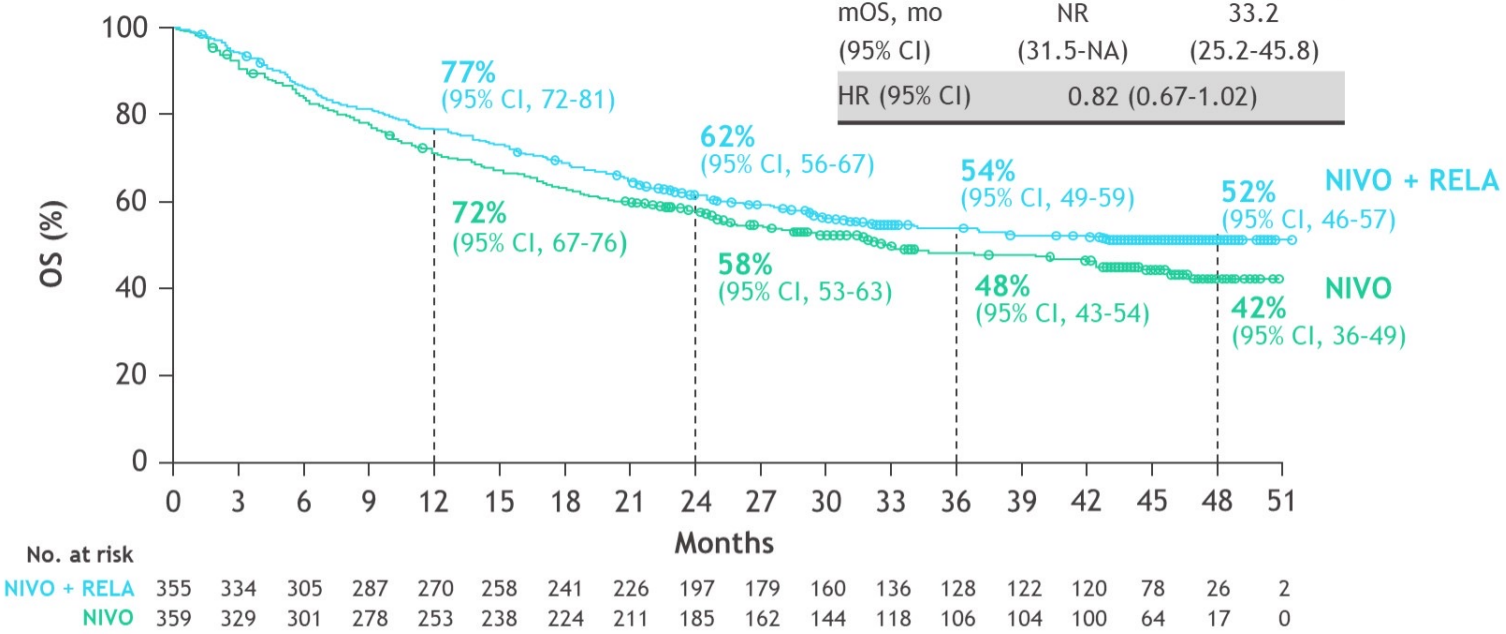


RELATIVITY-047 (NCT03470922). Median follow-up: 25.3 months.
Descriptive analysis. Statistical model for HR: stratified Cox proportional hazard model. Stratified by LAG-3, *BRAF* mutation status, and AJCC M stage. PD-L1 was removed from stratification because it led to subgroups with < 10 patients.

OS

Updated secondary endpoint

	NIVO + RELA (n = 355)	NIVO (n = 359)
mOS, mo	NR	33.2
(95% CI)	(31.5-NA)	(25.2-45.8)
HR (95% CI)	0.82 (0.67-1.02)	



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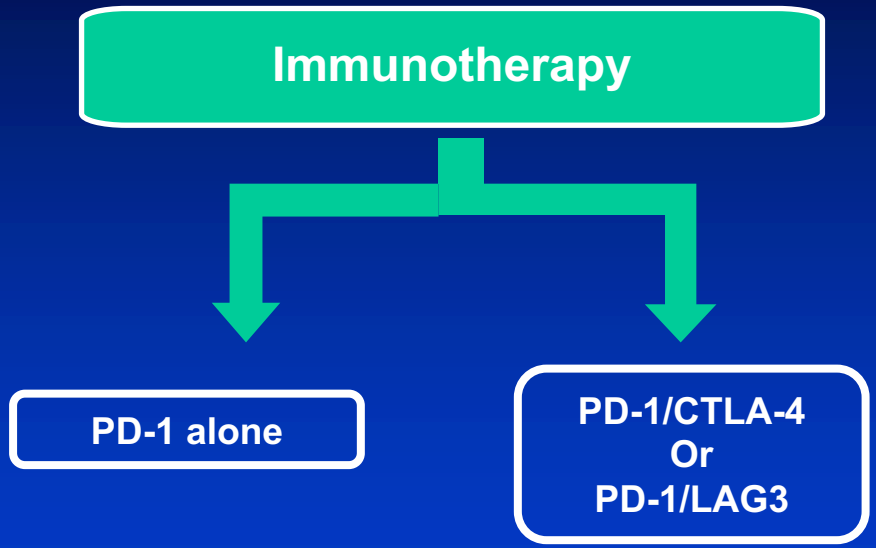
Monotherapy or Combination?



Immunotherapy To Date (1)

- Combination immunotherapy preferred for most patients with metastatic disease
  - Ipi/nivo has a longer track record but more toxic
  - Nivo/rela is better than nivo alone with minimally increased toxicity

Immunotherapy To Date (2)

- Ipi/nivo has not been compared with nivo/rela directly
  - Indirect comparisons are dangerous but early data show similar outcomes
- Monotherapy with anti-PD1 not used much anymore

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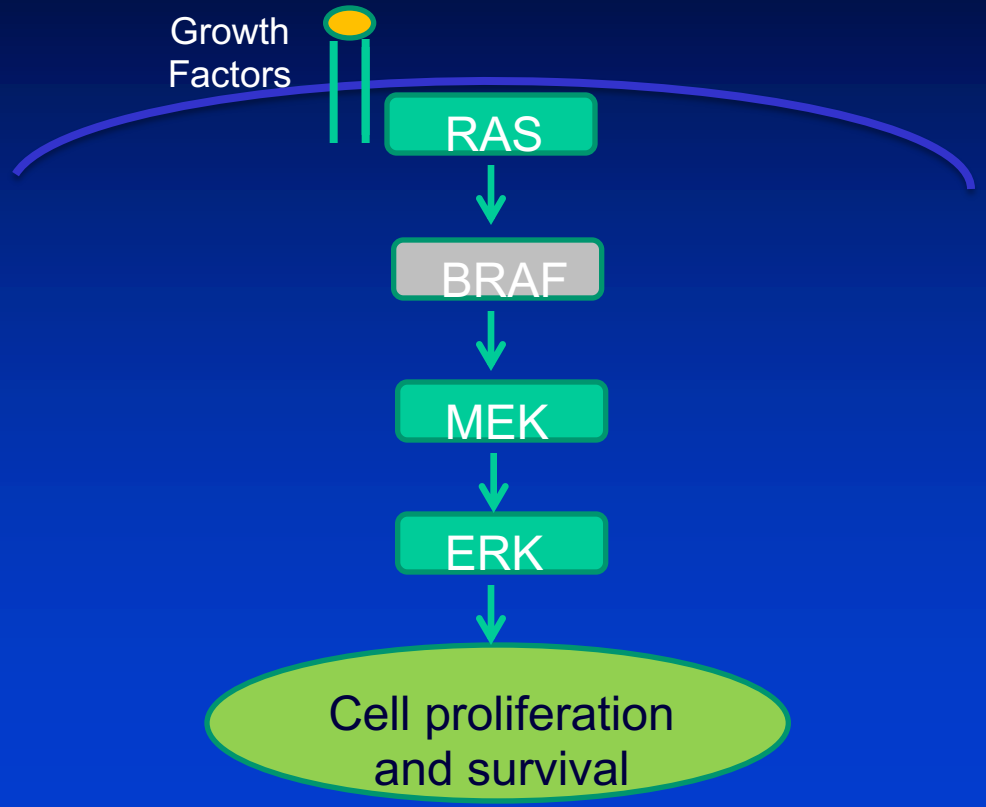
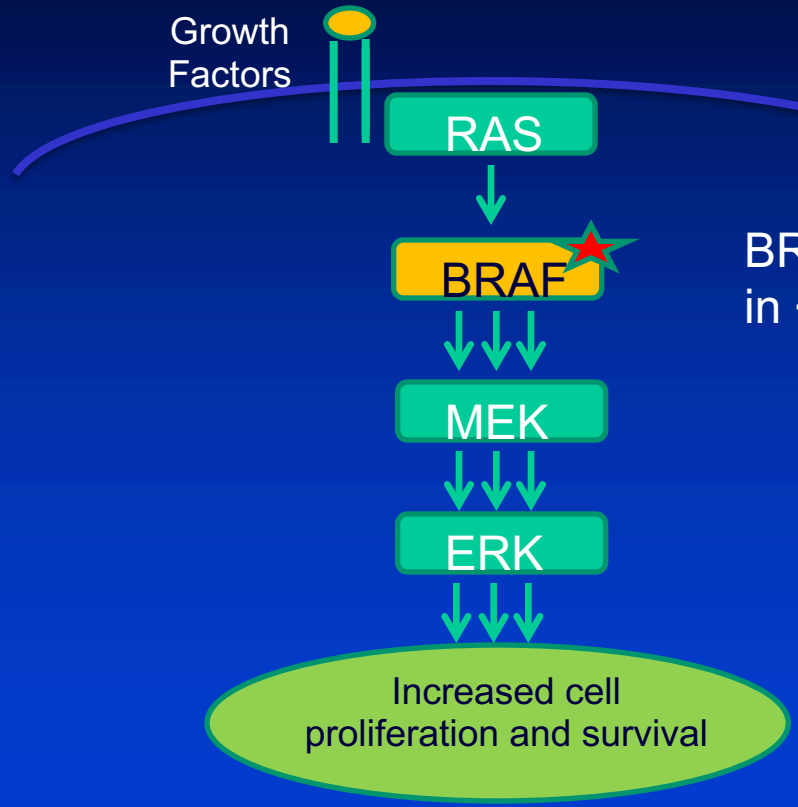
Targeted Therapy: MAPK Pathway

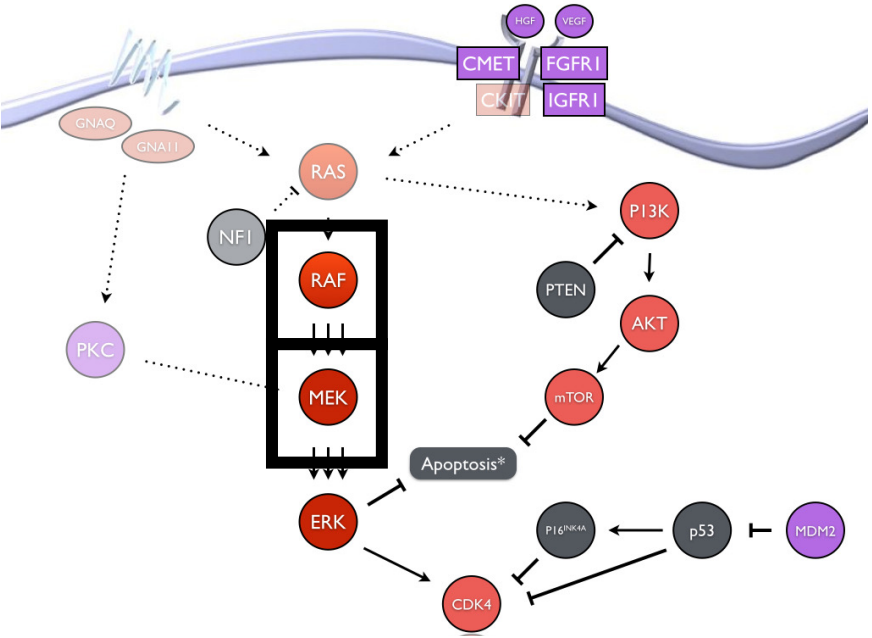


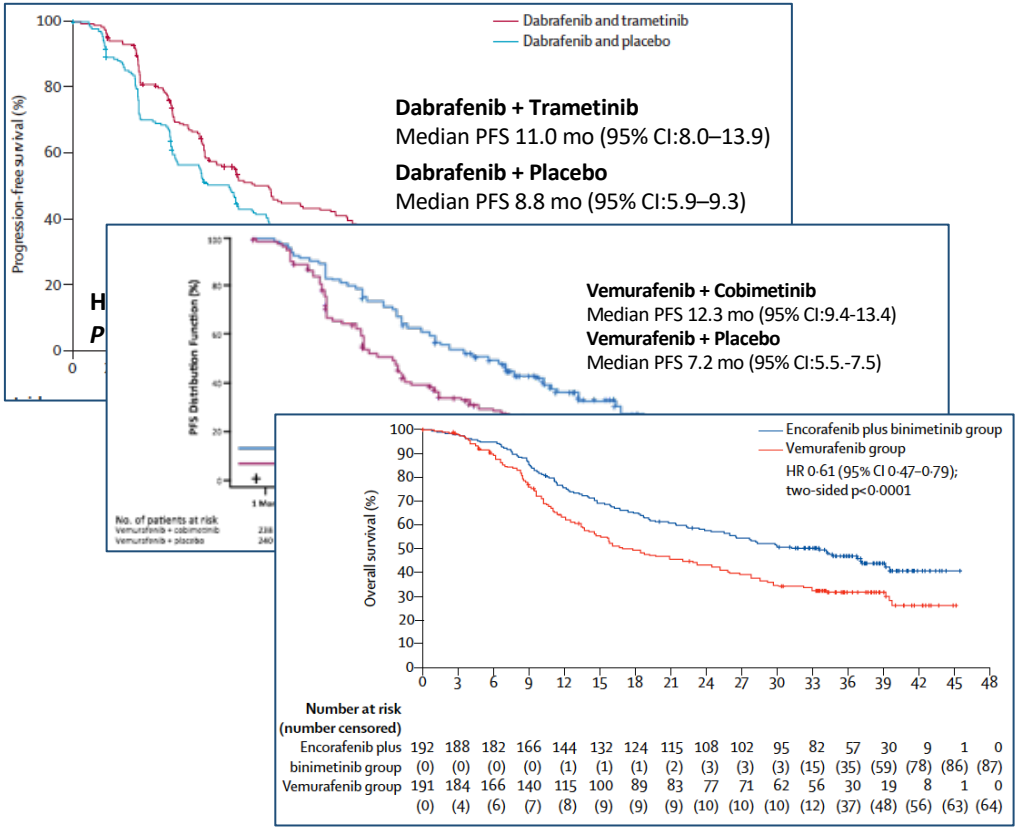
BRAF Mutation



BRAF mutation is present in ~50% of melanomas

Dual BRAF and MEK Inhibition Is Associated With High Response Rates and Improved PFS and OS





Long GV et al. *Lancet*. 2015.
Ascierto PA et al. *Lancet Oncol.* 2016.
Dummer R et al. *Lancet Oncol*. 2018.

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Evaluation of Atezolizumab, Cobimetinib, and Vemurafenib in Previously Untreated Patients With *BRAF*^{V600} Mutation–Positive Advanced Melanoma: Primary Results From the Phase 3 IMspire150 Trial

Grant A. McArthur, M.B., B.S., Ph.D.,[1] Daniil Stroyakovskiy, M.D.,[2] Helen Gogas, M.D., Ph.D.,[3] Caroline Robert, M.D., Ph.D.,[4] Karl Lewis, M.D.,[5] Svetlana Protsenko, M.D.,[6] Rodrigo Pereira, M.D.,[7] Thomas Eigentler, M.D.,[8] Piotr Rutkowski, M.D., Ph.D.,[9] Lev Demidov, M.D.,[10] Georgy Moiseevich Manikhas, M.D.,[11] Yibing Yan,[12] Kuan-Chieh Huang, Ph.D.,[12] Anne Uyei, M.D.,[12] Virginia McNally, Ph.D.,[13] Ralf Gutzmer, M.D.,[14] Paolo Ascierto, M.D.[15]

AACR Annual Meeting 2020

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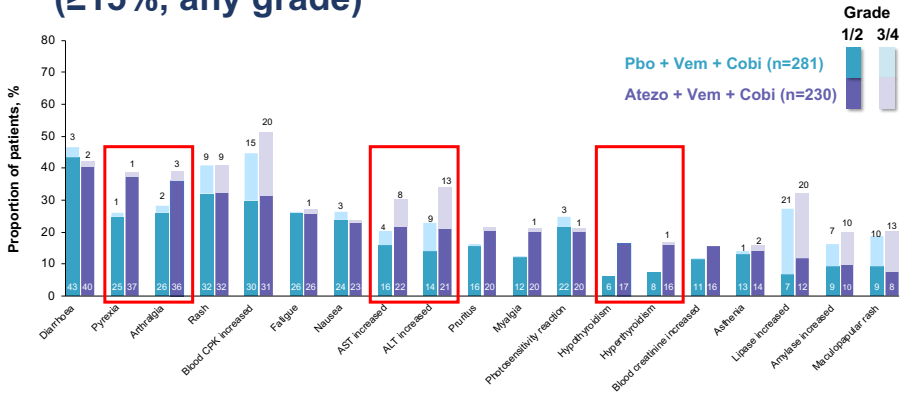
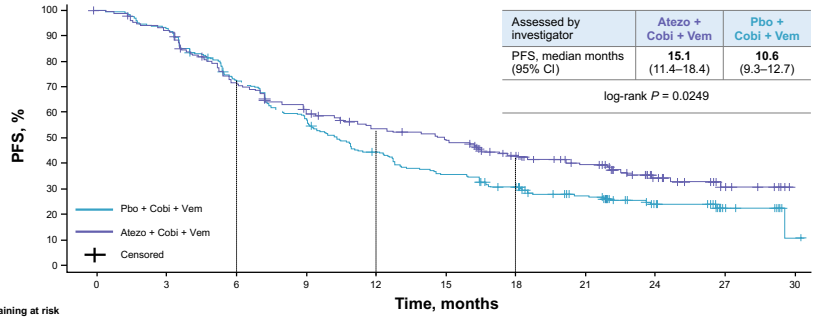
Common Treatment-Related AEs (≥15%, any grade)



AE, adverse event; ALT, alanine aminotransferase; AST, aspartate aminotransferase; CPK, creatine phosphokinase.
Listed AEs were reported at a frequency of ≥15%, along with corresponding frequencies for grade 3/4 events.

IMspire150: Primary Endpoint: Investigator-Assessed PFS



Assessed by investigator	Atezo + Cobi + Vem	Pbo + Cobi + Vem
PFS, median months (95% CI)	**15.1** (11.4–18.4)	**10.6** (9.3–12.7)

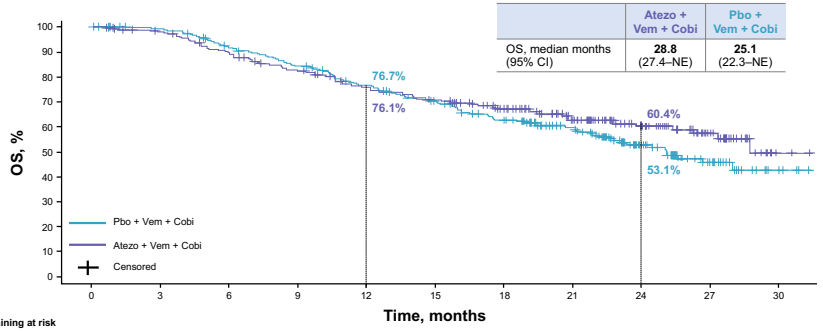
log-rank $P = 0.0249$

Patients remaining at risk

Pbo + Cobi + Vem	258	230	179	143	107	86	71	51	27	11	1
Atezo + Cobi + Vem	256	229	174	149	123	114	90	66	34	11	

Atezo, atezolizumab; CI, confidence interval; Cobi, cobimetinib; Pbo, placebo; Vem, vemurafenib.

IMspire150: Overall Survival



	Atezo + Vem + Cobi	Pbo + Vem + Cobi
OS, median months (95% CI)	**28.8** (27.4–NE)	**25.1** (22.3–NE)

Patients remaining at risk

Pbo + Vem + Cobi	258	249	225	206	175	161	139	105	57	26	5
Atezo + Vem + Cobi	256	242	220	198	173	165	144	105	66	28	2

Updated Survival In Patients With *BRAF*-mutant Melanoma Administered Pembrolizumab, Dabrafenib And Trametinib

Pier Francesco Ferrucci[1a]; Paolo A. Ascierto[2a]; Michele Maio[3]; Michele Del Vecchio[4]; Victoria Atkinson[5]; Henrik Schmidt[6]; Jacob E. Schachter[7]; Paola Queirolo[8]; Georgina V. Long[9]; Rosalie Stephens[10]; Inge Marie Svane[11]; Michal Lotem[12]; Mahmoud Abu-Amna[13]; Eduard Gasal[14]; Razi Ghori[15]; Scott J. Diede[15]; Elizabeth Croydon[15]; Antoni Ribas[16]

[a]Both authors contributed equally

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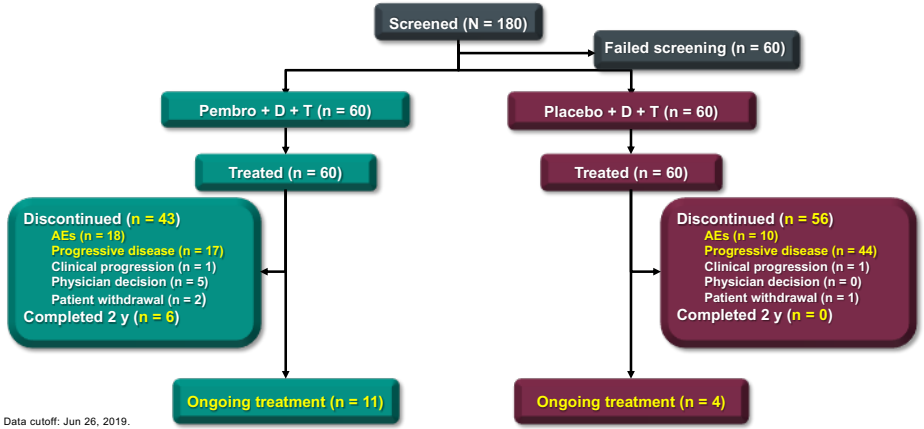
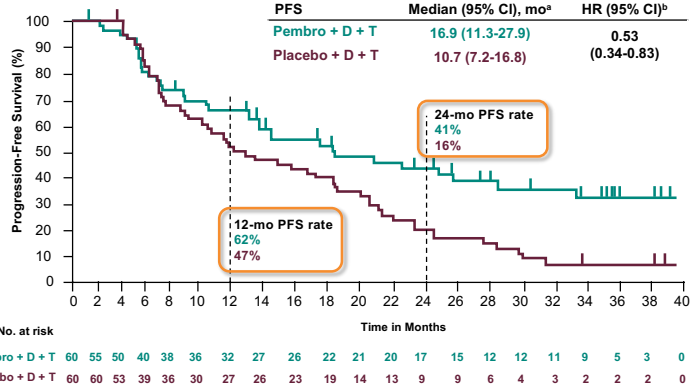
Study Disposition



Data cutoff: Jun 26, 2019.

Progression-Free Survival



[a]Based on Kaplan-Meier estimate of PFS, per investigator assessment.
[b]Based on Cox regression model with treatment as a covariate stratified by ECOG PS (0 vs 1) and LDH (LDH >1.1 × ULN vs =1.1 × ULN); owing to the small number of patients enrolled in the ECOG PS 1 and LDH ≤1.1 × ULN strata, these strata were combined.
Data cutoff: Jun 26, 2019.

Ascierto et al. Nature Med 2019

VIRTUAL ESMO congress 2020

Spartalizumab plus dabrafenib and trametinib in patients with previously untreated *BRAF* V600–mutant unresectable or metastatic melanoma: results from the randomized part 3 of the Phase III COMBI-i trial

Paul D. Nathan,[1] Reinhard Dummer,[2] Georgina V. Long,[3] Paolo A. Ascierto,[4] Hussein A. Tawbi,[5] Caroline Robert,[6] Piotr Rutkowski,[7] Oleg Leonov,[8] Caroline Dutriaux,[9] Mario Mandalà,[10] Paul Lorigan,[11] Pier Francesco Ferrucci,[12] Keith T. Flaherty,[13] Jan C. Brase,[14] Steven Green,[15] Tomas Haas,[15] Aisha Masood,[16] Eduard Gasal,[16] Antoni Ribas,[17] Dirk Schadendorf[18]

[1]Department of Medical Oncology, Mount Vernon Cancer Centre, Northwood, UK; [2]Department of Dermatology, University Hospital Zürich Skin Cancer Center, Zürich, Switzerland; [3]Department of Medical Oncology, Melanoma Institute Australia, The University of Sydney, and Royal North Shore and Mater Hospitals, Sydney, NSW, Australia; [4]Department of Melanoma, Cancer Immunotherapy and Development Therapeutics, Istituto Nazionale Tumori IRCCS "G. Pascale," Napoli, Italy; [5]Department of Melanoma Medical Oncology, The University of Texas MD Anderson Cancer Center, Houston, TX, USA; [6]Dermatology Service and Melanoma Research Unit, Gustave Roussy and Paris-Sud-Paris-Saclay University, Villejuif, France; [7]Department of Soft Tissue/Bone Sarcoma and Melanoma, Maria Skłodowska-Curie National Research Institute of Oncology, Warsaw, Poland; [8]Department of Medical Oncology, Clinical Oncological Dispensary, Omsk, Russian Federation; [9]Service de Dermatologie, Centre Hospitalier Universitaire de Bordeaux, Hôpital Saint-André, Bordeaux, France; [10]Department of Oncology and Haematology, Papa Giovanni XXIII Cancer Center Hospital, Bergamo, Italy; [11]Department of Medical Oncology, The Christie NHS Foundation Trust, Manchester, UK; [12]Cancer Biotherapy Unit, Department of Experimental Oncology, European Institute of Oncology, IRCCS, Milan, Italy; [13]Department of Medicine and Cancer Center, Massachusetts General Hospital Cancer Center and Harvard Medical School, Boston, MA, USA; [14]Precision Medicine, Novartis Pharma AG, Basel, Switzerland; [15]Clinical Development and Analytics, Novartis Pharma AG, Basel, Switzerland; [16]Oncology Clinical Development, Novartis Pharmaceuticals Corporation, East Hanover, NJ, USA; [17]Department of Medicine, Division of Hematology-Oncology, University of California, Los Angeles, Los Angeles, CA, USA; [18]Department of Dermatology, Comprehensive Cancer Center (Westdeutsches Tumorzentrum), University Hospital Essen, Essen, and German Cancer Consortium, Heidelberg, Germany

COMBI-i Study Design (Part 3)

N = 532

Key eligibility criteria
- *BRAF* V600 mutation–positive unresectable or metastatic melanoma
- Previously untreated
- No active brain metastases
- ECOG PS ≤ 2

RANDOMIZATION

- Spartalizumab 400 mg Q4W + dabrafenib 150 mg BID + trametinib 2 mg QD
- Placebo Q4W + dabrafenib 150 mg BID + trametinib 2 mg QD

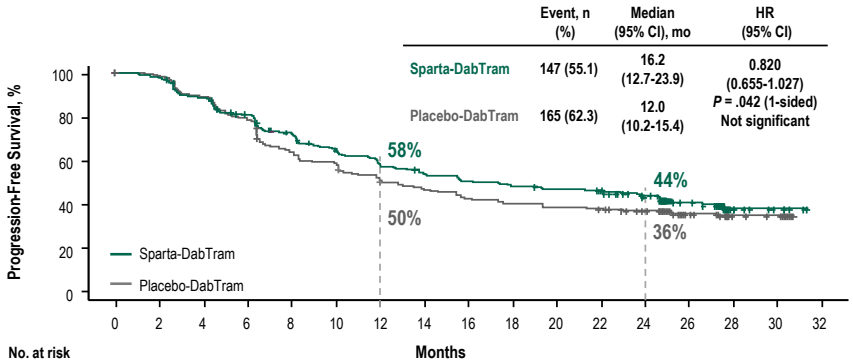
Randomization stratification
- ECOG PS
- LDH level

Primary endpoint: Investigator-assessed PFS using RECIST 1.1

Secondary endpoints: OS, ORR, DOR, DCR, safety, PRO, PK

BID, twice daily; DCR, disease control rate; DOR, duration of response; ECOG PS, Eastern Cooperative Oncology Group performance status; LDH, lactate dehydrogenase; ORR, objective response rate; OS, overall survival; PFS, progression-free survival; PK, pharmacokinetics; Q4W, every 4 weeks; QD, once daily; RECIST, Response Evaluation Criteria in Solid Tumors.

Investigator-Assessed Progression-Free Survival

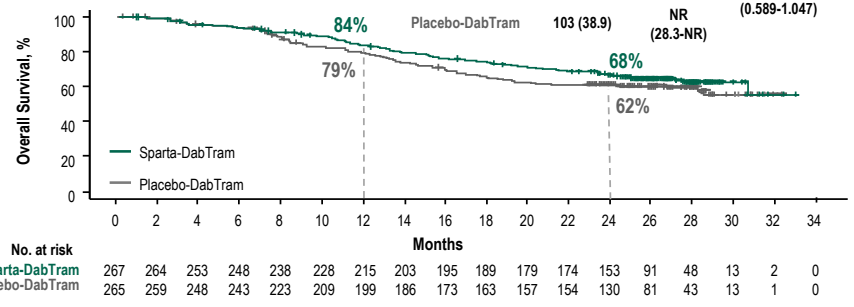


	Event, n (%)	Median (95% CI), mo	HR (95% CI)
Sparta-DabTram	147 (55.1)	16.2 (12.7-23.9)	0.820 (0.655-1.027)
Placebo-DabTram	165 (62.3)	12.0 (10.2-15.4)	*P* = .042 (1-sided) Not significant

No. at risk																
Sparta-DabTram	267	256	229	204	180	159	142	130	121	115	111	108	90	40	13	5	0
Placebo-DabTram	265	252	228	202	162	148	127	115	105	100	95	93	76	36	11	8	0

HR, hazard ratio.

Overall Survival



	Events n (%)	Median (95% CI), mo	HR (95% CI)
Sparta-DabTram	90 (33.7)	NR (30.6-NR)	0.785 (0.589-1.047)
Placebo-DabTram	103 (38.9)	NR (28.3-NR)	

No. at risk																
Sparta-DabTram	267	264	253	248	238	228	215	203	195	189	179	174	153	91	48	13	2	0
Placebo-DabTram	265	259	248	243	223	209	199	186	173	163	157	154	130	81	43	13	1	0

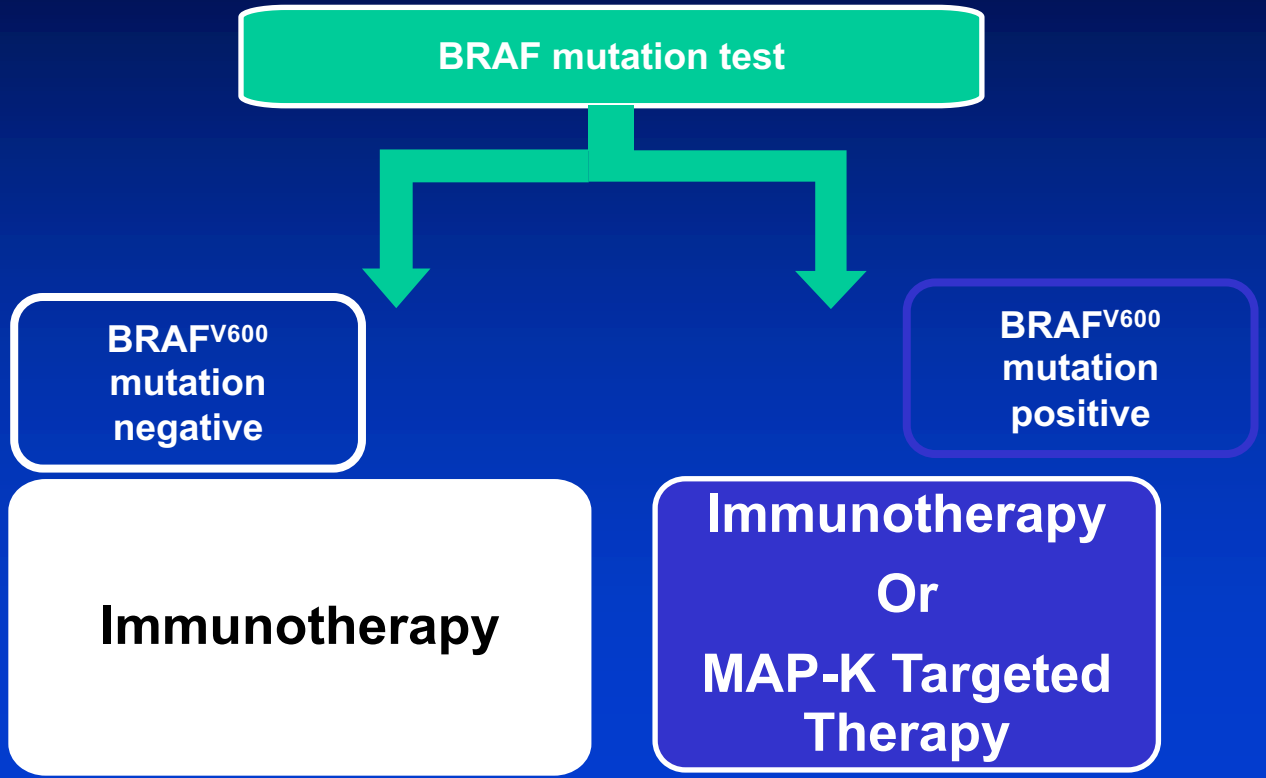
- Overall survival could be statistically tested only after the primary endpoint was determined to be statistically significant

NR, not reached.

Targeted Therapy To Date

- BRAF/MEK combination therapy is better than single agent BRAF or MEK
  - 3 FDA approved combinations available
- Triple therapy (dabrafenib, trametinib, atezolizumab) is FDA approved
  - Enthusiasm is low because only 1/3 trials positive (PFS only)

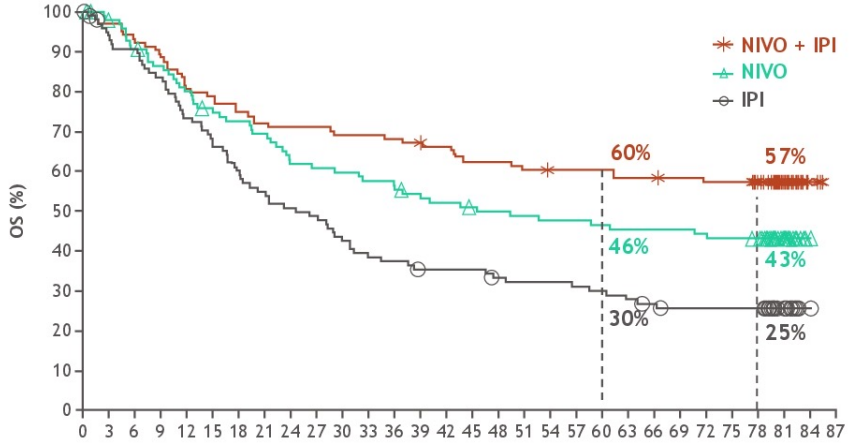
Melanoma Therapy Decision Point



OS by *BRAF* mutation status[a]

BRAF mutant

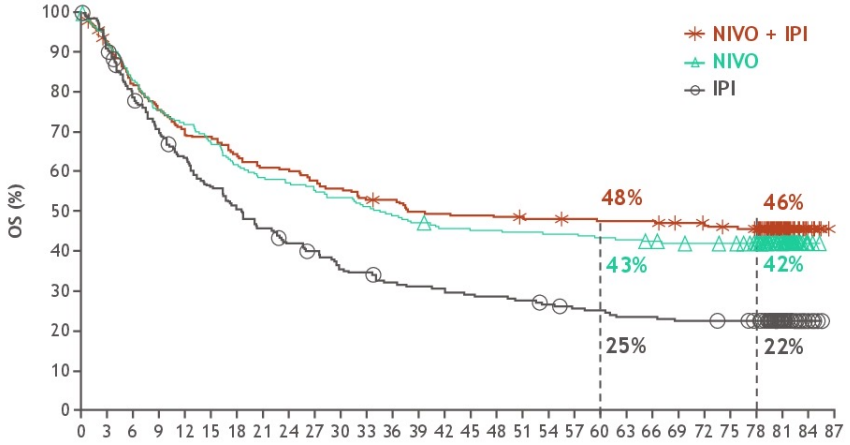
	NIVO + IPI (n = 103)	NIVO (n = 98)	IPI (n = 100)
Median (95% CI), mo	NR (50.7-NR)	45.5 (26.4-NR)	24.6 (17.9-31.0)
HR (95% CI) vs IPI	0.43 (0.30-0.60)	0.63 (0.44-0.90)	-
HR (95% CI) vs NIVO[b]	0.68 (0.46-1.0)	-	-



No. at risk																												
NIVO + IPI	103	99	96	91	83	80	77	74	73	73	71	71	70	69	67	63	63	61	60	60	60	58	58	57	56	56	51	29	3	0
NIVO	98	93	86	81	75	69	67	64	57	56	55	53	52	48	47	45	44	43	42	42	41	40	40	40	39	38	37	17	1	0
IPI	100	91	88	81	71	64	58	53	49	47	41	37	36	33	33	33	30	29	29	28	27	25	23	21	21	21	21	11	1	0

BRAF wild-type

	NIVO + IPI (n = 211)	NIVO (n = 218)	IPI (n = 215)
Median (95% CI), mo	39.1 (27.5-NR)	34.4 (24.1-59.2)	18.5 (14.1-22.7)
HR (95% CI) vs IPI	0.58 (0.45-0.74)	0.63 (0.50-0.80)	-
HR (95% CI) vs NIVO[b]	0.92 (0.71-1.18)	-	-



No. at risk																												
NIVO + IPI	211	193	169	157	144	142	133	127	126	120	116	110	109	103	102	101	100	98	98	97	96	96	95	93	91	89	87	37	7	0
NIVO	218	199	180	164	156	145	134	127	124	119	116	111	106	102	98	97	97	96	95	95	93	92	90	88	87	86	80	42	2	0
IPI	215	194	165	146	132	117	105	95	86	81	72	70	64	62	61	58	57	55	52	49	48	45	45	43	43	42	40	21	6	0

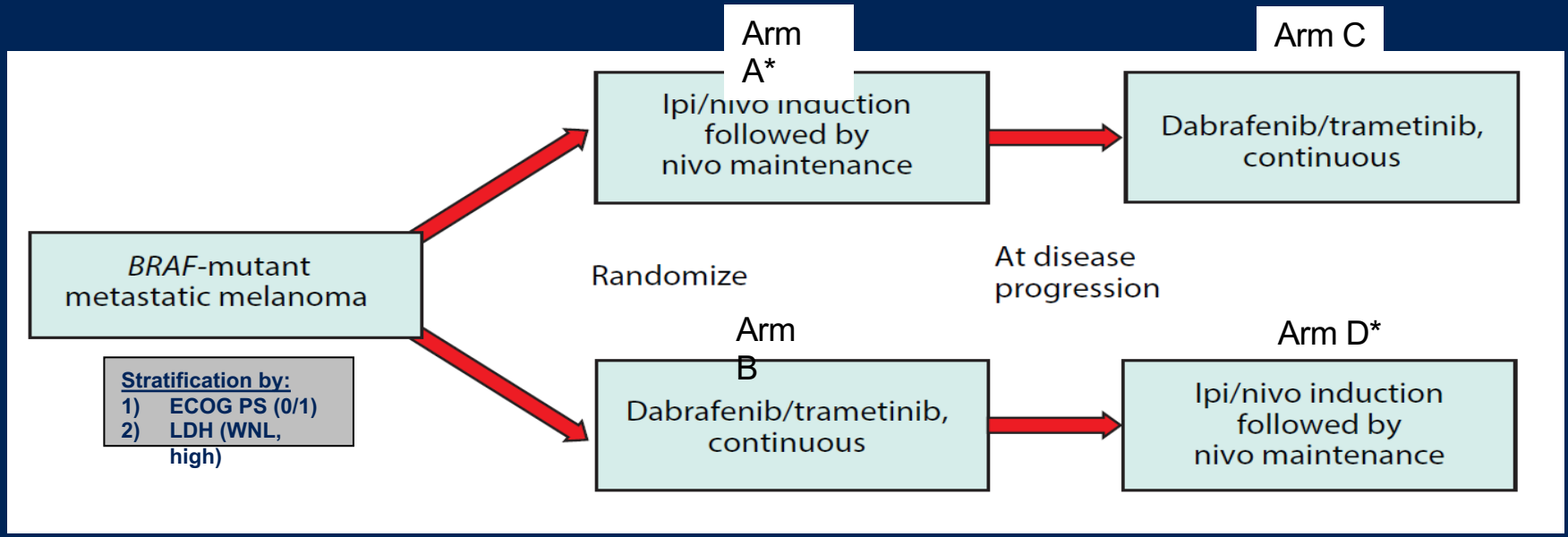
Key Ongoing Trials Evaluating Targeted Therapy Vs Combination Immunotherapy

	SECOMBIT	EORTC-1612-MG	DREAMseq
Population	Stage III (unresectable) or IV	stage III or IV (cutaneous or mucosal)	Stage III (unresectable) or IV
	BRAF V600-mutant	*BRAF V600E* or *V600K*-mutant	*BRAF V600*-mutant
N	251	270	300
Primary Endpoint	OS	PFS	OS
Primary Completion	April 2021	April 2022	October 2022
IO Regimen	NIVO 1 mg/kg IV + IPI 3 mg/kg IV Q3W x 4 → NIVO 3 mg/kg IV Q2W	NIVO 3 mg/kg Q3W + IPI 1 mg/kg Q3W x4 → NIVO 480 mg Q4W	NIVO 1 mg/kg + IPI 3 mg/kg **or** NIVO 3 mg/kg + IPI 1 mg/kg → NIVO 3 mg/kg maintenance
Targeted Regimen	Encorafenib 450 mg PO QD + Binimetinib 45 mg PO BID	Encorafenib 450 mg QD + Binimetinib 45 mg BID	Dabrafenib 150 mg PO BID + Trametinib 2 mg PO QD
Sequencing	Targeted → IO IO → Targeted Targeted → IO → Targeted	Targeted → IO IO only	Targeted → IO IO → Targeted

BID = twice daily; IO = immunotherapy; IPI = ipilimumab; IV = intravenous; NIVO = nivolumab; OS = overall survival; PD = progressive disease; PFS = progression-free survival; PO = orally; Q2W = every 2 weeks; Q3W = every 3 weeks; Q4W = every 4 weeks; QD = once daily.

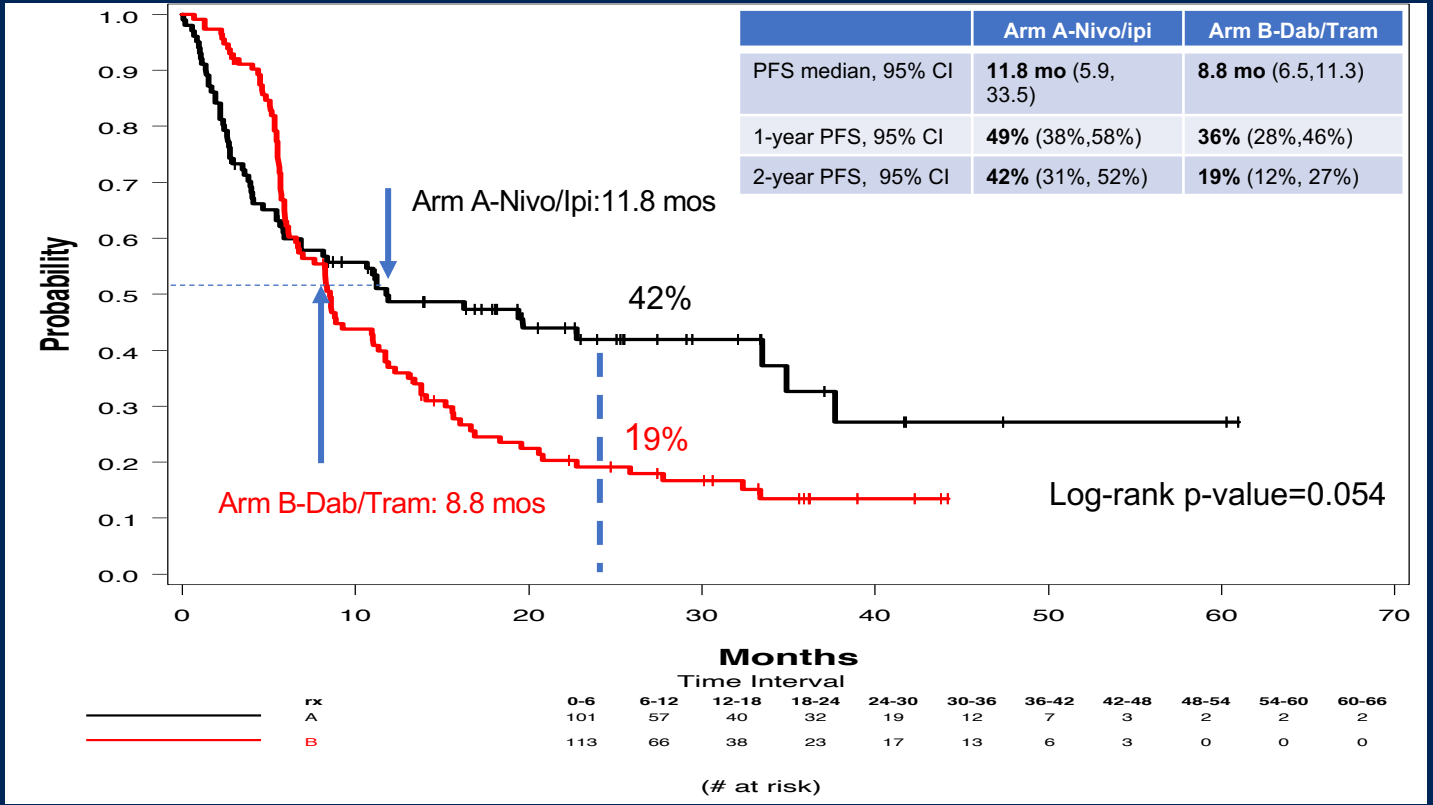
Clinical trial information: https://clinicaltrials.gov/ct2/show/NCT02631447; https://clinicaltrials.gov/ct2/show/NCT03235245; https://clinicaltrials.gov/ct2/show/NCT02224781

DREAMseq Trial Treatment Schema



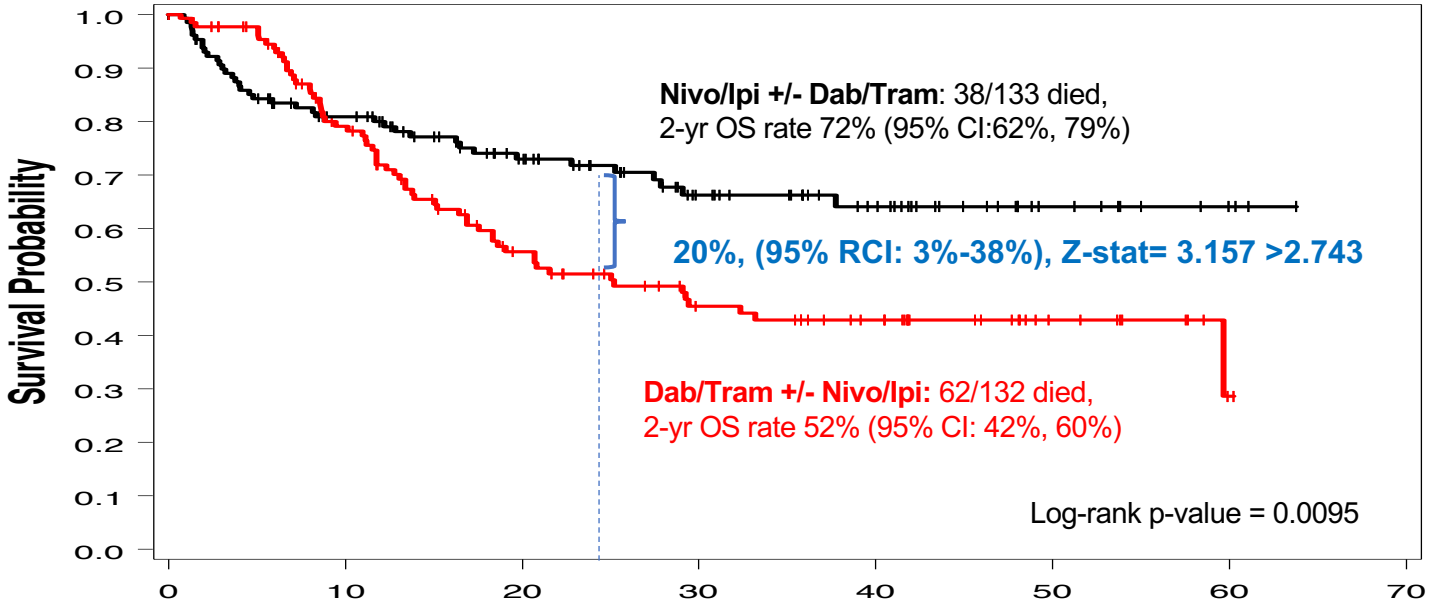
*Nivo/Ipi Induction = 12 wks; nivo maintenance = 72 wks

Progression Free Survival (PFS): Step1 (n=214)



	Arm A-Nivo/ipi	Arm B-Dab/Tram
PFS median, 95% CI	**11.8 mo** (5.9, 33.5)	**8.8 mo** (6.5,11.3)
1-year PFS, 95% CI	**49%** (38%,58%)	**36%** (28%,46%)
2-year PFS, 95% CI	**42%** (31%, 52%)	**19%** (12%, 27%)

Overall Survival (OS): Step 1 +/- Step 2



Time Interval

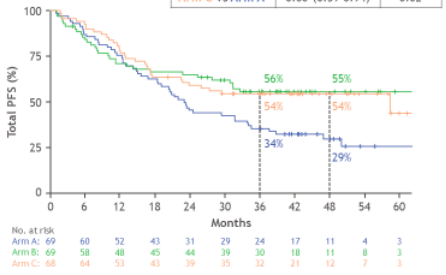
Treatment	0-6	6-12	12-18	18-24	24-30	30-36	36-42	42-48	48-54	54-60	60-66
IO+/-TT	133	99	87	71	55	42	33	23	15	6	3
TT+/-IO	132	115	78	60	47	35	30	18	15	6	1

(# at risk)

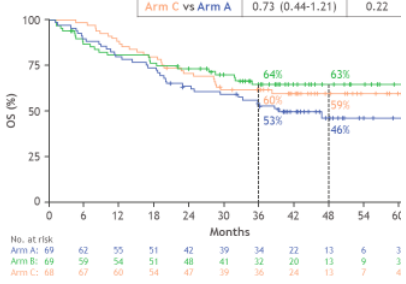
The Best Sequencing Is Combination Immunotherapy First

SECOMBIT: 4-year survival

Total PFS	HR (95% CI)[a]	*P* value
Arm B vs Arm A	0.58 (0.37-0.91)	0.01
Arm C vs Arm A	0.60 (0.39-0.94)	0.02



OS	HR (95% CI)[a]	*P* value
Arm B vs Arm A	0.66 (0.39-1.12)	0.13
Arm C vs Arm A	0.73 (0.44-1.21)	0.22

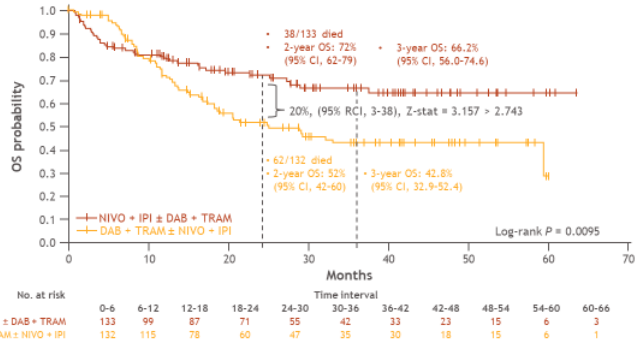


Adapted from Ascierto PA

This material may include information about investigational products and / or uses that are not approved for use in any country or in the country of your residence. Therefore, before prescribing any product, always refer to local materials such as the prescribing information and / or the Summary of Product Characteristics (SPC). Not all discussed therapies are approved for clinical use. Bristol Myers Squibb only recommends usage of approved products. Please check the product information of your country, approvals may vary. Refer to each country's local guidance for specific therapeutic strategies. Median follow-up was 43 months (estimated with the reverse Kaplan-Meier method). [a]Exploratory analysis. OS, overall survival; PFS, progression-free survival.

Ascierto PA et al. Presentation at the ESMO Congress; September 9-13, 2022; Paris, France. Abstract LBA41.

DREAMseq: overall survival (step 1 ± step 2)



No. at risk	Time interval									
	0-6	6-12	12-18	18-24	24-30	30-36	36-42	42-48	48-54	54-60	60-66
NIVO + IPI ± DAB + TRAM	133	99	87	71	55	42	33	23	15	6	3
DAB + TRAM ± NIVO + IPI	132	115	78	60	47	35	30	18	15	6	1

Adapted from Atkins MB.

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DAB, dabrafenib; IPI, ipilimumab; NIVO, nivolumab; OS, overall survival; TRAM, trametinib.

Atkins MB. Presentation at the American Society of Clinical Oncology (ASCO) Annual Meeting; June 3-7, 2022; Chicago, IL. Updates on abstract 356154.

Overview of Options Adjuvant Therapy

- Immunotherapy (All patients)
  - Anti-PD1
    - Pembrolizumab or nivolumab)
- Targeted therapy (BRAF+ patients)
  - BRAF/MEK combo
    - Dabrafenib/trametinib

CheckMate 238: Study Design

Patients with:

- **High-risk, completely resected stage IIIB/IIIC or stage IV[a] melanoma**
- **No prior systemic therapy**
- **ECOG PS 0/1**

1:1

n = 453 → **NIVO 3 mg/kg IV Q2W and IPI placebo IV Q3W for 4 doses, then Q12W from week 24**

n = 453 → **IPI 10 mg/kg IV Q3W for 4 doses, then Q12W from week 24 and NIVO placebo IV Q2W**

Follow-up

Maximum treatment duration of 1 year

Stratified by:

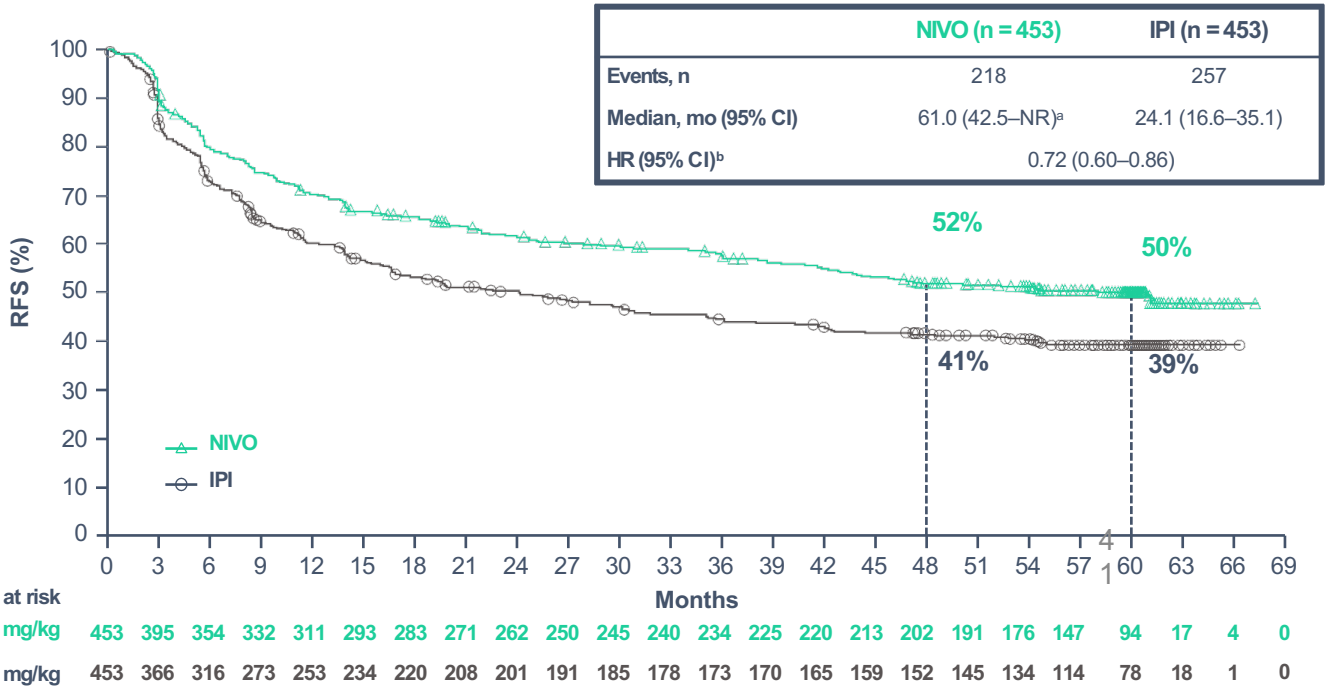
1) Disease stage: IIIB/IIIC vs IV M1a or M1b vs IV M1c
2) Tumor PD-L1 status at a 5% cutoff

Primary endpoint: RFS

Database lock: January 31, 2019; minimum follow-up of 36 months for all patients

NCT02388906.[a]Per American Joint Committee on Cancer (AJCC) Cancer Staging Manual, seventh edition.

Primary Endpoint
60 Month RFS in All Patients

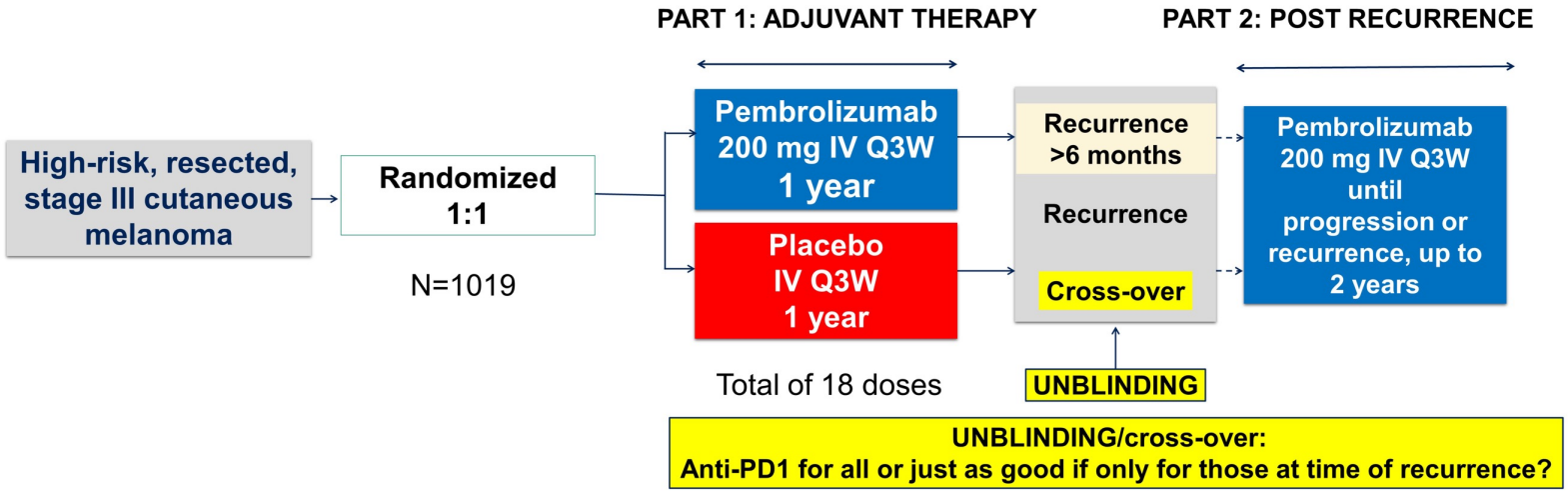


- New events since 4-year database lock: 6 (NIVO – 4 regional, 2 distant) and 4 (IPI – 1 each of local, distant, new primary, and death)

[a]Median not stable. [b]Stratified. Mo, month; NR, not reached.

Weber J et al. SMR 2021.

EORTC 1325/KEYNOTE-54 Study Design



Stratification factors:

✓**AJCC-7 Stage**: IIIA (>1 mm metastasis) vs. IIIB vs. IIIC 1-3 positive lymph nodes vs. IIIC ≥4 positive lymph nodes

✓**Region**: North America, European countries, Australia/New Zealand, other countries

Primary Endpoints:

- **RFS (per investigator) in overall ITT population,** and **in patients with PD-L1-positive tumors**

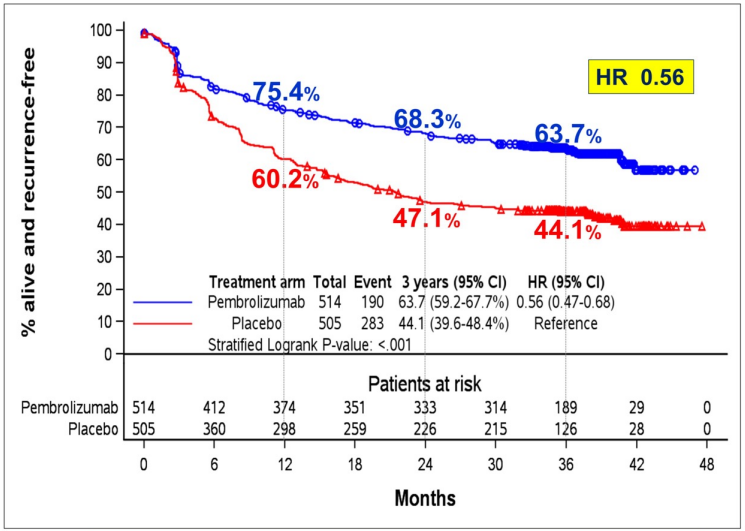
Secondary Endpoints:

- **DMFS and OS** in these 2 populations; **Safety, Health-related quality of life**

EORTC 1325/KEYNOTE-54: RFS ASCO (2020) and DMFS (ESMO 2020)

RFS updated analysis @ 3YR (ASCO 2020)[1]

- ***Cut-off date*** (30-Sep-2019); median follow-up: **3** years; **473 RFS events**

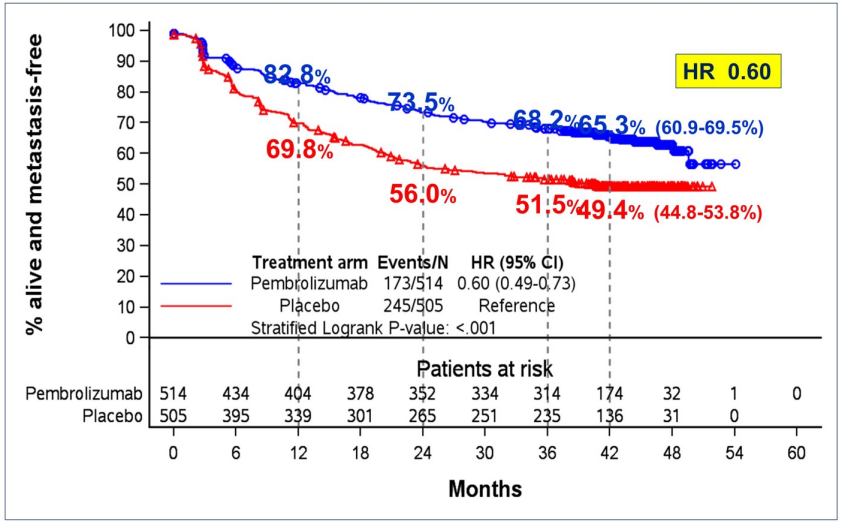


irAE: grade 1-5 (38%); grade 3-5 (7%)

[1]Eggermont AMM, et al. *J Clin Oncol* 2020;38:3925-36

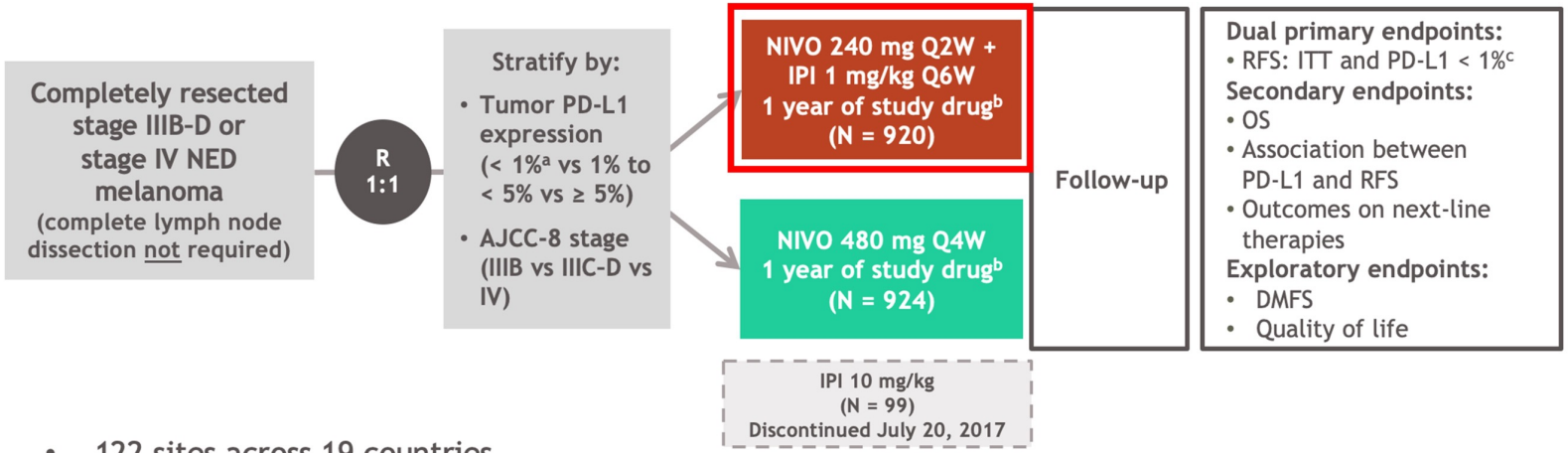
DMFS final analysis @ 3.5 YR (ESMO 2020)[2]

- ***Cut-off date*** (3-Apr-2020); median follow-up: **3.5** years; **418 DMFS events** (423 planned: ~87% power HR=0.725)



[2]Eggermont AMM, et al. *Lancet Oncol.* 2021;22:643-654

CheckMate 915 study design



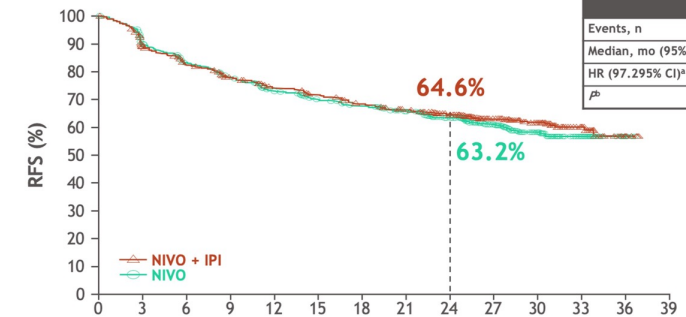
- 122 sites across 19 countries
- Database lock Sept 8, 2020
- Minimum follow-up of approximately 24 months (median 28 months)

Presented by GV Long, AACR 2021.

[a]Or indeterminate; [b]Until recurrence, unacceptable toxicity, or 1 year of treatment; [c]In November 2019, the data monitoring committee indicated that the dual primary endpoint of RFS in patients with tumor PD-L1 < 1% was not met; the study remained blinded until the ITT endpoint was evaluable. AJCC, American Joint Committee on Cancer; DMFS, distant metastasis-free survival; NED, no evidence of disease; PD-L1, programmed death-ligand 1.

Dual primary endpoint: RFS in ITT population

AACR American Association for Cancer Research
FINDING CURES TOGETHER



	NIVO + IPI (n = 920)	NIVO (n = 924)
Events, n	327	347
Median, mo (95% CI)	NR	NR
HR (97.295% CI)[a]	0.92 (0.77-1.09)	
P[b]	0.269	

No. at risk														
NIVO + IPI	920	783	720	669	630	605	572	547	505	371	193	74	9	0
NIVO	924	793	721	669	615	578	554	525	476	362	181	69	5	0

[a]Stratified; [b]Log-rank test. NR, not yet reached.

Dual primary endpoint: RFS in patients with tumor PD-L1 < 1%

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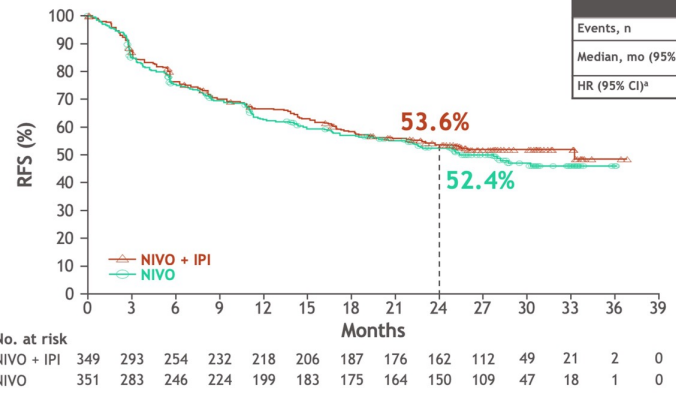


	NIVO + IPI (n = 349)	NIVO (n = 351)
Events, n	159	166
Median, mo (95% CI)	33.2 (22.2-NR)	25.3 (19.8-NR)
HR (95% CI)[a]	0.91 (0.73-1.14)	

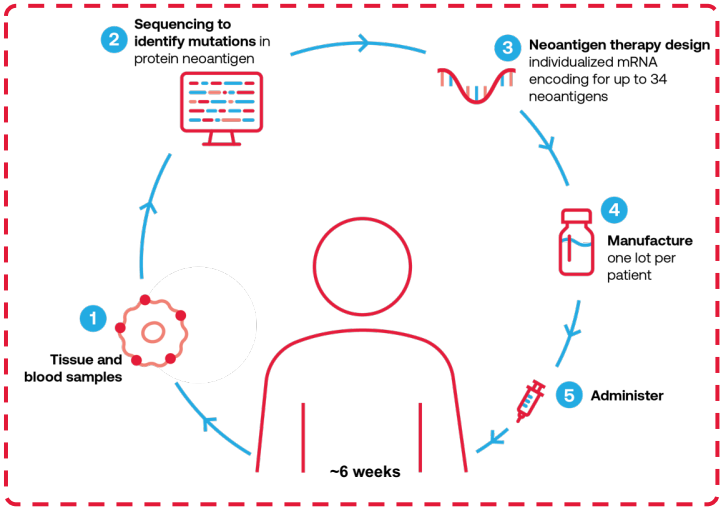
No. at risk														
NIVO + IPI	349	293	254	232	218	206	187	176	162	112	49	21	2	0
NIVO	351	283	246	224	199	183	175	164	150	109	47	18	1	0

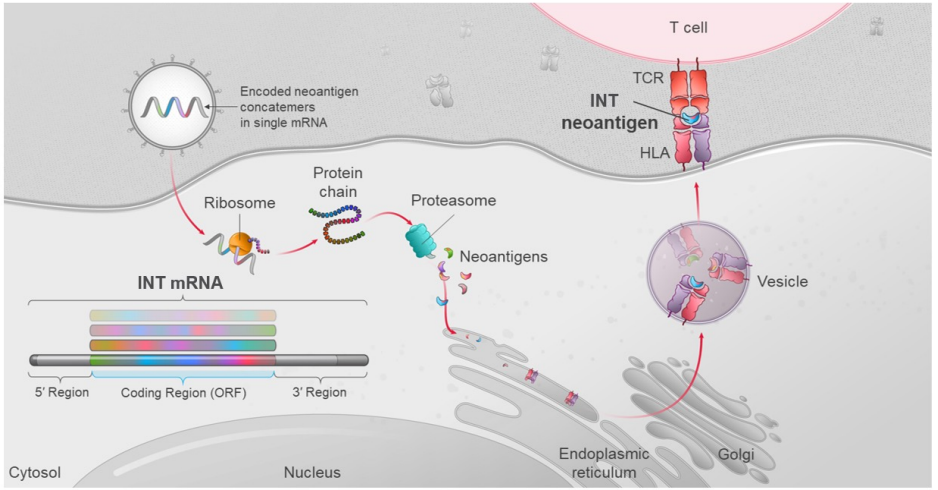
[a]Stratified. NR, not yet reached; PD-L1, programmed death-ligand 1.

Presented by GV Long, AACR 2021.

mRNA-4157 (V940) Mechanism of Action

- mRNA-4157 (V940) is **an individualized neoantigen therapy** designed to target an individual patient's unique tumor mutations and encodes up to 34 neoantigens[1,2]
- Therapies targeting neoantigens can increase endogenous **neoantigen T-cell responses and induce epitope spreading** to novel antigens with the ability **to drive antitumor responses** and **maintain memory** with cytolytic properties, potentially **producing long-term disease control** for patients[3-7]





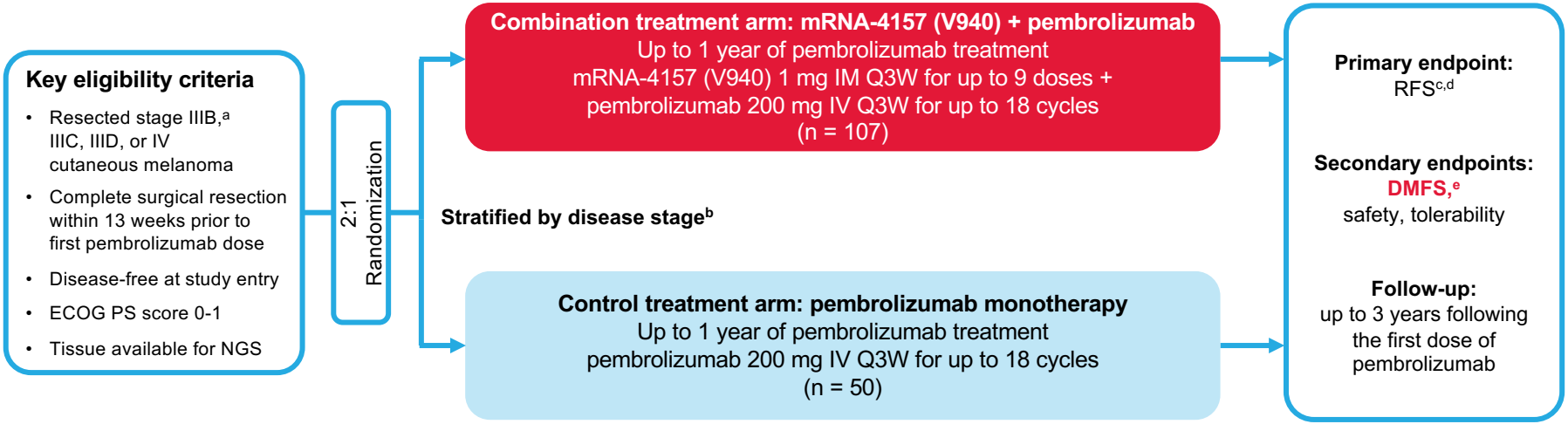
HLA, human leukocyte antigen; INT, individualized neoantigen therapy; ORF, open reading frame.

1. Burris HA, et al. *J Clin Oncol*. 2019;37(suppl 15). Abstract 2523. 2. Zhong S, et al. *Cancer Res*. 80(suppl 16). Abstract 6539. 3. Wirth TC, Kühnel F. *Front Immunol*. 2017;8:1848. 4. Ott PA, et al. *Nature*. 2017;547:217-221. 5. Hu Z, et al. *Nat Med*. 2021;27:515-525. 6. Ott PA, et al. *Cell*. 2020;183:347-362. 7. Palmer CD, et al. *Nat Med*. 2022;28:1619-1629.

PRESENTED BY: Adnan Khattak, MBBS, FRACP, PhD

mRNA-4157-P201/KEYNOTE-942 (NCT03897881) Study Design

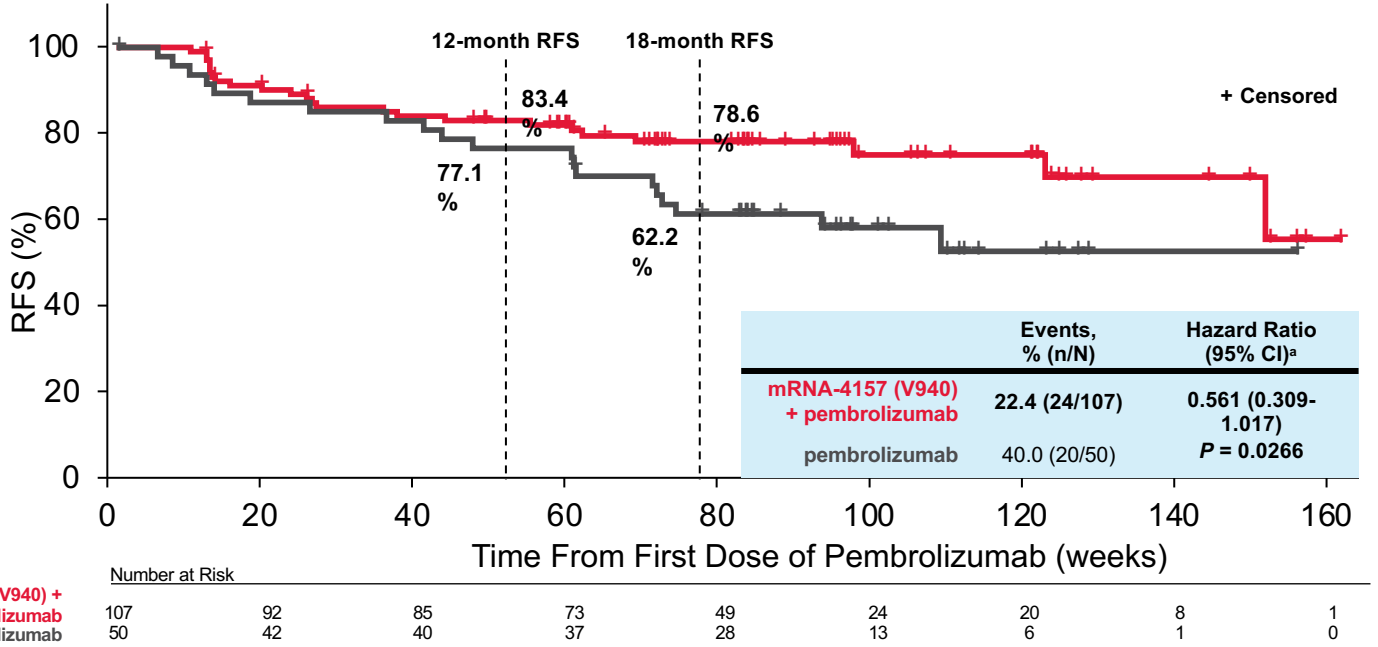
Randomized, phase 2, open-label study in adjuvant resected melanoma patients at high risk of recurrence



Designed with 80% power to detect an HR of 0.5 with ≥40 RFS events (with a 1-sided alpha of 0.1)
DMFS analysis was prespecified for testing following positive RFS in the ITT population[f]
Median follow-up[g]: 23 months for mRNA-4157 (V940) + pembrolizumab
24 months for pembrolizumab monotherapy

[a]Patients with stage IIIB disease were eligible only if relapse occurred within 3 months of prior surgery of curative intent. [b]According to the 8th edition of the American Joint Committee on Cancer Staging Manual. [c]The primary endpoint was investigator-assessed RFS (defined as the time from first dose of pembrolizumab until the date of first recurrence [local, regional, or distant metastasis], a new primary melanoma, or death from any cause) in the intention-to-treat population. [d]The primary analysis for RFS was specified to occur after all patients completed ≥12 months on study and ≥40 RFS events were observed. Descriptive analysis was specified to occur when ≥51 RFS events were observed. [e]Investigator-assessed DMFS was defined as the time from first dose of pembrolizumab until the date of first distant recurrence or death from any cause. [f]The stratified log-rank test was used for comparison. [g]Time of database cutoff was November 14, 2022.

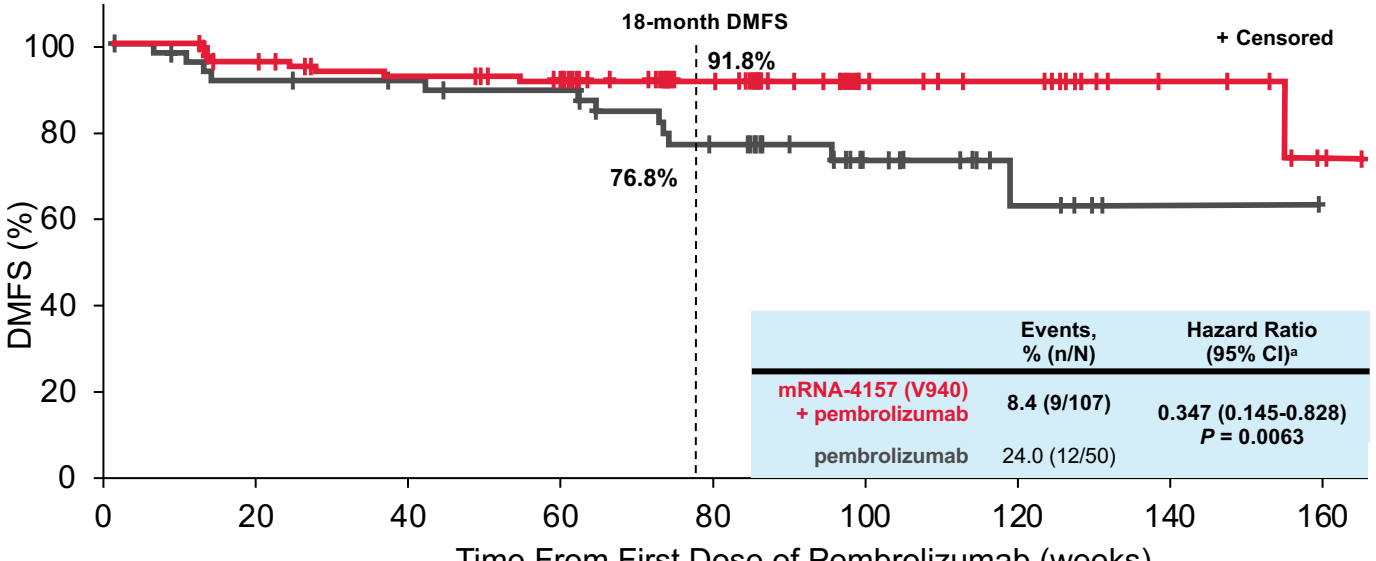
Primary Efficacy Endpoint: RFS[1]



[a]The hazard ratio and 95% CI for mRNA-4157 (V940) plus pembrolizumab versus pembrolizumab is estimated using a Cox proportional hazards model with treatment group as a covariate, stratified by disease stage (stages IIIB or IIIC or IIID vs stage IV) used for randomization. The *P* value is based on a 1-sided log-rank test stratified by disease stage (stages IIIB or IIIC or IIID vs stage IV) used for randomization.

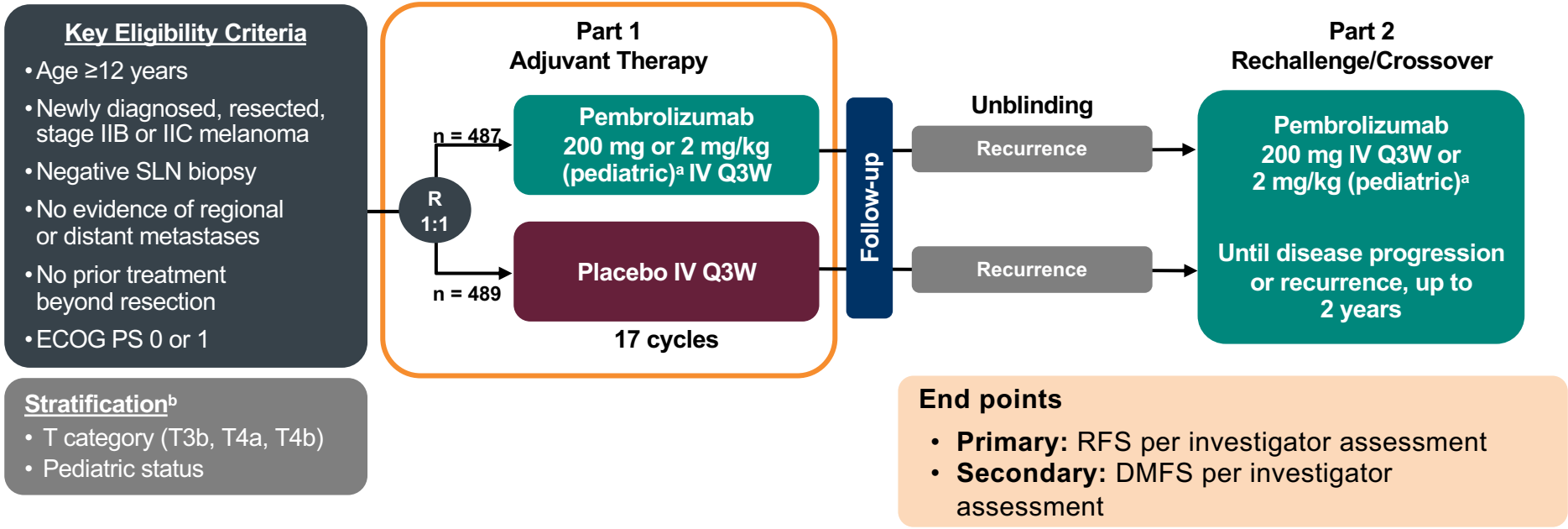
1. Khattak A, et al. Presented at the American Association for Cancer Research® (AACR) Annual Meeting; April 14-19, 2023; Orlando, FL, USA. Oral presentation CT001.

Secondary Efficacy Endpoint: DMFS



[a]The hazard ratio and 95% CI for mRNA-4157 (V940) plus pembrolizumab versus pembrolizumab is estimated using a Cox proportional hazards model with treatment group as a covariate, stratified by disease stage (stages IIIB or IIIC or IIID vs stage IV) used for randomization. The *P* value is based on a 1-sided log-rank test stratified by disease stage (stages IIIB or IIIC or IIID vs stage IV) used for randomization. At 18-months, the estimated DMFS rates were 91.8% (95% CI, 84.2-95.8) versus 76.8% (95% CI, 61.0-86.8) in the combination and monotherapy arm, respectively.

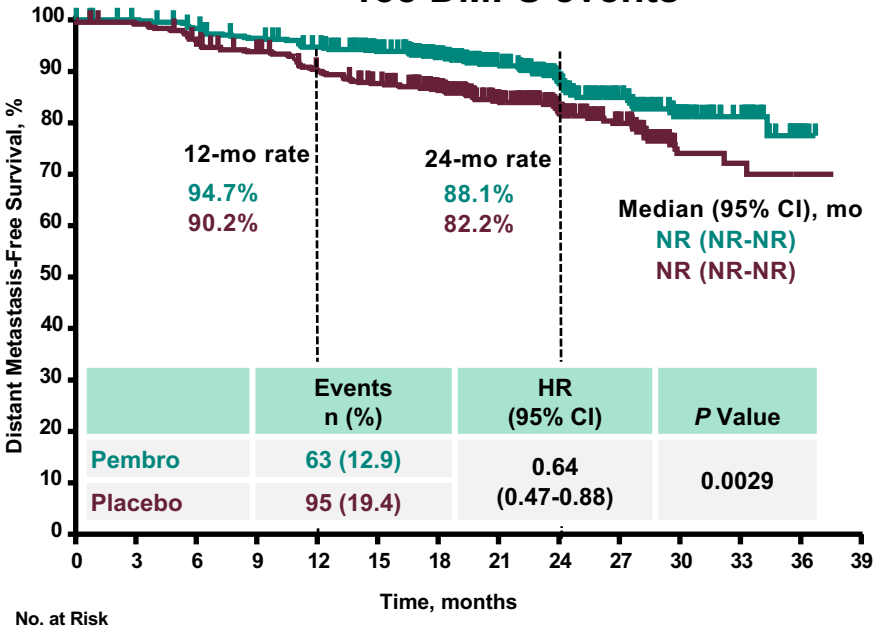
KEYNOTE-716 Study Design (NCT03553836)



[a]Up to a maximum of 200 mg for pediatric (aged 12 to 17 years) patients.
[b]*BRAF* mutation and PD-L1 expression status were not prespecified stratification factors because of tissue availability.

DMFS: ITT Population

Median follow-up: 27.4 months[1]
158 DMFS events

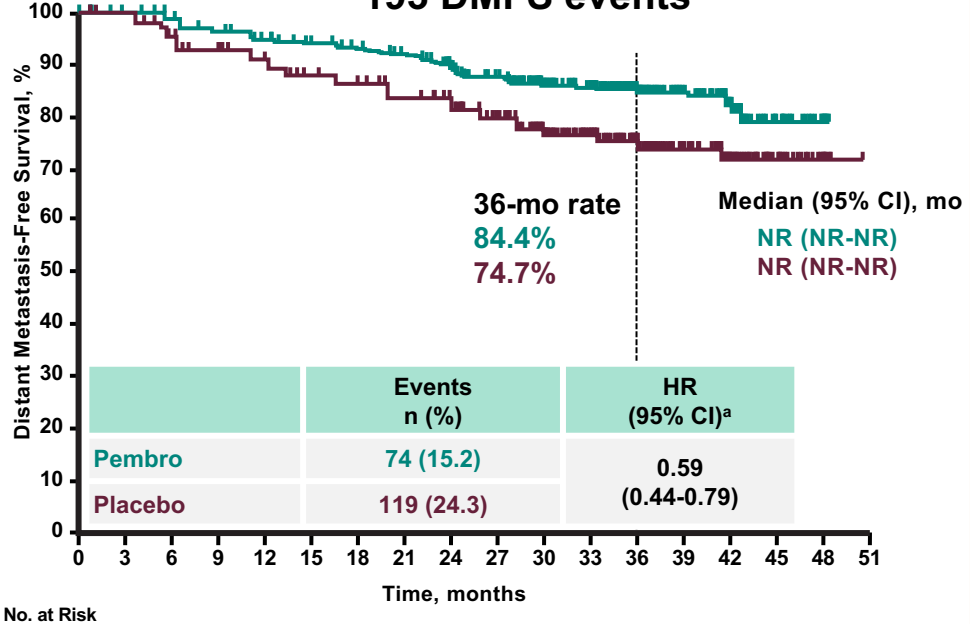


	Events n (%)	HR (95% CI)	*P* Value
Pembro	63 (12.9)	0.64 (0.47-0.88)	0.0029
Placebo	95 (19.4)		

No. at Risk

487	480	469	456	443	421	375	318	217	157	79	35	5	0
489	482	465	448	424	406	363	303	204	156	65	37	5	0

Median follow-up: 39.4 months
193 DMFS events



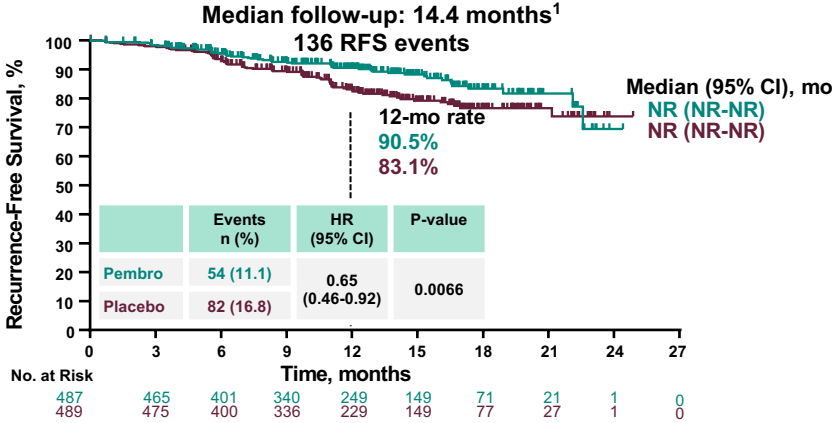
	Events n (%)	HR (95% CI)[a]
Pembro	74 (15.2)	0.59 (0.44-0.79)
Placebo	119 (24.3)	

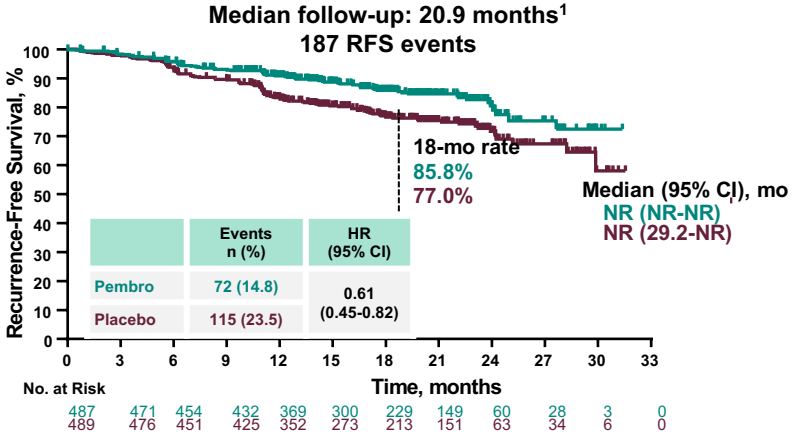
No. at Risk

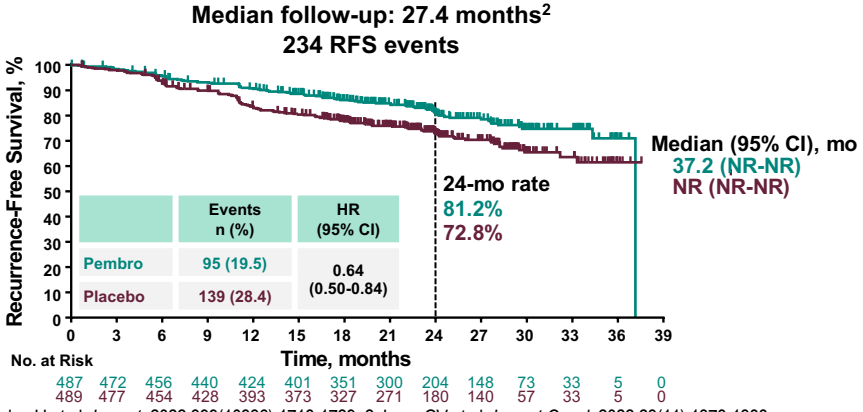
487	480	469	456	444	434	427	417	396	376	322	276	185	130	71	22	5	0
489	482	463	449	427	412	402	389	372	350	287	243	176	131	62	32	7	0

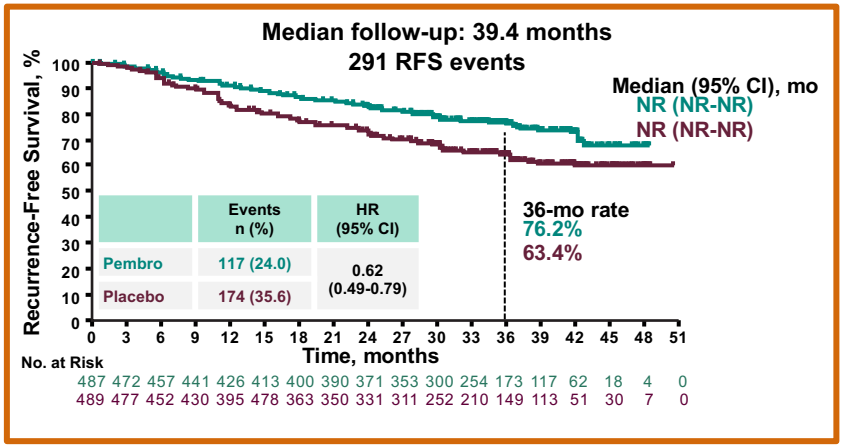
Long GV et al. *Lancet Oncol*. 2022;23(11):1378-1388.

RFS: ITT Population



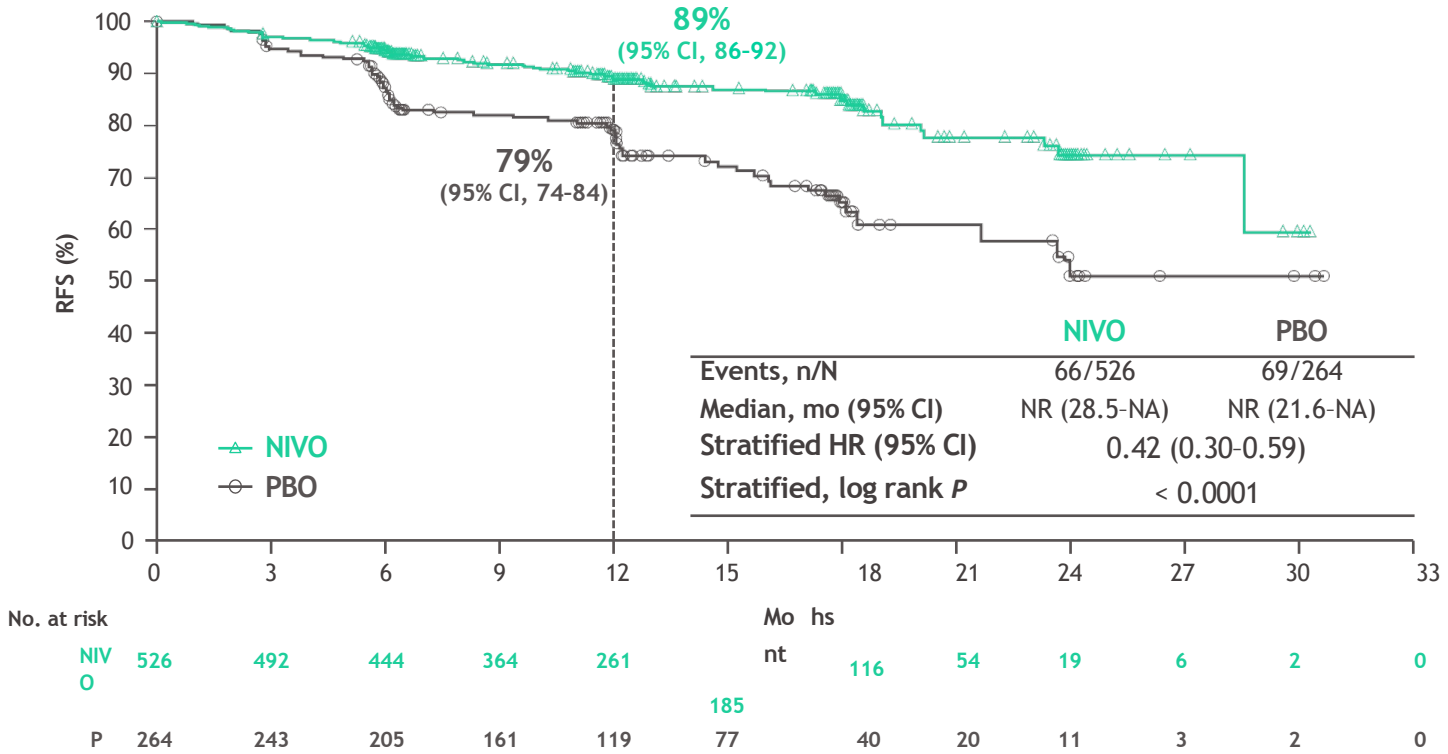






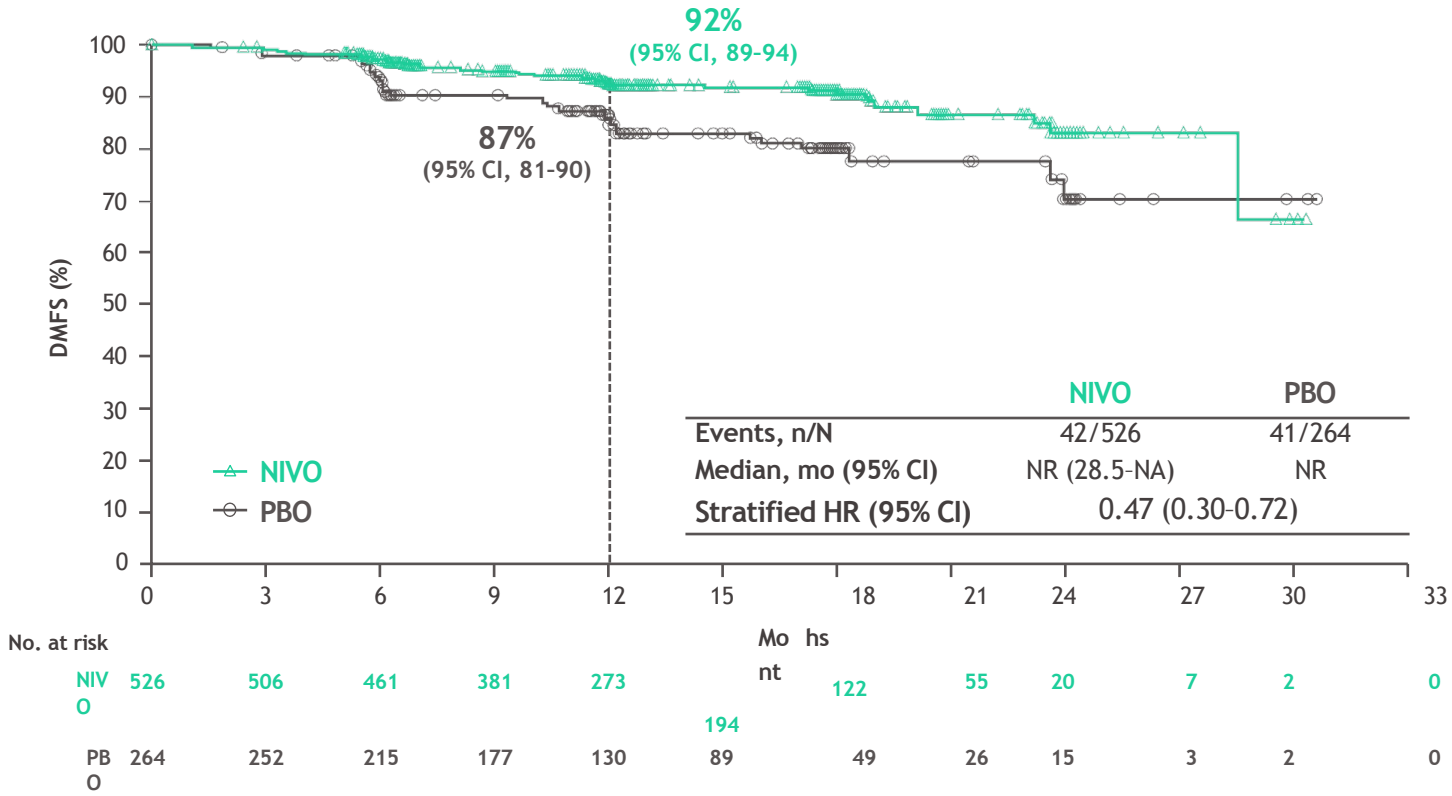
1. Luke JJ et al. *Lancet*. 2022;399(10336):1718-1729. 2. Long GV et al. *Lancet Oncol*. 2022;23(11):1378-1388.

Checkmate 76K (Nivo vs. Placebo): Primary endpoint: RFS



NA, not available; NR, not reached.

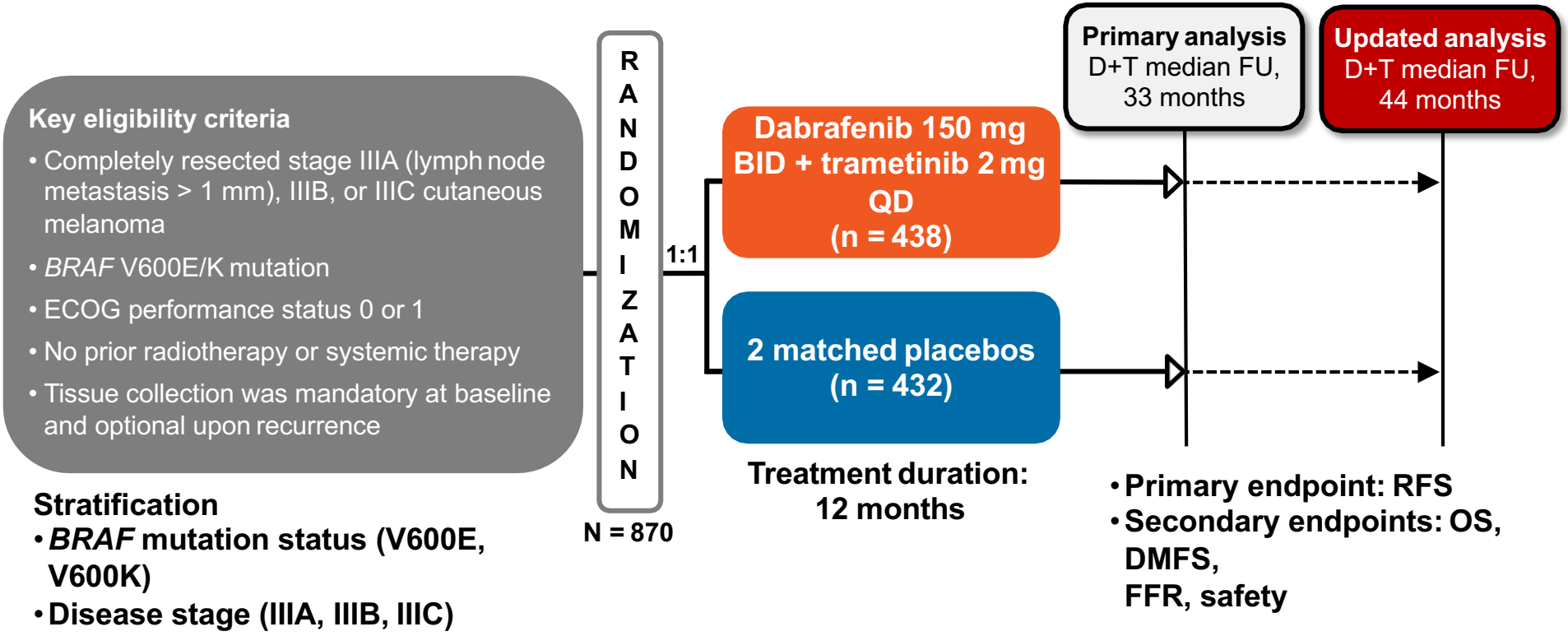
Checkmate 76K (Nivo vs Placebo): Secondary endpoint: DMFS



Overview of Options Adjuvant Therapy

- Immunotherapy (All patients)
  - Anti-PD1
    - Pembrolizumab or nivolumab)
- Targeted therapy (BRAF+ patients)
  - BRAF/MEK combo
    - Dabrafenib/trametinib

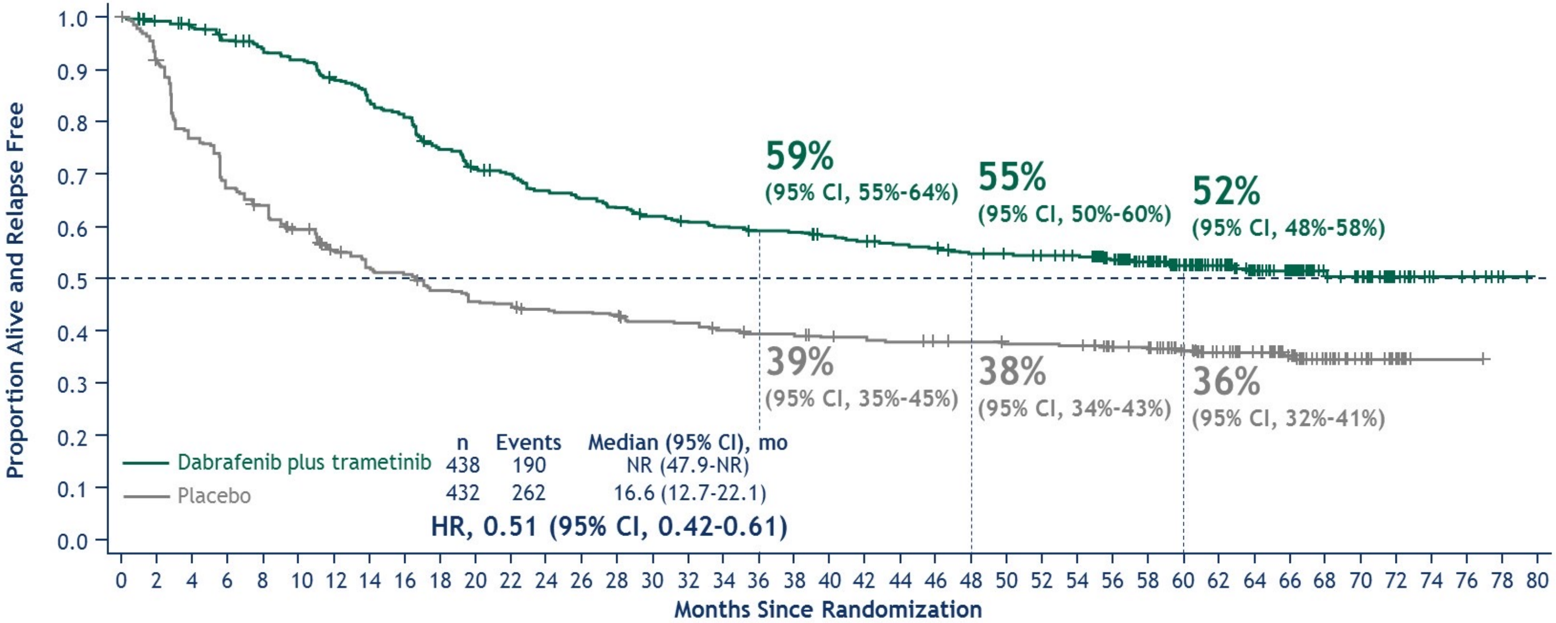
COMBI-AD: STUDY DESIGN—AND EXTENDED FOLLOW-UP ANALYSIS



BID, twice daily; DMFS, distant metastasis–free survival; D+T, dabrafenib + trametinib; ECOG, Eastern Cooperative Oncology Group; FFR, freedom from relapse; FU, follow-up; QD, once daily.

Long GV, et al. *N Engl J Med*. 2017;377:1813-1823.

Relapse-Free Survival

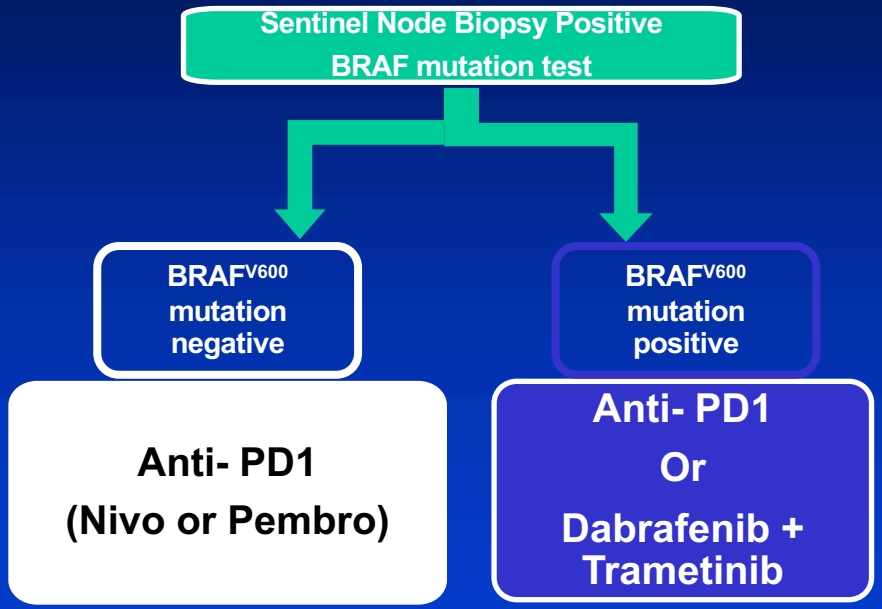


No. at risk

Dabrafenib plus trametinib	438	413	405	391	381	372	354	335	324	298	281	275	262	256	249	242	236	233	229	228	221	217	213	210	204	202	199	195	176	156	133	109	92	80	45	38	17	8	6	2	0
Placebo	432	387	322	280	263	243	219	204	199	185	178	175	168	166	164	158	157	151	147	146	143	140	139	137	136	133	133	132	121	115	99	80	69	56	35	26	13	1	1	0	0

HR, hazard ratio; NR, not reached.

Adjuvant Therapy Approach



Future Directions

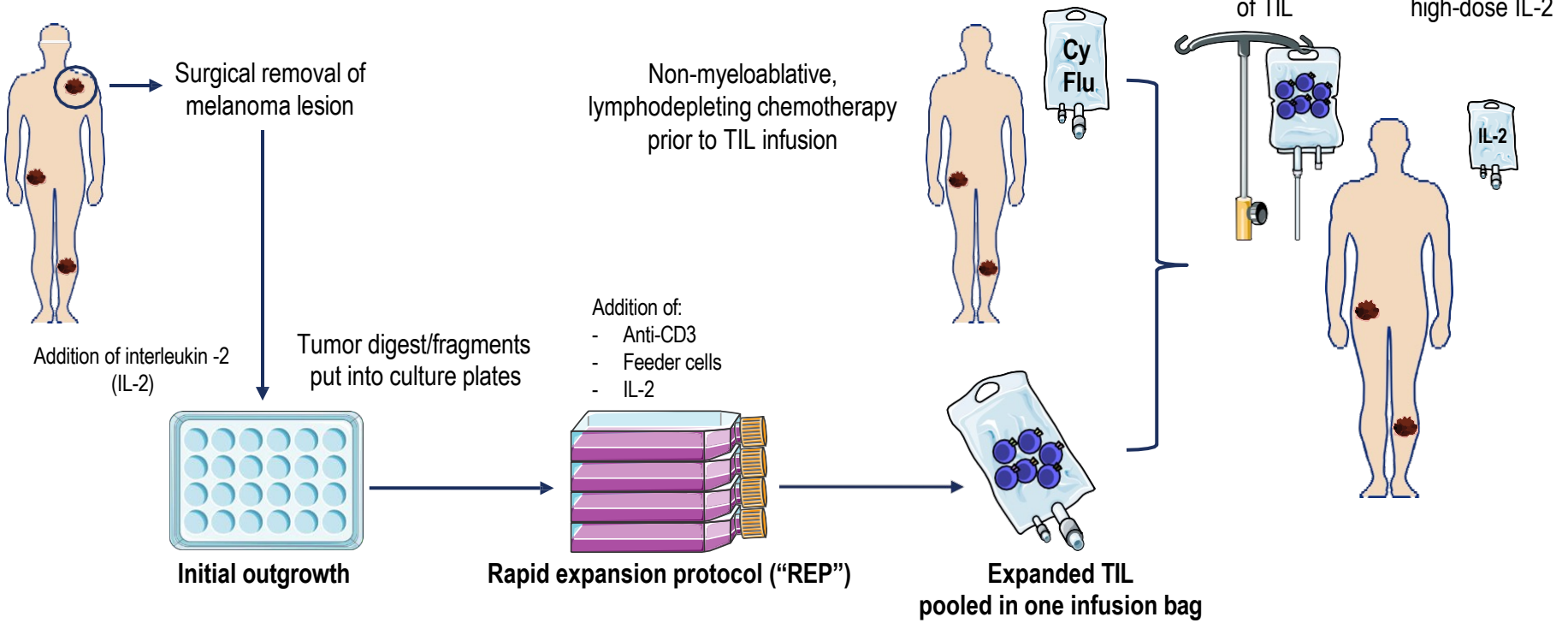
- Cellular (TIL) therapy
  - For patients who progress or fail on immunotherapy and targeted therapy
- Neoadjuvant therapy

Future Directions

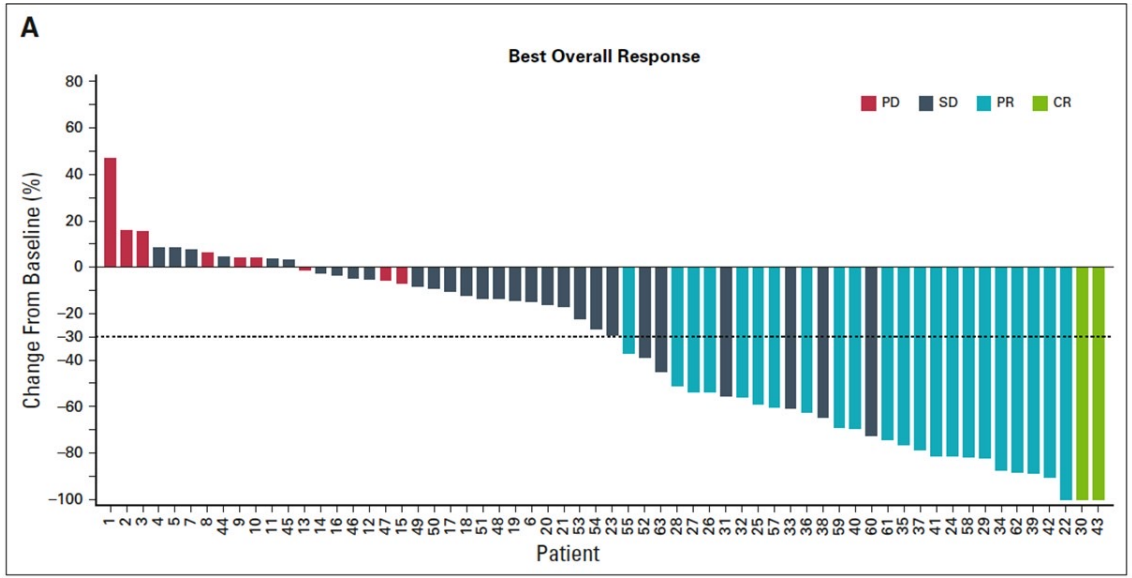
- Cellular (TIL) therapy
  - For patients who progress or fail on immunotherapy and targeted therapy
- Neoadjuvant therapy

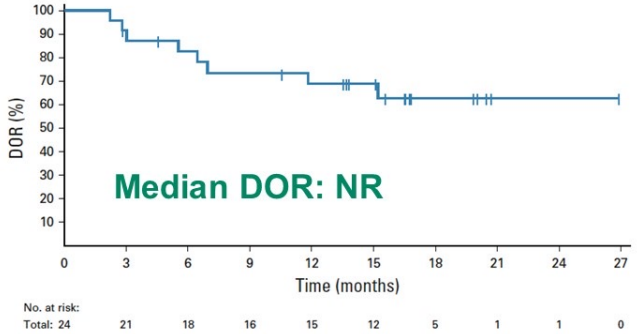
Tumor-infiltrating lymphocytes (TIL)

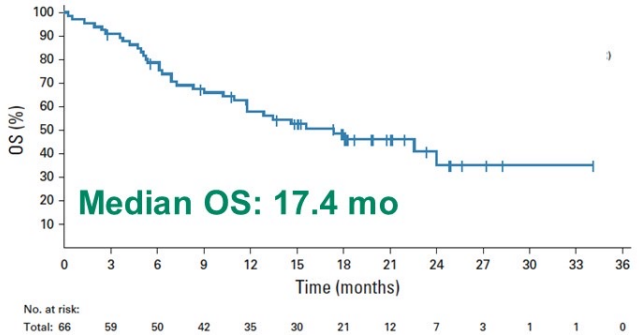
Preparation and treatment



Lifileucel for PD-1 Refractory Melanoma



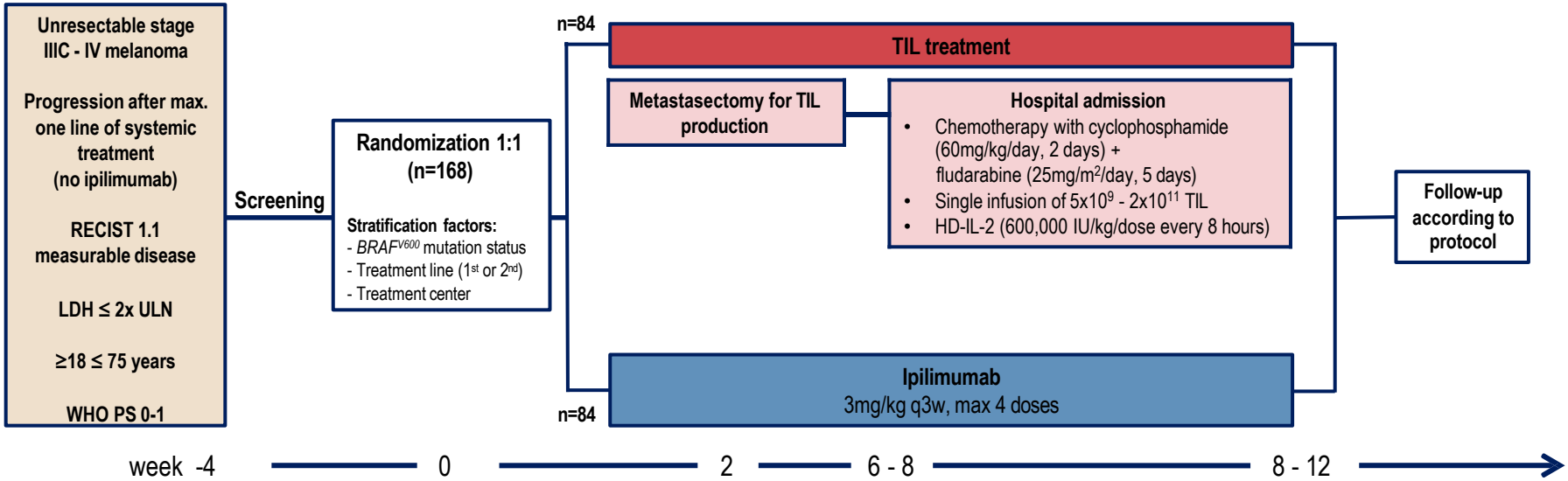




ORR: 36%
(95% CI, 25 to 49)

(Sarnaik et al. *J Clin Oncol* 2021)

Trial design

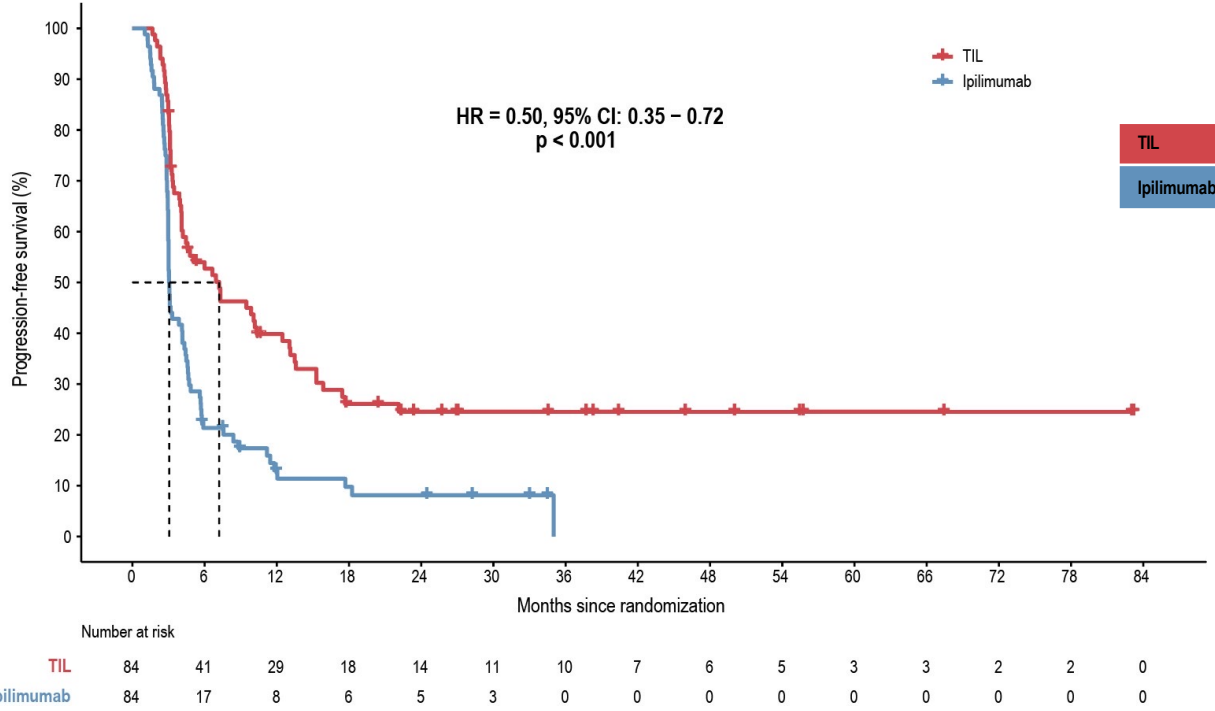


Primary endpoint: Progression-free survival (PFS) according to RECIST 1.1 per investigator review in the intention-to-treat population (ITT)*

*Using the stratified (unweighted) log-rank test and the stratified cox regression model. The study was considered to be positive when PFS after TIL is significantly longer than ipilimumab, based on the log-rank test with a two-sided p-value below 0.05.

Results (1)

Progression-free survival according to RECIST 1.1 in the ITT population



	Median follow-up (months)	Median PFS (months)	95% CI	6 month PFS (%)	95% CI
TIL	33.5	7.2	4.2 - 13.1	52.7	42.9 - 64.7
Ipilimumab	33.0	3.1	3.0 - 4.3	21.4	14.2 - 32.2

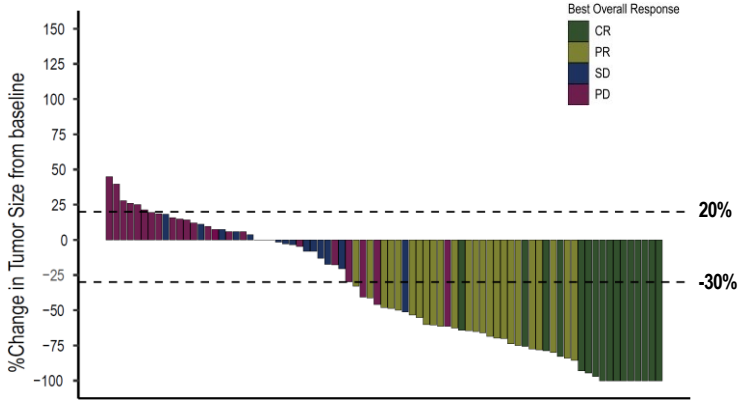
Results (2)

Best overall response according to RECIST 1.1*

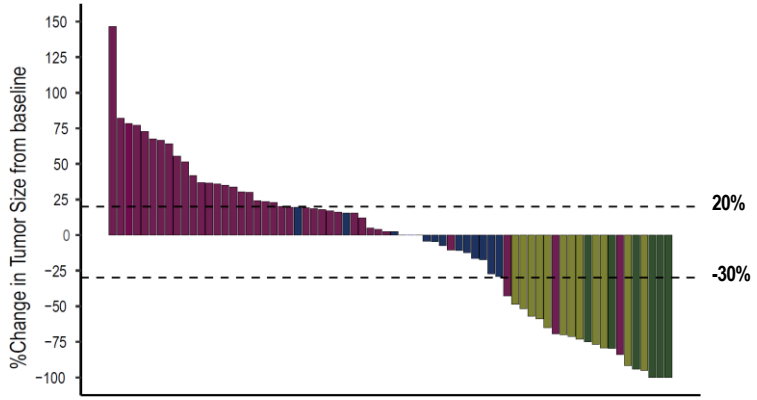
	TIL (n=84)	Ipilimumab (n=84)
Best overall response	**n (%)**	**n (%)**
Complete response	17 (20.2)	6 (7.1)
Partial response	24 (28.6)	12 (14.3)
Stable disease	16 (19.1)	15 (17.9)
Progressive disease	24 (28.6)	40 (47.6)
Not evaluable/done[#]	3 (3.6)	11 (13.1)
Overall response[†]	41 (48.8)	18 (21.4)
Clinical benefit[‡]	57 (67.9)	33 (39.3)

*In the intention-to-treat population. [#]In 3 (3.6%) and 11 (13.1%) of TIL and ipilimumab treated patients, respectively, best radiologic response could not be evaluated or was not done due to an event (death or need to start subsequent anticancer therapy) before the moment of first response evaluation or due to unevaluable target lesions in follow-up. [†]Defined as CR plus PR and [‡]CR, PR plus SD according to RECIST 1.1.

TIL treatment

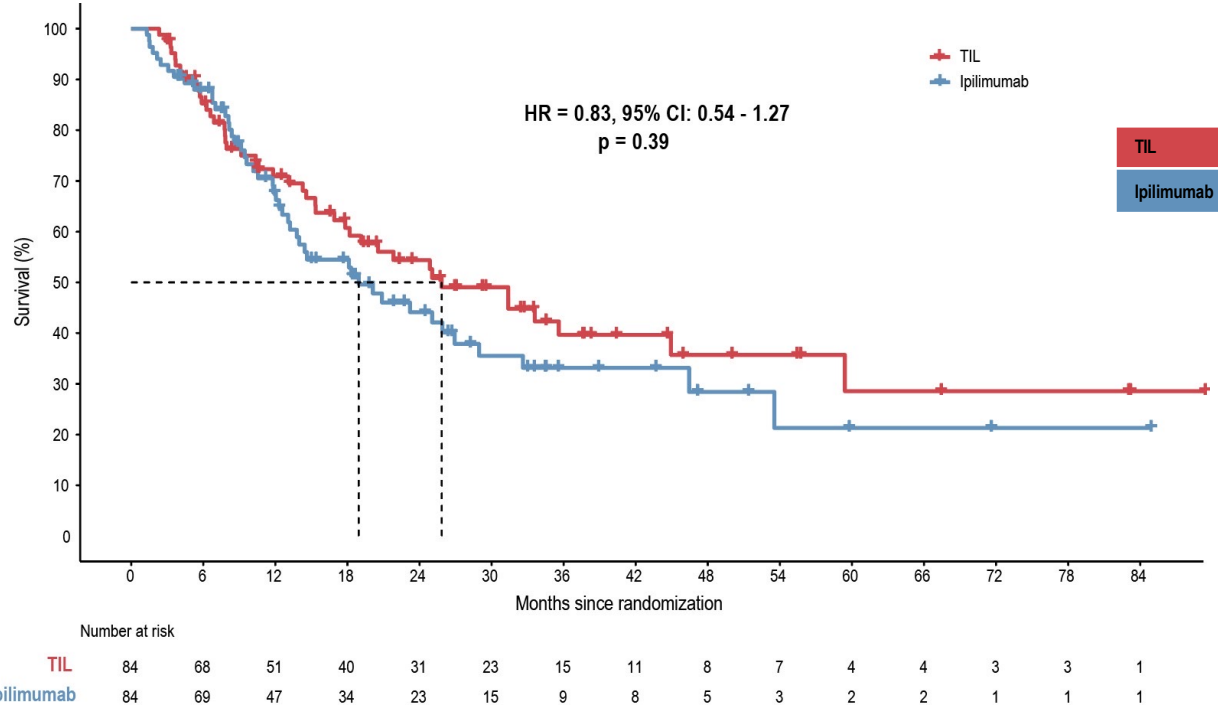


Ipilimumab treatment



Results (3)

Overall survival in the ITT population



	Median overall survival (months)	95% CI	2 year overall survival (%)	95% CI
TIL	25.8	18.2 – NR	54.4	44.0 – 67.3
Ipilimumab	18.9	13.8 – 32.6	44.1	33.7 – 57.8

Future Directions

- Cellular (TIL) therapy
  - For patients who progress or fail on immunotherapy and targeted therapy
- Neoadjuvant therapy

Why neoadjuvant treatment?

- **Downstaging disease**

→ facilitate resection/less morbidity

- **Destruction of micrometastases**

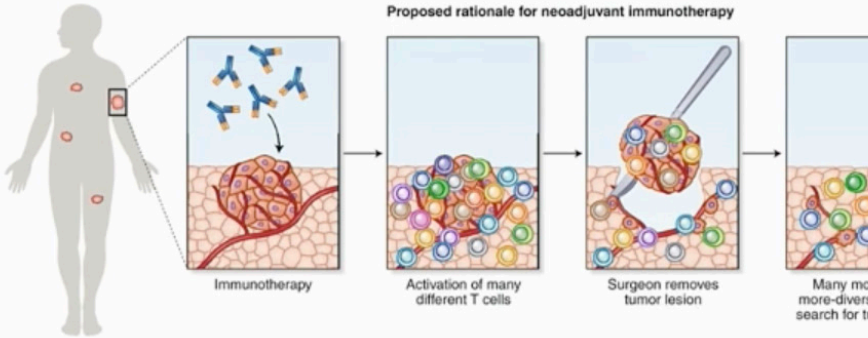
→ prevention of distant metastasis

- **More tumor antigens**

→ better and deeper immune response

- **Objectify the individual therapy response**

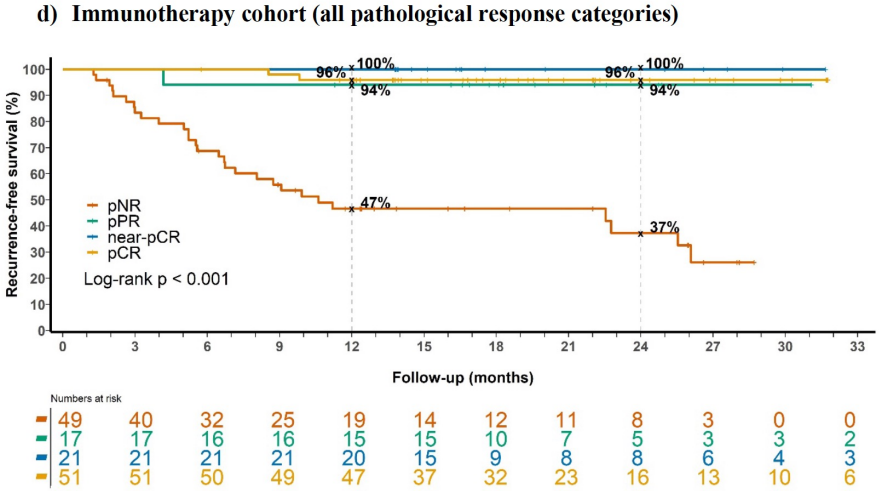
→ Personalised therapy



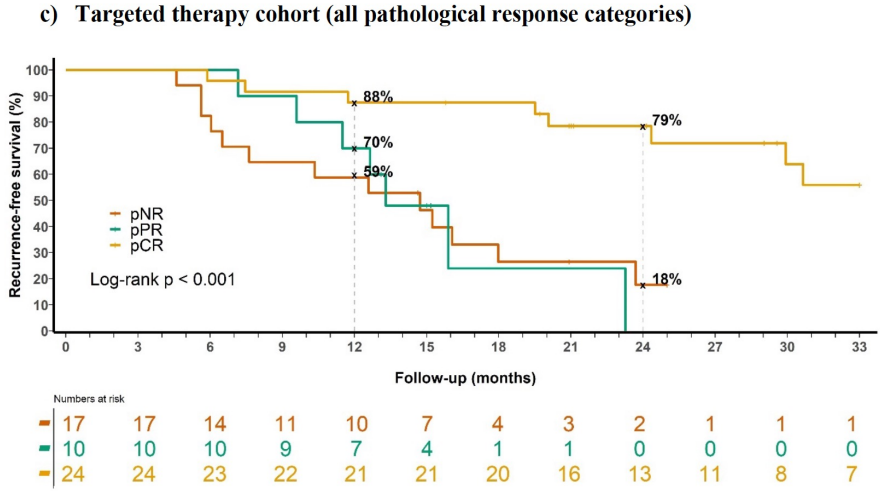
Versluis et al. Nature Medicine, 2020.

INMC pooled analysis: Pathologic response better surrogate marker for immunotherapy than for targeted therapy

Immunotherapy



Targeted Therapy



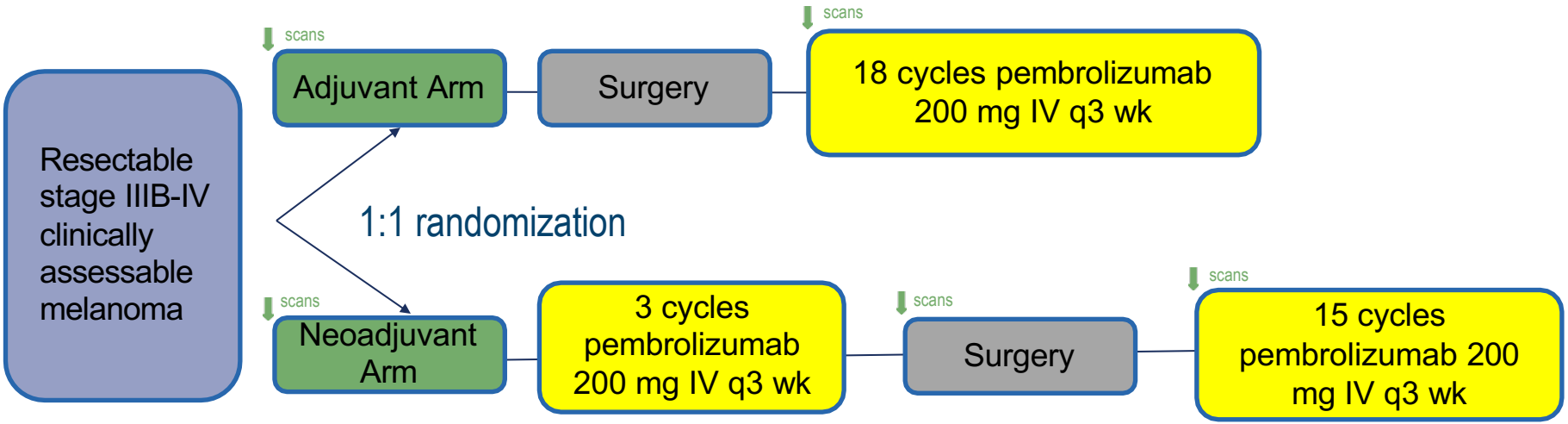
*No patient had a near-pCR

2021 ESMO congress

Menzies et al., Nat Med 2021

S1801 Study Schema

Primary endpoint: Event-free survival

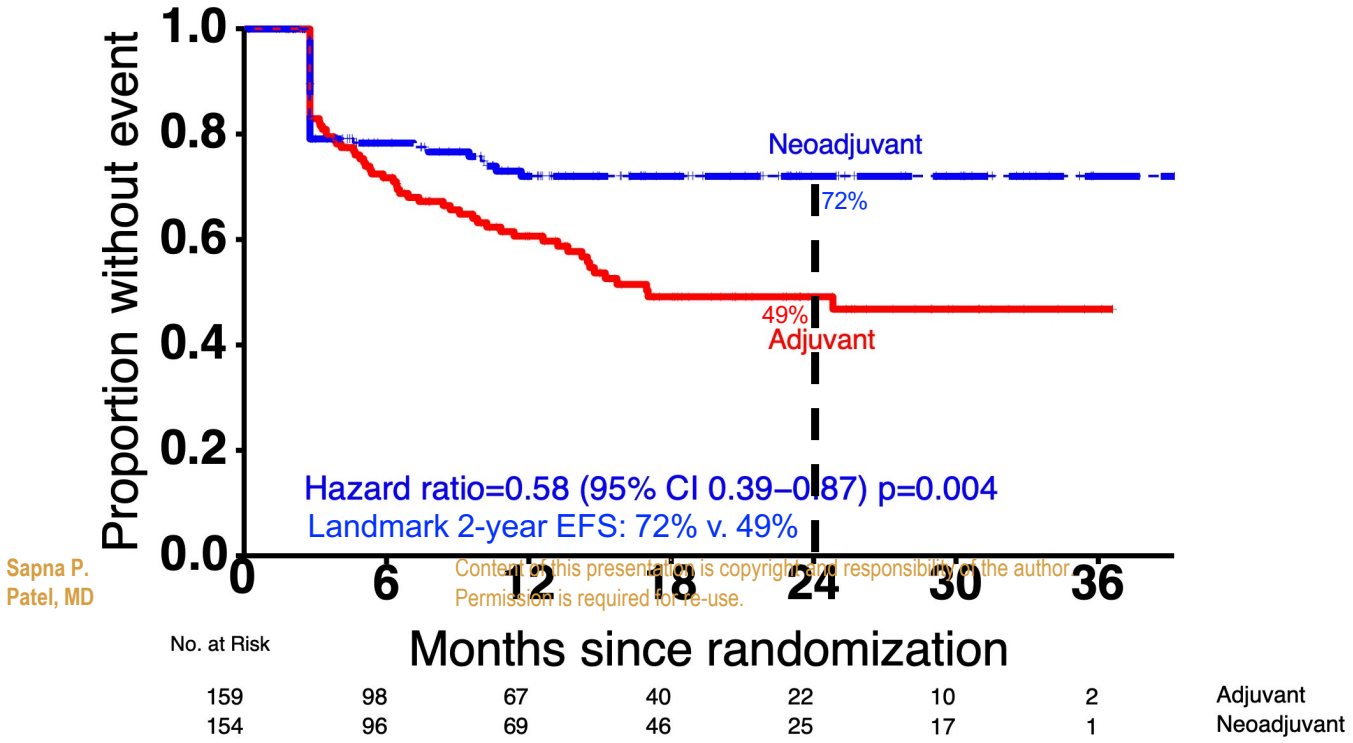


radiographic assessment (scans)

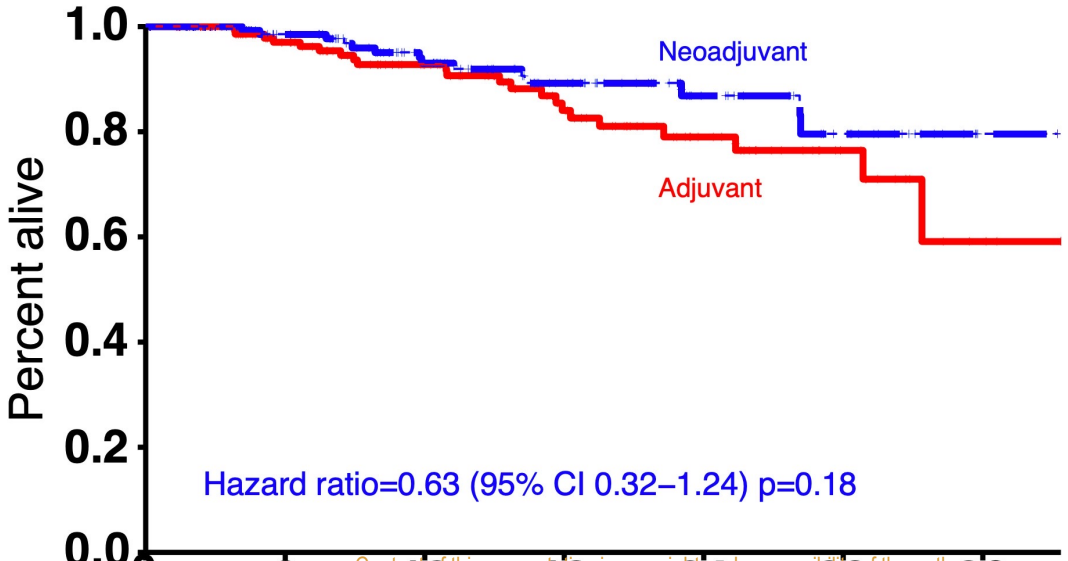
Additional criteria: strata included AJCC 8th ed. stage and LDH, adjuvant radiation allowed, concomitant radiation & pembrolizumab was not allowed, brain metastasis excluded, uveal melanoma excluded

Surgery type and extent was required to be pre-specified and carried out regardless of radiologic response to therapy

S1801 primary endpoint: Event-free survival



Overall survival



No. at Risk

159	124	93	60	33	15	3	Adjuvant
154	124	90	59	30	19	1	Neoadjuvant

Sapna P. Patel, MD

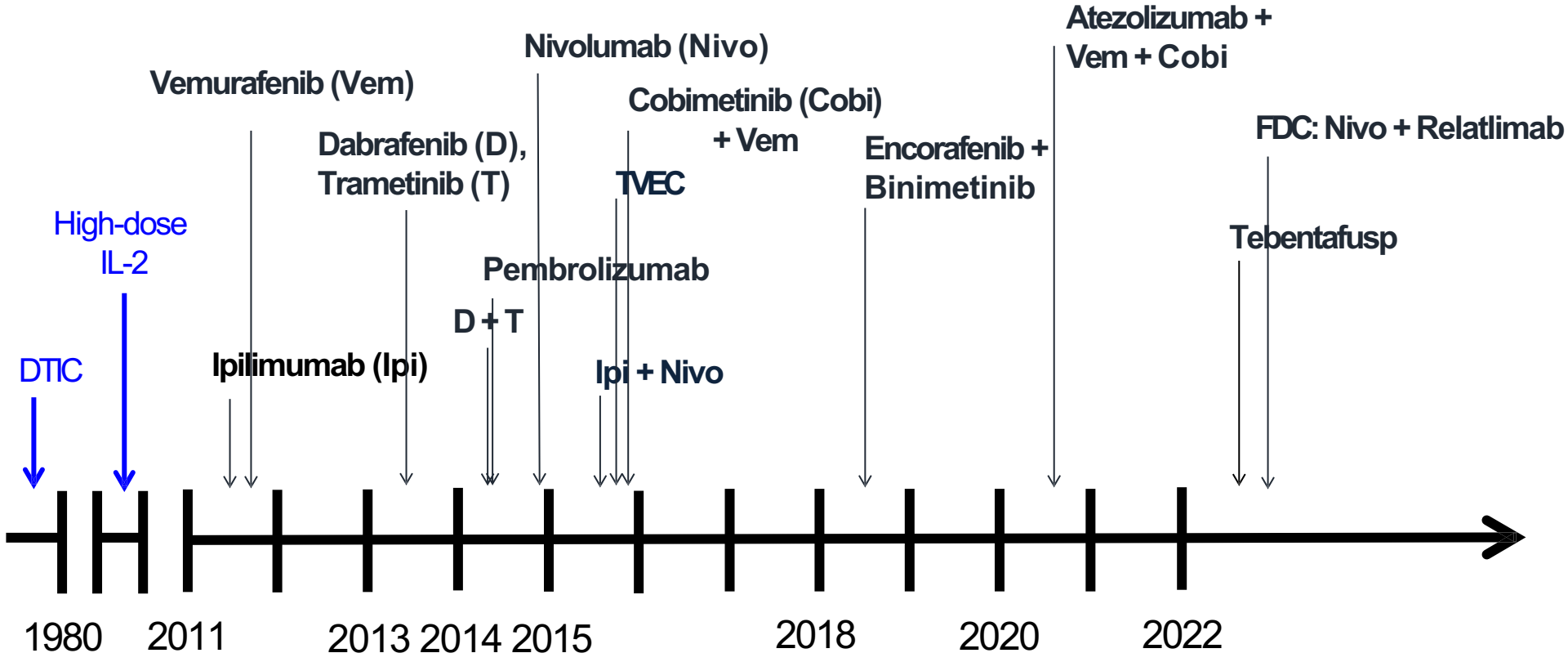
Summary & Conclusions

- For first-line therapy of metastatic melanoma, combination immunotherapy has emerged as the preferred first-line option regardless of BRAF mutation status
  - Ipi/Nivo in most patients
  - Rela/Nivo in selected patients
- Triple therapy for BRAF-MT patients is an approved option but the data are controversial
- Encouraging data for refractory patients with TIL-based therapies

Summary & Conclusions (2)

- For stage III patients after surgical resection adjuvant therapy options are
  - Single agent anti-PD1 (all patients)
  - BRAF/MEK combination (BRAF+ patients)
- New data for stage IIB and IIC melanoma suggest adjuvant immunotherapy is effective
- Neoadjuvant therapy for Stage III patients is an emerging option and additional data are awaited

Advanced Melanoma Treatment Landscape 2023



Thank you!