

# Changes in the Treatment Landscape of HER2 Positive Breast Cancer

Virginia Kaklamani, MD DSc

Professor of Medicine

Leader, Breast Oncology Program



Mays Cancer Center

UT Health  
San Antonio

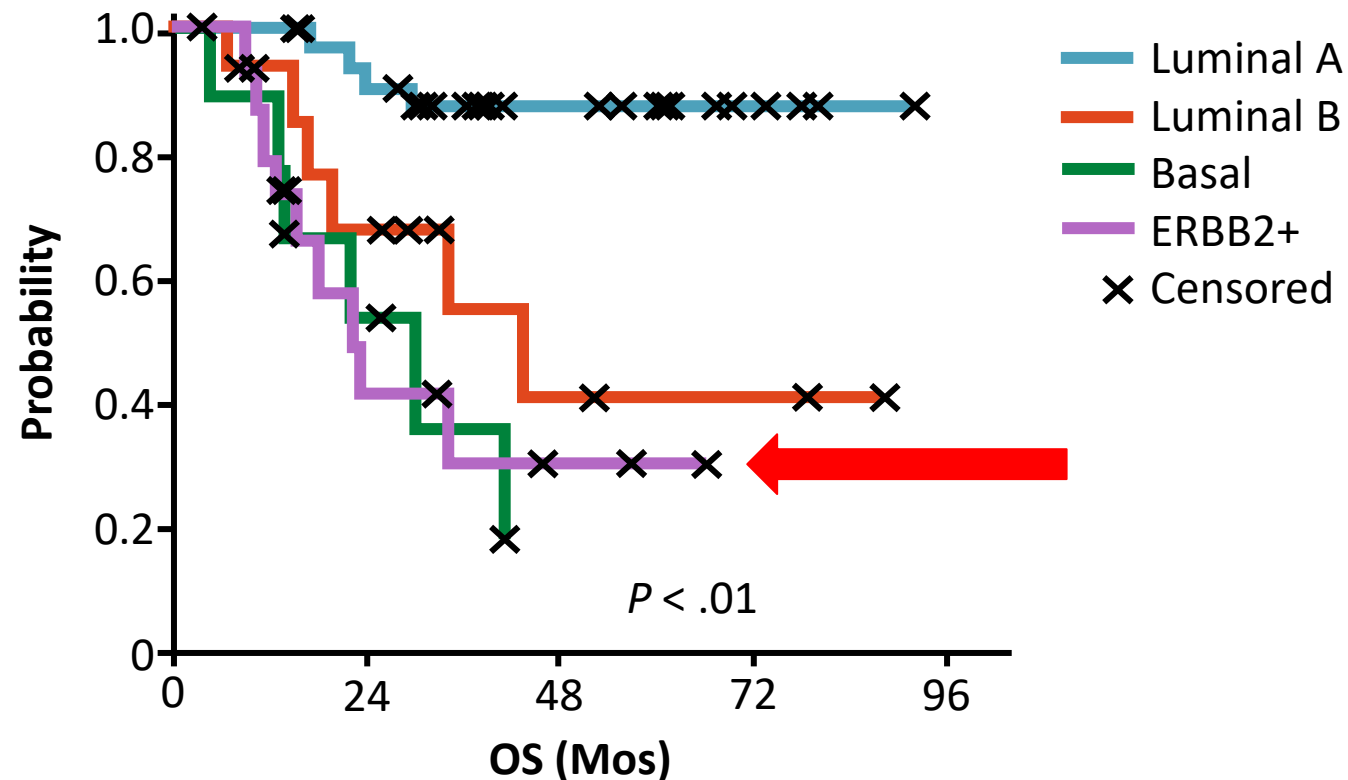
MDAnderson  
~~Cancer Center~~

# Disclosures

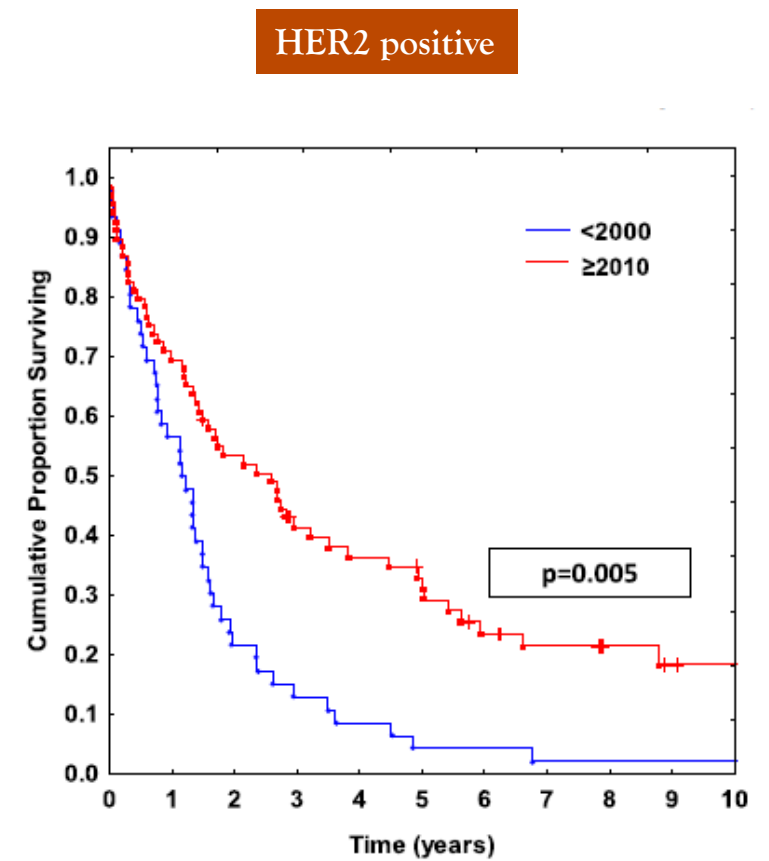
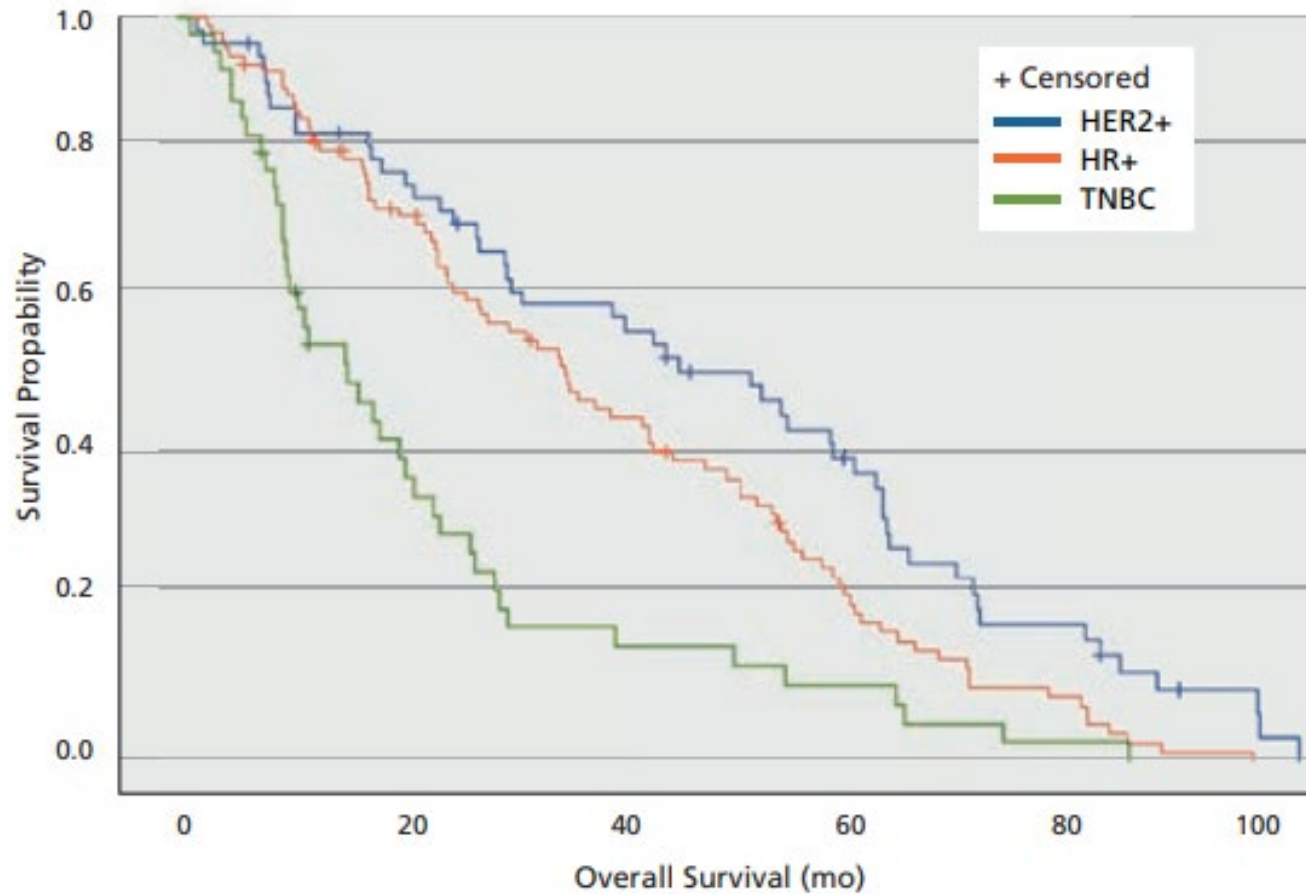
- **Honoraria from:** Daichi, Astrazeneka, Genentech, Gilead, Novartis, Pfizer, Seagen, Lilly, Genomic Health
- **Grant/Research funding from:** EISAI

# The Prognosis of HER2+ Disease Is Poor Without Trastuzumab

Response to Chemo in Locally Advanced Breast Cancer by Subtype (N = 72)

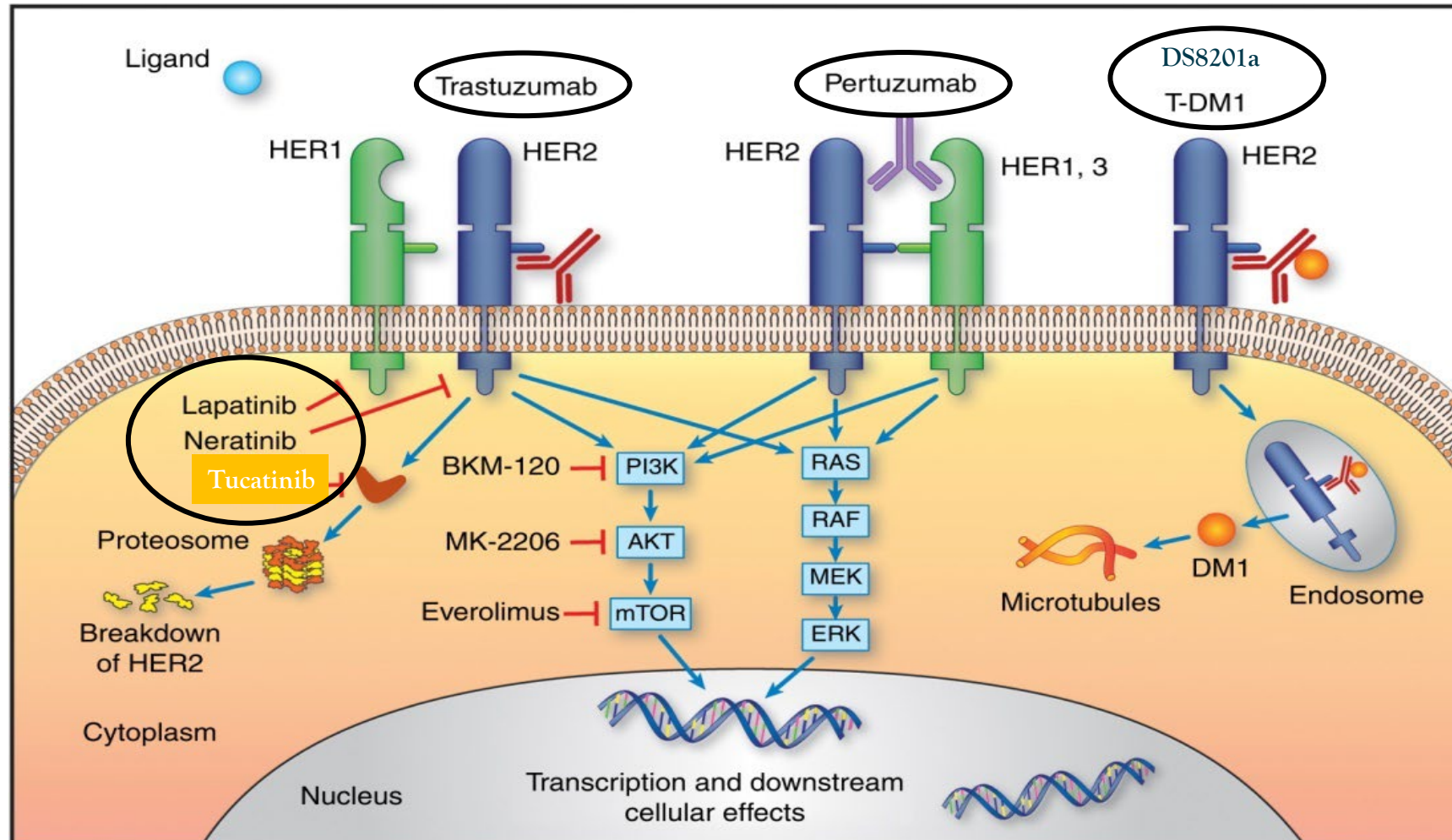


# Survival Improvement in Metastatic Breast Cancer



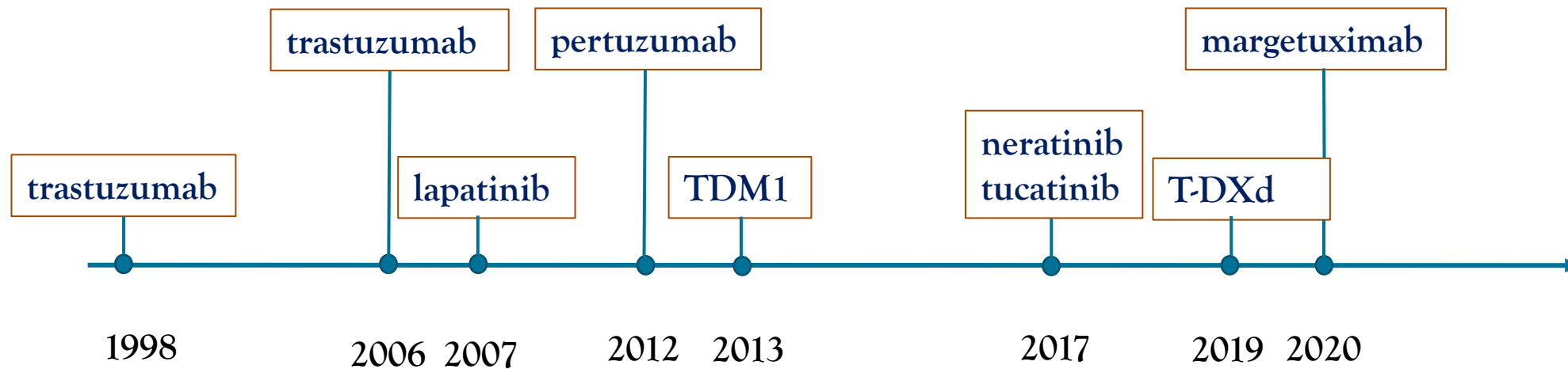
- HER2 positive Early Stage Breast Cancer
- HER2 positive Metastatic Breast Cancer

# HER2 Targeted Therapies



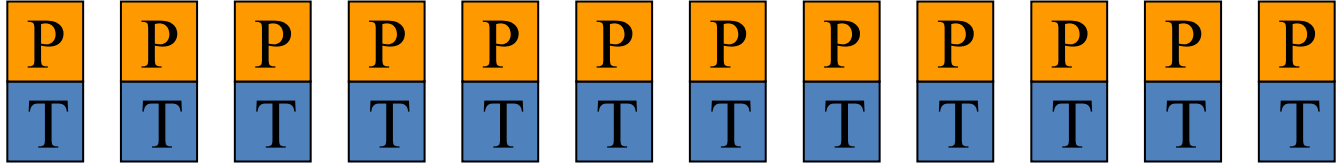
[Proliferation, survival, invasion, angiogenesis]

# Landscape of HER2 Targeted Agents

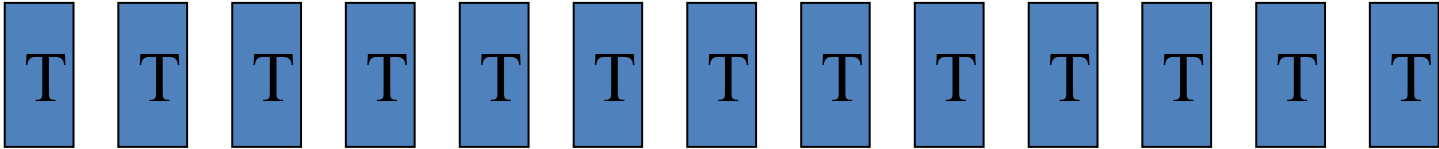


# Clinical Stage: APT Trial

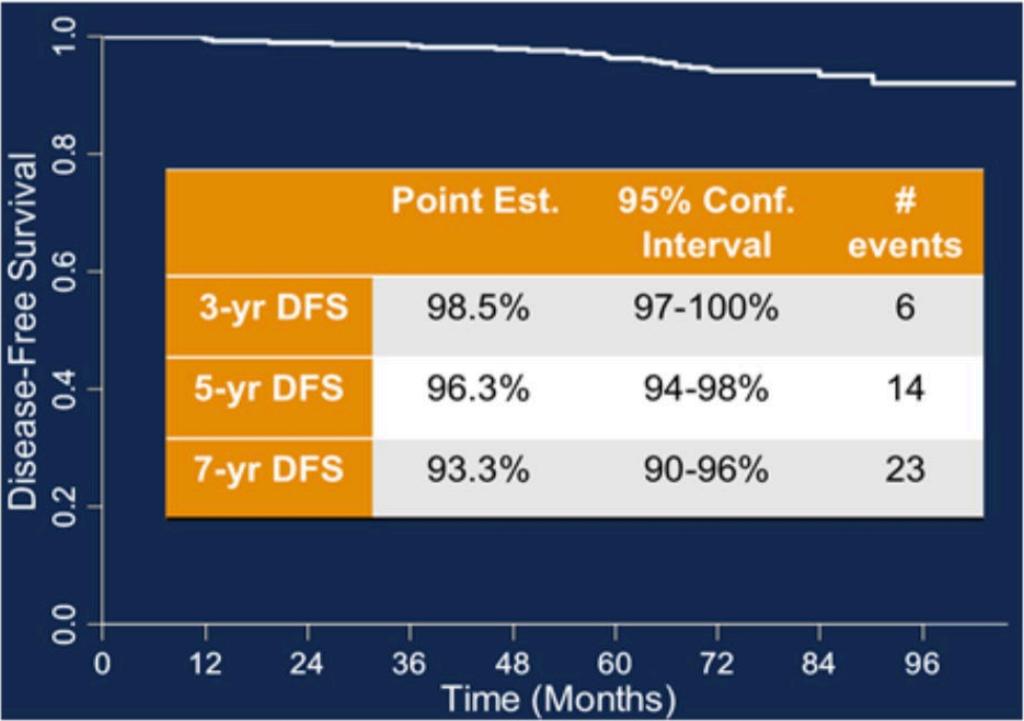
**HER2+**  
**Node Negative**  
 $\leq 3$  cm  
**N=406**



**PACLITAXEL 80 mg/m<sup>2</sup> + TRASTUZUMAB 2mg/kg x12**



**FOLLOWED BY 13 EVERY 3 WEEK DOSES  
 OF TRASTUZUMAB (6 mg/kg)**



Tolaney S, et al. *J Clin Oncol.* 2019;37:1868-1875.

*Tolaney et al, NEJM 2015*

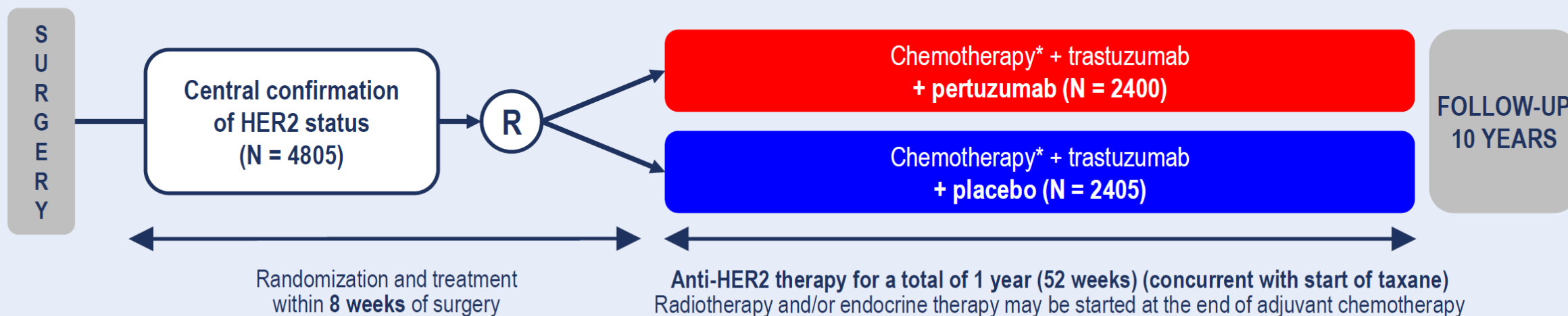


# APHINITY: A Phase III Adjuvant Study Investigating the Benefit of Pertuzumab when Added to Trastuzumab + Chemotherapy

VIRGINIA KAKLAMANI

July 19, 2022

Enclosure 1 of 1



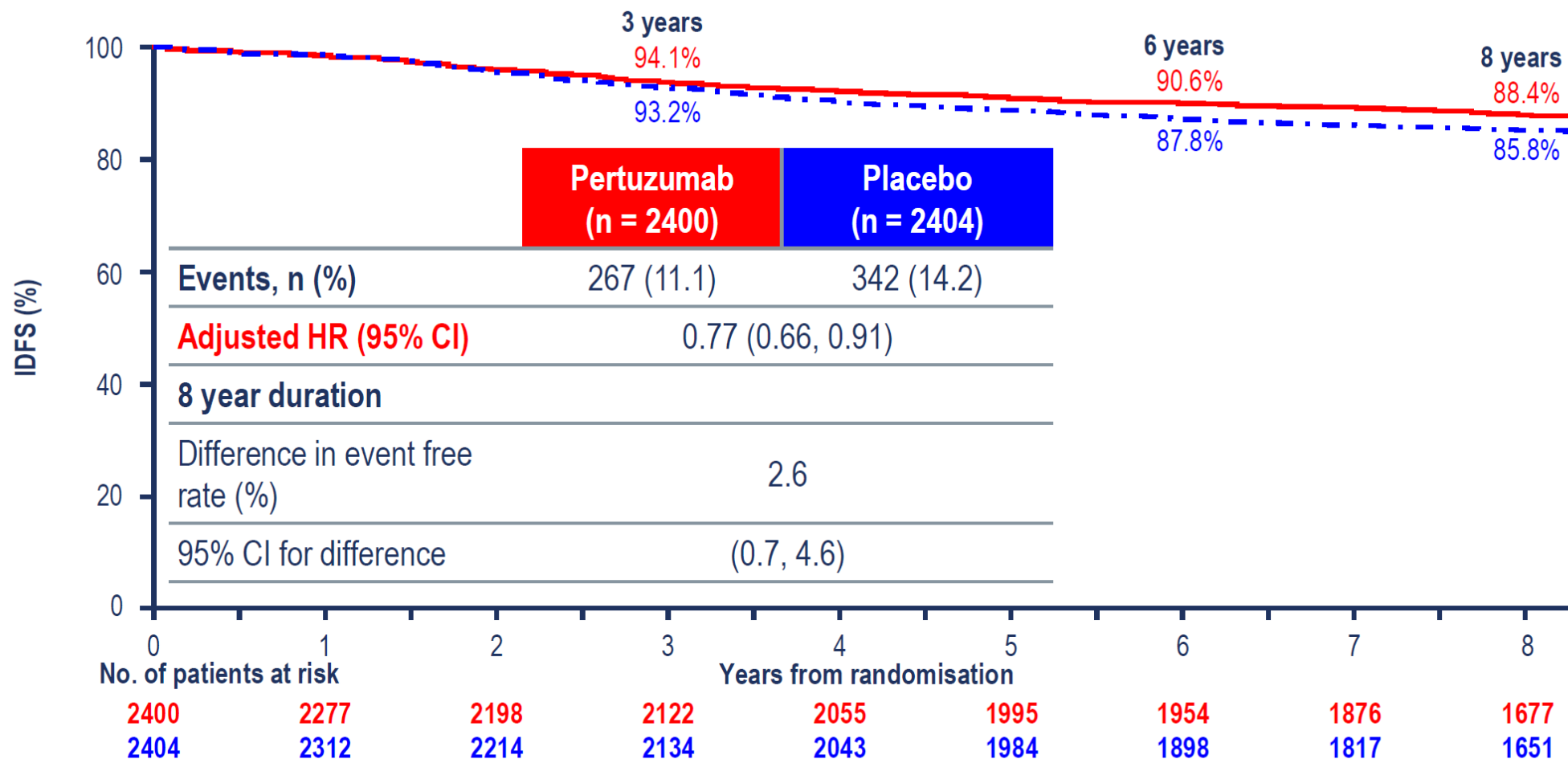
- **Primary endpoint:** IDFS (APHINITY definition differs from STEEP definition)
- **Secondary endpoint:** IDFS with 2<sup>nd</sup> primary non-breast primary cancers included, DFS, OS, RFI, DRFI, safety, and HRQoL
- **Stratification factors:** nodal status, HR status, chemotherapy regimen, geographic region, protocol version (A vs. B)
- **Clinical cut off date (CCOD)** at the time of primary analysis was 19 Dec 2016, median follow up of 45.4 months

\* Standard anthracycline or non-anthracycline (TCH) regimens were allowed: 3–4 x FEC (or FAC) → 3–4 x TH; 4 x AC (or EC) → 4 x TH; 6 x TCH.

DFS, disease-free survival; DRFI, distant relapse-free interval; HR, hormone receptor; HRQoL, health-related quality of life; IDFS, invasive disease-free survival; OS, overall survival; RFI, relapse-free interval.

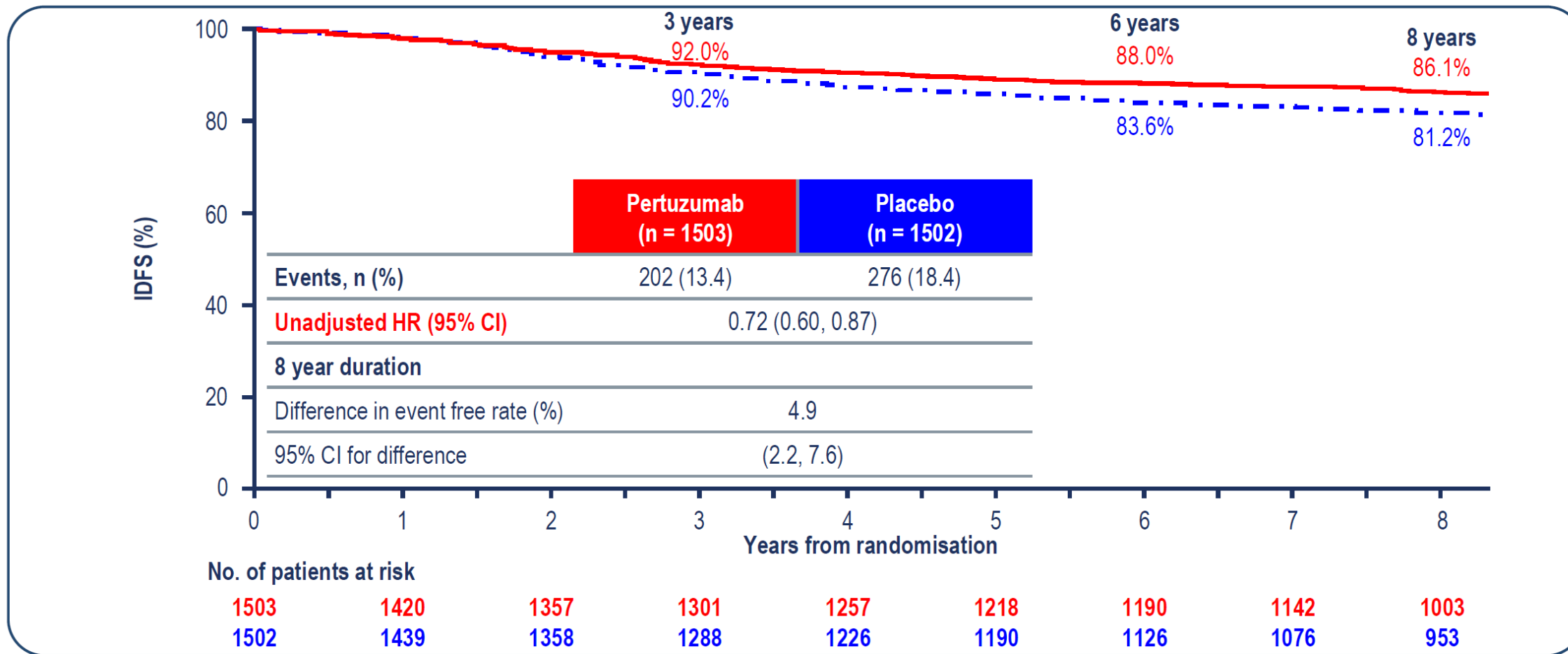
adapted from von Minckwitz et al. N Engl J Med 2017; [www.clinicaltrials.gov/ct2/show/NCT01358877](http://www.clinicaltrials.gov/ct2/show/NCT01358877).

# APHINITY Updated Descriptive IDFS Analysis at 8.4 Years Median FU by Treatment Regimen - ITT population



# APHINITY Updated Descriptive IDFS Analysis at 8.4 Years Median FU by treatment regimen

## Node-positive Cohort



The node positive cohort continues to derive clear benefit from addition of pertuzumab.

# APHINITY Updated Descriptive Analysis

## 8.4 year median FU, Site of First Occurrence of an IDFS Event by Nodal Status

	Node-positive Cohort		Node-negative Cohort	
	Pertuzumab N=1503	Placebo N=1502	Pertuzumab N=897	Placebo N=902
Total patients with IDFS event: n (%)	202 (13.4%)	276 (18.4%)	65 (7.2%)	66 (7.3%)
Category of IDFS event: n (%)				
• Distant recurrence	131 (8.7%)	184 (12.3%)	18 (2.0%)	20 (2.2%)
• CNS metastases	43 (2.9%)	48 (2.9%)	8 (0.9%)	5 (0.6%)
• Locoregional BC recurrence	23 (1.5%)	39 (2.6%)	9 (1.0%)	18 (2.0%)
• Contralateral invasive BC recurrence	13 (0.9%)	16 (1.1%)	15 (1.7%)	6 (0.7%)
• Death without prior event	35 (2.3%)	37 (2.5%)	23 (2.6%)	22 (2.4%)

**Hierarchy applied if a patient experiences additional IDFS event(s) within 61 days of their 1<sup>st</sup> IDFS event**

# KATHERINE Trial

- cT1-4/N0-3/M0 at presentation (cT1a-b/N0 excluded)
- Centrally confirmed HER2-positive breast cancer
- Neoadjuvant therapy must have consisted of
  - Minimum of 6 cycles of chemotherapy
    - Minimum of 9 weeks of taxane
    - Anthracyclines and alkylating agents allowed
    - All chemotherapy prior to surgery
  - Minimum of 9 weeks of trastuzumab
    - Second HER2-targeted agent allowed
- Residual invasive tumor in breast or axillary nodes
- Randomization within 12 weeks of surgery

R  
1:1

N=1486

**T-DM1**  
3.6 mg/kg IV Q3W  
14 cycles

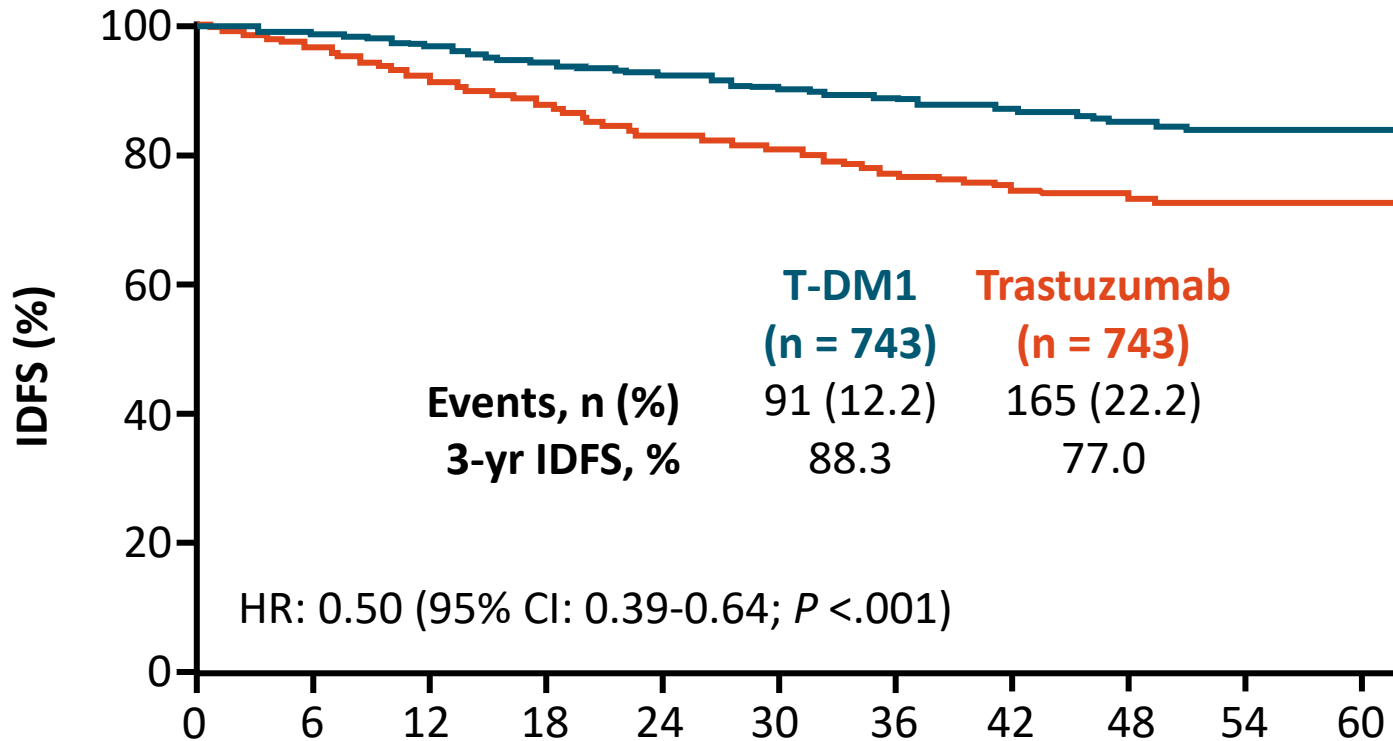
**Trastuzumab**  
6 mg/kg IV Q3W  
14 cycles

Radiation and endocrine therapy  
per protocol and local guidelines

## Stratification factors:

- Clinical presentation: Inoperable (stage cT4 or cN2–3) vs operable (stages cT1-3N0-1)
- Hormone receptor: ER or PR positive vs ER negative and PR negative/unknown
- Preoperative therapy: Trastuzumab vs trastuzumab plus other HER2-targeted therapy
- Pathological nodal status after neoadjuvant therapy: Positive vs negative/not done

# KATHERINE: IDFS



Patients at Risk, n	Mo Since Randomization										
	0	6	12	18	24	30	36	42	48	54	60
<b>T-DM1</b>	743	707	681	658	633	561	409	255	142	44	4
<b>Trastuzumab</b>	743	676	635	594	555	501	342	220	119	38	4

First IDFS Event, %	T-DM1	T
Any	12.2	22.2
Distant recurrence	10.5*	15.9 <sup>†</sup>
Locoregional recurrence	1.1	4.6
Contralateral breast cancer	0.4	1.3
Death without prior event	0.3	0.4

CNS events: \*5.9% vs <sup>†</sup>4.3%.

# ExteNET Trial

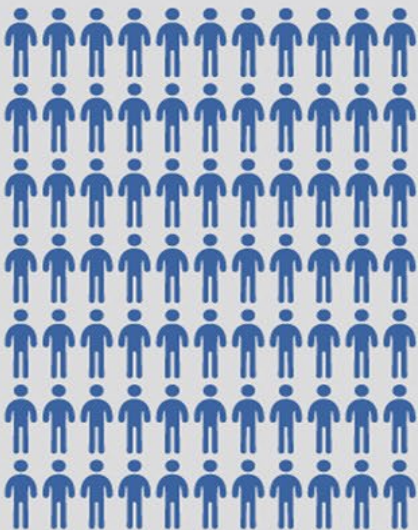
## Neratinib for Early-Stage HER2-Positive Breast Cancer

International, Randomized, Phase 3 ExteNET Trial

Intention-to-treat population

**2840** patients

HER2+ early-stage breast cancer after prior trastuzumab



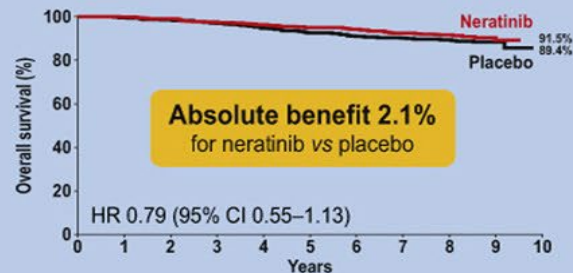
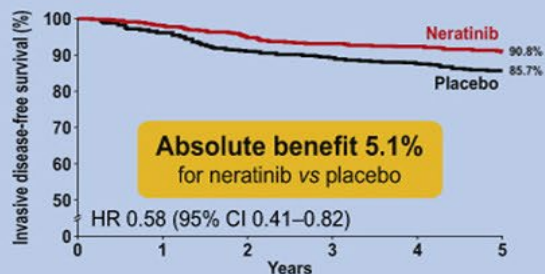
Invasive disease-free survival  
5 years' follow-up

Overall survival  
8 years' follow-up

HER2+/HR+ early-stage breast cancer within 1 year of prior trastuzumab\*

**1334** patients

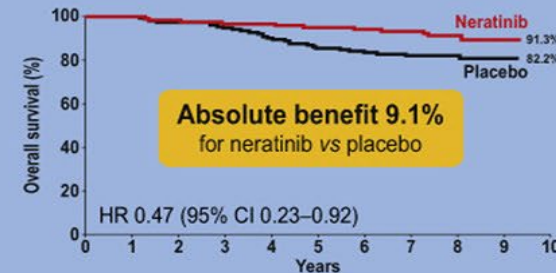
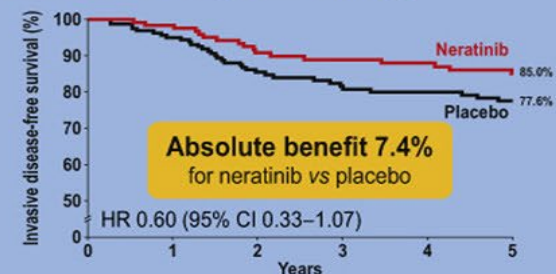
HER2+/HR+ early-stage breast cancer within 1 year of prior trastuzumab



Patients with residual disease after neoadjuvant therapy

**295** patients

HER2+/HR+ early-stage breast cancer within 1 year of prior trastuzumab with residual disease after neoadjuvant therapy



\*According to labelling in the European Union and other countries

# ExteNET: Cumulative Incidence of CNS Recurrences as First Site of Metastases at 5 Yr

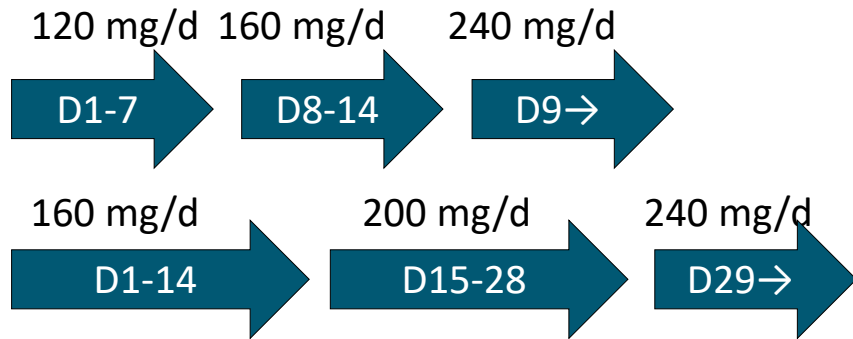
Population or Subgroup	CNS Events (n)		Incidence of CNS Recurrences at 5 Yr (95% CI)	
	Neratinib	Placebo	Neratinib	Placebo
HR+/ $\leq$ 1 yr	4 (670)	12 (664)	0.7 (0.2-1.7)	2.1 (1.1-3.5)
Nodal status				
▪ Positive	4 (540)	10 (539)	0.8 (0.3-2.0)	2.2 (1.1-3.8)
▪ Negative	0 (130)	2 (125)	0 (NE)	1.9 (0.4-6.0)
Prior trastuzumab regimen				
▪ Concurrent	2 (411)	8 (415)	0.6 (0.1-1.9)	2.3 (1.1-4.3)
▪ Sequential	2 (259)	4 (249)	0.9 (0.2-3.0)	1.8 (0.6-4.3)
Adjuvant or neoadjuvant therapy				
▪ Adjuvant	3 (508)	6 (472)	0.7 (0.2-2.0)	1.5 (0.6-3.0)
▪ Neoadjuvant	1 (162)	6 (192)	0.7 (0.1-3.3)	3.7 (1.5-7.4)
pCR status*				
▪ No	1 (131)	5 (164)	0.8 (0.1-4.0)	3.6 (1.3-7.8)
▪ Yes	0 (17)	1 (21)	0 (NE)	5.0 (0.3-21.2)

\*Among the 354 patients who received neoadjuvant therapy, 295 achieved a pCR, and 21 had no outcome reported.

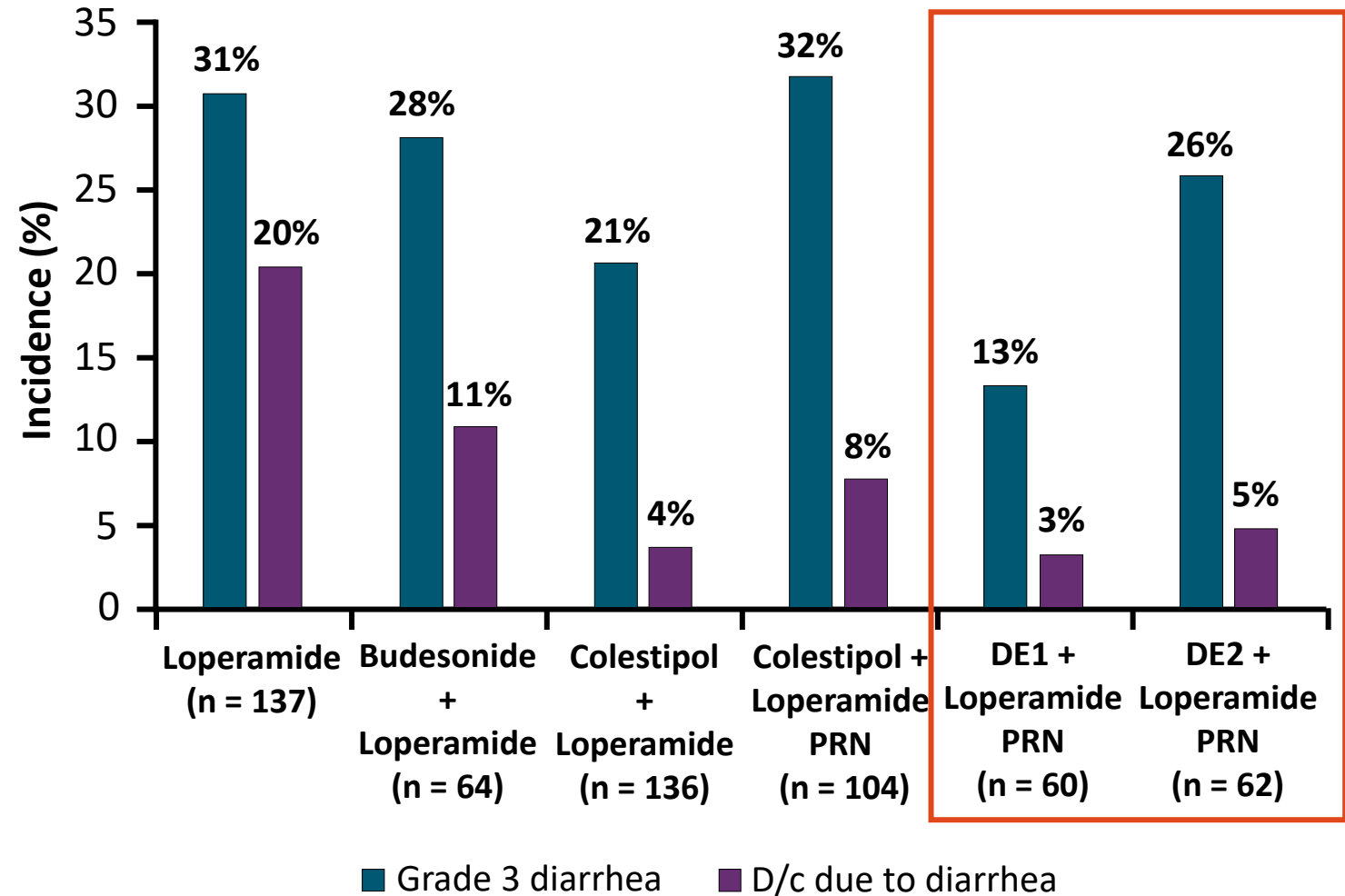


# CONTROL: Key Diarrhea Outcomes (All Cohorts)

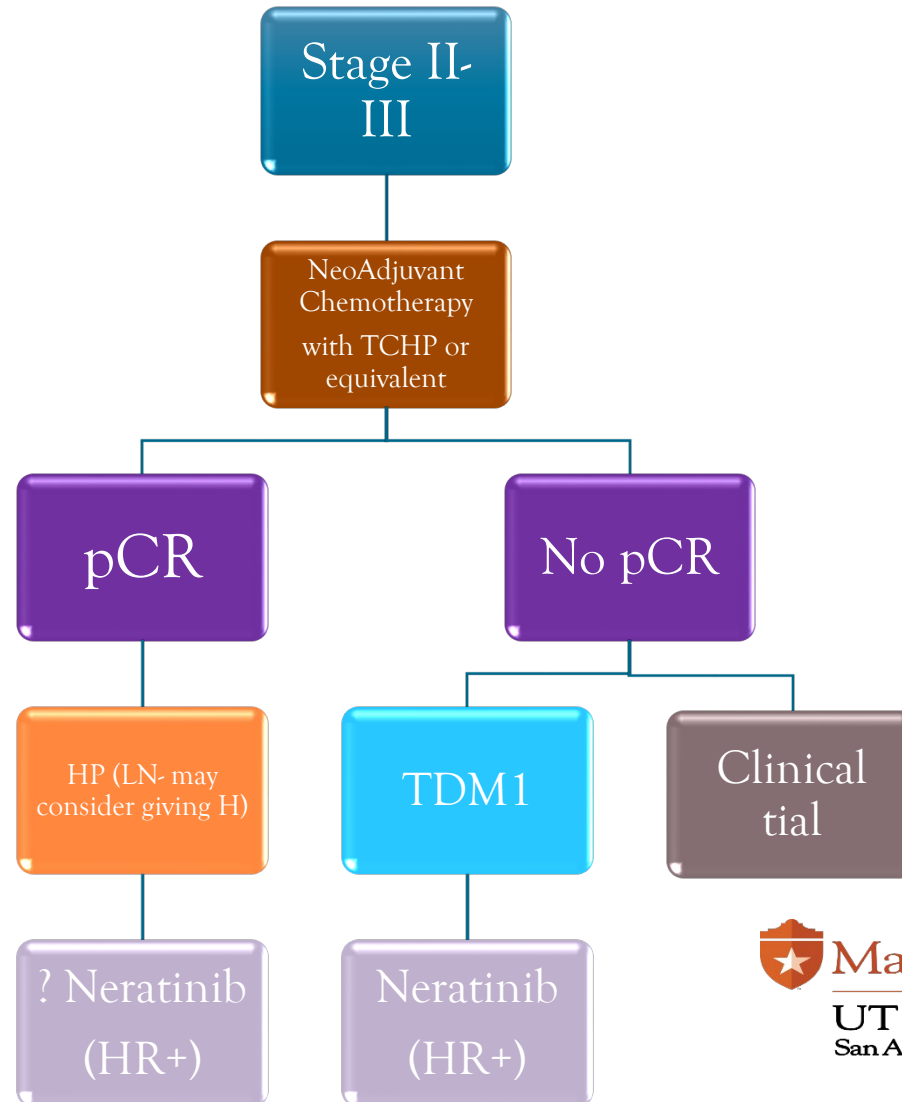
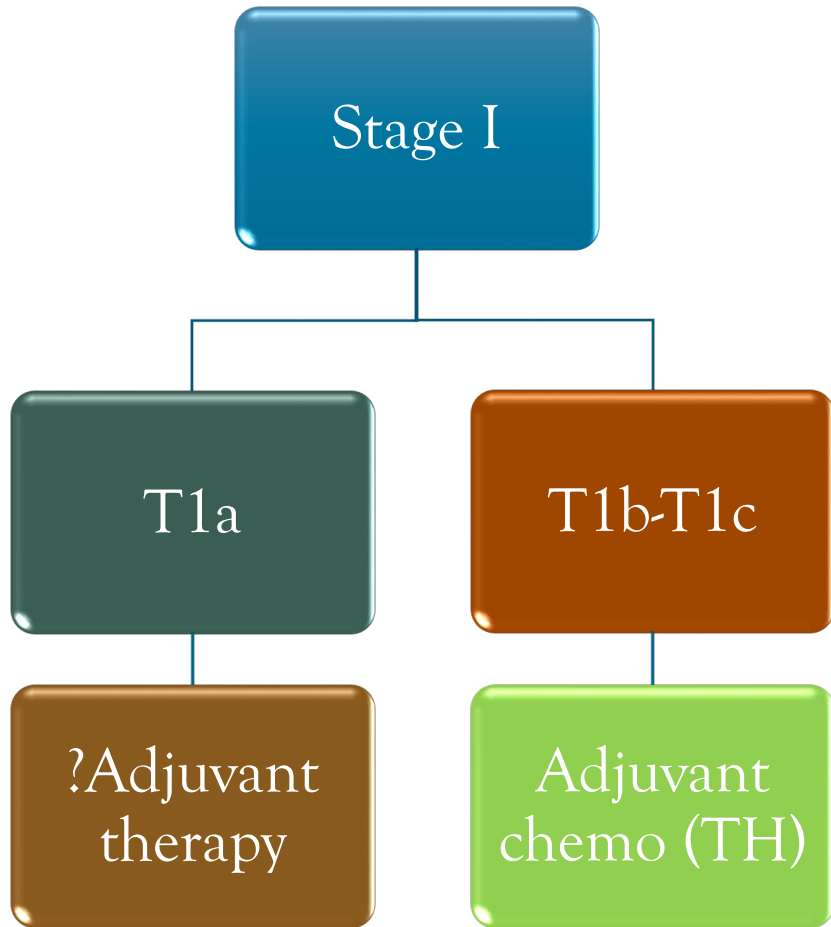
## Neratinib Dose-escalation Cohorts



Outcome, n (%)	Neratinib DE Cohort 1 (n = 60)	Neratinib DE Cohort 2 (n = 62)
Grade 1, 2	51 (85.0)	45 (72.6)
Grade 3	8 (13.3)	16 (25.8)
Median time to first onset of grade 3 diarrhea, days	45	20

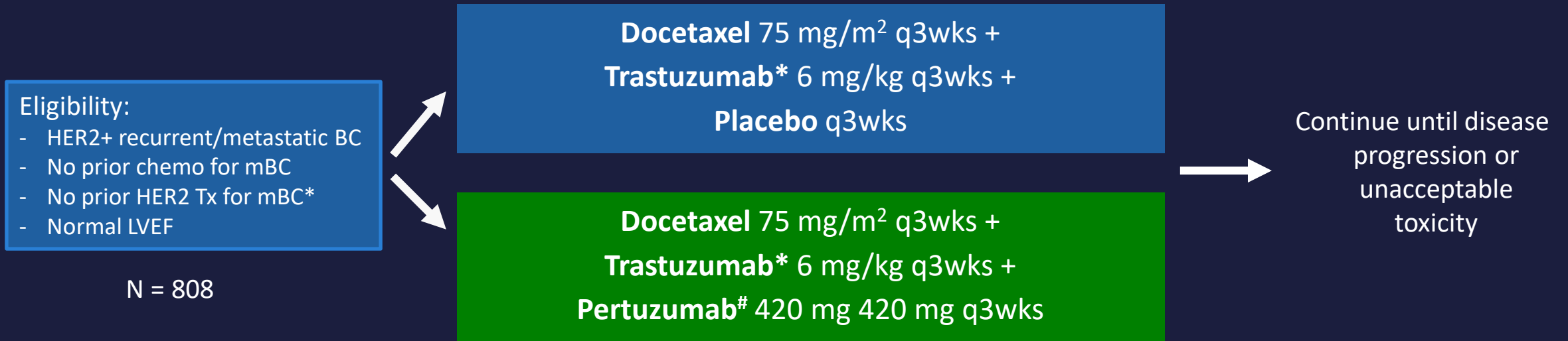


# Treatment of HER2+ EBC



- HER2 positive Early Stage Breast Cancer
- HER2 positive Metastatic Breast Cancer

# CLEOPATRA - Dual HER2 Targeting 1L



Continue chemo x 6-8 cycles then targeted therapy alone (add endo therapy if HR+)

\* Only ~10% prior (neo)adj trastuzumab

**Primary Endpoint:**

- Independently assessed PFS

**Secondary Endpoints**

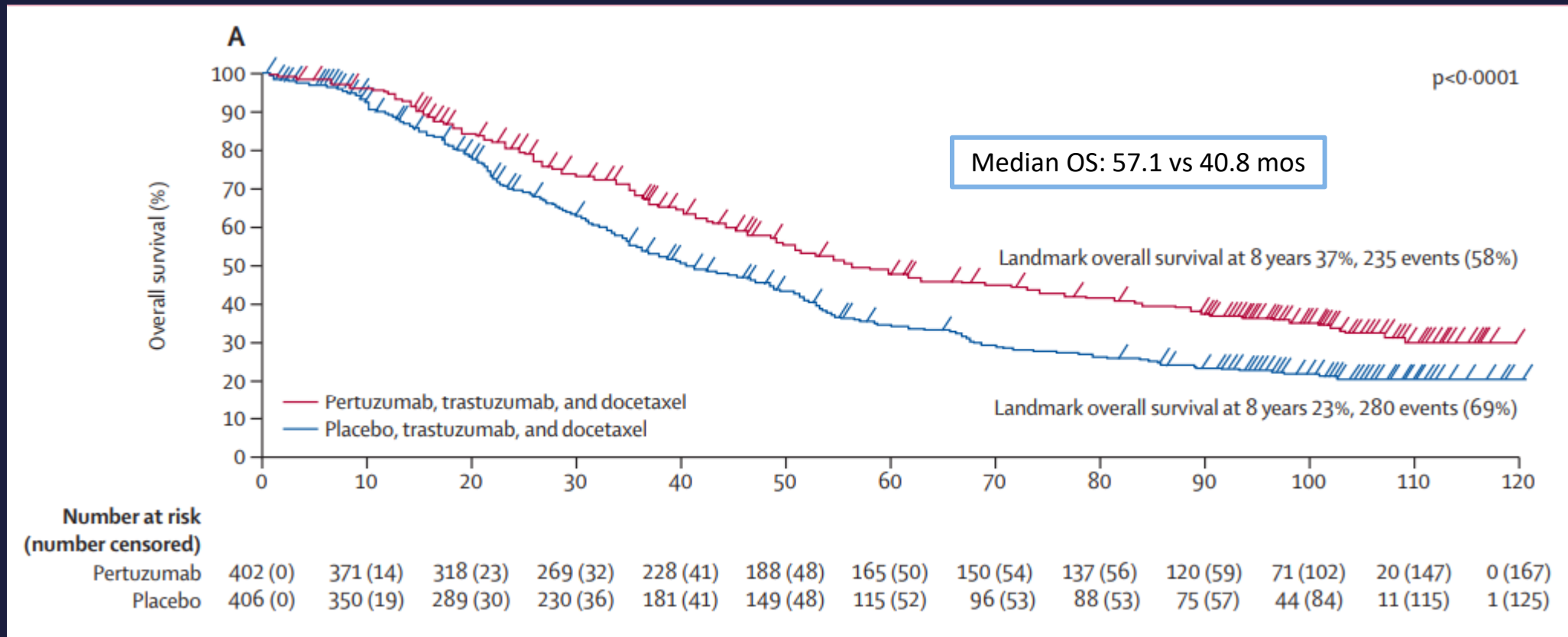
- Investigator assessed PFS, ORR, OS, Safety

\*Trastuzumab 8 mg/kg loading dose

# Pertuzumab 840 mg loading dose

# CLEOPATRA: 1L Docetaxel, Trastuzumab +/- Pertuzumab

## End-of-Study OS in ITT Population\*



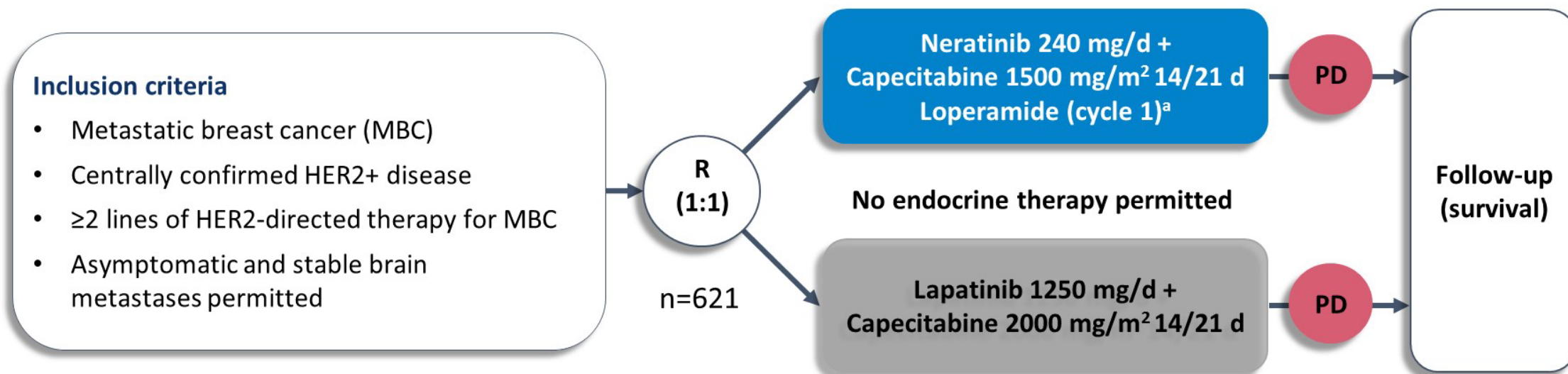
\* Cross over patients analyzed in placebo arm

OS compared between arms using log-rank test, stratified by prior treatment status and geographical region

- Main side effects with pertuzumab (typically low grade) – increased diarrhea, rash, neutropenia
- No increased incidence of cardiac toxicity noted

# NALA study design

Neratinib is an irreversible pan-HER TKI (HER1, 2, 4)



## Inclusion criteria

- Metastatic breast cancer (MBC)
- Centrally confirmed HER2+ disease
- ≥2 lines of HER2-directed therapy for MBC
- Asymptomatic and stable brain metastases permitted

## Stratification variables

- Number of prior HER2 therapies for MBC
- Disease location
- HR status
- Geographic location

No endocrine therapy permitted

Lapatinib 1250 mg/d +  
Capecitabine 2000 mg/m<sup>2</sup> 14/21 d

## Endpoints

- Co-primary: PFS (centrally confirmed) and OS
- Secondary: PFS (local), ORR, DoR, CBR, intervention for CNS metastases, safety, health outcomes

Loperamide 4 mg with first dose of neratinib, followed by 2 mg every 4 h for first 3 d, then loperamide 2 mg every 6–8 h until end of Cycle 1. Thereafter as needed

~ 40% trastuzumab only

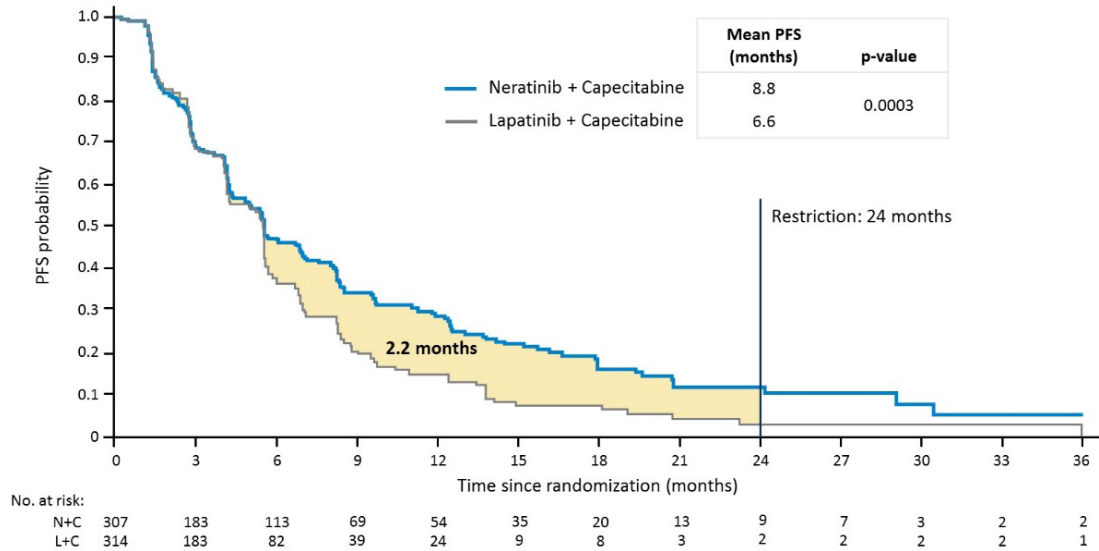
~ 20% trastuzumab and T-DM1

~ 33% prior trastuzumab, pertuzumab and T-DM1

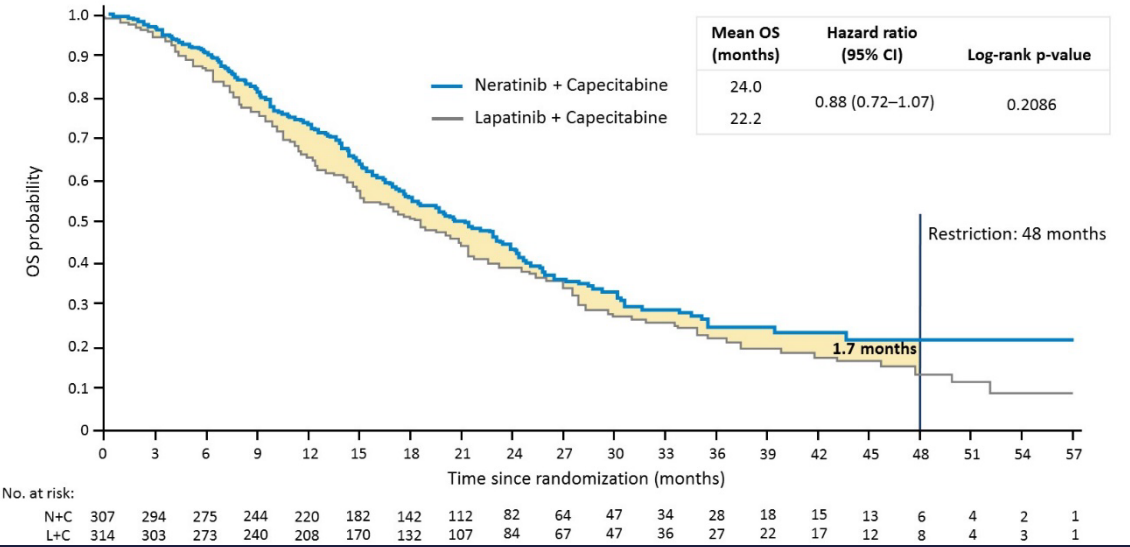
# NALA Study

## Capecitabine + Neratinib or Lapatinib

### Prespecified restricted means analysis – PFS



### OS (co-primary endpoint)



FDA approval 2/2020:

Neratinib indicated in combination with cape for advanced HER2+ BC who have received 2 or more prior anti-HER2-based regimens in the metastatic setting.

# HER2CLIMB

## RP2 double-blind, placebo-controlled trial

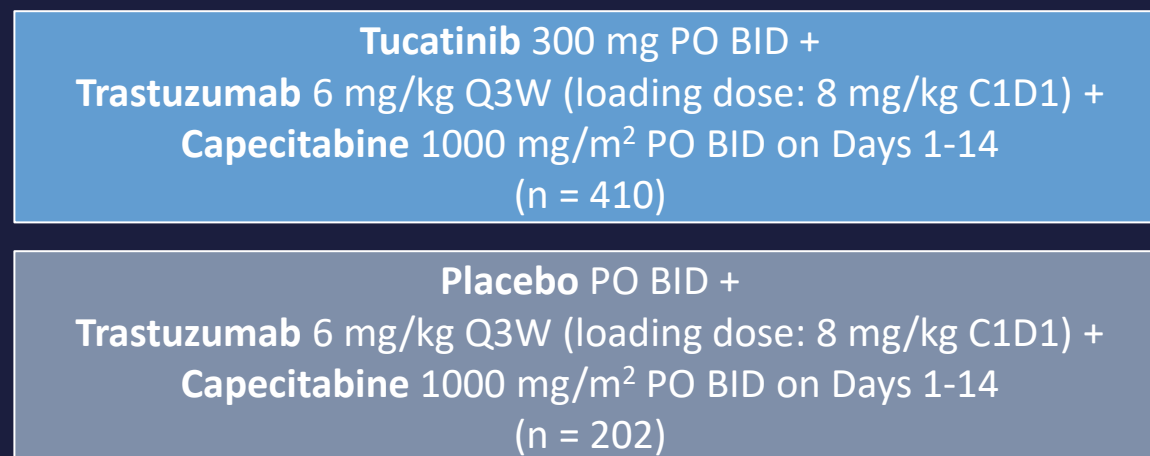
(N = 612)

21-day cycles

- HER2+ MBC
- prior trastuzumab, pertuzumab, and T-DM1
- ECOG PS 0/1
- Brain mets allowed\*

\*Including:

- previously treated stable mets
- untreated mets OR treated progressing mets not needing immediate local therapy



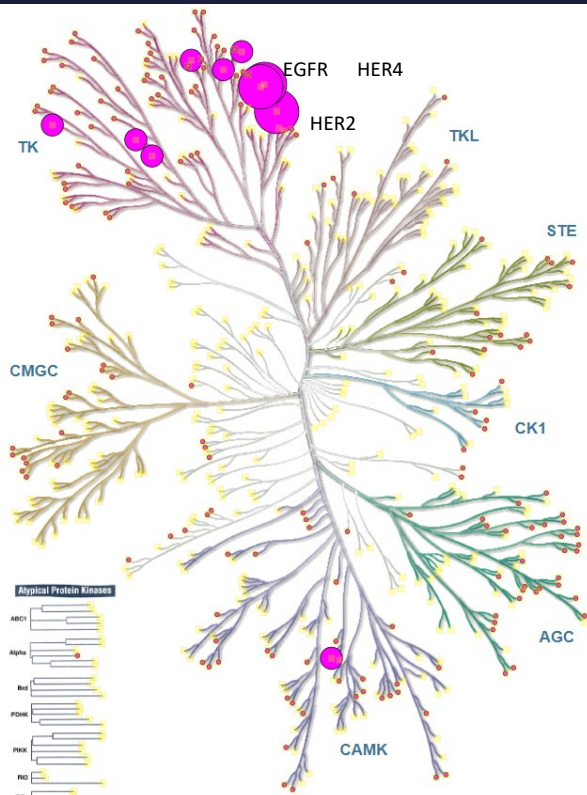
Primary endpoint: PFS (RECIST v 1.1 by BICR) in 1<sup>st</sup> 480 randomized patients

Secondary endpoints (total pop'n): OS, PFS in pts with brain mets, ORR in pts with measurable dz, safety

- 90% power with 288 events at  $\alpha = 5\%$ , HR: 0.6
- Stratified by brain mets (yes vs no), ECOG PS (0 vs 1), and region (US or Canada vs rest of world)

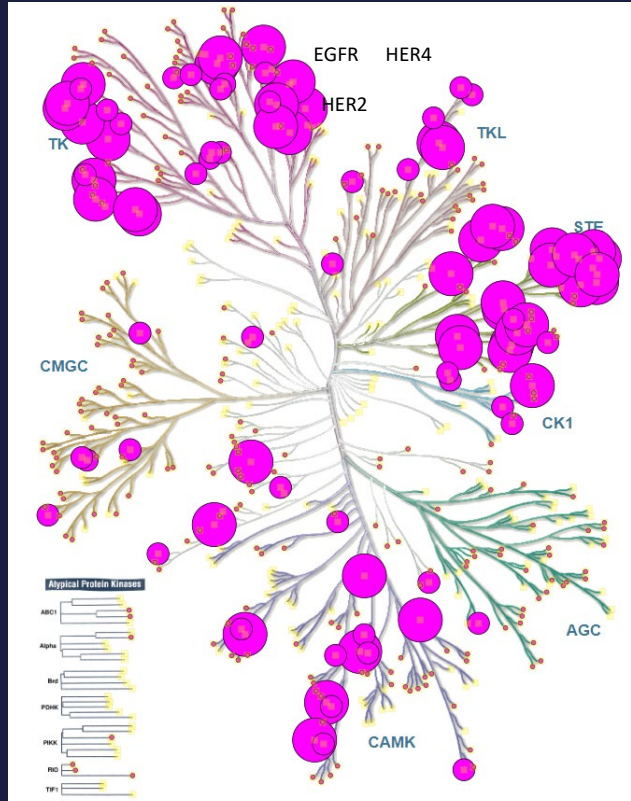


# Tucatinib is a HER2 Selective Kinase Inhibitor



Tucatinib

- $IC_{50} < 1\mu M$  (large circle)
- $1\mu M < IC_{50} < 10\mu M$  (medium circle)
- $IC_{50} > 10\mu M$  (small circle)



Neratinib

Kinome scan data from the Library of Integrated Network-based Cellular Signatures (<https://lincs.hms.harvard.edu/kinomescan/>)

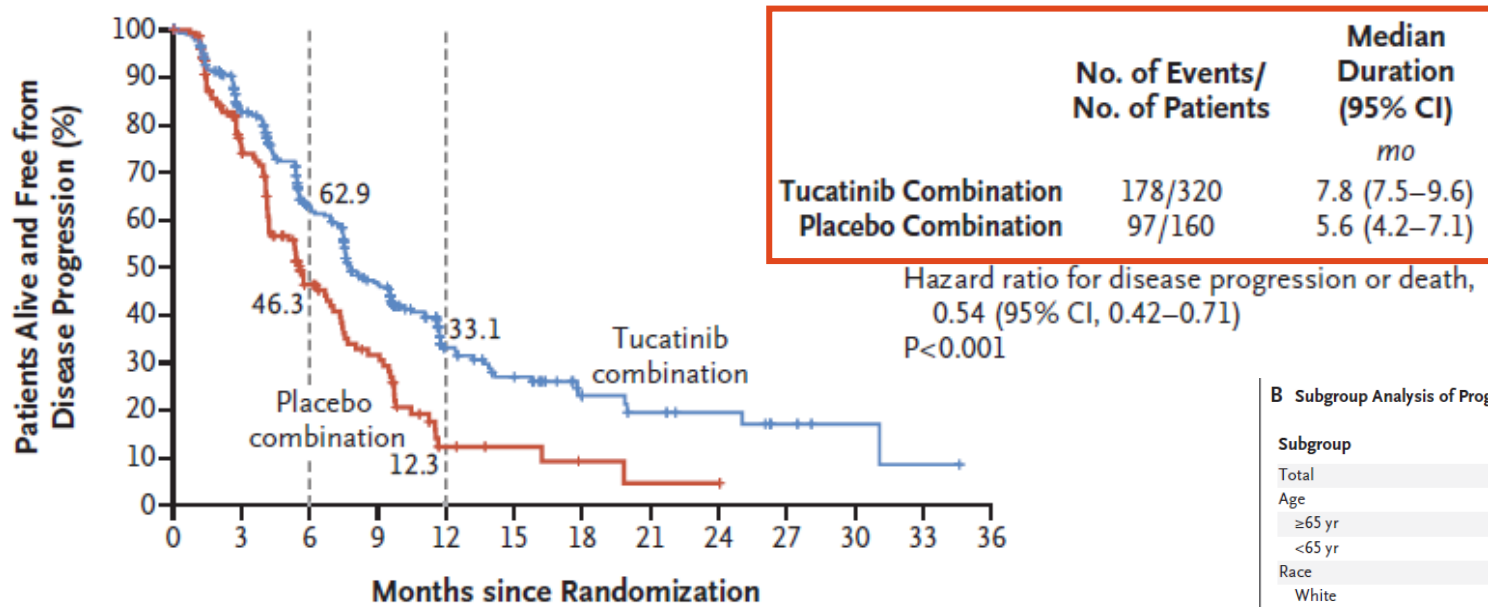
- Kinome analysis shows limited activity in a panel of 237 protein kinases at 1 or 10  $\mu M$ 
  - Activity is restricted to HER2 related kinases EGFR and HER4
- Tucatinib is selective for HER2 vs. EGFR in biochemical assays

Compound	Biochemical Selectivity (Kinase Assays)	
	HER2 $IC_{50}$ (nM)	EGFR $IC_{50}$ (nM)
Tucatinib	6.9	449
Neratinib	5.6	1.8
Lapatinib	109	48

- *Lapatinib and neratinib inhibit EGFR and HER2 with similar potencies*

# HER2CLIMB: PFS (Primary Endpoint Population)

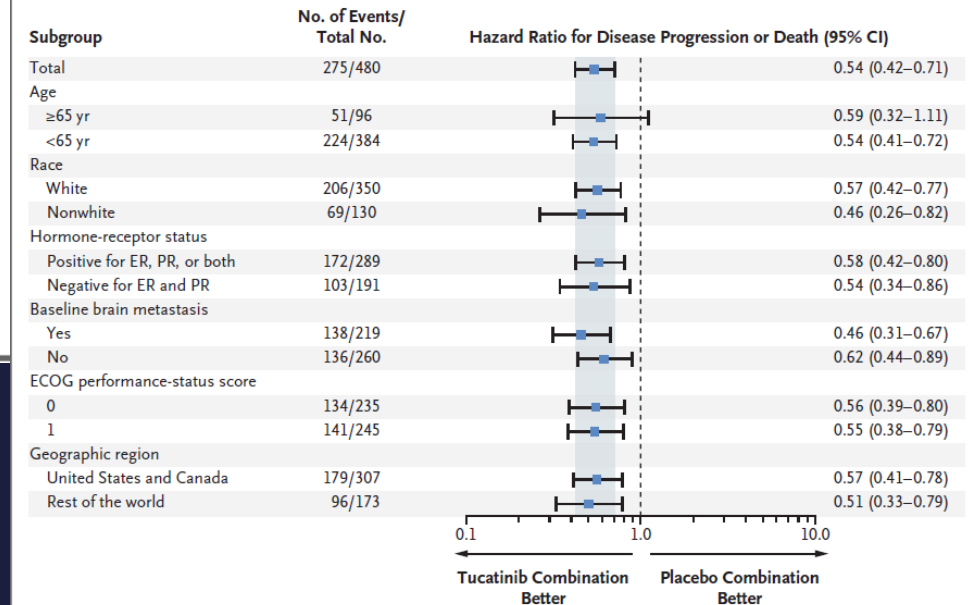
**A** Kaplan–Meier Estimates of Progression-free Survival



**No. at Risk**

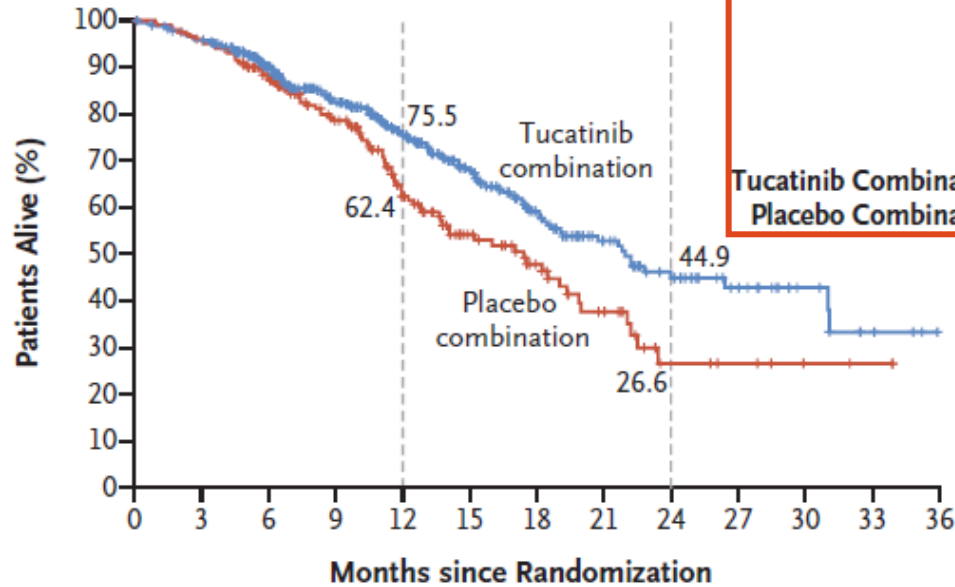
Tucatinib combination	320	235	152	98	40	29	15	10	8	4	2	1	0
Placebo combination	160	94	45	27	6	4	2	1	1	0	0	0	0

**B** Subgroup Analysis of Progression-free Survival



# HER2CLIMB: OS (Primary Endpoint Population)

**A Kaplan–Meier Estimates of Overall Survival**



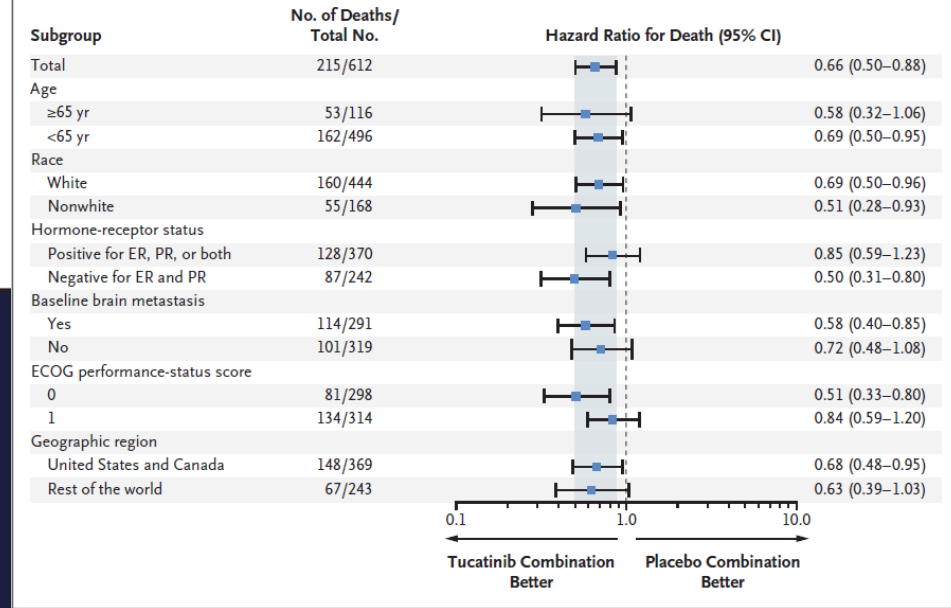
	No. of Deaths/ No. of Patients	Median Duration (95% CI) <i>mo</i>
<b>Tucatinib Combination</b>	130/410	21.9 (18.3–31.0)
<b>Placebo Combination</b>	85/202	17.4 (13.6–19.9)

Hazard ratio for death,  
0.66 (95% CI, 0.50–0.88)  
P=0.005

**No. at Risk**

Tucatinib combination	410	388	322	245	178	123	80	51	34	20	10	4	0
Placebo combination	202	191	160	119	77	48	32	19	7	5	2	1	0

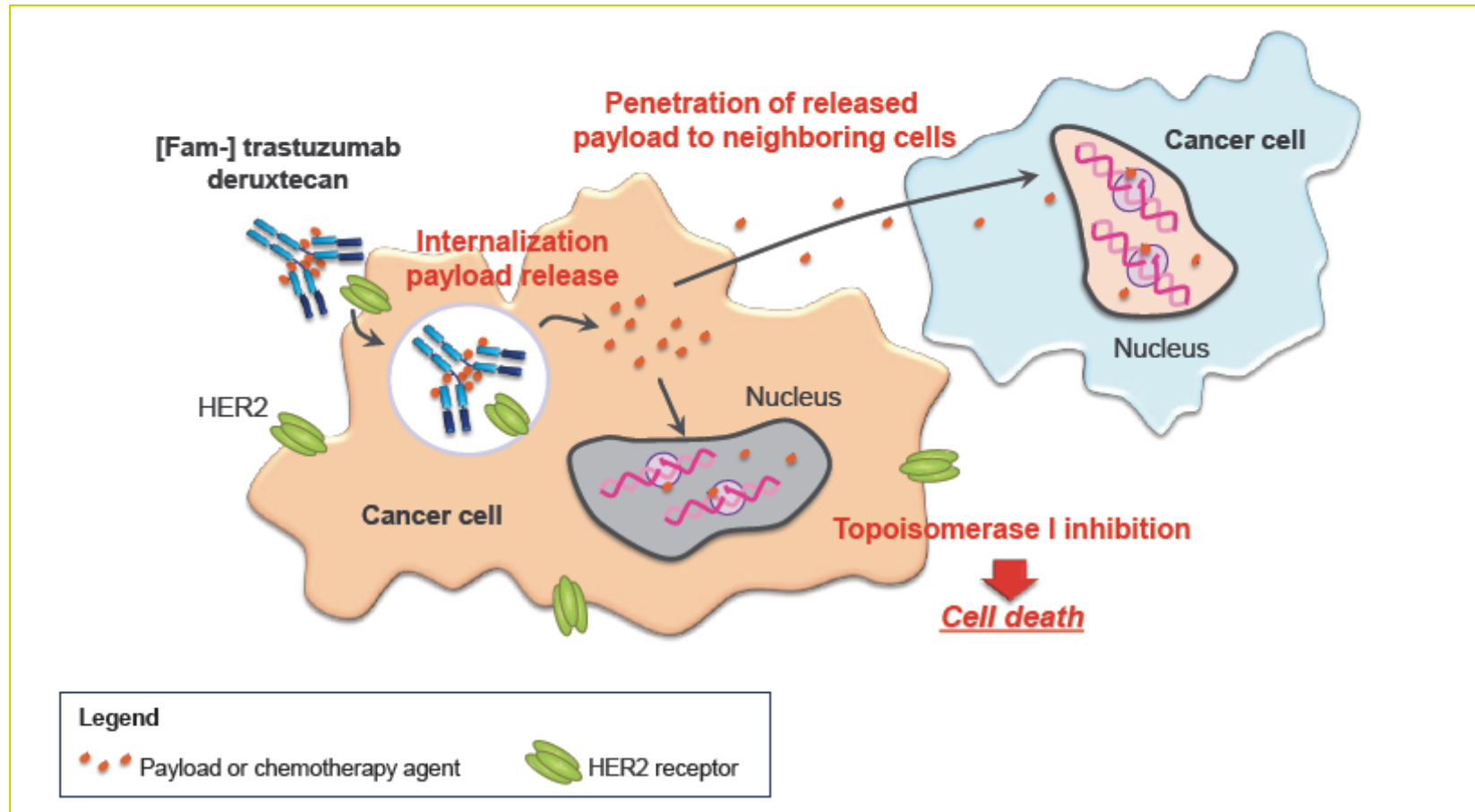
**B Subgroup Analysis of Overall Survival**



FDA approval 4/2020:

Tucatinib indicated in combination with tras and cape for advanced HER2+ BC (including pts with brain metastases) who have received 1 or more prior anti-HER2-based regimens in the metastatic setting.

# DS-8201's Membrane-permeable Payload Can Attack Neighbouring Cancer Cells (ie, Bystander Effect)



ADCC= antibody-dependent cellular cytotoxicity; HER2=human epidermal growth factor receptor 2; Topo-1=topoisomerase I.

# DESTINY-Breast03: First Randomized Ph3 Study of T-DXd

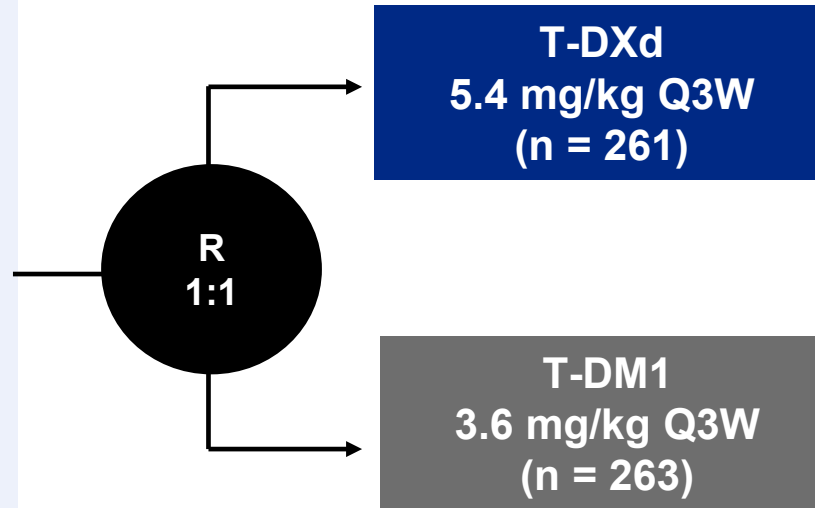
An open-label, multicenter study (NCT03529110)

## Patients

- Unresectable or metastatic HER2-positive<sup>a</sup> breast cancer
- Previously treated with trastuzumab and taxane in advanced/metastatic setting<sup>b</sup>
- Could have clinically stable, treated brain metastases

## Stratification factors

- Hormone receptor status
- Prior treatment with pertuzumab
- History of visceral disease



## Primary endpoint

- PFS (BICR)

## Key secondary endpoint

- OS

## Secondary endpoints

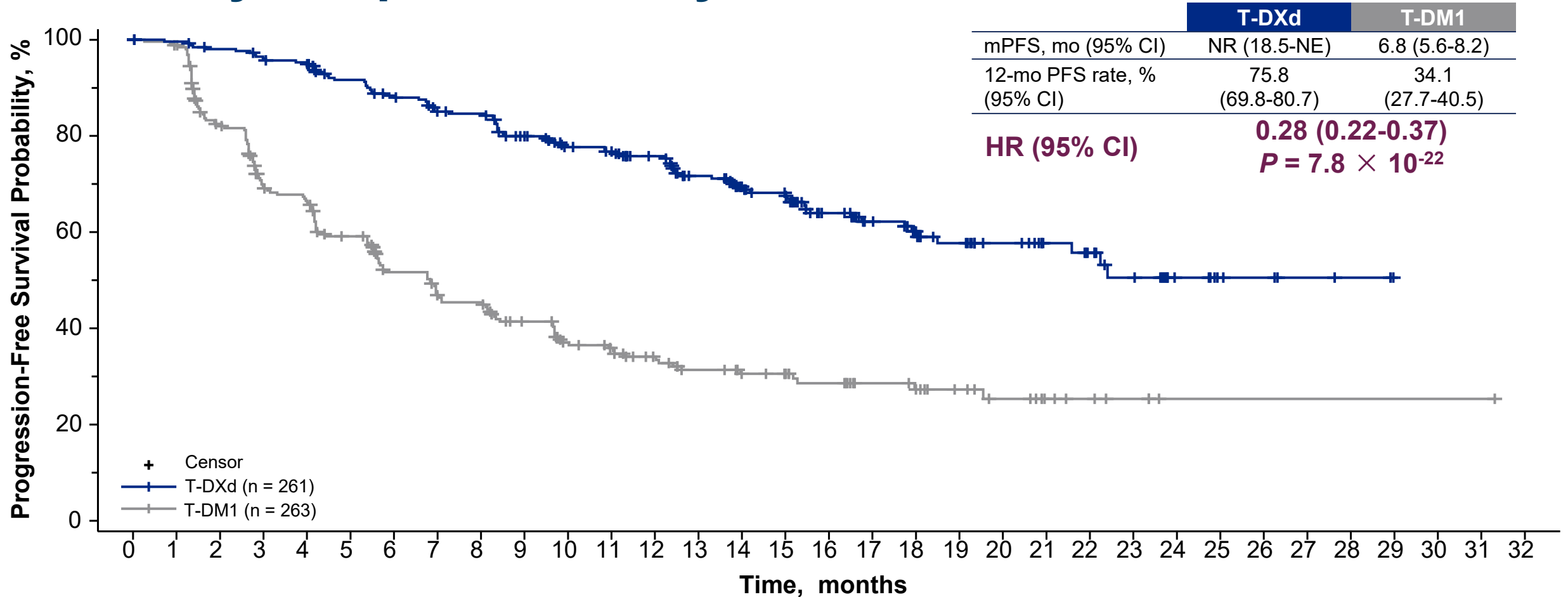
- ORR (BICR and investigator)
- DOR (BICR)
- PFS (investigator)
- Safety

## Interim analysis for PFS (data cutoff: May 21, 2021)

- Efficacy boundary for superiority:  $P < 0.000204$  (based on 245 events)
- IDMC recommendation to unblind study (July 30, 2021)

**Key secondary endpoint, OS:** boundary for efficacy:  $P < 0.000265$  (based on 86 events)

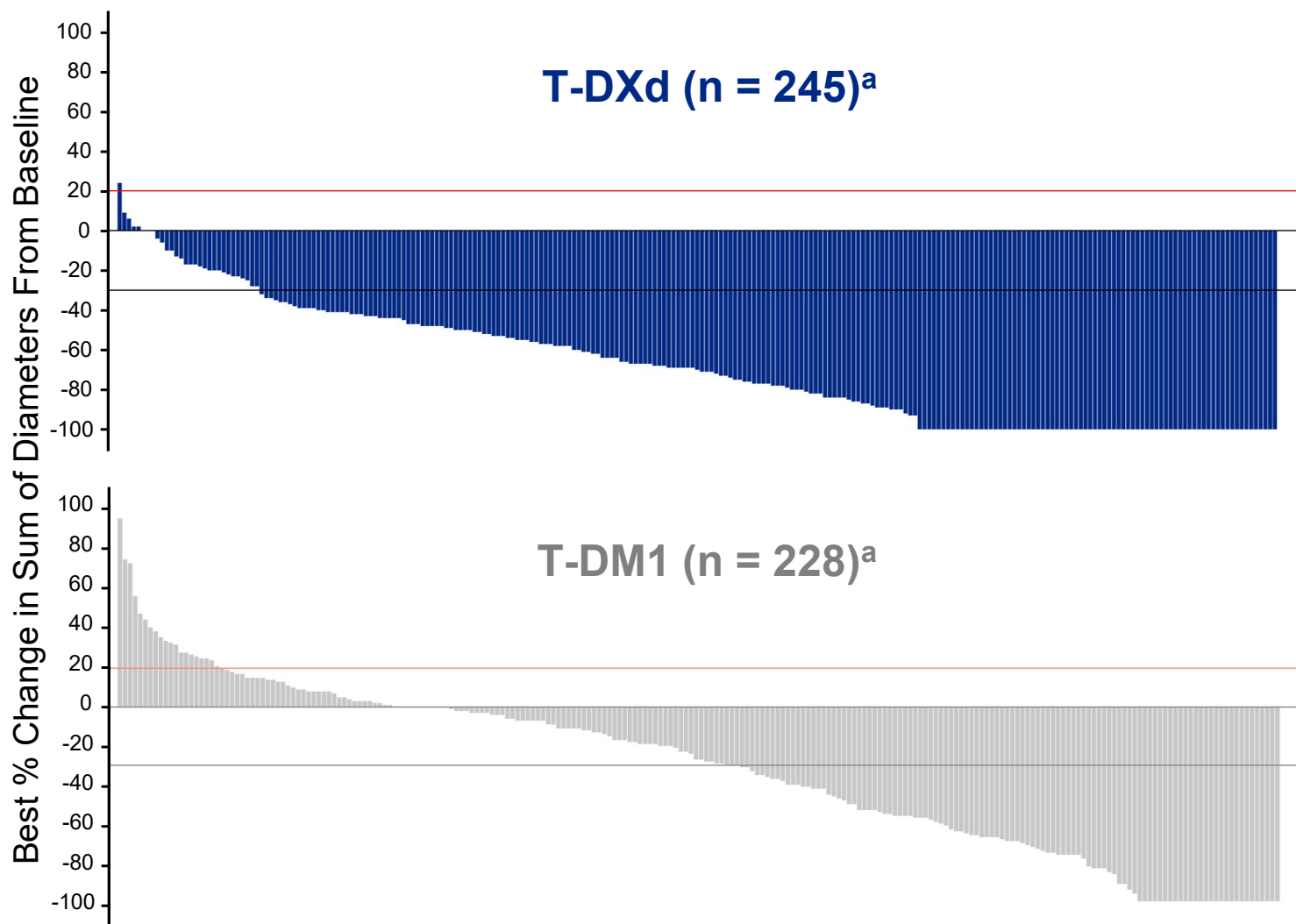
# Primary Endpoint: PFS by BICR



## Patients Still at Risk:

T-DXd (261)	261	256	250	244	240	224	214	202	200	183	168	164	150	132	112	105	79	64	53	45	36	29	25	19	10	6	5	3	2	0		
T-DM1 (263)	263	252	200	163	155	132	108	96	93	78	65	60	51	43	37	34	29	23	21	16	12	8	6	4	1	1	1	1	1	1	1	0

# Confirmed ORR and Best Overall Response



	<b>T-DXd (n = 261)</b>	<b>T-DM1 (n = 263)</b>
<b>Confirmed ORR</b>		
n (%) <sup>b</sup>	208 ( <b>79.7</b> )	90 ( <b>34.2</b> )
[95% CI]	[74.3-84.4]	[28.5-40.3]
	<i>P</i> < .0001	
<b>CR</b>	42 ( <b>16.1</b> )	23 ( <b>8.7</b> )
<b>PR</b>	166 ( <b>63.6</b> )	67 ( <b>25.5</b> )
SD	44 (16.9)	112 (42.6)
PD	3 (1.1)	46 (17.5)
Not evaluable	6 (2.3)	15 (5.7)
<b>CR + PR + SD (DCR)</b>	252 (96.6)	202 (76.8)

# Adverse Events of Special Interest

Adjudicated as drug-related ILD/pneumonitis <sup>a</sup> , n (%)						
n (%)	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Any Grade
T-DXd (n = 257)	7 (2.7)	18 (7.0)	2 (0.8)	0	0	27 (10.5)
T-DM1 (n = 261)	4 (1.5)	1 (0.4)	0	0	0	5 (1.9)

- There were no grade 4 or 5 adjudicated drug-related ILD/pneumonitis events observed with T-DXd

LVEF, n (%)						
n (%)	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Any Grade
T-DXd (n = 257)	1 (0.4) <sup>b</sup>	6 (2.3) <sup>c</sup>	0	0	0	7 (2.7)
T-DM1 (n = 261)	0	1 (0.4) <sup>c</sup>	0	0	0	1 (0.4)

- In the T-DXd arm, all LVEF adverse events reported were asymptomatic and no cases of cardiac failure occurred



# Margetuximab: HER2-Targeted Antibody With Modified Fc to Increase Immune Response

- Margetuximab has same affinity for HER2 as trastuzumab
- Modified Fc (constant) domain with change in 5 amino acids
  - ↑ binding to **activating CD16A** (FcγRIIIA) → ↑ NK, monocyte ADCC
  - ↓ binding to **inhibitory CD32B** (FcγRIIB) → ↑ monocyte ADCC
- Largest impact in cells with low affinity Fc receptor (FF or FV)

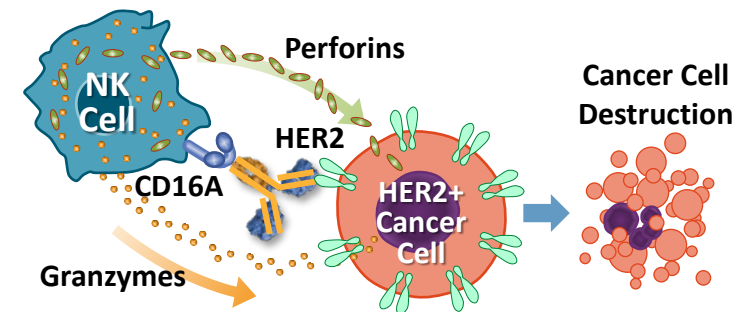
		Affinity (nM)		Margetuximab Affinity Fold Change
		~ Trastuzumab (IgG1)	Margetuximab	
<b>CD16A</b> (activating) aa158				
F (Phe) allele	Low Affinity	1059	161	↑ <b>6.6 x</b>
V (Val) allele	High Affinity	415	89	↑ <b>4.6 x</b>
<b>CD32B</b> (inhibitory)		52	437	↓ <b>8.4x</b>

- *Hypothesis: Margetuximab superiority over trastuzumab will be greatest in patients with low affinity Fc receptor (FF or FV)*

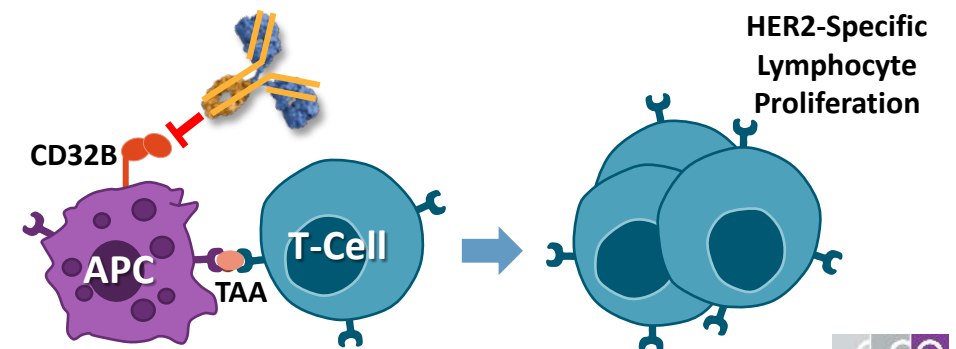
# Margetuximab: Fc Engineering Alters Fc Receptor Affinities and Activates the Immune Response

- Margetuximab has the same specificity, affinity to HER2 as trastuzumab with similar ability to disrupt signaling
- However, via Fc engineering with intent to activate immune responses, margetuximab has altered Fc receptor affinity
  - Trastuzumab: WT IgG1 effector domains; binds and activates immune cells
  - Margetuximab: increased affinity for activating Fcγ RIIIA (CD16A) and decreased affinity for inhibitory Fcγ RIIIB (CD32B)

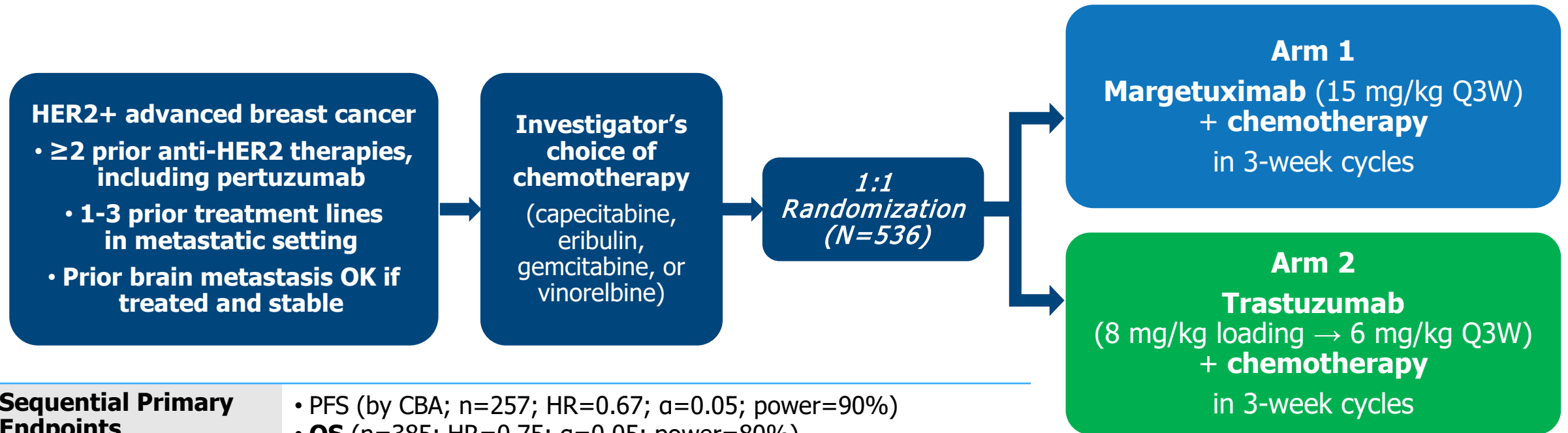
**Increased CD16A Affinity:  
Enhance Innate Immunity/More Potent ADCC Stimulation**



**Decreased CD32B Affinity:  
Enhance Adaptive Immunity/Increase Immune Activation**



# Study CP-MGAH22-04 (SOPHIA) Design<sup>1,2</sup>



## Sequential Primary Endpoints

- PFS (by CBA; n=257; HR=0.67; α=0.05; power=90%)
- **OS** (n=385; HR=0.75; α=0.05; power=80%)

## Secondary Endpoints

- **PFS** (Investigator assessed)
- Objective response rate (ORR) by CBA

## Tertiary/Exploratory Endpoints

- **ORR** (Investigator assessed)
- **Clinical benefit rate (CBR), duration of response (DoR)**
- **Safety** profile, antidrug antibody
- **Effect of CD16A, CD32A, and CD32B** on margetuximab efficacy

## Stratification:

- Chemotherapy choice
- Prior therapies (≤2 vs >2)
- Metastatic sites (≤2 vs >2)

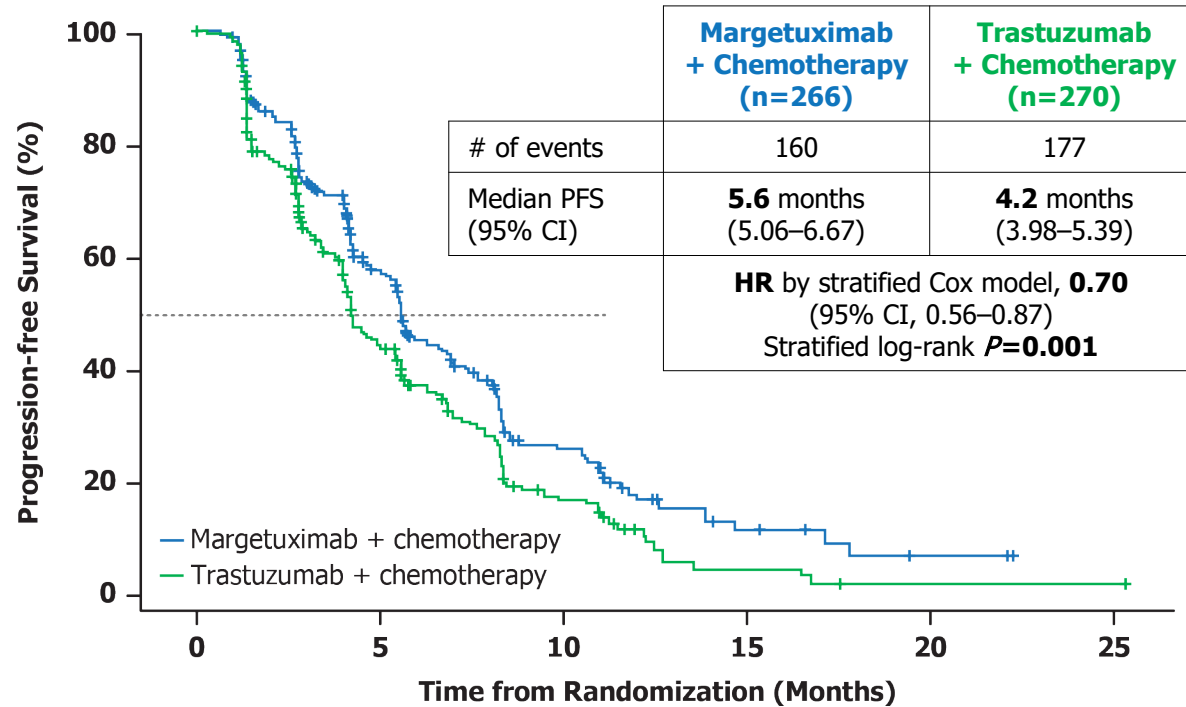
CBA=central blinded analysis; HR=hazard ratio; OS=overall survival; PFS=progression-free survival; Q3W=every 3 weeks.

1. Rugo HS, et al. *J Clin Oncol*. 2016;34(suppl 15):TPS630. 2. Clinicaltrials.gov. NCT02492711. <https://clinicaltrials.gov/ct2/show/NCT02492711>. Accessed September 30, 2019.

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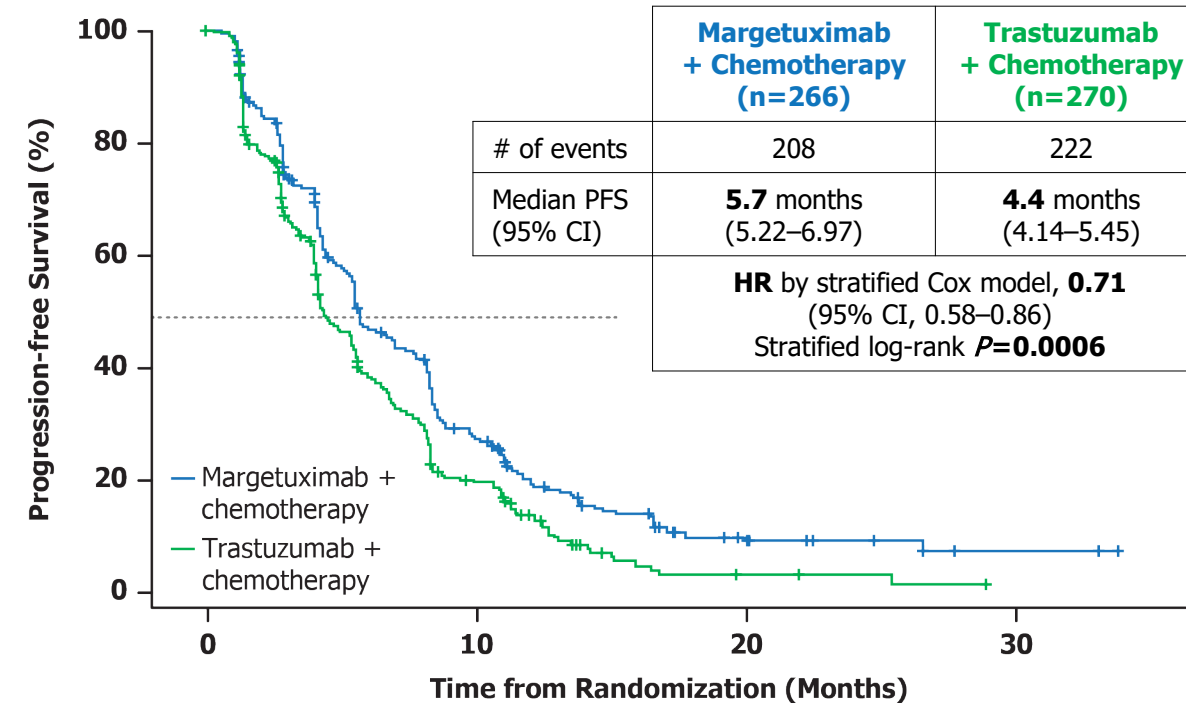
# Investigator-Assessed PFS

## Investigator-Assessed PFS (Oct-2018 Cutoff)<sup>a</sup> 30% Risk Reduction of Disease Progression



Margetuximab	266	206	155	112	72	61	33	32	16	13	8	7	3	2	2	0
Trastuzumab	270	184	130	87	59	45	25	21	10	5	4	3	1	1	1	1

## Investigator-Assessed PFS (Sep-2019 Cutoff)<sup>b</sup> 29% Risk Reduction of Disease Progression



Margetuximab	266	210	137	100	62	36	25	14	11	6	5	3	2	2	0
Trastuzumab	270	192	108	72	42	20	8	4	3	2	2	1	0		

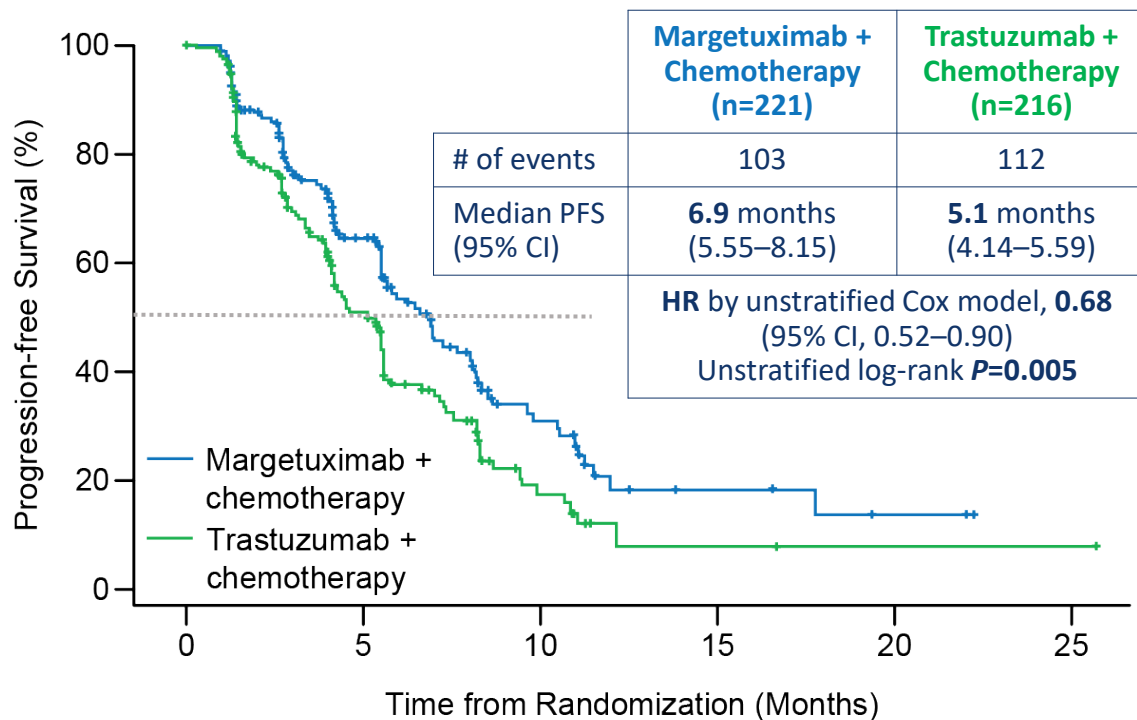
ITT population: N=536. <sup>a</sup>PFS analysis triggered by last randomization on October 10, 2018, after 265 PFS events. <sup>b</sup>PFS analysis performed as of September 10, 2019, after 430 PFS events occurred.

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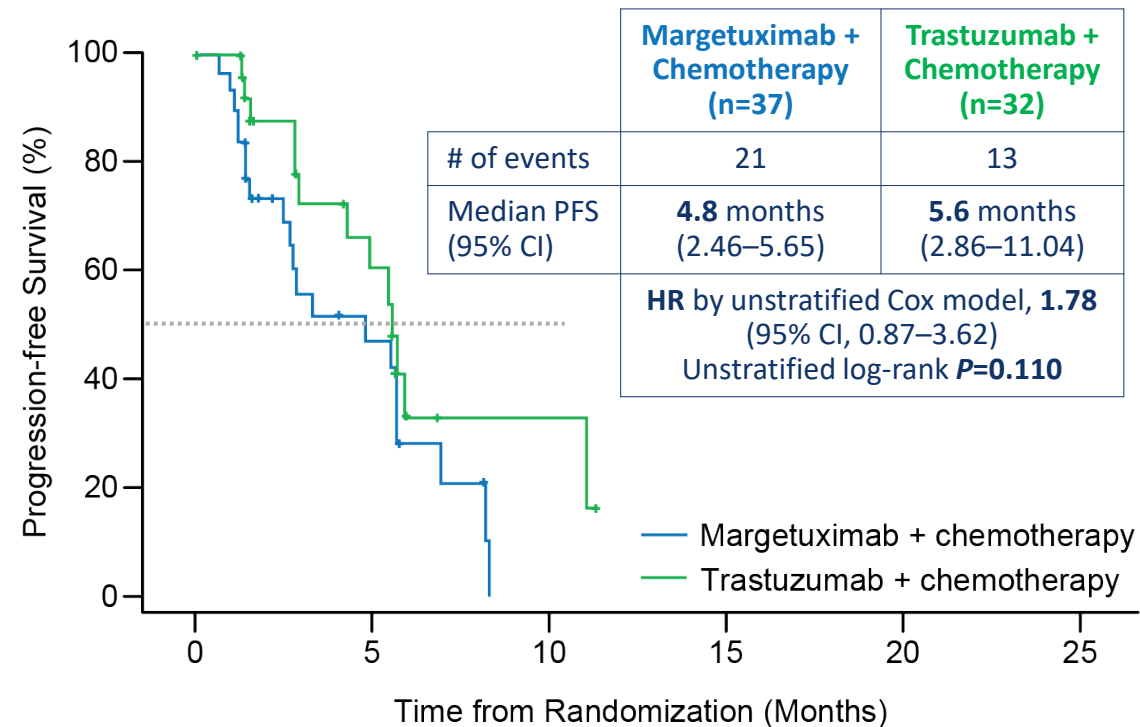
# Planned\* Exploratory PFS Analysis by CD16A Genotype, by CBA

506 patients genotyped (94%)

FF or FV, n=437 of 506 (86%)



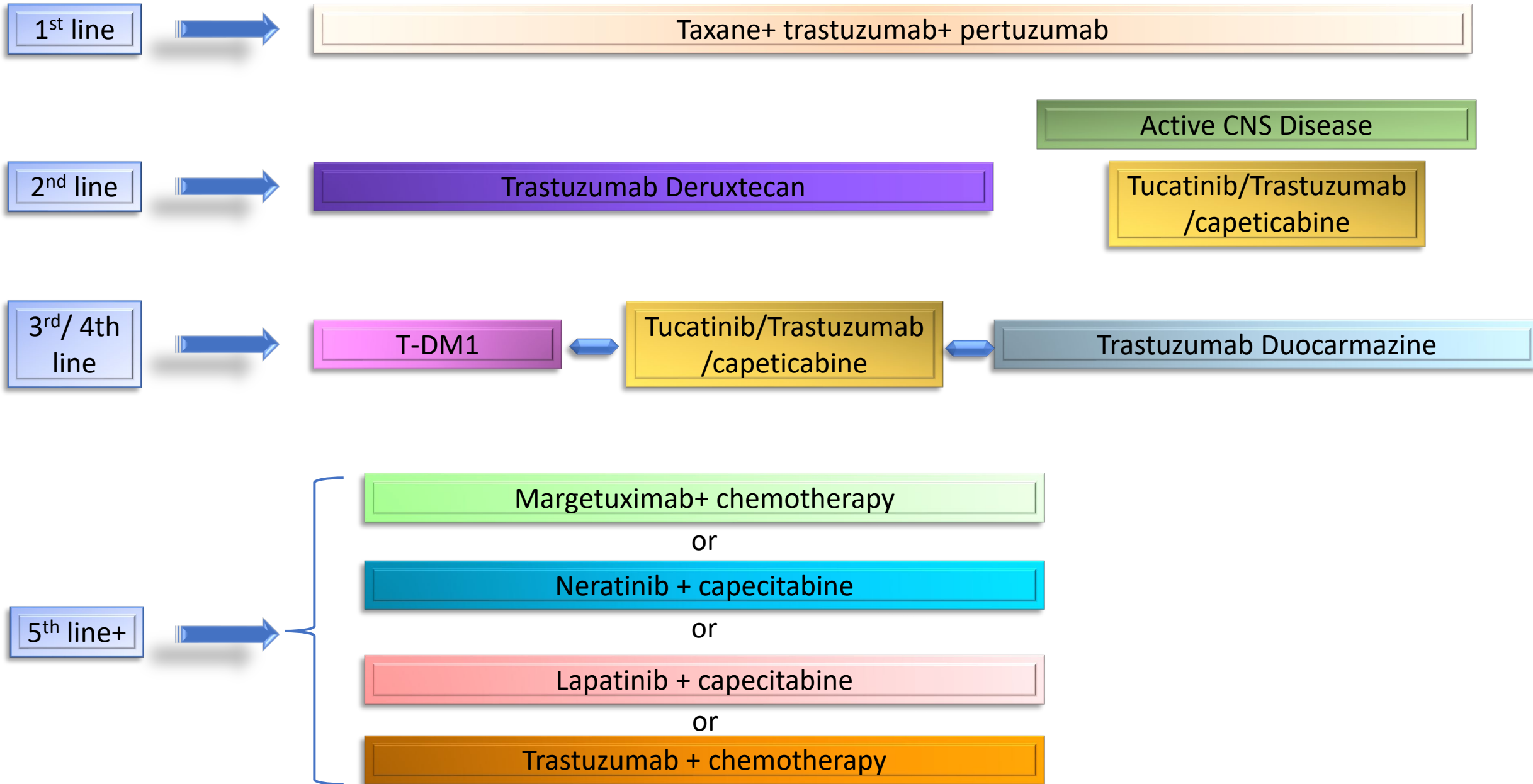
VV, n=69 of 506 (14%)



Margetuximab	221	157	84	42	21	8	6	4	2	0
Trastuzumab	216	129	62	30	11	2	2	1	1	1

Margetuximab	37	16	10	3	0	
Trastuzumab	32	18	10	2	2	0

# Treatment Landscape of HER2+ MBC



# Conclusions

- Advances in HER2 positive breast cancer have significantly improved OS both in the early stage and metastatic setting
- Novel therapies offer several options for our patients
- ADCs and bispecific Ab show promise
- Treating brain metastases still challenging

Thank you !

