

Supplementary Table 1. ORRs and assessing criteria of clinical trials included in the analysis

Regimen	Cancer Type	Line	Biomarker	study							
				Phase2	Phase 2 ORR	N(Responder/total)	assessing criteria	Phase3	Phase 3 ORR	N(Responder/total)	assessing criteria
Atezolizumab	NSCLC	2L	TC1/2/3 or IC1/2/3	(Fehrenbacher et al., 2016)	38%	55/144	RECIST v1.1	(Rittmeyer et al., 2017)	14%	60/425	RECIST v1.1
Atezolizumab	NSCLC	1L	TC2/3	(Peters et al., 2017)	22%	31/142	RECIST v1.1	(Herbst et al., 2020)	31%	85/277	RECIST v1.1
Atezolizumab	Bladder cancer	2L	TC2/3	(Rosenberg et al., 2016)	27%	84/310	RECIST v1.1, imRECIST	(Powles et al., 2018)	23%	107/467	RECIST v1.1
Avelumab	NSCLC	2L	PD-L1(1%)	(Gulley et al., 2017)	25%	46/184	RECIST v1.1	(Barlesi et al., 2018)	19%	75/396	RECIST v1.1
Avelumab	NSCLC	2L	PD-L1(50%)	(Gulley et al., 2017)	33%	61/184	RECIST v1.1	(Barlesi et al., 2018)	26%	103/396	RECIST v1.1
Avelumab	NSCLC	2L	PD-L1(80%)	(Gulley et al., 2017)	43%	79/184	RECIST v1.1	(Barlesi et al., 2018)	31%	123/396	RECIST v1.1
Avelumab	Ovarian cancer	2L	PD-L1	(Disis et al., 2019)	10%	12/125	RECIST v1.1, irRECIST	(Pujade-Lauraine et al., 2021)	4%	8/188	RECIST v1.1,
Camrelizumab	Esophageal cancer	2L	PD-L1	(Huang et al., 2018)	33%	10/30	RECIST v1.1	(Huang et al., 2020)	20%	46/228	RECIST v1.1
Nivolumab	NSCLC	2L	PD-L1	(Rizvi et al., 2015)	15%	17/117	RECIST v1.1	(Brahmer et al., 2015)	20%	27/135	RECIST v1.1
Nivolumab	NSCLC	2L	PD-L1>5%	(Gettinger et al., 2016)	50%	26/52	RECIST v1.1	(Carbone et al., 2017)	26%	70/271	RECIST v1.1
Nivolumab	Melanoma	2L	PD-L1	(Topalian et al., 2012)	31%	32/104	RECIST v1.0	(Larkin et al., 2018)	27%	73/272	RECIST v1.1
Nivolumab	Glioblastoma	2L	/	(Omuro et al., 2018)	11%	1/10	RANO	(Reardon et al., 2020)	8%	14/184	RANO
Nivolumab	Ovarian Cancer	2L	PD-L1	(Hamanishi et al., 2015)	15%	3/20	RECIST v1.1	(Hamanishi et al., 2021)	8%	12/157	RECIST v1.1
Nivolumab	Esophageal cancer	2L	PD-L1	(Kudo et al., 2017)	17%	11/65	RECIST v1.1	(Kato et al., 2019)	19%	40/210	RECIST v1.1
Nivolumab	RCC	2L	PD-L1	(Motzer, Rini, et al., 2015)	22%	37/168	RECIST v1.1	(Motzer, Escudier, et al., 2015)	25%	103/410	RECIST v1.1
Nivolumab	Gastric cancer	2L	PD-L1	(Janjigian et al., 2018)	12%	7/59	RECIST v1.1	(Kang et al., 2017)	11%	37/330	RECIST v1.1
Nivolumab	MPM	2L	PD-L1	(Okada et al., 2019)	29%	10/34	RECIST v1.1, mRECIST	(Fennell et al., 2021)	11%	24/221	RECIST v1.1, mRECIST
Pembrolizumab	HL	HSCT	PD-L1	(Chen et al., 2017)	72%	151/210	RRC	(Kuruvilla et al., 2021)	66%	99/151	RRC
Pembrolizumab	TNBC	2L	PD-L1	(Nanda et al., 2016)	19%	21/111	RECIST v1.1	(Winer et al., 2021)	10%	30/312	RECIST v1.1

Pembrolizumab	HNSCC	2L	PD-L1	(Seiwert et al., 2016)	16%	10/60	RECIST v1.1	(Cohen et al., 2019)	15%	36/247	RECIST v1.1, imRECIST
Pembrolizumab	Gastric cancer	1L	PD-L1 \geq 1%	(Bang et al., 2019)	26%	8/31	RECIST v1.1	(Shitara et al., 2020)	15%	38/256	RECIST v1.1
Pembrolizumab	Bladder cancer	2L	PD-L1	(Taylor et al., 2020)	31%	43/137	RECIST v1.1	(Y.Loriot et al., 2022)	25%	55/218	RECIST v1.1
Cemiplimab	Cervix cancer	2L	PD-L1	(Rischin et al., 2020)	17%	2/10	RECIST v1.1	(Tewari et al., 2022)	16%	50/304	RECIST v1.1
Avelumab+Axitinib	RCC	1L	PD-L1	(Choueiri et al., 2018)	66%	36/55	RECIST v1.1	(Motzer et al., 2019)	55%	244/442	RECIST v1.1
Atezolizumab+bevacizumab	RCC	1L	PD-L1	(McDermott et al., 2018)	64%	65/101	RECIST v1.1	(Rini, Powles, et al., 2019)	47%	213/454	RECIST v1.1
Atezolizumab+Chemotherapy	NSCLC	1L	/	(Liu et al., 2017)	46%	12/25	RECIST v1.1	(Nishio et al., 2021)	43%	126/292	RECIST v1.1
Atezolizumab+Paclitaxel(Albumin bound)	TNBC	1L	PD-L1	(Adams et al., 2019)	41%	14/33	RECIST v1.1	(Schmid et al., 2018)	59%	266/451	RECIST v1.1
Gemcitabine+cisplatin+durvalumab+tremelimumab	Biliary tract cancer	1L	PD-L1	(Oh et al., 2022)	72%	89/124	irRECIST	(Oh D-Y, 2022)	26%	89/341	RECIST v1.1
Camrelizumab+rivoceranib	HCC	1L	PD-L1	(Xu, Shen, et al., 2021)	34%	65/190	RECIST v1.1	(Qin et al., 2022)	25%	69/272	RECIST v1.1
Atezolizumab+Cobimetinib	Melanoma	1L	PD-L1/BRAF	(Hellmann et al., 2019)	41%	62/150	RECIST v1.1	(Gogas et al., 2021)	26%	58/222	RECIST v1.1
Atezolizumab+Cobimetinib	CRC	3L	PD-L1/BRAF/RAS	(Hellmann et al., 2019)	8%	12/150	RECIST v1.1	(Eng et al., 2019)	3%	5/183	RECIST v1.1
Nivolumab+bempegaldesleukin	Melanoma	1L	PD-L1/BRAF	(Diab et al., 2021)	53%	22/41	RECIST v1.1	(Diab, 2022)	28%	108/391	RECIST v1.1
Nivolumab+bempegaldesleukin	RCC	1L	PD-L1	(Tannir et al., 2022)	35%	17/49	RECIST v1.1	(Nizar Tannir, 2022)	23%	118/514	RECIST v1.1
Pembrolizumab+talinogene laherparepvec	Melanoma	2L	/	(G. V. Long et al., 2016)	62%	16/25	RECIST v1.1	(Chesney et al., 2023)	49%	168/346	irRECIST
Pembrolizumab+Axitinib	RCC	1L	PD-L1	(Atkins et al., 2018)	73%	38/52	RECIST v1.1	(Rini, Plimack, et al., 2019)	59%	256/432	RECIST v1.1
Pembrolizumab+Epacadostat	Melanoma	1L	PD-L1/IDO1	(Mitchell et al., 2018)	56%	35/62	RECIST v1.1	(Long et al., 2019)	34%	121/354	RECIST v1.1
Pembrolizumab+Chemotherapy	TNBC	1L	PD-L1 \geq 1%	(Chun et al., 2022)	43%	6/14	RECIST v1.1	(Cortes et al., 2020)	53%	114/215	RECIST v1.1
Pembrolizumab+Chemotherapy	Gastric cancer	1L	PD-L1	(Bang et al., 2019)	60%	15/25	RECIST v1.1	(Shitara et al., 2020)	49%	126/257	RECIST v1.1
Pembrolizumab+Lenvatinib	HCC	1L	AFP	(Finn et al., 2020)	36%	36/100	RECIST v1.1	(Finn, 2022)	26%	103/395	RECIST v1.1
Lenvatinib+Pembrolizumab	endometrial cancer	1L	MSI-H/dMMR	(Makker et al., 2020)	64%	7/11	RECIST v1.1	(Makker et al., 2022)	40%	26/45	RECIST v1.1
Pembrolizumab+pomalido	MM	3L	PD-L1/CD3	(Badros et al., 2020)	60%	29/48	International	(Mateos et al., 2020)	34%	43/125	International

midе+dexamethasone				2017)			Myeloma Working Group criteria	2019)			Myeloma Working Group criteria
Pembrolizumab+Dabrafenib+trametinib	Melanoma	1L	PD-L1/BRAF	(Ascierto et al., 2019)	78%	47/60	RECIST v1.1	(Dummer et al., 2022)	69%	184/267	RECIST v1.1
Pembrolizumab+trastuzumab	Gastric cancer	1L	PD-L1/HER2	(Janjigian et al., 2020)	91%	34/37	RECIST v1.1	(Janjigian & Kawazoe, 2021)	74%	161/217	RECIST v1.1
Durvalumab+Tremelimumab+Chemotherapy	NSCLC	1L	PD-L1 TC <25%	(Antonia et al., 2016)	23%	23/102	RECIST v1.1	(Planchard et al., 2020)	15%	26/174	RECIST v1.1
Atezolizumab+cobimetinib+vemurafenib	Melanoma	1L	PD-L1/BRAF	(Sullivan et al., 2019)	72%	95/133	RECIST v1.1	(Gutzmer et al., 2020)	66%	164/247	RECIST v1.1
Sintilimab+IBI305	HCC	1L	α-fetoprotein	(Ren et al., 2021)	25%	9/37	RECIST v1.1, mRECIST	(Ren et al., 2021)	24%	91/380	RECIST v1.1, mRECIST
Sintilimab+chemotherapy	NSCLC-Squamous	1L	PD-L1	(Jiang et al., 2021)	65%	27/41	RECIST v1.1	(Zhou et al., 2021)	45%	80/179	RECIST v1.1
Sintilimab+chemotherapy	NSCLC-Non Squamous	1L	PD-L1	(Jiang et al., 2021)	68%	28/41	RECIST v1.1	(Yang et al., 2020)	52%	138/266	RECIST v1.1
Oxaliplatin+Sintilimab+Capecitabine	Gastric cancer	1L	PD-L1	(Jiang et al., 2020)	85%	17/20	RECIST v1.1	(Xu, Jiang, et al., 2021)	65%	213/327	RECIST v1.1
Nivolumab+Ipilimumab	NSCLC	1L	PD-L1	(Hellmann et al., 2017)	48%	37/77	RECIST v1.1	(Hellmann et al., 2018)	36%	50/139	RECIST v1.1
Ipilimumab+Nivolumab	Melanoma	1L	PD-L1/BRAF	(Hodi et al., 2016)	61%	58/95	RECIST v1.1	(Larkin et al., 2015)	58%	181/314	RECIST v1.1

Supplement Table 2 Table of primary endpoints and week intervals for tumor assessment of clinical trials included in the analysis

Regimen	Cancer Type	study					
		Phase2	Primary Endpoint	Intervals for tumor assessment	Phase3	Primary Endpoint	Intervals for tumor assessment
Atezolizumab	NSCLC	(Fehrenbacher et al., 2016)	OS	Every 6 weeks for 36 weeks, followed by 9-weeks interval	(Rittmeyer et al., 2017)	OS	Every 6 weeks for 36 weeks, followed by 9-weeks interval
Atezolizumab	NSCLC	(Peters et al., 2017)	ORR	Every 6 weeks for 12 months, followed by 9-weeks interval	(Herbst et al., 2020)	OS	Every 6 weeks for 48 weeks, followed by 9-weeks interval
Atezolizumab	Bladder cancer	(Rosenberg et al., 2016)	ORR	Every 9 weeks for 12 months, followed by 12-weeks interval	(Powles et al., 2018)	OS	Every 9 weeks for 54 weeks, followed by 12-weeks interval
Avelumab	NSCLC	(Gulley et al., 2017)	BOR	Every 6 weeks	(Barlesi et al., 2018)	OS	Every 6 weeks for 12 months, followed by 12-weeks interval
Avelumab	NSCLC	(Gulley et al., 2017)	BOR	Every 6 weeks	(Barlesi et al., 2018)	OS	Every 6 weeks for 12 months, followed by 9-weeks interval
Avelumab	NSCLC	(Gulley et al., 2017)	BOR	Every 6 weeks	(Barlesi et al., 2018)	OS	Every 6 weeks for 12 months, followed by 9-weeks interval
Avelumab	Ovarian cancer	(Disis et al., 2019)	BOR	Every 6 weeks	(Pujade-Lauraine et al., 2021)	OS/PFS	Every 8 weeks until disease progression
Camrelizumab	Esophageal cancer	(Huang et al., 2018)	Safety	Every 8 weeks for 6 months,	(Huang et al., 2020)	OS	Every 8 weeks

				followed by 12-weeks interval			
Nivolumab	NSCLC	(Rizvi et al., 2015)	ORR	Every 6 weeks until disease progression	(Brahmer et al., 2015)	OS	Every 6 weeks
Nivolumab	NSCLC	(Gettinger et al., 2016)	ORR	Every 3 months until documented progression	(Carbone et al., 2017)	OS	Every 6 weeks for 48 weeks, followed by 12-weeks interval
Nivolumab	Melanoma	(Topalian et al., 2012)	Safety	unknown	(Larkin et al., 2018)	ORR/OS	Every 6 weeks for 1 year, followed by 12-weeks interval
Nivolumab	Glioblastoma	(Omuro et al., 2018)	Safety	Every 6 weeks for 12 weeks, followed by 8-weeks interval	(Reardon et al., 2020)	OS	Every 6 weeks for 12 weeks, followed by 8-weeks interval
Nivolumab	Ovarian Cancer	(Hamanishi et al., 2015)	ORR	Every 2 months for 1 year or until PD, progression	(Hamanishi et al., 2021)	OS	Every 8 weeks for 48 weeks, followed by 12-weeks interval
Nivolumab	Esophageal cancer	(Kudo et al., 2017)	ORR	Every 6 weeks for 1 year, followed by 12-weeks interval	(Kato et al., 2019)	OS	Every 6 weeks for 1 year, followed by 12-weeks interval
Nivolumab	RCC	(Motzer, Rini, et al., 2015)	ORR	Every 6 weeks for 12 months, followed by 12-weeks interval	(Motzer, Escudier, et al., 2015)	OS	Every 8 weeks for 1 year, followed by 12-weeks interval
Nivolumab	Gastric cancer	(Janjigian et al., 2018)	ORR	Every 6 weeks for 24 weeks, followed by 12-weeks interval	(Kang et al., 2017)	OS	Every 6 weeks for 14 months, followed by 12-weeks interval

Nivolumab	MPM	(Okada et al., 2019)	ORR	Every 6 weeks	(Fennell et al., 2021)	OS/PFS	Every 6 weeks
Pembrolizumab	HL	(Chen et al., 2017)	ORR	Every 12 weeks	(Kuruville et al., 2021)	OS/PFS	Every 12 weeks
Pembrolizumab	TNBC	(Nanda et al., 2016)	ORR	Every 8 weeks	(Winer et al., 2021)	OS	Every 9 weeks for 12 months, followed by 12-weeks interval
Pembrolizumab	HNSCC	(Seiwert et al., 2016)	ORR	unknown	(Cohen et al., 2019)	OS	6 weeks for 1 year, and then 9 weeks
Pembrolizumab	Gastric cancer	(Bang et al., 2019)	ORR	Every 6 weeks for 1 year, followed by 9-weeks interval	(Shitara et al., 2020)	OS/PFS	Every 6 weeks
Pembrolizumab	Bladder cancer	(Taylor et al., 2020)	Safety	24 th week	(Y.Loriot et al., 2022)	OS/PFS	unknown
Cemiplimab	Cervix cancer	(Rischin et al., 2020)	Safety	Every 8 weeks	(Tewari et al., 2022)	OS	Every 4 weeks at beginning, then every 6 weeks
Avelumab+Axitinib	RCC	(Choueiri et al., 2018)	Safety	Every 6 weeks for 1 year, followed by 12-weeks interval	(Motzer et al., 2019)	OS/PFS	Every 6 weeks for 18 months, followed by 12-weeks interval
Atezolizumab+bevacizumab	RCC	(McDermott et al., 2018)	PD/PFS	Every 12 weeks	(Rini, Powles, et al., 2019)	OS/PD/PFS	Every 6 weeks for 78 weeks, followed by 12-weeks interval
Atezolizumab+Chemotherapy	NSCLC	(Liu et al., 2017)	Safety	unknown	(Nishio et al., 2021)	OS/PFS	Every 6 weeks for 48 weeks, followed by 9-weeks interval

Atezolizumab+Paclitaxel(Albumin bound)	TNBC	(Adams et al., 2019)	Safety	Every 4 weeks for 1 year, followed by 8-weeks interval	(Schmid et al., 2018)	OS/PFS	Every 8 weeks for 12 months, followed by 12-weeks interval
Gemcitabine+cisplatin+durvalumab+remelimumab	Biliary tract cancer	(Oh et al., 2022)	ORR	Every 6 weeks	(Oh D-Y, 2022)	OS	unknown
Camrelizumab+rivoceranib	HCC	(Xu, Shen, et al., 2021)	ORR	8 weeks for 48 weeks, and then 12 weeks	(Qin et al., 2022)	OS/PFS	unknown
Atezolizumab+Cobimetinib	Melanoma	(Hellmann et al., 2019)	ORR	Every 8 weeks	(Gogas et al., 2021)	ORR/OS	Every 8 weeks for 80 weeks, followed by 12-weeks interval
Atezolizumab+Cobimetinib	CRC	(Hellmann et al., 2019)	ORR	Every 8 weeks	(Eng et al., 2019)	OS/PFS	Every 8 weeks until PD
Nivolumab+bempegaldesleukin	Melanoma	(Diab et al., 2021)	Safety	Every 8 weeks	(Diab, 2022)	PFS	unknown
Nivolumab+bempegaldesleukin	RCC	(Tannir et al., 2022)	ORR	Every 8 weeks	(Nizar Tannir, 2022)	ORR/OS	unknown
Pembrolizumab+talimogene laherparepvec	Melanoma	(G. V. Long et al., 2016)	Safety	unknown	(Chesney et al., 2023)	OS/PFS	Every 12 weeks
Pembrolizumab+Axitinib	RCC	(Atkins et al., 2018)	Safety	Every 6 weeks for 66 weeks, followed by 12-weeks interval	(Rini, Plimack, et al., 2019)	OS/PFS	Every 6 weeks for 54 weeks, followed by 12-weeks interval
Pembrolizumab+Epacadostat	Melanoma	(Mitchell et al., 2018)	ORR	Every 9 weeks for 18 months, followed by 12-weeks interval	(Long et al., 2019)	OS/PFS	Every 9 weeks for 102 weeks, followed by 12-weeks interval
Pembrolizumab+Chemotherapy	TNBC	(Chun et al., 2022)	Safety	unknown	(Cortes et al., 2020)	OS/PFS	Every 8 weeks for 24 weeks,

							followed by 9-weeks interval
Pembrolizumab+Chemotherapy	Gastric cancer	(Bang et al., 2019)	ORR	Every 6 weeks for 1 year, followed by 9-weeks interval	(Shitara et al., 2020)	OS/PFS	Every 6 weeks
Pembrolizumab+Lenvatinib	HCC	(Finn et al., 2020)	ORR	Every 6 weeks for 24 weeks, followed by 9-weeks interval	(Finn, 2022)	OS/PFS	unknown
Lenvatinib+Pembrolizumab	endometrial cancer	(Makker et al., 2020)	ORR	Every 8 weeks	(Makker et al., 2022)	OS/PFS	Every 6 weeks for 24 weeks, followed by 9-weeks interval
Pembrolizumab+pomalidomide+dexamethasone	MM	(Badros et al., 2017)	Safety	unknown	(Mateos et al., 2019)	OS/PFS	unknown
Pembrolizumab+Dabrafenib+trametinib	Melanoma	(Ascierto et al., 2019)	ORR/PFS	Every 6 weeks for 18 months, followed by 12-weeks interval	(Dummer et al., 2022)	PFS	unknown
Pembrolizumab+trastuzumab	Gastric cancer	(Janjigian et al., 2020)	PFS	Every 9 weeks	(Janjigian & Kawazoe, 2021)	OR/PFS	Every 6 weeks
Durvalumab+Tremelimumab+Chemotherapy	NSCLC	(Antonia et al., 2016)	ORR	Every 8 weeks for 12 months, followed by 6-months interval	(Planchard et al., 2020)	OS	Every 8 weeks for 12 months, followed by 6-months interval
Atezolizumab+cobimetinib+vemurafenib	Melanoma	(Sullivan et al., 2019)	Safety	Every 4 weeks	(Gutzmer et al., 2020)	PFS	Every 8 weeks for 24 months, followed by 12-weeks interval
Sintilimab+IBI305	HCC	(Ren et al.,	OS/PFS	Every 6 weeks	(Ren et al.,	OS/PFS	Every 6 weeks

		2021)		for 48 weeks, followed by 12- weeks interval	2021)		for 48 weeks, followed by 12- weeks interval
Sintilimab+chemotherapy	NSCLC-Squamous	(Jiang et al., 2021)	ORR	Every 9 weeks	(Zhou et al., 2021)	OS/PFS	Every 9 weeks for 48 weeks, followed by 12- weeks interval
Sintilimab+chemotherapy	NSCLC-Non Squamous	(Jiang et al., 2021)	ORR	Every 9 weeks	(Yang et al., 2020)	OS/PFS	Every 9 weeks for 48 weeks, followed by 12- weeks interval
Oxaliplatin+Sintilimab+Capecitabine	Gastric cancer	(Jiang et al., 2020)	ORR	Every 9 weeks	(Xu, Jiang, et al., 2021)	OS	unknown
Nivolumab+Ipilimumab	NSCLC	(Hellmann et al., 2017)	ORR	Every 6 weeks for 24 weeks, followed by 12- weeks interval	(Hellmann et al., 2018)	OS/PFS	Every 6 weeks for 24 weeks, followed by 12- weeks interval
Ipilimumab+Nivolumab	Melanoma	(Hodi et al., 2016)	ORR	Every 6 weeks for 1 year, followed by 12- weeks interval	(Larkin et al., 2015)	OS/PFS	Every 6 weeks for 49 weeks, followed by 12- weeks interval

Supplementary Table 3. Cochrane standards for assessing risk of bias in included studies

Study	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personell (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)
(Fehrenbacher et al., 2016)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Rittmeyer et al., 2017)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Peters et al., 2017)	Low risk	Unclear risk	Low risk	Low risk	Low risk	Low risk
(Herbst et al., 2020)	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk
(Rosenberg et al., 2016)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Powles et al., 2018)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Gulley et al., 2017)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Barlesi et al., 2018)	Low risk	Unclear risk	Low risk	Low risk	Low risk	Low risk
(Gulley et al., 2017)	Unclear risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Barlesi et al., 2018)	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk
(Gulley et al., 2017)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Barlesi et al., 2018)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Disis et al., 2019)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Pujade-Lauraine et al., 2021)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Huang et al., 2018)	Low risk	Unclear risk	Low risk	Low risk	Unclear risk	Low risk
(Huang et al., 2020)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Rizvi et al., 2015)	Unclear risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Brahmer et al., 2015)	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk
(Gettinger et al., 2016)	Low risk	Unclear risk	Low risk	Low risk	Low risk	Low risk
(Carbone et al., 2017)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Topalian et al., 2012)	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk

(Larkin et al., 2018)	Unclear risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Omuro et al., 2018)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Reardon et al., 2020)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Hamanishi et al., 2015)	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk
(Hamanishi et al., 2021)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Kudo et al., 2017)	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk
(Kato et al., 2019)	Low risk	Low risk	Low risk	Low risk	Unclear risk	Low risk
(Motzer, Rini, et al., 2015)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Motzer, Escudier, et al., 2015)	Low risk	Unclear risk	Low risk	Low risk	Low risk	Low risk
(Janjigian et al., 2018)	Unclear risk	Low risk	Low risk	Low risk	Low risk	Unclear risk
(Kang et al., 2017)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Okada et al., 2019)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Fennell et al., 2021)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Chen et al., 2017)	Low risk	Low risk	Low risk	Low risk	Unclear risk	Low risk
(Kuruvilla et al., 2021)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Nanda et al., 2016)	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk
(Winer et al., 2021)	Unclear risk	Unclear risk	Low risk	Low risk	Low risk	Low risk
(Seiwert et al., 2016)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Cohen et al., 2019)	Low risk	Low risk	Low risk	Low risk	Unclear risk	Low risk
(Bang et al., 2019)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Shitara et al., 2020)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Taylor et al., 2020)	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk
(Y.Loriot et al., 2022)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Rischin et al., 2020)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Tewari et al., 2022)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Choueiri et al., 2018)	Low risk	Low risk	Low risk	Low risk	Unclear risk	Low risk

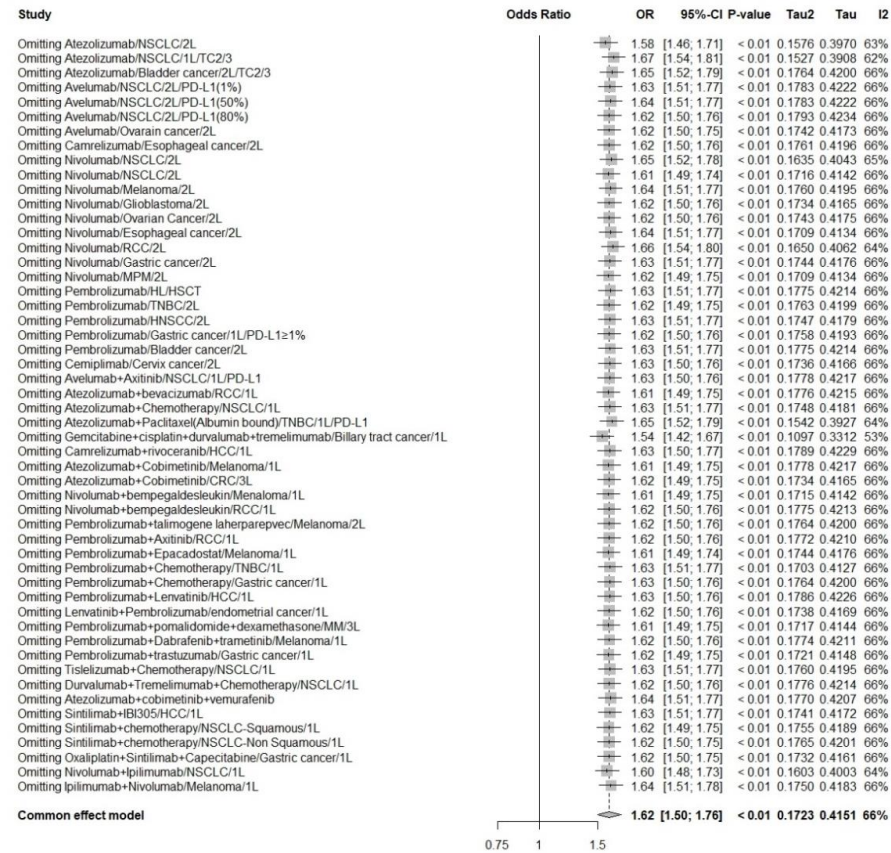
(Motzer et al., 2019)	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk
(McDermott et al., 2018)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Rini, Powles, et al., 2019)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Liu et al., 2017)	Unclear risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Nishio et al., 2021)	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk
(Adams et al., 2019)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Schmid et al., 2018)	Low risk	Unclear risk	Low risk	Low risk	Low risk	Low risk
(Oh et al., 2022)	Low risk	Low risk	Low risk	Low risk	Unclear risk	Low risk
(Oh D-Y, 2022)	unknown	unknown	unknown	unknown	unknown	unknown
(Xu, Shen, et al., 2021)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Qin et al., 2022)	unknown	unknown	unknown	unknown	unknown	unknown
(Hellmann et al., 2019)	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk
(Gogas et al., 2021)	Low risk	Unclear risk	Low risk	Low risk	Low risk	Low risk
(Hellmann et al., 2019)	Unclear risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Eng et al., 2019)	Low risk	Low risk	Low risk	Low risk	Unclear risk	Low risk
(Diab et al., 2021)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Diab, 2022)	unknown	unknown	unknown	unknown	unknown	unknown
(Tannir et al., 2022)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Nizar Tannir, 2022)	unknown	unknown	unknown	unknown	unknown	unknown
(G. V. Long et al., 2016)	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk
(Chesney et al., 2023)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Atkins et al., 2018)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Rini, Plimack, et al., 2019)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Mitchell et al., 2018)	Unclear risk	Low risk	Low risk	Low risk	Unclear risk	Low risk
(Long et al., 2019)	Low risk	Low risk	Unclear risk	Low risk	Low risk	Low risk
(Chun et al., 2022)	Unclear risk	Low risk	Low risk	Low risk	Low risk	Unclear risk

(Cortes et al., 2020)	Low risk	Low risk	Low risk	Low risk	Unclear risk	Low risk
(Bang et al., 2019)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Shitara et al., 2020)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Finn et al., 2020)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Finn, 2022)	unknown	unknown	unknown	unknown	unknown	unknown
(Makker et al., 2020)	Low risk	Low risk	Low risk	Low risk	Unclear risk	Low risk
(Makker et al., 2022)	Unclear risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Badros et al., 2017)	Low risk	Low risk	Low risk	Low risk	Unclear risk	Low risk
(Mateos et al., 2019)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Ascierto et al., 2019)	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk
(Dummer et al., 2022)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Janjigian et al., 2020)	Low risk	Low risk	Low risk	Low risk	Unclear risk	Low risk
(Janjigian & Kawazoe, 2021)	Low risk	Unclear risk	Low risk	Low risk	Low risk	Low risk
(Antonia et al., 2016)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Planchard et al., 2020)	Unclear risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Sullivan et al., 2019)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Gutzmer et al., 2020)	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk
(Ren et al., 2021)	Unclear risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Ren et al., 2021)	Low risk	Low risk	Low risk	Low risk	Unclear risk	Low risk
(Jiang et al., 2021)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Zhou et al., 2021)	Unclear risk	Unclear risk	Low risk	Low risk	Low risk	Low risk
(Jiang et al., 2021)	Unclear risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Yang et al., 2020)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Jiang et al., 2020)	Low risk	Low risk	Low risk	Unclear risk	Low risk	Low risk
(Xu, Jiang, et al., 2021)	unknown	unknown	unknown	unknown	unknown	unknown
(Hellmann et al., 2017)	Unclear risk	Low risk	Low risk	Low risk	Unclear risk	Low risk

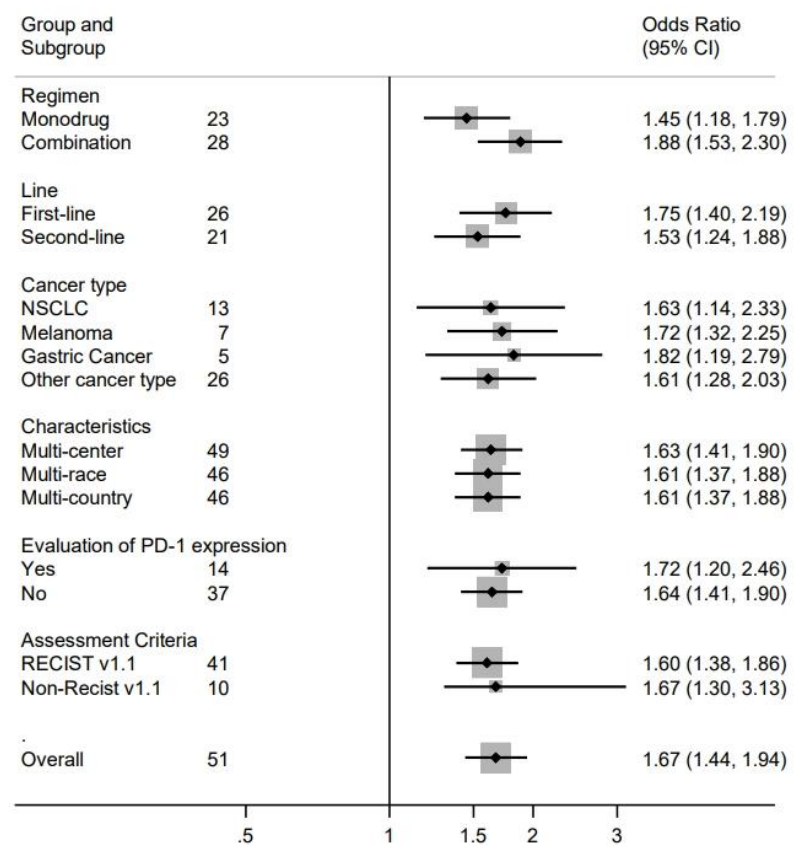
(Hellmann et al., 2018)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Hodi et al., 2016)	Low risk	Unclear risk	Unclear risk	Low risk	Unclear risk	Low risk
(Larkin et al., 2015)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk

Supplementary Table 4. Multinomial logistics models for determinants of overestimation.

Models	Estimate	Standard Error	P value
Multinomial Logistic Model 1			
Autoimmune disease	2.205818	0.935784	0.0184139*
Other malignancy history	-0.29868	0.799317	0.7086488
PD-1 expression of tumor cells or immune cells	-1.24573	0.787039	0.1134648
Size	0.001129	0.002598	0.6637954
Multinomial Logistic Model 2			
Autoimmune disease	2.206813	0.936306	0.01842643*
PD-1 expression of tumor cells or immune cells	-1.18696	0.782397	0.12924528
Prior immunotherapy treatment	0.247124	1.018564	0.80829974
Size	0.001393	0.002509	0.57878478
Multinomial Logistic Model 3			
Autoimmune disease	2.099053	0.927734	0.02366291*
PD-1 expression of tumor cells or immune cells	-1.17903	0.783309	0.13227475
Immunosuppressive therapy	0.438969	0.705617	0.53387211
Size	0.00177	0.002581	0.49279497



Supplementary Figure 1. Stepwise exclusion approach to evaluate sensitivity.



Supplementary Figure 2. subgroup analysis. combined results of these subgroups were statistically significant and consistent with the original conclusion of the meta-analysis.

References

- Adams, S., Diamond, J. R., Hamilton, E., Pohlmann, P. R., Tolaney, S. M., Chang, C. W., Zhang, W., Iizuka, K., Foster, P. G., Molinero, L., Funke, R., & Powderly, J. (2019). Atezolizumab Plus nab-Paclitaxel in the Treatment of Metastatic Triple-Negative Breast Cancer With 2-Year Survival Follow-up: A Phase 1b Clinical Trial. *JAMA Oncol*, *5*(3), 334-342. <https://doi.org/10.1001/jamaoncol.2018.5152>
- Antonia, S., Goldberg, S. B., Balmanoukian, A., Chaft, J. E., Sanborn, R. E., Gupta, A., Narwal, R., Steele, K., Gu, Y., Karakunnel, J. J., & Rizvi, N. A. (2016). Safety and antitumour activity of durvalumab plus tremelimumab in non-small cell lung cancer: a multicentre, phase 1b study. *Lancet Oncol*, *17*(3), 299-308. [https://doi.org/10.1016/S1470-2045\(15\)00544-6](https://doi.org/10.1016/S1470-2045(15)00544-6)
- Ascierto, P. A., Ferrucci, P. F., Fisher, R., Del Vecchio, M., Atkinson, V., Schmidt, H., Schachter, J., Queirolo, P., Long, G. V., Di Giacomo, A. M., Svane, I. M., Lotem, M., Bar-Sela, G., Couture, F., Mookerjee, B., Ghori, R., Ibrahim, N., Moreno, B. H., & Ribas, A. (2019). Dabrafenib, trametinib and pembrolizumab or placebo in BRAF-mutant melanoma. *Nat Med*, *25*(6), 941-946. <https://doi.org/10.1038/s41591-019-0448-9>
- Atkins, M. B., Plimack, E. R., Puzanov, I., Fishman, M. N., McDermott, D. F., Cho, D. C., Vaishampayan, U., George, S., Olencki, T. E., Tarazi, J. C., Rosbrook, B., Fernandez, K. C., Lechuga, M., & Choueiri, T. K. (2018). Axitinib in combination with pembrolizumab in patients with advanced renal cell cancer: a non-randomised, open-label, dose-finding, and dose-expansion phase 1b trial. *Lancet Oncol*, *19*(3), 405-415.

[https://doi.org/10.1016/S1470-2045\(18\)30081-0](https://doi.org/10.1016/S1470-2045(18)30081-0)

Badros, A., Hyjek, E., Ma, N., Lesokhin, A., Dogan, A., Rapoport, A. P., Kocoglu, M., Lederer, E., Philip, S., Milliron, T., Dell, C., Goloubeva, O., & Singh, Z.

(2017). Pembrolizumab, pomalidomide, and low-dose dexamethasone for relapsed/refractory multiple myeloma. *Blood*, *130*(10), 1189-1197.

<https://doi.org/10.1182/blood-2017-03-775122>

Bang, Y. J., Kang, Y. K., Catenacci, D. V., Muro, K., Fuchs, C. S., Geva, R., Hara, H., Golan, T., Garrido, M., Jalal, S. I., Borg, C., Doi, T., Yoon, H. H.,

Savage, M. J., Wang, J., Dalal, R. P., Shah, S., Wainberg, Z. A., & Chung, H. C. (2019). Pembrolizumab alone or in combination with chemotherapy

as first-line therapy for patients with advanced gastric or gastroesophageal junction adenocarcinoma: results from the phase II nonrandomized

KEYNOTE-059 study. *Gastric Cancer*, *22*(4), 828-837. <https://doi.org/10.1007/s10120-018-00909-5>

Barlesi, F., Vansteenkiste, J., Spigel, D., Ishii, H., Garassino, M., de Marinis, F., Ozguroglu, M., Szczesna, A., Polychronis, A., Uslu, R., Krzakowski, M., Lee,

J. S., Calabro, L., Aren Frontera, O., Ellers-Lenz, B., Bajars, M., Ruisi, M., & Park, K. (2018). Avelumab versus docetaxel in patients with platinum-

treated advanced non-small-cell lung cancer (JAVELIN Lung 200): an open-label, randomised, phase 3 study. *Lancet Oncol*, *19*(11), 1468-1479.

[https://doi.org/10.1016/S1470-2045\(18\)30673-9](https://doi.org/10.1016/S1470-2045(18)30673-9)

Brahmer, J., Reckamp, K. L., Baas, P., Crino, L., Eberhardt, W. E., Poddubskaya, E., Antonia, S., Pluzanski, A., Vokes, E. E., Holgado, E., Waterhouse, D.,

- Ready, N., Gainor, J., Aren Frontera, O., Havel, L., Steins, M., Garassino, M. C., Aerts, J. G., Domine, M., . . . Spigel, D. R. (2015). Nivolumab versus Docetaxel in Advanced Squamous-Cell Non-Small-Cell Lung Cancer. *N Engl J Med*, *373*(2), 123-135. <https://doi.org/10.1056/NEJMoa1504627>
- Carbone, D. P., Reck, M., Paz-Ares, L., Creelan, B., Horn, L., Steins, M., Felip, E., van den Heuvel, M. M., Ciuleanu, T. E., Badin, F., Ready, N., Hiltermann, T. J. N., Nair, S., Juergens, R., Peters, S., Minenza, E., Wrangle, J. M., Rodriguez-Abreu, D., Borghaei, H., . . . CheckMate, I. (2017). First-Line Nivolumab in Stage IV or Recurrent Non-Small-Cell Lung Cancer. *N Engl J Med*, *376*(25), 2415-2426. <https://doi.org/10.1056/NEJMoa1613493>
- Chen, R., Zinzani, P. L., Fanale, M. A., Armand, P., Johnson, N. A., Brice, P., Radford, J., Ribrag, V., Molin, D., Vassilakopoulos, T. P., Tomita, A., von Tresckow, B., Shipp, M. A., Zhang, Y., Ricart, A. D., Balakumaran, A., Moskowitz, C. H., & Keynote. (2017). Phase II Study of the Efficacy and Safety of Pembrolizumab for Relapsed/Refractory Classic Hodgkin Lymphoma. *J Clin Oncol*, *35*(19), 2125-2132. <https://doi.org/10.1200/JCO.2016.72.1316>
- Chesney, J. A., Ribas, A., Long, G. V., Kirkwood, J. M., Dummer, R., Puzanov, I., Hoeller, C., Gajewski, T. F., Gutzmer, R., Rutkowski, P., Demidov, L., Arenberger, P., Shin, S. J., Ferrucci, P. F., Haydon, A., Hyngstrom, J., van Thienen, J. V., Haferkamp, S., Guilera, J. M., . . . Gogas, H. (2023). Randomized, Double-Blind, Placebo-Controlled, Global Phase III Trial of Talimogene Laherparepvec Combined With Pembrolizumab for Advanced Melanoma. *J Clin Oncol*, *41*(3), 528-540. <https://doi.org/10.1200/JCO.22.00343>
- Choueiri, T. K., Larkin, J., Oya, M., Thistlethwaite, F., Martignoni, M., Nathan, P., Powles, T., McDermott, D., Robbins, P. B., Chism, D. D., Cho, D., Atkins, M.

- B., Gordon, M. S., Gupta, S., Uemura, H., Tomita, Y., Compagnoni, A., Fowst, C., di Pietro, A., & Rini, B. I. (2018). Preliminary results for avelumab plus axitinib as first-line therapy in patients with advanced clear-cell renal-cell carcinoma (JAVELIN Renal 100): an open-label, dose-finding and dose-expansion, phase 1b trial. *Lancet Oncol*, *19*(4), 451-460. [https://doi.org/10.1016/S1470-2045\(18\)30107-4](https://doi.org/10.1016/S1470-2045(18)30107-4)
- Chun, B., Pucilowska, J., Chang, S., Kim, I., Nikitin, B., Koguchi, Y., Redmond, W. L., Bernard, B., Rajamanickam, V., Polaske, N., Fields, P. A., Conrad, V., Schmidt, M., Urba, W. J., Conlin, A. K., McArthur, H. L., & Page, D. B. (2022). Changes in T-cell subsets and clonal repertoire during chemoimmunotherapy with pembrolizumab and paclitaxel or capecitabine for metastatic triple-negative breast cancer. *J Immunother Cancer*, *10*(1). <https://doi.org/10.1136/jitc-2021-004033>
- Cohen, E. E. W., Soulieres, D., Le Tourneau, C., Dinis, J., Licitra, L., Ahn, M. J., Soria, A., Machiels, J. P., Mach, N., Mehra, R., Burtness, B., Zhang, P., Cheng, J., Swaby, R. F., Harrington, K. J., & investigators, K.-. (2019). Pembrolizumab versus methotrexate, docetaxel, or cetuximab for recurrent or metastatic head-and-neck squamous cell carcinoma (KEYNOTE-040): a randomised, open-label, phase 3 study. *Lancet*, *393*(10167), 156-167. [https://doi.org/10.1016/S0140-6736\(18\)31999-8](https://doi.org/10.1016/S0140-6736(18)31999-8)
- Cortes, J., Cescon, D. W., Rugo, H. S., Nowecki, Z., Im, S. A., Yusof, M. M., Gallardo, C., Lipatov, O., Barrios, C. H., Holgado, E., Iwata, H., Masuda, N., Otero, M. T., Gokmen, E., Loi, S., Guo, Z., Zhao, J., Aktan, G., Karantza, V., . . . Investigators, K.-. (2020). Pembrolizumab plus chemotherapy versus

- placebo plus chemotherapy for previously untreated locally recurrent inoperable or metastatic triple-negative breast cancer (KEYNOTE-355): a randomised, placebo-controlled, double-blind, phase 3 clinical trial. *Lancet*, 396(10265), 1817-1828. [https://doi.org/10.1016/S0140-6736\(20\)32531-9](https://doi.org/10.1016/S0140-6736(20)32531-9)
- Diab, A. (2022). *First disclosure of efficacy and safety of bempedaldesleukin (BEMPEG) plus nivolumab (NIVO) vs NIVO monotherapy in advanced melanoma (MEL)*. <https://oncologypro.esmo.org/meeting-resources/esmo-congress/pivot-io-001-first-disclosure-of-efficacy-and-safety-of-bempedaldesleukin-bempeg-plus-nivolumab-nivo-vs-nivo-monotherapy-in-advanced-melanoma>
- Diab, A., Tykodi, S. S., Daniels, G. A., Maio, M., Curti, B. D., Lewis, K. D., Jang, S., Kalinka, E., Puzanov, I., Spira, A. I., Cho, D. C., Guan, S., Puente, E., Nguyen, T., Hoch, U., Currie, S. L., Lin, W., Tagliaferri, M. A., Zalevsky, J., . . . Hurwitz, M. E. (2021). Bempedaldesleukin Plus Nivolumab in First-Line Metastatic Melanoma. *J Clin Oncol*, 39(26), 2914-2925. <https://doi.org/10.1200/JCO.21.00675>
- Disis, M. L., Taylor, M. H., Kelly, K., Beck, J. T., Gordon, M., Moore, K. M., Patel, M. R., Chaves, J., Park, H., Mita, A. C., Hamilton, E. P., Annunziata, C. M., Grote, H. J., von Heydebreck, A., Grewal, J., Chand, V., & Gulley, J. L. (2019). Efficacy and Safety of Avelumab for Patients With Recurrent or Refractory Ovarian Cancer: Phase 1b Results From the JAVELIN Solid Tumor Trial. *JAMA Oncol*, 5(3), 393-401. <https://doi.org/10.1001/jamaoncol.2018.6258>
- Dummer, R., Long, G. V., Robert, C., Tawbi, H. A., Flaherty, K. T., Ascierto, P. A., Nathan, P. D., Rutkowski, P., Leonov, O., Dutriaux, C., Mandala, M.,

- Lorigan, P., Ferrucci, P. F., Grob, J. J., Meyer, N., Gogas, H., Stroyakovskiy, D., Arance, A., Brase, J. C., . . . Schadendorf, D. (2022). Randomized Phase III Trial Evaluating Spaltalizumab Plus Dabrafenib and Trametinib for BRAF V600-Mutant Unresectable or Metastatic Melanoma. *J Clin Oncol*, *40*(13), 1428-1438. <https://doi.org/10.1200/JCO.21.01601>
- Eng, C., Kim, T. W., Bendell, J., Argiles, G., Tebbutt, N. C., Di Bartolomeo, M., Falcone, A., Fakih, M., Kozloff, M., Segal, N. H., Sobrero, A., Yan, Y., Chang, I., Uyei, A., Roberts, L., Ciardiello, F., & Investigators, I. M. (2019). Atezolizumab with or without cobimetinib versus regorafenib in previously treated metastatic colorectal cancer (IMblaze370): a multicentre, open-label, phase 3, randomised, controlled trial. *Lancet Oncol*, *20*(6), 849-861. [https://doi.org/10.1016/S1470-2045\(19\)30027-0](https://doi.org/10.1016/S1470-2045(19)30027-0)
- Fehrenbacher, L., Spira, A., Ballinger, M., Kowanzetz, M., Vansteenkiste, J., Mazieres, J., Park, K., Smith, D., Artal-Cortes, A., Lewanski, C., Braiteh, F., Waterkamp, D., He, P., Zou, W., Chen, D. S., Yi, J., Sandler, A., Rittmeyer, A., & Group, P. S. (2016). Atezolizumab versus docetaxel for patients with previously treated non-small-cell lung cancer (POPLAR): a multicentre, open-label, phase 2 randomised controlled trial. *Lancet*, *387*(10030), 1837-1846. [https://doi.org/10.1016/S0140-6736\(16\)00587-0](https://doi.org/10.1016/S0140-6736(16)00587-0)
- Fennell, D. A., Ewings, S., Ottensmeier, C., Califano, R., Hanna, G. G., Hill, K., Danson, S., Steele, N., Nye, M., Johnson, L., Lord, J., Middleton, C., Szlosarek, P., Chan, S., Gaba, A., Darlison, L., Wells-Jordan, P., Richards, C., Poile, C., . . . investigators, C. t. (2021). Nivolumab versus placebo in

patients with relapsed malignant mesothelioma (CONFIRM): a multicentre, double-blind, randomised, phase 3 trial. *Lancet Oncol*, 22(11), 1530-1540.

[https://doi.org/10.1016/S1470-2045\(21\)00471-X](https://doi.org/10.1016/S1470-2045(21)00471-X)

Finn, R. (2022). *Primary results from the phase III LEAP-002 study: Lenvatinib plus pembrolizumab versus lenvatinib as first-line (1L) therapy for advanced hepatocellular carcinoma (aHCC)*. <https://oncologypro.esmo.org/meeting-resources/esmo-congress/primary-results-from-the-phase-iii-leap-002-study-lenvatinib-plus-pembrolizumab-versus-lenvatinib-as-first-line-1l-therapy-for-advanced-hepatoce>

Finn, R. S., Ikeda, M., Zhu, A. X., Sung, M. W., Baron, A. D., Kudo, M., Okusaka, T., Kobayashi, M., Kumada, H., Kaneko, S., Pracht, M., Mamontov, K., Meyer, T., Kubota, T., Dutcus, C. E., Saito, K., Siegel, A. B., Dubrovsky, L., Mody, K., & Llovet, J. M. (2020). Phase Ib Study of Lenvatinib Plus Pembrolizumab in Patients With Unresectable Hepatocellular Carcinoma. *J Clin Oncol*, 38(26), 2960-2970. <https://doi.org/10.1200/JCO.20.00808>

G. V. Long, Reinhard Dummer, & li, X. (2016). *Efficacy analysis of MASTERKEY-265 phase 1b study of talimogene laherparepvec (T-VEC) and pembrolizumab (pembro) for unresectable stage IIIB-IV melanoma*. https://ascopubs.org/doi/abs/10.1200/JCO.2016.34.15_suppl.9568

Gettinger, S., Rizvi, N. A., Chow, L. Q., Borghaei, H., Brahmer, J., Ready, N., Gerber, D. E., Shepherd, F. A., Antonia, S., Goldman, J. W., Juergens, R. A., Laurie, S. A., Nathan, F. E., Shen, Y., Harbison, C. T., & Hellmann, M. D. (2016). Nivolumab Monotherapy for First-Line Treatment of Advanced Non-Small-Cell Lung Cancer. *J Clin Oncol*, 34(25), 2980-2987. <https://doi.org/10.1200/JCO.2016.66.9929>

- Gogas, H., Dreno, B., Larkin, J., Demidov, L., Stroyakovskiy, D., Eroglu, Z., Francesco Ferrucci, P., Pigozzo, J., Rutkowski, P., Mackiewicz, J., Rooney, I., Voulgari, A., Troutman, S., Pitcher, B., Guo, Y., Yan, Y., Castro, M., Mulla, S., Flaherty, K., & Arance, A. (2021). Cobimetinib plus atezolizumab in BRAF(V600) wild-type melanoma: primary results from the randomized phase III IMspire170 study. *Ann Oncol*, *32*(3), 384-394. <https://doi.org/10.1016/j.annonc.2020.12.004>
- Gulley, J. L., Rajan, A., Spigel, D. R., Iannotti, N., Chandler, J., Wong, D. J. L., Leach, J., Edenfield, W. J., Wang, D., Grote, H. J., Heydebreck, A. V., Chin, K., Cuillerot, J. M., & Kelly, K. (2017). Avelumab for patients with previously treated metastatic or recurrent non-small-cell lung cancer (JAVELIN Solid Tumor): dose-expansion cohort of a multicentre, open-label, phase 1b trial. *Lancet Oncol*, *18*(5), 599-610. [https://doi.org/10.1016/S1473-0245\(17\)30240-1](https://doi.org/10.1016/S1473-0245(17)30240-1)
- Gutzmer, R., Stroyakovskiy, D., Gogas, H., Robert, C., Lewis, K., Protsenko, S., Pereira, R. P., Eigentler, T., Rutkowski, P., Demidov, L., Manikhas, G. M., Yan, Y., Huang, K. C., Uyei, A., McNally, V., McArthur, G. A., & Ascierto, P. A. (2020). Atezolizumab, vemurafenib, and cobimetinib as first-line treatment for unresectable advanced BRAF(V600) mutation-positive melanoma (IMspire150): primary analysis of the randomised, double-blind, placebo-controlled, phase 3 trial. *Lancet*, *395*(10240), 1835-1844. [https://doi.org/10.1016/S0140-6736\(20\)30934-X](https://doi.org/10.1016/S0140-6736(20)30934-X)
- Hamanishi, J., Mandai, M., Ikeda, T., Minami, M., Kawaguchi, A., Murayama, T., Kanai, M., Mori, Y., Matsumoto, S., Chikuma, S., Matsumura, N., Abiko, K.,

- Baba, T., Yamaguchi, K., Ueda, A., Hosoe, Y., Morita, S., Yokode, M., Shimizu, A., . . . Konishi, I. (2015). Safety and Antitumor Activity of Anti-PD-1 Antibody, Nivolumab, in Patients With Platinum-Resistant Ovarian Cancer. *J Clin Oncol*, *33*(34), 4015-4022. <https://doi.org/10.1200/JCO.2015.62.3397>
- Hamanishi, J., Takeshima, N., Katsumata, N., Ushijima, K., Kimura, T., Takeuchi, S., Matsumoto, K., Ito, K., Mandai, M., Nakai, H., Sakuragi, N., Watari, H., Takahashi, N., Kato, H., Hasegawa, K., Yonemori, K., Mizuno, M., Takehara, K., Niikura, H., . . . Konishi, I. (2021). Nivolumab Versus Gemcitabine or Pegylated Liposomal Doxorubicin for Patients With Platinum-Resistant Ovarian Cancer: Open-Label, Randomized Trial in Japan (NINJA). *J Clin Oncol*, *39*(33), 3671-3681. <https://doi.org/10.1200/JCO.21.00334>
- Hellmann, M. D., Ciuleanu, T. E., Pluzanski, A., Lee, J. S., Otterson, G. A., Audigier-Valette, C., Minenza, E., Linardou, H., Burgers, S., Salman, P., Borghaei, H., Ramalingam, S. S., Brahmer, J., Reck, M., O'Byrne, K. J., Geese, W. J., Green, G., Chang, H., Szustakowski, J., . . . Paz-Ares, L. (2018). Nivolumab plus Ipilimumab in Lung Cancer with a High Tumor Mutational Burden. *N Engl J Med*, *378*(22), 2093-2104. <https://doi.org/10.1056/NEJMoa1801946>
- Hellmann, M. D., Kim, T. W., Lee, C. B., Goh, B. C., Miller, W. H., Jr., Oh, D. Y., Jamal, R., Chee, C. E., Chow, L. Q. M., Gainor, J. F., Desai, J., Solomon, B. J., Das Thakur, M., Pitcher, B., Foster, P., Hernandez, G., Wongchenko, M. J., Cha, E., Bang, Y. J., . . . Bendell, J. (2019). Phase Ib study of

atezolizumab combined with cobimetinib in patients with solid tumors. *Ann Oncol*, 30(7), 1134-1142. <https://doi.org/10.1093/annonc/mdz113>

Hellmann, M. D., Rizvi, N. A., Goldman, J. W., Gettinger, S. N., Borghaei, H., Brahmer, J. R., Ready, N. E., Gerber, D. E., Chow, L. Q., Juergens, R. A., Shepherd, F. A., Laurie, S. A., Geese, W. J., Agrawal, S., Young, T. C., Li, X., & Antonia, S. J. (2017). Nivolumab plus ipilimumab as first-line treatment for advanced non-small-cell lung cancer (CheckMate 012): results of an open-label, phase 1, multicohort study. *Lancet Oncol*, 18(1), 31-41. [https://doi.org/10.1016/S1470-2045\(16\)30624-6](https://doi.org/10.1016/S1470-2045(16)30624-6)

Herbst, R. S., Giaccone, G., de Marinis, F., Reinmuth, N., Vergnenegre, A., Barrios, C. H., Morise, M., Felip, E., Andric, Z., Geater, S., Ozguroglu, M., Zou, W., Sandler, A., Enquist, I., Komatsubara, K., Deng, Y., Kuriki, H., Wen, X., McClelland, M., . . . Spigel, D. R. (2020). Atezolizumab for First-Line Treatment of PD-L1-Selected Patients with NSCLC. *N Engl J Med*, 383(14), 1328-1339. <https://doi.org/10.1056/NEJMoa1917346>

Hodi, F. S., Chesney, J., Pavlick, A. C., Robert, C., Grossmann, K. F., McDermott, D. F., Linette, G. P., Meyer, N., Giguere, J. K., Agarwala, S. S., Shaheen, M., Ernstoff, M. S., Minor, D. R., Salama, A. K., Taylor, M. H., Ott, P. A., Horak, C., Gagnier, P., Jiang, J., . . . Postow, M. A. (2016). Combined nivolumab and ipilimumab versus ipilimumab alone in patients with advanced melanoma: 2-year overall survival outcomes in a multicentre, randomised, controlled, phase 2 trial. *Lancet Oncol*, 17(11), 1558-1568. [https://doi.org/10.1016/S1470-2045\(16\)30366-7](https://doi.org/10.1016/S1470-2045(16)30366-7)

Huang, J., Xu, B., Mo, H., Zhang, W., Chen, X., Wu, D., Qu, D., Wang, X., Lan, B., Yang, B., Wang, P., Zhang, H., Yang, Q., & Jiao, Y. (2018). Safety, Activity,

and Biomarkers of SHR-1210, an Anti-PD-1 Antibody, for Patients with Advanced Esophageal Carcinoma. *Clin Cancer Res*, 24(6), 1296-1304.

<https://doi.org/10.1158/1078-0432.CCR-17-2439>

Huang, J., Xu, J., Chen, Y., Zhuang, W., Zhang, Y., Chen, Z., Chen, J., Zhang, H., Niu, Z., Fan, Q., Lin, L., Gu, K., Liu, Y., Ba, Y., Miao, Z., Jiang, X., Zeng, M., Chen, J., Fu, Z., . . . Group, E. S. (2020). Camrelizumab versus investigator's choice of chemotherapy as second-line therapy for advanced or metastatic oesophageal squamous cell carcinoma (ESCOR): a multicentre, randomised, open-label, phase 3 study. *Lancet Oncol*, 21(6), 832-842.

[https://doi.org/10.1016/S1470-2045\(20\)30110-8](https://doi.org/10.1016/S1470-2045(20)30110-8)

Janjigian, Y. Y., Bendell, J., Calvo, E., Kim, J. W., Ascierto, P. A., Sharma, P., Ott, P. A., Peltola, K., Jaeger, D., Evans, J., de Braud, F., Chau, I., Harbison, C. T., Dorange, C., Tschaika, M., & Le, D. T. (2018). CheckMate-032 Study: Efficacy and Safety of Nivolumab and Nivolumab Plus Ipilimumab in Patients With Metastatic Esophagogastric Cancer. *J Clin Oncol*, 36(28), 2836-2844. <https://doi.org/10.1200/JCO.2017.76.6212>

Janjigian, Y. Y., & Kawazoe, A. (2021). Combined PD-1 and HER2 blockade for HER2-positive gastric cancer. *Nature*, 600(7890), 727-730.

<https://doi.org/10.1038/s41586-021-04161-3>

Janjigian, Y. Y., Maron, S. B., Chatila, W. K., Millang, B., Chavan, S. S., Alterman, C., Chou, J. F., Segal, M. F., Simmons, M. Z., Momtaz, P., Shcherba, M., Ku, G. Y., Zervoudakis, A., Won, E. S., Kelsen, D. P., Ilson, D. H., Nagy, R. J., Lanman, R. B., Ptashkin, R. N., . . . Hechtman, J. F. (2020). First-line

pembrolizumab and trastuzumab in HER2-positive oesophageal, gastric, or gastro-oesophageal junction cancer: an open-label, single-arm, phase 2 trial. *Lancet Oncol*, 21(6), 821-831. [https://doi.org/10.1016/S1470-2045\(20\)30169-8](https://doi.org/10.1016/S1470-2045(20)30169-8)

Jiang, H., Zheng, Y., Qian, J., Mao, C., Xu, X., Li, N., Xiao, C., Wang, H., Teng, L., Zhou, H., Wang, S., Zhu, D., Peng, B., Shen, L., & Xu, N. (2020). Safety and efficacy of sintilimab combined with oxaliplatin/capecitabine as first-line treatment in patients with locally advanced or metastatic gastric/gastroesophageal junction adenocarcinoma in a phase Ib clinical trial. *BMC Cancer*, 20(1), 760. <https://doi.org/10.1186/s12885-020-07251-z>

Jiang, H., Zheng, Y., Qian, J., Mao, C., Xu, X., Li, N., Xiao, C., Wang, H., Teng, L., Zhou, H., Wang, S., Zhu, D., Sun, T., Yu, Y., Guo, W., & Xu, N. (2021). Efficacy and safety of sintilimab in combination with chemotherapy in previously untreated advanced or metastatic nonsquamous or squamous NSCLC: two cohorts of an open-label, phase 1b study. *Cancer Immunol Immunother*, 70(3), 857-868. <https://doi.org/10.1007/s00262-020-02738-x>

Kang, Y. K., Boku, N., Satoh, T., Ryu, M. H., Chao, Y., Kato, K., Chung, H. C., Chen, J. S., Muro, K., Kang, W. K., Yeh, K. H., Yoshikawa, T., Oh, S. C., Bai, L. Y., Tamura, T., Lee, K. W., Hamamoto, Y., Kim, J. G., Chin, K., . . . Chen, L. T. (2017). Nivolumab in patients with advanced gastric or gastro-oesophageal junction cancer refractory to, or intolerant of, at least two previous chemotherapy regimens (ONO-4538-12, ATTRACTION-2): a randomised, double-blind, placebo-controlled, phase 3 trial. *Lancet*, 390(10111), 2461-2471. [https://doi.org/10.1016/S0140-6736\(17\)31827-5](https://doi.org/10.1016/S0140-6736(17)31827-5)

Kato, K., Cho, B. C., Takahashi, M., Okada, M., Lin, C. Y., Chin, K., Kadowaki, S., Ahn, M. J., Hamamoto, Y., Doki, Y., Yen, C. C., Kubota, Y., Kim, S. B., Hsu,

- C. H., Holtved, E., Xynos, I., Kodani, M., & Kitagawa, Y. (2019). Nivolumab versus chemotherapy in patients with advanced oesophageal squamous cell carcinoma refractory or intolerant to previous chemotherapy (ATTRACTION-3): a multicentre, randomised, open-label, phase 3 trial. *Lancet Oncol*, *20*(11), 1506-1517. [https://doi.org/10.1016/S1470-2045\(19\)30626-6](https://doi.org/10.1016/S1470-2045(19)30626-6)
- Kudo, T., Hamamoto, Y., Kato, K., Ura, T., Kojima, T., Tsushima, T., Hironaka, S., Hara, H., Satoh, T., Iwasa, S., Muro, K., Yasui, H., Minashi, K., Yamaguchi, K., Ohtsu, A., Doki, Y., & Kitagawa, Y. (2017). Nivolumab treatment for oesophageal squamous-cell carcinoma: an open-label, multicentre, phase 2 trial. *Lancet Oncol*, *18*(5), 631-639. [https://doi.org/10.1016/S1470-2045\(17\)30181-X](https://doi.org/10.1016/S1470-2045(17)30181-X)
- Kuruvilla, J., Ramchandren, R., Santoro, A., Paszkiewicz-Kozik, E., Gasiorowski, R., Johnson, N. A., Fogliatto, L. M., Goncalves, I., de Oliveira, J. S. R., Buccheri, V., Perini, G. F., Goldschmidt, N., Kriachok, I., Dickinson, M., Komarnicki, M., McDonald, A., Ozcan, M., Sekiguchi, N., Zhu, Y., . . . investigators, K.-. (2021). Pembrolizumab versus brentuximab vedotin in relapsed or refractory classical Hodgkin lymphoma (KEYNOTE-204): an interim analysis of a multicentre, randomised, open-label, phase 3 study. *Lancet Oncol*, *22*(4), 512-524. [https://doi.org/10.1016/S1470-2045\(21\)00005-X](https://doi.org/10.1016/S1470-2045(21)00005-X)
- Larkin, J., Chiarion-Sileni, V., Gonzalez, R., Grob, J. J., Cowey, C. L., Lao, C. D., Schadendorf, D., Dummer, R., Smylie, M., Rutkowski, P., Ferrucci, P. F., Hill, A., Wagstaff, J., Carlino, M. S., Haanen, J. B., Maio, M., Marquez-Rodas, I., McArthur, G. A., Ascierto, P. A., . . . Wolchok, J. D. (2015).

Combined Nivolumab and Ipilimumab or Monotherapy in Untreated Melanoma. *N Engl J Med*, 373(1), 23-34.

<https://doi.org/10.1056/NEJMoa1504030>

Larkin, J., Minor, D., D'Angelo, S., Neyns, B., Smylie, M., Miller, W. H., Jr., Gutzmer, R., Linette, G., Chmielowski, B., Lao, C. D., Lorigan, P., Grossmann, K., Hassel, J. C., Sznol, M., Daud, A., Sosman, J., Khushalani, N., Schadendorf, D., Hoeller, C., . . . Weber, J. (2018). Overall Survival in Patients With Advanced Melanoma Who Received Nivolumab Versus Investigator's Choice Chemotherapy in CheckMate 037: A Randomized, Controlled, Open-Label Phase III Trial. *J Clin Oncol*, 36(4), 383-390. <https://doi.org/10.1200/JCO.2016.71.8023>

Liu, S. V., Camidge, D. R., Gettinger, S. N., Giaccone, G., Heist, R. S., Hodi, F. S., Ready, N. E., Zhang, W., Wallin, J., Funke, R., Waterkamp, D., Foster, P., Iizuka, K., & Powderly, J. D. (2017). Atezolizumab (atezo) plus platinum-based chemotherapy (chemo) in non-small cell lung cancer (NSCLC): Update from a phase Ib study. *Journal of Clinical Oncology*, 35(15_suppl), 9092-9092. https://doi.org/10.1200/JCO.2017.35.15_suppl.9092

Long, G. V., Dummer, R., Hamid, O., Gajewski, T. F., Caglevic, C., Dalle, S., Arance, A., Carlino, M. S., Grob, J. J., Kim, T. M., Demidov, L., Robert, C., Larkin, J., Anderson, J. R., Maleski, J., Jones, M., Diede, S. J., & Mitchell, T. C. (2019). Epcadostat plus pembrolizumab versus placebo plus pembrolizumab in patients with unresectable or metastatic melanoma (ECHO-301/KEYNOTE-252): a phase 3, randomised, double-blind study. *Lancet Oncol*, 20(8), 1083-1097. [https://doi.org/10.1016/S1470-2045\(19\)30274-8](https://doi.org/10.1016/S1470-2045(19)30274-8)

- Makker, V., Colombo, N., Casado Herraiez, A., Santin, A. D., Colomba, E., Miller, D. S., Fujiwara, K., Pignata, S., Baron-Hay, S., Ray-Coquard, I., Shapira-Frommer, R., Ushijima, K., Sakata, J., Yonemori, K., Kim, Y. M., Guerra, E. M., Sanli, U. A., McCormack, M. M., Smith, A. D., . . . Study, K.-I. (2022). Lenvatinib plus Pembrolizumab for Advanced Endometrial Cancer. *N Engl J Med*, *386*(5), 437-448. <https://doi.org/10.1056/NEJMoa2108330>
- Makker, V., Taylor, M. H., Aghajanian, C., Oaknin, A., Mier, J., Cohn, A. L., Romeo, M., Bratos, R., Brose, M. S., DiSimone, C., Messing, M., Stepan, D. E., Dutcus, C. E., Wu, J., Schmidt, E. V., Orlowski, R., Sachdev, P., Shumaker, R., & Casado Herraiez, A. (2020). Lenvatinib Plus Pembrolizumab in Patients With Advanced Endometrial Cancer. *J Clin Oncol*, *38*(26), 2981-2992. <https://doi.org/10.1200/JCO.19.02627>
- Mateos, M. V., Blacklock, H., Schjesvold, F., Oriol, A., Simpson, D., George, A., Goldschmidt, H., Larocca, A., Chanan-Khan, A., Sherbenou, D., Avivi, I., Benyamini, N., Iida, S., Matsumoto, M., Suzuki, K., Ribrag, V., Usmani, S. Z., Jagannath, S., Ocio, E. M., . . . Investigators, K.-. (2019). Pembrolizumab plus pomalidomide and dexamethasone for patients with relapsed or refractory multiple myeloma (KEYNOTE-183): a randomised, open-label, phase 3 trial. *Lancet Haematol*, *6*(9), e459-e469. [https://doi.org/10.1016/S2352-3026\(19\)30110-3](https://doi.org/10.1016/S2352-3026(19)30110-3)
- McDermott, D. F., Huseni, M. A., Atkins, M. B., Motzer, R. J., Rini, B. I., Escudier, B., Fong, L., Joseph, R. W., Pal, S. K., Reeves, J. A., Sznol, M., Hainsworth, J., Rathmell, W. K., Stadler, W. M., Hutson, T., Gore, M. E., Ravaud, A., Bracarda, S., Suarez, C., . . . Powles, T. (2018). Clinical activity and molecular correlates of response to atezolizumab alone or in combination with bevacizumab versus sunitinib in renal cell carcinoma. *Nat Med*, *24*(6),

749-757. <https://doi.org/10.1038/s41591-018-0053-3>

- Mitchell, T. C., Hamid, O., Smith, D. C., Bauer, T. M., Wasser, J. S., Olszanski, A. J., Luke, J. J., Balmanoukian, A. S., Schmidt, E. V., Zhao, Y., Gong, X., Maleski, J., Leopold, L., & Gajewski, T. F. (2018). Epacadostat Plus Pembrolizumab in Patients With Advanced Solid Tumors: Phase I Results From a Multicenter, Open-Label Phase I/II Trial (ECHO-202/KEYNOTE-037). *J Clin Oncol*, *36*(32), 3223-3230. <https://doi.org/10.1200/JCO.2018.78.9602>
- Motzer, R. J., Escudier, B., McDermott, D. F., George, S., Hammers, H. J., Srinivas, S., Tykodi, S. S., Sosman, J. A., Procopio, G., Plimack, E. R., Castellano, D., Choueiri, T. K., Gurney, H., Donskov, F., Bono, P., Wagstaff, J., Gaurer, T. C., Ueda, T., Tomita, Y., . . . CheckMate, I. (2015). Nivolumab versus Everolimus in Advanced Renal-Cell Carcinoma. *N Engl J Med*, *373*(19), 1803-1813. <https://doi.org/10.1056/NEJMoa1510665>
- Motzer, R. J., Penkov, K., Haanen, J., Rini, B., Albiges, L., Campbell, M. T., Venugopal, B., Kollmannsberger, C., Negrier, S., Uemura, M., Lee, J. L., Vasiliev, A., Miller, W. H., Jr., Gurney, H., Schmidinger, M., Larkin, J., Atkins, M. B., Bedke, J., Alekseev, B., . . . Choueiri, T. K. (2019). Avelumab plus Axitinib versus Sunitinib for Advanced Renal-Cell Carcinoma. *N Engl J Med*, *380*(12), 1103-1115. <https://doi.org/10.1056/NEJMoa1816047>
- Motzer, R. J., Rini, B. I., McDermott, D. F., Redman, B. G., Kuzel, T. M., Harrison, M. R., Vaishampayan, U. N., Drabkin, H. A., George, S., Logan, T. F., Margolin, K. A., Plimack, E. R., Lambert, A. M., Waxman, I. M., & Hammers, H. J. (2015). Nivolumab for Metastatic Renal Cell Carcinoma: Results of a Randomized Phase II Trial. *J Clin Oncol*, *33*(13), 1430-1437. <https://doi.org/10.1200/JCO.2014.59.0703>

Nanda, R., Chow, L. Q., Dees, E. C., Berger, R., Gupta, S., Geva, R., Puzstai, L., Pathiraja, K., Aktan, G., Cheng, J. D., Karantza, V., & Buisseret, L. (2016).

Pembrolizumab in Patients With Advanced Triple-Negative Breast Cancer: Phase Ib KEYNOTE-012 Study. *J Clin Oncol*, *34*(21), 2460-2467.

<https://doi.org/10.1200/JCO.2015.64.8931>

Nishio, M., Barlesi, F., West, H., Ball, S., Bordoni, R., Cobo, M., Longeras, P. D., Goldschmidt, J., Jr., Novello, S., Orlandi, F., Sanborn, R. E., Szalai, Z., Ursol,

G., Mendus, D., Wang, L., Wen, X., McClelland, M., Hoang, T., Phan, S., & Socinski, M. A. (2021). Atezolizumab Plus Chemotherapy for First-Line

Treatment of Nonsquamous NSCLC: Results From the Randomized Phase 3 IMpower132 Trial. *J Thorac Oncol*, *16*(4), 653-664.

<https://doi.org/10.1016/j.jtho.2020.11.025>

Nizar Tannir, M. N. F., N. Agarwal, S.K. Pal, D. Cho, D.J. George, W. Hong, L. Tang, A. Qureshi, M.A. Tagliaferri, J. Zalevsky, K.D. Penkov. (2022).

Bempegaldesleukin (BEMPEG) plus nivolumab (NIVO) compared to the investigator's choice of sunitinib or cabozantinib in previously untreated

advanced renal cell carcinoma (RCC): Results from a phase III randomized study (PIVOT-09). [https://oncologypro.esmo.org/meeting-](https://oncologypro.esmo.org/meeting-resources/esmo-congress/bempegaldesleukin-bempeg-plus-nivolumab-nivo-compared-to-the-investigator-s-choice-of-sunitinib-or-cabozantinib-in-previously-untreated-advance)

[resources/esmo-congress/bempegaldesleukin-bempeg-plus-nivolumab-nivo-compared-to-the-investigator-s-choice-of-sunitinib-or-cabozantinib-in-](https://oncologypro.esmo.org/meeting-resources/esmo-congress/bempegaldesleukin-bempeg-plus-nivolumab-nivo-compared-to-the-investigator-s-choice-of-sunitinib-or-cabozantinib-in-previously-untreated-advance)

[previously-untreated-advance](https://oncologypro.esmo.org/meeting-resources/esmo-congress/bempegaldesleukin-bempeg-plus-nivolumab-nivo-compared-to-the-investigator-s-choice-of-sunitinib-or-cabozantinib-in-previously-untreated-advance)

Oh D-Y, e. a. (2022). *Durvalumab plus cisplatin/gemcitabine is now standard of care for patients with advanced/metastatic biliary tract cancer.*

<https://dailyreporter.esmo.org/esmo-congress-2022/upper-gi-tumours/durvalumab-plus-cisplatin-gemcitabine-is-now-standard-of-care-for-patients-with-advanced-metastatic-biliary-tract-cancer>

Oh, D. Y., Lee, K. H., Lee, D. W., Yoon, J., Kim, T. Y., Bang, J. H., Nam, A. R., Oh, K. S., Kim, J. M., Lee, Y., Guthrie, V., McCoon, P., Li, W., Wu, S., Zhang, Q., Rebeatto, M. C., & Kim, J. W. (2022). Gemcitabine and cisplatin plus durvalumab with or without tremelimumab in chemotherapy-naive patients with advanced biliary tract cancer: an open-label, single-centre, phase 2 study. *Lancet Gastroenterol Hepatol*, 7(6), 522-532. [https://doi.org/10.1016/S2468-1253\(22\)00043-7](https://doi.org/10.1016/S2468-1253(22)00043-7)

Okada, M., Kijima, T., Aoe, K., Kato, T., Fujimoto, N., Nakagawa, K., Takeda, Y., Hida, T., Kanai, K., Imamura, F., Oizumi, S., Takahashi, T., Takenoyama, M., Tanaka, H., Hirano, J., Namba, Y., & Ohe, Y. (2019). Clinical Efficacy and Safety of Nivolumab: Results of a Multicenter, Open-label, Single-arm, Japanese Phase II study in Malignant Pleural Mesothelioma (MERIT). *Clin Cancer Res*, 25(18), 5485-5492. <https://doi.org/10.1158/1078-0432.CCR-19-0103>

Omuro, A., Vlahovic, G., Lim, M., Sahebjam, S., Baehring, J., Cloughesy, T., Voloschin, A., Ramkissoon, S. H., Ligon, K. L., Latek, R., Zwirter, R., Strauss, L., Paliwal, P., Harbison, C. T., Reardon, D. A., & Sampson, J. H. (2018). Nivolumab with or without ipilimumab in patients with recurrent glioblastoma: results from exploratory phase I cohorts of CheckMate 143. *Neuro Oncol*, 20(5), 674-686. <https://doi.org/10.1093/neuonc/nox208>

- Peters, S., Gettinger, S., Johnson, M. L., Janne, P. A., Garassino, M. C., Christoph, D., Toh, C. K., Rizvi, N. A., Chaft, J. E., Carcereny Costa, E., Patel, J. D., Chow, L. Q. M., Koczywas, M., Ho, C., Fruh, M., van den Heuvel, M., Rothenstein, J., Reck, M., Paz-Ares, L., . . . Felip, E. (2017). Phase II Trial of Atezolizumab As First-Line or Subsequent Therapy for Patients With Programmed Death-Ligand 1-Selected Advanced Non-Small-Cell Lung Cancer (BIRCH). *J Clin Oncol*, *35*(24), 2781-2789. <https://doi.org/10.1200/JCO.2016.71.9476>
- Planchard, D., Reinmuth, N., Orlov, S., Fischer, J. R., Sugawara, S., Mandziuk, S., Marquez-Medina, D., Novello, S., Takeda, Y., Soo, R., Park, K., McCleod, M., Geater, S. L., Powell, M., May, R., Scheuring, U., Stockman, P., & Kowalski, D. (2020). ARCTIC: durvalumab with or without tremelimumab as third-line or later treatment of metastatic non-small-cell lung cancer. *Ann Oncol*, *31*(5), 609-618. <https://doi.org/10.1016/j.annonc.2020.02.006>
- Powles, T., Duran, I., van der Heijden, M. S., Loriot, Y., Vogelzang, N. J., De Giorgi, U., Oudard, S., Retz, M. M., Castellano, D., Bamias, A., Flechon, A., Gravis, G., Hussain, S., Takano, T., Leng, N., Kadel, E. E., 3rd, Banchereau, R., Hegde, P. S., Mariathasan, S., . . . Ravaud, A. (2018). Atezolizumab versus chemotherapy in patients with platinum-treated locally advanced or metastatic urothelial carcinoma (IMvigor211): a multicentre, open-label, phase 3 randomised controlled trial. *Lancet*, *391*(10122), 748-757. [https://doi.org/10.1016/S0140-6736\(17\)33297-X](https://doi.org/10.1016/S0140-6736(17)33297-X)
- Pujade-Lauraine, E., Fujiwara, K., Ledermann, J. A., Oza, A. M., Kristeleit, R., Ray-Coquard, I. L., Richardson, G. E., Sessa, C., Yonemori, K., Banerjee, S., Leary, A., Tinker, A. V., Jung, K. H., Madry, R., Park, S. Y., Anderson, C. K., Zohren, F., Stewart, R. A., Wei, C., . . . Monk, B. J. (2021). Avelumab

alone or in combination with chemotherapy versus chemotherapy alone in platinum-resistant or platinum-refractory ovarian cancer (JAVELIN Ovarian 200): an open-label, three-arm, randomised, phase 3 study. *Lancet Oncol*, 22(7), 1034-1046. [https://doi.org/10.1016/S1470-2045\(21\)00216-3](https://doi.org/10.1016/S1470-2045(21)00216-3)

Qin, S., L.S. Chan, S. Gu, Y. Bai, Z. Ren, Lin , , X., Z. Chen, W. Jia, Y. Jin, Y. Guo, A.V. Sultanbaev, M. Pazgan-Simon, M. Pisetska, X. Liang, C. Chen, Z.

Nie, L. Wang, A. Cheng, A. Kaseb, & Vogel, A. (2022). *Camrelizumab (C) plus rivoceranib (R) vs. sorafenib (S) as first-line therapy for unresectable hepatocellular carcinoma (uHCC): A randomized, phase III trial.* <https://oncologypro.esmo.org/meeting-resources/esmo-congress/camrelizumab-c-plus-rivoceranib-r-vs.-sorafenib-s-as-first-line-therapy-for-unresectable-hepatocellular-carcinoma-uhcc-a-randomized-phase>

Reardon, D. A., Brandes, A. A., Omuro, A., Mulholland, P., Lim, M., Wick, A., Baehring, J., Ahluwalia, M. S., Roth, P., Bahr, O., Phuphanich, S., Sepulveda, J.

M., De Souza, P., Sahebjam, S., Carleton, M., Tatsuoka, K., Taitt, C., Zwirtes, R., Sampson, J., & Weller, M. (2020). Effect of Nivolumab vs Bevacizumab in Patients With Recurrent Glioblastoma: The CheckMate 143 Phase 3 Randomized Clinical Trial. *JAMA Oncol*, 6(7), 1003-1010. <https://doi.org/10.1001/jamaoncol.2020.1024>

Ren, Z., Xu, J., Bai, Y., Xu, A., Cang, S., Du, C., Li, Q., Lu, Y., Chen, Y., Guo, Y., Chen, Z., Liu, B., Jia, W., Wu, J., Wang, J., Shao, G., Zhang, B., Shan, Y.,

Meng, Z., . . . group, O.-s. (2021). Sintilimab plus a bevacizumab biosimilar (IBI305) versus sorafenib in unresectable hepatocellular carcinoma (ORIENT-32): a randomised, open-label, phase 2-3 study. *Lancet Oncol*, 22(7), 977-990. [https://doi.org/10.1016/S1470-2045\(21\)00252-7](https://doi.org/10.1016/S1470-2045(21)00252-7)

Rini, B. I., Plimack, E. R., Stus, V., Gafanov, R., Hawkins, R., Nosov, D., Pouliot, F., Alekseev, B., Soulieres, D., Melichar, B., Vynnychenko, I., Kryzhanivska, A., Bondarenko, I., Azevedo, S. J., Borchiellini, D., Szczylik, C., Markus, M., McDermott, R. S., Bedke, J., . . . Investigators, K.-. (2019). Pembrolizumab plus Axitinib versus Sunitinib for Advanced Renal-Cell Carcinoma. *N Engl J Med*, *380*(12), 1116-1127.

<https://doi.org/10.1056/NEJMoa1816714>

Rini, B. I., Powles, T., Atkins, M. B., Escudier, B., McDermott, D. F., Suarez, C., Bracarda, S., Stadler, W. M., Donskov, F., Lee, J. L., Hawkins, R., Ravaud, A., Alekseev, B., Staehler, M., Uemura, M., De Giorgi, U., Mellado, B., Porta, C., Melichar, B., . . . Group, I. M. S. (2019). Atezolizumab plus bevacizumab versus sunitinib in patients with previously untreated metastatic renal cell carcinoma (IMmotion151): a multicentre, open-label, phase 3, randomised controlled trial. *Lancet*, *393*(10189), 2404-2415. [https://doi.org/10.1016/S0140-6736\(19\)30723-8](https://doi.org/10.1016/S0140-6736(19)30723-8)

Rischin, D., Gil-Martin, M., Gonzalez-Martin, A., Brana, I., Hou, J. Y., Cho, D., Falchook, G. S., Formenti, S., Jabbour, S., Moore, K., Naing, A., Papadopoulos, K. P., Baranda, J., Fury, W., Feng, M., Stankevich, E., Li, J., Yama-Dang, N. A., Yoo, S. Y., . . . Fury, M. G. (2020). PD-1 blockade in recurrent or metastatic cervical cancer: Data from cemiplimab phase I expansion cohorts and characterization of PD-L1 expression in cervical cancer. *Gynecol Oncol*, *159*(2), 322-328. <https://doi.org/10.1016/j.ygyno.2020.08.026>

Rittmeyer, A., Barlesi, F., Waterkamp, D., Park, K., Ciardiello, F., von Pawel, J., Gadgeel, S. M., Hida, T., Kowalski, D. M., Dols, M. C., Cortinovis, D. L.,

- Leach, J., Polikoff, J., Barrios, C., Kabbinavar, F., Frontera, O. A., De Marinis, F., Turna, H., Lee, J. S., . . . Group, O. A. K. S. (2017). Atezolizumab versus docetaxel in patients with previously treated non-small-cell lung cancer (OAK): a phase 3, open-label, multicentre randomised controlled trial. *Lancet*, *389*(10066), 255-265. [https://doi.org/10.1016/S0140-6736\(16\)32517-X](https://doi.org/10.1016/S0140-6736(16)32517-X)
- Rizvi, N. A., Mazieres, J., Planchard, D., Stinchcombe, T. E., Dy, G. K., Antonia, S. J., Horn, L., Lena, H., Minenza, E., Mennequier, B., Otterson, G. A., Campos, L. T., Gandara, D. R., Levy, B. P., Nair, S. G., Zalcman, G., Wolf, J., Souquet, P. J., Baldini, E., . . . Ramalingam, S. S. (2015). Activity and safety of nivolumab, an anti-PD-1 immune checkpoint inhibitor, for patients with advanced, refractory squamous non-small-cell lung cancer (CheckMate 063): a phase 2, single-arm trial. *Lancet Oncol*, *16*(3), 257-265. [https://doi.org/10.1016/S1470-2045\(15\)70054-9](https://doi.org/10.1016/S1470-2045(15)70054-9)
- Rosenberg, J. E., Hoffman-Censits, J., Powles, T., van der Heijden, M. S., Balar, A. V., Necchi, A., Dawson, N., O'Donnell, P. H., Balmanoukian, A., Loriot, Y., Srinivas, S., Retz, M. M., Grivas, P., Joseph, R. W., Galsky, M. D., Fleming, M. T., Petrylak, D. P., Perez-Gracia, J. L., Burris, H. A., . . . Dreicer, R. (2016). Atezolizumab in patients with locally advanced and metastatic urothelial carcinoma who have progressed following treatment with platinum-based chemotherapy: a single-arm, multicentre, phase 2 trial. *Lancet*, *387*(10031), 1909-1920. [https://doi.org/10.1016/S0140-6736\(16\)00561-4](https://doi.org/10.1016/S0140-6736(16)00561-4)
- Schmid, P., Adams, S., Rugo, H. S., Schneeweiss, A., Barrios, C. H., Iwata, H., Dieras, V., Hegg, R., Im, S. A., Shaw Wright, G., Henschel, V., Molinero, L., Chui, S. Y., Funke, R., Husain, A., Winer, E. P., Loi, S., Emens, L. A., & Investigators, I. M. T. (2018). Atezolizumab and Nab-Paclitaxel in Advanced

Triple-Negative Breast Cancer. *N Engl J Med*, 379(22), 2108-2121. <https://doi.org/10.1056/NEJMoa1809615>

Seiwert, T. Y., Burtneß, B., Mehra, R., Weiss, J., Berger, R., Eder, J. P., Heath, K., McClanahan, T., Lunceford, J., Gause, C., Cheng, J. D., & Chow, L. Q.

(2016). Safety and clinical activity of pembrolizumab for treatment of recurrent or metastatic squamous cell carcinoma of the head and neck

(KEYNOTE-012): an open-label, multicentre, phase 1b trial. *Lancet Oncol*, 17(7), 956-965. [https://doi.org/10.1016/S1470-2045\(16\)30066-3](https://doi.org/10.1016/S1470-2045(16)30066-3)

Shitara, K., Van Cutsem, E., Bang, Y. J., Fuchs, C., Wyrwicz, L., Lee, K. W., Kudaba, I., Garrido, M., Chung, H. C., Lee, J., Castro, H. R., Mansoor, W.,

Braghiroli, M. I., Karaseva, N., Caglevic, C., Villanueva, L., Goekkurt, E., Satake, H., Enzinger, P., . . . Tabernero, J. (2020). Efficacy and Safety of

Pembrolizumab or Pembrolizumab Plus Chemotherapy vs Chemotherapy Alone for Patients With First-line, Advanced Gastric Cancer: The

KEYNOTE-062 Phase 3 Randomized Clinical Trial. *JAMA Oncol*, 6(10), 1571-1580. <https://doi.org/10.1001/jamaoncol.2020.3370>

Sullivan, R. J., Hamid, O., Gonzalez, R., Infante, J. R., Patel, M. R., Hodi, F. S., Lewis, K. D., Tawbi, H. A., Hernandez, G., Wongchenko, M. J., Chang, Y.,

Roberts, L., Ballinger, M., Yan, Y., Cha, E., & Hwu, P. (2019). Atezolizumab plus cobimetinib and vemurafenib in BRAF-mutated melanoma patients.

Nat Med, 25(6), 929-935. <https://doi.org/10.1038/s41591-019-0474-7>

Tannir, N. M., Cho, D. C., Diab, A., Sznol, M., Bilen, M. A., Balar, A. V., Grignani, G., Puente, E., Tang, L., Chien, D., Hoch, U., Choudhury, A., Yu, D., Currie,

S. L., Tagliaferri, M. A., Zalevsky, J., Siefker-Radtke, A. O., & Hurwitz, M. E. (2022). Bempegaldesleukin plus nivolumab in first-line renal cell

- carcinoma: results from the PIVOT-02 study. *J Immunother Cancer*, 10(4). <https://doi.org/10.1136/jitc-2021-004419>
- Taylor, M. H., Lee, C. H., Makker, V., Rasco, D., Dutcus, C. E., Wu, J., Stepan, D. E., Shumaker, R. C., & Motzer, R. J. (2020). Phase IB/II Trial of Lenvatinib Plus Pembrolizumab in Patients With Advanced Renal Cell Carcinoma, Endometrial Cancer, and Other Selected Advanced Solid Tumors. *J Clin Oncol*, 38(11), 1154-1163. <https://doi.org/10.1200/JCO.19.01598>
- Tewari, K. S., Monk, B. J., Vergote, I., Miller, A., de Melo, A. C., Kim, H. S., Kim, Y. M., Lisysanskaya, A., Samouelian, V., Lorusso, D., Damian, F., Chang, C. L., Gotovkin, E. A., Takahashi, S., Ramone, D., Pikiel, J., Mackowiak-Matejczyk, B., Guerra Alia, E. M., Colombo, N., . . . En-Cx, E. P. (2022). Survival with Cemiplimab in Recurrent Cervical Cancer. *N Engl J Med*, 386(6), 544-555. <https://doi.org/10.1056/NEJMoa2112187>
- Topalian, S. L., Hodi, F. S., Brahmer, J. R., Gettinger, S. N., Smith, D. C., McDermott, D. F., Powderly, J. D., Carvajal, R. D., Sosman, J. A., Atkins, M. B., Leming, P. D., Spigel, D. R., Antonia, S. J., Horn, L., Drake, C. G., Pardoll, D. M., Chen, L., Sharfman, W. H., Anders, R. A., . . . Sznol, M. (2012). Safety, activity, and immune correlates of anti-PD-1 antibody in cancer. *N Engl J Med*, 366(26), 2443-2454. <https://doi.org/10.1056/NEJMoa1200690>
- Winer, E. P., Lipatov, O., Im, S. A., Goncalves, A., Munoz-Couselo, E., Lee, K. S., Schmid, P., Tamura, K., Testa, L., Witzel, I., Ohtani, S., Turner, N., Zambelli, S., Harbeck, N., Andre, F., Dent, R., Zhou, X., Karantza, V., Mejia, J., . . . investigators, K.-. (2021). Pembrolizumab versus investigator-choice chemotherapy for metastatic triple-negative breast cancer (KEYNOTE-119): a randomised, open-label, phase 3 trial. *Lancet Oncol*, 22(4), 499-

511. [https://doi.org/10.1016/S1470-2045\(20\)30754-3](https://doi.org/10.1016/S1470-2045(20)30754-3)

Xu, J., Jiang, H., Pan, Y., Gu, K., Cang, S., Han, L., Shu, Y., Li, J., Zhao, J., Pan, H., Luo, S., Qin, Y., Guo, Q., Bai, Y., Ling, Y., Guo, Y., Li, Z., Liu, Y., Wang, Y., & Zhou, H. (2021). LBA53 Sintilimab plus chemotherapy (chemo) versus chemo as first-line treatment for advanced gastric or gastroesophageal junction (G/GEJ) adenocarcinoma (ORIENT-16): First results of a randomized, double-blind, phase III study. *Annals of Oncology*, 32.

<https://doi.org/10.1016/j.annonc.2021.08.2133>

Xu, J., Shen, J., Gu, S., Zhang, Y., Wu, L., Wu, J., Shao, G., Zhang, Y., Xu, L., Yin, T., Liu, J., Ren, Z., Xiong, J., Mao, X., Zhang, L., Yang, J., Li, L., Chen, X., Wang, Z., . . . Wang, Q. (2021). Camrelizumab in Combination with Apatinib in Patients with Advanced Hepatocellular Carcinoma (RESCUE): A Nonrandomized, Open-label, Phase II Trial. *Clin Cancer Res*, 27(4), 1003-1011. <https://doi.org/10.1158/1078-0432.CCR-20-2571>

Y.Loriot, Arjun Vasant Balar, & Ronald De Wit, J. A. G., Petros Grivas, Nobuaki Matsubara, Blanca Homet Moreno, Eric Sbar, Xieyang Calvin Jia, Corina E. Dutcus, Arlene O. Siefker-Radtke. (2022). *Phase III study of first-line pembrolizumab (pembro) plus lenvatinib (len) in patients (pts) with advanced urothelial carcinoma (UC) ineligible for platinum-based chemotherapy: LEAP-011*. <https://meetings.asco.org/abstracts-presentations/184080>

Yang, Y., Wang, Z., Fang, J., Yu, Q., Han, B., Cang, S., Chen, G., Mei, X., Yang, Z., Ma, R., Bi, M., Ren, X., Zhou, J., Li, B., Song, Y., Feng, J., Li, J., He, Z., Zhou, R., . . . Zhang, L. (2020). Efficacy and Safety of Sintilimab Plus Pemetrexed and Platinum as First-Line Treatment for Locally Advanced or

Metastatic Nonsquamous NSCLC: a Randomized, Double-Blind, Phase 3 Study (Oncology pRogram by InnovENT anti-PD-1-11). *J Thorac Oncol*, 15(10), 1636-1646. <https://doi.org/10.1016/j.jtho.2020.07.014>

Zhou, C., Wu, L., Fan, Y., Wang, Z., Liu, L., Chen, G., Zhang, L., Huang, D., Cang, S., Yang, Z., Zhou, J., Zhou, C., Li, B., Li, J., Fan, M., Cui, J., Li, Y., Zhao, H., Fang, J., . . . Zhang, W. (2021). Sintilimab Plus Platinum and Gemcitabine as First-Line Treatment for Advanced or Metastatic Squamous NSCLC: Results From a Randomized, Double-Blind, Phase 3 Trial (ORIENT-12). *J Thorac Oncol*, 16(9), 1501-1511. <https://doi.org/10.1016/j.jtho.2021.04.011>

