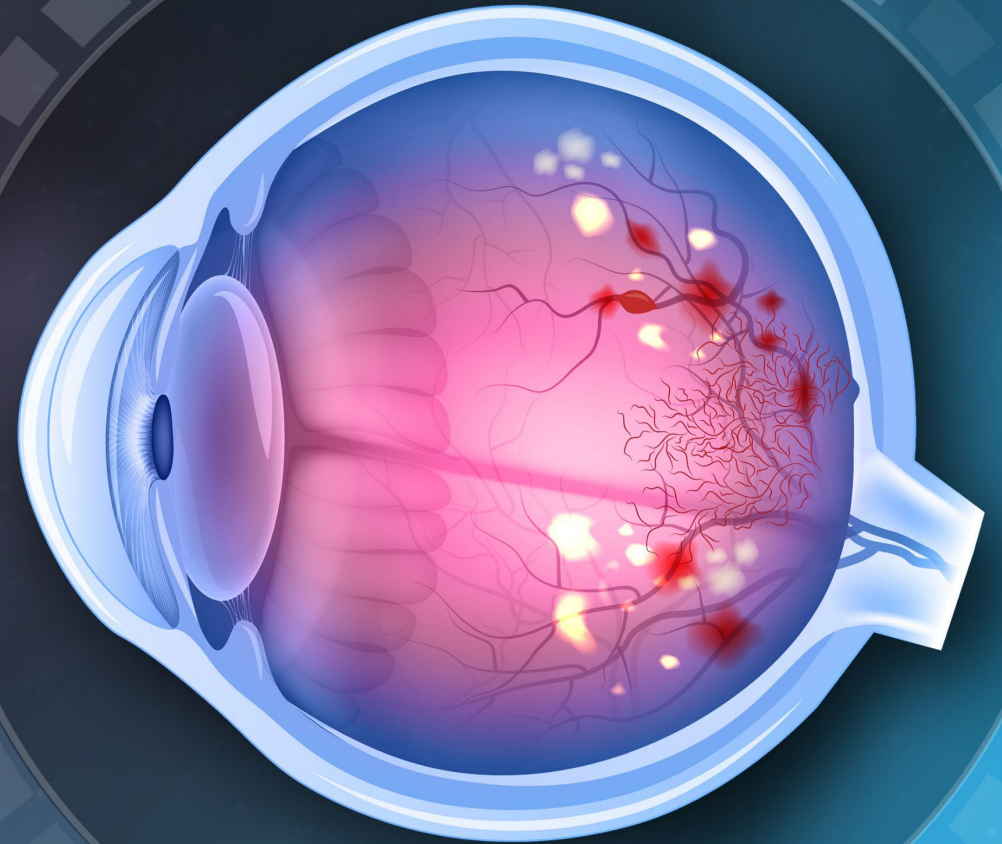


Easing the Burden of Retinal Diseases:

# A Focus on the Optimal Application of Intravitreal Therapy in DME and nAMD

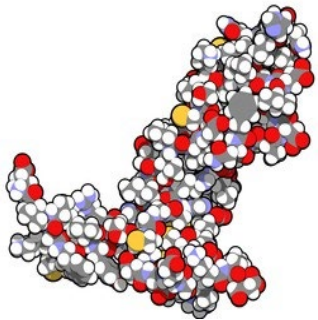


# DME and nAMD: Common Blinding Retinal Diseases of Increasing Prevalence and Burden



**DME and nAMD are 2 central vision losses worldwide; both diseases that:**

- Continue to increase in incidence and prevalence
- Confer substantial social and economic burdens on patients and society
- Negatively impact patient QoL



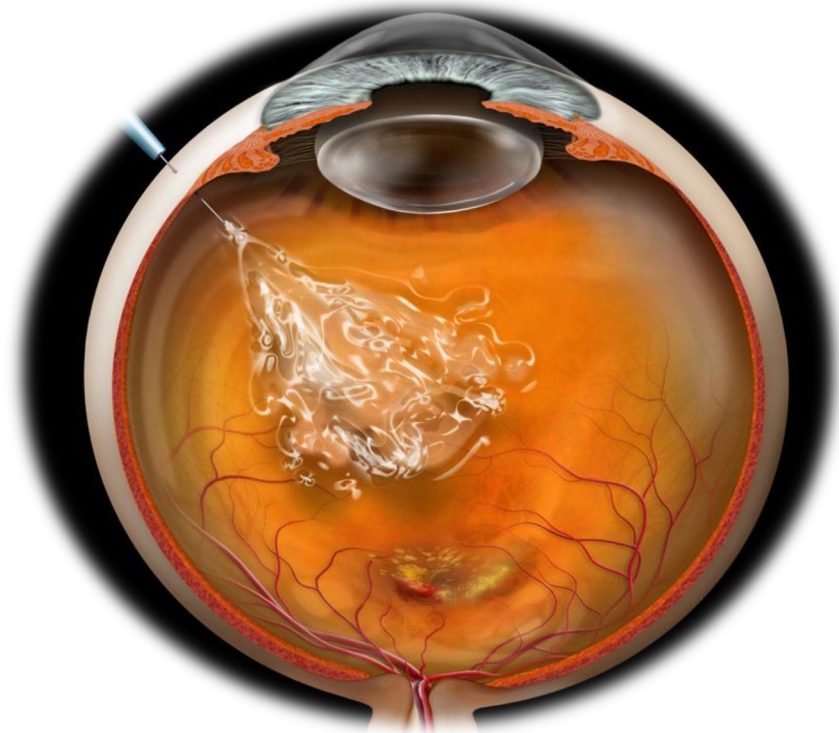
**Despite differing etiologies, vascular permeability is a common hallmark of nAMD and DME; VEGF is a key mediator of this process:**

- The Ang/Tie2 pathway has also been shown to contribute to RNV in DME and nAMD.
  - Overexpression of Ang-2 prevents Tie2 receptors from regulating angiogenesis, resulting in vascular destabilization and inflammation

Ang-2, angiopoietin-2; DME, diabetic macular edema; nAMD, neovascular age-related macular edema; RNV, retinal neovascularization; Tie2, tyrosine kinase with immunoglobulin-like and endothelial growth factor–like domains-2; VEGF, vascular endothelial growth factor

Color photograph of a normal macula. The normal retinal | Open-i (nih.gov). Kim JE. *Am J Manag Care*. 2022;28(3 Suppl):S35-S43. [Vascular Endothelial Growth Factor Vefg Protein Stock Illustration 349724825 | Shutterstock.](#)

# IVT Anti-VEGF Therapy for DME and nAMD



*Published clinical practice guidelines uniformly recommend IVT anti-VEGF therapy for both nAMD and DME, with limited alternative treatments and preventive measures to consider.*

IVT, intravitreal

[Anti-VEGF eye injection interactive - Stock eye images \(jirehdesign.com\)](#). Kim JE. *Am J Manag Care*. 2022;28(3 Suppl):S35-S43; Flaxel CJ, et al. *Ophthalmology*. 2020;127(1):P1-P65; Bakri SJ, et al. *J Vitreoretin Dis*. 2019;3:145-152; Kaiser SM, et al. *J Experiment Pharmacol*. 2021;13:905-912.

# Limitations of IVT Anti-VEGF Therapy for DME and nAMD in Clinical Practice



In clinical trials, IVT anti-VEGF therapy is highly effective for the treatment of DME and nAMD



Visual outcomes in the real-world drop-off long-term



Visual outcomes correlate with treatment intensity (number of injections) in real-world setting



The need for frequent monitoring and injections imposes a high treatment burden and leads to poor treatment adherence

# Addressing Unmet Needs in DME and nAMD: Lowering the Treatment Burden



*Treatment strategies that maintain clinical benefits of IVT anti-VEGF therapy while reducing overall treatment and visit burden are needed.*

## Adjusting Treatment Interval of Conventional IVT Anti-VEGF



- Fixed dosing interval extension, PRN, and T&E regimens may be beneficial to some patients and afford fewer visits and injections
- However, these approaches rely on clinicians' ability to identify disease activity that is likely to be responsive treatment

## Approval of New IVT Agents



- Low molecular weight, single-chain antibody fragment (scFV) designed to improve tissue penetration and increased duration of action
- Humanized, bispecific mAb designed independently bind and dual inhibit 2 distinct angiogenic pathways

## Novel Delivery Mechanisms and Formulations of Anti-VEGF Agents



- Sustained-release device(s) to address the short duration of action and the low effective concentration of available anti-VEGF agents
- Higher dose formulations of conventional IVT anti-VEGF agents; exploit linear PK of these therapies to extend dosing interval

PRN, pro re nata; T&E, treat and extend

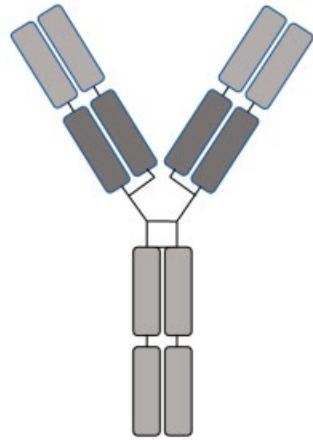
Kim JE. *Am J Manag Care*. 2022;28(3 Suppl):S35-S43; Tatsumi T. *Int J Mol Sci*. 2023;24:9591; Guymer RH, Campbell TG. *Lancet*. 2023;401:1459-1479; Xu M. et al. *Drug Des Devel Ther*. 2022;16:3241-3262.

# Diabetic Macular Edema



- Diabetic macular edema (DME) represents a major cause of vision impairment in diabetic patients with an increasing prevalence worldwide
  - In the diabetic retina, fluid accumulation in the macular area leads to increased central retinal/macular thickness, resulting in DME
- The prevalence of DME varies widely, ranging from 4.2% to 14.3% in people with T1DM and from 1.4% to 5.57% in people with T2DM
- The high prevalence of DR and DME not only seriously affects people's quality of life, but also lays a heavy economic burden on healthcare budget

# Conventional IVT Anti-VEGF Therapies for DME



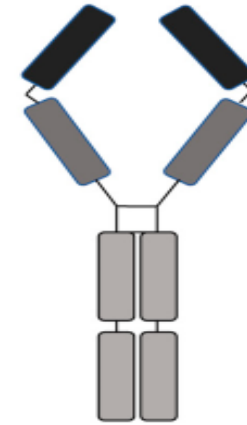
## Bevacizumab

- Humanized mAb that binds VEGFA.
- **Not** FDA Approved
- **Dosing:** 1.25 mg, Q4W<sup>a</sup>



## Ranibizumab

- Humanized, monoclonal antibody fragment that binds VEGFA
- FDA Approved
- **Dosing:** 0.3 mg, Q4W<sup>b</sup>



## Aflibercept

- VEGFR1/2-Fc fusion protein, binds VEGFA, VEGFB, & PLGF
- FDA Approved
- **Dosing:** 2 mg Q4WX5 → Q8W<sup>c</sup>

<sup>a</sup>Or PRN based on ophthalmological assessment

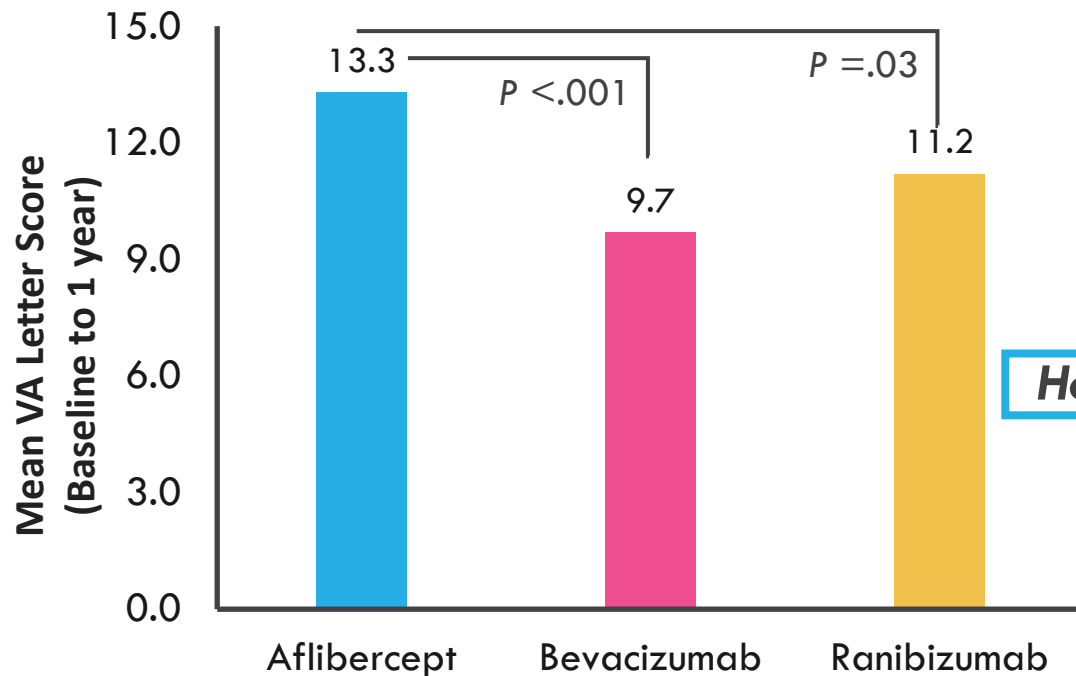
<sup>b</sup>Patients may extend the dosing interval up to Q12W after 3 to 4 monthly doses, if deemed appropriate based on T&E dosing

<sup>c</sup>Select patients may require monthly dosing beyond the initial 5 months

# Comparative Effectiveness of Bevacizumab, Ranibizumab, and Aflibercept for DME



N=660 adults with DME involving the macular center randomly assigned to receive the following IVT anti-VEGF therapies as frequently as Q4W (according to protocol-specified algorithm)



- Relative effect depended on baseline VA ( $P < .001$  for interaction).
  - When initial VA loss was mild, there was no apparent differences, on average, between treatment groups
  - When initial VA was worse, aflibercept was more effective at improving vision
- In addition, there were no significant differences among the study groups in the rates of SAEs ( $P = .40$ ), hospitalization, death, or major cardiovascular events
- All 3 groups showed VA improvement from baseline to 2 years with a decreased number of injections in year 2; superiority of aflibercept over ranibizumab, noted at 1 year, was also no longer identified

SAEs, serious adverse effects; VA, visual acuity

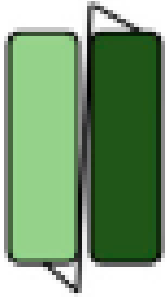
Diabetic Retinopathy Clinical Research Network. *N Engl J Med.* 2015;372:1193-1203; Wells JA, et al. *Ophthalmology.* 2016;123:P1351-P1359.



# Recently Approved IVT Agents for DME: Moving Towards a Lower Treatment Burden

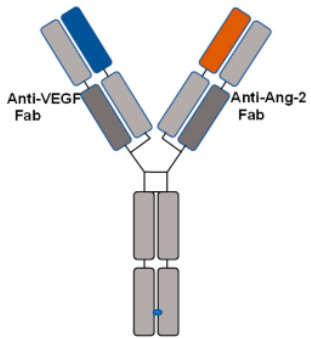


## Brolucizumab



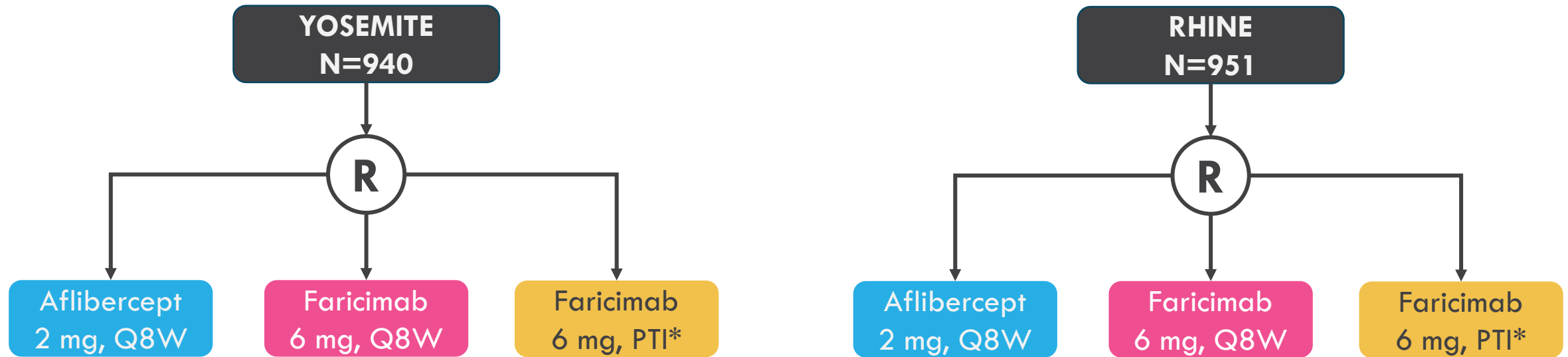
- Engineered by grafting complementarity determining regions of a novel anti-VEGF-A antibody to a human single-chain variable fragment (scFv) scaffold
- **Dosing:** 6 mg Q6W (5X) → Q8W to Q12W thereafter
- *The potential risk for intraocular inflammation (IOI), including retinal vasculitis and retinal vascular occlusion has precluded many healthcare providers from using this agent in patients with DME, as well as nAMD.*

## Faricimab



- Bispecific antibody that binds to VEGF-A and Ang2
- **Dosing:**
  1. 6 mg Q4W ( $\geq 4X$ ) → dosing interval may be extended in  $\leq Q4W$  increments or shortened by  $\leq Q8W$  increments based on CST and VA evaluations **OR**
  2. 6 mg Q4W (X6) → Q8W thereafter

# YOSEMITE and RHINE: Randomized Phase 3 Trials of Faricimab for DME



## Key Endpoints

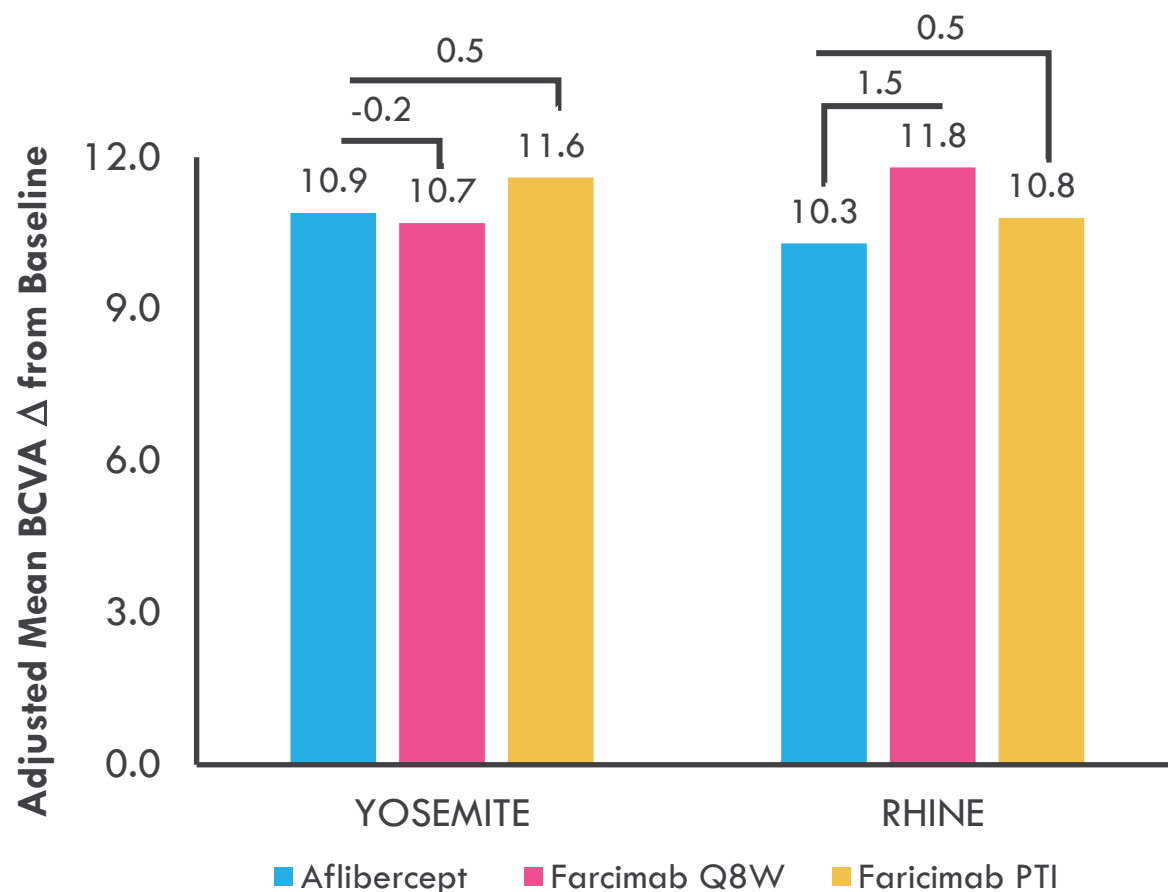
- $\Delta$  in BCVA from baseline at 1 year averaged over weeks 48, 52, and 56
- Safety

\*Dosing intervals were extended, maintained, or reduced (Q4W up to Q16W) based on disease activity at active dosing visits

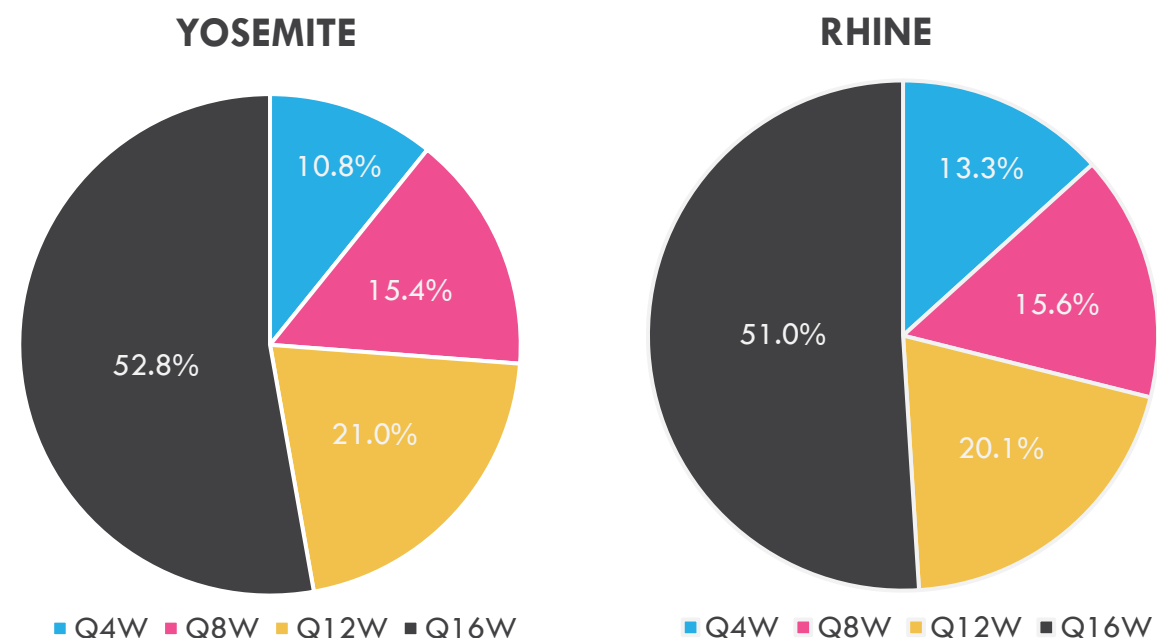
PTI, personalized treatment interval

Wykoff CC, et al. *Lancet*. 2022;399:741-755.

# YOSEMITE and RHINE: Results



Patients in the Faricimab PTI Groups who achieved dosing Q4W, Q8W, Q12W, or Q16W at week 52

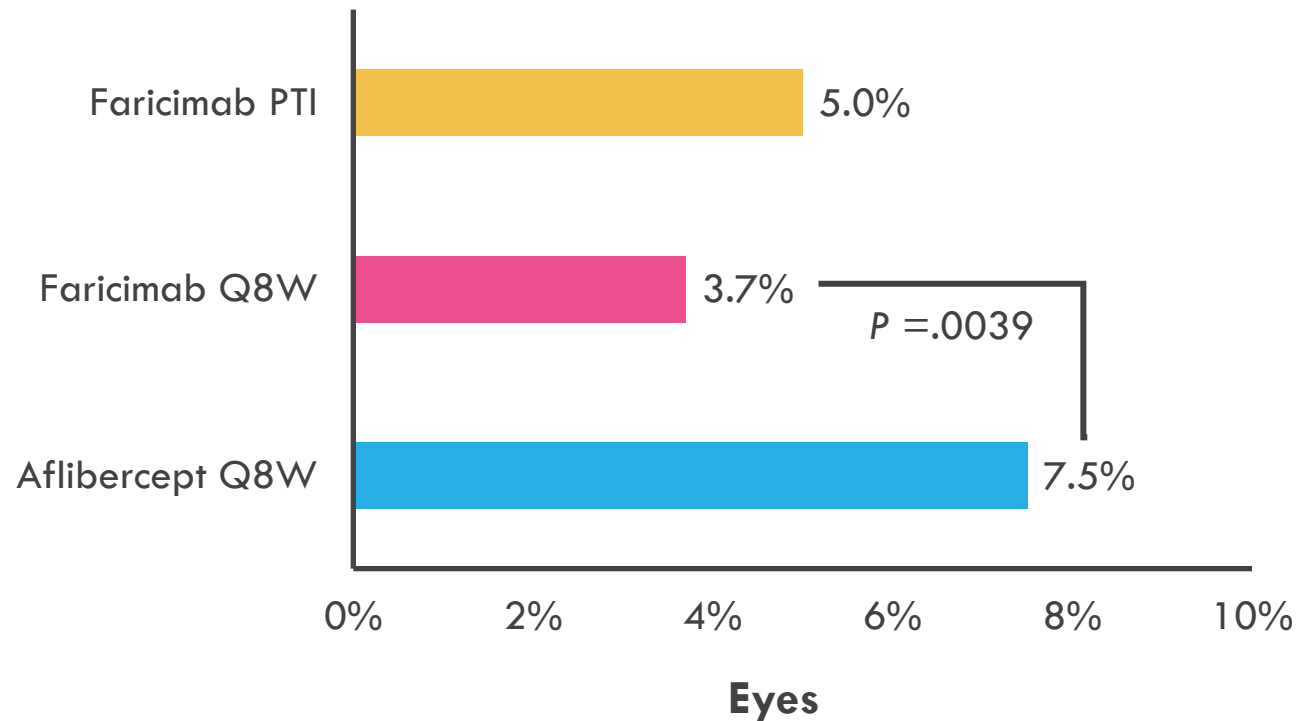


*Incidence of ocular AEs was comparable between faricimab Q8W, faricimab PTI, and aflibercept in both studies*

# Impact of Faricimab on ERM Formation: Post-Hoc Analysis from YOSEMITE/RHINE



## ERM Formation Over 2 Years



Eyes that developed ERMs during the study period tended to have worse BCVA and CST outcomes versus those that did not develop ERMs

At 2 years, eyes that developed ERMs also tended to have higher rates of intraretinal (75.9% vs 48.6%) and subretinal fluid (10.6% vs 3.4%) versus those without ERM

Dosing was extended to Q16W in a larger proportion of eyes without ERMs in the PTI group versus those with ERMs (64.3% vs 25%)

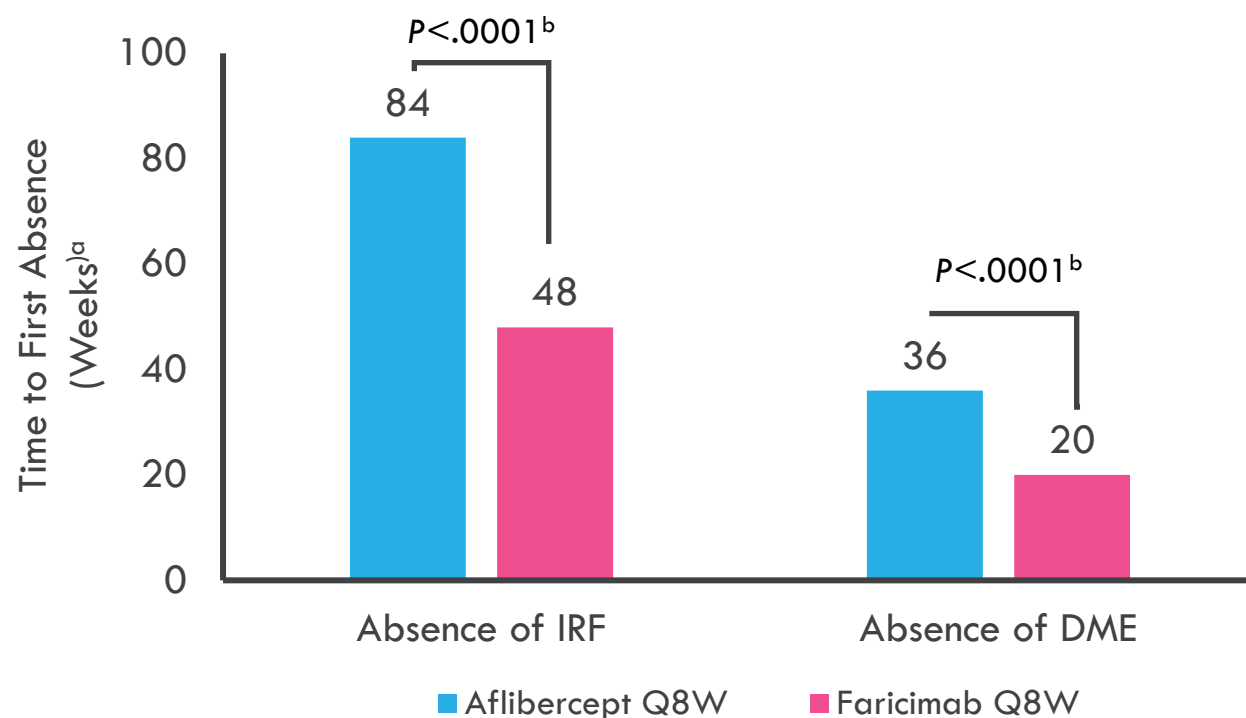
ERM, epiretinal membrane

Jaffe GJ, et al. ASRS 2023. Late Breaking Abstract.

# Additional Data on Faricimab in DME



## Post-Hoc Analysis of YOSEMITE/RHINE Time to Retinal Fluid Control<sup>1</sup>



<sup>a</sup>50<sup>th</sup> percentile for time to IRF absence, 75<sup>th</sup> percentile for time to DME absence

<sup>b</sup>Similar results noted for faricimab PTI versus aflibercept

## FARETINA-DME<sup>2</sup>

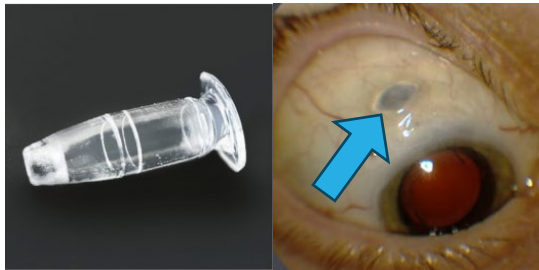
- Ongoing real-world data study utilizing data from the IRIS registry (AAO EHR registry); 3000 eyes included of which 12.5% were treatment-naïve
- Best documented VA  $\geq 20/40$  in 51% treatment-experienced and 44% treatment-naïve eyes
- Treatment-naïve eyes gained ~4 letters VA between 1<sup>st</sup> & 3<sup>rd</sup> injection; treatment-experienced eyes remained relatively stable
- Injection interval extended Q6W within the first 1 to 2 injections in ~62% of treatment-experienced and treatment-naïve eyes

# Evolving Drug Delivery and Dosing Strategies of Conventional Anti-VEGF Therapies for DME



## High-dose, Extended Interval Aflibercept FDA Approved: August 2023

- T&E studies (ARIES and ALTAIR), and a post-hoc analysis of the VIEW trials have indicated that ~50% of patients are effectively treated with ~Q12W dosing of aflibercept 2 mg
- Aflibercept has a linear PK curve; 8 mg aflibercept should provide 2 half-lives more duration in addition to delivering a 4-fold higher molar dose compared to its standard formulation
- Engineered in a 70- $\mu$ L formulation following efforts to optimize solubility, viscosity, stability, and tolerability



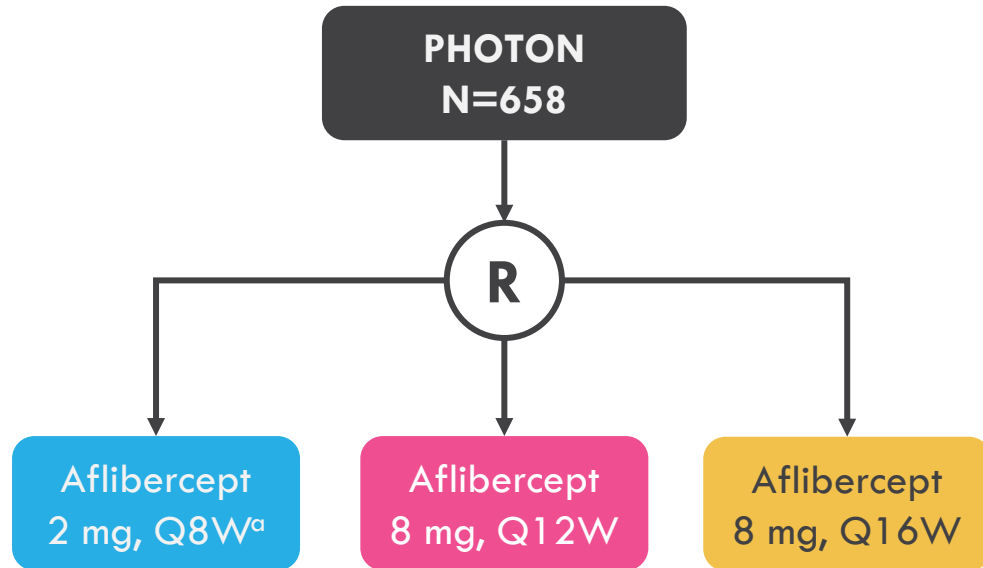
## Ranibizumab PDS

- Permanent, refillable implant that is inserted through a small incision into the sclera and pars plana; allows for the controlled continuous release of ranibizumab into the vitreous over time
- Offers a potential treatment strategy to maintain the clinical benefits of IVT anti-VEGF therapy while reducing overall treatment burden
- Approved by the US FDA in October 2021 for maintenance of vision and retinal anatomy in patients with nAMD

PDS, port delivery system

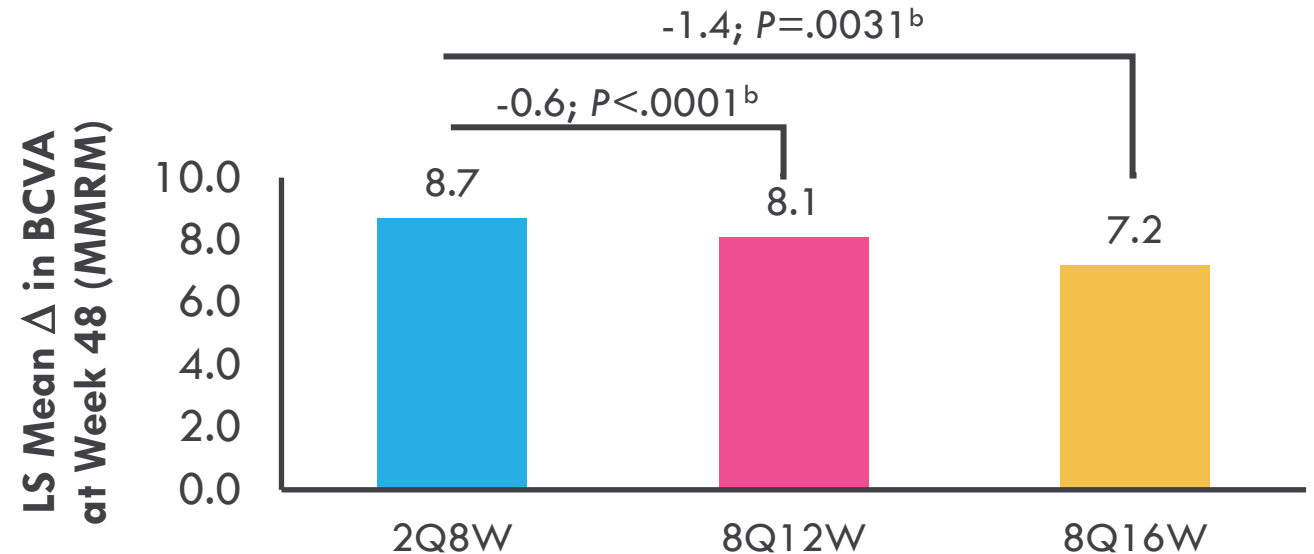
Aflibercept HD. Prescribing Information (fda.gov). Eichenbaum DA, et al. *BMJ Open Ophthalmol.* 2022;7:e001104; Brown DM. *Invest Ophthalmol. Vis Sci.* 2022;63:1345 (F0179); Do D, Rhoades W, et al. *Retina.* 2020;40:643-647; Mitchell PW, et al. *Retina.* 2021;41:1911-1920; Ohji M, et al. *Adv Ther.* 2020;37:1173-1187; Khurana RN, et al. *Am J Ophthalmol.* 2019;200:161-168; Ranibizumab PDS. [Prescribing Information \(fda.gov\)](https://www.fda.gov/drugs/development-research-and-manufacturing/preparing-a-drug-application-for-the-fda/submitting-a-drug-application-to-the-fda/submitting-a-drug-application-to-the-fda/submitting-a-drug-application-to-the-fda).

# Phase 2/3 Study of Aflibercept 8 mg for DME



## Primary Endpoint

- Mean  $\Delta$  in BCVA at week 48



## At 96 Weeks

- 8Q12W and 8Q16W groups had non-inferior BCVA compared to 2QW, with up to 6 fewer injections
- 89% of 8 mg patients maintained  $\geq 12$ -week dosing intervals
- Safety of aflibercept 8 mg was comparable to that of aflibercept 2 mg over 96 weeks

<sup>a</sup>2-mg arm received 5 initial monthly injections; 8-mg arms received 3 initial monthly injections

<sup>b</sup>1-sided test for non-inferiority at 4-letter margin

# Pagoda: Phase 3 Study of Ranibizumab PDS for DME



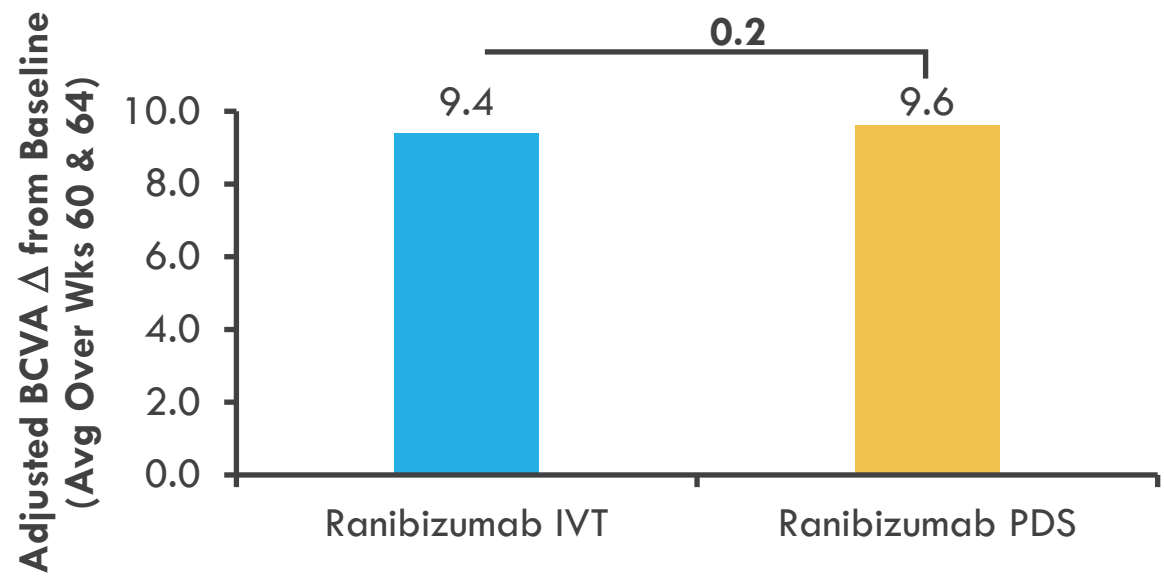
- N=634
- T1D or T2D
- Tx naïve to any treatment for DR with/without DME
- or**
- Previously treated, but no tx study eye ≤6 months prior to randomization



Ranibizumab IVT  
0.5 mg, Q4W

Ranibizumab PDS  
100 mg/mL, Q24W

**Primary Endpoint**  
Adjusted  $\Delta$  from baseline in BCVA score averaged over weeks 60 and 64

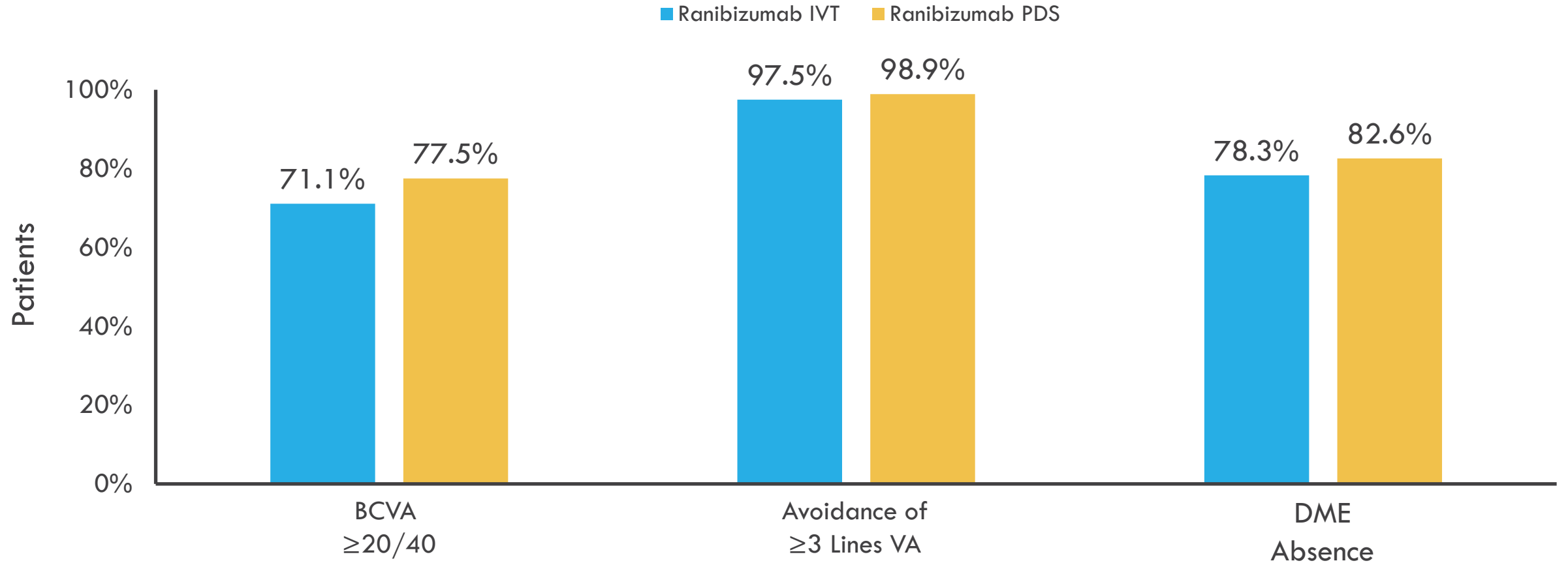


Endpoint	Rani IVT	Rani PDS
Mean CST $\Delta$ from baseline, $\mu\text{m}$	-199.7 $\mu\text{m}$	-203.5 $\mu\text{m}$
No supplemental treatment through week 64: Refill-exchange interval 1	N/A	95.9%
No supplemental treatment through week 64: Refill-exchange interval 2	N/A	97.4%
$\geq 2$ -step improvement from baseline on ETDRS-DRSS at week 64	41.9%	39.0%

CST, center subfield thickness; DR, diabetic retinopathy; DRSS, Diabetic Retinopathy Severity Scale; ETDRS, Early Treatment Diabetic Retinopathy Study  
Khanani AM, et al. Presented at Bascom Palmer Eye Institute Angiogenesis, Exudation, and Degeneration 2023 Virtual Meeting. Oral Presentation.



# Additional Findings from Pagoda



# Pagoda: Safety and Tolerability



Adverse Effects	Rani IVT	Rani PDS
Nonocular AEs	70.4%	69.1%
Ocular AEs: Study eye	44.6%	91.1%
<i>Ocular AEs of Special Interest</i>		
• Cataract	7.3%	10.9%
• Vitreous hemorrhage	1.6%	9.7%
• Endophthalmitis	0.3%	0%
• Conjunctival bleb	0%	7.8%
• Conjunctival erosion	0%	1.9%
• Conjunctival retraction	0%	1.3%
• Implant dislocation	0%	0.3%

***In late 2022, the ocular implant, insertion tool assembly, (including the drug vial and initial fill needle) for ranibizumab PDS were voluntarily recalled due to septum dislodgement and paused implantations, including ongoing global clinical trials***

Khanani AM, et al. Presented at Bascom Palmer Eye Institute Angiogenesis, Exudation, and Degeneration 2023 Virtual Meeting. Oral Presentation.

Sharma A, et al. *Int J Retina Vitreous*. 2023;9:6.



# Panel Discussion

# Critical Imaging Modalities for Monitoring Patients with Retinal Diseases



## Optical Coherence Tomography (OCT)

- Retinal thickness

## Fluorescein Angiography

- Vascular permeability
- Fluid leakage
- Retinal neovascularization

# Interprofessional Management of DME (and nAMD)



## Optometrists

- Often initial point of contact for many patients with DME (and nAMD)
- First to observe signs of neovascularization and ensure timely referral to retina specialists
- Identify eyes that require retreatment

## Retina Specialists

- Formal diagnosis
- Primary treatment
- Ongoing monitoring, follow-up, and retreatment

## Pharmacists

- Disease state awareness
- Importance of adherence
- Answer questions related to treatments

## Primary and Secondary Care Physicians

- Manage key aspects of underlying disease (ie, diabetes)
- Manage other comorbidities
- Preventive care

# Patient Profile: Ann

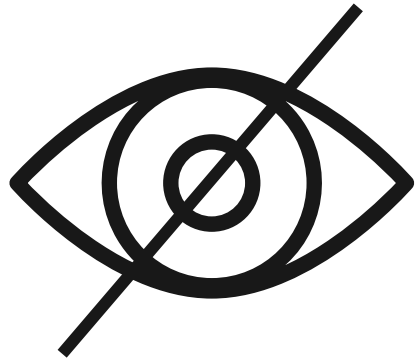
## Ann



70-year-old Female

- 35-year history of type 2 diabetes
  - ✓ Well-controlled, A1c improving
- DME/DR in both eyes
  - ✓ First noticed symptoms 6 years ago when she lost her glasses while on vacation
  - ✓ Upon return, optometrist could not get BCVA to 20/20
  - ✓ Referred to retina specialist

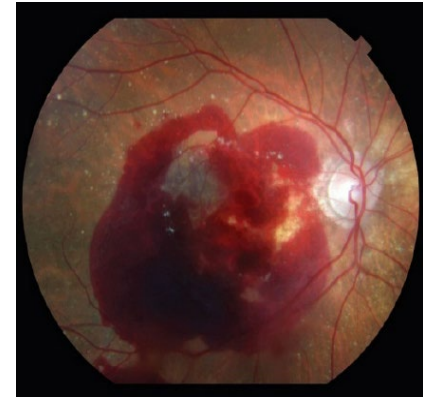
# Age-Related Macular Degeneration



Most common cause of severe vision loss in developed countries and 3<sup>rd</sup> common cause of legal blindness worldwide

> 25%

Proportion of patients with advanced AMD in one eye who will develop advanced AMD in the other eye within 10 years



Neovascular AMD (nAMD) accounts for 10% to 15% of AMD cases

# Conventional IVT Anti-VEGF Therapies for nAMD: Bevacizumab and Ranibizumab



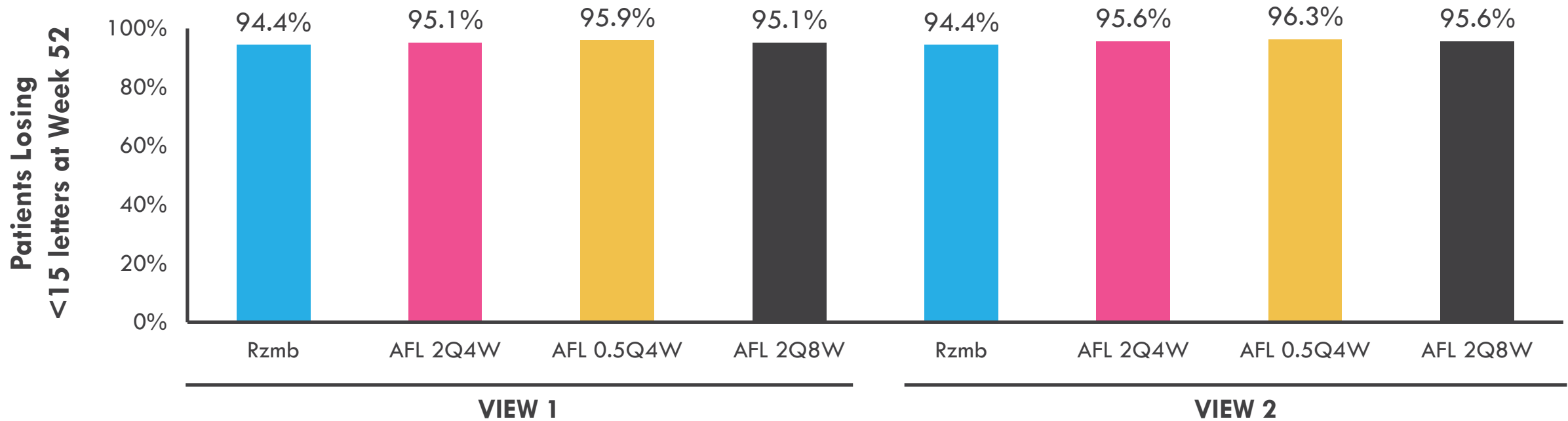
- **Bevacizumab**
  - **Dosing:** 1.25 mg, Q4W or PRN/T&E based on ophthalmologic assessment
  - Comparative trials and uncontrolled case series reported improvements in VA and decreased retinal thickness by optical coherence tomography (OCT) following intravitreal bevacizumab treatment
- **Ranibizumab**
  - **Dosing:** 0.5 mg, Q4W or PRN/T&E based on ophthalmologic assessment
  - Improved vision compared to sham injection and photodynamic therapy in the MARINA and ANCHOR studies, respectively
- Data has shown bevacizumab and ranibizumab produce similar effects on visual acuity



# Conventional IVT Anti-VEGF Therapies for nAMD: Aflibercept

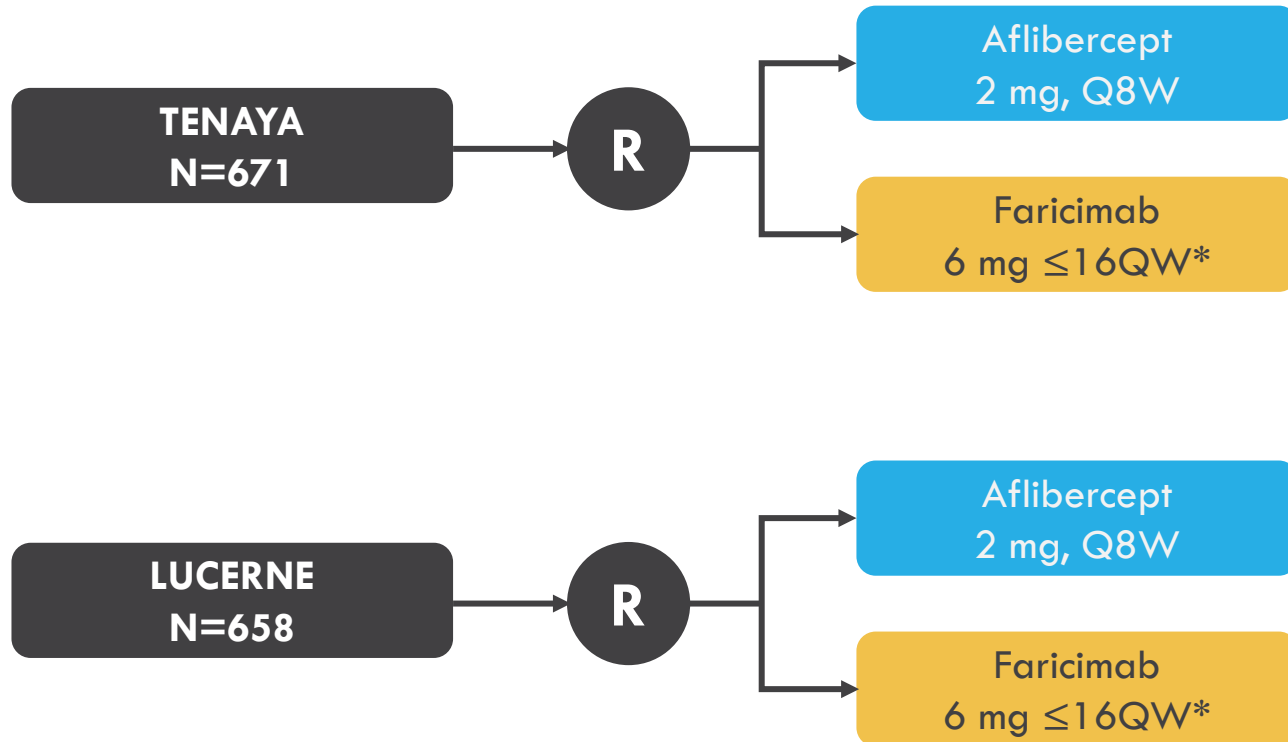


## Results from VIEW 1 and VIEW 2 Trials



***Approved aflibercept dosing: 2 mg Q4W, 3X → Q8W thereafter***

# Faricimab: Bispecific Antibody Targeting VEGF and Ang2 for nAMD



## Endpoints

### Primary

- $\Delta$  in BCVA from baseline averaged over weeks 40, 44, and 48

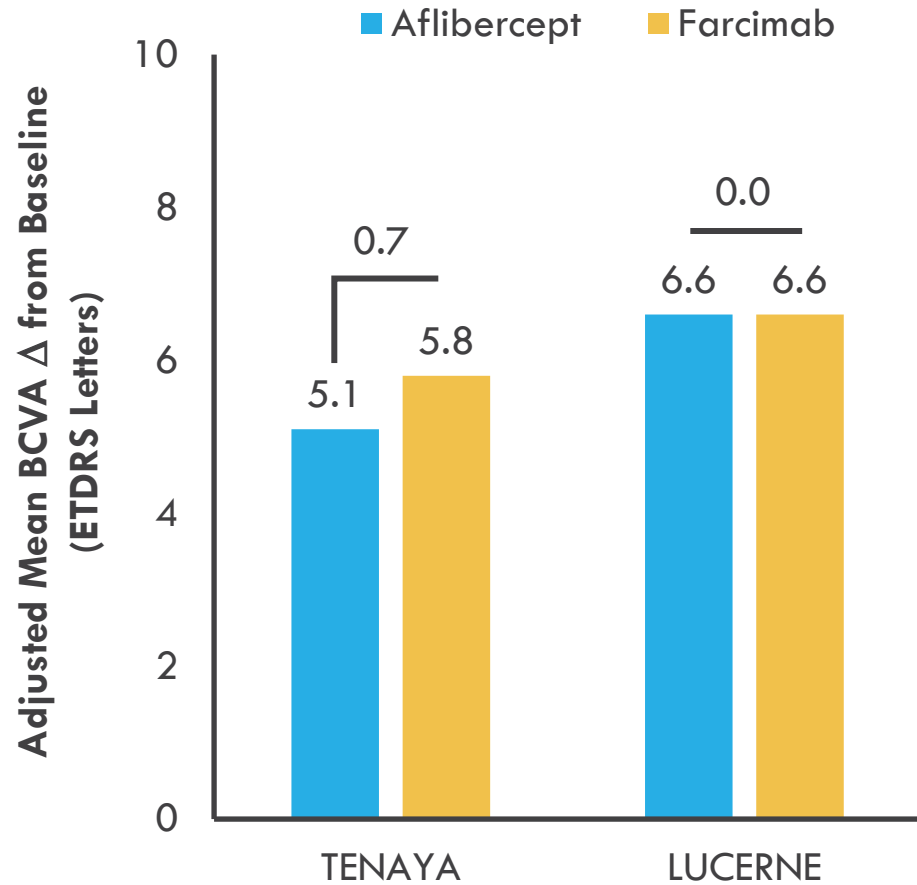
### Key Secondary

- Proportion of faricimab-treated patients on 16-week, 12-week, and 8-week schedules at week 48
- Safety

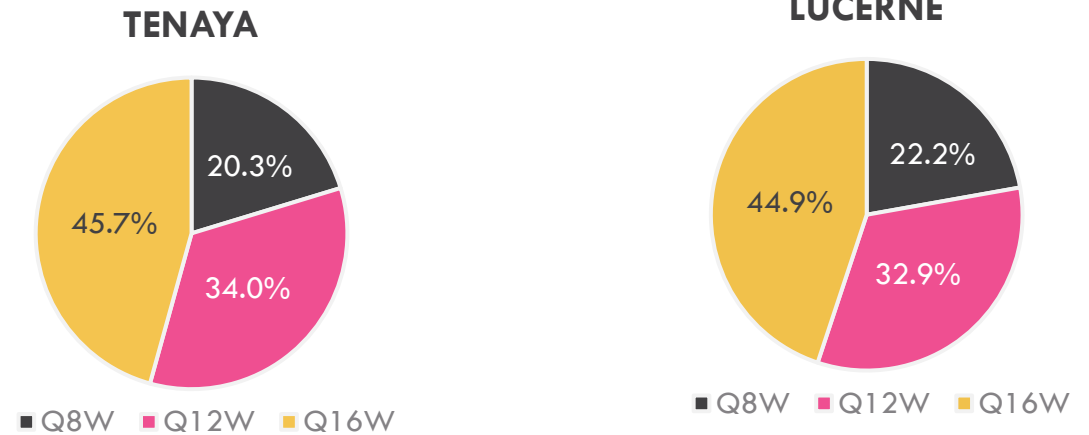
\*Based on protocol-defined disease activity assessments at weeks 20 & 24

Heier JS, et al. *Lancet*. 2022;399:729-740.

# TENAYA and LUCERNE: Results



## Patients in Faricimab Group Who Completed Week 48 Treatment by Fixed-Dosing Interval



- Treatment with faricimab  $\leq$ Q16W resulted in CST reductions from baseline at all timepoints up to week 48, and was comparable with aflibercept Q8W
- Adjusted mean changes in total CNV lesion area and total area of leakage from baseline with faricimab at week 48 were comparable with aflibercept
- Overall, faricimab up to every 16 weeks was well tolerated; the most common ocular AEs in study eye were consistent with those expected in patients with nAMD receiving IVT treatment and the incidence was comparable between treatment groups

# Effects of Faricimab on Fluid Parameters in nAMD: Post-Hoc Analysis of TENAYA/LUCERNE



- $\Delta$  in CST, absence of SRF and IRF, and time to absence of SRF and IRF were assessed in the faricimab versus aflibercept arms during the initial matched-dosing period (weeks 0 to 12).

Fluid Parameter	Aflibercept Q8W	Faricimab $\leq$ Q16W	P
$\Delta$ in CST from baseline	-133 $\mu\text{m}$	-145 $\mu\text{m}$	$\leq$ .0001
Absence of SRF & IRF	67%	77%	$\leq$ .0001
Time to absence of SRF & IRF <sup>a</sup>	12 weeks	8 weeks	$<$ .0001

<sup>a</sup>75th percentile

Querques G, et al. *Invest Ophthalmol Vis Sci.* 2023;64:2185.

# FARETINA-AMD Study



Ongoing real-world data study utilizing data from the IRIS registry (AAO EHR registry); 17,500 eyes included, of which 6.2% were treatment-naïve

94% of nAMD treated with faricimab were previously treated with anti-VEGF agents, with ~67% of patients switched from aflibercept

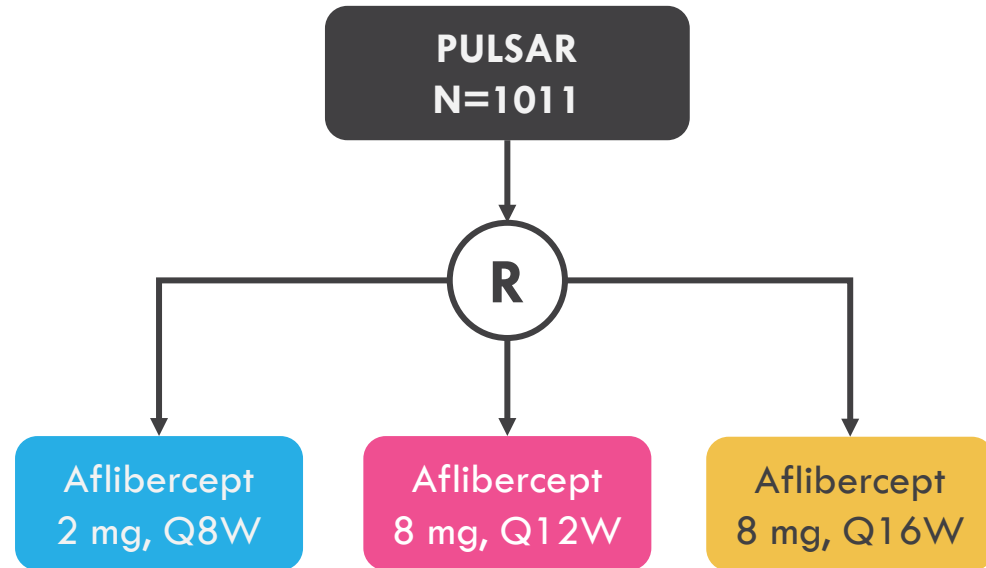
Best documented VA  $\geq 20/40$  in 49% treatment-experienced and 37% treatment-naïve eyes

Treatment-naïve eyes gained mean 2 letters VA; treatment-experienced eyes remained relatively stable

69% of previously treated eyes achieved an extended interval, of which 55% extended after 1 to 2 injections of faricimab

66% of treatment-naïve eyes, the analysis showed extended the interval, of which 43% extended after 1 to 2 injections

# Phase 3 Study of Aflibercept 8 mg for nAMD



**Primary Endpoint**

- $\Delta$  from baseline in BCVA at week 48

Endpoint	Aflib 2Q8W	Aflib 8Q12W	Aflib 8Q16W
LS Mean $\Delta$ from baseline in BCVA at week 48 (MMRM)	7.0	6.1 -0.97 P=.0009*	5.9 -1.14 P=.0011*
Patients without retinal fluid in center subfield at week 16	52%	62%	65%
Proportion of patients maintaining $\geq$ Q12W interval through week 48	-	83%	

\*1-sided test for non-inferiority at 4-letter margin

- Safety of aflibercept 8 mg is consistent with the known safety profile of the 2 mg formulation
- Visual gains and safety observed with aflibercept 8 mg at week 48 were maintained through week 96

# Novel Drug Delivery Mechanism for nAMD: Ranibizumab PDS



## ARCHWAY

- N=418
- nAMD dx w/in 9 mo of screening
- $\geq 3$  prior anti-VEGF injections w/in 6 mo of screening
- Treatment responsive

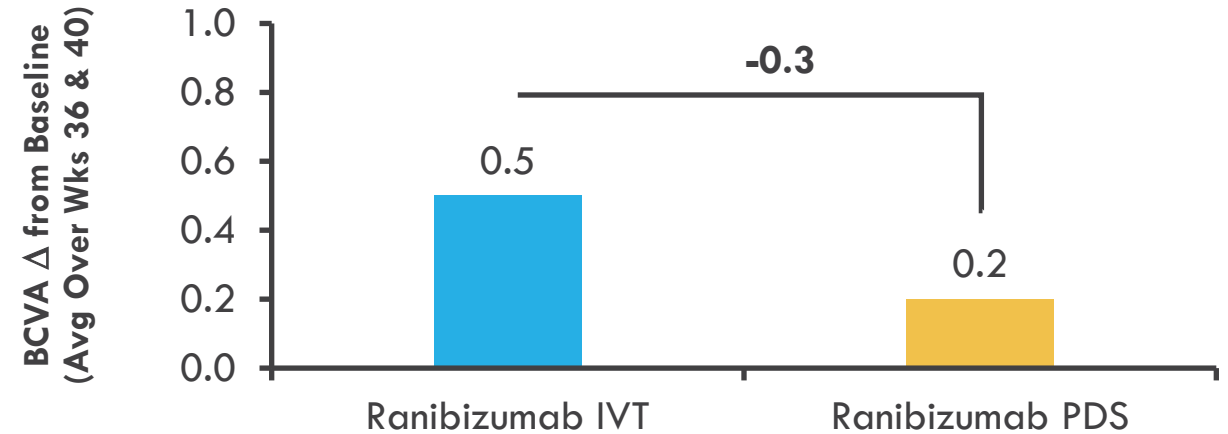
R

Ranibizumab IVT  
0.5 mg, Q4W

Ranibizumab PDS  
100 mg/mL, Q24W

## Primary Endpoint

- $\Delta$  from baseline in BCVA score at the average of weeks 36 and 40



Endpoint	Rani IVT	Rani PDS
Adjust mean CPT $\Delta$ from baseline, $\mu\text{m}$	2.6	5.4
<i>Ocular AEs of Special Interest</i>		
- Vitreous hemorrhage	2.4%	5.2%
- Endophthalmitis	0%	1.6%
- Conjunctival erosion	0%	2.4%
- Conjunctival retraction	0%	2.0%

CPT, center point thickness

Holekamp NM, et al. *Ophthalmology* 2022;129:295-307.



# Panel Discussion



# Potential Barriers to Clinical Trial Access: Enrollment in Patients with nAMD and DME

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- Inclusion/exclusion criteria
- Lack of awareness
- Disease severity
- Presence of comorbidity
- Time commitment
- Transportation
- Informed consent process

# Patient Profile: Lance

Lance



**85-year-old Male**

- ~8-year history of nAMD; optometrist identified leakage in right eye during routine examination
  - ✓ Later developed nAMD in left eye
  - ✓ Referred to retina specialist for evaluation and treatment
- Stopped treatment after resolution of symptoms
- Treatment resumed upon return of symptoms; retinal scarring noted on examination

# Summary



- 
- DME and nAMD are major cause of visual impairment and blindness with increasing prevalence.
  - Although the advent of anti-VEGF therapy has transformed the management of these diseases, the burden these treatments impose on patients is substantial.
  - In this regard, several strategies targeting VEGF and other angiogenic pathways have either been approved in recent years or are in the later stages of clinical development; real-world data on their usage is starting to evolve.