



# NEW THERAPEUTIC DIRECTIONS IN ADVANCED LUNG CANCER

Jonathan W. Riess MD MS Professor of Medicine Medical Director Thoracic Oncology

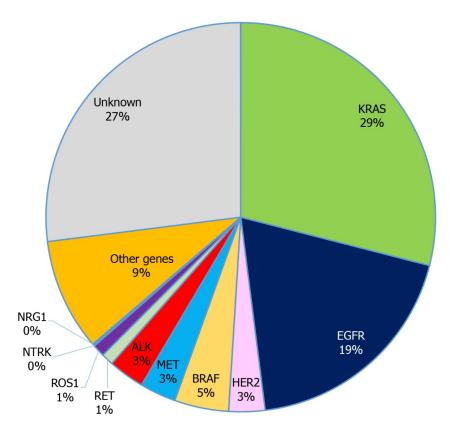
**UC Davis Comprehensive Cancer Center** 

# **Oncogene Drivers in NSCLC**

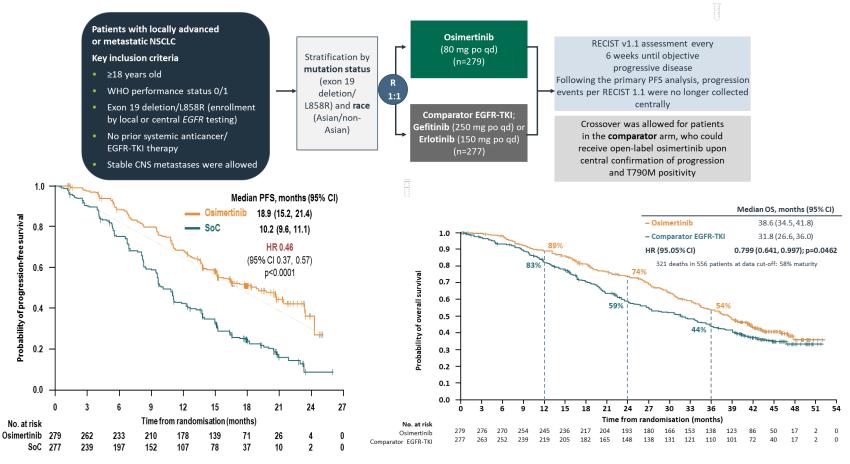
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COMPREHENSIVE CANCER CENTER

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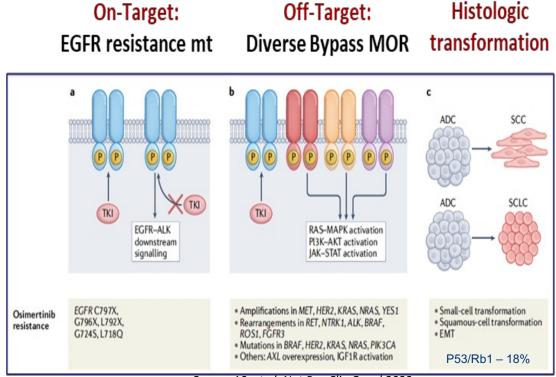


# FLAURA: Osimertinib vs comparator EGFR-TKI as first-line treatment for EGFRm advanced NSCLC



Ramalingam SS, et al. ESMO 2019. Abstract LBA5\_PR.

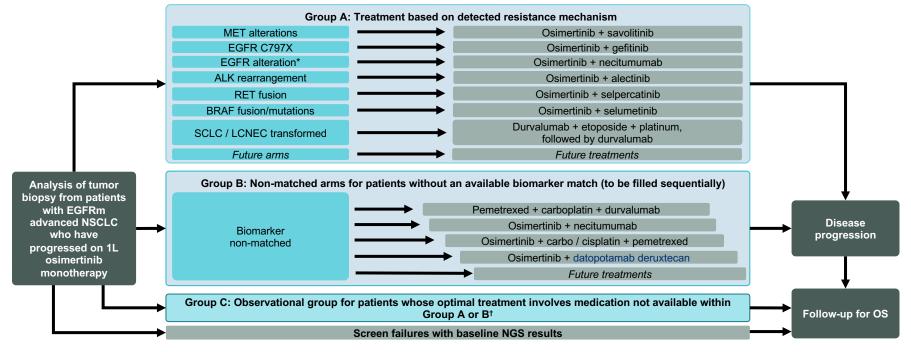
# **Mechanisms of Osimertinib Resistance**



Cooper AS, et al, Nat Rev Clin Oncol 2022

### **ORCHARD** study design

 Ongoing Phase II, open-label, multicenter, multi-drug, biomarkerdirected, platform study



#### H. Yu, JW Riess et al Clinical Lung Cancer 2021

\*Patients eligible for enrollment to the osimertinib + necitumumab arm had secondary EGFR alterations, including amplification, L718 or G724 mutation and exon 20 insertion; <sup>†</sup>E.g. presence of an actionable biomarker for which treatment is not currently available in ORCHARD.

1L, first-line; ALK, anaplastic lymphoma kinase; EGFRm, epidermal growth factor receptor mutation-positive; LCNEC, large cell neuroendocrine carcinoma; NSCLC, non-small cell lung cancer; NGS, next-generation sequencing; OS, overall survival; SCLC, small cell lung cancer

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# Osimertinib With / Without Platinum-Based Chemotherapy as First-Line Treatment in Patients with EGFRm Advanced NSCLC (FLAURA2)

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 Prof Natalia Valdiviezo<sup>13</sup>, Prof Samreen Ahmed<sup>14</sup>, Dr Jean-Marc Maurel<sup>15</sup>, Dr Igor Andrasina<sup>16</sup>, Dr Jonathan Goldman<sup>17</sup>, Dr Dana Ghiorghiu<sup>18</sup>, Dr Dakshayini Kulkarni<sup>18</sup>, Dr Xiangning Huang<sup>19</sup>, Prof Kunihiko Kobayashi<sup>20</sup>

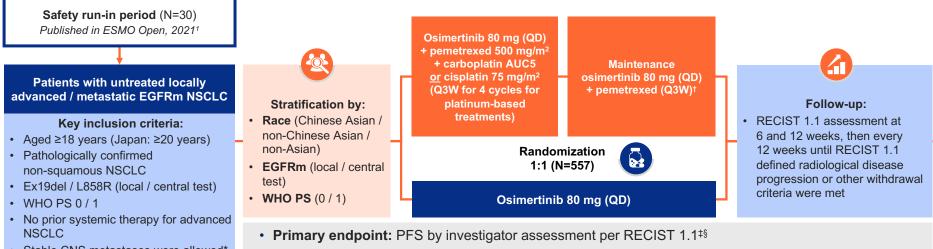
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 <sup>17</sup>David Geffen School of Medicine at UCLA, Los Angeles, CA, USA; <sup>18</sup>Department of Oncology Research & Development, AstraZeneca, Cambridge, UK; <sup>20</sup>Department of Resipratory Medicine, Saitama Medical University International Medical Center, Hidaka, Saitama, Japan

PL03.13





# FLAURA2 Phase III study design



- Stable CNS metastases were allowed\*
- Brain scans at baseline (MRI / CT)

- Sensitivity analysis: PFS by BICR assessment per RECIST 1.1
- Secondary endpoints: OS, ORR, DoR, DCR, HRQoL, safety (AEs by CTCAE v5) and PFS2<sup>‡</sup>

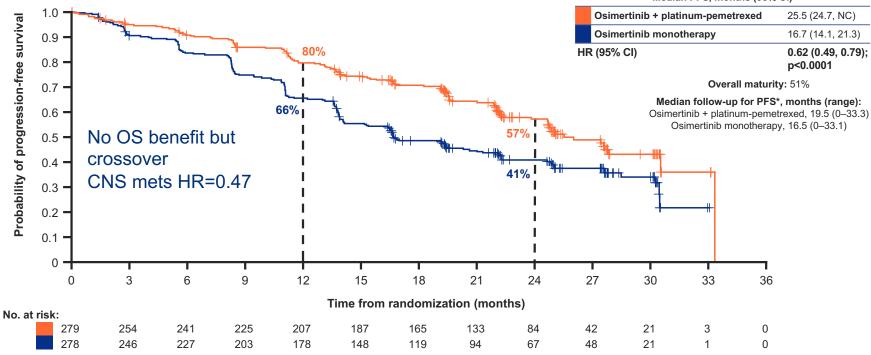
#### 1. Planchard et al. ESMO Open 2021;6:100271

\*Not requiring steroids for at least two weeks; <sup>1</sup>Pemetrexed maintenance continued until a discontinuation criterion was met; <sup>1</sup>Efficacy analyses in the full analysis set, defined as all patients randomized to study treatment regardless of the treatment actually received, and safety analyses in the safety analysis set, defined as all randomized to study treatment regardless of the treatment actually received, and safety since the safety analysis set, defined as all randomized patients who received <sup>21</sup> dose of study treatment – one patient who was randomized to osimetrinib plus platinum-pemetrexed received only osimetrinib and was therefore included in the osimetrinib monotherapy safety analysis set; who-sided significance level

AE: adverse event: AUC, area under curve; BICR, blinded independent central review; CNS, contral nervous system; CT, computed tomography; CTCAE. Common Terminology Criteria for Adverse Events; DCR, disease control rate; DOR, duration of response; EGFRm, epidermal growth factor receptor-mutated; EGFR-TKI, EGFR-tyrosine kinase inhibitor; Ex19del, exon 19 deletion; HR, hazard ratio; HRQoL, health-related quality of life; MRI, magnetic response inaging; NSCLC, non-small cell lung cancer; ORR, objective response rate; OS, overall survival; PFS, progression-free survival; PFS2, second progression-free survival; OPS, exoration performance status

# Progression-free survival per investigator

• Median PFS was improved by ~8.8 months with osimertinib plus platinum-pemetrexed vs osimertinib monotherapy



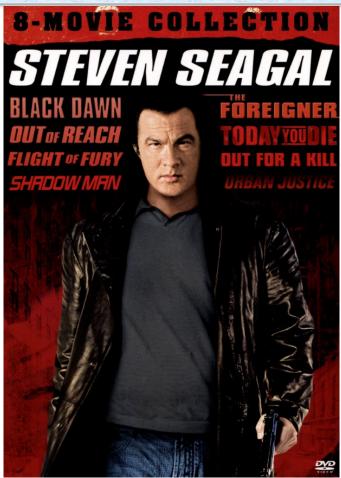
Median PFS, months (95% CI)

Data cut-off: 03 April 2023

\*In all patients

CI, confidence interval; HR, hazard ratio; NC, not calculable; PFS, progression-free survival





ctDNA positive on treatment

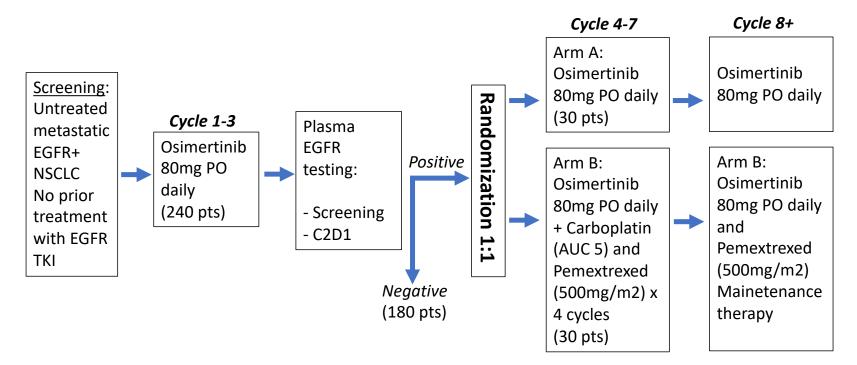
Co-mutations p53/RB1, RBM10

CNS metastases

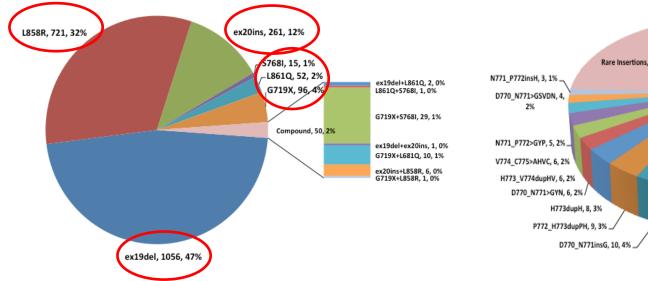
Tumor volume/disease burden?

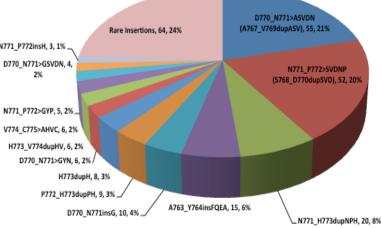


# **Shedders Trial**



# **EGFR** mutations are heterogeneous

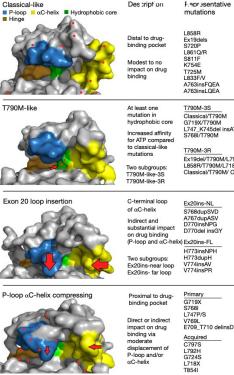




#### JW Riess et al. JTO 2018

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# **Osimertinib Efficacy in Atypical EGFR Mutations**



R	Intermediate
V sFQEA sLQEA	Resistant 3rd gen 2nd gen 1st gen Ex20ins-active
-3S al/T790M T790M 745del insATSPE 790M	T790M-3S 3rd gen PKCi ALKi 2nd gen 1st gen
- <u>3R</u> //T790M/L792H T790M/L718X al/T790M/ C797S	T790M-3R PKCi ALKi 3rd gen 2nd gen 1st gen
s-NL IPSVD IPASV sNPG el insGY	Ex20ins-NL Ex20ins-active 2nd gen 1st gen 3rd gen
s-FL	Ex20ins-FL

Drug

selectivity

- Ex20ins-active 2nd gen 1st gen 3rd gen Ex20ins-FL Ex20ins-active 2nd gen 1st gen 3rd gen
- D 1st gen Ex20ins-active 3rd gen

- Structure-Function relationship and classification predicts TKI activity in EGFR mutant NSCLC.
- Role of EGFR moAb and bispecifics by mutation needs to be more fully explored.

Robichaux et al. Nature 2021.



# **Amivantamab Efficacy in EGFR Exon 20 insertion**

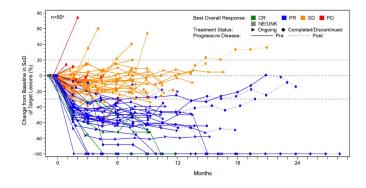
#### Amivantamab: Efficacy by BICR

BICR-assessed Response	Efficacy Population (n=81)
Overall response rate	40% (95% CI, 29–51)
Median duration of response	11.1 months (95% CI, 6.9–NR)
Best response, n (%)	
Complete response	3 (4)
Partial response	29 (36)
Stable disease	39 (48)
Progressive disease	8 (10)
Not evaluable	1 (1)
Clinical benefit rate <sup>a</sup>	74% (95% CI, 63–83)

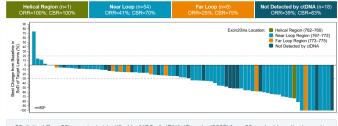
Median follow-up: 9.7 months (range, 1.1–29.3)

#### mPFS: 8.3 mo (95% Cl, 6.5-10.9) mOS: 22.8 mo (95% Cl, 14.6-NR)

#### **Amivantamab: Responses Over Time**



#### Best ORR by Insertion Region of Exon 20 (detected by ctDNA)



25 distinct Exon20ins variants identified by NGS of ctDNA (Guardant360®) from 63 evaluable patient samples

#### K. Park et al JCO 2021



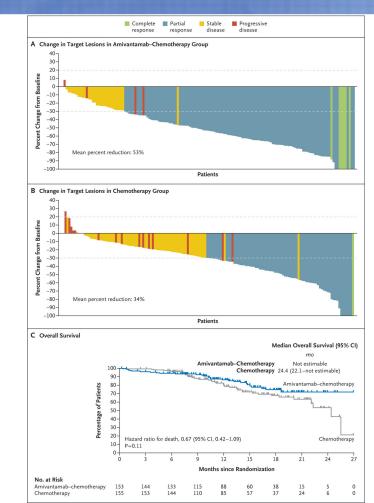
#### UC DAVIS HEALTH



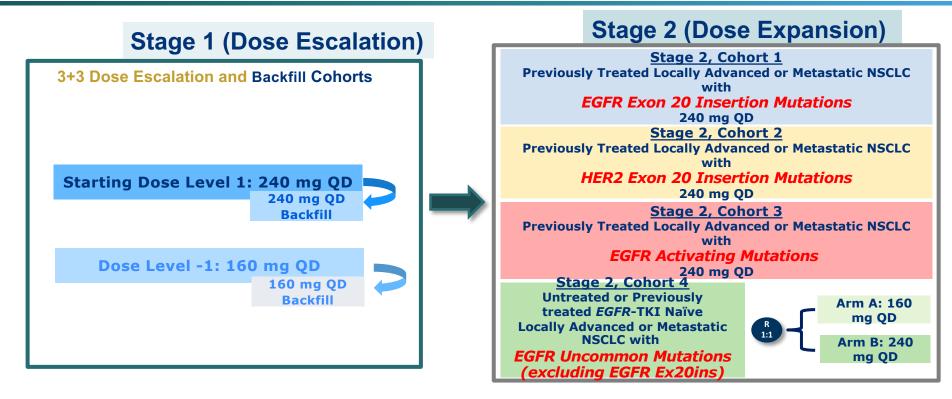
COMPREHENSIVE

#### A Progression-free Survival, Blinded Independent Central Review 100-90 80-Percentage of Patients 70-60-50-6.7 mo (95% Cl. Amiyantamab-40-5.6-7.3) chemotherapy 30-11.4 mo (95% CI, Hazard ratio for disease 20-9.8 - 13.7progression or death, 0.40 (95% CI, 0.30-0.53) Chemotherapy 10 -P<0.001 0 12 15 18 21 0 q 24 Months since Randomization No. at Risk Amivantamab-153 135 105 74 50 33 15 3 0 chemotherapy Chemotherapy 155 131 74 41 14 4 2 0

#### C. Zhou et al NEJM 2023



FURMO-002: Phase 1b Study in NSCLC Harboring Activating EGFR and HER2 Kinase Domain Mutations



#### Key Eligibility Criteria

• NSCLC with documented EGFR or HER2 mutation by local testing (tissue or blood)

### Clinicaltrials.gov NCT05364073 furmo@arrivent.com





#### SEPTEMBER 9-12, 2023 | SINGAPORE

### **Confirmed ORR by IRC by Cohort**

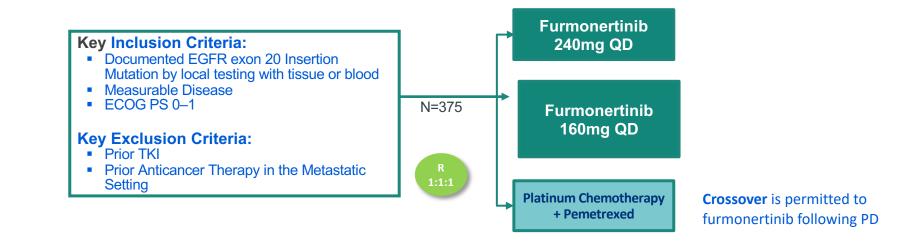
Efficacy by IRC	Treatment Naïve 240mg N=28*	Previously Treated 240mg N= 26 <sup>#</sup>	Previously Treated 160mg N= 26 <sup>#</sup>	
Confirmed ORR, % (95% CI)	78.6% (59.05%, 91.70%)	46.2% (26.59%, 66.63%)	38.5% (20.23%, 59.43%)	
Best Response, n (%)				
Partial response (PR)	22 (78.6%)	12 (46.2%)	10 (38.5%)	
Stable disease (SD)	6 (21.4%)	12 (46.2%)	12 (46.2%)	
Progressive disease (PD)	0	0	4 (15.4%)	
Not evaluable/Not done	0 / 0	1 (3.8%) / 1 (3.8%)	0 / 0	
DoR, median (months) (95% CI)	15.2 (8.74, 24.84)	13.1 (5.62, 13.80)	9.7 (5.59, NA)	
DCR (CR+PR+SD), % (95% CI)	100.0% (87.66%, 100.00%)	92.3% (74.87%, 99.05%)	84.6% (65.13%, 95.64%)	

Analysis is based on EGFR exon 20ins patients who had measurable disease at baseline by IRC, had  $\geq$  2 tumor assessments, had PD/death, or discontinued from treatment.

- \* 2 patients: one patient had no measurable target lesion at baseline by IRC; another patient did not have an exon 20 insertion mutation.
- # 26 of the 28 patients in 240 mg and 160 mg cohorts respectively had at least 2 tumor assessments by June 15, 2023.

IRC, independent review committee ; ORR, objective response rate; DoR, duration of response; DCR: Disease Control Rate; CI, confidence interval;

# FURVENT: Ph3 1L EGFR Ex20ins NSCLC Study Design (FURMO-004)



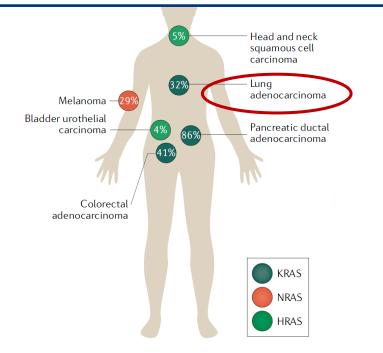
**Primary endpoint:** PFS by BICR per RECIST v1.1 **Key secondary endpoints:** OS, ORR, DOR, PRO, Safety, PK

Clinicaltrials.gov NCT05607550 FURVENTStudy.com

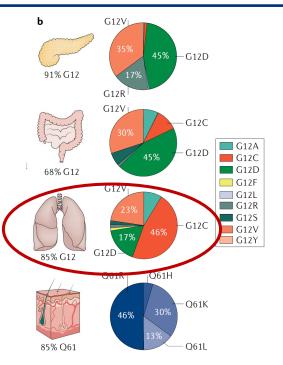


# **KRAS** mutations in cancer – Focus on NSCLC

### Frequency of KRAS Mutations by Tumor Type



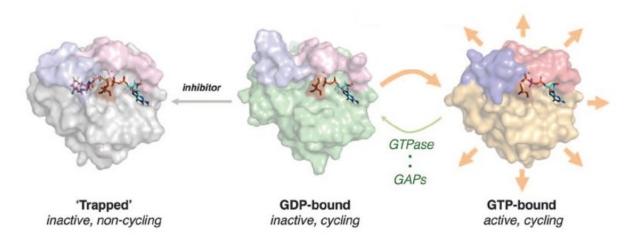
### KRAS Mutation Subtypes By Tumor Tupe



Figures from Moore AR et al. Nat Rev Drug Discov 19, 533–552 (2020).



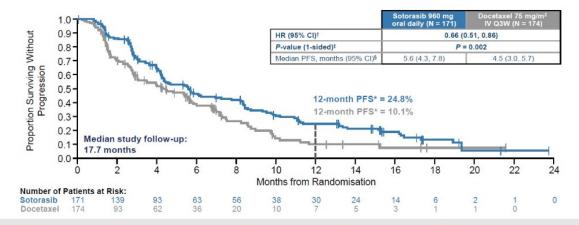
# KRAS G12C Inhibitors Bind, Inactive GDP bound RAS and Trap It In Inactive State



From P. Lito et al. Science 2016

# **Codebreak 200: Topline Results**

### Primary Endpoint: PFS by BICR



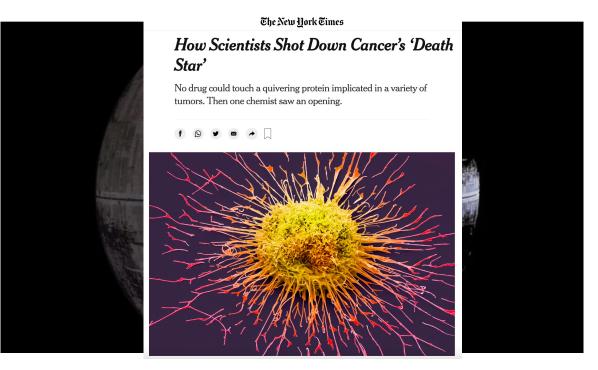
CodeBreaK 200 met its primary endpoint with sotorasib demonstrating superior PFS over docetaxel (HR 0.66, *P* = 0.002); 12-month PFS rate was 24.8% for sotorasib and 10.1% for docetaxel

#### ORR 28.1% vs. 13.2%

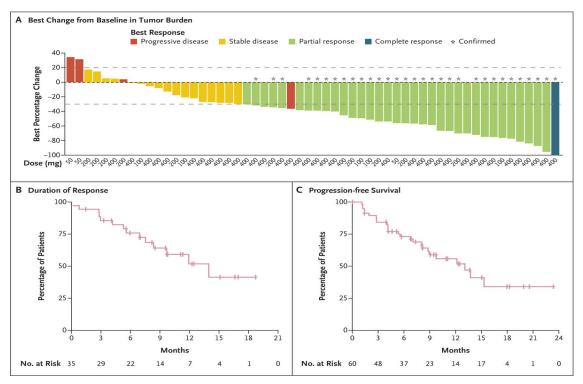
mOS 10.6 (soto) vs. 11.3 months (doce). No difference in OS. 34% crossover in docetaxel arm

## M. Johnson et al ESMO 2022





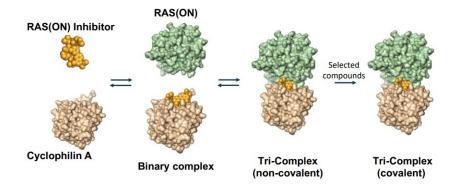
# Anti-tumor Activity of Divarasib in Patients with Advanced KRAS G12C NSCLC



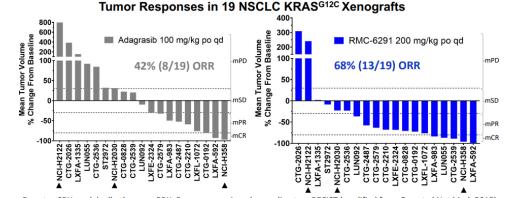
#### A Sacher et al. N Engl J Med 2023;389:710-721.

# **RAS(ON)** Inhibitors

 Less susceptible to adaptive resistance compared to GDP bound RAS



- RMC-6291 KRAS G12C (ON) inhibitor
- RMC-9805 KRAS G12D
  (ON) inhibitor
- RMC-6236-Pan RAS(ON)



Denotes CDX model; all others are PDX. Responses assigned according to mRECIST (modified from Gao et al Nat Med. 2015).

Kelsey S. AACR-NCI-EORTC 2021. Hofmann MH, et al. Cancer Discov. 2022 Apr 1;12(4):924-937.



# AACR

merican Associatio for Cancer Research



#### KRAS<sup>G12C</sup>-Mutant NSCLC Previously Treated With or Naïve to a KRAS<sup>G12C</sup>(OFF) Inhibitor: Best Response

Best % Change in SOD from Baseline in Target Tumor Burden

Evaluable for Efficacy\* (N=17) Tumor Response (per RECIST 1.1) Prior Naïve to 400 mg BID 200 mg OD 100 Best overall response, 300 mg BID 100 mg QD G12Ci G12Ci n (%) 200 mg BID 50 mg QD 80 (n=10) (n=7)  $\rightarrow$  = on treatment 60 -5 (50) 3 (43) # KRAS<sup>G12C</sup> inhibitor-treated Partial response<sup>†</sup> 40 -5 (50) 4 (57) 20 -SD Stable disease SD SD 0 SD SD SD Progressive disease 0 0 SD SD # -20 -SD -40 PRu PRu PR ORR, n (%) 5 (50) 3 (43) PR PR # PR # -60 PRu PR DCR (CR+PR+SD), -80 10 (100) 7 (100) n (%) -100 Week of Most 5 18 12 12 12 6 36 5 11 12 5 18 26 30 17 5 12 Recent Scan

\*All treated patients who received a first dose of RMC-6291 at least 8 weeks prior to data extract date; <sup>†</sup>PR includes 5 confirmed and 3 unconfirmed. CR, complete response; DCR, disease control rate; G12Ci, G12C inhibitor; PD, progressive disease; PR, partial response; PRu, unconfirmed partial response; SD, stable disease: SOD, sum of diameters: ORR objective response rate: DCR, disease control rate: RECIST, response evaluation criteria in solid tumors.

Data Extracted 05 October 2023.

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### **KRAS<sup>G12X</sup> NSCLC: Best Response**

Kathrvn C. Arbour, MD

**Tumor Response** Evaluable for Efficacy (N = 40)<sup>a</sup> (per RECIST 1.1) Best % Change from Baseline in Target Lesion 100-Best overall response, n (%) 80 mg QD 200/220 ma QD CR 1 (3) 120 mg QD 300 mg QD PR 14 (35) 160 ma QD 400 mg QD SD 19 (48) → On Treatment 50-PD 5 (13) PD **NF<sup>b</sup>** 1 (3) ORR, n (%) 15 (38) PD Confirmed, n 12 SD SD SD SD SD  $\begin{array}{c} \rightarrow \rightarrow \rightarrow \text{sd} \text{ sd} \text{ sd} \text{ sd} \\ \rightarrow \rightarrow \rightarrow \rightarrow \text{sd} \text{ pd} \end{array}$ DCR (CR+PR+SD), 34 (85) n (%)  $\rightarrow \stackrel{\text{SD}}{\rightarrow} \stackrel{$  $\begin{array}{c} \text{SD SD SD SD SD SD SD} \\ \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow PR^{*} PR PR PR PR PR^{*} PR PR^{*} PR^{$ \*Unconfirmed PR per RECIST 1.1. <sup>a</sup>Patients who received first dose of -50 -RMC-6236 at least 8 weeks prior to data extract date. <sup>b</sup>One subject withdrew from study PR without post-baseline scans. 100-**KRAS G12 Mutation** Week of Most Recent scan 27 11 27 12 17 12 27 13 6 13 12 19 12 6 6 6 18 13 5 26 6

> CR, complete response; DCR, disease control rate; NE, not evaluable; ORR, objective response rate; PD, progressive disease; PR, partial response; RECIST, Response Evaluation Criteria in Solid Tumors; SD, stable disease.



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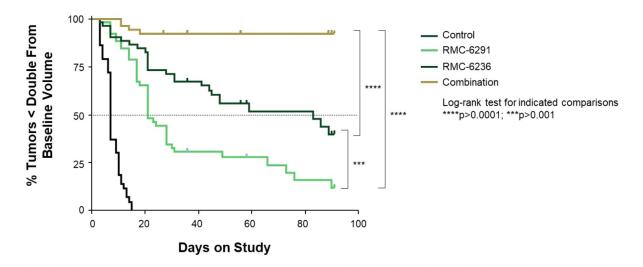


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### RMC-6236 + RMC-6291 Doublet Overcomes Resistance AAGR and Prolongs Durability in KRAS<sup>G12C</sup> NSCLC Models



 RAS(ON) inhibitor doublet has been evaluated across seven models, including five identified as resistant to RMC-6291 monotherapy



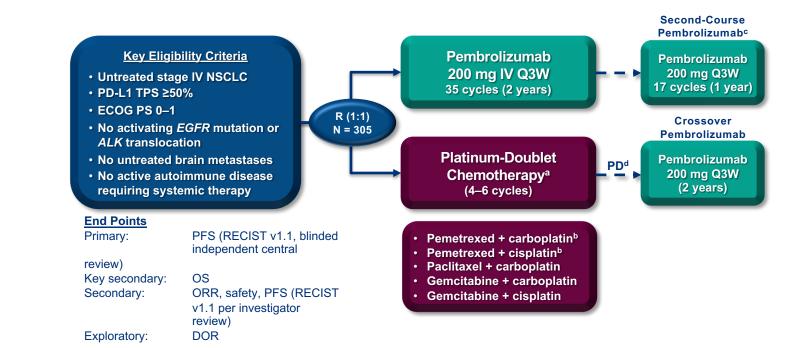
### KEYNOTE-024 5-Year OS Update: First-Line Pembrolizumab vs Platinum-Based Chemotherapy in Patients with Metastatic Non– Small-Cell Lung Cancer and PD-L1 Tumor Proportion Score ≥50%

<u>Julie R. Brahmer</u>,<sup>1</sup> Delvys Rodríguez-Abreu,<sup>2</sup> Andrew G. Robinson,<sup>3</sup> Rina Hui,<sup>4</sup> Tibor Csőszi,<sup>5</sup> Andrea Fülöp,<sup>6</sup> Maya Gottfried,<sup>7</sup> Nir Peled,<sup>8</sup> Ali Tafreshi,<sup>9</sup> Sinead Cuffe,<sup>10</sup> Mary O'Brien,<sup>11</sup> Suman Rao,<sup>12</sup> Katsuyuki Hotta,<sup>13</sup> Ticiana A. Leal,<sup>14</sup> Jonathan W. Riess,<sup>15</sup> Erin Jensen,<sup>16</sup> Bin Zhao,<sup>16</sup> M. Catherine Pietanza,<sup>16</sup> Martin Reck<sup>17</sup>

<sup>1</sup>Sidney Kimmel Comprehensive Cancer Center at Johns Hopkins, Baltimore, MD, USA; <sup>2</sup>Hospital Universitario Insular de Gran Canaria, Las Palmas, Spain; <sup>3</sup>Cancer Centre of Southeastern Ontario at Kingston General Hospital, Kingston, ON, Canada; <sup>4</sup>Westmead Hospital and the University of Sydney, Sydney, NSW, Australia; <sup>5</sup>Jász-Nagykun-Szolnok County Hospital, Szolnok, Hungary; <sup>6</sup>Országos Korányi Pulmonológiai Intézet, Budapest, Hungary; <sup>7</sup>Meir Medical Center, Kfar-Saba, Israel; <sup>8</sup>Soroka Cancer Center, Ben Gurion University, Beer Sheva, Israel; <sup>9</sup>Wollongong Private Hospital and University of Wollongong, Wollongong, NSW, Australia; <sup>10</sup>St. James's Hospital and Cancer Trials Ireland (formerly ICORG – All Ireland Cooperative Oncology Research Group), Dublin, Ireland; <sup>11</sup>The Royal Marsden Hospital, Sutton, Surrey, UK; <sup>12</sup>MedStar Franklin Square Hospital, Baltimore, MD, USA; <sup>13</sup>Okayama University Hospital, Okayama, Japan; <sup>14</sup>Carbone Cancer Center, University of Wisconsin, Madison, WI, USA; <sup>15</sup>UC Davis Comprehensive Cancer Center, North (ARCN), member of the German Center for Lung Research (DZL), Grosshansdorf, Airway Research Center North (ARCN),



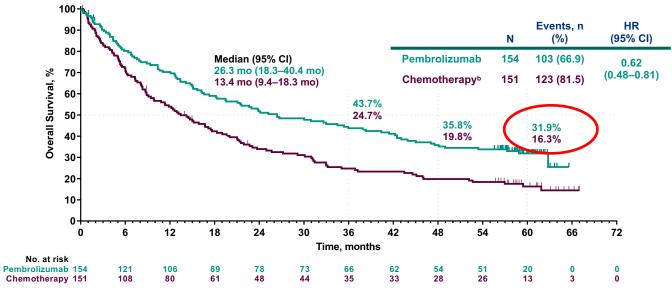
# **KEYNOTE-024 Study Design (NCT02142738)**



<sup>a</sup>Optional pemetrexed maintenance therapy for nonsquamous disease. <sup>b</sup>Permitted for nonsquamous disease only. <sup>c</sup>Patients randomized to pembrolizumab who completed 2 years of therapy or who stopped pembrolizumab after achieving CR and then had PD were eligible for a second course of pembro monotherapy. <sup>c</sup>Before the DMC recommendation and amendment 6, which permitted those in the chemotherapy arm to be offered pembrolizumab (based on interim analysis 2 data), patients were eligible for crossover when PD was confirmed by blinded, independent central radiology review.



# **Overall Survival**<sup>a</sup>



<sup>a</sup>ITT population.

<sup>b</sup>Effective crossover rate from chemotherapy to anti–PD-L1 therapy, 66.0% (99 patients in total crossed over to anti–PD-[L]1 therapy: 83 patients crossed over to pembrolizumab during the study, and 16 patients received subsequent anti–PD-L1 therapy outside of crossover; patients may have received >1 subsequent anti–PD-L1 therapy). Data cutoff: June 1, 2020.

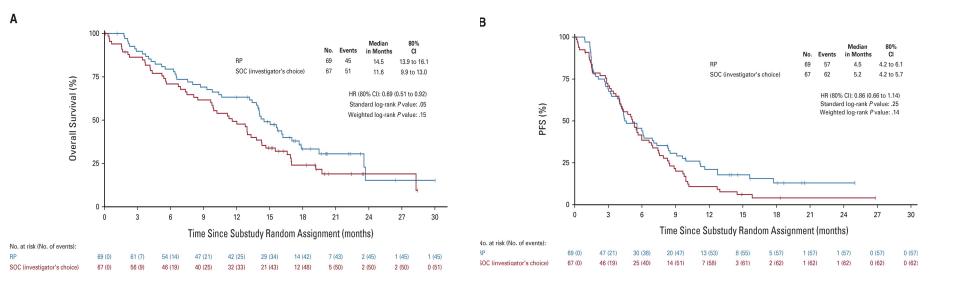


# Lung-MAP: Master Protocol for Lung Cancer

- Lung MAP is an umbrella trial. Genomic/molecular profiling and then assignment to matched and unmatched arms based on results.
- Initially developed for squamous NSCLC given lack of genomic targets in that histology.
- Now expanded across NSCLC histologies and includes oncogene driver mutations (EGFR mutation/MET amp – S1900G)
- Lung-MAP is open at more than 700 sites across the United States. (Bring the trials and drugs to the patient)



# OS and PFS in S1800A (Pembrolizumab + Ramucirumab vs. SOC)

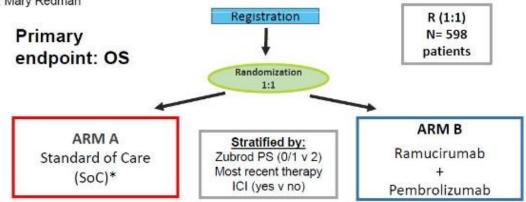




# S2302, Project Pragmatica

S2302, PROJECT PRAGMATICA: A PROSPECTIVE RANDOMIZED STUDY OF RAMUCIRUMAB (NSC 749128) PLUS PEMBROLIZUMAB (MK-3475; NSC 776864) VERSUS STANDARD OF CARE FOR PARTICIPANTS PREVIOUSLY TREATED WITH IMMUNOTHERAPY FOR STAGE IV OR RECURRENT NON-SMALL CELL LUNG CANCER

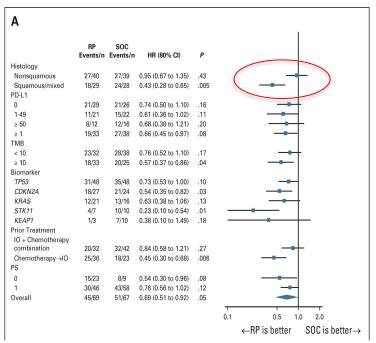
Chair: Karen Reckamp, MD; Co-chair: Konstantin Dragnev, MD; TBD Statistician: Mary Redman



"SoC treatment is to be determined by the treating investigator and participant. It is recommended that the choice of SoC drug(s) is based on NCCN guidelines for a "systemic therapy for advanced or metastatic disease-subsequent."

# **Forrest Plot S1800A**

# **Overall Survival**

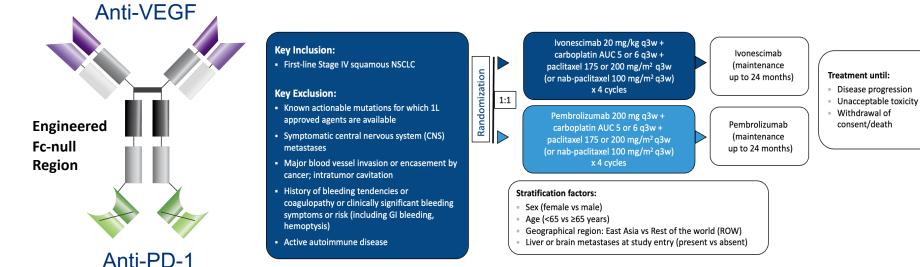


# **Progression-Free Survival**

R

В					
	RP Events/n	SOC Events/n	HR (80% CI)	Р	
Histology					
Nonsquamous	34/40	34/39	0.95 (0.69 to 1.29)	.41	
Squamous/mixed	23/29	28/28	0.55 (0.38 to 0.80)	.02	
PD-L1					
0	27/29	25/26	0.84 (0.58 to 1.22)	.28	
1-49	16/21	22/22	0.53 (0.34 to 0.81)	.03	
≥ 50	8/12	12/16	0.86 (0.48 to 1.55)	.37	
≥ 1	24/33	34/38	0.67 (0.48 to 0.95)	.07	
тмв					
< 10	29/32	36/38	0.91 (0.66 to 1.26)	.36	
≥ 10	24/33	23/25	0.61 (0.42 to 0.89)	.05	
Biomarker					
TP53	39/48	43/48	0.80 (0.60 to 1.06)	.16	
CDKN2A	22/27	24/24	0.49 (0.33 to 0.74)	.01	
KRAS	16/21	15/16	0.65 (0.41 to 1.04)	.12	
STK11	5/7	10/10	0.41 (0.19 to 0.90)	.07	
KEAP1	2/3	10/10	0.42 (0.15 to 1.15)	.14	
Prior Treatment					
IO + Chemotherapy					
Combination	26/32	40/42	0.88 (0.64 to 1.23)	.31	
Chemotherapy→IO	31/36	21/23	0.63 (0.44 to 0.90)	.05	
PS					
0	21/23	8/9	0.79 (0.46 to 1.35)	.28	
1	36/46	54/58	0.71 (0.54 to 0.94)	.06	
Overall	57/69	62/67	0.86 (0.66 to 1.14)	.25	-
				-	
				0.1	0.5 1.0 2.0
					←RP is better SOC is better-

HARMONi-3: A Randomized, Controlled, Multiregional Phase 3 Study of Ivonescimab Combined with Chemotherapy Versus Pembrolizumab Combined with Chemotherapy for the First-line Treatment of Metastatic Squamous Non-Small Cell Lung Cancer

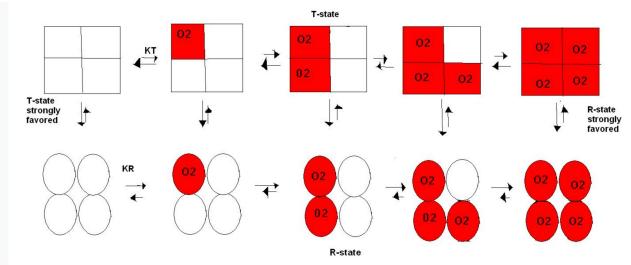


Ivonescimab: First-in-Class PD-1/VEGF Bispecific Antibody in Clinical Development



# **Cooperative Binding and Ivonescimab**





# Conclusions

- Advances in lung cancer treatment (expanding toolbox) have meaningfully improved survival for our patients (N. Howlander NEJM 2020)
- UC Davis has exciting clinical trials to address these unmet needs both for IO and targeted therapies.
- Bringing these therapies to early stage disease is the next step with the potential to "cure" patients.